WAREWORK

Speed up your Software Development

Cloud Distribution for Desktop

V1.2.1 _ Java Edition

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About this tutorial

Who should read this guide?

This tutorial is intended for Java software programmers who are interested in developing applications on the Warework Framework.

Prerequisites

Before proceeding with this tutorial you should have a good knowledge of the Java programming language. It is also recommended that you have some knowledge about:

- Design patterns (basic ones like Singleton, Factory and Facade; also Inversion of Control would be desirable).
- Logging mechanisms.
- Log4j.
- XML.
- How to parse XML files with SAX (optional).
- SQL.
- JDBC.
- JPA.
- Object Database Management Systems.
- Properties files.
- c3p0.
- JavaMail.
- JNDI.
- Spring Framework.

Typographical conventions

The following table resumes the typographical conventions used in this tutorial:

`courier new`	Code examples, packages, class methods, constants, URLs, files, identifiers and menu options.
`courier new bold`	Emphasis and code relationship.

About the examples

In this tutorial you will find code fragments that represent short examples about a particular topic of the Framework. In order to run those examples, you will need a Java Virtual Machine. First check out which Java version requires this Warework Distribution and after that you should get the Virtual Machine at:

http://www.oracle.com/technetwork/java/archive-139210.html

It is also recommended to use an IDE (Integrated Development Environment) where to create and run the examples because they speed up the development process. Eclipse (http://www.eclipse.org/) and NetBeans (http://netbeans.org/) are widely used for Java software development.

Further information

For information about design patterns the best-known book is “Design Patterns: Elements of Reusable Object-Oriented Software” (GAMMA, Erich, HELM, Richard, JOHNSON, Ralph and VLISSIDES, John. Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley Professional. 1994).

See the definition of “Java logging framework” for information about how log tools work at:

http://en.wikipedia.org/wiki/Java_Logging_Frameworks.

For information about the Log4j Framework please review the following link:

http://logging.apache.org/log4j/

For information about XML please review the following link:

http://en.wikipedia.org/wiki/XML

If you plan to create a custom Loader to parse an XML file, you can review the following tutorial:

http://docs.oracle.com/javase/tutorial/jaxp/sax/parsing.html

For information about properties file please review the `java.util.Properties` API:

http://docs.oracle.com/javase/1.4.2/docs/api/java/util/Properties.html

For information about SQL we recommend you to check out this great resource: “SQL Cookbook” (MOLINARO, Anthony. SQL Cookbook. O’Reilly. 2005).

For information about JDBC please review the following tutorial:

http://docs.oracle.com/javase/tutorial/jdbc/index.html

For information about the c3p0 Framework please review the following link:

http://www.mchange.com/projects/c3p0/

For information about the JavaMail API please review the following link:

http://www.oracle.com/technetwork/java/javamail/index.html

Review the definition of an Object Database Management System in the following location:

http://en.wikipedia.org/wiki/Object_database

For information about JPA please review the following tutorial:

http://docs.oracle.com/javaee/5/tutorial/doc/bnbpz.html

The following link shows how to acquire the JPA `EntityManager` in different contexts. It will help you to configure the JPA Data Store with JNDI:

http://docs.oracle.com/cd/B31017_01/web.1013/b28221/usclient005.htm

The following link is about JPA and cache. Very useful to properly configure JPA:

https://blogs.oracle.com/carolmcdonald/entry/jpa_caching

For information about the Spring Framework we recommend you to check out this reference guide:

http://static.springsource.org/spring/docs/1.2.9/reference/preface.html

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- Eclipse is a registered trademark of the Eclipse Foundation.
- Netbeans is a registered trademark of Oracle Corporation and/or its affiliates.
- Log4j is a registered trademark of the Apache Software Foundation.
- Oracle is a registered trademark of Oracle Corporation and/or its affiliates.
- MySQL is a registered trademark of Oracle Corporation and/or its affiliates.
- DB2 is a registered trademark of IBM Corporation and/or its affiliates.
- MongoDB is a registered trademark of 10gen, Inc.
- db4o is a registered trademark of Versant Corporation.
- WebLogic is a registered trademark of Oracle Corporation and/or its affiliates.
- Gmail is a registered trademark of Google Corporation and/or its affiliates.
- Apache Derby is a registered trademark of the Apache Software Foundation.
- Android is a registered trademark of Google Corporation and/or its affiliates.
- Spring Framework is a trademark of SpringSource, Inc.
- Hibernate is a registered trademark of Red Hat, Inc.

Chapter 1: Overview

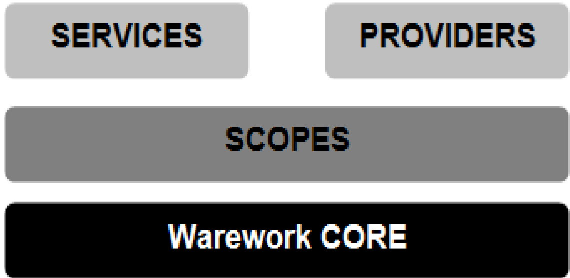
Warework Cloud Distribution for Desktop is a software development Framework for the Java programming language that simplifies the creation of applications in desktop platforms. This multi-purpose Framework is very useful because:

- It provides a basic infrastructure for an application as it includes a relational database and Services to send emails, work with data stores and perform log operations.
- It organizes the structure of an application with pluggable components. You can expand the functionality of the Framework whenever you want and leave the task of managing new features to Warework.
- It sets up the basic mechanisms to make your application run across multiple platforms. Do you plan to execute your application in Android? No problem, you can reuse most of your code by simply changing the Warework Distribution.

This software library sets the rules and basic elements to help developers in the creation of applications and with the usage of other Warework elements. The Java edition of Warework Cloud Distribution for Desktop presents these characteristics:

- **Embeddable**. It does not need any external library to run and it is ready to work on Java Standard Editions, version 6 and up.
- **Simple API**. Its functions are versatile and easy to understand helping developers be productive very quickly.
- **Modular**. It can be expanded with Warework components and other complex frameworks that determine the size of the application to create.
- **Pre-configured**. It includes default Templates that allow you to start-up your projects in seconds. This document includes some examples that show how to work with Templates. There we demonstrate how to log messages with one line of code and how to connect with a relational database with just three lines of code.
- **Design patterns**. It is built upon well-known design patterns like Inversion of Control and those defined by the Gang of Four (Factory, Facade, Singleton, etc.) so it provides a common programming style to software developers.

Let us see now what is inside of this software library. In Warework, you will typically deal with three different types of components: Scopes, Services and Providers. These components are managed by a central unit named Warework CORE and together can be seen as follows:

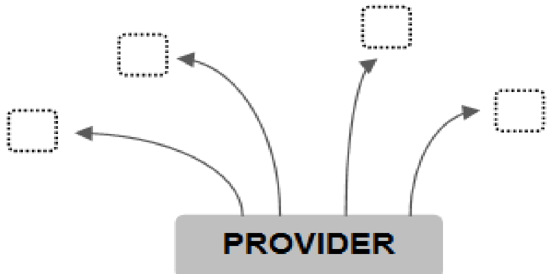


Scopes

A Warework Scope is an enclosing context where attributes, Services and Providers are associated. You are free to define what a Scope can be; it can represent, for instance, a Market System where Services and Providers perform operations like food delivery, lighting management, etc. In Desktop Distributions, the concept of Scope typically matches with the concept of System. That is, your application represents a System that performs specific operations to solve concrete problems.

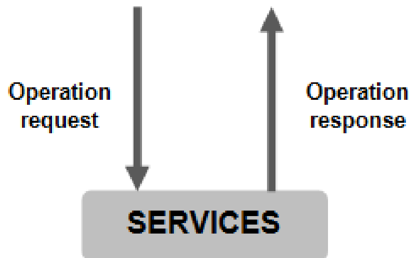
Providers

Warework Providers are Framework components that retrieve objects from a specific place and make them available for the developer. How those objects are generated and managed depends on the implementation of the Provider but in general, they all share these three important characteristics: Providers just provide objects, each Provider must exist in a specific Scope and their life span depends on the Scope where they exist.



Services

A Warework Service is a managed component of the Framework that presents a set of related functionalities. They keep sorted and under control different groups of activities, allow to run common operations at the same point and resume important facts of complex sub-systems. The Log Service, for example, gives the required functionality to perform log operations, using just one interface and with different types of implementations (like Log4j) working at the same time. Services, like Providers do, must exist in a specific Scope and their life span depends on the Scope where they exist.



Components included in this Distribution

Warework Cloud Distribution for Desktop includes the following software libraries by default:

- Warework components
  - Warework CORE version 1.2.0
  - Warework CORE Extension Module version 1.5.0
  - Warework Data Store Extension Module version 1.1.0
  - Warework Log4j Logger version 1.0.1
  - Warework Data Store Service version 1.3.0
  - Warework Properties Data Store version 1.2.0
  - Warework JDBC Data Store version 1.3.0
  - Warework JPA Data Store version 1.2.0
  - Warework Pool Service version 1.0.2
  - Warework c3p0 Pooler version 1.0.1
  - Warework Mail Service version 1.0.2
  - Warework JavaMail Client version 1.0.1
  - Warework Converter Service version 1.0.2
  - Warework FileText Provider version 1.1.2
  - Warework JNDI Provider version 1.0.1
  - Warework Spring Provider version 1.0.1
  - Warework Object Deserializer Provider version 1.1.2
  - Warework Properties Provider version 1.0.2
- Third party libraries

- Log4j version 1.2.17
- c3p0 version 0.9.1.2
- JavaMail version 1.4.7
- H2 Database Engine version 1.3.173
- AOP Alliance version 1.0
- Commons Logging version 1.1.1
- Spring Framework version 3.2.4
- Java Transaction API version 1.1
- Service Data Objects version 2.1.1
- Eclipse Persistence version 2.1.0
- Eclipselink version 2.5.0

Chapter 2: Download

Requisites

In order to run the library Warework Cloud Distribution for Desktop version 1.2.1 you need to have Java version 1.6 or later.

License

This product includes software developed by Warework and third party organizations. In consequence, it is licensed under the terms and conditions of different software licenses where each license applies to at least one included module. The association between each module and each license is defined in a file named `NOTICE.txt` that exists in the downloaded zip. These licenses are also accessible at Warework servers in the following locations:

Warework Software Library License 1.0

http://resources.warework.com/lib/lic/wsll-1.0.txt

GNU Lesser General Public License 2.1

http://resources.warework.com/lib/lic/lgpl-2.1.txt

Eclipse Public License 1.0

http://resources.warework.com/lib/lic/epl-1.0.txt

Common Development and Distribution License 1.0

http://resources.warework.com/lib/lic/cddl-1.0.txt

Apache License Version 2.0

http://resources.warework.com/lib/lic/apache-2.0.txt

Public Domain

http://resources.warework.com/lib/lic/pub-dom.txt

Service Data Objects

http://resources.warework.com/lib/lic/sdo.txt

Download

If you agree with the terms specified in the license then you can download this software library in the following direction:

```
http://repository.warework.com/maven/2/com/warework/distribution/ware-
work-java-dist-cloud-desktop/1.2.1/warework-java-dist-cloud-desktop-1.2.1-
bundle.zip
```

Maven

Maven users can link to this library by adding this code in the `pom.xml` file of the project:

```
<dependency>
   <groupId>com.warework.distribution</groupId>
   <artifactId>warework-java-dist-cloud-desktop</artifactId>
   <version>1.2.1</version>
</dependency>
```

You also have to indicate in the `pom.xml` or the global settings file where is located the Maven 2 repository. Use the following code in any of those files to achieve this:

```
<repositories>
   <repository>
      <id>warework-repository</id>
      <name>Warework Repository</name>
      <url>http://repository.warework.com/maven/2</url>
      <layout>default</layout>
      <releases>
         <enabled>true</enabled>
         <updatePolicy>always</updatePolicy>
         <checksumPolicy>fail</checksumPolicy>
      </releases>
      <snapshots>
         <enabled>false</enabled>
         <updatePolicy>never</updatePolicy>
         <checksumPolicy>fail</checksumPolicy>
      </snapshots>
   </repository>
</repositories>
```

Chapter 3: Library support

API

Java developers that are looking for technical information about the programming interface can review the API (HTML) of this library as it is bundled in the downloaded file and is accessible via Internet in the `api.warework.com` sub-domain as follows:

http://api.warework.com/java/warework-java-dist-cloud-desktop/1.2.1/index.html

Change logs

This software library registers its changes in a log that is bundled in the downloaded file and is also accessible in the `log.warework.com` sub-domain as follows:

http://log.warework.com/java/warework-java-dist-cloud-desktop.txt

Bug report

We really appreciate comments about software libraries developed by Warework. Prior to reporting a failure to us, you should consider reviewing good practices about how to submit a bug at:

http://www.warework.com/documentation.page#bug

You can report a bug to us at:

http://www.warework.com/support.page

Releases

Every time a software library is released by Warework we notify users via Twitter. Our continuous integration system automatically sends a message each time a library is packaged and placed in the repository. To keep up to date with our libraries follow us on Twitter at:

http://twitter.com/#!/warework_info

Chapter 4: Quick start

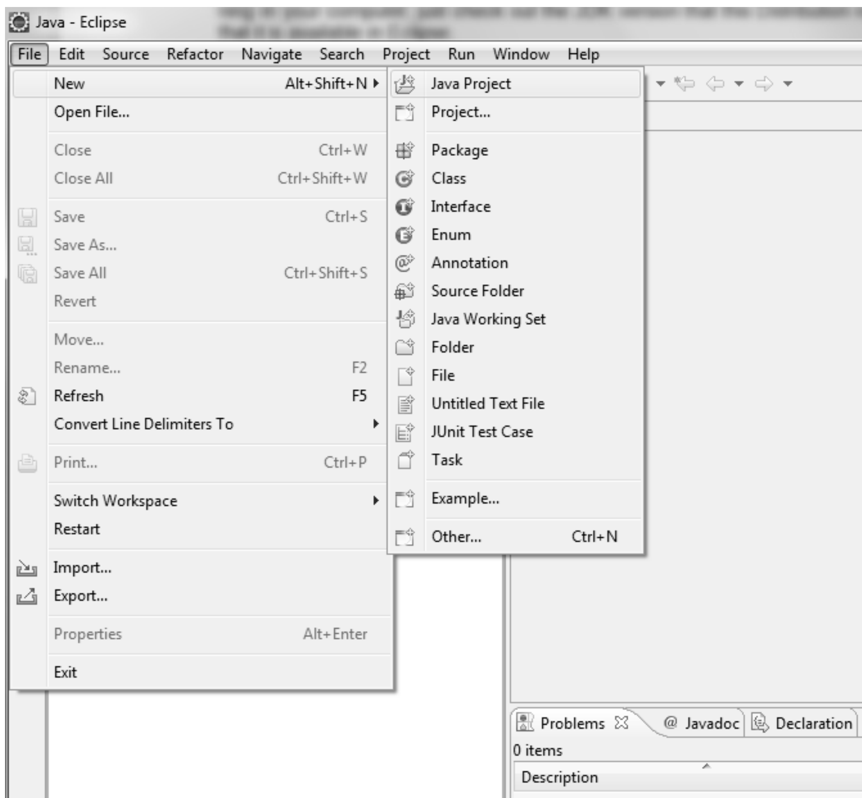
Create a new Eclipse project

In this user manual we are going to use Eclipse to show how to structure the code and the resources in a project. Eclipse is not mandatory (you can use any IDE you want), we use it just to show pictures of projects to help with the examples described in this tutorial.

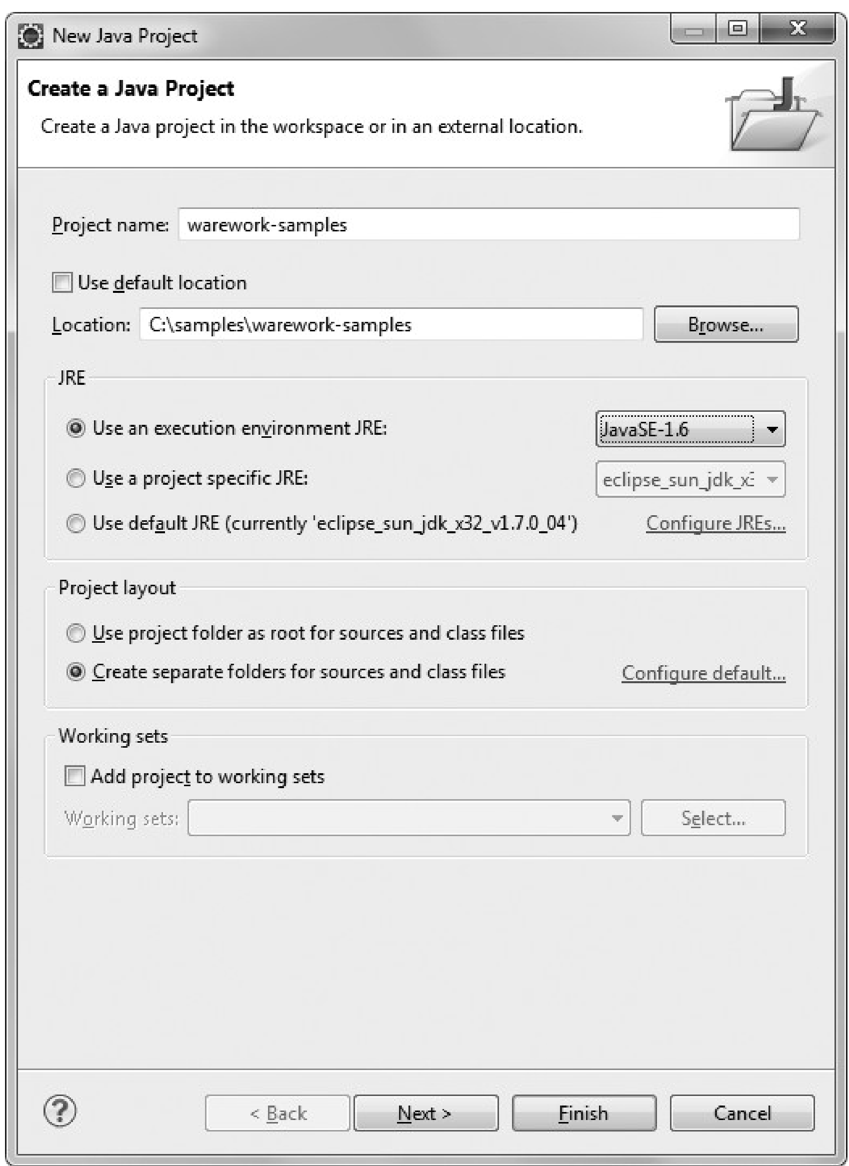
Any modern version of Eclipse is fine to work with this software library. If it is your first time with Eclipse, download and install the latest version of Eclipse IDE for Java EE Developers. If you already have an instance of Eclipse running in your computer, just check out the JDK version that this Distribution requires and ensure that it is available in Eclipse. It is also recommended that your previously installed version of Eclipse has DTP Plugin to browse data in relational databases (if your Eclipse is for Java EE Developers it should be installed by default).

Once Eclipse is running in your computer, you can create a project to work with the Warework Distribution by following these steps:

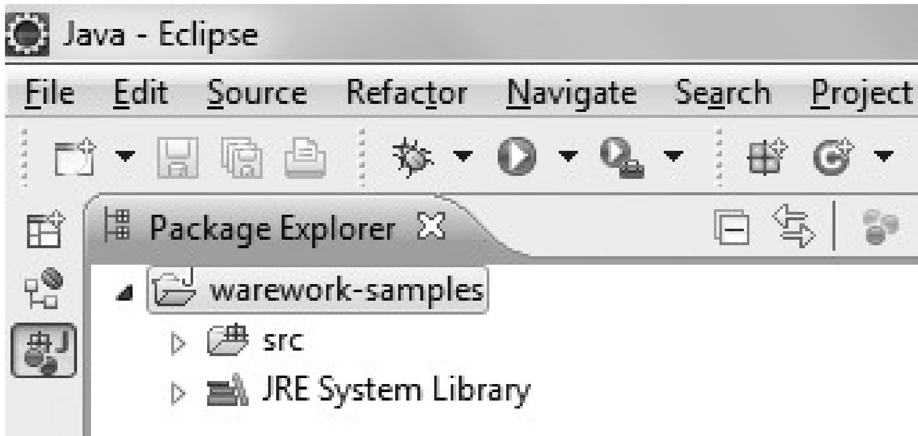
1. **Create a new Java Project**: Select "`File`" in the main menu of the Eclipse IDE, after that "`New`" and finally "`Java Project`".



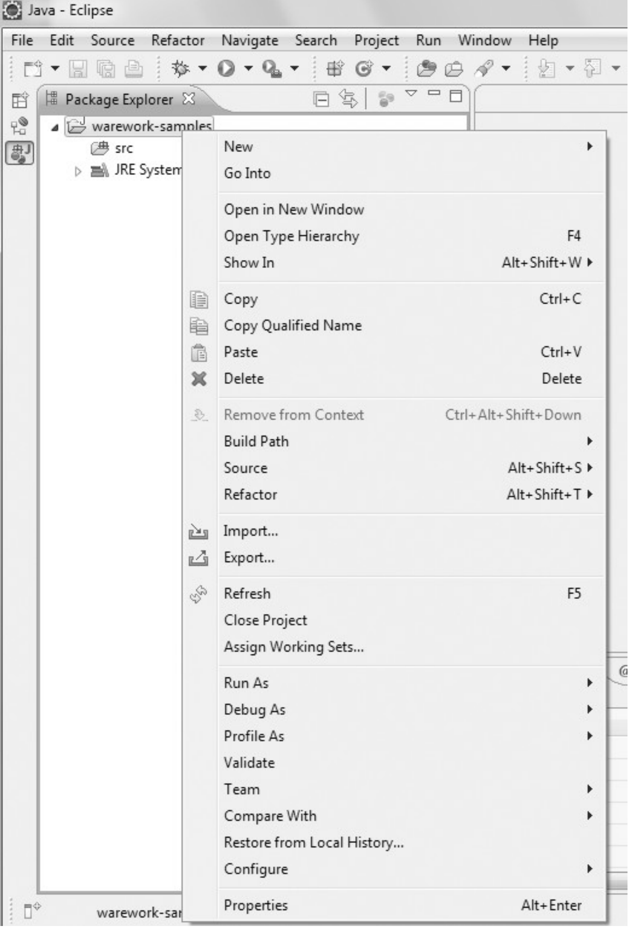
2. **Set the name of the project:** just fill the "`Project name`" box in the new window and click "`Finish`" (remember to validate first that JRE version is fine to meet the Distribution requisites).



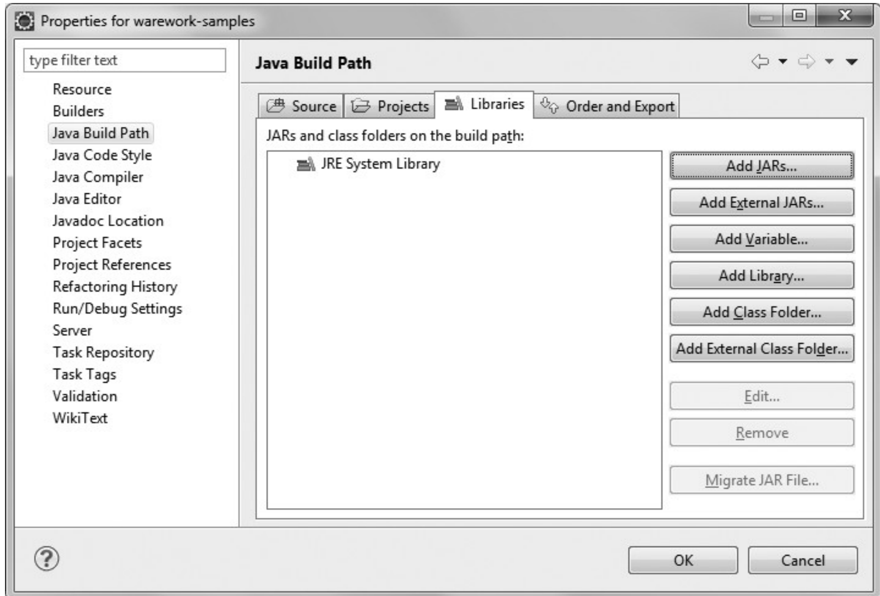
Once the new project is created, you should see something like this:



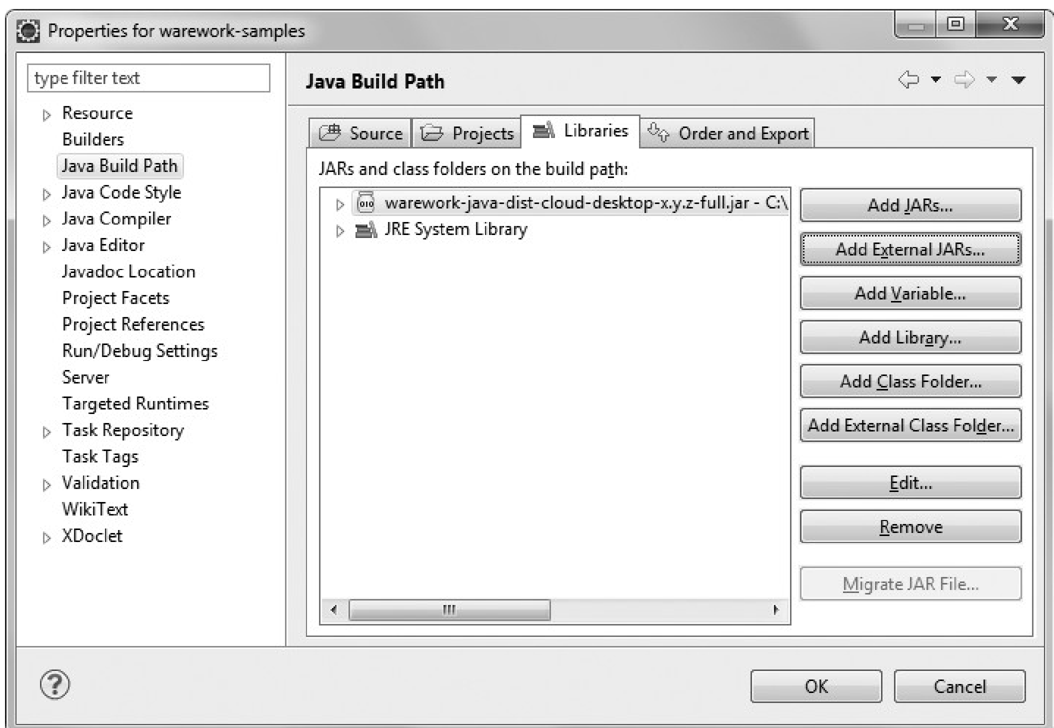
3. **Configure the project:** Right click on the new project and select "`Properties`".



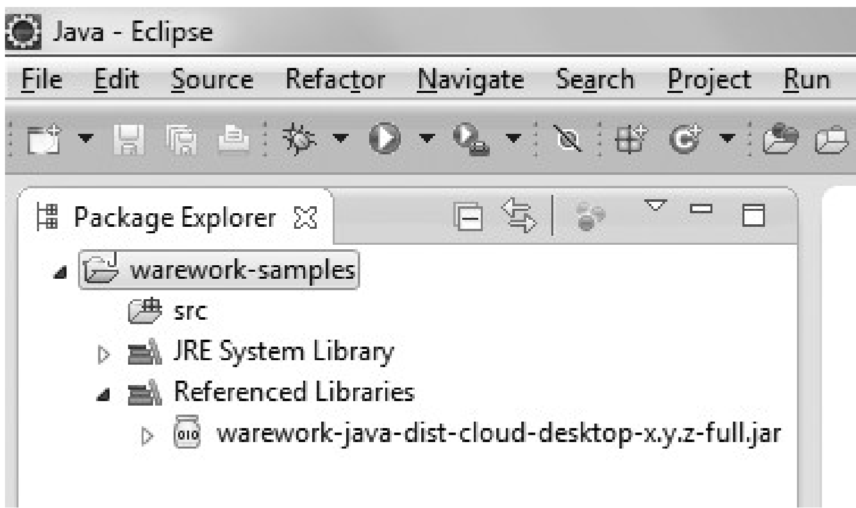
4. **Go to the "Libraries" tab:** in the new window, first select in the left panel the option "`Java Build Path`" and after that select the "`Libraries`" tab. Now you should see a window like this:



5. **Include the Warework Distribution in your project:** click the "`Add External JARs…`" button and select the location of the software library. Once it is selected, the Properties window will display the Warework Distribution:

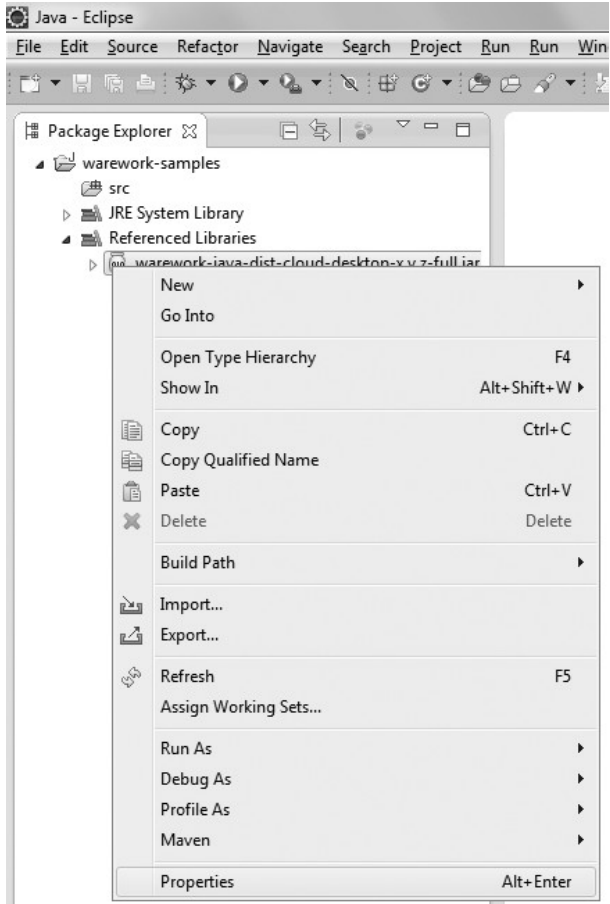


Now click "`OK`" button and check out that the Warework Distribution exists in your project:

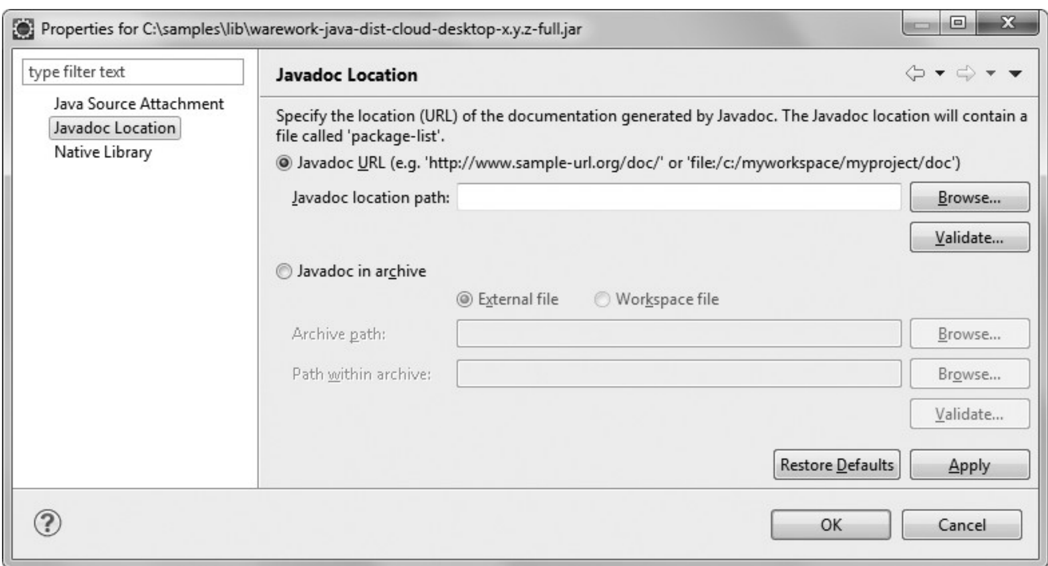


At this point, you are ready to perform operations with Warework.

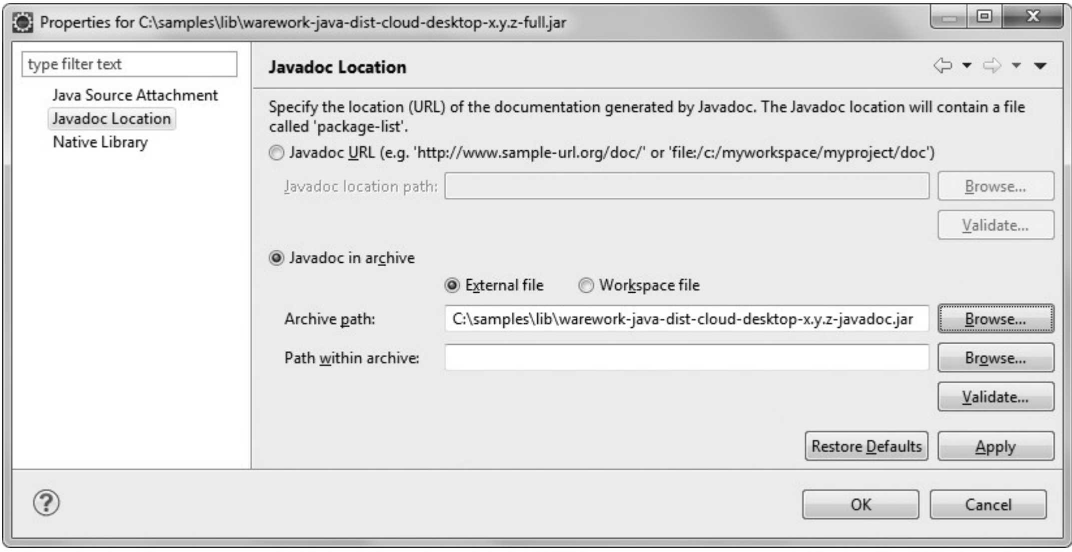
6. **Link the library documentation (optional):** to access the software library documentation directly in Eclipse you have to specify the location of the Javadoc JAR file. First, right click on the name of the Warework Distribution library and select "`Properties`":



This action will pop up a new window. Select in this new window "`Javadoc location`" in the left panel:



After that, select "`Javadoc in archive`" option in the right panel and then the "`Browse…`" button that matches the "`Archive path`" field. Now select the Javadoc archive for this Warework Distribution. This is what you should see after it is selected:



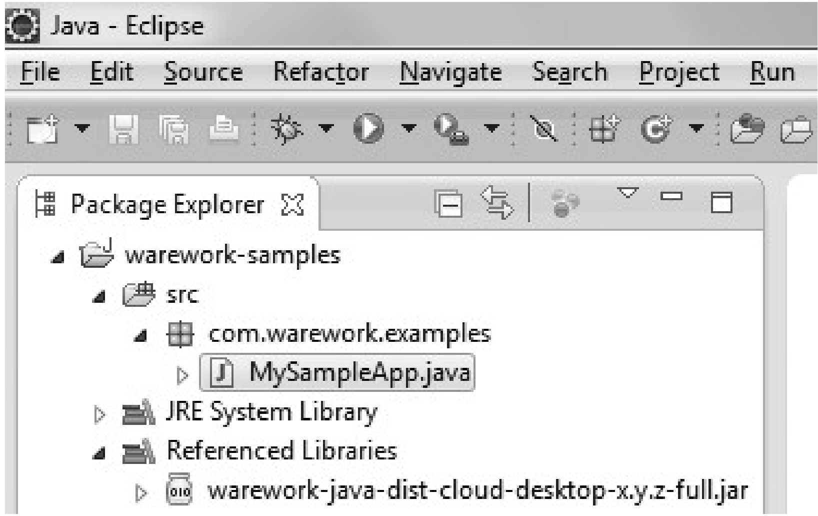
Click "`OK`" and it is done.

Now that we have a new Eclipse project created and the Warework library is configured, we can create a new Java class where to write some examples. To create a new Java class, just follow these steps:

1. Right click on the name of the project and select "`New`" and after that click the "`Class`" menu option.

2. A new window pops up and requests some data to create the class. Fill the "`Package`" box with the value "`com.warework.examples`" (a package is like a folder where you place related classes together), the "`Name`" box with "`MySampleApp`" (this is the name for the class) and select the "`public static void main(String[] args)`" checkbox. Once it is done, you should see a picture like this:

Now click "`Finish`" and the new class is shown in the project as follows:



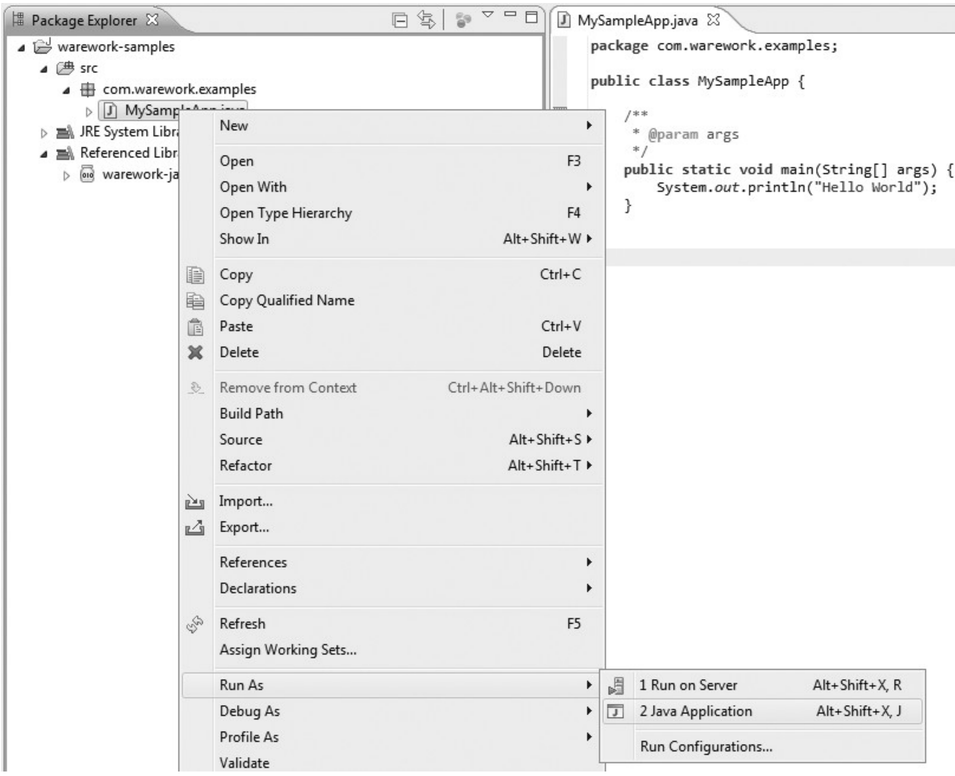
3. You will also see the code generated for this class in the Java editor. Something like this:

```
package com.warework.examples;

public class MySampleApp {

   /**
    * @param args
    */
   public static void main(String[] args) {
      // TODO Auto-generated method stub

   }

}
```

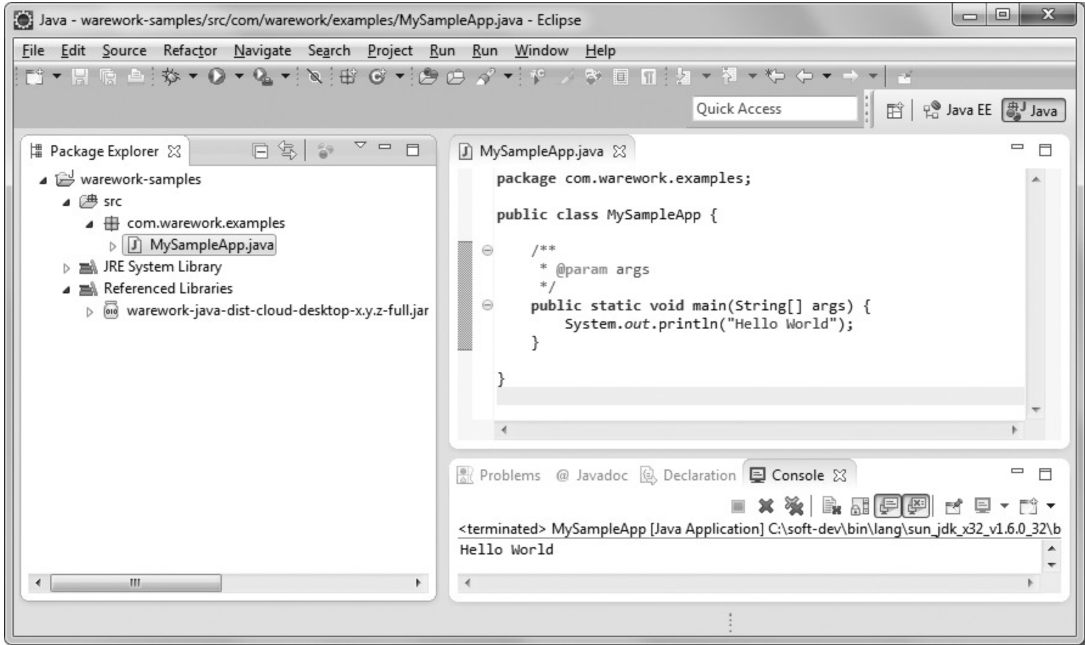
To test our class, we are going to write the classic "`Hello World`" message in the output console. To achieve this task, write this code in your class:

```
package com.warework.examples;

public class MySampleApp {

   /**
    * @param args
    */
   public static void main(String[] args) {
      System.out.println("Hello World");
   }

}
```

Perfect, now we can run the one million dollar app by right-clicking the class name in the package explorer window. When the menu pops up, select: "`Run As`" and then "`Java Application`":



This will run the application and the "`Hello World`" message will be displayed in the Eclipse console:



At this point, you can try out some examples to play with Warework. You can simply copy the content of the example from here and paste it in your sample class. If you are going to copy and paste the examples, please bear in mind these facts:

1. Do not delete the "`package`" statement from your class. For simplicity, we will show in the examples only the content of the class (without "`package`" and "`import`" statements) so if you replace all your code with the example, remember to place the "`package`" statement as the first line of your code.

2. When you paste the code in your class, you will need to import the required Warework classes to make the example work. To import the classes you have to select "`Source`" from the main menu and then the "`Organize Imports`" option. This action will include some "`import`" statements on top of your code and eliminate problems like "`XYZ cannot be resolved`" or "`XYZ cannot be resolved to a variable`".

Sample 1: Start up your application with a Template

Warework provides a Template with everything that you need to quickly start up a software application with the Framework. You can perform log and database operations without installing and configuring anything. Just place the JAR of this Distribution in your classpath and Warework handles the rest.

In this and the following examples we will create an application named "`system`". Check it out now how to start up an application using this template and this application name:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create a fully configured system.
         ScopeFactory.createTemplate(MySampleApp.class, "full", "system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

If you execute this code, the Eclipse "`Console`" window should display something like this:

```
Console   Servers   Problems   Progress   Builds   Merge Results   Data Source Explorer
MySampleApp [Java Application] C:\soft-dev\bin\servers\oracle_weblogic_v12.1.1\jdk160_29\bin\javaw.exe (04/01/2013 17:43:15)
[2013-01-04 17:43:19,117]-[INFO  @ system] - WAREWORK connected Client 'default-client' in Service 'log-service'.
[2013-01-04 17:43:19,119]-[INFO  @ system] - WAREWORK created Service 'log-service'.
[2013-01-04 17:43:19,121]-[INFO  @ system] - WAREWORK created Provider 'collection-provider'.
[2013-01-04 17:43:19,122]-[INFO  @ system] - WAREWORK created Provider 'datastore-view-provider'.
[2013-01-04 17:43:19,133]-[INFO  @ system] - WAREWORK created Data Store 'local-relational-database' in Service 'datastore-service'.
[2013-01-04 17:43:19,135]-[INFO  @ system] - WAREWORK created Service 'datastore-service'.
[2013-01-04 17:43:19,136]-[INFO  @ system] - ----------------------------------------------------
[2013-01-04 17:43:19,136]-[INFO  @ system] - WAREWORK CONFIGURED SCOPE 'system' AND NOW IT'S READY
[2013-01-04 17:43:19,136]-[INFO  @ system] - ----------------------------------------------------
```

Sample 2: Log messages

Warework includes by default Log4j, the industry-standard utility for executing log operations. It is automatically configured so you just need to worry about writing the message and the log level to use:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Log messages in different levels.
         system.debug("Debug message");
         system.info("Info message");
         system.warning("Warning message");
         system.log("Fatal message", LogServiceConstants.LOG_LEVEL_Fatal);

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Logs are redirected by default to the console. When you execute this code, logs should appear in the console like it is shown in the following picture:

```
Console  Servers  Problems  Progress  Builds  Merge Results  Data Source Explorer
MySampleApp [Java Application] C:\soft-dev\bin\servers\oracle_weblogic_v12.1.1\jdk160_29\bin\javaw.exe (04/01/2013 17:29:29)
[2013-01-04 17:29:36,255]-[INFO  @ system] - WAREWORK connected Client 'default-client' in Service 'log-service'.
[2013-01-04 17:29:36,257]-[INFO  @ system] - WAREWORK created Service 'log-service'.
[2013-01-04 17:29:36,258]-[INFO  @ system] - WAREWORK created Provider 'collection-provider'.
[2013-01-04 17:29:36,259]-[INFO  @ system] - WAREWORK created Provider 'datastore-view-provider'.
[2013-01-04 17:29:36,269]-[INFO  @ system] - WAREWORK created Data Store 'local-relational-database' in Service 'datastore-service'.
[2013-01-04 17:29:36,271]-[INFO  @ system] - WAREWORK created Service 'datastore-service'.
[2013-01-04 17:29:36,272]-[INFO  @ system] - ----------------------------------------------------
[2013-01-04 17:29:36,272]-[INFO  @ system] - WAREWORK CONFIGURED SCOPE 'system' AND NOW IT'S READY
[2013-01-04 17:29:36,273]-[INFO  @ system] - ----------------------------------------------------
[2013-01-04 17:29:37,627]-[DEBUG @ system] - Debug message
[2013-01-04 17:29:37,892]-[INFO  @ system] - Info message
[2013-01-04 17:29:38,149]-[WARN  @ system] - Warning message
[2013-01-04 17:29:38,452]-[FATAL @ system] - Fatal message
```

If you plan to write logs in separate files or any other output, please review how to override the default Log4j configuration.

Sample 3: Run SQL in embedded database

Warework includes by default (bundled within the JAR of the Warework Distribution) a relational database. It is the H2 Database Engine and it is automatically configured so you do not have to install, neither configure, anything in order to perform relational database operations. It is about 4 lines of code to start running SQL. Check this out with the following examples:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
```

```
            RDBMSView ddbb = (RDBMSView) system.
               getObject("relational-database");

            // Connect with the database.
            ddbb.connect();

            // Create a new table in the database.
            ddbb.executeUpdate("CREATE TABLE TEST1 (MESSAGE VARCHAR(99))", null);

            // Begin a transaction in the database management system.
            ddbb.beginTransaction();

            // First SQL statement.
            String sql1 = "INSERT INTO TEST1 (MESSAGE) VALUES ('ABC')";

            // Second SQL statement.
            String sql2 = "INSERT INTO TEST1 (MESSAGE) VALUES ('DEF')";

            // Third SQL statement.
            String sql3 = "INSERT INTO TEST1 (MESSAGE) VALUES ('GHI')";

            // Execute three SQL update statements at once.
            ddbb.executeUpdate(sql1 + ";" + sql2 + ";" + sql3,
               new Character(';'));

            // Commits changes in the database.
            ddbb.commit();

            // Disconnect the database.
            ddbb.disconnect();

            // Shut down your application.
            ScopeContext.remove("system", true, true);

         } catch (Exception e) {
            e.printStackTrace();
         }
   }
}
```

The following example shows you how to retrieve an object to process the result of a query:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();

         // Query the database.
         ResultRows result = (ResultRows) ddbb.
            executeQuery("SELECT * FROM TEST1", -1, -1);

         // Iterate rows.
```

```
            while (result.next()) {

               // Get the string value of a given column name.
               String message = result.getString("MESSAGE");

            }

            // Disconnect with the database.
            ddbb.disconnect();

            // Shut down your application.
            ScopeContext.remove("system", true, true);

         } catch (Exception e) {
            e.printStackTrace();
         }
      }
   }
```

Now, we are going to create four text files, write SQL statements in them and finally execute the content of each file in the database. First, you have to create the files in the `/META-INF/<scope-name>/statement/sql` directory of your project, for example:

- `/META-INF/system/statement/sql/init-ddbb.sql`

  This could be the content of the `init-ddbb.sql` file:

  ```
  CREATE TABLE HOME_USER (
        ID NUMERIC(5, 0) NOT NULL,
        NAME VARCHAR(25) NOT NULL,
        PRIMARY KEY (ID)
     )
  ```

- `/META-INF/system/statement/sql/create-user.sql`

  This could be the content of the `create-user.sql` file:

  ```
  INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
  ```

  Check out that we have defined two variables named `USER_ID` and `USER_NAME`. We will replace these variables later on to register a specific user in the database.

- `/META-INF/system/statement/sql/list-users.sql`

  This could be the content of the `list-users.sql` file:

  ```
  SELECT * FROM HOME_USER
  ```

- `/META-INF/system/statement/sql/find-user.sql`

  This could be the content of the `find-user.sql` file:

```
SELECT * FROM HOME_USER WHERE ID=${USER_ID}
```

After creating these files, in Eclipse IDE you should see a picture like this:

- warework-samples
  - src
    - com.warework.examples
      - MySampleApp.java
    - META-INF
      - system
        - statement
          - sql
            - create-user.sql
            - find-user.sql
            - init-ddbb.sql
            - list-users.sql
  - JRE System Library
  - Referenced Libraries
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

The following example shows how to execute the `init-ddbb.sql` script:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();

         // Create the table in the database.
         ddbb.executeUpdateByName("init-ddbb", null, null);

         // Disconnect with the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

To register a new user in the `HOME_USER` table, you have to replace the variables defined in the `create-user.sql` file with specific values:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();

         // Values for variables.
         Hashtable values = new Hashtable();

         // Set variables for the update statement.
         values.put("USER_ID", new Integer(3));
         values.put("USER_NAME", "Ian Sharpe");

         // Create a new user in the database.
         ddbb.executeUpdateByName("create-user", values, null);

         // Commit changes.
         ddbb.commit();

         // Disconnect with the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Once you have some data, you can list the users like this:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();
```

```
            // List every home user from the database.
            ResultRows result = (ResultRows) ddbb.
               executeQueryByName("list-users", null, -1, -1);

            // Disconnect with the database.
            ddbb.disconnect();

            // Shut down your application.
            ScopeContext.remove("system", true, true);

         } catch (Exception e) {
            e.printStackTrace();
         }
      }
   }
```

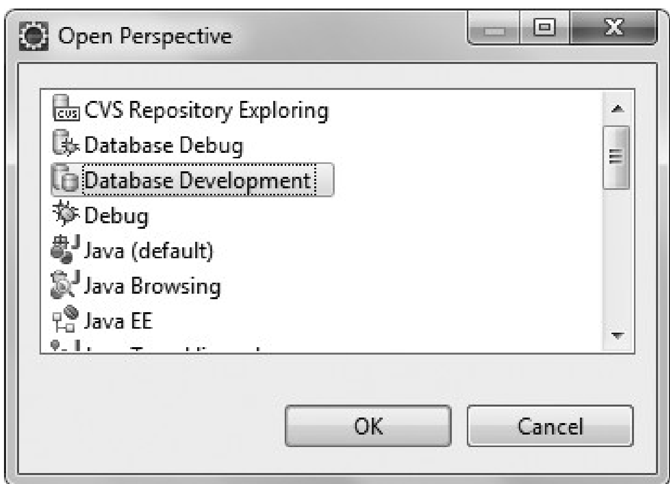
You can also filter the result by replacing variables with values in a query statement. The following example shows how to retrieve a specific home user from the database:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();

         // Values for variables.
         Hashtable values = new Hashtable();

         // Set variables for the update statement.
         values.put("USER_ID", new Integer(3));

         // Search for a specific user.
         ResultRows result = (ResultRows) ddbb.
            executeQueryByName("find-user", values, -1, -1);

         // Disconnect with the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Configure Eclipse with H2 database

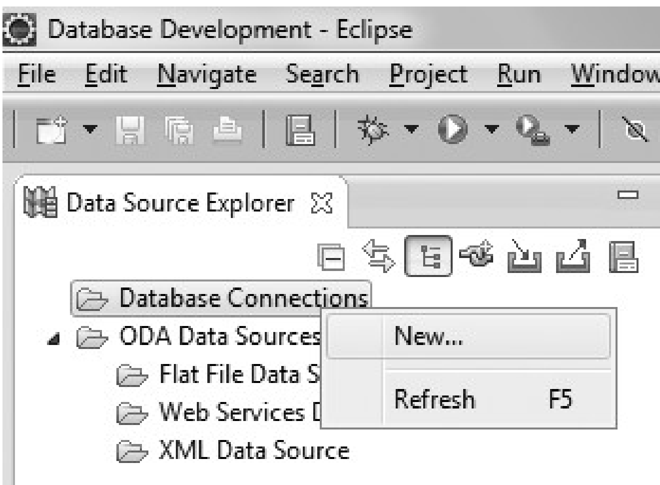
Once you executed some SQL statements, you can explore the contents of the database by connecting Eclipse with H2. To achieve this task, perform these steps:

1. Select option "Window" in the main menu and then "Open Perspective" and "Other…". This will show up the following window:



   Just select "Database Development" and click "OK".

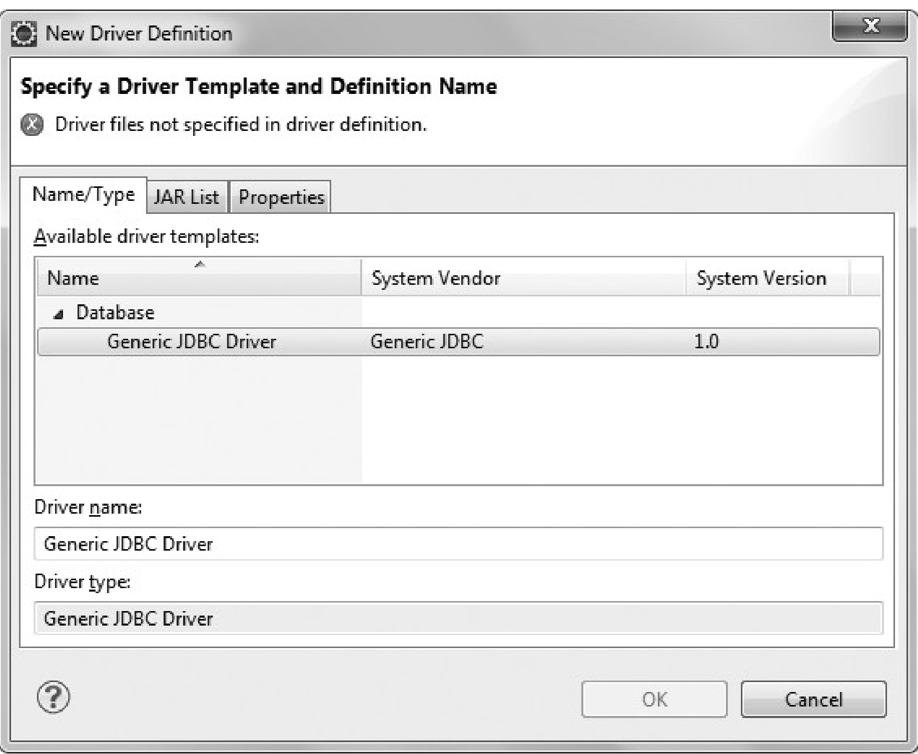
2. Now we are going to create a connection profile. Right click on "Database Connections" in "Data Source Explorer" window and then select "New":



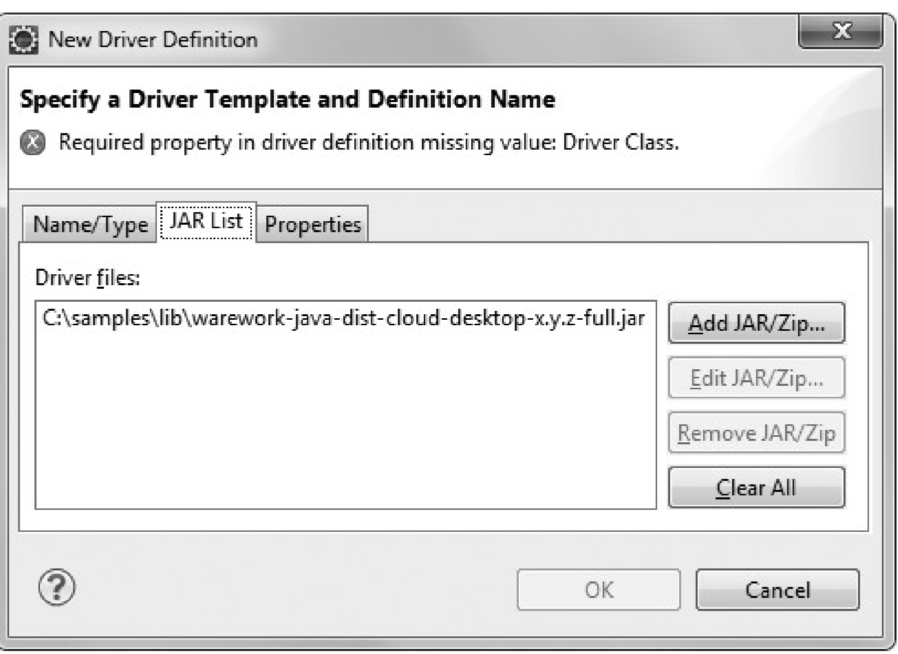
3. A new window pops up. Now select in this window "Generic JDBC" profile type, enter the name for the connection and then click "Next":

4. Now click on the icon next to "`Drivers`" to add a new driver definition:

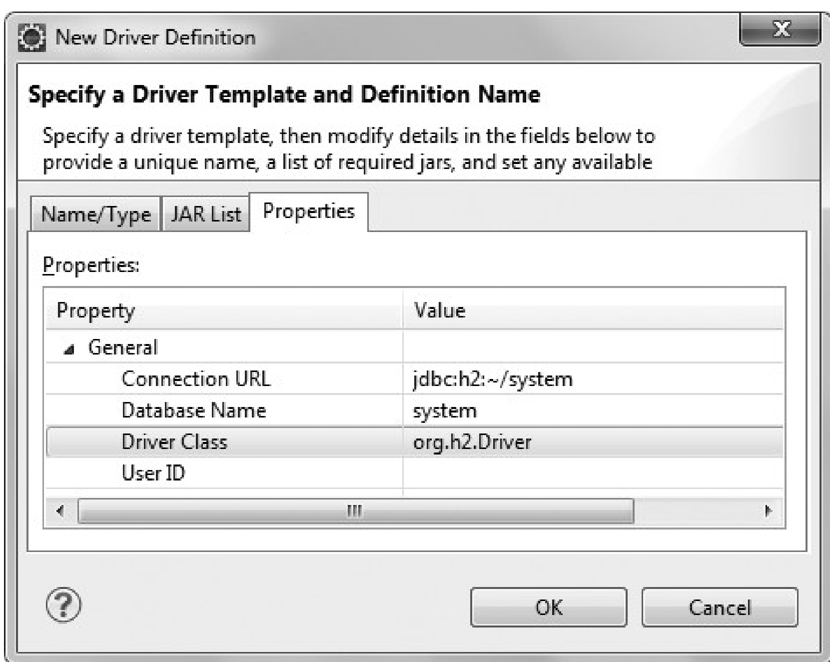
5. This action opens a new window. Now, at "`Name/Type`" tab, select the driver version:



6. Now select the "`JAR List`" tab and browse for the Warework JAR which includes de H2 database. In this tab, click on "`Add JAR/Zip`" and select the JAR:



7. After that, go to the "`Properties`" tab and fill each field like it is shown in the following picture:

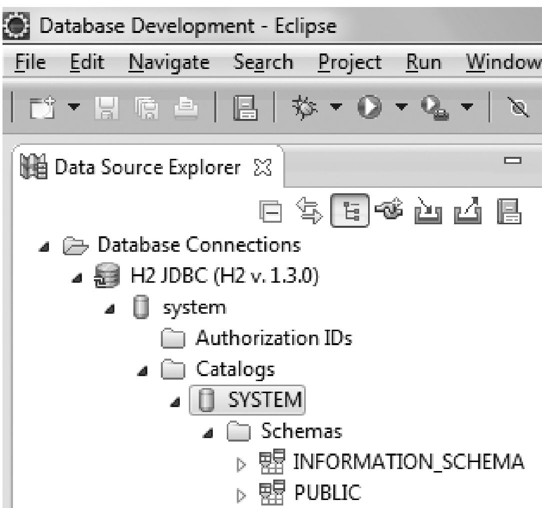


8. Now click "`OK`" to close the "`New Driver Definition`" window and return to the "`New Connection Profile`" window. The connection with the database is almost ready. Before testing it, we have to specify the "`User name`" property with value "`sys-tem`". It is also recommended to check out the "`Save password`" check box:

Please note that <u>user and database names ("`system`") must be the name of the Scope</u>:

```
// Database and Scope names must be the same.
ScopeFactory.createTemplate(MySampleApp.class, "full", "system");
```

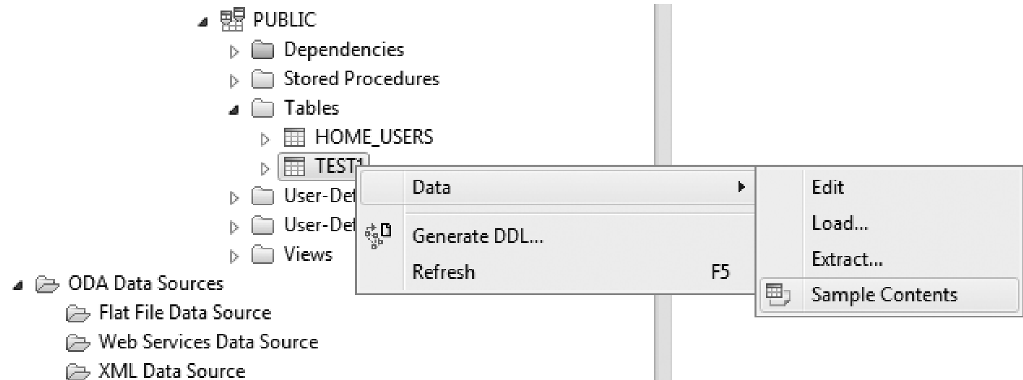
9. Perfect. Now it is the right time to test the database connection. Click on "`Test Connection`" button and, if connection is OK, then click on "`Finish`". This will show the new connection in the "`Data Source Explorer`" window.



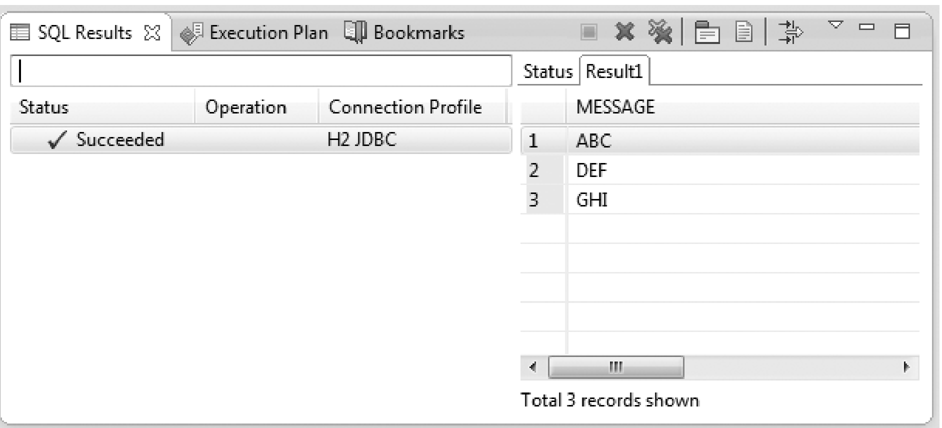
If you expand the "`PUBLIC`" schema you should see the previously created tables:

Database Connections
H2 JDBC (H2 v. 1.3.0)
system
Authorization IDs
Catalogs
SYSTEM
Schemas
INFORMATION_SCHEMA
PUBLIC
Dependencies
Stored Procedures
Tables
HOME_USERS
TEST1
User-Defined Functions
User-Defined Types
Views

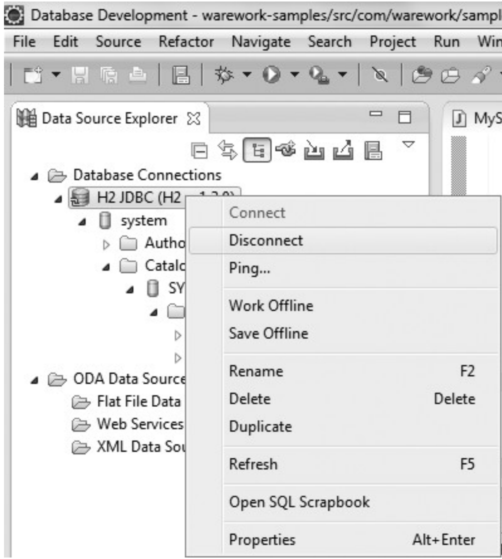
10. To review the contents of one table, just right click on the specific table and select "`Sample Contents`" from "`Data`" option:



This will display some rows from selected table in the "`SQL Results`" window:



11. The last step is about closing the database connection. We have to perform this action because the H2 database is not configured in server mode (to handle multiple connections at the same time) so, to avoid undesired problems in the future, <u>remember always to disconnect the database before performing other database operations</u> (with your application or another Eclipse window). Just right click on the database connection name and select "`Disconnect`":



Generate Java Beans from database tables with JPA

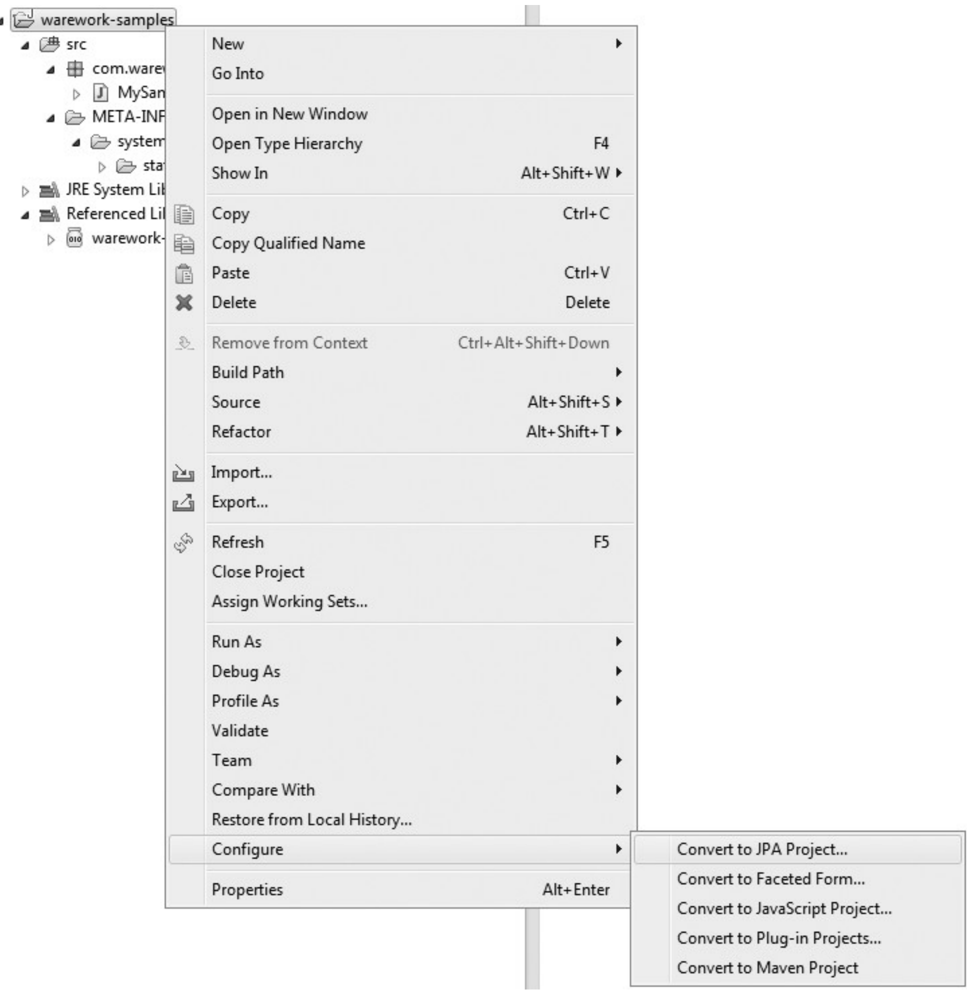
When working with databases in Java, it is very common to pair each table of the database with one Java Bean. This approach, known as ORM, is very useful because it allows you to use simple Java Beans to perform complex database operations. You can execute queries and insert, update and remove table rows without the need to write SQL statements, just with Java Beans. To decrease your development time, especially when working with many tables, it is highly recommended that you use JPA, the standard ORM tool for Java, to handle database operations with Java Beans.

About JPA you should know that it is a specification, that is, it does not provide the main functionality to perform ORM operations; it just specifies how to do it. So, in order to make JPA work, you must use a JPA implementation. Warework includes by default EclipseLink, which is one of the best JPA implementations in the market.

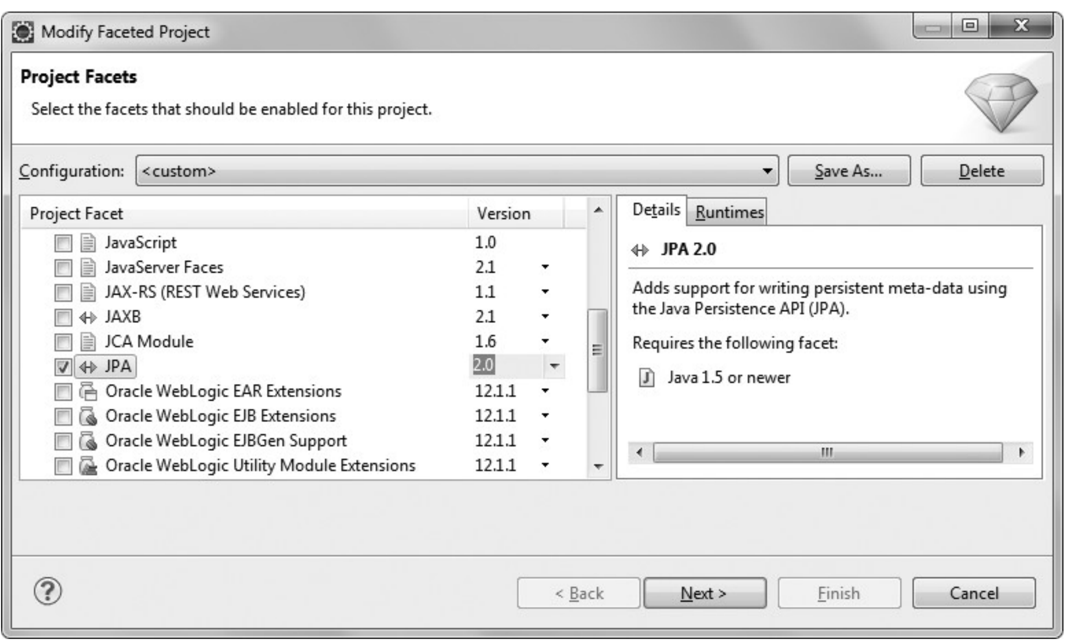
Now we are going to see how to generate one Java Bean per database table with Eclipse and JPA. The first thing we have to do is to enable JPA in our Eclipse project. We achieve this task with the following steps:

1. If you are not in the Java perspective, first select it:

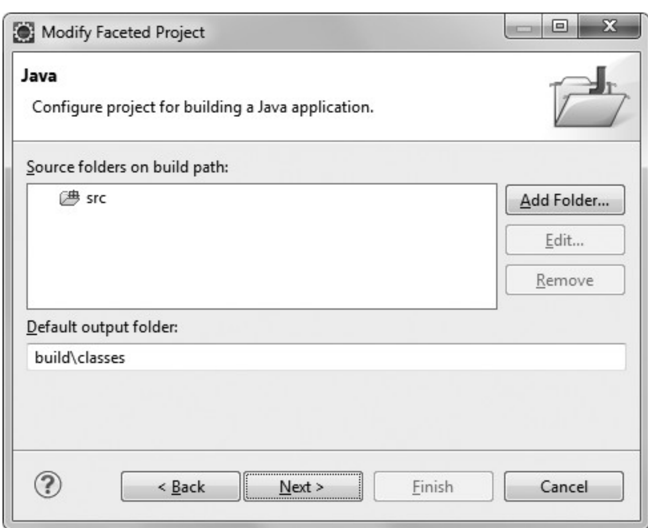
2. In the "`Package Explorer`" window, right click on your project and select "`Convert to JPA Project…`" from menu option "`Configure`":



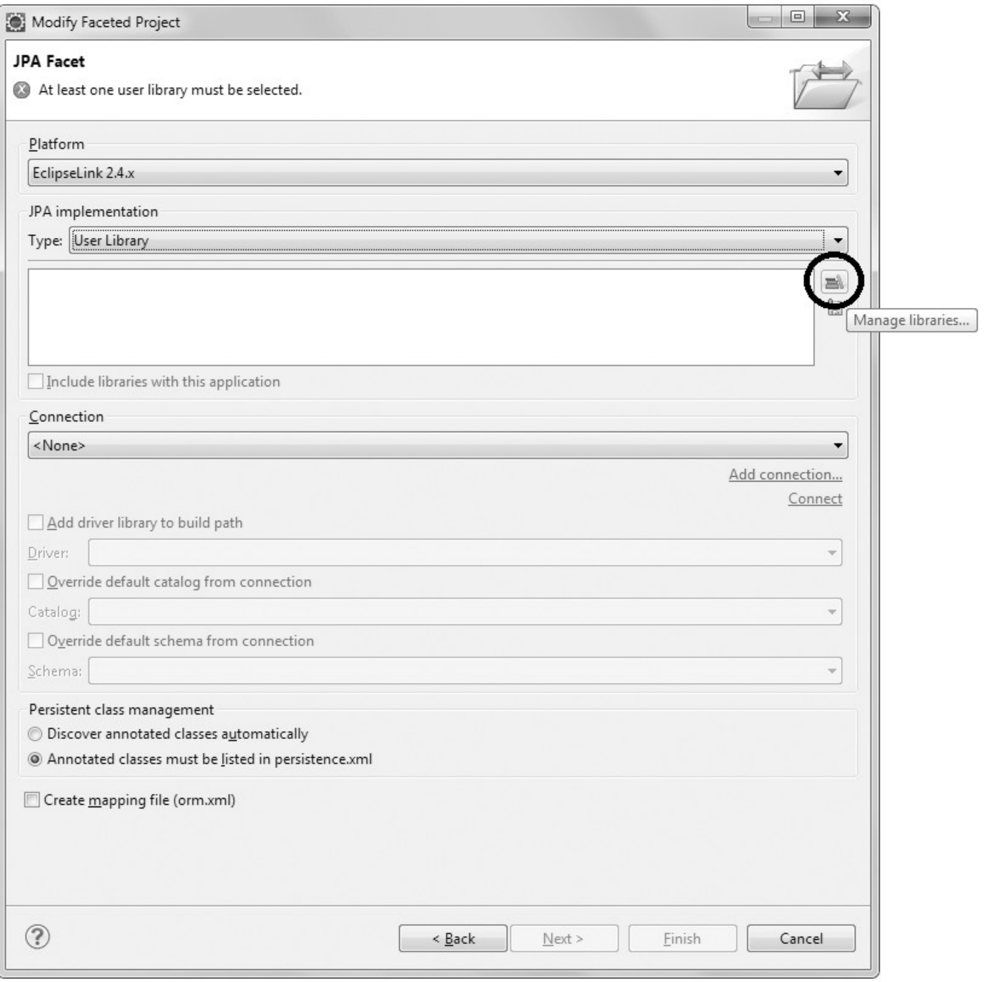
3. A new window pops up. Review that JPA version is "`2.0`" and click "`Next`":



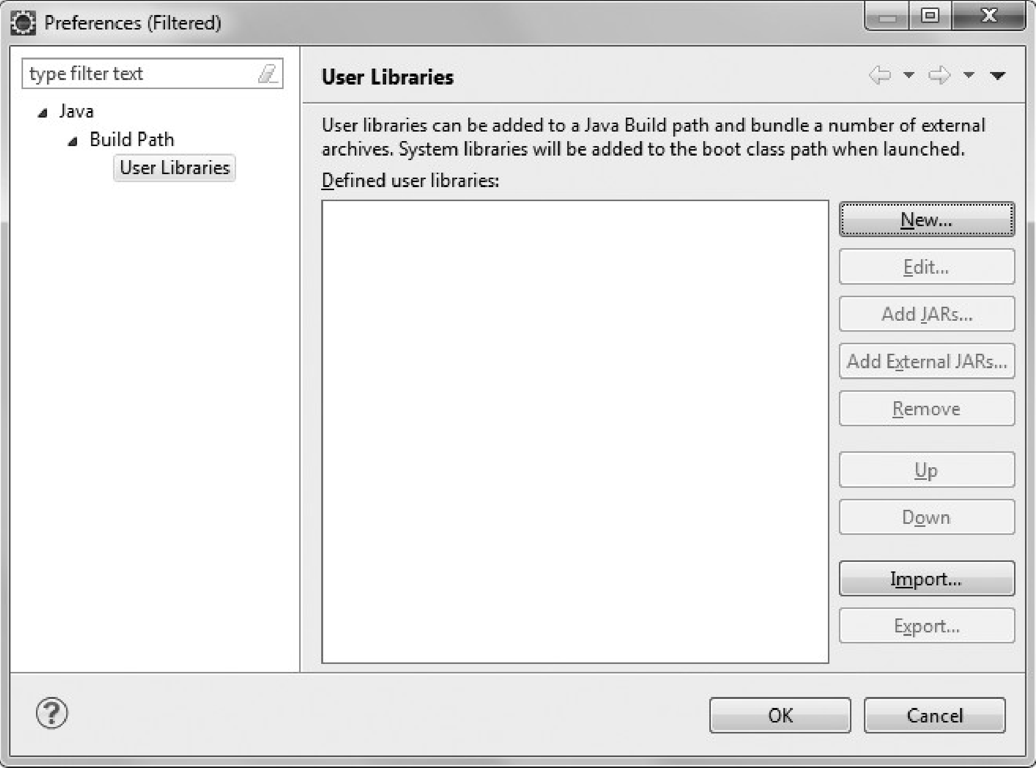
4. In this step leave default values and click "`Next`":



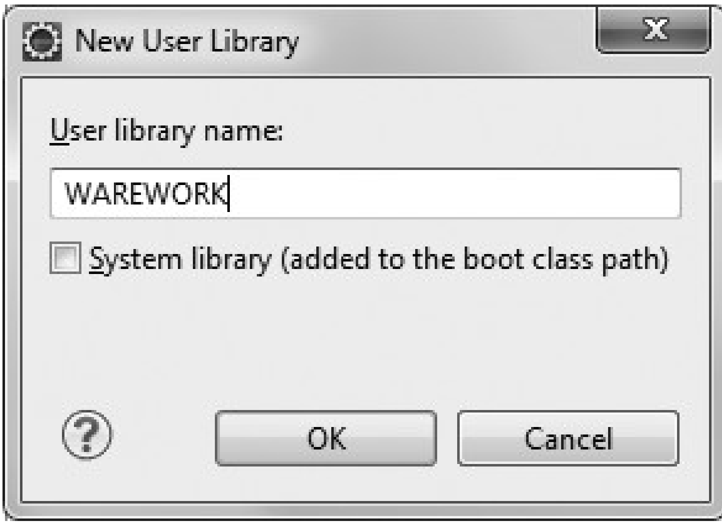
5. Now, select in the "`Platform`" drop list the [EclipseLink version included]() with this Warework Distribution. After that, click on the "`Manage libraries…`" button that exists in the JPA implementation area:



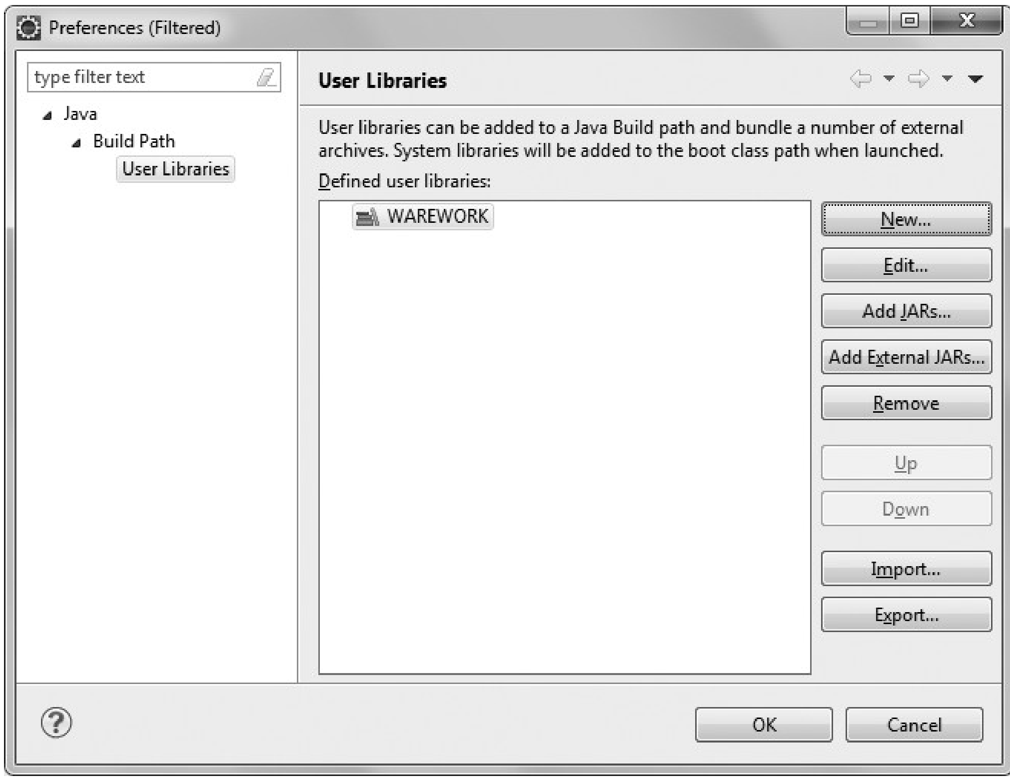
6. This action will display a new window where we are going to define a new library for Eclipse (a library in Eclipse is a set of JARs). Click "`New…`" to create a new library:



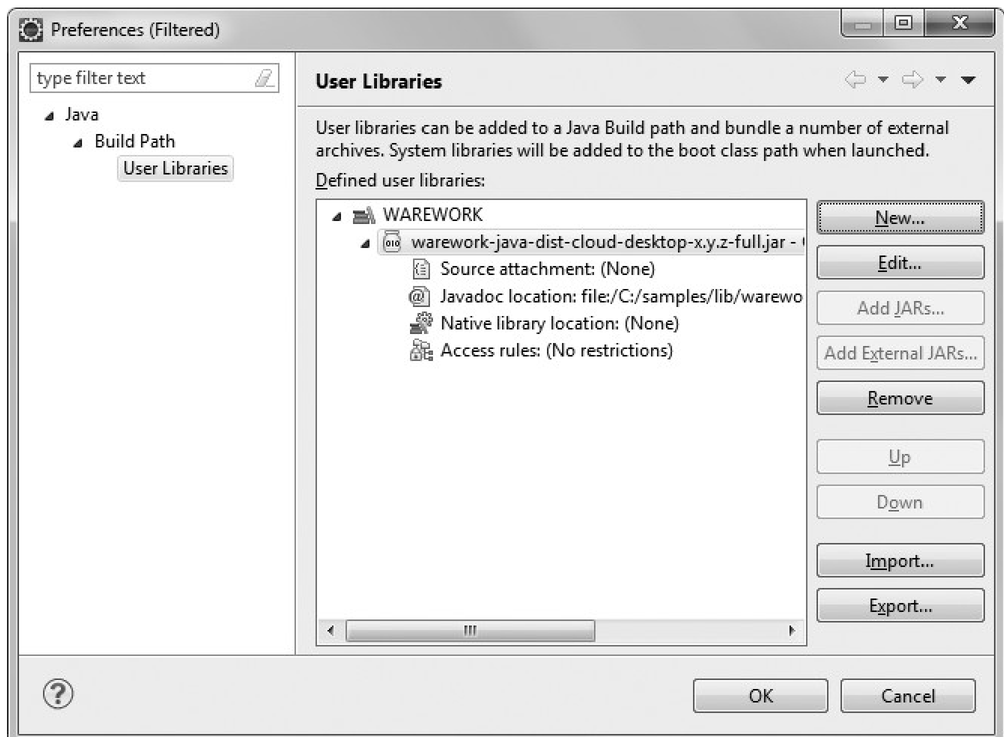
7. Now, type the name of the new Eclipse library and click "`OK`":



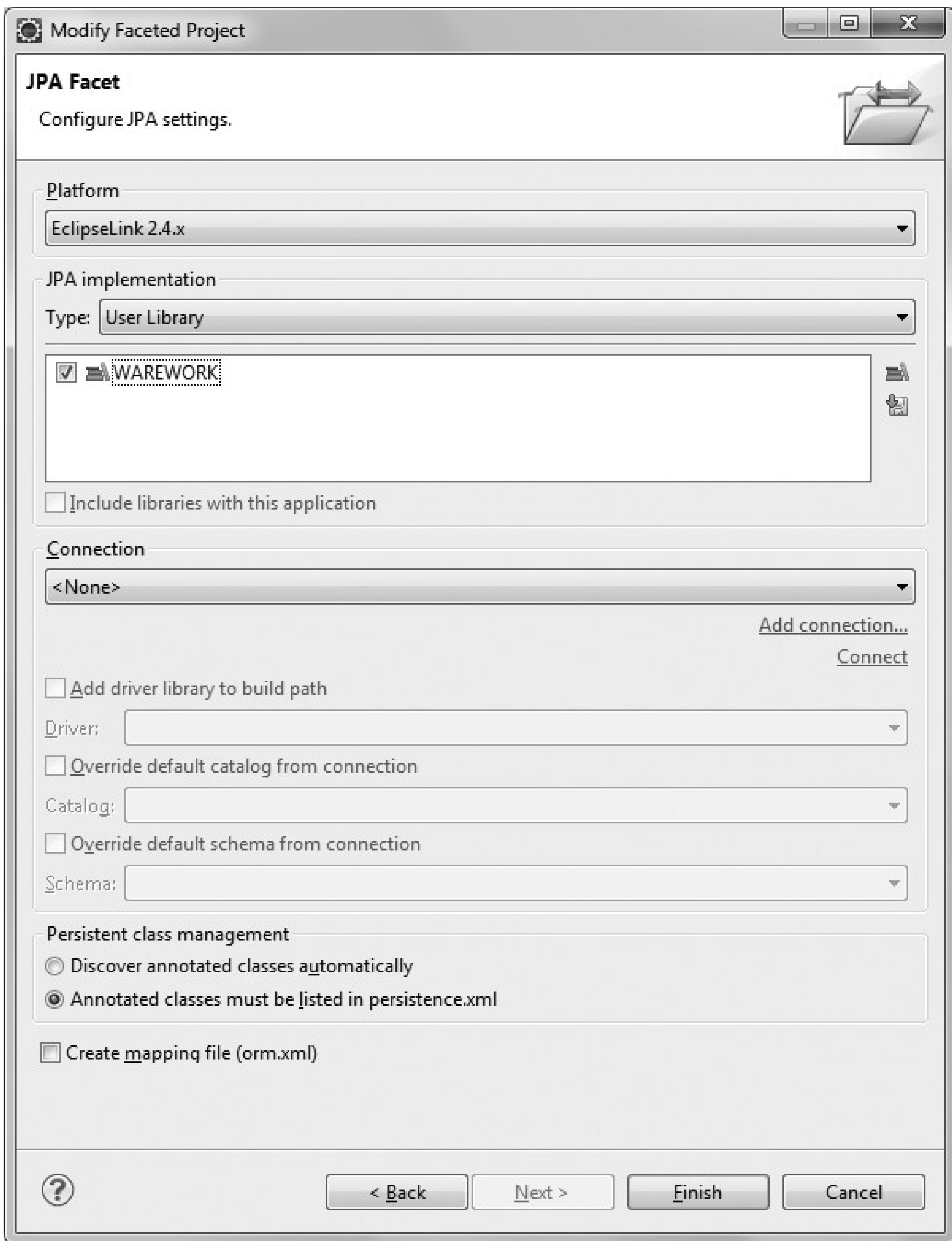
8. The "`User Libraries`" window now should display the library like this:



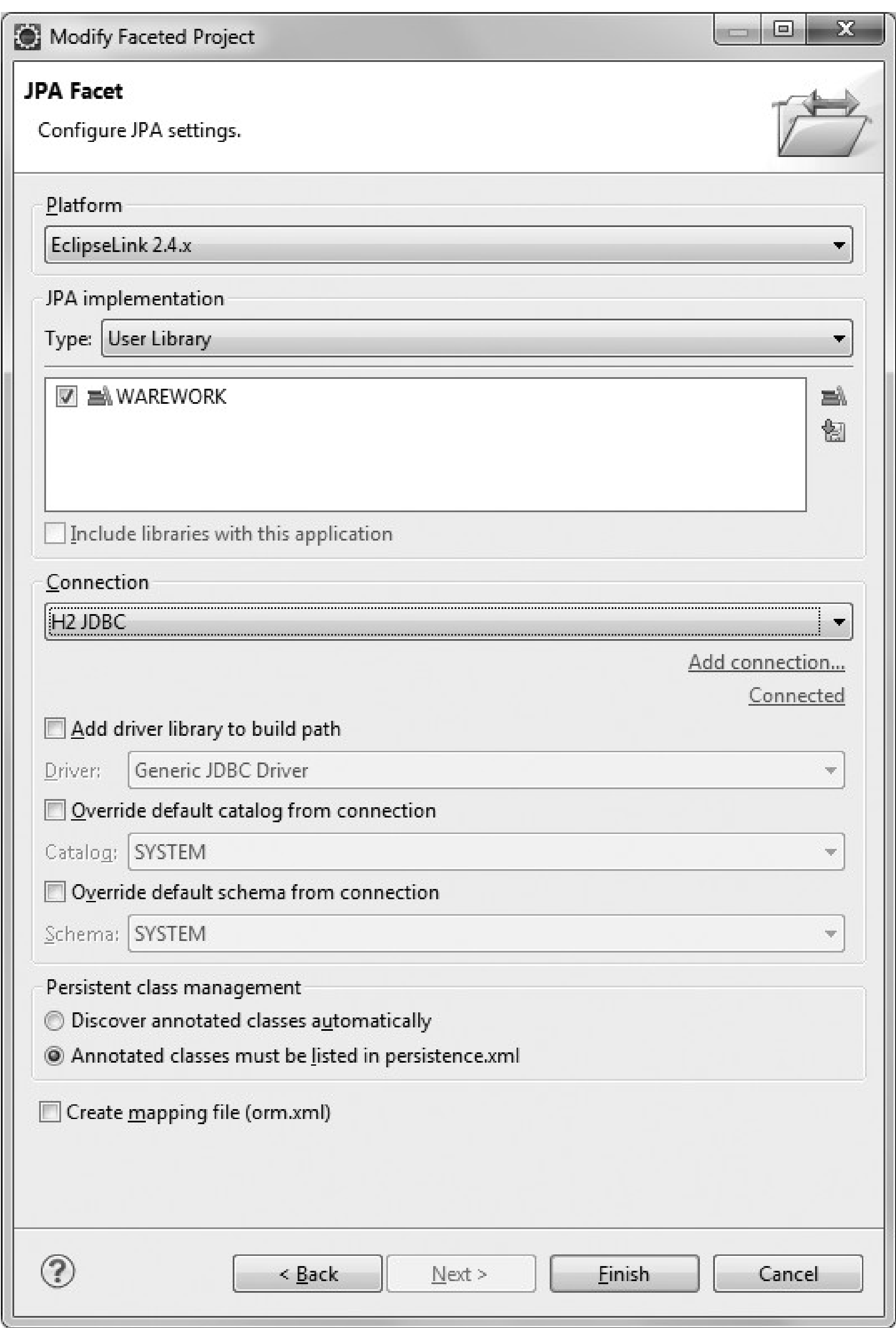
9. The new library is created but it is not configured yet. We have to add the JAR which contains EclipseLink. As Warework includes EclipseLink by default, we just have to specify where the Warework JAR is. Click on "`Add External JARs...`" and select the location of the Warework JAR. Once you locate it, the "`User Libraries`" window updates the library and shows the included JAR:



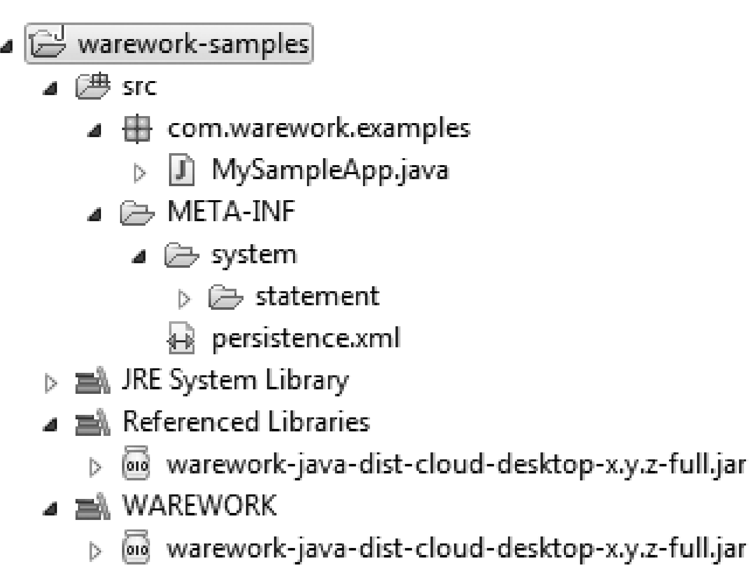
10. Click "OK" to close the "User Libraries" window and show again the "JPA Facet" window. The new Warework library is shown in the "JPA implementation" area, just check it out:



11. Now, select from the "Connection" drop list the database connection created before and click on "Connect":

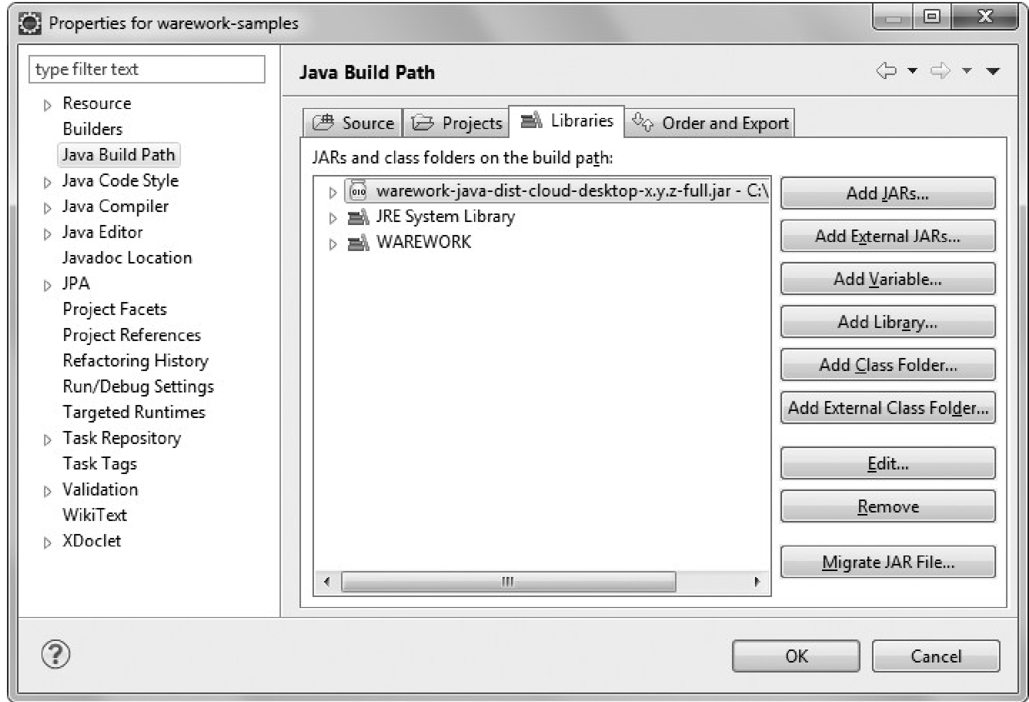


12. Finally, click "`Finish`" to enable JPA in your project. Now, your project may look like this:

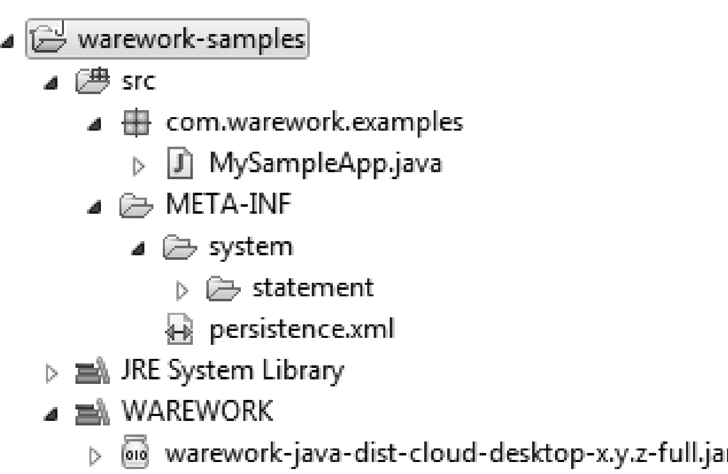


Notice that a new "`persistence.xml`" file is created at "`META-INF`" directory.

13. Because the Warework JAR is now duplicated in your project, you should remove the JAR from "`Referenced Libraries`" to keep just one reference to it. Right click on the project and select "`Properties`". In the new window select "`Java Build Path`" on the left panel and after that the "`Libraries`" tab in the right panel. At this point, select the Warework JAR like it is shown in the following picture:

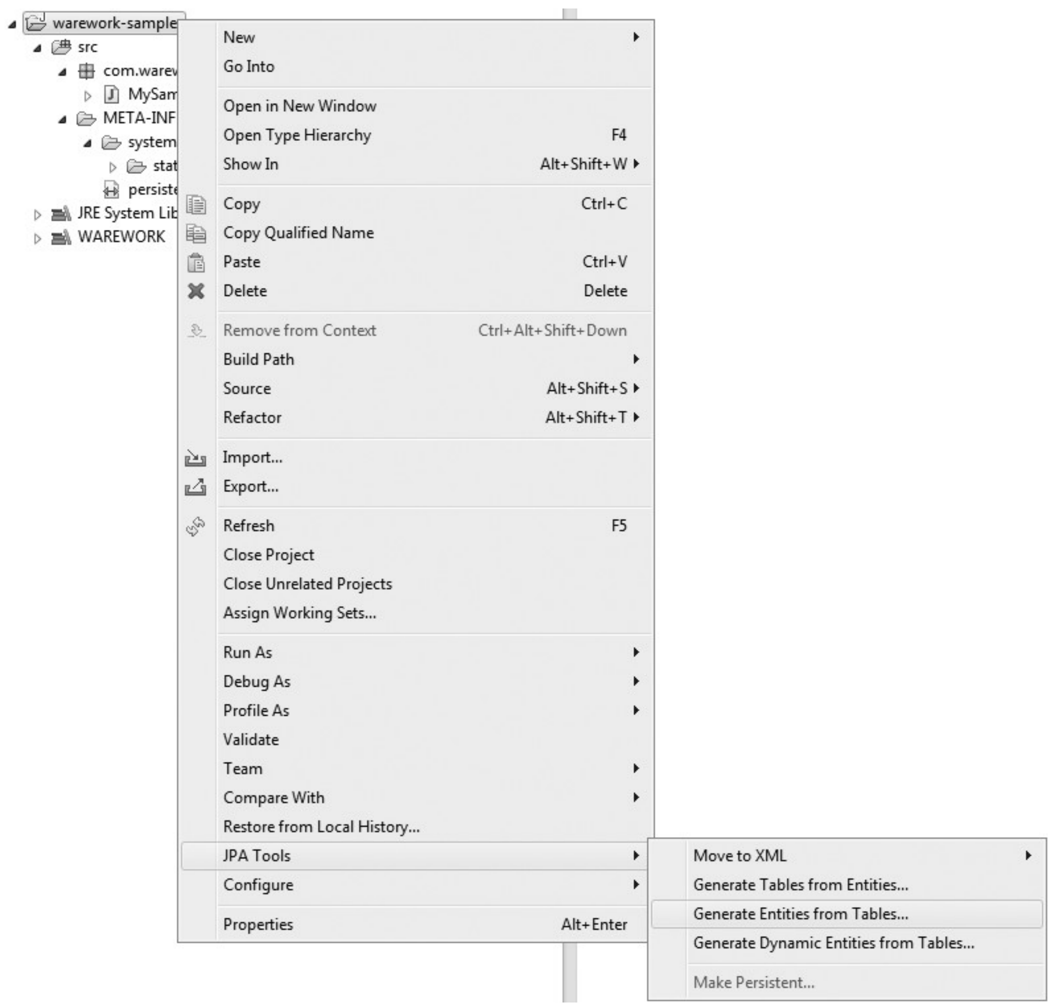


14. Click "`Remove`" and "`OK`" and the project is updated like this (sometimes Eclipse does not refresh the "`Package Explorer`" window very well after this operation; you may need to press F5 when the project is selected to refresh the window):

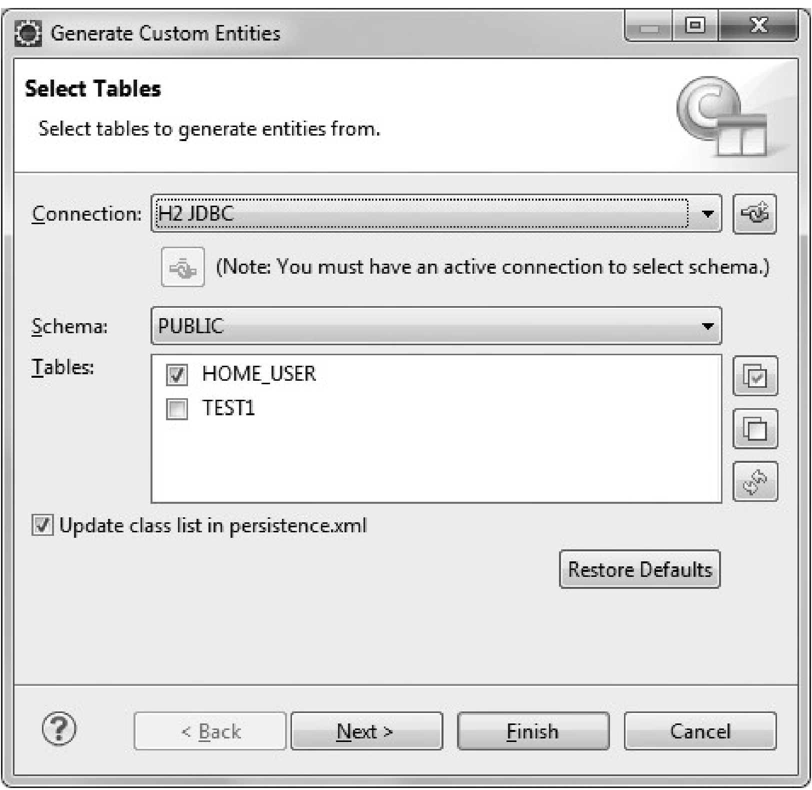


Once JPA is enabled in your Eclipse project, you can generate one Java Bean for every table that exists in the database. Check it out how to create them:

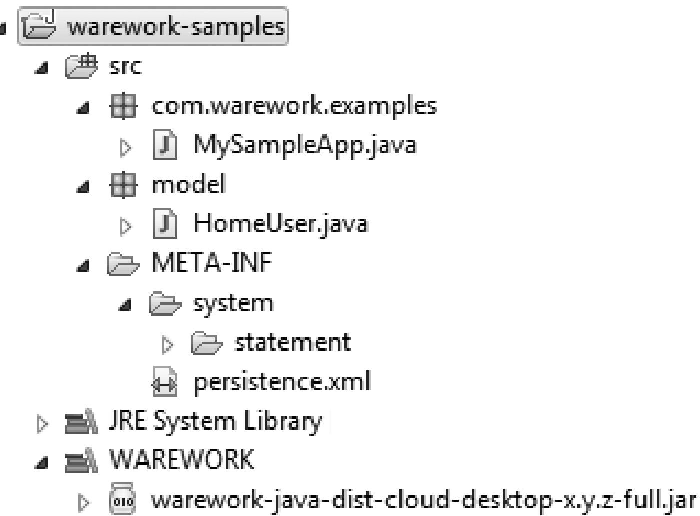
1. In the "`Package Explorer`" window, right click on your project and select "`Generate Entities from Tables...`" from menu option "`JPA Tools`":



2. A new windows pops up. Here you have to specify the connection created before, the "PUBLIC" schema and the tables that you want to convert into Java Beans. For our examples, we are going to select just the "HOME_USER" table:



3. In the future, you should click "Next" and configure in detail how Java Beans are created from database tables (how the sequences for primary keys are generated, target package for the Java Beans source code, mapping data types, etc.). For our example, we just keep default values unmodified so we are going to click on "Finish". The new Java Bean is created in the project:



4. Job is almost done. We just have to update the "`persistence.xml`" file to specify the name of the JPA persistence unit. Open this file and set the name of your Scope ("`system`") for the name of the "`persistence-unit`" XML tag:

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.0"
   xmlns="http://java.sun.com/xml/ns/persistence"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
   http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd">

   <persistence-unit name="system">
      <class>model.HomeUser</class>
   </persistence-unit>

</persistence>
```

Sample 4: Execute ORM operations in embedded database

At this point, your Eclipse project is JPA-enabled and you should be able to perform ORM operations with the Warework ORM View. First, we are going to execute some CRUD operations with the ORM View:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         ORMView ddbb = (ORMView) system.getObject("orm-database");

         // Connect with the relational database.
         ddbb.connect();

         // Begin a transaction in the relational database.
         ddbb.beginTransaction();

         // Create a JPA entity.
         HomeUser user = new HomeUser();

         // Set some data in the Java Bean.
         user.setId(1l);
         user.setName("Arnold Brown");

         // Save the JPA entity in the relational database.
         ddbb.save(user);

         // Update some data in the Java Bean.
         user.setName("Arnold Brown Jr.");

         // Update the object in the relational database.
         ddbb.update(user);

         // Delete the object in the relational database.
         ddbb.delete(user);

         // Commits changes in the relational database.
```

```
         ddbb.commit();

         // Disconnect the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

That is great. We created a new row in the `HOME_USER` table and then updated and deleted it without writing any SQL code. Let us review in the following example how to find a specific object (a row in the `HOME_USER` table) from the database:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         ORMView ddbb = (ORMView) system.getObject("orm-database");

         // Connect with the relational database.
         ddbb.connect();

         // Create the filter to find the object.
         HomeUser filter = new HomeUser();

         // Set the data required to locate the object in the database.
         filter.setId(3l);

         // Find the object which type is "HomeUser" and ID is 3.
         HomeUser user = (HomeUser) ddbb.find(filter);

         // Disconnect the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

It is also possible to search for a list of objects from the database. You can do so in three different ways. One of them consists of using the JPA entity (the Java Bean generated from the database) as a filter for the query. For example, you can set the values for attributes of the JPA entity, specify the operation to perform (this is optional, by default performs an "equals to" operation) and sort results like this:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         ORMView ddbb = (ORMView) system.getObject("orm-database");

         // Connect with the relational database.
         ddbb.connect();

         // Create the filter to find the objects.
         HomeUser filter = new HomeUser();

         // Set the data required to find the objects in the database.
         filter.setId(1l);

         // Define which operators to use.
         Hashtable operator = new Hashtable();

         // Set which operation to perform for each attribute of the filter.
         operator.put("id", Operator.GREATER_THAN);

         // Define the order of the results.
         OrderBy order = new OrderBy();

         // Set ascending order for field "ID".
         order.addAscending("id");

         // List Home Users which ID is greater than 1 and sorted by ID.
         List<HomeUser> users = (List<HomeUser>) ddbb.list(filter,
            operator, order, -1, -1);

         // Disconnect the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

You can also create custom queries with a specific Warework `Query` object:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         ORMView ddbb = (ORMView) system.getObject("orm-database");

         // Connect with the relational database.
         ddbb.connect();
```

```
         // Define the query.
         Query query = new Query(getScope());

         // Search for User objects.
         query.setObject(HomeUser.class);

         // Define the WHERE clause.
         Where where = new Where(system);

         // Create one OR expression.
         Or or = where.createOr();

         // Filter by name and password.
         or.add(where.createLikeValue("name", "Ian Sharpe"));
         or.add(where.createGreaterThanValue("id", 1l));

         // Set the OR expression in the WHERE clause.
         where.setExpression(or);

         // List Home Users named 'Ian Sharpe' or ID is greater than 1.
         List<HomeUser> users = (List<HomeUser>) ddbb.list(query);

         // Disconnect the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Sometimes it is much better to keep your queries in separate files. With Warework you can create XML files that represent database queries like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.0.0.xsd">

   <object>model.HomeUser</object>

   <where>
      <or>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Ian Sharpe</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>id</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Long</type>
               <value>1</value>
            </value-operand>
         </expression>
      </or>
```

```
   </where>

</query>
```

XML files like this should exist in the `/META-INF/system/statement/xoq` directory of your project. Let us store this query in a file named "`find-user.xml`":

```
warework-sample
   src
      com.warework.samples
         MySampleApp.java
      model
         HomeUser.java
      META-INF
         system
            statement
               sql
               xoq
                  find-user.xml
         persistence.xml
   JRE System Library
   WAREWORK
```

Once the query is located in the right place, we can execute it very easily:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         ORMView ddbb = (ORMView) system.getObject("orm-database");

         // Connect with the relational database.
         ddbb.connect();

         // Read the content of 'find-user.xml' and execute it.
         List<HomeUser> users = (List<HomeUser>) ddbb.
            executeQueryByName("find-user", null, -1, -1);

         // Disconnect the database.
         ddbb.disconnect();

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Sample 5: Send emails

You have to create an XML file named mail-service.xml in the /META-INF/<scope-name> directory of your project, for example:

- warework-samples
  - src
    - com.warework.examples
      - MySampleApp.java
    - META-INF
      - system
        - statement
        - mail-service.xml
  - JRE System Library
  - WAREWORK
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

The following is an example for the content of the mail-service.xml file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client"
            connector="com.warework.service.mail.client.connector. …
            … JavaMailSenderConnector">
         <parameter name="mail.host" value="smtp.host.com" />
         <parameter name="mail.port" value="587" />
         <parameter name="mail.transport.protocol" value="smtp" />
         <parameter name="mail.user" value="sample@mail.com" />
         <parameter name="mail.password" value="password" />
         <parameter name="mail.smtp.auth" value="true" />
         <parameter name="mail.smtp.starttls.enable" value="true" />
         <parameter name="mail.message.charset" value="utf-8" />
         <parameter name="mail.message.subtype" value="html" />
      </client>
   </clients>

</proxy-service>
```

Once the configuration for the Mail Service is ready, you can send an email like this:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");
```

```
         // Get an instance of the Mail Service.
         MailServiceFacade mailService = (MailServiceFacade) system.
            getService("mail-service");

         // Connect with the mail server.
         mailService.connect("default-client");

         // Send an email.
         mailService.send("default-client", "subject",
            "from@mail.com", "to@mail.com",
            "cc1@mail.com;cc2@mail.com", null, null, "mail message");

         // Disconnect with the mail server.
         mailService.disconnect("default-client");

         // Shut down your application.
         ScopeContext.remove("system", true, true);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Sample 6: Configure your application from scratch

Templates are cool but most of the times you will need to create a specific configuration for your application so you can specify in detail everything that you need.

To achieve this, first you have to create the main configuration file for your application. In this file you will define the Services and Providers that allow you to perform operations with the Framework. Just create an XML in the `/META-INF` directory of your project with any name you want, for example:

```
warework-samples
   src
      com.warework.examples
         MySampleApp.java
      META-INF
         system.xml
   JRE System Library
   Referenced Libraries
      warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Use the following code as a reference for the content of the `/META-INF/system.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>

      <provider name="sql-statement-provider"
```

```
      class="com.warework.provider.FileTextProvider">
      <parameter name="config-target"
         value="/META-INF/system/statement/sql" />
      <parameter name="file-extension" value="sql" />
      <parameter name="remove-new-line-character" value="true" />
      <parameter name="remove-tab-character" value="true" />
   </provider>

   <provider name="jpql-statement-provider"
      class="com.warework.provider.FileTextProvider">
      <parameter name="config-target"
         value="/META-INF/system/statement/jpql" />
      <parameter name="file-extension" value="jpql" />
      <parameter name="remove-new-line-character" value="true" />
      <parameter name="remove-tab-character" value="true" />
   </provider>

   <provider name="object-query-provider"
      class="com.warework.provider.ObjectQueryProvider">
      <parameter name="config-target"
         value="/META-INF/system/statement/xoq" />
   </provider>

   <provider name="spring-provider"
      class="com.warework.provider.SpringProvider">
      <parameter name="config-target"
         value="/META-INF/system/applicationContext.xml" />
   </provider>

   <provider name="datastore-view-provider"
      class="com.warework.provider.DatastoreViewProvider">
      <parameter name="service-name" value="datastore-service" />
   </provider>

   <provider name="ddbb-connection-provider"
      class="com.warework.provider.PooledObjectProvider">
      <parameter name="service-name" value="pool-service" />
   </provider>

</providers>

<services>

   <service name="log-service"
      class="com.warework.service.log.LogServiceImpl">
      <parameter name="config-class"
         value="com.warework.core.loader.ProxyServiceSAXLoader" />
      <parameter name="config-target"
         value="/META-INF/system/log-service.xml" />
   </service>

   <service name="datastore-service"
      class="com.warework.service.datastore.DatastoreServiceImpl">
      <parameter name="config-class"
         value="com.warework.service.datastore.DatastoreSAXLoader" />
      <parameter name="config-target"
         value="/META-INF/system/datastore-service.xml" />
   </service>

   <service name="pool-service"
      class="com.warework.service.pool.PoolServiceImpl">
      <parameter name="config-class"
         value="com.warework.core.loader.ProxyServiceSAXLoader" />
      <parameter name="config-target"
         value="/META-INF/system/pool-service.xml" />
   </service>
```

```
      <service name="mail-service"
         class="com.warework.service.mail.MailServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/mail-service.xml" />
      </service>

   </services>

</scope>
```

This XML file defines four Services, each one with a custom configuration file. Let us review the configuration of the Log Service with the content of the `/META-INF/system/log-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client"
            connector="com.warework.service.log.client.connector. …
            … Log4jPropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/system/log/log4j.properties"/>
      </client>
   </clients>

</proxy-service>
```

This Log Service configuration file indicates that Log4j is going to be the default logging mechanism for your application and that Log4j is configured with the `/META-INF/system/log/log4j.properties` file. The content for this properties file could be like this:

```
log4j.logger.default-client=DEBUG, consoleApp
log4j.appender.consoleApp=org.apache.log4j.ConsoleAppender
log4j.appender.consoleApp.layout=org.apache.log4j.PatternLayout
log4j.appender.consoleApp.layout.ConversionPattern=[%d]-[%-5p] - %m%n
```

Now we are going to review the configuration of the Data Store Service with the content of the `/META-INF/system/datastore-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="relational-database"
         connector="com.warework.service.datastore. …
            … client.connector.JDBCConnector">
         <parameters>
            <parameter name="client-connection-provider-name"
               value="ddbb-connection-provider"/>
            <parameter name="client-connection-provider-object"
```

```
                value="c3p0-client"/>
          </parameters>
          <views>
             <view class="com.warework.service.datastore. …
                … client.JDBCViewImpl" name="rdbms-view"
                provider="sql-statement-provider"/>
          </views>
       </datastore>
       <datastore name="orm-database"
          connector="com.warework.service.datastore. …
             … client.connector.JPAConnector">
          <parameters>
             <parameter name="persistence-unit" value="system"/>
             <parameter name="javax.persistence.jdbc.driver"
                value="org.h2.Driver"/>
             <parameter name="javax.persistence.jdbc.url"
                value="jdbc:h2:~/system"/>
             <parameter name="javax.persistence.jdbc.user"
                value="system"/>
             <parameter name="eclipselink.cache.shared.default"
                value="false"/>
          </parameters>
          <views>
             <view class="com.warework.service.datastore. …
                … client.JPAViewImpl" name="orm-view"
                provider="jpql-statement-provider"/>
          </views>
       </datastore>
    </datastores>

</datastore-service>
```

The following `/META-INF/system/pool-service.xml` file represents the content for the Pool Service configuration:

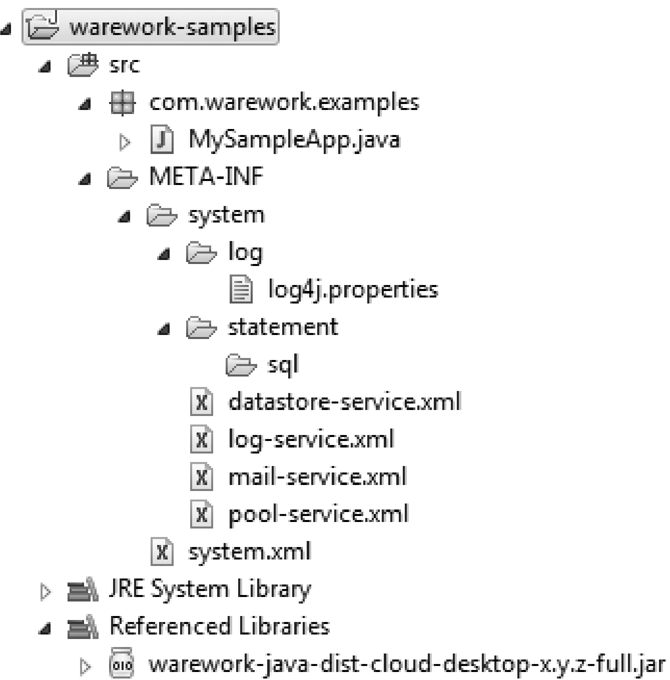
```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="c3p0-client"
            connector="com.warework.service.pool.client.connector. …
            … C3P0Connector">
         <parameter name="jdbc-url" value="jdbc:h2:~/system;USER=system"/>
         <parameter name="driver-class" value="org.h2.Driver"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
   </clients>

</proxy-service>
```

And the `/META-INF/system/mail-service.xml` file represents the content for the Mail Service configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
```

```
      <client name="default-client"
            connector="com.warework.service.mail.client.connector. …
            … JavaMailSenderConnector">
         <parameter name="mail.host" value="smtp.host.com" />
         <parameter name="mail.port" value="587" />
         <parameter name="mail.transport.protocol" value="smtp" />
         <parameter name="mail.user" value="sample@mail.com" />
         <parameter name="mail.password" value="password" />
         <parameter name="mail.smtp.auth" value="true" />
         <parameter name="mail.smtp.starttls.enable" value="true" />
         <parameter name="mail.message.charset" value="utf-8" />
         <parameter name="mail.message.subtype" value="html" />
      </client>
   </clients>

</proxy-service>
```

All these resources may look like this in your project:



Now it is the time to create the application using your custom configuration:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Configure the application with the 'system.xml' file.
         ScopeFacade system = ScopeFactory.createFacade(MySampleApp.class,
            "system", "my-app-name");

         // ...perform operations here...

         // Shut down your application.
         ScopeContext.remove("my-app-name ", true, true);

      } catch (Exception e) {
         e.printStackTrace();
```

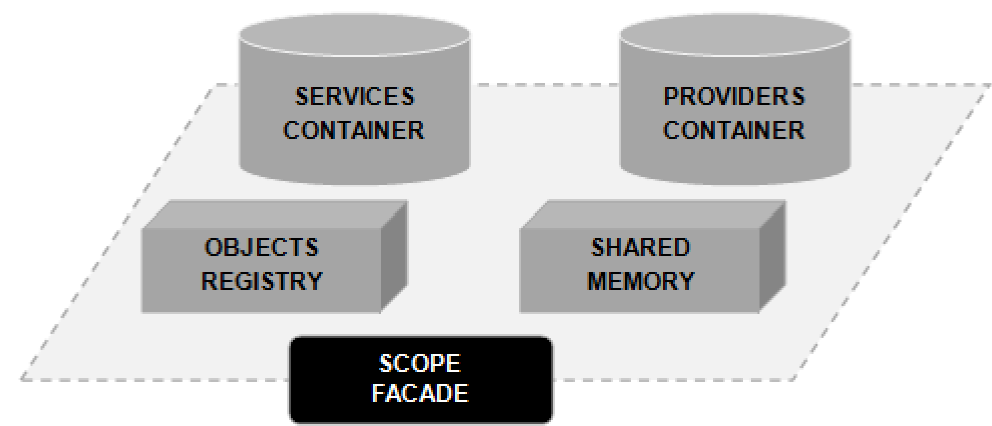
```
            }
        }
    }
```

PART I: BASIC CONCEPTS

Chapter 5: Scopes

A Warework Scope is a closed context where Services, Providers and other types of objects exist. Scopes can be a lot of things; it is up on you to define what you want them to be. Imagine that we want to build an application or system that represents a fruit market; you can create a Scope to represent the market and execute the required operations with specific Providers and Services.

Scopes provide a set of common methods to work with Framework components and other objects. They can store any kind of objects in a shared memory and create, invoke and remove Services and Providers. Check this out with the following image:



- The Services Container is where the Scope stores each Service. You can create, store, use and remove Services.
- The Providers Container is another area of the Scope where Providers exist. You can create, store, use and remove Providers.
- The Objects Registry is a special area of the Scope where references to objects exist. Each of these references links a name into an object that can be retrieved by a Provider. You can create, store, use and remove Objects References.
- The Shared Memory is where you can store, retrieve and remove objects of any type.
- The Scope Facade is the most important part for the software developer as it is the main door to start working with every element indicated in the previous points. You interact with a Scope with its Facade.

Configuration

A very important step to perform, but not mandatory, is to define the Scope configuration, specifying the Services, Providers and Objects References that must exist in a Scope when a new instance is created. It is recommended to keep the configuration of your applications in separate files where you can easily manage how your Scopes must behave.

Now we are going to see how to configure a Scope with an XML file. The first thing you need to check out is the format and content of this file. Here it is:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

An XML file like this allows you to define which Providers, Services, Object References and initialization parameters a Scope will have when it is created. Later on, we will review how each of these components are defined.

A very important fact is that Warework Cloud Distribution for Desktop requires you to place this XML file in the `META-INF` directory of your project and that the name for it can be any name you want. Example: if you plan to create a Scope that reads a file named "system", you have to create the XML like this:

```
/META-INF/system.xml
```

In the `META-INF` directory of your project you can store as many configuration files as you need. It allows you to keep in the same directory XML files that represent Scopes in development and production environments:

```
/META-INF/system-dev.xml
/META-INF/system-pro.xml
```

Warework gives also the opportunity to developers to use predefined configurations (called "Templates"). For those who require Scopes fully configured and ready to run, templates are the way to go. They allow you to create Scopes without the need to configure them; that is why the time needed to start up a new project is drastically reduced with Templates. Please, review chapters related with Templates later on.

Sometimes you may need to specify a set of parameters to configure how a Scope will be created and how it will behave once it is created. Initialization parameters are very useful too when you need to define constants (they are read only) for Services, Providers or the entire application. It is also important to know that you can use pre-defined parameters as well as custom ones. The following code shows how to define initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      <parameter name="name" value="John"/>
   </parameters>

</scope>
```

This is an example of a custom initialization parameter. We can define unlimited initialization parameters and retrieve them any time we want with the following code:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the value of the initialization parameter ("John").
String name = (String) scope.getInitParameter("name");
```

Keep in mind that initialization parameters defined in XML files are always `String` values and they will not change along the life of the Scope (you cannot delete or update any of them once the Scope is started). Services and Providers can read these parameters too.

There are predefined initialization parameters that are used to configure Scopes. Most of them are handled automatically by `ScopeFactory` included in this Distribution, the one responsible of the creation of the Scopes. You can review each one in the `ScopeL1Constants` class that exists in the `com.warework.core.scope` package.

Creating new Scopes

Regardless of whether a configuration has been specified or not, you always need to create a new Scope before start using it. The making process of a Scope is performed with the `ScopeFactory` class that exists in `com.warework.core.scope` package. It is fairly easy to create a new Scope. You just need to invoke method `createFacade` in the factory class with three arguments:

- A context class: the first argument must be any class that exists in your project and it is used to load resources from it.
- File name: It represents the name of the XML or serialized file to load for the Scope from the `META-INF` directory.
- Scope name: It is the name that you will use to retrieve the Scope later on.

Let us say that we have a test class named `Sample1`, which contains the `main` method. We can create a new Scope like so:

```
public class Sample1 {
   public static void main(String[] args) {
      try {
```

```
         ScopeFactory.createFacade(Sample1.class, "scope-config", "system");
      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

The previous code first tries to load from `/META-INF/scope-config.ser` a serialized file (Java Beans stored as binary files) with the configuration of the Scope. If this file does not exist, then it tries with the XML version of the configuration file (`/META-INF/scope-config.xml`). When any of those configuration files is found, a new Scope named "system" is created by the Factory.

Once the Scope is created, you can get an instance of it with the `ScopeContext` class that exists in `com.warework.core.scope` package. To retrieve an instance of the Scope created in the previous example, write this code:

```
public class Sample1 {
   public static void main(String[] args) {
      try {

         // Create the Scope.
         ScopeFactory.createFacade(Sample1.class, "scope-config", "system");

         // Get the Scope.
         ScopeFacade system = ScopeContext.get("system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

You can also get an instance of the Scope when you create it:

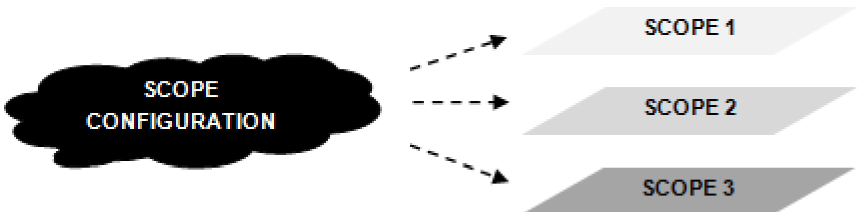
```
public class Sample1 {
   public static void main(String[] args) {
      try {

         // Create and get the Scope.
         ScopeFacade system = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Very important facts to know about this:

- No matter how many times you invoke `ScopeContext.get()` method, you will always get the same instance for the same Scope name. They will change only when the Scope is destroyed and created again.

```
public class Sample1 {
   public static void main(String[] args) {
      try {

         // Create and get the Scope.
         ScopeFacade system1 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system");

         // system2 is the same instance as system1.
         ScopeFacade system2 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system");

         // Remove the Scope. Now system1 and system2 are dead.
         ScopeContext.remove("system", false, false);

         // system3 is a new instance.
         ScopeFacade system3 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system");

         // system4 is the same instance as system3.
         ScopeFacade system4 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

- You can create multiple instances of Scopes with the same XML/serialized configuration file. Just give a different name for the Scope for the same configuration file and you will get a new Scope.




```
public class Sample1 {
   public static void main(String[] args) {
      try {

         // Create and get the Scope.
         ScopeFacade system1 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system1");

         // system2 is NOT the same instance as system1.
         ScopeFacade system2 = ScopeFactory.createFacade(Sample1.class,
            "scope-config", "system2");

      } catch (Exception e) {
         e.printStackTrace();
      }
```

```
        }
    }
```

The process is very similar for those who want to create a new Scope using a Template. This time there is no need to specify the name of the XML/serialized configuration file because it is automatically created by the Framework. Instead, you have to define the name of the Template to use. Check out this example:

```
public class Sample1 {
   public static void main(String[] args) {
      try {

         // Create the Scope.
         ScopeFactory.createTemplate(Sample1.class, "full", "system");

         // Get the Scope.
         ScopeFacade system = ScopeContext.get("system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

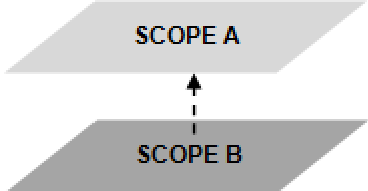
To create a Scope with a Template you also need the `ScopeFactory` class but now the method to invoke is `createTemplate()`. What does it mean "`full`"? It is a common name for Templates that represent configurations for Scopes with all the capabilities enabled.

Environment of a Scope

Sometimes Scopes may need to work with other Scopes to better organize complex environments and expand the available functionality. Warework Cloud Distribution for Desktop provides the required methods to achieve this task and help developers create bigger systems with control. In this Framework, the organization of complex systems is performed with:

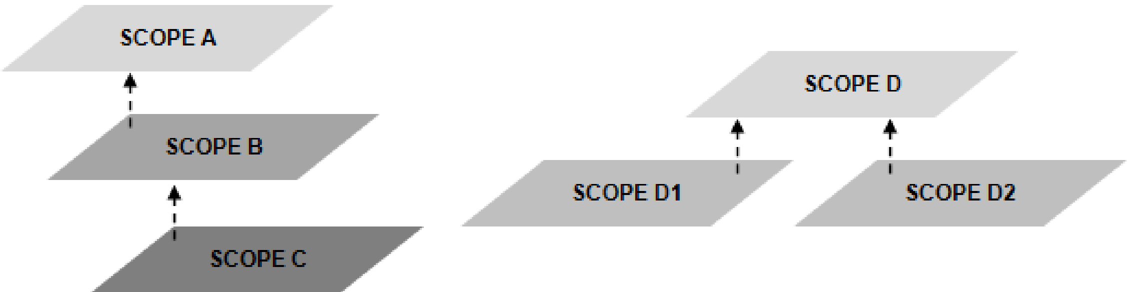
Parent Scopes

You can create a hierarchy of Scopes by saying that one Scope extends another Scope. That is, a Scope named B can extend another Scope named A in a way that B integrates the functionality provided by A:



When Scope B extends Scope A, B can use Services, Providers and Object References that exist in Scope A. It is important to know that parent Scopes can only be assigned when children Scopes are created. You cannot link Scope A with Scope B when B is already created.

Parent Scopes allows you to organize systems like this:



You can define the Parent Scope for a specific Scope in an XML file. It is useful when you need to start up a Parent Scope (or reuse it, if it already exists) for the main Scope that you want to create. A Scope factory that parses an XML file like this automatically creates the Parent Scope and assigns it to the main Scope (the Scope instance that you will get with the factory). It is important to keep in mind that only one Parent Scope can be defined per Scope. Check out in the following example how to define a Parent Scope:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parent name="parent-scope">

      <parameters>
         // Specify here the initialization parameters for the Parent Scope.
      </parameters>

      <providers>
         // Specify here the Providers for the Parent Scope.
      </providers>

      <objects>
         // Specify here the object references for the Parent Scope.
      </objects>

      <services>
         // Specify here the Services for the Parent Scope.
      </services>

   </parent>

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>
```

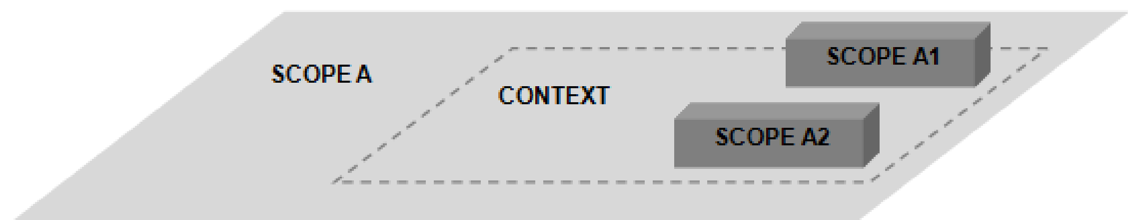
```
   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

Once the main Scope is created, you can retrieve its Parent Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get the Parent of the Scope.
ScopeFacade parent = scope.getParent();
```

Domains and the context of a Scope

Warework gives the possibility to include multiple Scopes into another Scope. This level of organization let software developers create domains where Scopes exist. If we include Scope A1 and Scope A2 into Scope A, Warework assumes the following facts:



- Scope A is the domain (named “Domain Scope”) of Scopes A1 and A2.
- Scopes A1 and A2 exist in the context of Scope A (Scope A can retrieve Scopes A1 and A2).
- Scopes A1 and A2 can retrieve an instance of their Domain Scope A.
- Scopes A1 and A2 can directly use Services, Providers and Object References that exist in Scope A.
- Scope A cannot directly use Services, Providers and Object References that exist in Scopes A1 and A2.

You can define the Domain Scope for a specific Scope in an XML file. It is useful when you need to create a Domain Scope (or reuse it, if it already exists) for the main Scope that you want to create. Keep in mind that only one Domain Scope can be defined per Scope. Check out in the following example how to define it:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <domain name="domain-scope">
```

```
      <parameters>
         // Specify here the initialization parameters for the Domain Scope.
      </parameters>

      <providers>
         // Specify here the Providers for the Domain Scope.
      </providers>

      <objects>
         // Specify here the object references for the Domain Scope.
      </objects>

      <services>
         // Specify here the Services for the Domain Scope.
      </services>

   </domain>

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

Once the main Scope is created, you can retrieve its Domain Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get the Domain of the Scope.
ScopeFacade domain = scope.getDomain();
```

The XML configuration file also allows you to define a set of Scopes that exist in the context of a Scope. This time, you can define as many Scopes as you need in the context of another Scope. Check this out with the following example:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>
```

```
   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

   <context>

      <scope name="scope-1">

         <parameters>
            // Specify here the initialization parameters for the Scope.
         </parameters>

         <providers>
            // Specify here the Providers for the Scope.
         </providers>

         <objects>
            // Specify here the object references for the Scope.
         </objects>

         <services>
            // Specify here the Services for the Scope.
         </services>

      </scope>

      <scope name="scope-2">...</scope>
      <scope name="scope-3">...</scope>

   </context>

</scope>
```

Once the main Scope is created, you can retrieve a Scope from the context of the main Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get a Scope from the context of the main Scope.
ScopeFacade contextScope = scope.getContext().get("scope-1");
```

Example

The following example shows a combination of multiple Scopes in just one XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parent name="p1">

      <parent name="p2">
```

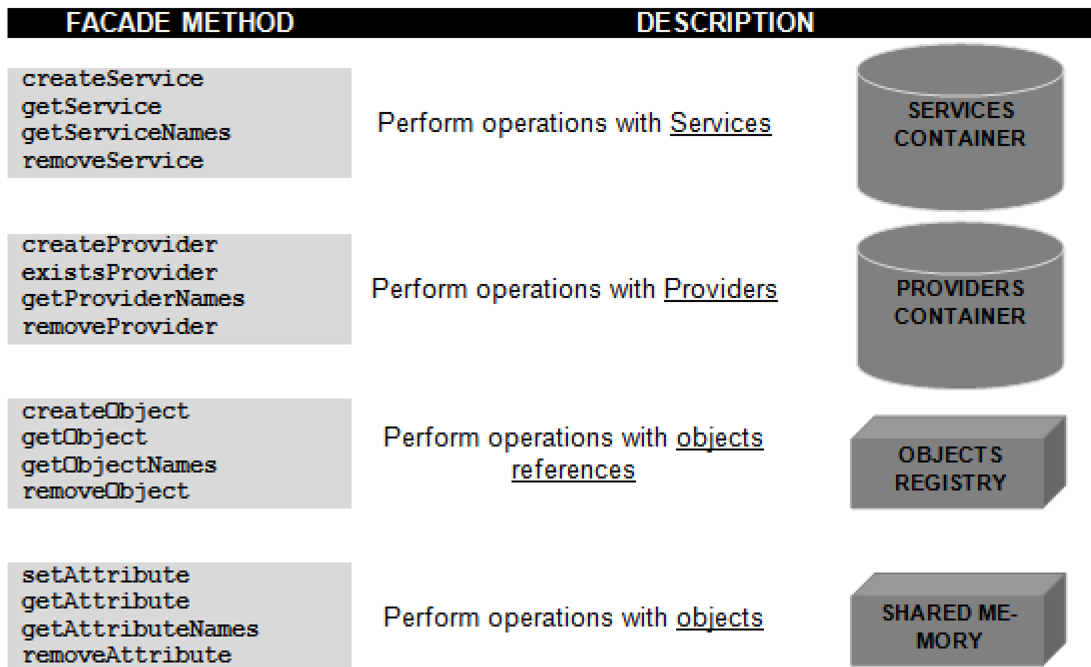
```
            <domain name="p2-d">…</domain>

            <context>
               <scope name="p2-c1">…</scope>
               <scope name="p2-c2">…</scope>
            </context>

         </parent>

         <domain name="p1-d">…</domain>

         <parameters>…</parameters>
         <providers>…</providers>
         <objects>…</objects>
         <services>…</services>

      </parent>

      <parameters>…</parameters>
      <providers>…</providers>
      <objects>…</objects>
      <services>…</services>

      <context>

         <scope name="c1">…</scope>
         <scope name="c2">…</scope>

         <scope name="c3">

            <parent name="c3-p">

               <context>
                  <scope name="c3-p-c1">…</scope>
                  <scope name="c3-p-c2">…</scope>
               </context>

            </parent>

            <parameters>…</parameters>
            <providers>…</providers>
            <objects>…</objects>
            <services>…</services>

         </scope>

      </context>

   </scope>
```

To retrieve Scopes from the main Scope, you can perform operations like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get Scopes from the main Scope.
ScopeFacade p2 = scope.getParent().getParent();
ScopeFacade p2_d = scope.getParent().getParent().getDomain();
ScopeFacade p2_c1 = scope.getParent().getParent().getContext().get("p2-c1");
```

Working with Scopes

Software developers can interact with Scopes through the ScopeFacade interface. The Warework Scope Facade provides methods to perform operations with Services, Providers and other objects. We can review which methods it provides and group them in the following table:



Create, retrieve and remove Services in a Scope

To create a Service in a Scope, you always need to provide a unique name for the Service and the implementation class of the Service.

```
// Create a new Service and register it in the Scope.
scope.createService("log-service", LogServiceImpl.class, null);
```

Once it is created, you can retrieve it using the same name (when you retrieve an instance of a Service, you will get an interface that represents a facade for that Service):

```
// Get an instance of the Log Service.
LogServiceFacade logService = (LogServiceFacade) scope.
   getService("log-service");
```

You can also perform both steps in a single line of code:

```
// Create a new Service, register in the Scope and return it.
LogServiceFacade logService = (LogServiceFacade) scope.
   createService("log-service", LogServiceImpl.class, null);
```

While the name of the Service can be any one you want, the implementation class must be the one specified in the Service documentation.

You should also need to bear in mind that Services created in a Scope are not only accessible in that Scope. Check this out with the following example:

- Imagine that we have two Scopes named A and B:

```
// Get an instance of Scope A.
ScopeFacade scopeA = …;

// Get an instance of Scope B.
ScopeFacade scopeB = …;
```

- If Scope B extends Scope A then we can access Scope A Services directly from the Scope B facade like this:

```
// Get one Service in Scope A from Scope B.
LogServiceFacade logService = (LogServiceFacade) scopeB.
   getService("log-service");
```

- If Scope A is the Domain of Scope B then we can access Scope A Services directly from the Scope B facade exactly as we saw in the previous point.

Here it is shown how to remove a Service:

```
// Remove the Log Service.
scope.removeService("log-service");
```

This line of code removes the Service in a specific Scope. You cannot directly remove Services that exist in parent and domain Scopes.

Sometimes you may require a list of Services that are accessible in a Scope. The following line of code gets the names of every Service that exists in a Scope, its parents Scopes and its domain Scope:

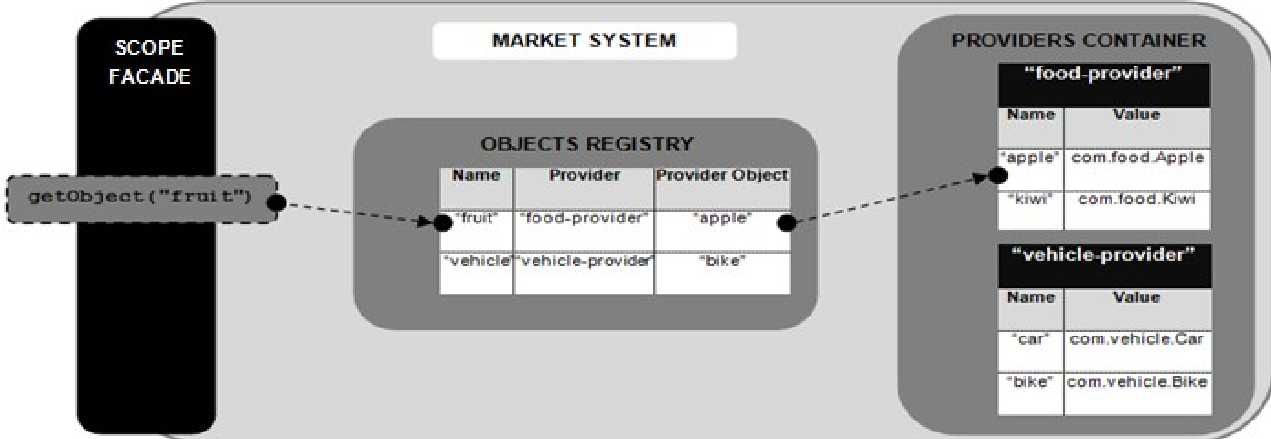
```
// Get the name of every accessible Service.
Enumeration names = scope.getServiceNames();
```

Create and remove Providers in a Scope

To create a Provider in a Scope, you always need to specify a unique name for the Provider and the implementation class of the Provider.

```
// Create a new provider and register it in the Scope. This provider
// retrieves objects that represent food.
scope.createProvider("food-provider", FoodProvider.class,
   null);
```

We cannot obtain their interfaces this time because its functionality is included in the Facade of the Scope with the `getObject` methods (remember: Providers just provide objects instances). When working with Providers, you need to know that on one side you can manage them (create and remove each Provider) and on the other side you can manage the objects a Provider can retrieve (create, get and remove references to them).



To remove a Provider is quite simple:

```
// Remove the food Provider.
scope.removeProvider("food-provider");
```

This line of code removes the Provider in a specific Scope. You cannot directly remove Providers that exist in parent and domain Scopes.

Sometimes you may require a list of Providers that are accessible in a Scope. The following line of code gets the names of every Provider that exists in a Scope, its parents Scopes and its domain Scope:

```
// Get the name of every accessible Provider.
Enumeration providerNames = scope.getProviderNames();
```

To validate if a Provider exists in a Scope, its parents Scopes or its domain Scope, run this code:

```
// Validate if the 'food-provider' exists.
boolean exists = scope.existsProvider("food-provider");
```

Create, use and remove Objects References in a Scope

Once you have at least one Provider in a Scope, you can create a reference to an object that exists in that Provider. To create a reference you always need to specify a unique name for it, the Provider where to extract the object and which object to get:

```
// Create a reference named 'fruit' to an object named 'apple' in a
// Provider named 'food-provider'.
scope.createObject("fruit", "food-provider", "apple");
```

Now that we have the reference created, we can access the object just by doing:

```
// Get the 'apple' object from the 'food-provider'.
Food fruit = (Food) scope.getObject("fruit");
```

You can also request an object directly, without the need to create a reference:

```
// Get the 'apple' object from the 'food-provider'.
Food fruit = (Food) scope.getObject("food-provider", "apple");
```

The powerful idea behind this is that you are isolating how an object is created. In our example, as the Food Provider just knows about creating food objects like apples and kiwis, every object that this Provider can retrieve implements the `Food` interface. This allows us to easily change the food we want:

```
// Gets the 'kiwi' object from the 'food-provider'.
Food fruit = (Food) scope.getObject("food-provider", "kiwi");
```

Now, let's remove an Object Reference:

```
// Remove the fruit Object Reference.
scope.removeObject("fruit");
```

This line of code removes the Object Reference (not the object itself in the Provider) in a specific Scope. You cannot remove references that exist in its parents Scopes or its domain Scope.

The following line of code gets the names of every Object Reference that exists in a Scope, its parents Scopes and its domain Scope:

```
// Get the name of every accessible Object Reference.
Enumeration names = scope.getObjectNames();
```

Get, add and remove objects in a Scope

Scopes provide a special area where to store objects of any type. These objects can be accessed only from the Scope facade where they exist.

To store an object, you have to give the object a name (this name must be unique):

```
// Save the fruit in the shared memory.
scope.setAttribute("best-market-food", fruit);
```

To get the object:

```
// Get the fruit from the shared memory.
Food food = (Food) scope.getAttribute("best-market-food");
```

To remove that object:

```
// Remove the fruit in the shared memory.
scope.removeAttribute("best-market-food");
```

The following line of code gets the names of every object that is stored in the shared memory of a Scope:

```
// Get the name of every object stored in the Scope.
Enumeration names = scope.getAttributeNames();
```

Chapter 6: Services

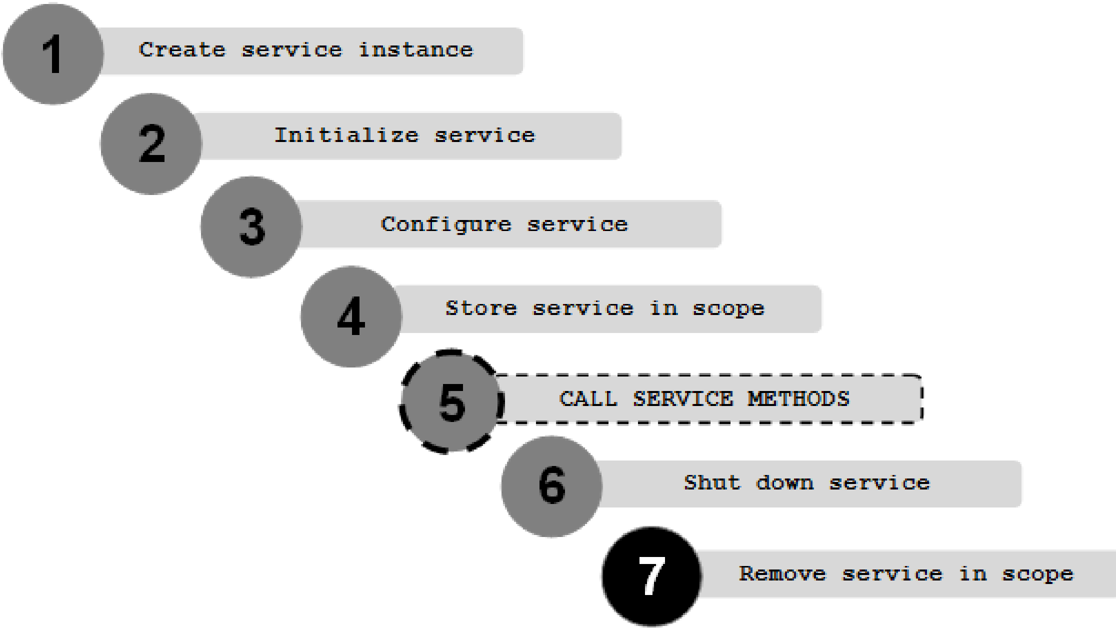
Warework Services are components of the Framework that present these features:

- **Encapsulation.** They group a set of related functions of a particular topic.
- **Common life cycle.** Each Service goes through a series of states before they can be used and destroyed.
- **Centrally controlled.** Services are created and stored in Scopes. You can retrieve a Service via a Scope.
- **Configurable.** Services may be configured on start-up, with different sources like plain Java objects or XML files, or during runtime.
- **Pre-built or custom.** You can use existing Warework Services or create your own ones.
- **Extend the functionality of systems.** Services are distributed as JAR files that, when plugged in the Framework, provide extra support for your application.

Some Services may perform simple operations and may not require configuration at all. However, there will be others that perform more complex tasks and require to be fully configured. Software developers can add into the Framework as many Services as they need. Check out our Web site to view Services created by Warework and download every one that fits your needs.

Service life cycle

Even that each Service defines its own behavior, they all must implement the `ServiceFacade` interface (check out the `com.warework.core.service` package) to accomplish the default requisites of a Service life cycle. When a class implements this interface, it is managed by the Framework in the following way:



1. **Create a new instance of the Service.** When you invoke method `createService()` in a Scope, it creates a new Service only if it does not exist in that Scope.

2. **Initialize the Service.** When a new Service instance is created, it may prepare itself to accept an initial configuration and methods invocations.

3. **Configure the Service.** Each Service supports specific sources of configuration (XML files, Java objects ...) and decides how it has to be configured.

4. **Store the Service in the Scope.** Once the Service is created and configured, it is stored in the Scope where the `createService()` was invoked.

5. **Call Service methods.** At this point, Service is configured and you can use it by invoking its methods.

6. **Shut down the Service.** The method `removeService()` that exists in every Scope is responsible for telling to a specific Service that it has to stop working and that it must be prepared for being erased.

7. **Remove the Service in the Scope.** After a Service stops the execution, it is removed from the Scope where it belongs to.

Configuration

When a Service is created, it may accept a set of parameters that can be used to specify how the Service must be initialized or configured and also to represent specific constants that define how the Service must work.

Suppose we want to specify when the Lighting Service of a market must turn on and off. We could write something like this:

```
// Create a map where to store the configuration parameters.
 Hashtable parameters = new Hashtable();

// Configure how the Service must work by specifying the hour
// when the lights turn on and off.
parameters.put("turn-on-lights", new Integer(8));
parameters.put("turn-off-lights", new Integer(19));

// Create the Service with the configuration.
LightingServiceFacade service = (LightingServiceFacade) scope.
   createService("lighting-service",
   LightingServiceImpl.class, parameters);
```

These parameters indicate how the Service must work but they can also provide information for the initialization process of the Service:

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how the Service must be initialized.
parameters.put("test-bulbs-on-startup", Boolean.TRUE);

// Create the Service with the configuration.
LightingServiceFacade service = (LightingServiceFacade) scope.
   createService("lighting-service",
   LightingServiceImpl.class, parameters);
```

Each Service can use these parameters how and whenever they want. It is very important for you to know that there are by default two of them that are specifically designed for the configuration process of the Service. The first one is defined with the constant PARAMETER_ConfigTarget that exists in the `ServiceConstants` class of the `com.warework.core.service` package and indicates that the Service must read the configuration from a given object.

```
// Create the configuration for the Lighting Service.
LightingConfig config = new LightingConfig();

// Configure the Lighting Service.
config.setLightType("led");
config.setLightColor("white");

// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure where to read the configuration for the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Service with the configuration.
LightingServiceFacade service = (LightingServiceFacade) scope.
   createService("lighting-service",
   LightingServiceImpl.class, parameters);
```

The second one is defined with the constant PARAMETER_ConfigClass that exists in the same class and indicates that the Service must read the configuration using a given class that decides how and where to read that configuration. The class that you pass as the value of the parameter must implement the LoaderFacade interface that exists in the `com.warework.core.loader` package and is responsible for loading configurations from different sources, like XML files:

Lighting Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<lighting-service>
   <light-type>led</light-type>
   <light-color>white</light-color>
</lighting-service>
```

Lighting Service Java code:

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how to read the configuration for the Service.
// NOTE: You may pass the class or a string that represents that class.
parameters.put(ServiceConstants.PARAMETER_ConfigClass,
   LightingServiceConfigLoader.class);

// Create the Service with the configuration.
LightingServiceFacade service = (LightingServiceFacade) scope.
   createService("lighting-service",
   LightingServiceImpl.class, parameters);
```

In this example, the `LightingServiceConfigLoader` class reads the XML file, copies the content into Java objects and provides those objects for the configuration of the Service. Keep in mind that every parameter specified in the configuration is not passed just to the Service, they all are also given to the loader class.

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how and where to read the configuration for the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigClass,
   LightingServiceConfigLoader.class);
parameters.put("config-target", "/META-INF/system/lighting.xml");

// Create the Service with the configuration.
LightingServiceFacade service = (LightingServiceFacade) scope.
   createService("lighting-service",
   LightingServiceImpl.class, parameters);
```

For Services that have to exist when a Scope is created, you need to define these Services in an XML configuration file. The following example shows how to define multiple Services in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="sample1-service"
         class="com.warework.service.sample1.Sample1ServiceImpl"/>
      <service name="sample2-service"
         class="com.warework.service.sample2.Sample2ServiceImpl"/>
      …
```

```
   </services>

</scope>
```

These Services do not have parameters. That is, just with the name and the class, the Service should be ready to run.

To retrieve a Service from a Scope we can write something like:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of Service "Sample1".
Sample1ServiceFacade service = (Sample1ServiceFacade) scope.
   getService("sample1-service");
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. This is an example of a Service configured with parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>

</scope>
```

In this example, the Log Service accepts parameters to define where to load an XML file for the configuration of the Service. You will need to review the parameters that a Service can accept with the class that defines the constants of the Service (in this example, the `LogServiceConstants.class`).

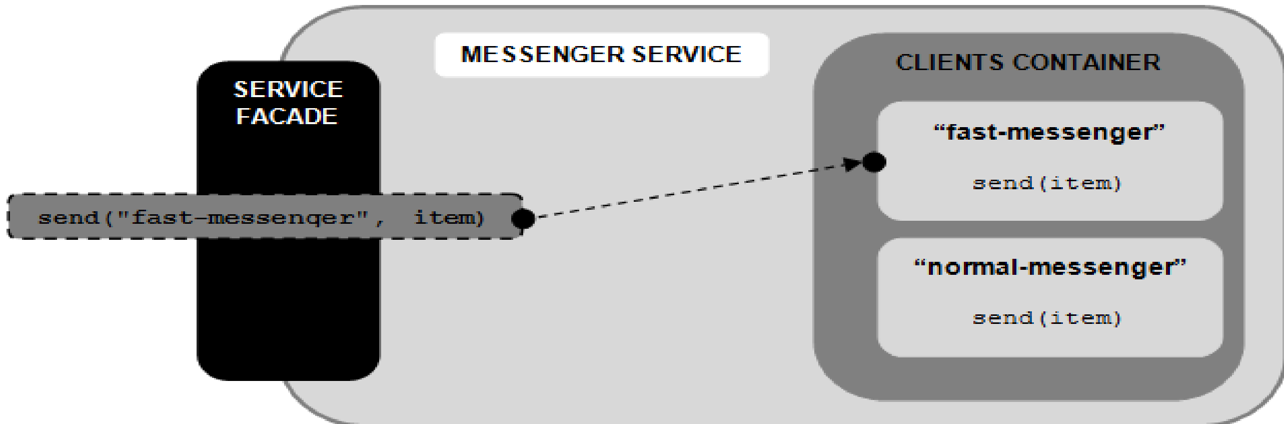
Proxy Services

There is a special kind of Service that is prepared to handle multiple implementations for the same Service logic. Each implementation is called “Client” and performs operations related to the Service logic. On the other hand, the Service that bundles all the implementations is called “Proxy Service”. This idea lets us:

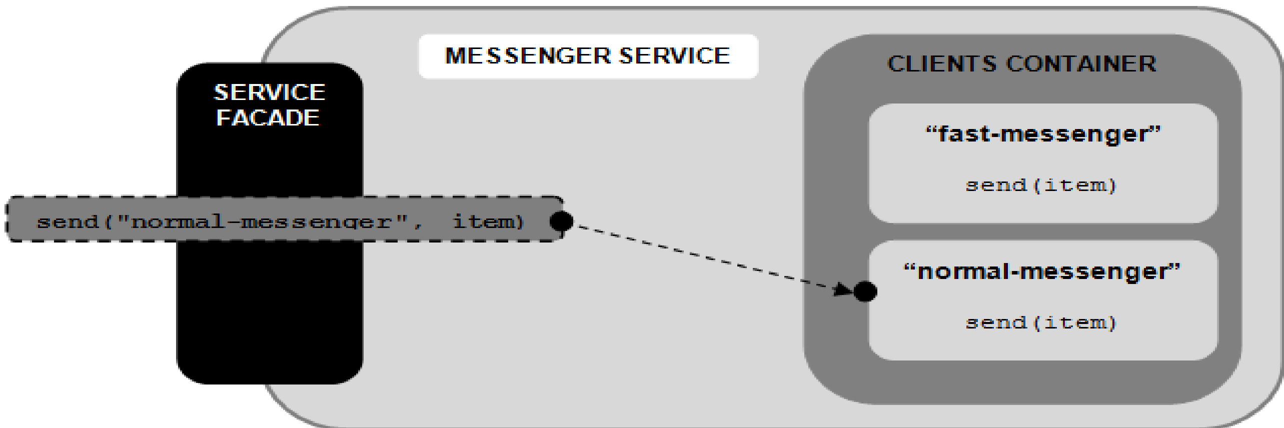
- Manage more than one implementation at the same place.
- Simplify and centralize the use of multiple components that perform the same tasks.
- Be prepared to changes in our software infrastructure.

- Replace an existing implementation with another one that best fits our needs.
- Make our systems more portable through different environments.
- Set up a modular software application.

Suppose that a Market System works with two different messenger companies: one for fast sending and the other one for normal sending. We can see how to send fast an item as follows:



If we are not worried about time, we can send the same item just by changing the name of the Client:



Add Clients into Services

A Proxy Service can handle as many Clients as you need. To add a Client into a Service of this kind you just need to invoke the method `createClient()` that exists in that Service. This method requests a name for the new Client and a special class named "Connector" which performs the creation of the Client. So, we can say that Warework Connectors are responsible for the creation of Clients in specific Services. Let's create one in our Market System example:

```
// Create the Service in the Scope.
MessengerServiceFacade service = (MessengerServiceFacade) scope.
   createService("messenger-service",
   MessengerServiceImpl.class, null);
```

```
// Add a Client in the Service.
service.createClient("fast-messenger", FastConnector.class, null);
```

In this example, the `FastConnector` class creates a specific Messenger Client and stores it in the Messenger Service. Connectors are also capable of creating the connections that a Client may require to work (like connections with databases). We start a connection with a Client by calling the method `connect()` that exists in the Service:

```
// Connect the Client.
service.connect("fast-messenger");
```

Once it is connected, we can access the Service logic by invoking its methods:

```
// Send the item.
service.send("fast-messenger", item);
```

As you can see, Proxy Services always require the name of the Client when you want to perform an operation. In the following code, we are going to send the same item but this time with the normal messenger:

```
// Add a Client in the Service.
service.createClient("normal-messenger", NormalConnector.class, null);

// Connect the Client.
service.connect("normal-messenger");

// Send the item.
service.send("normal-messenger", item);
```

Warework provides in the Website multiple Clients for each Proxy Service. Just check out the extensions section of the Service. There you can see a list of Clients that are supported by the Service.

More operations with Clients

The following table summarizes all the common operations that share these Services:

Method	Description
createClient(String clientName, Class connectorType, Hashtable connectionParameters)	Creates a new Client in the Service.
getClientNames()	Gets the names of all the Clients bound to a Service.
existsClient(String clientName)	Validates if a Client is bound to a Service.
removeClient(String clientName)	Removes a Client bound in a Service. If the Service does not have a Client bound to the specified name, this method does nothing. If Client is connected, this method disconnects it first.
removeAllClients()	Removes all the Clients bound in a Service.
getClientType(String clientName)	Gets the class that implements the

	Client.
isClientType(String clientName, Class clientType)	Validates if a Client is the same type of a given class.
connect(String clientName)	Connects the Client.
getConnection(String clientName)	Gets the connection of a Client. First you will need to connect the Client to retrieve the connection, otherwise this method will return null.
disconnect(String clientName)	Closes a connection with a Client.
disconnectAll()	Closes the connection of every Client.
isConnected(String clientName)	Validates if a Client is connected.

Configuration

Proxy Services can be configured in a common way to automatically initialize the Clients that a Service may need. This is done with the `ProxyService` class that exists in `com.warework.core.model` package. The following example shows how to configure two Clients when a Service is created:

```
// Create a configuration for the Proxy Service.
ProxyService config = new ProxyService();

// Configure two Clients for the Proxy Service.
config.setClient("fast-messenger", FastConnector.class);
config.setClient("normal-messenger", NormalConnector.class);

// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure where to read the configuration for the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Messenger Service.
MessengerServiceFacade messengerService = (MessengerServiceFacade) scope
   .createService("messenger-service", MessengerServiceImpl.class,
   parameters);
```

This time, when we execute the `createService` method with this configuration, it creates every Client that `ProxyService` contains when the Service is started up. Warework recommends configuring Proxy Services in this way when you know that a set of Clients must exist since the beginning of the life of a Service. Particularly, you will notice that this way is much comfortable when configuring Clients because parameters can be passed with a single line of code:

```
// Create a configuration for the Proxy Service.
ProxyService config = new ProxyService();

// Configure a Client for the Proxy Service.
config.setClient("fast-messenger", FastConnector.class);
config.setClientParameter("fast-messenger", "check-speed",
   Boolean.TRUE);
```

Every time you create a Client, you can pass a set of parameters to the Connector so it can customize the creation and behavior of the Client. The previous line of code performs this task and it is the same as doing this:

```
// Create the Service in the Scope.
MessengerServiceFacade service = (MessengerServiceFacade) scope.
   createService("messenger-service",
   MessengerServiceImpl.class, null);

// Create a map where to store the Connector's parameters.
Hashtable parameters = new Hashtable();

// Configure where to read the configuration for the Service.
parameters.put("check-speed", Boolean.TRUE);

// Add a Client in the Service.
service.createClient("fast-messenger", FastConnector.class, parameters);
```

The way to configure a Proxy Service with XML is slightly different. You need to create a separate XML file for the Proxy Service and reference it from the Scope XML file. The following example shows how to define a Proxy Service and the configuration file that it requires. The first thing you have to do is to register the Service:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>

</scope>
```

This XML file defines a Log Service and a configuration file for it. You specify the configuration file for the Service with two special parameters:

- **`config-class`**: this parameter represents the class that reads the XML configuration for the Service. The most common value for this parameter is `com.warework.core.loader.ProxyServiceSAXLoader` as it is a generic loader of configuration files for Proxy Services. Anyway, some Services may use their own Loaders for XML files or simply skip the configuration process by removing this parameter. Review the value for this parameter in the documentation of each Service.

- **`config-target`**: this parameter represents the location of the XML file to load. You have to place this file at `/META-INF` directory of your project.

Once it is registered in the Scope we proceed with the creation of the Proxy Service configuration file. Based on the previous example, this could be the content of the **`log-service.xml`** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client"
      connector="com.warework.service.log.client.connector.ConsoleConnector"/>
   </clients>

</proxy-service>
```

You can define as many clients as you need for the Proxy Service. Once the Scope is started, you can work with Clients like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of the Log Service.
LogServiceFacade service = (LogServiceFacade) scope.getService("log-service");

// Connect the Client.
service.connect("default-client");

// Perform operations with the Client here ...

// Disconnect the Client.
service.disconnect("default-client");
```

Some clients may require configuration parameters. The following example shows how a Client specifies a configuration file for it.

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client" connector="…">
         <parameter name="config-target" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Client to know which parameters it accepts.

Create custom Services, Clients, Connectors and Loaders

The creation process of a Service consists of two steps. The first one is about defining your own Service logic in an interface that extends the `ServiceFacade` interface (check out this class in the `com.warework.core.service` package):

```
import com.warework.core.service.ServiceFacade;

public interface LightingServiceFacade extends ServiceFacade {

   public void switchON();

   public void switchOFF();

}
```

The second one has to do with implementing your interface in a class that extends the AbstractService class. This abstract class provides the default functionality to make an object behave as a Service. Just extend it, implement your interface and write the required methods:

```
import com.warework.core.service.AbstractService;
import com.warework.core.service.ServiceException;

public class LightingServiceImpl extends AbstractService implements
   LightingServiceFacade {

   // NOTE 1: List every initialization parameter with the protected
   // method "getInitParameterNames()" that exists in the
   // AbstractService class.

   // NOTE 2: Get the value of an initialization parameter with the
   // protected method "getInitParameter(String name)" that exists
   // in the AbstractService class.

   // ----- AbstractService methods

   public void close() throws ServiceException {
      // Write here the code required to finish the execution of
      // the Service.
   }

   protected void initialize() throws ServiceException {
      // Write here the code required to initialize the execution
      // of the Service.
   }

   protected void configure(Object config) throws ServiceException {
      // Write here the code required to configure the Service.
   }

   // ----- LightingService methods

   public void switchON() {
      // Specific Service logic here.
   }

   public void switchOFF() {
      // Specific Service logic here.
   }

}
```

If you plan to handle multiple Clients, you have to perform two similar steps. First create your own Service logic in an interface that extends the ProxyServiceFacade interface (check out this class in the `com.warework.core.service` package):

```
import com.warework.core.service.ProxyServiceFacade;

public interface MessengerServiceFacade extends
   ProxyServiceFacade {

   public void send(String clientName, Item item);

}
```

After that, implement your interface in a class that extends the AbstractProxyService class. This abstract class provides the default functionality to make an object behave as a Proxy Service. Just extend it, implement your interface and write the required methods:

```
import com.warework.core.service.AbstractProxyService;

public class MessengerServiceImpl extends AbstractProxyService
   implements MessengerServiceFacade {

   // NOTE 1: You can override protected method 'initialize()' to
   // customize your initialization process.

   // NOTE 2: You can override protected method 'termiante()' to
   // customize your finalization process.

   // NOTE 3: You can override protected method
   // 'configure(Object config)' to customize the configuration process.

   // NOTE 4: You can invoke protected method 'getClient(String name)'
   // to get clients instances.
   public void send(String clientName, Object item) {
      // Specific Service logic here.
   }

}
```

To create Clients for Proxy Services you also need to perform two steps. First write the specific Client/Service logic in an interface that extends the ClientFacade interface (check out this class in the `com.warework.core.service.client` package) and after that, implement this interface in a class that extends the AbstractClient class:

Client interface

```
import com.warework.core.service.client.ClientFacade;

public interface MessengerFacade extends ClientFacade {
   public void send(Item item);
}
```

Normal messenger implementation

```
import com.warework.core.service.client.AbstractClient;
import com.warework.core.service.client.ClientException;

public class NormalMessenger extends AbstractClient implements
```

```
   MessengerFacade {

   // NOTE 1: You can override protected method 'initialize()' to
   // customize the initialization process of the Client.

   // NOTE 2: You can invoke protected method 'getScope()' to get
   // the scope where this Client exists.

   // ----- MessengerFacade methods

   public void send(Item item) {
      // Write here the client logic.
   }

   // ----- AbstractClient methods

   protected void close() throws ClientException {
      // Write here the code required to close the connection
      // with the Client.
   }
   protected boolean isClosed() {
      // Write here the code required to decide if the connection
      // with the client is closed.
      return false;
   }

}
```

Fast messenger implementation

```
import com.warework.core.service.client.AbstractClient;
import com.warework.core.service.client.ClientException;

public class FastMessenger extends AbstractClient implements
   MessengerFacade {

   // NOTE 1: You can override protected method 'initialize()' to
   // customize the initialization process of the Client.

   // NOTE 2: You can invoke protected method 'getScope()' to get
   // the scope where this Client exists.

   // ----- MessengerFacade methods

   public void send(Item item) {
      // Write here the Client logic.
   }

   // ----- AbstractClient methods

   protected void close() throws ClientException {
      // Write here the code required to close the connection
      // with the Client.
   }

   protected boolean isClosed() {
      // Write here the code required to decide if the connection
      // with the Client is closed.
      return false;
   }

}
```

Every time you create a Client for a Service, you need to create at least one Connector for that Client. Now we are going to create two Connectors: one for the Fast Messenger Client and another one for the Normal Messenger Client. This time we just need to extend the AbstractConnector class that exists in the package `com.warework.core.service.client.connector`:

Normal messenger Connector implementation

```
import com.warework.core.service.client.connector.AbstractConnector;
import com.warework.core.service.client.connector.ConnectorException;

public class NormalMessengerConnector extends AbstractConnector {

   // NOTE 1: You can override protected method 'createClient()' to
   // customize the creation and initialization process of the
   // Client.


   // NOTE 2: You can invoke protected method 'getScope()' to get
   // the scope where this Client exists.

   // NOTE 3: You can invoke protected method
   // 'getInitParameterNames()' to get the names of initialization
   // parameters of the Connector.

   // NOTE 4: You can invoke protected method
   // 'getInitParameter(String name)' to get the value of an
   // initialization parameters of the Connector.

   public Class getClientType() {
      return NormalMessenger.class;
   }

   public Object getClientConnection() throws ConnectorException {
      // Create and return here the object that represents the
      // connection with the Client. You may call
      // "createConnectionSource()" method here.
      return null;
   }

   protected Class getServiceType() {
      return MessengerServiceImpl.class;
   }

   protected Object createConnectionSource()
      throws ConnectorException {
      // Create and return here the object that holds the
      // information required to create/get the connection with
      // the Client.
      return null;
   }

}
```

Fast messenger Connector implementation

```
import com.warework.core.service.client.connector.AbstractConnector;
import com.warework.core.service.client.connector.ConnectorException;
```

```
public class FastMessengerConnector extends AbstractConnector {

   // NOTE 1: You can override protected method 'createClient()' to
   // customize the creation and initialization process of the
   // Client.

   // NOTE 2: You can invoke protected method 'getScope()' to get
   // the Scope where this Client exists.

   // NOTE 3: You can invoke protected method
   // 'getInitParameterNames()' to get the names of initialization
   // parameters of the Connector.

   // NOTE 4: You can invoke protected method
   // 'getInitParameter(String name)' to get the value of an
   // initialization parameters of the Connector.

   public Class getClientType() {
      return FastMessenger.class;
   }

   public Object getClientConnection() throws ConnectorException {
      // Create and return here the object that represents the
      // connection with the Client. You may call
      // "createConnectionSource()" method here.
      return null;
   }

   protected Class getServiceType() {
      return MessengerServiceImpl.class;
   }

   protected Object createConnectionSource()
      throws ConnectorException {
      // Create and return here the object that holds the
      // information required to create/get the connection with
      // the Client.
      return null;
   }

}
```

You can also create custom XML Loaders for your own Services. The first thing you need to do is to create the Loader that reads the XML file and parses it into a Java object. Just create a class that extends the AbstractSAXLoader class that exists in the `com.warework.core.-loader` package, like this:

```
public class SampleSAXLoader extends AbstractSAXLoader {

   public void startElement(String uri, String localName, String qName,
         Attributes attributes) throws SAXException {
      // Parse every XML tag here with the "qName" argument.
      // Each value for the object to return is set here.
      // This method is executed when <> open tag is found.
   }

   public void endElement(String uri, String localName, String qName)
      throws SAXException {
      // Parse every XML tag here with the "qName" variable.
      // Each value for the object to return is set here.
      // This method is executed when </> close tag is found.
```

```
   }

   protected Object getConfiguration() {
      // Return here the object that represents the content of the XML file.
      return null;
   }

}
```

In general, you have to perform the following steps to properly implement this class:

1. Create an object/attribute that represents the XML. It will store the values from the XML file in it.
2. Parse the XML file with SAX methods `startElement` and `endElement`. In these methods you have to fill the attribute with the values you find in the XML file.
3. Return the attribute at `getConfiguration` method when the work is done.

Here it is an example:

```
public class SampleSAXLoader extends AbstractSAXLoader {

   // Object that represents the XML file.
   private ServiceConfig config;

   public void startElement(String uri, String localName, String qName,
         Attributes attributes) throws SAXException {
      if ((qName.equals("firstTag")) ||
           (localName.equals("firstTag"))) {

         // Create the object that represents the XML file.
         config = new ServiceConfig();

      } else if ((qName.equals("anotherTag")) ||
           (localName.equals("anotherTag"))) {
         config.setName(attributes.getValue("name"));
      } else if (...) {
         ...
      }
   }

   // "endElement" method is optional.

   protected Object getConfiguration() {
      return config;
   }

}
```

Finally, we have to reference the new Loader in the Service:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
```

```
      <service name="sample-service"
            class="com.warework.service.sample.SampleServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.SampleSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/sample-service.xml" />
      </service>
   </services>

</scope>
```

Chapter 7: Providers

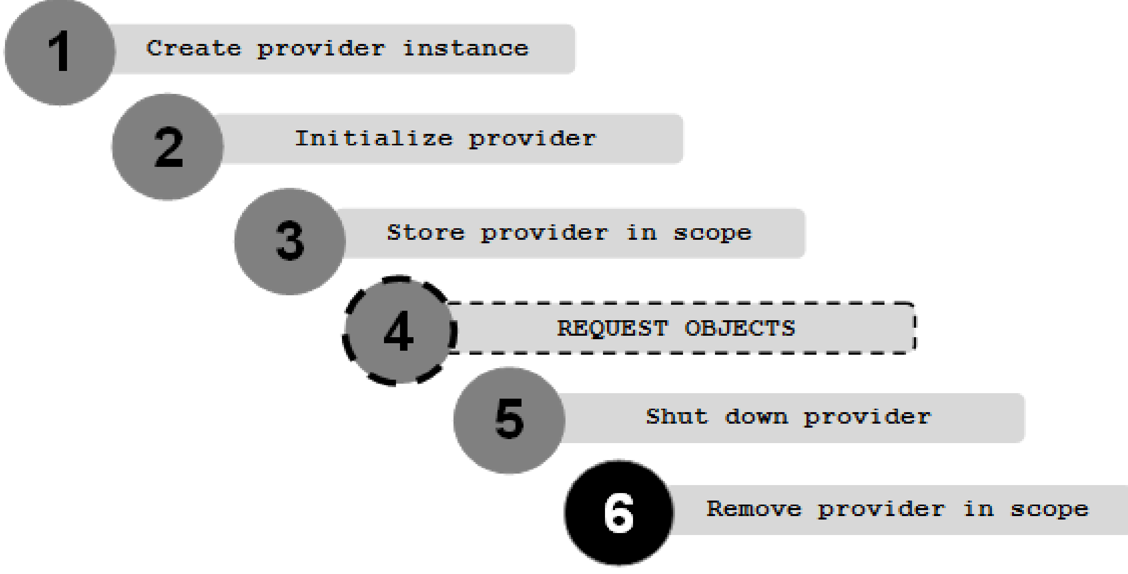
This Framework integrates a specific type of component called "Provider" that handles how objects are created and retrieved. Some Providers may create new instances of objects while others may reuse the existing ones, some may be very simple while others may delegate their operations to more powerful frameworks, some may provide objects locally while others do remotely... Each one decides how to work, but all of them behave in the same way: as objects providers. Warework Providers present these features:

- **Encapsulation.** They group a set of related functions about a particular topic.
- **Common life cycle.** Each Provider goes through a series of states before they can be used and destroyed.
- **Centrally controlled.** Providers are created and stored in Scopes. You can use a Provider via a Scope.
- **Configurable.** Providers may be configured on start-up with a set of parameters.
- **Pre-built or custom.** You can use existing Warework Providers or create your own ones.
- **Extend the functionality of systems.** Providers are distributed as JAR files that, when plugged in the Framework, provide extra support for your application.

Software developers can add into the Framework as many Providers as they need. Check out the Web site (menu option: `Download`) to view Providers created by Warework and download those that fit your needs.

Provider life cycle

Even that each Provider defines its own behavior, they all must extend the `AbstractProvider` class (check out the `com.warework.core.provider` package) to accomplish the default requisites of a Provider life cycle. When a class implements this interface, it is managed by the Framework in the following way:



1. **Create a new instance of the Provider.** When you invoke method `createProvider()` in a Scope, it creates a new Provider only if it does not exist in that Scope.

2. **Initialize the Provider.** When a new Provider instance is created, it may prepare itself before accepting objects requests.

3. **Store the Provider in the Scope.** Once the Provider is created and initialized, it is stored in the Scope where the `createProvider()` was invoked.

4. **Request objects.** At this point, Provider is running and you can use it by invoking Scope methods like `getObject()`.

5. **Shut down the Provider.** The method `removeProvider()` that exists in every Scope is responsible for telling to a specific Provider that it has to stop working and that it must prepare to be erased.

6. **Remove the Provider in the Scope.** After a Provider stops the execution, it is removed from the Scope where it belongs to.

Configuration

When a Provider is created, it may accept a set of parameters that can be used to specify how the Provider must be initialized and also to represent specific constants that define how the Provider must work.

Suppose we want to specify if foods that are out of date have to be available in a Market System. We could write something like this:

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how the Provider must work.
parameters.put("out-of-date-food", Boolean.FALSE);
```

```
// Create a new Provider and register it in the Scope.
scope.createProvider("food-provider", FoodProvider.class, parameters);
```

These parameters indicate how the Provider must work but they can also provide information for the initialization process of the Provider:

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how the Provider must be initialized.
parameters.put("test-food-on-startup", Boolean.TRUE);

// Create a new Provider and register it in the Scope.
scope.createProvider("food-provider", FoodProvider.class, parameters);
```

Each Provider can use those parameters how and whenever they want. By default, Providers define two parameters that can be used by the developer to configure the initialization and operation processes. The first one is defined with the constant PARAMETER_CreateObjects that exists in the `AbstractProvider` class of the `com.warework.core.provider` package and determines if every object managed by the Provider has to be bounded into the Scope automatically when the Provider is created.

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how the Provider must be initialized.
parameters.put(AbstractProvider.PARAMETER_CreateObjects, Boolean.TRUE);

// Create a new Provider, register it in the Scope and bound every
// object into the Scope.
scope.createProvider("food-provider", FoodProvider.class, parameters);

// Get a fruit object from the 'food-provider'.
Food fruit = (Food) scope.getObject("fruit");
```

The second one is defined with the constant PARAMETER_DisconnectOnLookup that exists in the same class and indicates if the connection with the Provider has to be closed after each `getObject` operation is requested (if so, the connection is opened on the next `getObject` operation). This parameter let us retrieve objects that come from a relational database very easily as the Provider can handle when to open and close the connection with the database automatically.

```
// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Configure how the Provider must work.
parameters.put(AbstractProvider.PARAMETER_DisconnectOnLookup,
   Boolean.TRUE);
parameters.put("server", "192.168.0.1");
parameters.put("user", "john");
parameters.put("password", "123");

// Create a new Provider and register it in the Scope.
scope.createProvider("food-provider", FoodProvider.class, parameters);

// Connect to the 'food' database, retrieve a fruit object and close the
```

```
// connection with the database.
Food fruit = (Food) scope.getObject("fruit");
```

For Providers that have to exist when a Scope is created, you need to define these Providers in an XML configuration file. The following example shows how to define multiple Providers in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="sample1-provider"
               class="com.warework.provider.Sample1Provider" />
      <provider name="sample2-provider"
               class="com.warework.provider.Sample2Provider" />
      …
   </providers>

</scope>
```

These Providers do not have parameters. That is, just with the name and the class, the Provider should be ready to run.

To retrieve an object from these Providers we can write something like:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get an object from "Sample1" Provider.
Object obj = scope.getObject("sample1-provider", "object-name");
```

Most of the times, you will need to specify a set of parameters that configure how the Provider must work. This is an example of a Provider configured with parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="standard-provider"
               class="com.warework.provider.StandardProvider">
         <parameter name="default-set" value="java.util.HashSet" />
         <parameter name="default-map" value="java.util.HashMap" />
         <parameter name="default-list" value="java.util.ArrayList" />
      </provider>
   </providers>

</scope>
```

In this example, the Standard Provider accepts parameters to define which classes it can create (review how this Provider works later on). You will need to review the parameters that a Provider can accept with the implementation class of the Provider (in this example, the `StandardProvider.class`).

Once you have defined at least one Provider, you can also define in an XML file references to objects that exist in a Provider. Check this out with the following code:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="standard-provider"
            class="com.warework.provider.StandardProvider">
         <parameter name="load-objects" value="false"/>
         <parameter name="default-set" value="java.util.HashSet"/>
         <parameter name="default-map" value="java.util.HashMap"/>
         <parameter name="default-list" value="java.util.ArrayList"/>
      </provider>
   </providers>

   <objects>
      <object name="map" provider="standard-provider" object="default-map"/>
   </objects>

</scope>
```

This time, you can retrieve new `HashMap` instances just by writing this:

```
// Get a new Map from the Standard Provider.
HashMap map = (HashMap) scope.getObject("map");
```

Every time this line of code is executed you will get a new `HashMap`. Review how the Provider works because it may retrieve unique instances (singleton) or objects from remote machines.

Create custom Providers

To create a Provider you just need to extend the [AbstractProvider] class that exists in the `com.warework.core.provider` package and implement the required methods:

```
import java.util.Enumeration;

import com.warework.core.provider.AbstractProvider;
import com.warework.core.provider.ProviderException;

public class FoodProvider extends AbstractProvider {

   // NOTE 1: List every initialization parameter with the protected
   // method "getInitParameterNames()" that exists in the
   // AbstractProvider class.

   // NOTE 2: Get the value of an initialization parameter with the
   // protected method "getInitParameter(String name)" that exists
   // in the AbstractProvider class.

   protected void initialize() throws ProviderException {
      // Write here the code required to prepare the execution of
      // the Provider. You may do not write nothing in here.
```

```
    }

    protected void connect() throws ProviderException {
        // Write here the code required to connect with the source that
        // stores the objects. You may do not write nothing in here.
        // This is the right place where to start a connection with a
        // database.
    }

    protected void disconnect() throws ProviderException {
        // Write here the code required to disconnect with the source
        // that stores the objects. You may do not write nothing in here.
        // This is the right place where to close a connection with a
        // database.
    }

    protected boolean isClosed() {
        // Write here the code required to decide if the connection with
        // the source that stores the objects is closed.
        return false;
    }

    protected Object getObject(String name) {
        // Write here the code required to retrieve an object. This is
        // the main method of every Provider and here you must specify
        // how each object may be created and/or configured.
        return null;
    }

    protected Enumeration getObjectNames() throws ProviderException {
        // Write here the code required to retrieve the name of every
        // object that this class can provide.
        // This method is called automatically when parameter
        // AbstractProvider.PARAMETER_CreateObjects is set to TRUE.
        return null;
    }

}
```

PART II: SERVICES

Chapter 8: Log Service

The Log Service is the central unit where to perform log operations in the Framework. It allows developers to send messages at runtime, with a level of granularity and in a chosen output (for example: consoles, files, databases, etc.).

As this Service is a Proxy Service, you can use multiple Loggers within one common interface and interact with all of them whenever you need. This functionality helps developers to switch between Log4j and Logback very quickly and without pain. It is also very useful for keeping the same log messages on different platforms.

Create and retrieve a Log Service

To create the Log Service in a Scope, you always need to provide a unique name for the Service and the `LogServiceImpl` class that exists in the `com.warework.service.log` package.

```
// Create the Log Service and register it in a Scope.
scope.createService("log-service", LogServiceImpl.class, null);
```

Once it is created, you can retrieve it using the same name (when you retrieve an instance of a Log Service, you will get the `LogServiceFacade` interface):

```
// Get an instance of the Log Service.
LogServiceFacade logService = (LogServiceFacade) scope.
   getService("log-service");
```

The following example shows how to define the Log Service in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl"/>
   </services>

</scope>
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. Review the next section to know how to define Loggers/Clients with these parameters.

Add and connect Loggers

Now the Log Service is running but you need at least one Logger to perform log operations. To add a Logger into the Log Service you have to invoke method createClient() that exists in its Facade. This method requests a name for the new Logger and a Connector which performs the creation of the Logger. Let's see how to register a sample Logger in this Service:

```
// Add a Logger in the Log Service.
logService.createClient("sample-logger", SampleConnector.class, null);
```

The SampleConnector class creates the Sample Logger and stores it in the Log Service. After that, we have to tell the Log Service that we want to perform operations with the Sample Logger. We do so by connecting the Logger:

```
// Connect the sample Logger.
logService.connect("sample-logger");
```

To configure Loggers in XML you need to create a separate XML file for the Log Service and reference it from the Scope XML file. The following example shows how to define a Log Service and the configuration file that it requires for the Loggers. The first thing you have to do is to register the Service as we did before, but this time with initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>

</scope>
```

Once it is registered in the Scope we proceed with the creation of the Log Service configuration file. Based on the previous example, this could be the content of the **log-service.xml** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-logger"
      connector="com.warework.service.log.client.connector.ConsoleConnector"/>
   </clients>

</proxy-service>
```

You can define as many Loggers as you need for the Log Service. Once the Scope is started, you can work with Clients like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of the Log Service.
LogServiceFacade logService = (LogServiceFacade) scope.
   getService("log-service");

// Connect the Client.
logService.connect("sample-logger");

// Perform operations with the Client.
…

// Disconnect the Client.
logService.disconnect("sample-logger");
```

Some Clients may require configuration parameters. The following example shows how a Client specifies one initialization parameter:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-logger" connector="…">
         <parameter name="…" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Logger to know which parameters it accepts.

Perform Log operations

Each Logger performs log operations with a level of granularity. Warework defines a common set of levels in the `LogServiceConstants` class that exists in the `com.warework.service.log` package and each one designates a log message in a specific context.

`LogServiceConstants.`**`LOG_LEVEL_Debug`**	This level designates detailed informational events used to debug applications.
`LogServiceConstants.`**`LOG_LEVEL_Info`**	This level designates informational messages that highlight the progress of the application.
`LogServiceConstants.`**`LOG_LEVEL_Warning`**	This level designates a potential problem.
`LogServiceConstants.`**`LOG_LEVEL_Fatal`**	This level designates serious failures that will presumably lead the application to abort.

These levels are generic and mostly used by all Loggers. Even when Loggers define more levels, Warework recommends you using only those specified at `LogServiceConstants` to

keep compatibility across them. It is helpful if you plan to change the Logger in the future, use many of them at the same time or move your application into a different environment.

To log a message with the Log Service is quite simple: just invoke the `log` method of the Log Service Facade with the name of the Logger to use, the message to log and the level of the log.

```
// Log a message using a standard log level.
logService.log("sample-logger", "A message from the Log Service",
   LogServiceConstants.LOG_LEVEL_Info);
```

You can also use each Logger levels directly with the specific constants that it defines in the Client class.

```
// Log a message with a specific sample Logger level.
logService.log("sample-logger", "Another message from the Log Service",
   SampleLogger.LOG_LEVEL_Trace);
```

As log operations are very common, Warework includes a faster way to perform them with the `log` method that exists in the Facade of each Scope. This method permits to invoke a log operation in a default Logger without the need to retrieve the Log Service.

```
// Log a message from a scope.
scope.log("This is faster!", LogServiceConstants.LOG_LEVEL_Info);
```

The previous line of code looks in the Scope for a Service named "log-service" that implements the `com.warework.service.log.LogServiceFacade` interface and then invokes the log operation on it with a Logger named "default-client". So, in order to make this method work, we have to create first the Log Service and a Logger with specific names.

```
// Create the Log Service.
LogServiceFacade logService = (LogServiceFacade) scope
   .createService("log-service", LogServiceImpl.class, null);

// Create a Logger.
logService.createClient("default-client", SampleConnector.class,
   null);
```

The Facade of the Scope also provides three short methods to perform log. Check out how to log `info`, `debug` and `warning` messages in both ways:

```
// Both ways to log with INFO level.
scope.log("Fast INFO log", LogServiceConstants.LOG_LEVEL_Info);
scope.info("Fastest INFO log");

// Both ways to log with DEBUG level.
scope.log("Fast DEBUG log", LogServiceConstants.LOG_LEVEL_Debug);
scope.debug("Fastest DEBUG log");

// Both ways to log with WARNING level.
scope.log("Fast WARNING log", LogServiceConstants.LOG_LEVEL_Warning);
scope.warning("Fastest WARNING log");
```

Console Logger

Warework includes by default a very simple Logger that performs log operations only with the console. If you are looking for a Logger where to execute complex operations you should better use the Apache Log4j Logger or similar. This Console Logger is suitable only if you plan to:

- Create a simple application.
- Run a quick test with the Framework.
- Perform simple log operations on many different environments.

Add a Console Logger

To add a Console Logger into the Log Service you have to invoke method `createClient()` that exists in its Facade just with a name and the `ConsoleConnector` class because this Logger does not accept to be configured. Let see how to register it:

```
// Add a console Logger in the Log Service.
logService.createClient("console-logger", ConsoleConnector.class, null);
```

Check it now how to do it with XML:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="console-logger"
      connector="com.warework.service.log.client.connector.ConsoleConnector"/>
   </clients>

</proxy-service>
```

Working with the Console Logger

You can perform operations with the Console Logger in the Log Service Facade. You have to invoke the `log` method with the name of the Console Logger to use, the message to log and the level of the log.

The Console Logger defines four log levels that exactly match with the ones defined at `LogServiceConstants`:

ConsoleLogger.**LOG_LEVEL_Debug**	This level designates detailed informational events used to debug applications.
ConsoleLogger.**LOG_LEVEL_Info**	This level designates informational messages that highlight the progress of the application.
ConsoleLogger.**LOG_LEVEL_Warning**	This level designates a potential problem.
ConsoleLogger.**LOG_LEVEL_Fatal**	This level designates serious failures that will presumably

	lead the application to abort.

To simplify the usage of the Logger, we will use the Console Logger with the levels defined at `LogServiceConstants` class:

```
// Remember always to connect the Logger first.
logService.connect("console-logger");

// Log a message using the console output.
logService.log("console-logger", "Log this message in the console",
   LogServiceConstants.LOG_LEVEL_Info);
```

This example will show in the console output something like:

```
[INFO @ <scope-name>] Log this message in the console
```

Log4j Logger

Log4j Logger gives the possibility to perform log operations with Log4j in Warework. This is a well-known and very stable Framework, used to log messages on multiple outputs like console, text files and also databases. If you plan to have fine grained control of what is logged on each output then Log4j is a very good choice.

Prior to work with this Logger, you should review the Log4j documentation, especially the section related with the configuration. There you will find how to define the target output for the logs and how to format for them.

Add a Log4j Logger

To add a Log4j Logger into the Log Service you have to invoke method `createClient()` that exists in its Facade with a name, a Log4j Connector class and a configuration for the Logger. You can use two different kinds of Connectors. If you plan to configure Log4j with a properties file, then you should use `Log4jPropertiesConnector` as follows:

```
// Create the configuration for the Logger.
Hashtable config = new Hashtable();

// Set the location of the Log4j configuration file.
config.put(Log4jPropertiesConnector.PARAMETER_ConfigTarget,
   "/META-INF/system/log4j.properties");

// Create the Log4j Logger.
logService.createClient("log4j-logger",
   Log4jPropertiesConnector.class, config);
```

The `Log4jPropertiesConnector` collects the configuration and sets up a Log4j Logger with the properties file that exists where `PARAMETER_ConfigTarget` specifies. Please review in the Log4j documentation how to configure Log4j with properties files. Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="log4j-logger"
            connector="com.warework.service.log.client.connector. …
            … Log4jPropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/system/log4j.properties"/>
      </client>
   </clients>

</proxy-service>
```

If you plan to configure Log4j with an XML file, then you should use `Log4jXMLConnector` as follows:

```
// Create the configuration for the Logger.
Hashtable config = new Hashtable();

// Set the location of the Log4j configuration file.
config.put(Log4jXMLConnector.PARAMETER_ConfigTarget,
   "/META-INF/system/log4j.xml");

// Create the Log4j Logger.
logService.createClient("log4j-logger", Log4jXMLConnector.class, config);
```

The `Log4jXMLConnector` collects the configuration and sets up a Log4j Logger with the XML file that exists where `PARAMETER_ConfigTarget` specifies. Please review in the Log4j documentation how to configure Log4j with XML files. Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="log4j-logger"
            connector="com.warework.service.log.client.connector. …
            … Log4jXMLConnector">
         <parameter name="config-target"
            value="/META-INF/system/log4j.xml"/>
      </client>
   </clients>

</proxy-service>
```

It is very important to know that the name you give to the Warework Logger must be the same name as the Log4j Logger. If we define the Warework Logger like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">
```

```
   <clients>
      <client name="log4j-logger"
            connector="com.warework.service.log.client.connector. …
            … Log4jPropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/system/log4j.properties"/>
      </client>
   </clients>

</proxy-service>
```

The Log4j specific configuration file should have a Logger with that name too. In a Log4j properties configuration file it could be like this:

```
log4j.logger.log4j-logger=DEBUG, consoleApp
log4j.appender.consoleApp=org.apache.log4j.ConsoleAppender
log4j.appender.consoleApp.layout=org.apache.log4j.PatternLayout
log4j.appender.consoleApp.layout.ConversionPattern=[%d]-[%-5p] - %m%n
```

Warework gives the possibility to define variables that will be replaced in the Log4j configuration file. Suppose that we have the following content in a Log4j properties file:

```
log4j.logger.log4j-logger=DEBUG, consoleApp
log4j.appender.consoleApp=org.apache.log4j.ConsoleAppender
log4j.appender.consoleApp.layout=org.apache.log4j.PatternLayout
log4j.appender.consoleApp.layout.ConversionPattern=[%d]- …
   …[%-5p @ %X{variable-user-name}] - %m%n
```

In this code we have defined a `user-name` variable. To replace that variable with a value we can configure the Log4j Logger like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="log4j-logger"
            connector="com.warework.service.log.client.connector. …
            … Log4jPropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/system/log4j.properties"/>
         <parameter name="variable-user-name" value="john"/>
      </client>
   </clients>

</proxy-service>
```

Now, for every log operation that is executed, the value "`john`" will be displayed in the output. You can define every variable you need, just remember to name these variables with the "`variable-`" prefix and Warework will replace them for you.

Working with the Log4j Logger

As with all Loggers, you can perform operations with the Log4j Logger in the Log Service Facade. You have to invoke the `log` method with the name of the Log4j Logger to use, the message to log and the level of the log.

The Log4j Logger defines the following log levels:

Log4jLogger.**LOG_LEVEL_Trace**	This level designates finer-grained informational events than the DEBUG level.
Log4jLogger.**LOG_LEVEL_Debug**	This level designates detailed informational events used to debug applications. Matches LogServiceContants.LOG_LEVEL_Debug
Log4jLogger.**LOG_LEVEL_Info**	This level designates informational messages that highlight the progress of the application. Matches LogServiceContants.LOG_LEVEL_Info
Log4jLogger.**LOG_LEVEL_Warning**	This level designates a potential problem. Matches LogServiceContants.LOG_LEVEL_Warning
Log4jLogger.**LOG_LEVEL_Error**	This level designates error events that might still allow the application to continue running
Log4jLogger.**LOG_LEVEL_Fatal**	This level designates serious failures that will presumably lead the application to abort. Matches LogServiceContants.LOG_LEVEL_Fatal

To simplify the usage of the Logger, we will use the Log4j Logger with the levels defined at `LogServiceConstants` class:

```
// Remember always to connect the Logger first.
logService.connect("log4j-logger");

// Log a message using the Log4j logger.
logService.log("log4j-logger", "Log this message with Log4j",
   LogServiceConstants.LOG_LEVEL_Info);
```

Chapter 9: Data Store Service

The Data Store Service is the central unit where to perform operations with data repositories in this Framework. It is a Proxy Service so you can manage multiple Data Stores in the same place like relational databases (MySQL, Oracle, DB2, etc.) or properties files for example. This Service gives the opportunity to manage any kind of Data Store and work with them using a common interface.

Operations like connect, disconnect, query, update and commit are supported in this Service. Check out in the following example how simple is the process of creating a new table in a relational database:

```
// Get an instance of the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope.
   getService("datastore-service");

// Connect to the relational database.
datastoreService.connect("my-database");

// Create a new table in the database.
datastoreService.update("my-database", null,
   "CREATE TABLE MESSAGES (MESSAGE VARCHAR(99))");

// Disconnect to the database.
datastoreService.disconnect("my-database");
```

You can also combine the Data Store Service with Providers to load statements from text files for Data Stores. That is, you can keep in separate files some commands that you need to execute in specific Data Stores. It lets you write, for example, SQL scripts in text files and execute them just by providing the name of the file. If you are a business application developer, you will love this feature.

Warework also gives the opportunity to change the way a Data Store is used. This Service is not just an abstract layer for Data Stores; it also provides the necessary mechanisms to dynamically update the functionality of a Data Store. This is done with Views and it is where the magic really begins with this Service.

Create and retrieve a Data Store Service

To create the Data Store Service in a Scope, you always need to provide a unique name for the Service and the `DatastoreServiceImpl` class that exists in the `com.warework.service.datastore` package.

```
// Create the Data Store Service and register it in a Scope.
scope.createService("datastore-service", DatastoreServiceImpl.class, null);
```

Once it is created, you can get an instance of it by using the same name (when you retrieve an instance of a Data Store Service, you will get the `DatastoreServiceFacade` interface):

```
// Get an instance of the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope.
   getService("datastore-service");
```

Add and connect to Data Stores

Now the Data Store Service is running but you need at least one Data Store where to perform operations. To add a Data Store into the Service you have to invoke method `createClient()` that exists in its Facade. This method requests a name for the new Data Store and a Connector which performs the creation of the Data Store. Let's see how to register a sample Data Store in this Service:

```
// Add a Data Store in the Data Store Service.
datastoreService.createClient("sample-datastore", SampleConnector.class,
   null);
```

The `SampleConnector` class creates the Sample Data Store and registers it in the Data Store Service. After that, we have to tell the Data Store Service that we want to perform operations with the Sample Data Store. We do so by connecting the Data Store:

```
// Connect the Sample Data Store.
datastoreService.connect("sample- datastore");
```

Perform Data Store operations

Each Data Store exposes its interface or functionality in two different places. First, you can find basic and common operations at `DatastoreServiceFacade` interface. These are operations that almost every Data Store can execute like `connect`, `disconnect`, `query`, `update` and `commit`. Like every Proxy Service, you have to provide the name of the Data Store where to perform any of these operations.

The second place where you can execute operations is in a View of a Data Store. Views are wrappers that upgrade the functionality provided by the Data Store (or another View) and they are organized like stacks. That is, you can add a View on top of a Data Store but you can also add a View on top of another View. This level of organization lets you transform the way which data is processed. Later on you will see that you can get a View of a Data Store with the `DatastoreServiceFacade` interface.

Example: we can have a JDBC Data Store to perform simple database operations with SQL commands. If we want to execute more specific operations we can add a RDBMS View (specific for relational databases) on top of the JDBC Data Store.

Common operations

Now we are going to review the basic Data Store operations provided by the `DatastoreServiceFacade` interface. We can group these operations as follows:

- Connect and disconnect Data Stores

The first operation you have to invoke to start working with a Data Store is `connect`:

```
// Connect the Sample Data Store.
datastoreService.connect("sample-datastore");
```

If `sample-datastore` represents a relational database then `connect` will start up a connection with the database. If it represents a properties file then it will open the file. Each Data Store handles the `connect` operation in a specific way.

After you perform the connection, you typically will execute other Data Store operations like `query`, `update` or `commit`. Once the job is done, you will need to close the Data Store:

```
// Disconnect the Sample Data Store.
datastoreService.disconnect("sample-datastore");
```

- Query Data Stores

There are multiple methods named `query` where you can retrieve information from a Data Store. The first one allows you to directly query data with a statement that is supported by the Data Store. For example, if `sample-datastore` represents a relational database then we could query the Data Store like this:

```
// Query the Sample Data Store.
Object result = datastoreService.
   query("sample-datastore", "SELECT * FROM HOME_USER");
```

Check it out now how easy is to make the `sample-datastore` behave as a different Data Store, like a properties file for example:

```
// Get the value of the 'user.name' property in the Sample Data Store.
String value = (String) datastoreService.
   query("sample-datastore", "user.name");
```

Very important facts to consider about this method:

As always with Proxy Services, you have to indicate the name of the Client (Data Store in this case) where to execute the query statement.

Each Data Store accepts a specific query language.

Each Data Store returns a specific type of object.

Please review the documentation associated to each Data Store to know which query language it accepts and what sort of object is returned.

When you query a Data Store you do not perform the query directly on the Data Store, instead you will execute the query in a View that wraps the Data Store. By default, this `query` method performs the operation in the View that is on top of the stack of Views of the Data Store (the "Current View"). But wait; did we add any View in the Data Store?

Well, every time you create a new Data Store, the Data Store Service creates a default View for the Data Store, wraps the Data Store with the default View and then saves the default View (not the Data Store, because the View contains the Data Store and not the other way) for later use. That is why you will always perform operations with Views and not directly with Data Stores.

To execute the query in a specific View you have to provide the class or the name of the View. Check it out with an example: suppose we have a View that is implemented with class `SampleView1` and it is responsible for transforming to uppercase the queries of a properties file Data Store. If we add this View in the Properties Data Store and we query it by specifying the class of the View, then we will get results/strings in uppercase:

```
// Value of property 'user.name.john' is 'John Wood'.
// 'query' returns 'JOHN WOOD'.
String name = (String) datastoreService.
   query("sample-datastore", SampleView1.class, "user.name.john");
```

We can also use this View by giving the name of the View:

```
// Value of property 'user.name.john' is 'John Wood'.
// 'query' returns 'JOHN WOOD'.
String name = (String) datastoreService.
   query("sample-datastore", "sample-view1", "user.name.john");
```

The difference about providing the name or the class of the View is:

> By name you retrieve exactly the View that you are looking for. This is typically the best option in most cases.
>
> By providing the class you retrieve the first View in the stack that matches the given class.

If we now add `SampleView2` to transform queries to lowercase then the Data Store will have two Views (`SampleView2` is on top of `SampleView1` and `SampleView1` is on top of the properties Data Store):

```
// Value of property 'user.name.john' is 'John Wood'.
// 'query' returns 'john wood'.
String name = (String) datastoreService.
   query("sample-datastore", SampleView2.class, "user.name.john");
```

With this code we get results in lowercase and, as `SampleView2` is now the Current View, we can get the same results with the following code:

```
// Value of property 'user.name.john' is 'John Wood'.
// 'query' returns 'john wood'.
// We use the View on top of the stack.
String name = (String) datastoreService.
   query("sample-datastore", "user.name.john");
```

The powerful idea about this is that you can choose which specific View to use when you run a query. Let us now query the Data Store to retrieve again results in uppercase:

```
// Value of property 'user.name.john' is 'John Wood'.
// 'query' returns 'JOHN WOOD'.
String name = (String) datastoreService.
   query("sample-datastore", SampleView1.class, "user.name.john");
```

This time we do not use the Current View (`SampleView2`), instead we indicate the Data Store Service to retrieve the View that we want and perform the query on it.

Another way to search for data in a Data Store is by loading and executing statements that exist in a Provider. This functionality allows you to read queries from files and run them in the Data Store, for example: you can setup a Provider to read SQL statements from text files and execute each one in a relational database, just by specifying the name of the Provider and the name of the text file to read. For the next sample code we are going to suppose that:

- `sample-datastore` represents now a relational database.
- There is a Provider named `sql-provider` that reads text files from a specific directory. When you request an object from this Provider, the name given is used to read the file. For example: if we request an object named `list-users`, this Provider looks for a file named `list-users.sql` in the directory, reads the file and return its content as a `String` object.

And this is the example:

```
// Query the Sample Data Store.
Object result = datastoreService.
   query("sample-datastore", "sql-provider", "list-users", null);
```

With this utility you can save prepared statements in a directory for any Data Store. You can also define some variables for these queries and replace them later on with specific values. Suppose that `list-users.sql` contains the following code:

```
SELECT * FROM HOME_USER A WHERE A.ID = ${USER_ID}
```

In this query we have defined a variable named `USER_ID`. We can assign a value to this variable to complete the query and then run it in the Data Store. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the query.
values.put("USER_ID", new Integer(8375));

// Query the Sample Data Store.
Object result = datastoreService.
   query("sample-datastore", "sql-provider", "list-users", values);
```

You can define as many variables as you need but only when the Data Store supports it. Not every Data Store can replace variables with values so please review the documentation of each Data Store to know if this functionality is enabled.

`query` methods also allows you to define in which View execute the query that exists in a Provider. Suppose that we have a View that is implemented with class `SampleView3` and it is responsible for transforming to uppercase the queries of a relational database.

```
// Get the results in uppercase.
Object result = datastoreService.
   query("sample-datastore", SampleView3.class,
   "sql-provider", "list-users", null);
```

It works as we saw before. We specify where to execute the query, from the stack of Views of the Data Store, to get a result in a specific way.

- Update Data Stores

  Before proceed with this section, read the previous point because update operations are used in the same way. This time, instead querying for data in a Data Store, you will create or modify information in a Data Store. For example, if `sample-datastore` represents a relational database then we could create a new table in the Data Store like this:

```
// Create a new table in the database.
datastoreService.update("sample-datastore",
   "CREATE TABLE MESSAGES (MESSAGE VARCHAR(99))");
```

If `sample-datastore` represents now a properties file then we could set a new property in the Data Store like this:

```
// Set a new property in the properties file.
datastoreService.update("sample-datastore",
   "user.name=John Wood");
```

Each Data Store performs the update operation in a specific manner. If you require executing `update` in a View, you can specify it by providing the name of the View or the implementation class of the View:

```
// Save properties in uppercase.
datastoreService.update("sample-datastore", "sample-view1",
   "user.name=John Wood");

// Update in the first View of the stack that matches given class.
datastoreService.update("sample-datastore", SampleView1.class,
   "user.name=John Wood");
```

You can also read update statements from Providers:

```
// Read 'create-contact.sql' and execute it.
datastoreService.update("sample-datastore",
   "sql-provider", "create-contact", null);
```

Let us say that we want to create a new user in the database, we can define a script named `create-user.sql` like this:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
```

Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
datastoreService.update("sample-datastore", "sql-provider",
   "create-user", values);
```

- Commit Data Stores

  Some Data Stores require you to confirm that latest `update` operations have to be executed. That is, you may run multiple `update` operations in a Data Store and it will not make these changes available until you invoke the `commit` method. It is like working with a text file in a note pad application. You write some text there, but it is not written into disk until you press the Save button. Databases, for example, typically require you to perform `commit` in order to persist the data. Please review the documentation of each Data Store to understand how it works with this operation.

  You can commit changes just by providing the name of the Data Store to execute the operation:

```
// Commit changes in a Data Store.
datastoreService.commit("sample-datastore");
```

  If you want to commit changes on every Data Store at once, then invoke `commitAll`:

```
// Commit changes in every Data Store.
datastoreService.commitAll();
```

Working with Views

Data Stores implement the basic functionalities that allow operating with specific data repositories. They expose this functionality with the `DatastoreServiceFacade` interface, with the methods that we reviewed in the previous section: `connect`, `disconnect`, `query`, `update` and `commit`. A key fact about this is that you cannot get an instance of a Data Store.

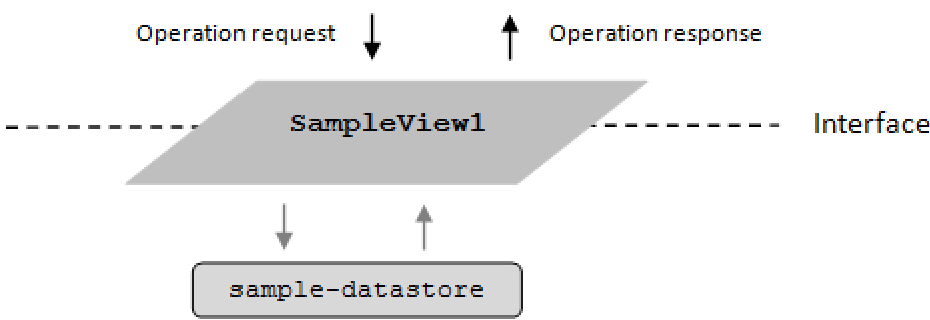
Another way to work with Data Stores is using Views. They let you to change the interface of a Data Store and provide a different set of methods to better adjust to your needs. Views are very handy when:

- You have to execute specialized operations in a specific type of Data Store.
- You need to handle a Data Store in a separate class, not with the Data Store Service. That is, you can get an instance of a View and work with it outside the Service.
- You require transforming data obtained from a Data Store or data to be saved in the Data Store.
- You want the same Data Store to provide multiple interfaces to work with it.

In order to work with Views, you always have to associate at least one View to a Data Store. The following example shows how to create a fictitious Data Store and how to associate a View to it:

```
// Create a Data Store in the Data Store Service.
datastoreService.createClient("sample-datastore", SampleConnector.class,
   null);

// Add a View on top of the Data Store.
datastoreService.addView("sample-datastore", SampleView1.class,
   "sample-view1", null, null);
```

When the second line of code is executed, the functionality of `sample-datastore` is updated to behave as `SampleView1` indicates. This View is added on top of the Data Store in a way that it wraps the operations provided by the Data Store and now, every time you interact with the Data Store, you do it through the View. Check it out with the following image:

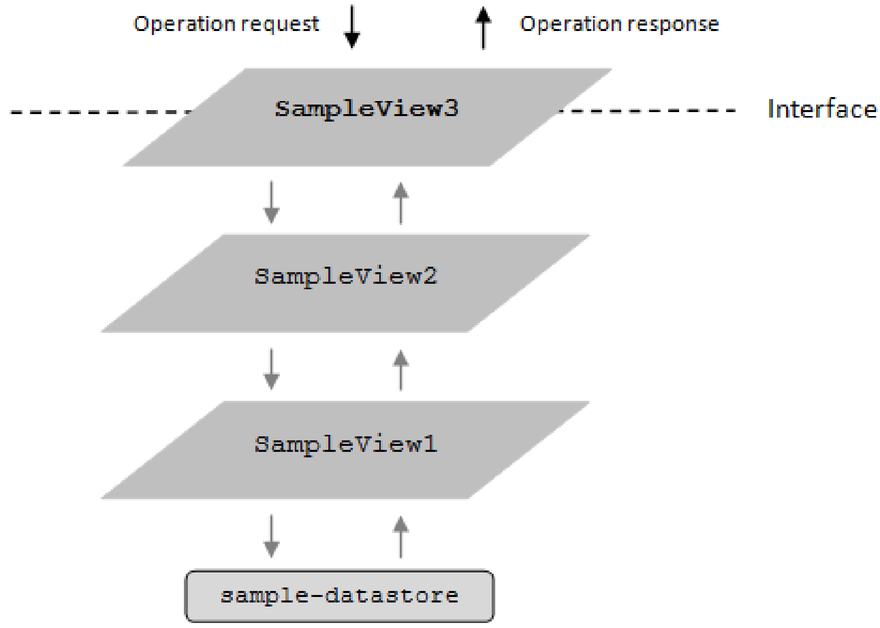


This example shows that `SampleView1` completely isolates the Data Store. Sometimes you may need to add more Views on top of existing ones to construct a stack of Views. This is great because it allows you to manage multiple interfaces for the same Data Store and choose the one you need for a specific operation. Check out this code:

```
// Create a Data Store in the Data Store Service.
datastoreService.createClient("sample-datastore", SampleConnector.class,
   null);

// Add first View.
datastoreService.addView("sample-datastore", SampleView1.class, "view1", null,
   null);

// Add second View.
```

```
datastoreService.addView("sample-datastore", SampleView2.class, "view2", null,
   null);

// Add third View.
datastoreService.addView("sample-datastore", SampleView3.class, "view3", null,
   null);
```

What is going on right now? Well, when you request an operation to the Data Store, now it is processed first by `SampleView3` because it is the Current View (the latest added in the stack). It will produce a response based on the data provided by another View of the stack or directly from the Data Store.



Another interesting feature is that Warework gives the opportunity to link a View with a default Provider. This is very useful when you need to read prepared statements from a specific source, like SQL commands from text files. Suppose we have a Provider named `sql-provider` which loads SQL scripts, we can link this Provider to the View when we create the View:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleView1.class, "view1"
   "sql-provider", null);
```

Now, when we request an operation to `SampleView1`, it can use the `sql-provider` to load and execute scripts. Each View can use its own Provider or, if it is not defined, the Provider that exists in another View of the same stack. By default, when a View does not have a Provider, the View uses the Provider that exists in the next View of the stack. If there are no Providers associated to any Views of the stack, then the View will not be able to retrieve objects from a default Provider.

Sometimes you may need to configure a View with a set of parameters. Read the documentation of the implementation class of each View to check out if it defines initialization parameters. The following example shows you how to setup the configuration for a View:

```
// Create a configuration for the View.
Hashtable parameters = new Hashtable();
```

```
// Configure the View with initialization parameters.
parameters.put("sample-param-1", "sample-value-1");

// Add a View and configure it.
datastoreService.addView("sample-datastore", SampleView1.class, "view1"
   null, parameters);
```

Once you have at least one View associated to a Data Store, you can get an instance of a View with the following line of code (for this example, suppose we added three Views as we did before):

```
// Get the Current View of the Data Store.
SampleView3 view = (SampleView3) datastoreService.getView("sample-datastore");

// Perform operations with the View.
view.operation1();
view.operation2();
view.operation2();
...
```

This method returns the Current View. If you need to retrieve another View from the stack of Views of the Data Store, then you have to indicate the name or the implementation class of the View that you want to get:

```
// Get a View from the stack of Views of the Data Store.
SampleView2 view = (SampleView2) datastoreService.getView("sample-datastore",
   "view2");

// Get a View from the stack of Views of the Data Store.
SampleView2 view = (SampleView2) datastoreService.getView("sample-datastore",
   SampleView2.class);
```

Wonderful, now we can decide which interface we want to use when working with a specific Data Store.

What happens if you request a View when there are no Views associated to the Data Store? This time you will get nothing:

```
// We get 'null' because 'sample-datastore' does not have Views.
Object view = datastoreService.getView("sample-datastore");
```

If you plan to remove Views from a Data Store, then you should consider which actions can be performed:

- Remove all Views at once

  This is the easiest way to empty the stack of Views of a Data Store. Just invoke `removeAllViews` for a specific Data Store like this:

  ```
  // Remove every View associated to the Data Store.
  datastoreService.removeAllViews("sample-datastore");
  ```

- Remove Current View

  To remove the View that exists on top of the stack of Views, just invoke `removeView` for a specific Data Store like this:

```
// Remove just one View, the Current View.
datastoreService.removeView("sample-datastore");
```

Finally, there is also another method that can be helpful in certain occasions. It is the `isDefaultView` method and it decides if a Data Store has Views associated to it.

```
// Returns TRUE if there are Views in the stack and FALSE if stack is empty.
boolean empty = datastoreService.isDefaultView("sample-datastore");
```

Data Store Service configuration

A Data Store Service is a special kind of Proxy Service which allows to be configured in two different ways. In the first place, as they are Proxy Services, you can configure them with the typical configuration Java objects and XML files that Proxy Services support. The second option consists of defining a specific Data Store Service configuration where you can set up Data Stores and Views.

Configuration with Proxy Service Java objects

The following example quickly shows how to create a Data Store Service with two Data Stores to be ready on start up:

```
// Create a configuration for the Data Store Service.
ProxyService config = new ProxyService();

// Configure two Data Stores for the Data Store Service.
config.setClient("sample-datastore1", Sample1Connector.class);
config.setClient("sample-datastore2", Sample2Connector.class);

// Create a map where to store the configuration of the Service.
Hashtable parameters = new Hashtable();

// Setup the configuration of the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope
   .createService("datastore-service", DatastoreServiceImpl.class,
   parameters);
```

You can also configure Data Stores with initialization parameters like this:

```
// Create a map where to store configuration parameters for the Data Store.
Hashtable dsParams = new Hashtable();
```

```
// Configure the Data Store.
dsParams.put("sample-param-1", "sample-value-1");
dsParams.put("sample-param-2", "sample-value-2");

// Create a configuration for the Data Store Service.
ProxyService config = new ProxyService();

// Configure two Data Stores for the Data Store Service.
config.setClient("sample-datastore1", Sample1Connector.class, dsParams);

// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Setup the configuration of the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope
   .createService("datastore-service", DatastoreServiceImpl.class,
   parameters);
```

Configuration with Data Store Service Java objects

Data Store Services can be configured in a specific way to automatically initialize the Data Stores that the Service may need. This is done with the `DatastoreService` class that exists in `com.warework.service.datastore.model` package. The following example shows how to configure two Data Stores when a Data Store Service is created:

```
// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();

// Configure two Data Stores for the Service.
config.setDatastore("sample1-datastore", Sample1Connector.class, null, null);
config.setDatastore("sample2-datastore", Sample2Connector.class, null, null);

// Create a map where to store the configuration parameters.
Hashtable parameters = new Hashtable();

// Setup the configuration of the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope
   .createService("datastore-service", DatastoreServiceImpl.class,
   parameters);
```

Do you need to pass some parameters to the Data Store? You can do it with a `Hashtable` when the Data Store is created, like this:

```
// Create a map where to store configuration parameters for the Data Store.
Hashtable dsParams = new Hashtable();

// Configure the Data Store.
dsParams.put("sample-param-1", "sample-value-1");
dsParams.put("sample-param-2", "sample-value-2");

// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();
```

```
// Create the Data Store with the configuration.
config.setDatastore("sample1-datastore", Sample1Connector.class,
   dsParams, null);

// Create a map where to store the configuration parameters for the Service.
Hashtable parameters = new Hashtable();

// Setup the configuration of the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope
   .createService("datastore-service", DatastoreServiceImpl.class,
   parameters);
```

You can also include initialization parameters once the Data Store is created:

```
// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();

// Define one Data Store for the Service.
config.setDatastore("sample1-datastore", Sample1Connector.class,
   null, null);

// Configure the Data Store.
config.setClientParameter("sample1-datastore", "sample-param-1",
   "sample-value-1");
config.setClientParameter("sample1-datastore", "sample-param-2",
   "sample-value-2");

// Create a map where to store the configuration parameters for the Service.
Hashtable parameters = new Hashtable();

// Setup the configuration of the Service.
parameters.put(ServiceConstants.PARAMETER_ConfigTarget, config);

// Create the Data Store Service.
DatastoreServiceFacade datastoreService = (DatastoreServiceFacade) scope
   .createService("datastore-service", DatastoreServiceImpl.class,
   parameters);
```

To specify a set of Views for a Data Store, you have to invoke `setView` method as many times as you need:

```
// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();

// Configure one Data Store for the Service.
config.setDatastore("sample1-datastore", Sample1Connector.class, null, null);

// Set up a View for the Data Store.
config.setView("sample1-datastore", Sample1View.class, "view1", null, null);
```

Remember that you can associate a default Provider for a View. It can be done as follows:

```
// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();

// Configure one Data Store for the Service.
config.setDatastore("sample1-datastore", Sample1Connector.class, null, null);

// Configure a View for the Data Store.
config.setView("sample1-datastore", Sample1View.class, "view1",
   "sql-provider", null);
```

When a View requires configuration, you can specify a set of initialization parameters like this:

```
// Create a configuration for the Data Store Service.
DatastoreService config = new DatastoreService();

// Configure one Data Store for the Service.
config.setDatastore("sample1-datastore", Sample1Connector.class, null, null);

// Create a configuration for the View.
Hashtable parameters = new Hashtable();

// Configure the View with initialization parameters.
parameters.put("sample-param-1", "sample-value-1");

// Configure a View for the Data Store.
config.setView("sample1-datastore", Sample1View.class, "view1",
   null, parameters);
```

Configuration with a generic Proxy Service XML file

Use the following templates to load a Data Store Service with Scope and Proxy Service configuration files. First, the Scope XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="datastore-service"
            class="com.warework.service.datastore.DatastoreServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/datastore-service.xml" />
      </service>
   </services>

</scope>
```

And now, the `datastore-service.xml`:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">
```

```
   <clients>
      <client name="sample-datastore" connector="…">
         <parameter name="sample-param-1" value="sample-value-1"/>
         <parameter name="sample-param-2" value="sample-value-2"/>
         …
      </client>
   </clients>

</proxy-service>
```

Configuration with a Data Store Service XML file

Use the following templates to load a Data Store Service with Scope and Data Store Service specific configuration files. Warework recommends you to use this type of configuration instead of the generic Proxy Service configuration file because with a Data Store Service XML file you can define Views. First, review how to configure this Service in the Scope XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="datastore-service"
            class="com.warework.service.datastore.DatastoreServiceImpl">
         <parameter name="config-class"
            value="com.warework.service.datastore.DatastoreSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/datastore-service.xml" />
      </service>
   </services>

</scope>
```

And now, the `datastore-service.xml`:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   < datastores>

      <datastore name="..." connector="...">

         <parameters>
            <parameter name="..." value="..."/>
            <parameter name="..." value="..."/>
         </parameters>

         <views>

            <view name="..." class="..." provider="...">
               <parameter name="..." value="..."/>
               <parameter name="..." value="..."/>
            </view>
```

```
            <view name="..." class="..." provider="...">
               <parameter name="..." value="..."/>
               <parameter name="..." value="..."/>
            </view>

         </views>

      </datastore>

      <datastore name="..." connector="...">

         <parameters>
            <parameter name="..." value="..."/>
            <parameter name="..." value="..."/>
         </parameters>

         <views>

            <view name="..." class="..." provider="...">
               <parameter name="..." value="..."/>
               <parameter name="..." value="..."/>
            </view>

            <view name="..." class="..." provider="...">
               <parameter name="..." value="..."/>
               <parameter name="..." value="..."/>
            </view>

         </views>

      </datastore>

   </datastores>

</datastore-service>
```

Remember that you can also provide a short class name to load the Service:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="datastore-service" class="datastore">
         <parameter name="config-class"
            value="com.warework.service.datastore.DatastoreSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/datastore-service.xml" />
      </service>
   </services>

</scope>
```

Views

In general, when you work with Views, you typically deal with the interface of a View instead of the implementation class. So, we can say that Views can be split in two. By one side we have the interface of the View and on the other side we have the class that implements this interface.

There is no need to perform any extra operation to work with the interface of a View. You just have to provide the same implementation class of the View when you create it, but this time, you have to cast the result of `getView` method to the interface of the View. Check this out with the following example:

```
// Create a Data Store in the Data Store Service.
datastoreService.createClient("sample-datastore", SampleConnector.class,
   null);

// Always use the implementation class of the View to create it.
datastoreService.addView("sample-datastore", SampleView1Impl.class, "view1",
   null, null);

// Get the View with the interface.
SampleView1 view = (SampleView1) datastoreService.getView("sample-datastore");
```

This is a much better idea. Now we can use the same interface of a View for different type of Data Stores. Of course, creating the View directly with the interface is completely forbidden:

```
// Never use the interface to create a View!!!
datastoreService.addView("sample-datastore", SampleView1.class, "view1",
   null, null);
```

Anyway, if you have to work with the implementation class because you need all the functionality that it provides, you can do it without problems:

```
// Use the implementation class of the View to create it.
datastoreService.addView("sample-datastore", SampleView1Impl.class, "view1",
   null, null);

// Get the View with the interface.
SampleView1Impl view = (SampleView1Impl) datastoreService.
   getView("sample-datastore");
```

In this section we are going to review some common interfaces to work with Views. Please, read the following points carefully because you will probably spend most of your time with these interfaces to interact with Data Stores.

Key-Value View

This View is an interface that represents an abstract Data Store composed of a collection of key-value pairs, such that each possible key appears at most once in the collection. It is like a `Hashtable` but this time the operations are performed in a Data Store. Operations associated with this View allow:

- Addition of pairs to the collection.
- Removal of pairs from the collection.
- Modification of the values of existing pairs.

- Lookup of the value associated with a particular key.

Working with this View is fairly easy because the KeyValueView interface (package: `com.warework.service.datastore.view`) only exposes a few methods and they all are very simple.

The first operation you have to perform to start working with a Data Store is the `connect` operation. There is no exception with the Key-Value View:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();
```

The following example shows how to add a new value associated to a key in the Data Store:

```
// Get an instance of a Key-Value View.
KeyValueView view = (KeyValueView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Create a new key named 'user.name' or update it.
view.put("user.name", "John Wood");
```

Some Data Stores may accept other keys and values different than Strings. This limitation is imposed by the Data Store so read carefully the documentation associated to the implementation class of the View and the Data Store that it supports. This example is completely perfect with this interface:

```
// Get an instance of a Key-Value View.
KeyValueView view = (KeyValueView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Create a new key-value or update an existing one.
view.put(new Integer(23), Boolean.TRUE);
```

Now, you can retrieve the value associated to the key like this:

```
// Get the value of key '23'.
Boolean value = (Boolean) view.get(new Integer(23));
```

This is how to remove a key and the value associated to it:

```
// Remove the key from the Data Store.
view.remove("user.enabled");
```

You can also get a list with the keys that exist in the Data Store:

```
// Get every key from the Data Store.
Enumeration keys = view.keys();
```

To retrieve the number of key-value pairs you have to invoke the `size` method like this:

```
// Count keys in Data Store.
int size = view.size();
```

Once you have performed a set of `put` or `remove` operations, it might be a good idea to perform `commit` to register the changes in the Data Store:

```
// Commit changes in a Data Store.
view.commit();
```

When the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Relational Database Management System (RDBMS) View

This View is an interface that represents a collection of data items organized as a set of formally-described tables. You can take advantage of this View to query and update with SQL statements relational databases like Oracle, MySQL, DB2, etc. Two basic operations are allowed here:

- Update operations

  Executes a given SQL statement, which may be an `INSERT`, `UPDATE`, or `DELETE` statement or an SQL statement that returns nothing, such as an SQL DDL statement (for example: `CREATE TABLE`).

- Query operations

  Executes a given SQL statement, typically a static SQL `SELECT` statement, to retrieve data from the relational database.

Even before you perform any of these operations, what you have to do first is to connect to the database management system:

```
// Get an instance of a RDBMS View interface.
RDBMSView view = (RDBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();
```

Perfect, now a connection with the database is ready to accept SQL commands. In the following examples we are going to save some information in a database but before that, it is recommended to begin a transaction with the database.

A transaction comprises a unit of work performed within a database management system, and treated in a coherent and reliable way independent of other transactions. Transactions in a database environment have two main purposes:

- To provide reliable units of work that allow correct recovery from failures and keep a database consistent even in cases of system failure, when execution stops (completely or partially) and many operations upon a database remain uncompleted, with unclear status.
- To provide isolation between programs accessing a database concurrently. If this isolation is not provided the programs outcome are possibly erroneous.

Transactions provide an "all-or-nothing" proposition, stating that each work-unit performed in a database must either complete in its entirety or have no effect whatsoever. Further, the system must isolate each transaction from other transactions, results must conform to existing constraints in the database, and transactions that complete successfully must get written to durable storage.

To begin a transaction in a database management system you have to perform the following actions:

```
// Get an instance of a RDBMS View interface.
RDBMSView view = (RDBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();
```

Now it is the right time to perform some update operations. First, we are going to add one row in a table of the database:

```
// Get an instance of a RDBMS View interface.
RDBMSView view = (RDBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create the SQL statement to execute.
String sql = "INSERT INTO HOME_USER (ID, NAME) VALUES (1, 'John Wood')";

// Run the SQL update statement.
view.executeUpdate(sql, null);
```

Another option is to execute multiple statements at once. You can do it by specifying a separator character which delimits each statement:

```
// SQL statement to create first user.
String sql1 = "INSERT INTO HOME_USER (ID, NAME) VALUES (1, 'John Wood')";

// SQL statement to create second user.
String sql2 = "INSERT INTO HOME_USER (ID, NAME) VALUES (2, 'James Sharpe')";

// SQL statement to create third user.
String sql3 = "INSERT INTO HOME_USER (ID, NAME) VALUES (3, 'Sofia Green')";

// Execute three SQL update statements at once.
view.executeUpdate(sql1 + ";" + sql2 + ";" + sql3, new Character(';'));
```

Perform update operations like this when you have to dynamically construct SQL statements in Java. If your statements are not too complex to create, like the ones we saw in the previous example, you should consider storing them on separate files as they are easier to maintain. A very convenient way to keep SQL statements in separate files consist of keeping each statement (or a set of related statements) in an independent text file, for example: `create-user.sql`, `delete-user.sql`, `update-user.sql`, etc. Later on we can read these text files with a Provider (Warework recommends you to use the FileText Provider for this task) and use this Provider to read the statements for a View. Remember that you can define a default Provider for a View when you associate a View to a Data Store:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleViewImpl.class, "view1",
   "sql-provider", null);
```

The `sql-provider` Provider now can be used in the View as the default Provider to read text files from a specific directory. Let us say we have the following content for `create-user.sql`:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (1, 'John Wood')
```

If `sql-provider` is the default Provider in a RDBMS View, we can read the content of this file with the following code:

```
// Read the content of 'create-user.sql' and execute it.
view.executeUpdateByName("create-user", null, null);
```

When `executeUpdateByName` is invoked, these actions are performed:

1. The RDBMS View requests the `create-user` object to `sql-provider`.
2. `sql-provider` reads the content of `create-user.sql` and returns it (as a `String` object).
3. The RDBMS View executes the statement included at `create-user.sql` in the Data Store.

The RDBMS View and the FileText Provider are perfect mates. Both, in combination, will simplify a lot the process of executing scripts in your database. Just write simple text files with SQL statements and let Warework execute them for you. It is recommended that you check out the documentation associated to the FileText Provider to fully take advantage of this feature.

If we need a generic statement to create new users in the database, we can define the script `create-user.sql` with some variables, like this:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
```

Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
view.executeUpdateByName("create-user", values, null);
```

When your script contains multiple statements, you also have to indicate the character that delimits each statement. Suppose we have the following `create-user.sql` script:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME});
INSERT INTO ACTIVE_USERS (ID, NAME) VALUES (${USER_ID});
```

Now we can replace variables in multiple statements with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
view.executeUpdateByName("create-user", values, new Character(';'));
```

We can also use a Provider that is not the default Provider of the View. In this case, we just need to specify the Provider where to retrieve the statement to execute:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Execute a statement from the Provider that we define.
view.executeUpdateByName("another-provider", "create-user", values,
   new Character(';'));
```

This time, the `create-user.sql` statement is not retrieved by the default Provider of the View. The framework requests this statement from a Provider named "`another-provider`" and once it is loaded, then it is executed in the Data Store.

The RDBMS View also allows developers to define a callback object that will be invoked when the operation is done or it fails. Check out the following example:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Redirect to callback object once operation is executed.
view.executeUpdateByName("create-user", values, null,
   new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle successful operation here.
      // 'result' is null in RDBMS update operations.
   }

});
```

Now the RDBMS View redirects the execution to the callback object when `executeUpdateByName` is invoked. If operation is successful then method `onSuccess` is executed. Otherwise, if any error is found, then method `onFailure` is executed.

As you can see, creating the callback object is fairly easy. It is mandatory to provide a Scope (you can retrieve it from the Data Store Service for example) and implement two methods. When a callback object is defined for update operations of the RDBMS View (like `executeUpdateByName`), it is important to bear in mind that `onSuccess` method argument is always `null`.

Warework also automatically detects batch operations in scripts with multiple statements so you can perform an operation at `onSuccess` every time a single statement is executed in the Data Store. For example, if we have the following script:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME});
INSERT INTO ACTIVE_USERS (ID, NAME) VALUES (${USER_ID});
```

We can log the percentage of completion with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Redirect to callback object once operation is executed.
view.executeUpdateByName("create-user", values, null,
   new AbstractCallback(getScope()){
```

```
   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object r) {
      // This method is executed twice, one for every statement in the
      // 'create-user' script.
      System.out.println("progress: " + getBatch().progress());
   }

});
```

Method `getBatch` provides the following useful information about the batch operation in execution:

- `getBatch().count()`: counts the amount of callbacks executed in the batch operation.
- `getBatch().duration()`: gets how long (in milliseconds) is taking the current batch operation.
- `getBatch().id()`: gets the ID of the batch operation.
- `getBatch().progress()`: gets the percentage of completion of the current batch operation.
- `getBatch().size()`: gets the total of callbacks to perform in the batch operation.
- `getBatch().startTime()`: gets the time (in milliseconds) when the batch operation started.

It is also possible to pass objects / attributes to the callback so you can use them at `onSuccess` or `onFailure`. For this purpose, we have to use a `Hashtable` when the callback is created. Check out this example:

```
// Attributes for the callback.
Hashtable attributes = new Hashtable();

// Set the attributes.
attributes.put("color", "red");
attributes.put("password", new Integer(123));

// Redirect to callback with attributes.
view.executeUpdateByName("statement-name", null, null,
   new AbstractCallback(getScope(), attributes){

   protected void onFailure(Throwable t) {
      String color = (String) getAttribute("color");
   }

   protected void onSuccess(Object r) {
      // Retrieve every attribute name with 'getAttributeNames()'.
      Integer password = (Integer) getAttribute("password");
   }

});
```

Every update operation that we performed in the previous examples is related to the transaction that we created earlier in this section. Once the work is done, you should either commit or rollback the transaction. If the operations were executed without problems, then you should perform `commit` to register the changes in the database:

```
// Commits changes in the Database Management System.
view.commit();
```

In the other hand, if you find a failure, something unexpected happened or you just do not want to register the changes in the database, then you should perform `rollback` to undo every update operation executed since the transaction was started:

```
// Cancel latest update operations.
view.rollback();
```

We have reviewed with this interface how to connect to a database and perform update operations in it with a transaction. Now we are going to focus on query operations to know how to retrieve data from a relational database. The following code is an example to perform this action:

```
// Execute the statement to retrieve some data.
Object result = view.executeQuery("SELECT * FROM HOME_USER", -1, -1);
```

This code executes the SQL statement into the relational database and returns an object that represents the result provided by the database. By default, this result is in the form of a `ResultRows` object (check out the specific types returned by the implementation class of this View because each Data Store may provide the chance to get a different object as result) which represents the table of data returned by the database. It allows iterating each row of the table result and picking up the values of its columns. Check it out with the following example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Iterate rows until the end of the table. First row is 1, second 2 and so
// on. You must perform 'result.next()' at least one time to point the cursor
// to the first row.
while (result.next()) {

   /*
    * For each row we can retrieve the value of each column.
    */

   // Get the boolean value of a column. If the value is SQL NULL
   // (it is null in the database), the value returned is null.
   Boolean column1 = result.getBoolean("COLUMN1");

   // Get the numeric value of a column. You must specify the
   // numeric type to get.
   Short column2A = (Short) result.getNumber("COLUMN2A", Short.class);

   Integer column2B = (Integer) result.getNumber("COLUMN2B", Integer.class);

   Long column2C = (Long) result.getNumber("COLUMN2C", Long.class);

   Float column2D = (Float) result.getNumber("COLUMN2D", Float.class);
```

```
   Double column2E = (Double) result.getNumber("COLUMN2E", Double.class);

   BigDecimal column2F = (BigDecimal) result.getNumber("COLUMN2F",
      BigDecimal.class);

   // Get the string value.
   String column3 = result.getString("COLUMN3");

   // Get the date value.
   Date column4 = result.getDate("COLUMN4");

   // Get the array of bytes.
   byte[] column5 = result.getBlob("COLUMN5");

}
```

When you iterate result rows, you can specify the column (where to get the data) by name or by column index:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Iterate rows.
while (result.next()) {

   // Get the string value of a given column name.
   String column3A = result.getString("COLUMN3");

   // Get the string value of a given column index.
   String column3B = result.getString(3);

}
```

Another option is to retrieve a whole row as a Java Bean object. To achieve this, you have to provide to `getBean` a class that represents a Java Bean. A new instance of this class is created and used to store the values of the result columns. You may also provide a mapping where to relate result columns with bean attributes. Check it out with one example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");

// Iterate rows.
while (result.next()) {
```

```
   // Copy the values of specified columns into the User bean.
   User user = (User) result.getBean(User.class, mapping);

}
```

Warework can also create this mapping automatically when the columns names and bean attributes follow a specific naming convention. Here are the rules for columns and attributes names:

- Names of database columns are uppercase, for example: `PASSWORD`. Names of bean attributes are lowercase, for example: `password`.
- Spaces in columns names are specified with the underscore character: `DATE_OF_BIRTH`. The attributes of the bean use the camel notation: `dateOfBirth`.

Check out more examples:

- `NAME1` equals to `name1`
- `NAME_A` equals to `nameA`
- `A` equals to `a`
- `AA` equals to `aa`
- `A_B` equals to `aB`
- `A_B_C` equals to `aBC`

If `getBean` method does not receive the mapping configuration, it extracts by reflection the name of every attribute that exist in the given bean class. Each attribute name is converted into the corresponding column name and this column name is finally used to retrieve the value from the database result. If an attribute of the Java Bean does not exist as a result column, then it is discarded. The following example shows how this naming convention simplifies quite a lot the work:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Iterate rows.
while (result.next()) {

   // Copy the values of columns found into the User bean.
   User user = (User) result.getBean(User.class, null);

}
```

You can also transform the database result into a list:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");

// Create a list with User beans that represent each row from the database
// result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   mapping);
```

It is also possible to use auto-mapping:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.executeQuery("SELECT * FROM HOME_USER",
    -1, -1);

// Create a list with User beans that represent each row from the database
// result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   null);
```

Sometimes you may need to limit the number of rows returned by a database when a query operation is performed. Let us say that there are 26 registries or rows in the `HOME_USER` table and that we just expect to retrieve the first 10 rows. We can write something like this:

```
// Get the first 10 rows.
Object result = view.executeQuery("SELECT * FROM HOME_USER", 1, 10);
```

What is going on right now? When you specify the number of rows that you want in the result of a database, Warework automatically calculates the number of pages that hold this number of rows. In the previous example we specified 10 rows per result and with this information Warework estimates that the size of each page is 10 rows and that there are three pages: page 1 with 10 rows, page 2 with 10 rows and page 3 with 6 rows. If now we need to retrieve the next ten rows, we have to indicate that we want the second page:

```
// Get rows from 11 to 20.
Object result = view.executeQuery("SELECT * FROM HOME_USER", 2, 10);
```

If we request page number three, we get the last 6 registries from the database. The important fact to keep in mind here is that the number of rows remains as 10:

```
// Get rows from 21 to 26.
Object result = view.executeQuery("SELECT * FROM HOME_USER", 3, 10);
```

With queries, you can also write `SELECT` statements in separate text files (this time, just one statement per file). Suppose that the following code is the content of the `list-users.sql`file:

```
SELECT * FROM HOME_USER
```

If `sql-provider` still is our default Provider, we can read the script like this:

```
// Read the content of 'list-users.sql' and execute it in the database.
Object result = view.executeQueryByName("list-users", null, -1, -1);
```

There is also the possibility to define some variables in the query:

```
SELECT * FROM HOME_USER A WHERE A.ID = ${USER_ID}
```

Now we can assign a value to this variable to complete the query. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the query.
values.put("USER_ID", new Integer(8375));

// Read 'list-users.sql', replace variables and execute the final statement.
Object result = view.executeQueryByName("list-users", values, -1, -1);
```

The two last arguments allow you to define the page and maximum number of rows to retrieve. The following example shows how to get the second page with a fixed size of 10 rows per page:

```
// Get the second page with no more than 10 registries in it.
Object result = view.executeQueryByName("list-users", null, 2, 10);
```

We can also define callbacks in query operations. This time, `onSuccess` provides the result of the query:

```
// Handle result with callback object.
view.executeQueryByName("list-users", null, -1, -1,
   new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Do something.
   }

   protected void onSuccess(Object r) {

      // Get the result form the database.
      ResultRows result = (ResultRows) r;

      // Iterate rows.
      while (result.next()) {

         // Copy the values of columns found into the User bean.
```

```
            User user = (User) result.getBean(User.class, null);

         }

      }

   });
```

Query operations also allow us to use a different Provider than the default one defined for the View:

```
// Read the content of 'list-users.sql' and execute it in the database.
Object result = view.executeQueryByName("another-provider", "list-users",
   null, -1, -1);
```

As always, when the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Object Database Management System (ODBMS) View

This View is a facade for a database management system in which information is represented in the form of objects. It allows object-oriented programmers to develop a data model with Java objects, store them and replicate or modify existing objects to make new objects within the OODBMS. Six basic operations are allowed here:

- *Save*: Stores an object in the database.
- *Update*: Updates an object in the database.
- *Delete*: Removes an object in the database.
- *Find*: Retrieves a specific object from the database.
- *List*: Retrieves a list of objects from the database.
- *Count*: Counts objects in the database.

Connect with the database

Even before you perform any of these operations, what you have to do first is to connect to the database management system:

```
// Get an instance of an ODBMS View interface.
ODBMSView view = (ODBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();
```

Begin a transaction in the database

In the following examples we are going to save some information in the database but before that, it is recommended to begin a transaction with the database.

A transaction comprises a unit of work performed within a database management system, and treated in a coherent and reliable way independent of other transactions. Transactions in a database environment have two main purposes:

- To provide reliable units of work that allow correct recovery from failures and keep a database consistent even in cases of system failure, when execution stops (completely or partially) and many operations upon a database remain uncompleted, with unclear status.
- To provide isolation between programs accessing a database concurrently. If this isolation is not provided the programs outcome are possibly erroneous.

Transactions provide an "all-or-nothing" proposition, stating that each work-unit performed in a database must either complete in its entirety or have no effect whatsoever. Further, the system must isolate each transaction from other transactions, results must conform to existing constraints in the database, and transactions that complete successfully must get written to durable storage.

To begin a transaction in a database management system you have to perform the following actions:

```
// Get an instance of an ODBMS View interface.
ODBMSView view = (ODBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();
```

Save an object

Now it is the right time to perform some CRUD (Create, Read, Update, Delete) operations. First, we are going to save one object in the database:

```
// Get an instance of an ORM View interface.
ODBMSView view = (ODBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));
```

```
// Save the Java Bean in the data store.
view.save(user);
```

You can also invoke this method with a callback object. This object will be invoked when the operation is done or fails. Check out the following example

```
// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Handle successful operation here.
      // 'result' is the object just saved.
      User user = (User) result;

      // Display user name.
      System.out.println("User name: " + user.getName());

   }

});
```

It is also possible to pass objects / attributes to the callback so you can use them at `onSuccess` or `onFailure`. For this purpose, we have to use a `Hashtable` when the callback is created. Check out this example:

```
// Attributes for the callback.
Hashtable attributes = new Hashtable();

// Set the attributes.
attributes.put("color", "red");
attributes.put("password", new Integer(123));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope(), attributes){

   protected void onFailure(Throwable t) {
      String color = (String) getAttribute("color");
   }

   protected void onSuccess(Object result) {
      // Retrieve every attribute name with 'getAttributeNames()'.
      Integer password = (Integer) getAttribute("password");
   }
```

```
});
```

Now we are going to save multiple objects with just one line of code. You can save an array or a collection of objects like this:

```
// Save three Java Beans in the data store.
view.save(new User[]{user1, user2, user3});
```

If the underlying Data Store can save all those objects at once, just one operation will be performed. If not, the Framework will start a batch operation automatically. Batch operations are very useful because they allow us to track each operation executed. The following example stores a collection of Java Beans and displays data about the batch operation:

```
// We can also save collections.
List<User> users = new ArrayList<User>();

// Set some users in the collection.
users.add(user1);
users.add(user2);
users.add(user3);

// Save the collection in the data store.
view.save(users, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // This callback method is invoked three times, one for.
      // each object to save.

      // Get current object saved.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items saved.
      System.out.println("Total saved: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% saved: " + getBatch().progress());

   }

});
```

When Data Stores save arrays or collections at once but we want to use Warework batch operations instead (to track each object individually), in this case we have to configure the Data Store to work as we need. This is done with `PARAMETER_SkipNativeBatchSupport`. Use this constant (or value "`skip-native-batch-support`") in the connector of the Data Store to force the Framework use batch operations.

Method `getBatch` provides the following useful information about the batch operation in execution:

- `getBatch().count()`: counts the amount of callbacks executed in the batch operation.
- `getBatch().duration()`: gets how long (in milliseconds) is taking the current batch operation.
- `getBatch().id()`: gets the ID of the batch operation.
- `getBatch().progress()`: gets the percentage of completion of the current batch operation.
- `getBatch().size()`: gets the total of callbacks to perform in the batch operation.
- `getBatch().startTime()`: gets the time (in milliseconds) when the batch operation started.

Update objects

Previously stored objects in the database can be updated later on with new values:

```
// Update some data in the Java Bean.
user.setName("James Jr.");

// Update the object in the data store.
view.update(user);
```

You can also use callbacks and update multiple objects (arrays or collections) with batch operations:

```
// Update three Java Beans in the data store.
view.update(new User[]{user1, user2, user3}, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object updated.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items updated.
      System.out.println("Total updated: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% updated: " + getBatch().progress());

   }

});
```

Delete objects

The following example shows how to delete one object:

```
// Delete the object in the data store.
view.delete(user);
```

You can also use callbacks and delete arrays or collections with batch operations:

```
// Delete three Java Beans in the data store.
view.delete(new User[]{user1, user2, user3}, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object deleted.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items deleted.
      System.out.println("Total deleted: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% deleted: " + getBatch().progress());

   }

});
```

To remove every object of a specific type, we have to provide the class:

```
// Delete all users in the data store.
view.delete(User.class);
```

This code can be executed in two different ways by the Framework. It is very important to understand that `delete` method creates a query when a class is provided. If the Data Store that implements this View can delete the objects from a given query then you should not worry about running operations like this because the Data Store directly handles the operation and takes care about everything. When Data Stores do not support deleting objects with a given query, you need to know that, in this case, the Framework divides the operation in two different parts. First, it runs a query to retrieve a list of objects and after that deletes each item of the list. The problem arises when the list to delete is so big that it kills the virtual machine memory. So please, know your Data Store first and handle this operation with care.

If the underlying Data Store supports queries to delete multiple objects then batches will perform just one operation. When the Framework directly handles the operation because the Data Store does not support it, then you will be able to track each object deleted.

The following example shows how to remove a set of objects specified in a query:

```
// Define the query.
Query query = new Query(getScope());
```

```
// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Delete every user which name is 'Carl'.
view.delete(query);
```

We will show soon how to configure `Query` objects. By now just bear in mind that we can delete objects with queries too.

If the query is in the form of an XML file, you can load the query and delete the objects returned like this:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null);
```

This method uses a Provider to load the query from an XML file. Review later on how to list objects with XML files. We explain in detail there how this mechanism works and the same rules apply for `executeDeleteByName`. Also, like we have seen before, you can use callback here:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }

});
```

If the query accepts parameters, you can update the query with a `Hashtable`:

```
// Attributes for the query.
Hashtable filter = new Hashtable();

// Set the attributes.
filter.put("name", "John");

// Delete every user named "John".
view.executeDeleteByName("list-users", filter,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }
```

```
});
```

Commit or rollback a transaction

Every update operation that we performed in the previous examples is related to the transaction that we created before. Once the work is done, you should either commit or rollback the transaction. If the operations were executed without problems, then you should perform `commit` to register the changes in the database:

```
// Commits changes in the Database Management System.
view.commit();
```

In the other hand, if you find a failure, something unexpected happened or you just do not want to register the changes in the database, then you should perform `rollback` to undo every update operation executed since the transaction was started:

```
// Cancel latest update operations.
view.rollback();
```

Find an object in the database

Now we are going to see how to retrieve objects from the database. Depending on how many objects we want to get, we can perform two different types of operations.

To search for a specific object from the database you have to invoke the `find` method. This method requires you to provide an object of the same type as the one you want to retrieve, with some data in it so it will be used as a filter to find the object in the database. To better understand how it works, check out the API description of this method:

```
/**
 * Finds an object by its values. This method returns the object of the data
 * store which matches the type and all non-null field values from a given
 * object. This is done via reflecting the type and all of the fields from
 * the given object, and building a query expression where all
 * non-null-value fields are combined with AND expressions. So, the object
 * you will get will be the same type as the object that you will provide.
 * The result of the query must return one single object in order to avoid
 * an exception. In many cases, you may only need to provide the ID fields
 * of the object to retrieve one single object. In relational databases like
 * Oracle or MySQL, these ID fields are the primary keys.
 *
 * @param filter
 *            Filter used to find an object in the data store. This object
 *            specifies two things: first, the type of the object to search
 *            for in the data store, and second, the values that identify
 *            the object in the data store.
 * @return Object from the data store that matches the type and the values
 *         of the given object. If more than one object is found in the data
 *         store, then an exception is thrown. If no objects are found, then
 *         this method returns <code>null</code>.
 * @throws ClientException
 */
Object find(Object filter) throws ClientException;
```

Let's see some sample code. Suppose that there is a user named `Steve` in the database, we could retrieve an object instance that represents this user like this:

```
// Get an instance of an ODBMS View interface.
ODBMSView view = (ODBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Create the filter to find the object.
User filter = new User();

// Set the data required to locate the object in the database.
filter.setName("Steve");

// Find the object in the database which type is "User" and name is "Steve".
User user = (User) view.find(filter);
```

The object from the database is returned with all its data associated to it. The idea is that developers can search for an object just by providing some of its attributes and retrieve the same object type with the last information it had when it was stored or updated in the database. Bear in mind that an exception is thrown if more than one object is found in the database. This method just searches for a single object in the database. In order to retrieve a collection of objects, you should invoke different methods.

List objects from the database

Warework provides three different ways to retrieve a list of objects from a database. The first one works similar as the `find` method, but this time you will get a collection of objects (instead of one single object). Check it out with an example:

```
// Get an instance of an ODBMS View interface.
ODBMSView view = (ODBMSView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setPassword(new Integer(8713));

// Find the objects which type is "User" and password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

The main characteristic of this method is that it creates a query where every non-null attribute of the given object is combined with `AND` expressions, for example:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("Steve");
filter.setPassword(new Integer(8713));

// Find "User" objects which name is "Steve" and password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

When this operation is executed, Warework creates a query like this (it is just a representation of the query, it is not used by the underlying database):

```
User WHERE ((name = 'Steve') AND (password = 8713))
```

Also, when objects of the data model are related each other, every non-null attribute of the related objects is used to build the query. For example:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("steve@mail.com");

// Create the filter to find User objects.
User filter = new User();

// Set the data required to find User objects in the database.
filter.setName("Steve");
filter.setContact(contact);

// Find "User" objects which name is "Steve" and email is "steve@mail.com".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

This operation creates a query like this:

```
User WHERE ((name = 'Steve') AND (contact.email = 'steve@mail.com'))
```

While the `AND` expression is always used to create the query (there is no chance to modify this type of expression in this method), you can indicate which specific operation must be performed in the attributes of the object. By default, the equal operator is used when a non-null attribute is found but it is possible to use different ones like: not equals to, greater than, greater than or equals to, less than, less than or equals to, like, not like, is null or is not null. The following example shows how to list `User` objects which name is `Steve` and password is greater than `1000`:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("Steve");
filter.setPassword(new Integer(1000));

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("password", Operator.GREATER_THAN);

// Find "User"s which name is "Steve" and password is greater than "1000".
List<User> users = (List<User>) view.list(filter, operator, null, -1, -1);
```

This operation creates a query like this:

```
User WHERE ((name = 'Steve') AND (password > 1000))
```

It is also possible to change the operator in referenced objects:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("steve@mail.com");

// Create the filter to find User objects.
User filter = new User();

// Set the data required to find User objects in the database.
filter.setName("Steve");
filter.setContact(contact);

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("contact.email", Operator.LIKE);

// Find "User" objects which name is Steve and email is like "steve@mail.com".

List<User> users = (List<User>) view.list(filter, operator, null, -1, -1);
```

This is the generated query:

```
User WHERE ((name = 'Steve') AND (contact.email LIKE 'steve@mail.com'))
```

What if you just want to list all the objects of the same type? In this case you can provide just the class instead of an object instance:

```
// List all "User" objects.
List<User> users = (List<User>) view.list(User.class, null, null, -1, -1);
```

When you provide a class you can only specify two operators: `IS_NULL` and `IS_NOT_NULL`. This is because you cannot provide the values of the fields in a class. For example:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// Find every "User" which name is not null.
List<User> users = (List<User>) view.list(User.class, operator, null, -1, -1);
```

This operation creates a query like this:

```
User WHERE (name IS_NOT_NULL)
```

The same way we did before we can use a callback object in this method. Just bear in mind that now the result of the operation is provided by the callback `onSuccess` method:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// Find every "User" which name is not null.
view.list(User.class, null, null, -1, -1,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get database query result.
      List<User> users = (List<User>) result;

      // Handle collection here...

   }

});
```

Sort results

The third argument of the `list` method allows us to define how to sort the results. It is fairly easy:

```
// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for field "name".
order.addAscending("name");

// List every "User" sorted by name.
List<User> users = (List<User>) view.list(User.class, null, order, -1, -1);
```

The result of this operation will be a list of all users sorted in ascending order. The query generated looks like this:

```
User ORDER BY name ASC
```

Pagination

Sometimes you may need to limit the number of objects returned by the database when a query operation is performed. Let us say that there are 26 objects of `USER` type and that we just expect to retrieve the first 10 objects. We can write something like this:

```
// Get the first 10 objects.
List<User> users = (List<User>) view.list(User.class, null, null, 1, 10);
```

What is going on right now? When you specify the number of objects that you want in the result of a database, Warework automatically calculates the number of pages that hold this number of objects. In the previous example we specified 10 objects per result and with this information Warework estimates that the size of each page is 10 objects and that there are three pages: page 1 with 10 objects, page 2 with 10 objects and page 3 with 6 objects. If now we need to retrieve the next ten objects, we have to indicate that we want the second page:

```
// Get objects from 11 to 20.
List<User> users = (List<User>) view.list(User.class, null, null, 2, 10);
```

If we request page number three, we get the last 6 objects from the database. The important fact to keep in mind here is that the number of objects remains as 10:

```
// Get objects from 21 to 26.
List<User> users = (List<User>) view.list(User.class, null, null, 3, 10);
```

Creating custom queries with `Query` object

Warework also gives the possibility to create `Query` objects where to specify all the characteristics we had seen before. These `Query` objects allows to define `AND`, `OR` and `NOT` expressions as well, so they are more useful in certain cases. The following example shows how to run a simple query with this object:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// List every "User" object.
List<User> users = (List<User>) view.list(query);
```

This example retrieves every `User` object from the database. To filter the results, we have to create a `Where` clause for the query. Let's see how to filter the query by specifying a value for the `name` attribute of the `User` object:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Create the WHERE clause. You must provide an instance of ScopeFacade.
Where where = query.getWhere(true);

// Set an expression like: (name = 'Steve').
where.setExpression(where.createEqualToValue("name", "Steve"));

// List "User" objects which name is 'Steve'.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
User WHERE (name = 'Steve')
```

One great feature about `Query` objects is that you can assign values from different sources to the attributes of the object that define the search criteria. This is handled with Warework Providers, that is, you have to create an expression for the `Where` clause which gets the value from a Provider and assigns this value to the attribute of the object. For example, suppose that we have a Provider named "`password-provider`" which returns the password for a given user name. To search for a user which matches the password given by the Provider, we can create a query like this:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Filter by password; assign to password the value of the Provider.
where.setExpression(where.createEqualToProviderValue("password",
   "password-provider", "steve"));

// List "User" objects which name is 'Steve'.
List<User> users = (List<User>) view.list(query);
```

This time, the value for the attribute is not directly assigned by the developer; instead, it is assigned with the value returned by the Provider. So, if "`password-provider`" returns `8713` for "`steve`", then the query created looks like this:

```
User WHERE (password = 8713)
```

Now we are going to create one `AND` expression to filter the query with two attributes. Check it out with the following example:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(where.createLikeValue("name", "Steve"));
and.add(where.createGreaterThanValue("password", new Integer(1000)));

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" which name is like 'Steve' and password is greater than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
User WHERE ((name LIKE 'Steve') AND (password > 1000))
```

OR expressions with Query objects

With Query objects you can also specify OR expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one OR expression.
Or or = where.createOr();

// Filter by name and password.
or.add(where.createLikeValue("name", "Steve"));
or.add(where.createGreaterThanValue("password", new Integer(1000)));

// Set the OR expression in the WHERE clause.
where.setExpression(or);

// List "User" which name is like 'Steve' or password is greater than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates this query:

```
User WHERE ((name LIKE 'Steve') OR (password > 1000))
```

Of course, you can create more complex queries. The following example shows you how to mix multiple AND, OR and NOT expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create OR expression.
Or or1 = where.createOr();

// Filter by name.
or1.add(where.createLikeValue("name", "Arnold"));
or1.add(where.createLikeValue("name", "David"));

// Create NOT expression.
Not not = where.createNot(or1);

// Create another OR expression.
Or or2 = where.createOr();
```

```
// Filter by password.
or2.add(where.createGreaterThanValue("password", new Integer(1000)));
or2.add(where.createLessThanValue("password", new Integer(5000)));

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(not);
and.add(or2);

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" objects.
List<User> users = (List<User>) view.list(query);
```

And this is the query representation:

```
User WHERE (NOT ((name LIKE 'Arnold') OR (name LIKE 'David')) AND ((password >
1000) OR (password < 5000)))
```

Order and pagination with `Query` objects

`Query` objects also allow you to define the order of the results and which page to retrieve from the database. The following example shows you how to list the first ten users sorted by name in ascending order:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for field "name".
order.addAscending("name");

// Set order by.
query.setOrderBy(order);

// Set which page to get from the result.
query.setPage(1);

// Set maximum number of objects to get in the result.
query.setPageSize(10);

// List the first ten "User" objects sorted by name in ascending order.
List<User> users = (List<User>) view.list(query);
```

List objects with XML queries

Making queries like this is very useful when you have to dynamically create the query (you are free to create the query the way you need it) but, in certain cases, it is better for the programmer to create queries in separate XML files because they can be managed outside the Java code and they are easier to understand.

A very convenient way to keep object queries in separate files consist of keeping each statement in an independent XML file, for example: `find-user.xml`, `list-users.xml`, etc. Later on we can read these XML files with a Provider (Warework recommends you to use the Object Query Provider for this task) and use this Provider to read the statements for the ODBMS View. Remember that you can define a default Provider for a View when you associate a View to a Data Store:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleViewImpl.class,
   "view-name", "object-query-provider", null);
```

The `object-query-provider` now can be used in the View as the default Provider to read XML queries from a specific directory. Let us say we have the following content for `find-steve.xml`:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

If `object-query-provider` is the default Provider in an ODBMS View, we can read the content of this file with the following code:

```
// Read the content of 'find-steve.xml' and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-steve", null,
    -1, -1);
```

When `executeQueryByName` is invoked, these actions are performed:

4. The ODBMS View requests the `find-steve` object to `object-query-provider`.
5. `object-query-provider` reads the content of `find-steve.xml` and returns it (as a `Query` object).
6. The ODBMS View executes the statement included at `find-steve.xml` in the Data Store.

The ODBMS View and the Object Query Provider are perfect mates. Both, in combination, will simplify a lot the process of executing query statements in your object database. Just write

simple XML files and let Warework execute them for you. It is recommended that you check out the documentation associated to the Object Query Provider to fully take advantage of this feature.

Operators

In XML queries you can specify operators like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

And you can also use short keywords to identify them:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQ</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

Previous examples perform the same operation. Check out the following table to review which operators are supported and which short names you can use:

OPERATOR	FULL NAME	SHORT NAME
=	EQUAL_TO	EQ
!=	NOT_EQUAL_TO	NE
<	LESS_THAN	LT

<=	LESS_THAN_OR_EQUAL_TO	LE
>	GREATER_THAN	GT
>=	GREATER_THAN_OR_EQUAL_TO	GE
IS NULL	IS_NULL	IN
IS NOT NULL	IS_NOT_NULL	NN
LIKE	LIKE	LK
NOT LIKE	NOT_LIKE	NL

Value types

In XML queries you can specify different value types and some of them with short names. For example, the previous query can be written as:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQ</operator>
         <value-operand>
            <type>string</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

The following table summarizes which data types can be used with short names:

OBJECT TYPE	SHORT NAME
java.lang.Boolean	boolean
java.lang.Byte	byte
java.lang.Short	short
java.lang.Integer	int or integer
java.lang.Long	long
java.lang.Float	float
java.lang.Double	double
java.lang.Character	char or character
java.lang.String	string
java.util.Date	date

AND, OR and NOT expressions in XML queries

With XML Object Queries you can write the same queries as the one you will code with Query objects. These XML queries also allow defining AND, OR and NOT expressions as well, for example:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <and>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </and>
   </where>

</query>
```

This XML query looks like this:

```
User WHERE ((name LIKE 'Steve') AND (password > 1000))
```

Check it out now with an `OR` expression:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <or>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </or>
   </where>
```

```
</query>
```

Now, this XML query looks like this:

```
User WHERE ((name LIKE 'Steve') OR (password > 1000))
```

The following example shows a more complex query with `AND`, `OR` and `NOT` expressions:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <not>
         <and>
            <expression>
               <attribute>name</attribute>
               <operator>NOT_LIKE</operator>
               <value-operand>
                  <type>java.lang.String</type>
                  <value>James</value>
               </value-operand>
            </expression>
            <or>
               <expression>
                  <attribute>name</attribute>
                  <operator>NO_LIKE</operator>
                  <value-operand>
                     <type>java.lang.String</type>
                     <value>Arnold</value>
                  </value-operand>
               </expression>
               <expression>
                  <attribute>name</attribute>
                  <operator>IS_NOT_NULL</operator>
               </expression>
            <or>
         </and>
      <not>
   </where>

</query>
```

This is the output for the query:

```
User WHERE NOT ((name NOT_LIKE 'James') AND ((name NOT_LIKE 'Arnold') OR (name
IS_NOT_NULL)))
```

Setting date values in XML queries

Before we proceed with more different examples, keep in mind that it is also possible to assign date values to the attributes:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.util.Date</type>
            <value>1967/08/12</value>
            <format>yyyy/MM/dd</format>
            <locale>en_US</locale>
            <time-zone>europe/london</time-zone>
         </value-operand>
      </expression>
   </where>

</query>
```

With this information, Warework will try to parse the date and assign its value to the attribute. While `locale` and `time-zone` are not mandatory, you should always provide the `format` to properly parse the date. Check out some available locale codes here:

http://docs.oracle.com/javase/1.4.2/docs/guide/intl/locale.doc.html

Review how to retrieve `time-zone` codes in the following location:

http://docs.oracle.com/javase/1.4.2/docs/api/java/util/TimeZone.html

In XML queries it is also possible to assign values to attributes which come from defined variables or Providers.

Creating variables in XML queries

First we are going to review how to define a variable for an attribute. The idea about defining variables is simple: by one side, you have to create an expression in the XML query and define in there a name for a variable. This variable will be replaced later on at runtime with the values specified by the developer. The following `find-user.xml` query file defines a variable for the `name` attribute of the `User` object:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>LIKE</operator>
```

```
         <variable-operand name="USER_NAME"/>
      </expression>
   </where>

</query>
```

Now that we have defined a variable for the `name` attribute, we can replace this variable with a specific value as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the query.
values.put("USER_NAME", "Steve");

// Read 'find-user.xml', replace variables and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-user", values,
    -1, -1);
```

Once the value is assigned to the variable, the output query looks like this:

```
User WHERE (name LIKE 'Steve')
```

We can perform a similar action with a Provider. With Providers, instead of defining a variable in the query, we specify an object from a Provider that will be used as the value for the attribute. For example, suppose that we have a Provider named `password-provider` which returns user's passwords, that is, if we request object "`steve`", the Provider will return something like "`3425`". The following query shows how to assign the object named "`steve`" in Provider "`password-provider`" to the "`password`" attribute.

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>password</attribute>
         <operator>EQUALS_TO</operator>
         <provider-operand>
            <provider-name>password-provider</provider-name>
            <provider-object>steve</provider-object>
         </provider-operand>
      </expression>
   </where>

</query>
```

After the value "`3425`" is retrieved from the Provider and it is assigned to "`password`", this query is shown as follows:

```
User WHERE (password = 3425)
```

<u>Count database objects</u>

To count every object of a specific type we have to invoke the following operation:

```
// Count all users.
int count = view.count(User.class);
```

We can also use callbacks in count operations:

```
// Count users.
view.count(User.class, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get count.
      Integer count = (Integer) result;

   }

});
```

It is also possible to count the results of a query:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Count users which name is 'Carl'.
int count = view.count(query);
```

With `executeCountByName` we can count the objects that an XML query returns:

```
// Count result of "list-users" query.
int count = view.executeCountByName("list-users", null);
```

<u>Close the connection with the database</u>

As always, when the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Object Relational Mapping (ORM) View

This View is an interface for a relational database management system, where developers can perform operations in an object-oriented way (create, read, update and delete objects in the database) and also like it is done in relational databases, with query and update operations in a specific query language. This View is just a mix of the RDBMS and ODBMS Views in one single interface.

The Object-Relational Mapping is a technique where software developers can associate objects of the programming language (Java Beans) with tables of a relational database. Basically, it works as follows:

- There is a mapping configuration (typically, in the form of XML files or Java annotations) that specifies which Java object represents a table in the relational database. This configuration also specifies how each table column is associated with each object attribute and also the relationship of the tables/objects between each other.
- Once there is a mapping configuration, developers can create object instances and store them in the relational database (one object instance represents one row in a table of the database) without the need to write SQL. It is also possible to delete, update and search for objects very easily in the relational database.

This ORM View encapsulates an ORM engine. You can find many good Java ORM implementations out there like ORMLite, Hibernate or EclipseLink, for example. They all have their own characteristics but, in general, behave in the same manner. In Warework, for example, you can use for this purpose the Data Store for JPA, which uses JPA (Java Persistence API) as an ORM engine for this View.

The main advantage of using ORMs is that there is no need to write huge amounts of SQL code. Each ORM engine automatically creates the SQL code required to perform CRUD operations (Create, Read, Update and Delete) in a specific database. It means that an ORM engine can create SQL code for MySQL, Oracle or any databases that it supports, just by specifying the target database type.

This ORM View allows the following operations with objects:

- *Save*: Stores an instance of an object (typically, a serializable Java Bean) in the relational database as a new row in one table. Each bean attribute is associated with each column of the database. For example:

```
// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setId(new Integer(8713)); // Typically, a Primary Key
user.setName("James");
user.setDateOfBirth(new Date());

// Save the Java Bean with the ORM View.
view.save(user);
```

  When `save` operation is executed, the underlying implementation of the ORM View will create the corresponding SQL code to insert a new record in the database, something like this:

```
INSERT INTO USER (ID, NAME, DATE_OF_BIRTH)
   VALUES (8713, 'John Wood', '2013/03/07')
```

Once the statement is created, the ORM runs it in the database and the object is stored in the table.

- *Update*: Updates one row in a table of the database with the values of a given object.
- *Delete*: Removes one row in a table of the database that matches the values of a given object.
- *Find*: Retrieves an object from the database that represents a specific row of a table.
- *List*: Retrieves a list of objects from the table where each object represents one row.
- *Count*: Counts objects in the database.

This ORM View also allows executing query and update statements in a specific query language supported by the ORM engine. For example, JPA supports JPQL (JPA Query Language) which allows developers to create statements like SQL but in an object-oriented way.

Connect with the database

Even before you perform any of these operations, what you have to do first is to connect to the relational database management system:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();
```

Begin a transaction in the database

In the following examples we are going to save some information in the database but before that, it is recommended to begin a transaction with the database.

A transaction comprises a unit of work performed within a database management system, and treated in a coherent and reliable way independent of other transactions. Transactions in a database environment have two main purposes:

- To provide reliable units of work that allow correct recovery from failures and keep a database consistent even in cases of system failure, when execution stops (completely or partially) and many operations upon a database remain uncompleted, with unclear status.
- To provide isolation between programs accessing a database concurrently. If this isolation is not provided the programs outcome are possibly erroneous.

Transactions provide an "all-or-nothing" proposition, stating that each work-unit performed in a database must either complete in its entirety or have no effect whatsoever. Further, the system must isolate each transaction from other transactions, results must conform to existing con-

straints in the database, and transactions that complete successfully must get written to durable storage.

To begin a transaction in a relational database management system you have to perform the following actions:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();
```

Save an object

Now it is the right time to perform some CRUD (Create, Read, Update, Delete) operations. First, we are going to save one object in the database (insert one or multiple row):

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));

// Save the Java Bean in the data store.
view.save(user);
```

You can also invoke this method with a callback object. This object will be invoked when the operation is done or fails. Check out the following example

```
// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope()){
```

```
   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Handle successful operation here.
      // 'result' is the object just saved.
      User user = (User) result;

      // Display user name.
      System.out.println("User name: " + user.getName());

   }

});
```

It is also possible to pass objects / attributes to the callback so you can use them at `onSuccess` or `onFailure`. For this purpose, we have to use a `Hashtable` when the callback is created. Check out this example:

```
// Attributes for the callback.
Hashtable attributes = new Hashtable();

// Set the attributes.
attributes.put("color", "red");
attributes.put("password", new Integer(123));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope(), attributes){

   protected void onFailure(Throwable t) {
      String color = (String) getAttribute("color");
   }

   protected void onSuccess(Object result) {
      // Retrieve every attribute name with 'getAttributeNames()'.
      Integer password = (Integer) getAttribute("password");
   }

});
```

Now we are going to save multiple objects with just one line of code. You can save an array or a collection of objects like this:

```
// Save three Java Beans in the data store.
view.save(new User[]{user1, user2, user3});
```

If the underlying Data Store can save all those objects at once, just one operation will be performed. If not, the Framework will start a batch operation automatically. Batch operations are very useful because they allow us to track each operation executed. The following example stores a collection of Java Beans and displays data about the batch operation:

```
// We can also save collections.
List<User> users = new ArrayList<User>();

// Set some users in the collection.
users.add(user1);
users.add(user2);
```

```
users.add(user3);

// Save the collection in the data store.
view.save(users, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // This callback method is invoked three times, one for.
      // each object to save.

      // Get current object saved.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items saved.
      System.out.println("Total saved: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% saved: " + getBatch().progress());

   }

});
```

When Data Stores save arrays or collections at once but we want to use Warework batch operations instead (to track each object individually), in this case we have to configure the Data Store to work as we need. This is done with `PARAMETER_SkipNativeBatchSupport`. Use this constant (or value "`skip-native-batch-support`") in the connector of the Data Store to force the Framework use batch operations.

Method `getBatch` provides the following useful information about the batch operation in execution:

- `getBatch().count()`: counts the amount of callbacks executed in the batch operation.
- `getBatch().duration()`: gets how long (in milliseconds) is taking the current batch operation.
- `getBatch().id()`: gets the ID of the batch operation.
- `getBatch().progress()`: gets the percentage of completion of the current batch operation.
- `getBatch().size()`: gets the total of callbacks to perform in the batch operation.
- `getBatch().startTime()`: gets the time (in milliseconds) when the batch operation started.

Update objects

Previously stored objects (rows) in the database can be updated later on with new values:

```
// Update some data in the Java Bean.
user.setName("James Jr.");

// Update the object in the data store.
view.update(user);
```

You can also use callbacks and update multiple objects (arrays or collections) with batch operations:

```
// Update three Java Beans in the data store.
view.update(new User[]{user1, user2, user3}, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object updated.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items updated.
      System.out.println("Total updated: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% updated: " + getBatch().progress());

   }

});
```

Delete objects

The following example shows how to delete one object (removes the row from the table):

```
// Delete the object in the data store.
view.delete(user);
```

You can also use callbacks and delete arrays or collections with batch operations:

```
// Delete three Java Beans in the data store.
view.delete(new User[]{user1, user2, user3}, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object deleted.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());
```

```
        // Display items deleted.
        System.out.println("Total deleted: " + getBatch().count());

        // Display percentage of completion.
        System.out.println("% deleted: " + getBatch().progress());

    }

});
```

To remove every object of a specific type, we have to provide the class:

```
// Delete all users in the data store.
view.delete(User.class);
```

This code can be executed in two different ways by the Framework. It is very important to understand that `delete` method creates a query when a class is provided. If the Data Store that implements this View can delete the objects from a given query then you should not worry about running operations like this because the Data Store directly handles the operation and takes care about everything. When Data Stores do not support deleting objects with a given query, you need to know that, in this case, the Framework divides the operation in two different parts. First, it runs a query to retrieve a list of objects and after that deletes each item of the list. The problem arises when the list to delete is so big that it kills the virtual machine memory. So please, know your Data Store first and handle this operation with care.

If the underlying Data Store supports queries to delete multiple objects then batches will perform just one operation. When the Framework directly handles the operation because the Data Store does not support it, then you will be able to track each object deleted.

The following example shows how to remove a set of objects specified in a query:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Delete every user which name is 'Carl'.
view.delete(query);
```

We will show soon how to configure `Query` objects. By now just bear in mind that we can delete objects with queries too.

If the query is in the form of an XML file, you can load the query and delete the objects returned like this:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null);
```

This method uses a Provider to load the query from an XML file. Review later on how to list objects with XML files. We explain in detail there how this mechanism works and the same rules apply for `executeDeleteByName`. Also, like we have seen before, you can use callback here:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }

});
```

If the query accepts parameters, you can update the query with a `Hashtable`:

```
// Attributes for the query.
Hashtable filter = new Hashtable();

// Set the attributes.
filter.put("name", "John");

// Delete every user named "John".
view.executeDeleteByName("list-users", filter,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }

});
```

Commit or rollback a transaction

Every update operation that we performed in the previous examples is related to the transaction that we created before. Once the work is done, you should either commit or rollback the transaction. If the operations were executed without problems, then you should perform `commit` to register the changes in the database:

```
// Commits changes in the Relational Database Management System.
view.commit();
```

In the other hand, if you find a failure, something unexpected happened or you just do not want to register the changes in the database, then you should perform `rollback` to undo every update operation executed since the transaction was started:

```
// Cancel latest update operations.
view.rollback();
```

Find an object in the database

Now we are going to see how to retrieve objects from the database. Depending on how many objects we want to get, we can perform two different types of operations.

To search for a specific object from the database (one row in a table of the database) you have to invoke the `find` method. This method requires you to provide an object of the same type as the one you want to retrieve, with some data in it so it will be used as a filter to find the object in the database. To better understand how it works, check out the API description of this method:

```
/**
 * Finds an object by its values. This method returns the object of the data
 * store which matches the type and all non-null field values from a given
 * object. This is done via reflecting the type and all of the fields from
 * the given object, and building a query expression where all
 * non-null-value fields are combined with AND expressions. So, the object
 * you will get will be the same type as the object that you will provide.
 * The result of the query must return one single object in order to avoid
 * an exception. In many cases, you may only need to provide the ID fields
 * of the object to retrieve one single object. In relational databases like
 * Oracle or MySQL, these ID fields are the primary keys.
 *
 * @param filter
 *            Filter used to find an object in the data store. This object
 *            specifies two things: first, the type of the object to search
 *            for in the data store, and second, the values that identify
 *            the object in the data store.
 * @return Object from the data store that matches the type and the values
 *         of the given object. If more than one object is found in the data
 *         store, then an exception is thrown. If no objects are found, then
 *         this method returns <code>null</code>.
 * @throws ClientException
 */
Object find(Object filter) throws ClientException;
```

Let's see some sample code. Suppose that there is a user named `Steve` in the relational database, we could retrieve an object instance that represents this user like this:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Create the filter to find the object.
User filter = new User();

// Set the primary key.
filter.setId(new Integer(652));

// Search the user by primary key.
User user = (User) view.find(filter);
```

The object that represents that specific row from the database is returned with all its data associated to it. The idea is that developers can search for an object just by providing some of its attributes and retrieve the same object type with the last information it had when it was stored or updated in the database. Bear in mind that an exception is thrown if more than one object is found in the database. This method just searches for a single object in the database. In order to retrieve a collection of objects, you should invoke different methods.

List objects from the database

Warework provides three different ways to retrieve a list of objects from a database. The first one works similar as the `find` method, but this time you will get a collection of objects (instead of one single object). Check it out with an example:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect with the relational database.
view.connect();

// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setPassword(new Integer(8713));

// List every row from USER table which password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

The main characteristic of this method is that it creates a query where every non-null attribute of the given object is combined with `AND` expressions, for example:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("Steve");
filter.setPassword(new Integer(8713));

// Find "User" objects which name is "Steve" and password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

When this operation is executed, the ORM engine creates a query that may look like this:

```
SELECT * FROM USER WHERE ((NAME = 'Steve') AND (PASSWORD = 8713))
```

Also, when objects of the data model are related each other (typically, 1:1 relationships), every non-null attribute of the related objects is used to build the query. For example:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("steve@mail.com");

// Create the filter to find User objects.
User filter = new User();

// Set the data required to find User objects in the database.
filter.setName("Steve");
filter.setContact(contact);

// Find "User" objects which name is "Steve" and email is "steve@mail.com".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER A, CONTACT B
   WHERE ((B.USER = A.ID) AND (A.NAME = 'Steve') AND
          (B.EMAIL = 'steve@mail.com'))
```

While the `AND` expression is always used to create the query (there is no chance to modify this type of expression in this method), you can indicate which specific operation must be performed in the attributes of the object. By default, the equal operator is used when a non-null attribute is found but it is possible to use different ones like: not equals to, greater than, greater than or equals to, less than, less than or equals to, like, not like, is null or is not null. The following example shows how to list `User` objects which name is `Steve` and password is greater than `1000`:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("Steve");
filter.setPassword(new Integer(1000));

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("password", Operator.GREATER_THAN);

// Find "User"s which name is "Steve" and password is greater than "1000".
List<User> users = (List<User>) view.list(filter, operator, null, -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE ((NAME = 'Steve') AND (PASSWORD > 1000))
```

It is also possible to change the operator in referenced objects:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("steve@mail.com");

// Create the filter to find User objects.
User filter = new User();

// Set the data required to find User objects in the database.
filter.setName("Steve");
filter.setContact(contact);

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("contact.email", Operator.LIKE);

// Find "User" objects which name is Steve and email is like "steve@mail.com".
```

```
List<User> users = (List<User>) view.list(filter, operator, null, -1, -1);
```

This is the generated query:

```
SELECT * FROM USER A, CONTACT B
   WHERE ((B.USER = A.ID) AND (A.NAME = 'Steve') AND
          (B.EMAIL LIKE 'steve@mail.com'))
```

What if you just want to list all the objects of the same type? In this case you can provide just the class instead of an object instance:

```
// List every row from USER table.
List<User> users = (List<User>) view.list(User.class, null, null, -1, -1);
```

When you provide a class you can only specify two operators: `IS_NULL` and `IS_NOT_NULL`. This is because you cannot provide the values of the fields in a class. For example:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// List every row from USER table which NAME column is not null.
List<User> users = (List<User>) view.list(User.class, operator, null, -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE (NAME IS NOT NULL)
```

The same way we did before we can use a callback object in this method. Just bear in mind that now the result of the operation is provided by the callback `onSuccess` method:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// Find every "User" which name is not null.
view.list(User.class, null, null, -1, -1,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get database query result.
      List<User> users = (List<User>) result;

      // Handle collection here...

   }
```

```
});
```

Sort results

The third argument of the `list` method allows us to define how to sort the results. It is fairly easy:

```
// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for column "NAME".
order.addAscending("name");

// List every row from USER table sorted by name.
List<User> users = (List<User>) view.list(User.class, null, order, -1, -1);
```

The result of this operation will be a list of all users sorted in ascending order. The query generated looks like this:

```
SELECT * FROM USER ORDER BY NAME ASC
```

Pagination

Sometimes you may need to limit the number of objects returned by the ORM engine when a query operation is performed. Let us say that there are 26 rows in `USER` table and that we just expect to retrieve the first 10 rows/objects. We can write something like this:

```
// Get the first 10 objects.
List<User> users = (List<User>) view.list(User.class, null, null, 1, 10);
```

What is going on right now? When you specify the number of objects that you want in the result of a database, Warework automatically calculates the number of pages that hold this number of objects. In the previous example we specified 10 objects per result and with this information Warework estimates that the size of each page is 10 objects and that there are three pages: page 1 with 10 objects, page 2 with 10 objects and page 3 with 6 objects. If now we need to retrieve the next ten objects, we have to indicate that we want the second page:

```
// Get objects from 11 to 20.
List<User> users = (List<User>) view.list(User.class, null, null, 2, 10);
```

If we request page number three, we get the last 6 objects from the database. The important fact to keep in mind here is that the number of objects remains as 10:

```
// Get objects from 21 to 26.
List<User> users = (List<User>) view.list(User.class, null, null, 3, 10);
```

Creating custom queries with `Query` object

Warework also gives the possibility to create `Query` objects where to specify all the characteristics we had seen before. These `Query` objects allows to define `AND`, `OR` and `NOT` expressions

as well, so they are more useful in certain cases. The following example shows how to run a simple query with this object:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// List every row from USER table.
List<User> users = (List<User>) view.list(query);
```

This example retrieves every row from `USER` table of the database. To filter the results, we have to create a `Where` clause for the query. Let's see how to filter the query by specifying a value for the `name` attribute of the `User` object:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like: (name = 'Steve').
where.setExpression(where.createEqualToValue("name", "Steve"));

// List every row from USER table which name is 'Steve'.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE (NAME = 'Steve')
```

One great feature about `Query` objects is that you can assign values from different sources to the attributes of the object that define the search criteria. This is handled with Warework Providers, that is, you have to create an expression for the `Where` clause which gets the value from a Provider and assigns this value to the attribute of the object. For example, suppose that we have a Provider named "`password-provider`" which returns the password for a given user name. To search for a user which matches the password given by the Provider, we can create a query like this:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Filter by password; assign to password the value of the Provider.
where.setExpression(where.createEqualToProviderValue("password",
   "password-provider", "steve"));

// List "User" objects which name is 'Steve'.
```

```
List<User> users = (List<User>) view.list(query);
```

This time, the value for the attribute is not directly assigned by the developer; instead, it is assigned with the value returned by the Provider. So, if "password-provider" returns 8713 for "steve", then the query created looks like this:

```
SELECT * FROM USER WHERE (PASSWORD = 8713)
```

Now we are going to create one AND expression to filter the query with two attributes. Check it out with the following example:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(where.createLikeValue("name", "Steve"));
and.add(where.createGreaterThanValue("password", new Integer(1000)));

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" which name is like 'Steve' and password is greater than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') AND (PASSWORD > 1000))
```

OR expressions with Query objects

With Query objects you can also specify OR expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one OR expression.
Or or = where.createOr();

// Filter by name and password.
or.add(where.createLikeValue("name", "Steve"));
or.add(where.createGreaterThanValue("password", new Integer(1000)));
```

```
// Set the OR expression in the WHERE clause.
where.setExpression(or);

// List "User" which name is like 'Steve' or password is greater than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates this query:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') OR (PASSWORD > 1000))
```

Of course, you can create more complex queries. The following example shows you how to mix multiple `AND`, `OR` and `NOT` expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create OR expression.
Or or1 = where.createOr();

// Filter by name.
or1.add(where.createLikeValue("name", "Arnold"));
or1.add(where.createLikeValue("name", "David"));

// Create NOT expression.
Not not = where.createNot(or1);

// Create another OR expression.
Or or2 = where.createOr();

// Filter by password.
or2.add(where.createGreaterThanValue("password", new Integer(1000)));
or2.add(where.createLessThanValue("password", new Integer(5000)));

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(not);
and.add(or2);

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" objects.
List<User> users = (List<User>) view.list(query);
```

And this is the query representation:

```
SELECT * FROM USER WHERE (NOT ((NAME LIKE 'Arnold') OR (NAME LIKE 'David'))
   AND ((PASSWORD > 1000) OR (PASSWORD < 5000)))
```

Order and pagination with `Query` objects

`Query` objects also allow you to define the order of the results and which page to retrieve from the database. The following example shows you how to list the first ten users sorted by name in ascending order:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for field "name".
order.addAscending("name");

// Set order by.
query.setOrderBy(order);

// Set which page to get from the result.
query.setPage(1);

// Set maximum number of objects to get in the result.
query.setPageSize(10);

// List the first ten "User" objects sorted by name in ascending order.
List<User> users = (List<User>) view.list(query);
```

List objects with XML queries

Making queries `Query` object is very useful when you have to dynamically create the query (you are free to create the query the way you need it) but, in certain cases, it is better for the programmer to create queries in separate XML files because they can be managed outside the Java code and they are easier to understand.

A very convenient way to keep object queries in separate files consist of keeping each statement in an independent XML file, for example: `find-user.xml`, `list-users.xml`, etc. Later on we can read these XML files with a Provider (Warework recommends you to use the Object Query Provider for this task) and use this Provider to read the statements for the ORM View. Remember that you can define a default Provider for a View when you associate a View to a Data Store:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleViewImpl.class,
   "view-name", "object-query-provider", null);
```

The `object-query-provider` now can be used in the View as the default Provider to read XML queries from a specific directory. Let us say we have the following content for `find-steve.xml`:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>
```

```
   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

If `object-query-provider` is the default Provider in an ORM View, we can read the content of this file with the following code:

```
// Read the content of 'find-steve.xml' and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-steve", null,
    -1, -1);
```

When `executeQueryByName` is invoked, these actions are performed:

1. The ORM View requests the `find-steve` object to `object-query-provider`.
2. `object-query-provider` reads the content of `find-steve.xml` and returns it (as a `Query` object).
3. The ORM View executes the statement included at `find-steve.xml` in the relational database.

The ORM View and the Object Query Provider are perfect mates. Both, in combination, will simplify a lot the process of executing query statements in your database. Just write simple XML files and let Warework execute them for you. It is recommended that you check out the documentation associated to the Object Query Provider to fully take advantage of this feature.

Operators

In XML queries you can specify operators like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>
```

```
</query>
```

And you can also use short keywords to identify them:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQ</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

Previous examples perform the same operation. Check out the following table to review which operators are supported and which short names you can use:

OPERATOR	FULL NAME	SHORT NAME
=	EQUAL_TO	EQ
!=	NOT_EQUAL_TO	NE
<	LESS_THAN	LT
<=	LESS_THAN_OR_EQUAL_TO	LE
>	GREATER_THAN	GT
>=	GREATER_THAN_OR_EQUAL_TO	GE
IS NULL	IS_NULL	IN
IS NOT NULL	IS_NOT_NULL	NN
LIKE	LIKE	LK
NOT LIKE	NOT_LIKE	NL

Value types

In XML queries you can specify different value types and some of them with short names. For example, the previous query can be written as:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQ</operator>
```

```
         <value-operand>
            <type>string</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

The following table summarizes which data types can be used with short names:

OBJECT TYPE	SHORT NAME
`java.lang.Boolean`	boolean
`java.lang.Byte`	byte
`java.lang.Short`	short
`java.lang.Integer`	int or integer
`java.lang.Long`	long
`java.lang.Float`	float
`java.lang.Double`	double
`java.lang.Character`	char or character
`java.lang.String`	string
`java.util.Date`	date

`AND`, `OR` and `NOT` expressions in XML queries

With XML Object Queries you can write the same queries as the one you will code with `Query` objects. These XML queries also allow defining `AND`, `OR` and `NOT` expressions as well, for example:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <and>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </and>
   </where>

</query>
```

This XML query is converted into something like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') AND (PASSWORD > 1000))
```

Check it out now with an `OR` expression:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <or>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </or>
   </where>

</query>
```

Now, this XML query looks like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') OR (PASSWORD > 1000))
```

The following example shows a more complex query with `AND`, `OR` and `NOT` expressions:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <not>
         <and>
            <expression>
               <attribute>name</attribute>
               <operator>NOT_LIKE</operator>
               <value-operand>
```

```
                  <type>java.lang.String</type>
                  <value>James</value>
               </value-operand>
            </expression>
            <or>
               <expression>
                  <attribute>name</attribute>
                  <operator>NO_LIKE</operator>
                  <value-operand>
                     <type>java.lang.String</type>
                     <value>Arnold</value>
                  </value-operand>
               </expression>
               <expression>
                  <attribute>name</attribute>
                  <operator>IS_NOT_NULL</operator>
               </expression>
            <or>
         </and>
      <not>
   </where>

</query>
```

This is the output for the query:

```
SELECT * FROM USER WHERE NOT ((NAME NOT LIKE 'James') AND
    ((NAME NOT LIKE 'Arnold') OR (NAME IS NOT NULL)))
```

Setting date values in XML queries

Before we proceed with more different examples, keep in mind that it is also possible to assign date values to the attributes:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.util.Date</type>
            <value>1967/08/12</value>
            <format>yyyy/MM/dd</format>
            <locale>en_US</locale>
            <time-zone>europe/london</time-zone>
         </value-operand>
      </expression>
   </where>

</query>
```

With this information, Warework will try to parse the date and assign its value to the attribute. While `locale` and `time-zone` are not mandatory, you should always provide the `format` to properly parse the date. Check out some available locale codes here:

http://docs.oracle.com/javase/1.4.2/docs/guide/intl/locale.doc.html

Review how to retrieve `time-zone` codes in the following location:

http://docs.oracle.com/javase/1.4.2/docs/api/java/util/TimeZone.html

In XML queries it is also possible to assign values to attributes which come from defined variables or Providers.

Creating variables in XML queries

First we are going to review how to define a variable for an attribute. It is simple: by one side, you have to create an expression in the XML query and define in there a name for a variable. This variable will be replaced later on at runtime with the values specified by the developer. The following `find-user.xml` query file defines a variable for the `name` attribute of the `User` object:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>LIKE</operator>
         <variable-operand name="USER_NAME"/>
      </expression>
   </where>

</query>
```

Now that we have defined a variable for the `name` attribute, we can replace this variable with a specific value as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the query.
values.put("USER_NAME", "Steve");

// Read 'find-user.xml', replace variables and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-user", values,
    -1, -1);
```

Once the value is assigned to the variable, the output query looks like this:

```
SELECT * FROM USER WHERE (NAME LIKE 'Steve')
```

We can perform a similar action with a Provider. With Providers, instead of defining a variable in the query, we specify an object from a Provider that will be used as the value for the attribute. For example, suppose that we have a Provider named `password-provider` which returns user's passwords, that is, if we request object "`steve`", the Provider will return something like "`3425`". The following query shows how to assign the object named "`steve`" in Provider "`password-provider`" to the "`password`" attribute.

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>password</attribute>
         <operator>EQUALS_TO</operator>
         <provider-operand>
            <provider-name>password-provider</provider-name>
            <provider-object>steve</provider-object>
         </provider-operand>
      </expression>
   </where>

</query>
```

After the value "`3425`" is retrieved from the Provider and it is assigned to "`password`", this query is shown as follows:

```
SELECT * FROM USER WHERE (PASSWORD = 3425)
```

Running native update statements

This ORM View also allows executing native queries supported by the ORM engine. Some engines let developers to run SQL statements while others allow the execution of statements in a custom object-oriented query language (for example: Hibernate Query Language or JPA Query Language). The following fragment of code shows how to execute an SQL statement in the relational database with an ORM engine that supports SQL for native queries:

```
// Get an instance of a ORM View interface.
ORMView view = (ORMView) datastoreService.getView(…);

// Connect with the relational database.
view.connect();

// Begin a transaction in the relational database.
view.beginTransaction();

// Create the SQL statement to execute.
String sql = "INSERT INTO HOME_USERS (ID, NAME) VALUES (1, 'John Wood')";

// Run the SQL update statement.
view.executeUpdate(sql, null);

// Commit changes.
```

```
view.commit();
```

Another option is to execute multiple statements at once. You can do it by specifying a separator character which delimits each statement:

```
// SQL statement to create first user.
String sql1 = "INSERT INTO HOME_USERS (ID, NAME) VALUES (1, 'John Wood')";

// SQL statement to create second user.
String sql2 = "INSERT INTO HOME_USERS (ID, NAME) VALUES (2, 'James Sharpe')";

// SQL statement to create third user.
String sql3 = "INSERT INTO HOME_USERS (ID, NAME) VALUES (3, 'Sofia Green')";

// Execute three SQL update statements at once.
view.executeUpdate(sql1 + ";" + sql2 + ";" + sql3, new Character(';'));
```

Running scripts with update statements

If you define a default Provider for this View that reads plaint text files, like Warework FileText Provider, you can read `.sql` scripts and execute them in the database very easily. This time, instead of setting up the View with the Object Query Provider, we specify that the default Provider is a FileText Provider that reads `.sql` statements from a specific directory:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleViewImpl.class,
   "view-name", "sql-provider", null);
```

The `sql-provider` Provider now can be used in the View as the default Provider to read text files from a specific directory. Let us say we have the following content for `create-user.sql`:

```
INSERT INTO HOME_USERS (ID, NAME) VALUES (1, 'John Wood')
```

If `sql-provider` is the default Provider in a ORM View, we can read the content of this file with the following code:

```
// Read the content of 'create-user.sql' and execute it.
view.executeUpdateByName("create-user", null, null);
```

When `executeUpdateByName` is invoked, these actions are performed:

1. The ORM View requests the `create-user` object to `sql-provider`.
2. `sql-provider` reads the content of `create-user.sql` and returns it (as a `String` object).
3. The ORM View executes the statement included at `create-user.sql` in the relational database.

Defining variables in scripts with update statements

If we need a generic statement to create new users in the database, we can define the script `create-user.sql` with some variables, like this:

```
INSERT INTO HOME_USERS (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
```

Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the relational database.
view.executeUpdateByName("create-user", values, null);
```

When your script contains multiple statements, you also have to indicate the character that delimits each statement. Suppose we have the following `create-user.sql` script:

```
INSERT INTO HOME_USERS (ID, NAME) VALUES (${USER_ID}, ${USER_NAME});
INSERT INTO ACTIVE_USERS (ID, NAME) VALUES (${USER_ID});
```

Now we can replace variables in multiple statements with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
view.executeUpdateByName("create-user", values, new Character(';'));
```

Running native queries

Now we are going to focus on native query operations to know how to retrieve data from a relational database. The following code is an example to perform this action:

```
// Execute the statement to retrieve some data.
Object result = view.executeQuery("SELECT * FROM HOME_USERS", -1, -1);
```

This code executes the SQL statement into the relational database and returns an object that represents the result provided by the database. Remember that we are using SQL just as an example of a native query language and that it could be a complete different one like HQL or JPQL. The type of the result returned by this method depends on the implementation of the ORM engine, so please, check out the documentation of the Data Store that implements this ORM View to learn about the result type for this method.

Pagination with native queries

It is also possible to specify the page and size for the result set. In the following example, 1 represents the page to retrieve and 10 is the size of the result:

```
// Get the first 10 rows.
Object result = view.executeQuery("SELECT * FROM HOME_USERS", 1, 10);
```

Running native queries from scripts

With queries, you can also write `SELECT` statements in separate text files (this time, just one statement per file). Suppose that the following code is the content of the `list-users.sql`file:

```
SELECT * FROM HOME_USERS
```

If `sql-provider` still is our default Provider, we can read the script like this:

```
// Read the content of 'list-users.sql' and execute it in the database.
Object result = view.executeQueryByName("list-users", null, -1, -1);
```

Defining variables in a query script

There is also the possibility to define some variables in the query:

```
SELECT * FROM HOME_USERS A WHERE A.ID = ${USER_ID}
```

Now we can assign a value to this variable to complete the query. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the query.
values.put("USER_ID", new Integer(8375));

// Read 'list-users.sql', replace variables and execute the final statement.
Object result = view.executeQueryByName("list-users", values, -1, -1);
```

The two last arguments allow you to define the page and the maximum number of objects to retrieve. The following example shows how to get the second page with a fixed size of 10 objects per page:

```
// Get the second page with no more than 10 registries in it.
Object result = view.executeQueryByName("list-users", null, 2, 10);
```

Count database objects

To count every object of a specific type (every row in a table) we have to invoke the following operation:

```
// Count all users.
int count = view.count(User.class);
```

We can also use callbacks in count operations:

```
// Count users.
view.count(User.class, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get count.
      Integer count = (Integer) result;

   }

});
```

It is also possible to count the results of a query:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Count users which name is 'Carl'.
int count = view.count(query);
```

With `executeCountByName` we can count the objects that an XML query returns:

```
// Count result of "list-users" query.
int count = view.executeCountByName("list-users", null);
```

Close the connection with the database

As always, when the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Create custom Views

The creation process of a View consists of two steps. The first one is about defining your own View logic in an interface that extends, at least, the `DatastoreView` interface. Check out this

class in the `com.warework.service.datastore.view` package; you can also extend more interfaces of Views in this package.

```
import com.warework.service.datastore.view.DatastoreView;

public interface MyView extends DatastoreView {

   public void operation1();

   public void operation2();

}
```

The second one has to do with implementing your interface in a class that extends the `AbstractDatastoreView` class. This abstract class provides the default functionality to make an object behave as a View. Just extend it, implement your interface and write the required methods:

```
import com.warework.service.datastore.AbstractDatastoreView;

public class MyViewImpl extends AbstractDatastoreView implements
   MyView {

   // NOTE 1: Query the Data Store with method "query()" that exists in the
   // AbstractDatastoreView class.

   // NOTE 2: Update the Data Store with method "update()" that exists in the
   // AbstractDatastoreView class.

   // NOTE 3: Commit the Data Store with method "commit()" that exists in the
   // AbstractDatastoreView class.

   // NOTE 4: Connect the Data Store with method "connect()" that exists in
   // the AbstractDatastoreView class.

   // NOTE 5: Disconnect the Data Store with method "disconnect()" that exists

   // in the AbstractDatastoreView class.

   // NOTE 6: Validate if connection is open with method "isConnected()" that
   // exists in the AbstractDatastoreView class.

   // NOTE 7: Get the main Data Store with method "getDatastore()" that
   // exists in the AbstractDatastoreView class.

   // NOTE 8: Get the next View in the stack of Views of the Data Store with
   // method "getParentView()" that exists in the AbstractDatastoreView class.

   // NOTE 9: Get a statement from the default Provider with method
   // "getStatement()" that exists in the AbstractDatastoreView class.

   // NOTE 10: List every initialization parameter with the protected
   // method "getInitParameterNames()" that exists in the
   // AbstractDatastoreView class.

   // NOTE 11: Get the value of an initialization parameter with the
   // protected method "getInitParameter(String name)" that exists
   // in the AbstractDatastoreView class.
```

```
   // ----- MyView methods

   public void operation1() {
      // Perform your Data Store operations here.
   }

   public void operation2() {
      // Perform your Data Store operations here.
   }

}
```

Hashtable Data Store

This Data Store allows you to perform operations with a Hashtable, that is, a memory key-value Data Store. You can create one instance of this map and add, query, update and remove the values that it has by providing keys. These operations can be executed with the Data Store Service Facade, with well-known methods like: `connect`, `disconnect`, `query`, `update` and `commit`. You can also perform the same operations with a Key-Value View specifically designed for a Hashtable Data Store.

Add a Hashtable Data Store

To add a Hashtable Data Store into the Data Store Service you have to invoke method `createClient()` that exists in its Facade with a name and the Hashtable Connector class. You can use just one type of Connector and it does not require any configuration:

```
// Create the Hashtable Data Store.
datastoreService.createClient("hashtable-datastore",
   HashtableConnector.class, null);
```

Check it now how to do it with the Data Store Service XML configuration file (this functionality is provided by Warework Data Store Extension Module):

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   <datastores>
      <datastore name="hashtable-datastore" connector=
      "com.warework.service.datastore.client.connector.HashtableConnector"/>
   </datastores>

</datastore-service>
```

Working with the Hashtable Data Store

Like every Data Store, you can perform operations with Hashtable Data Stores in the Data Store Service Facade. Now we are going to review the basic Hashtable Data Store operations

provided by the DatastoreServiceFacade interface. We can group these operations as follows:

- Connect and disconnect Hashtable Data Stores

  The first operation you have to invoke to start working with a Hashtable Data Store is `connect`:

```
// Connect the Hashtable Data Store.
datastoreService.connect("hashtable-datastore");
```

  After you perform the connection, you typically will execute other Hashtable Data Store operations like `query`. Once the job is done, you will need to close the Hashtable Data Store:

```
// Disconnect the Hashtable Data Store.
datastoreService.disconnect("hashtable-datastore");
```

- Query Hashtable Data Stores

  There are two methods, both named `query`, where you can retrieve information from a Hashtable Data Store. The first one (and the most useful one) allows you to directly search for the value associated to a key:

```
// Get the value of the 'user.name' key in the Data Store.
String value = (String) datastoreService.
   query("hashtable-datastore", "user.name");
```

  You can use different types of keys too, also retrieve different types of values (remember, the underlying collection is a simple instance of a `Hashtable` class):

```
// Get the value of the 536 key in the Data Store.
Date dateofBirth = (Date) datastoreService.
   query("hashtable-datastore", new Integer(536));
```

  Another way to search for data in a Data Store is by loading and executing statements that exist in a Provider. This functionality is rarely used with Hashtable Data Stores. If you still want to read a key from a Provider, please review the Data Store Service documentation.

- Update Hashtable Data Stores

  This time, instead of querying for data in a Hashtable Data Store, you will create or modify a key in the Data Store. For example:

```
// Set a new key in the Hashtable.
datastoreService.update("hashtable-datastore", "user.name=John Wood");
```

To store/update values different than strings, you will need to provide an array of objects, where the first position of the array represents the key and the second position the value for that key:

```
// Set key 536 with the current date.
datastoreService.update("hashtable-datastore",
   new Object[]{new Integer(536), new Date()});
```

- Commit Hashtable Data Stores

  This operation does not perform any action in the Hashtable so there is no need to worry about committing this Data Store.

Key-Value View for Hashtable Data Stores

This View is a class that implements the Key-Value interface for the Hashtable Data Store. Now we are going to see how to associate a View of this type with a Hashtable Data Store and how to perform operations with the View.

- Setting up the View

  There is no need to configure this View with initialization parameters, so just add the View in the stack of Views of the Hashtable Data Store:

```
// Add Key-Value View for Hashtable Data Stores.
datastoreService.addView("hashtable-datastore",
   HashtableViewImpl.class, "key-value-view", null, null);
```

Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="hashtable-datastore"
         connector="com.warework.service.datastore. …
            … client.connector.HashtableConnector">
         <views>
            <view class="com.warework.service.datastore. …
               … client.HashtableViewImpl" name="key-value-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

You can also provide short class names to identify Connectors and Views:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="hashtable-datastore" connector="Hashtable">
         <views>
            <view class="Hashtable" name="key-value-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

- Working with the Key-Value View for Hashtable Data Stores

  Now we are going to review the basic operations provided by the `HashtableViewImpl` class. Working with this View is fairly easy because the `KeyValueView` interface (package: `com.warework.service.datastore.view`) only exposes a few methods and they all are very simple.

  The first operation you have to perform to start working with a Data Store is the `connect` operation. There is no exception with the Key-Value View:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("hashtable-datastore");

// Connect the Hashtable Data Store.
view.connect();
```

  The following example shows how to add a new value associated to a key in the Hashtable Data Store:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("hashtable-datastore");

// Connect the Hashtable Data Store.
view.connect();

// Create a new key named 'user.name' or update it.
view.put("user.name", "John Wood");
```

  Remember, you can use values different than Strings:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("hashtable-datastore");

// Connect the Hashtable Data Store.
view.connect();

// Create a new 536 key named with the current date.
view.put(new Integer(536), new Date());
```

  Now, you can retrieve the value associated to a key like this:

```
// Get the value of the 536 key.
Date value = (Date) view.get(new Integer(536));
```

This is how to remove a key and the value associated to it:

```
// Remove the key from the Hashtable Data Store.
view.remove("user.name");
```

You can also get a list with the keys that exist in the Data Store:

```
// Get every key from the Hashtable Data Store.
Enumeration keys = view.keys();
```

When finished, you have to disconnect the Hashtable Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Properties Data Store

This Data Store allows you to perform operations with properties files. You can load one of this configuration files and query the properties that it has just by providing keys. There is also the possibility to add new properties or update existing ones, and save them in the same file that you loaded. These operations can be executed with the Data Store Service Facade, with well-known methods like: `connect`, `disconnect`, `query`, `update` and `commit`. You can also perform the same operations with a Key-Value View specifically designed for a Properties Data Store.

Add a Properties Data Store

To add a Properties Data Store into the Data Store Service you have to invoke method `createClient()` that exists in its Facade with a name, the Properties Connector class and a configuration for the Data Store. You can use just one type of Connector:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the location of the properties file.
config.put(PropertiesConnector.PARAMETER_ConfigTarget,
   "/META-INF/config.properties");

// Create the Properties Data Store.
datastoreService.createClient("properties-datastore",
   PropertiesConnector.class, config);
```

The `PropertiesConnector` collects the configuration and sets up a Properties Data Store with the properties file that exists where `PARAMETER_ConfigTarget` specifies. Check it now how to do it with the Data Store Service XML configuration file (this functionality is provided by Warework Data Store Extension Module):

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   <datastores>
      <datastore name="properties-datastore" connector=
      "com.warework.service.datastore.client.connector.PropertiesConnector">
         <parameter name="config-target" value="/META-INF/config.properties"/>
      </datastore>
   </datastores>

</datastore-service>
```

For those who need to load a properties file from a different JAR, remember that you can do so by adding parameter `PropertiesConnector.PARAMETER_ContextLoader`.

Working with the Properties Data Store

Like every Data Store, you can perform operations with Properties Data Stores in the Data Store Service Facade. Now we are going to review the basic Properties Data Store operations provided by the `DatastoreServiceFacade` interface. We can group these operations as follows:

- Connect and disconnect Properties Data Stores

  The first operation you have to invoke to start working with a Properties Data Store is `connect`:

  ```
  // Connect the Properties Data Store.
  datastoreService.connect("properties-datastore");
  ```

  After you perform the connection, you typically will execute other Properties Data Store operations like `query`, the most used one. Once the job is done, you will need to close the Properties Data Store:

  ```
  // Disconnect the Properties Data Store.
  datastoreService.disconnect("properties-datastore");
  ```

- Query Properties Data Stores

  There are two methods, both named `query`, where you can retrieve information from a Properties Data Store. The first one (and the most useful one) allows you to directly search for the value associated to a key:

```
// Get the value of the 'user.name' property in the Data Store.
String value = (String) datastoreService.
   query("properties-datastore", "user.name");
```

Another way to search for data in a Data Store is by loading and executing statements that exist in a Provider. This functionality is rarely used with Properties Data Stores. If you still want to read a key from a Provider, please review the Data Store Service documentation.

- Update Properties Data Stores

  This time, instead querying for data in a Properties Data Store, you will create or modify a key in the Data Store. For example:

```
// Set a new property in the properties file.
datastoreService.update("properties-datastore", "user.name=John Wood");
```

- Commit Properties Data Stores

  You can commit changes just by providing the name of the Properties Data Store:

```
// Update existing properties file.
datastoreService.commit("properties-datastore");
```

  Note that sometimes you will not be able to perform this action because you may not have write permissions.

Key-Value View for Properties Data Stores

This View is a class that implements the Key-Value interface and it represents an abstract Data Store composed of a collection of key-value pairs, such that each possible key appears at most once in the collection.

Now we are going to see how to associate a View of this type with a Properties Data Store and how to perform operations with the View.

- Setting up the View

  There is no need to configure this View with initialization parameters, so just add the View in the stack of Views of the Properties Data Store:

```
// Add Key-Value View for Properties Data Stores.
datastoreService.addView("properties-datastore",
   PropertiesViewImpl.class, "keyvalue-view", null, null);
```

  Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="properties-datastore"
         connector="com.warework.service.datastore. …
            … client.connector.PropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/config.properties"/>
         <views>
            <view class="com.warework.service.datastore. …
               … client.PropertiesViewImpl" name="keyvalue-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

You can also provide short class names to identify Connectors and Views:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="properties-datastore" connector="Properties">
         <parameter name="config-target"
            value="/META-INF/config.properties"/>
         <views>
            <view class="Properties" name="keyvalue-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

- Working with the Key-Value View for Properties Data Stores

  Now we are going to review the basic operations provided by the `PropertiesViewImpl` class. Working with this View is fairly easy because the `KeyValueView` interface (package: `com.warework.service.datastore.view`) only exposes a few methods and they all are very simple.

  The first operation you have to perform to start working with a Data Store is the `connect` operation. There is no exception with the Key-Value View:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("properties-datastore");

// Connect the Properties Data Store.
view.connect();
```

  The following example shows how to add a new value associated to a key in the Properties Data Store:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("properties-datastore");

// Connect the Properties Data Store.
view.connect();

// Create a new key named 'user.name' or update it.
view.put("user.name", "John Wood");
```

A very important fact to bear in mind is that this View will accept only `String` values, if a different type is given, then an exception will be thrown.

Now, you can retrieve the value associated to a key like this:

```
// Get the value of the 'user.name' key.
String value = (String) view.get("user.name");
```

This is how to remove a key and the value associated to it:

```
// Remove the key from the Properties Data Store.
view.remove("user.name");
```

You can also get a list with the names of the keys that exist in the Data Store:

```
// Get every key from the Properties Data Store.
Enumeration keys = view.keys();
```

To retrieve the number of key-value pairs you have to invoke the `size` method like this:

```
// Count keys in Data Store.
int size = view.size();
```

Once you have performed a set of `put` or `remove` operations, it might be a good idea to perform `commit` to register the changes in the Properties Data Store:

```
// Commit changes in the Properties Data Store.
view.commit();
```

When the work is done, you have to disconnect the Properties Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

JDBC Data Store

This Data Store allows you to perform operations with relational databases using the JDBC technology. It is a wrapper for JDBC that simplifies the process of connecting with a database and the way you query or update data in it with SQL.

You can either use common methods from the Data Store Service like `connect`, `disconnect`, `query`, `update` and `commit`; or perform more specific operations with the implementations provided for the RDBMS and Key-Value Views.

The JDBC Data Store integrates perfectly with other components of the Framework to retrieve database connections. For example: you can either use a `javax.sql.DataSource` object from a JNDI Provider in a server platform or retrieve a `java.sql.Connection` object from the Warework Pool Service. In general, you will setup the connection for this Data Store with an XML configuration file; it is very probably that you will not need to write a single line of Java code to configure your database connection.

The execution of SQL statements is very easy and most of the times one line of code is enough to perform the task. This JDBC Data Store allows you to:

- Create a `String` object that represents an SQL statement.
- Run SQL commands like `SELECT` or `INSERT` that exist in a text file.
- Define variables in a SQL script and replace them with specific values before the script is executed.

Add a JDBC Data Store

To add a JDBC Data Store into the Data Store Service you have to invoke method `createClient()` that exists in its Facade with a name, the `JDBCConnector` class and a configuration for the Data Store.

This configuration has to specify a Provider where to retrieve a `javax.sql.DataSource` or a `java.sql.Connection` object (the first one store the information required to create a connection with the database and the second represents the connection itself). A Provider configured for the `JDBCConnector` typically will return a `DataSource` object in a server platform (for example: you can get a `DataSource` object from a JNDI Provider which is configured to work in a WebLogic Application Server) and a `Connection` object in a standalone application (in most cases, it is a good idea to get `Connection` objects with the Warework Pool Service; you can use for example a c3p0 Pooler/Client in this Service to define and create your database connections using a pool of `Connection` objects).

If you can get an instance of a `DataSource` from a Provider, then you should configure this Data Store like this:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the name of the Provider where to retrieve the DataSource object.
config.put(JDBCConnector.PARAMETER_ConnectionSourceProviderName,
   "datasource-provider");

// Set the name of the object that represents the DataSource in the Provider.
config.put(JDBCConnector.PARAMETER_ConnectionSourceProviderObject,
   "datasource-object-name");

// Create the JDBC Data Store.
```

```
datastoreService.createClient("jdbc-datastore", JDBCConnector.class, config);
```

With this code we instruct the JDBC Connector to retrieve a `DataSource` object named `datasource-object-name` (if it is a JNDI name, it may look like `jdbc/myApplicationDS`) from Provider `datasource-provider` (in a server platform, this Provider usually is a JNDI Provider).

Check it now how to do it with the Data Store Service XML configuration file (this functionality is provided by Warework Data Store Extension Module):

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   <datastores>
      <datastore name="jdbc-datastore" connector=
      "com.warework.service.datastore.client.connector.JDBCConnector">
         <parameters>
            <parameter name="connection-source-provider-name"
               value="datasource-provider"/>
            <parameter name="connection-source-provider-object"
               value="datasource-object-name"/>
         </parameters>
      </datastore>
   </datastores>

</datastore-service>
```

If you can get an instance of a `Connection` object from a Provider, then you should configure the JDBC Data Store like this:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the name of the Provider where to retrieve the Connection object.
config.put(JDBCConnector.PARAMETER_ClientConnectionProviderName,
   "connection-provider");

// Set the name of the object that represents the Connection in the Provider.
config.put(JDBCConnector.PARAMETER_ClientConnectionProviderObject,
   "connection-object-name");

// Create the JDBC Data Store.
datastoreService.createClient("jdbc-datastore", JDBCConnector.class, config);
```

This time we instruct the JDBC Connector to get from Provider `connection-provider` (in a stand-alone application, this Provider usually is the Pooled Object Provider which retrieves object instances from the Pool Service; this Provider is bundled within the Pool Service) a `java.sql.Connection` object named `connection-object-name` (in a Pooled Object Provider it is the name of the Client/Pooler where to retrieve the object instance).

Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">
```

```
   <datastores>
      <datastore name="jdbc-datastore" connector=
      "com.warework.service.datastore.client.connector.JDBCConnector">
         <parameters>
            <parameter name="client-connection-provider-name"
               value="connection-provider"/>
            <parameter name="client-connection-provider-object"
               value="connection-object-name"/>
         </parameters>
      </datastore>
   </datastores>

</datastore-service>
```

There is another option for those who plan to create the `DataSource` programmatically: the `PARAMETER_DataSource` parameter. It allows you to specify for the Connector a `DataSource` object created by yourself. Check this out with the following code:

```
// Create an instance of a Data Source.
DataSource myDataSource = ...;

// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the Data Source to use.
config.put(JDBCConnector.PARAMETER_DataSource, myDataSource);

// Create the JDBC Data Store.
datastoreService.createClient("jdbc-datastore", JDBCConnector.class, config);
```

Working with the JDBC Data Store

Like every Data Store, you can perform operations with JDBC Data Stores in the Data Store Service Facade. Now we are going to review the basic JDBC Data Store operations provided by the `DatastoreServiceFacade` interface. We can group these operations as follows:

- Connect and disconnect JDBC Data Stores

  The first operation you have to invoke to start working with a JDBC Data Store is `connect`:

  ```
  // Connect with the relational database.
  datastoreService.connect("jdbc-datastore");
  ```

  After you perform the connection, you typically will execute other JDBC Data Store operations like `query` or `update`. Once the job is done, you will need to close the JDBC Data Store:

  ```
  // Disconnect with the relational database.
  datastoreService.disconnect("jdbc-datastore");
  ```

- Query JDBC Data Stores

There are two methods, both named `query`, where you can retrieve information from a relational database. The first one allows you to directly execute an SQL statement:

```
// Run a SELECT statement in the relational database.
ResultRows value = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");
```

The JDBC Data Store returns by default a `ResultRows` object which provides the necessary methods to process the result (rows and columns) of the query. It allows iterating each row of the table result and picking up the values of its columns. Check it out with the following example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");

// Iterate rows until the end of the table. First row is 1, second 2 and

// so on. You must perform 'result.next()' at least one time to point
// the cursor to the first row.
while (result.next()) {

   /*
    * For each row we can retrieve the value of each column.
    */

   // Get the boolean value of a column. If the value is SQL NULL
   // (it is null in the database), the value returned is null.
   Boolean column1 = result.getBoolean("COLUMN1");

   // Get the numeric value of a column. You must specify the
   // numeric type to get.
   Short column2A = (Short) result.getNumber("COLUMN2A", Short.class);

   Integer column2B = (Integer) result.getNumber("COLUMN2B",
      Integer.class);

   Long column2C = (Long) result.getNumber("COLUMN2C", Long.class);

   Float column2D = (Float) result.getNumber("COLUMN2D", Float.class);

   Double column2E = (Double) result.getNumber("COLUMN2E",
      Double.class);

   BigDecimal column2F = (BigDecimal) result.getNumber("COLUMN2F",
      BigDecimal.class);

   // Get the string value.
   String column3 = result.getString("COLUMN3");

   // Get the date value.
   Date column4 = result.getDate("COLUMN4");

   // Get the array of bytes.
   byte[] column5 = result.getBlob("COLUMN5");

}
```

When you iterate result rows, you can specify the column (where to get the data) by name or by column index:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");

// Iterate rows.
while (result.next()) {

   // Get the string value of a given column name.
   String column3A = result.getString("COLUMN3");

   // Get the string value of a given column index.
   String column3B = result.getString(3);

}
```

Another option is to retrieve a whole row as a Java Bean object. To achieve this, you have to provide to `getBean` a class that represents a Java Bean. A new instance of this class is created and used to store the values of the result columns. You may also provide a mapping where to relate result columns with bean attributes. Check it out with one example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", null, "SELECT * FROM HOME_USER");

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");

// Iterate rows.
while (result.next()) {

   // Copy the values of specified columns into the User bean.
   User user = (User) result.getBean(User.class, mapping);

}
```

Warework can also create this mapping automatically when the columns names and bean attributes follow a specific naming convention. Here are the rules for columns and attributes names:

> Names of database columns are uppercase, for example: `PASSWORD`. Names of bean attributes are lowercase, for example: `password`.

Spaces in columns names are specified with the underscore character: `DATE_OF_BIRTH`. The attributes of the bean use the camel notation, for example: `dateOfBirth`.

Check out more examples:

`NAME1` equals to `name1`

`NAME_A` equals to `nameA`

`A` equals to `a`

`AA` equals to `aa`

`A_B` equals to `aB`

`A_B_C` equals to `aBC`

If `getBean` method does not receive the mapping configuration, it extracts by reflection the name of every attribute that exist in the given bean class. Each attribute name is converted into the corresponding column name and this column name is finally used to retrieve the value from the database result. If an attribute of the Java Bean does not exist as a result column, then it is discarded. The following example shows how this naming convention simplifies quite a lot the work:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");

// Iterate rows.
while (result.next()) {

   // Copy the values of columns found into the User bean.
   User user = (User) result.getBean(User.class, null);

}
```

You can also transform the database result into a list:

```
// Execute the statement to retrieve some data.
ResultRows resultRows = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");
```

```
// Create a list with User beans that represent each row from the
// database result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   mapping);
```

It is also possible to use auto-mapping:

```
// Execute the statement to retrieve some data.
ResultRows resultRows = (ResultRows) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");

// Create a list with User beans that represent each row from the
// database result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   null);
```

By default, you will always get a `ResultRows` object with a JDBC Data Store when you run a query. It is also possible to configure this Data Store to retrieve JDBC `ResultSet` objects instead of Warework `ResultRows` objects. To achieve this, you have to configure the JDBC Data Store with `PARAMETER_NativeResultSet`, like this:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Retrieve JDBC's ResultSet instead of Warework's ResultRows.
config.put(JDBCConnector.PARAMETER_NativeResultSet, Boolean.TRUE);

// Create the JDBC Data Store.
datastoreService.createClient("jdbc-datastore", JDBCConnector.class,
config);
```

Once it is configured like this, you will get a `ResultSet` object when you run a query:

```
// Execute the statement and return a JDBC ResultSet object.
ResultSet result = (ResultSet) datastoreService.
   query("jdbc-datastore", "SELECT * FROM HOME_USER");
```

Another way to search for data in a JDBC Data Store is by loading and executing statements that exist in a Provider. This functionality allows you to read queries from files and run them in the JDBC Data Store, for example: you can setup a FileText Provider to read SQL statements from text files and execute each one in a relational database, just by specifying the name of the Provider and the name of the text file to read. For the next sample code we are going to suppose that there is a FileText Provider named `sql-provider` that reads text files from a specific directory. When you request an object from this Provider, the name given is used to read the file. For example: if we request an object named `list-users`, this Provider looks for a file named `list-users.sql` in the directory, reads the file and return its content as a `String` object. This is the example:

```
// Read a statement from a text file and execute if in the Data Store.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", "sql-provider", "list-users", null);
```

With this utility you can save prepared statements in a directory for a JDBC Data Store. You can also define some variables for these queries and replace them later on with specific values. Suppose that `list-users.sql` contains the following code:

```
SELECT * FROM HOME_USER A WHERE A.ID = ${USER_ID}
```

In this query we have defined a variable named `USER_ID`. We can assign a value to this variable to complete the query and then run it in the JDBC Data Store. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the SQL statement.
values.put("USER_ID", new Integer(8375));

// Query the JDBC Data Store.
ResultRows result = (ResultRows) datastoreService.
   query("jdbc-datastore", "sql-provider", "list-users", values);
```

- Update JDBC Data Stores

  This time, instead of querying for data in a relational database, you will create or modify information with the JDBC Data Store. For example, we can create a new table in the database like this:

```
// Create a new table in the relational database.
datastoreService.update("jdbc-datastore",
   "CREATE TABLE MESSAGES (MESSAGE VARCHAR(99))");
```

  You can also read update statements from Providers:

```
// Read 'create-contact.sql' and execute it.
datastoreService.update("jdbc-datastore",
   "sql-provider", "create-contact", null);
```

  Let us say that we want to create a new user in the database, we can define a script named `create-user.sql` like this:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
```

  Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
```

```
datastoreService.update("jdbc-datastore", "sql-provider",
   "create-user", values);
```

Sometimes you may need to pass `null` values for these variables to indicate that a specific field will not contain any data. For this purpose, you have to use the `JDBCNullType` class (package: `com.warework.service.datastore.client`) to specify the type of the field/column in a table of the database where you need to set the `null` value. For example, suppose that column `FAVOURITE_COLOR` in table `HOME_USER` stores `String` values and that it is not a mandatory field:

```
INSERT INTO HOME_USER (ID, NAME, FAVOURITE_COLOR) VALUES (${USER_ID},
   ${USER_NAME}, ${USER_COLOR})
```

If we do not want to assign any value to `USER_COLOR` variable, we can set this field to `null` as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");
values.put("USER_COLOR", JDBCNullType.VARCHAR);

// Create a new user in the database.
datastoreService.update("jdbc-datastore", "sql-provider",
   "create-user", values);
```

Now, with this code we instruct the Data Store to add a new row in the table where `FAVOURITE_COLOR` is intentionally left blank. In order to use the appropriate JDBC `null` type, review the API documentation of the `JDBCNullType` class and check out the constants that it defines.

- Commit JDBC Data Stores

  You can commit changes just by providing the name of the JDBC Data Store:

```
// Commit changes.
datastoreService.commit("jdbc-datastore");
```

RDBMS View for JDBC Data Stores

The `JDBCViewImpl` class (package: `com.warework.service.datastore.client`) is a View that implements the `RDBMSView` interface and it provides a better way to interact with relational databases using JDBC. Now we are going to see how to associate a View of this type with a JDBC Data Store and how to perform operations with the View.

- Setting up the View

There is no need to configure this View with initialization parameters, so just add the View in the stack of Views of the JDBC Data Store:

```
// Add the RDBMS View for JDBC Data Stores.
datastoreService.addView("jdbc-datastore",
   JDBCViewImpl.class, "rdbms-view", null, null);
```

Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="jdbc-datastore"
         connector="com.warework.service.datastore. …
            … client.connector.JDBCConnector">
         <parameters>
            <parameter name="connection-source-provider-name"
               value="datasource-provider"/>
            <parameter name="connection-source-provider-object"
               value="datasource-object-name"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. …
               … client.JDBCViewImpl" name="rdbms-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

You can also provide short class names to identify Connectors and Views:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="jdbc-datastore" connector="JDBC">
         <parameters>
            <parameter name="connection-source-provider-name"
               value="datasource-provider"/>
            <parameter name="connection-source-provider-object"
               value="datasource-object-name"/>
         </parameters>
         <views>
            <view class="JDBC" name="rdbms-view"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

- Working with the RDBMS View for JDBC Data Stores

Now we are going to review the methods provided by the `JDBCViewImpl` class. Two basic operations are allowed here:

Update operations

Executes a given SQL statement, which may be an `INSERT`, `UPDATE`, or `DELETE` statement or an SQL statement that returns nothing, such as an SQL DDL statement (for example: `CREATE TABLE`).

Query operations

Executes a given SQL statement, typically a static SQL `SELECT` statement, to retrieve data from the relational database.

Even before you perform any of these operations, what you have to do first is to connect to the relational database:

```
// Get an instance of a RDBMS View interface.
RDBMSView view = (RDBMSView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();
```

Perfect, now a connection with the database is ready to accept SQL commands. In the following examples we are going to save some information in a relational database but before that, it is recommended to begin a transaction with the database. To do it you have to perform the following actions:

```
// Get an instance of a RDBMS View.
RDBMSView view = (RDBMSView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();

// Begin a transaction in the relational database.
view.beginTransaction();
```

Now it is the right time to perform some update operations. First, we are going to add one row in a table of the database:

```
// Get an instance of a RDBMS View.
RDBMSView view = (RDBMSView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create the SQL statement to execute.
String sql = "INSERT INTO HOME_USER (ID, NAME) "
   + "VALUES (1, 'John Wood')";
```

```
// Run the SQL update statement.
view.executeUpdate(sql, null);
```

Another option is to execute multiple statements at once. You can do it by specifying a separator character which delimits each statement:

```
// SQL statement to create first user.
String sql1 = "INSERT INTO HOME_USER (ID, NAME) VALUES "
   + "(1, 'John Wood')";

// SQL statement to create second user.
String sql2 = "INSERT INTO HOME_USER (ID, NAME) VALUES "
   + "(2, 'James Sharpe')";

// SQL statement to create third user.
String sql3 = "INSERT INTO HOME_USER (ID, NAME) VALUES "
   + "(3, 'Sofia Green')";

// Execute three SQL update statements at once.
view.executeUpdate(sql1 + ";" + sql2 + ";" + sql3, new Character(';'));
```

Perform update operations like this when you have to dynamically construct SQL statements in Java. If your statements are not too complex to create, like the ones we saw in the previous example, you should consider storing them on separate files as they are easier to maintain. A very convenient way to keep SQL statements in separate files consist of keeping each statement (or a set of related statements) in an independent text file, for example: `create-user.sql`, `delete-user.sql`, `update-user.sql`, etc. Later on we can read these text files with a Provider (Warework recommends you to use the FileText Provider for this task) and use this Provider to read the statements for the RDBMS View. Remember that you can define a default Provider for a View when you associate a View to a Data Store:

```
// Add a View and link a Provider to it.
datastoreService.addView("jdbc-datastore", JDBCViewImpl.class,
   "rdbms-view", "sql-provider", null);
```

The `sql-provider` Provider now can be used in the View as the default Provider to read text files from a specific directory. Let us say we have the following content for `create-user.sql`:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (1, 'John Wood')
```

If `sql-provider` is the default Provider in a RDBMS View, we can read the content of this file with the following code:

```
// Read the content of 'create-user.sql' and execute it.
view.executeUpdateByName("create-user", null, null);
```

When `executeUpdateByName` is invoked, these actions are performed:

The RDBMS View requests the `create-user` object to `sql-provider`.

`sql-provider` reads the content of `create-user.sql` and returns it (as a `String` object).

The RDBMS View executes the statement included at `create-user.sql` in the JDBC Data Store.

The RDBMS View and the FileText Provider are perfect mates. Both, in combination, will simplify a lot the process of executing scripts in your database. Just write simple text files with SQL statements and let Warework execute them for you. It is recommended that you check out the documentation associated to the FileText Provider to fully take advantage of this feature.

If we need a generic statement to create new users in the relational database, we can define the script `create-user.sql` with some variables, like this:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME})
```

Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
view.executeUpdateByName("create-user", values, null);
```

Remember that you can also specify `null` values with the `JDBCNullType`:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", JDBCNullType.VARCHAR);

// Create a new user in the database.
view.executeUpdateByName("create-user", values, null);
```

When your script contains multiple statements, you also have to indicate the character that delimits each statement. Suppose we have the following `create-user.sql` script:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME});
INSERT INTO ACTIVE_USERS (ID, NAME) VALUES (${USER_ID});
```

Now we can replace variables in multiple statements with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Create a new user in the database.
view.executeUpdateByName("create-user", values, new Character(';'));
```

We can also use a Provider that is not the default Provider of the View. In this case, we just need to specify the Provider where to retrieve the statement to execute:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Execute a statement from the Provider that we define.
view.executeUpdateByName("another-provider", "create-user", values,
   new Character(';'));
```

This time, the `create-user.sql` statement is not retrieved by the default Provider of the View. The Framework requests this statement from a Provider named "`an-other-provider`" and once it is loaded, then it is executed in the Data Store.

The RDBMS View also allows developers to define a callback object that will be invoked when the operation is done or it fails. Check out the following example:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Redirect to callback object once operation is executed.
view.executeUpdateByName("create-user", values, null,
   new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle successful operation here.
      // 'result' is null in RDBMS update operations.
   }

});
```

Now the RDBMS View redirects the execution to the callback object when `executeUp-dateByName` is invoked. If operation is successful then method `onSuccess` is executed. Otherwise, if any error is found, then method `onFailure` is executed.

As you can see, creating the callback object is fairly easy. It is mandatory to provide a Scope (you can retrieve it from the Data Store Service for example) and implement two

methods. When a callback object is defined for update operations of the RDBMS View (like `executeUpdateByName`), it is important to bear in mind that `onSuccess` method argument is always `null`.

Warework also automatically detects batch operations in scripts with multiple statements so you can perform an operation at `onSuccess` every time a single statement is executed in the Data Store. For example, if we have the following script:

```
INSERT INTO HOME_USER (ID, NAME) VALUES (${USER_ID}, ${USER_NAME});
INSERT INTO ACTIVE_USERS (ID, NAME) VALUES (${USER_ID});
```

We can log the percentage of completion with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the update statement.
values.put("USER_ID", new Integer(3));
values.put("USER_NAME", "Ian Sharpe");

// Redirect to callback object once operation is executed.
view.executeUpdateByName("create-user", values, null,
   new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object r) {
      // This method is executed twice, one for every statement in the
      // 'create-user' script.
      System.out.println("progress: " + getBatch().progress());
   }

});
```

Method `getBatch` provides the following useful information about the batch operation in execution:

- `getBatch().count()`: counts the amount of callbacks executed in the batch operation.
- `getBatch().duration()`: gets how long (in milliseconds) is taking the current batch operation.
- `getBatch().id()`: gets the ID of the batch operation.
- `getBatch().progress()`: gets the percentage of completion of the current batch operation.
- `getBatch().size()`: gets the total of callbacks to perform in the batch operation.
- `getBatch().startTime()`: gets the time (in milliseconds) when the batch operation started.

It is also possible to pass objects / attributes to the callback so you can use them at `onSuccess` or `onFailure`. For this purpose, we have to use a `Hashtable` when the callback is created. Check out this example:

```
// Attributes for the callback.
Hashtable attributes = new Hashtable();

// Set the attributes.
attributes.put("color", "red");
attributes.put("password", new Integer(123));

// Redirect to callback with attributes.
view.executeUpdateByName("statement-name", null, null,
   new AbstractCallback(getScope(), attributes){

   protected void onFailure(Throwable t) {
      String color = (String) getAttribute("color");
   }

   protected void onSuccess(Object r) {
      // Retrieve every attribute name with 'getAttributeNames()'.
      Integer password = (Integer) getAttribute("password");
   }

});
```

Every update operation that we performed in the previous examples is related to the transaction that we created earlier in this section. Once the work is done, you should either commit or rollback the transaction. If the operations were executed without problems, then you should perform `commit` to register the changes in the database:

```
// Commits changes in the Relational Database Management System.
view.commit();
```

In the other hand, if you find a failure, something unexpected happened or you just do not want to register the changes in the database, then you should perform `rollback` to undo every update operation executed since the transaction was started:

```
// Cancel latest update operations.
view.rollback();
```

We have reviewed with this interface how to connect to a database and perform update operations in it with a transaction. Now we are going to focus on query operations to know how to retrieve data from a relational database. The following code is an example to perform this action:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);
```

This code executes the SQL statement into the relational database and returns an object that represents the result provided by the database. By default, this result is in the form of a `ResultRows` object (check out the specific types returned by the implementation class of this View because each Data Store may provide the chance to get a differ-

ent object as result) which represents the table of data returned by the database. It allows iterating each row of the table result and picking up the values of its columns. Check it out with the following example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);

// Iterate rows until the end of the table. First row is 1, second 2 and

// so on. You must perform 'result.next()' at least one time to point
// the cursor to the first row.
while (result.next()) {

   /*
    * For each row we can retrieve the value of each column.
    */

   // Get the boolean value of a column. If the value is SQL NULL
   // (it is null in the database), the value returned is null.
   Boolean column1 = result.getBoolean("COLUMN1");

   // Get the numeric value of a column. You must specify the
   // numeric type to get.
   Short column2A = (Short) result.getNumber("COLUMN2A", Short.class);

   Integer column2B = (Integer) result.getNumber("COLUMN2B",
      Integer.class);

   Long column2C = (Long) result.getNumber("COLUMN2C", Long.class);

   Float column2D = (Float) result.getNumber("COLUMN2D", Float.class);

   Double column2E = (Double) result.getNumber("COLUMN2E",
      Double.class);

   BigDecimal column2F = (BigDecimal) result.getNumber("COLUMN2F",
      BigDecimal.class);

   // Get the string value.
   String column3 = result.getString("COLUMN3");

   // Get the date value.
   Date column4 = result.getDate("COLUMN4");

   // Get the array of bytes.
   byte[] column5 = result.getBlob("COLUMN5");

}
```

When you iterate result rows, you can specify the column (where to get the data) by name or by column index:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);

// Iterate rows.
while (result.next()) {
```

```
    // Get the string value of a given column name.
    String column3A = result.getString("COLUMN3");

    // Get the string value of a given column index.
    String column3B = result.getString(3);

}
```

Another option is to retrieve a whole row as a Java Bean object. To achieve this, you have to provide to `getBean` a class that represents a Java Bean. A new instance of this class is created and used to store the values of the result columns. You may also provide a mapping where to relate result columns with bean attributes. Check it out with one example:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.
    executeQuery("SELECT * FROM HOME_USER", -1, -1);

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");

// Iterate rows.
while (result.next()) {

    // Copy the values of specified columns into the User bean.
    User user = (User) result.getBean(User.class, mapping);

}
```

Warework can also create this mapping automatically when the columns names and bean attributes follow a specific naming convention. Here are the rules for columns and attributes names:

Names of database columns are uppercase, for example: `PASSWORD`. Names of bean attributes are lowercase, for example: `password`.

Spaces in columns names are specified with the underscore character: `DATE_OF_BIRTH`. The attributes of the bean use the camel notation, for example: `dateOfBirth`.

Check out more examples:

`NAME1` equals to `name1`

`NAME_A` equals to `nameA`

`A` equals to `a`

`AA` equals to `aa`

`A_B` equals to `aB`

`A_B_C` equals to `aBC`

If `getBean` method does not receive the mapping configuration, it extracts by reflection the name of every attribute that exist in the given bean class. Each attribute name is converted into the corresponding column name and this column name is finally used to retrieve the value from the database result. If an attribute of the Java Bean does not exist as a result column, then it is discarded. The following example shows how this naming convention simplifies quite a lot the work:

```
// Execute the statement to retrieve some data.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);

// Iterate rows.
while (result.next()) {

   // Copy the values of columns found into the User bean.
   User user = (User) result.getBean(User.class, null);

}
```

You can also transform the database result into a list:

```
// Execute the statement to retrieve some data.
ResultRows resultRows = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);

// Map table result columns with bean attributes.
Hashtable mapping = new Hashtable();

// Map result 'NAME' column with bean 'name' attribute.
mapping.put("NAME", "name");

// Map result 'DATE_OF_BIRTH' column with bean 'dateOfBirth' attribute.
mapping.put("DATE_OF_BIRTH", "dateOfBirth");

// Map result 'PASSWORD' column with bean 'password' attribute.
mapping.put("PASSWORD", "password");

// Create a list with User beans that represent each row from the
// database result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   mapping);
```

It is also possible to use auto-mapping:

```
// Execute the statement to retrieve some data.
ResultRows resultRows = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);
```

```
// Create a list with User beans that represent each row from the
// database result.
Vector resultList = AbstractResultRows.toList(resultRows, User.class,
   null);
```

By default, you will always get a `ResultRows` object with a JDBC Data Store when you run a query. It is also possible to configure this Data Store to retrieve JDBC `ResultSet` objects instead of Warework `ResultRows` objects. To achieve this, you have to configure the JDBC Data Store with `PARAMETER_NativeResultSet`, like this:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the name of the Provider where to retrieve the Connection object.
config.put(JDBCConnector.PARAMETER_NativeResultSet, Boolean.TRUE);

// Create the JDBC Data Store.
datastoreService.createClient("jdbc-datastore", JDBCConnector.class,
config);
```

Once it is configured like this, you will get a `ResultSet` object when you run a query:

```
// Execute the statement and return a JDBC ResultSet object.
ResultSet result = (ResultSet) view.
   executeQuery("SELECT * FROM HOME_USER", -1, -1);
```

Sometimes you may need to limit the number of rows returned by a database when a query operation is performed. Let us say that there are 26 registries or rows in the `HOME_USER` table and that we just expect to retrieve the first 10 rows. We can write something like this:

```
// Get the first 10 rows.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", 1, 10);
```

What is going on right now? When you specify the number of rows that you want in the result of a database, Warework automatically calculates the number of pages that hold this number of rows. In the previous example we specified 10 rows per result and with this information Warework estimates that the size of each page is 10 rows and that there are three pages: page 1 with 10 rows, page 2 with 10 rows and page 3 with 6 rows. If now we need to retrieve the next ten rows, we have to indicate that we want the second page:

```
// Get rows from 11 to 20.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", 2, 10);
```

If we request page number three, we get the last 6 registries from the database. The important fact to keep in mind here is that the number of rows remains as 10:

```
// Get rows from 21 to 26.
ResultRows result = (ResultRows) view.
   executeQuery("SELECT * FROM HOME_USER", 3, 10);
```

With queries, you can also write `SELECT` statements in separate text files (this time, just one statement per file). Suppose that the following code is the content of the `list-users.sql`file:

```
SELECT * FROM HOME_USER
```

If `sql-provider` still is our default Provider, we can read the script like this:

```
// Read the content of 'list-users.sql' and execute it in the database.
ResultRows result = (ResultRows) view.
   executeQueryByName("list-users", null, -1, -1);
```

There is also the possibility to define some variables in the query:

```
SELECT * FROM HOME_USER A WHERE A.ID = ${USER_ID}
```

Now we can assign a value to this variable to complete the query. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the query.
values.put("USER_ID", new Integer(8375));

// Read 'list-users.sql', replace variables and execute the statement.
ResultRows result = (ResultRows) view.
   executeQueryByName("list-users", values, -1, -1);
```

The two last arguments allow you to define the page and maximum number of rows to retrieve. The following example shows how to get the second page with a fixed size of 10 rows per page:

```
// Get the second page with no more than 10 registries in it.
ResultRows result = (ResultRows) view.
   executeQueryByName("list-users", null, 2, 10);
```

We can also define callbacks in query operations. This time, `onSuccess` provides the result of the query:

```
// Handle result with callback object.
view.executeQueryByName("list-users", null, -1, -1,
   new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Do something.
   }

   protected void onSuccess(Object r) {
```

```
        // Get the result form the database.
        ResultRows result = (ResultRows) r;

        // Iterate rows.
        while (result.next()) {

            // Copy the values of columns found into the User bean.
            User user = (User) result.getBean(User.class, null);

        }

    }

});
```

Query operations also allow us to use a different Provider than the default one defined for the View:

```
// Read the content of 'list-users.sql' and execute it in the database.
Object result = view.executeQueryByName("another-provider",
   "list-users", null, -1, -1);
```

As always, when the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Key-Value View for JDBC Data Stores

This View allows you to use a table from a relational database as a Key-Value Data Store. The KeyValueJDBCViewImpl class at `com.warework.service.datastore.client` package implements the `KeyValueView` interface and it provides the necessary methods to achieve this task. To work with it you have to specify a table from a database, which column of this table correspond to the keys (it must be of `String` type) and the column that matches the values for these keys. Now we are going to see how to associate a View of this type with a JDBC Data Store and how to perform operations with the View.

- Setting up the View

  As stated before, in order to work with this View you always have to configure three initialization parameters: the name of a table, the name of the column in this table that represents the keys and the name of the column that represents the values. There is another optional parameter that allows you to define the name of the schema: `PARAMETER_Schema`. You may use it in some relational databases to specify the schema where the table exists. The following example shows you how to setup the configuration for this View:

```
// Create a configuration for the View.
Hashtable parameters = new Hashtable();

// Configure the View with initialization parameters.
parameters.put(KeyValueJDBCViewImpl.PARAMETER_Schema,
   "SAMPLE_SCHEMA");
```

```
parameters.put(KeyValueJDBCViewImpl.PARAMETER_TableName,
   "SAMPLE_TABLE");
parameters.put(KeyValueJDBCViewImpl.PARAMETER_TableKeyField,
   "KEY_COLUNM");
parameters.put(KeyValueJDBCViewImpl.PARAMETER_TableValueField,
   "VALUE_COLUMN");

// Add the Key-Value View for the JDBC Data Store.
datastoreService.addView("jdbc-datastore",
   KeyValueJDBCViewImpl.class, "keyvalue-view", null, parameters);
```

Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="jdbc-datastore"
         connector="com.warework.service.datastore. …
            … client.connector.JDBCConnector">
         <parameters>
            <parameter name="connection-source-provider-name"
               value="datasource-provider"/>
            <parameter name="connection-source-provider-object"
               value="datasource-object-name"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. …
               … client.KeyValueJDBCViewImpl" name="keyvalue-view">
               <parameter name="schema" value="SAMPLE_SCHEMA"/>
               <parameter name="table-name" value="SAMPLE_TABLE"/>
               <parameter name="table-key-field" value="KEY_COLUMN"/>
               <parameter name="table-value-field"
                  value="VALUE_COLUMN"/>
            </view>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

You can also provide short class names to identify Connectors and Views:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="jdbc-datastore" connector="JDBC">
         <parameters>
            <parameter name="connection-source-provider-name"
               value="datasource-provider"/>
            <parameter name="connection-source-provider-object"
               value="datasource-object-name"/>
         </parameters>
         <views>
            <view class="KeyValueJDBC" name="keyvalue-view">
               <parameter name="schema" value="SAMPLE_SCHEMA"/>
               <parameter name="table-name" value="SAMPLE_TABLE"/>
```

```
                <parameter name="table-key-field" value="KEY_COLUMN"/>
                <parameter name="table-value-field"
                   value="VALUE_COLUMN"/>
             </view>
          </views>
       </datastore>
    </datastores>

</datastore-service>
```

- <u>Working with the Key-Value View for JDBC Data Stores</u>

Now we are going to review the basic operations provided by the `KeyValueJDB-CViewImpl` class. Working with this View is fairly easy because the [`KeyValueView`]() interface (package: `com.warework.service.datastore.view`) only exposes a few methods and they all are very simple.

The first operation you have to perform to start working with a Data Store is the `connect` operation. There is no exception with the Key-Value View:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();
```

The following example shows how to add a new `String` value associated to a key in the JDBC Data Store:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();

// Create a new key named 'user.name' or update it.
view.put("user.name", "John Wood");
```

The value field in a JDBC Data Store can be different than `String` type so you can probably store values like `Integer` or `Date`. This limitation is imposed by the underlying database; read the documentation of your database vendor and check out which types are available. This example is completely perfect with this interface:

```
// Get an instance of a Key-Value interface.
KeyValueView view = (KeyValueView) datastoreService.
   getView("jdbc-datastore");

// Connect the JDBC Data Store.
view.connect();

// Create a new key-value or update an existing one.
view.put("user.age", new Integer(25));
```

Now, you can retrieve the value associated to a key like this:

```
// Get the value of the 'user.age' key.
Integer value = (Integer) view.get("user.age");
```

This is how to remove a key and the value associated to it:

```
// Remove a row in a table.
view.remove("user.age");
```

You can also get a list with the names of the keys that exist in the Data Store:

```
// Get every key from the JDBC Data Store.
Enumeration keys = view.keys();
```

To retrieve the number of key-value pairs you have to invoke the `size` method like this:

```
// Count keys in Data Store.
int size = view.size();
```

Once you have performed a set of `put` or `remove` operations, it might be a good idea to perform `commit` to register the changes in the JDBC Data Store:

```
// Commit changes in the JDBC Data Store.
view.commit();
```

When the work is done, you have to disconnect the JDBC Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

JPA Data Store

This Data Store allows you to perform operations with relational databases using the Java Persistence API (JPA). It is a wrapper for JPA that simplifies even more the way you query and update data in a relational database with JPQL statements, XML queries and Java beans with JPA annotations.

You can either use common methods from the Data Store Service like `connect`, `disconnect`, `query`, `update` and `commit`; or perform more specific operations with the JPA implementation provided for the ORM View.

This ORM View for JPA Data Stores allows invoking CRUD (Create, Read, Update and Delete) methods with simple Java Beans. This sample code demonstrates how to perform these operations:

```
// Create a JPA entity.
User user1 = new User();

// Set some data in the Java Bean.
user1.setName("James");
user1.setPassword(new Integer(8713));

// Save the JPA entity in the relational database.
view.save(user1);

// Update some data in the Java Bean.
user1.setName("James Jr.");

// Update the object in the relational database.
view.update(user1);

// Find the same object we just updated.
User user2 = (User) view.find(user1);

// Delete the object in the relational database.
view.delete(user1);
```

With the JPA implementation of the ORM View you can list objects from the database in many different ways, for example, with queries defined in XML files:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

You can also use a Java Bean (with JPA annotations) as a filter for the query:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("John");
filter.setPassword(new Integer(10));

// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for field "password".
order.addAscending("password");

// List users which name is "John", password is 10 and sorted by password.
```

```
List<User> users = (List<User>) view.list(filter, null, order, -1, -1);
```

And this is just a quick example. In this user guide we demonstrate how to enable pagination in database results, execute JPQL statements from text files, define variables in JPQL scripts and much more with the JPA Data Store.

Add a JPA Data Store

To add a JPA Data Store into the Data Store Service you have to invoke method `createClient()` that exists in its Facade with a name, the `JPAConnector` class and a configuration for the Data Store:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Configure here the JPA Data Store.
...

// Create the JPA Data Store.
datastoreService.createClient("jpa-datastore", JPAConnector.class, config);
```

The configuration for this Connector has to specify how to retrieve database connections for the JPA engine. You can configure the JPA Data Store in two different ways.

Configure the JPA Data Store for JSE deployments

For desktop applications, you should configure the JPA Data Store by specifying the name of the persistence unit to use and some configuration parameters for the JPA engine:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Name of the JPA Persistence Unit defined at 'persistence.xml' file.
config.put(JPAConnector.PARAMETER_PersistenceUnit, "my-app-pu");

// JDBC driver class. This one shows the driver for MySQL.
config.put("javax.persistence.jdbc.driver", "com.mysql.jdbc.Driver");

// JDBC URL. This one is a template for MySQL.
config.put("javax.persistence.jdbc.url",
   "jdbc:mysql://host:port/database-name");

// User.
config.put("javax.persistence.jdbc.user", "the-user-name");

// Password.
config.put("javax.persistence.jdbc.password", "the-password");

// Create the JPA Data Store.
datastoreService.createClient("jpa-datastore", JPAConnector.class, config);
```

Check it now how to do it with the Data Store Service XML configuration file (this functionality is provided by Warework Data Store Extension Module):

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   <datastores>
      <datastore name="jpa-datastore" connector=
      "com.warework.service.datastore.client.connector.JPAConnector">
         <parameters>
            <parameter name="persistence-unit"
               value="my-app-pu"/>
            <parameter name="javax.persistence.jdbc.driver"
               value="com.mysql.jdbc.Driver"/>
            <parameter name="javax.persistence.jdbc.url"
               value="jdbc:mysql://host:port/database-name"/>
            <parameter name="javax.persistence.jdbc.user"
               value="the-user-name"/>
            <parameter name="javax.persistence.jdbc.password"
               value="the-password"/>
         </parameters>
      </datastore>
   </datastores>

</datastore-service>
```

This example shows how to configure JPA to use the persistence unit named "`my-app-pu`" from the `/META-INF/persistence.xml` file. Bear in mind that these parameters do not need to be defined again in the `persistence.xml` file.

Configure the JPA Data Store to get database connections with JNDI

This configuration type is frequently used in application servers. The process is similar but this time you have to specify at least two different parameters:

- `JPAConnector.PARAMETER_ClientConnectionProviderName`

  This parameter defines the name of a JNDI Provider that exists in a Scope. This Provider is used to retrieve the JPA database connection (an instance of `EntityManager`) via JNDI so, in order to make it work; this Provider must be running before an object is requested to it. Review the documentation of the JNDI Provider before configuring the JPA Data Store like this.

- `JPAConnector.PARAMETER_ClientConnectionProviderObject`

  This parameter identifies the name of the JPA database connection in the JNDI context. It is used by the Data Store to instruct the JNDI Provider which object to retrieve.

  In Java EE environments, the JNDI name for the JPA connection can be specified in different places. For example, in Servlets you can use the `@PersistenceContext` annotation for this purpose:

  ```
  @PersistenceContext(name = "persistence/em", unitName = "my-app-pu")
  ```

  In this example, "`persistence/em`" represents the JNDI name and "`my-app-pu`" which JPA persistence unit to use from the `persistence.xml` file. Review the docu-

mentation of your JEE application server to better understand how and where this JNDI name can be defined.

- `JPAConnector.PARAMETER_UserTransactionProviderObject`

  This is an optional parameter. It identifies the name of the JTA user transaction in the JNDI context. If this parameter is not specified, the default JNDI name used to retrieve the transaction is "`java:comp/UserTransaction`". If you need to use a different JNDI name then you can set that name with this parameter.

The following example shows how to configure the JPA Data Store to use JNDI:

```
// Create the configuration for the Data Store.
Hashtable config = new Hashtable();

// Set the name of the JNDI Provider.
config.put(JPAConnector.PARAMETER_ClientConnectionProviderName,
   "jndi-provider");

// Set the JNDI name of the JPA database connection.
config.put(JPAConnector.PARAMETER_ClientConnectionProviderObject,
    "persistence/em");

// Create the JPA Data Store.
datastoreService.createClient("jpa-datastore", JPAConnector.class, config);
```

In this example, a JNDI Provider named "`jndi-provider`" must exist in order to retrieve the database connection.

Check it now how to configure it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/datastore
   -service-1.1.0.xsd">

   <datastores>
      <datastore name="jpa-datastore" connector=
      "com.warework.service.datastore.client.connector.JPAConnector">
         <parameters>
            <parameter name="client-connection-provider-name"
               value="jndi-provider"/>
            <parameter name="client-connection-provider-object"
               value="persistence/em"/>
         </parameters>
      </datastore>
   </datastores>

</datastore-service>
```

Working with the JPA Data Store

Like every Data Store, you can perform operations with JPA Data Stores in the Data Store Service Facade. Now we are going to review the basic JPA Data Store operations provided by the `DatastoreServiceFacade` interface. We can group these operations as follows:

- Connect and disconnect JPA Data Stores

  The first operation you have to invoke to start working with a JPA Data Store is `connect`:

```
// Connect with the relational database.
datastoreService.connect("jpa-datastore");
```

  After you perform the connection, you typically will execute other JPA Data Store operations like `query` or `update`. Once the job is done, you will need to close the JPA Data Store:

```
// Disconnect with the relational database.
datastoreService.disconnect("jpa-datastore");
```

- Query JPA Data Stores

  There are two methods, both named `query`, where you can retrieve information from the relational database. The first one allows you to directly execute a JPQL statement (JPA Query Language):

```
// Run a SELECT statement in the relational database.
List<User> result = (List<User>) datastoreService.
   query("jpa-datastore", "SELECT u FROM User u");
```

  In this example, the JPA Data Store returns a list of `User` objects that represents the result of a query. JPA runs the query in the database and maps each row of the result into a Java Bean configured with JPA annotations.

  Execute query statements from text files

  Another way to search for data in a JPA Data Store is by loading and executing JPQL statements that exist in a FileText Provider. This functionality allows you to read queries from text files and run them in the JPA Data Store, for example: you can setup a FileText Provider to read JPQL statements from text files and execute each one in the relational database, just by specifying the name of the Provider and the name of the text file to read.

  For the next sample code we are going to suppose that there is a FileText Provider named `jpql-provider` that reads text files from a specific directory. When you request an object from this Provider, the name given is used to read the file. For example: if we request an object named `list-users`, this Provider looks for a file named `list-users.jpql` in the directory, reads the file and return its content as a `String` object. After that, the String returned (which represents a JPQL statement) is used to execute the query in the database. This is the example:

```
// Read a statement from a text file and execute if in the database.
List<User> result = (List<User>) datastoreService.
   query("jpa-datastore", "jpql-provider", "list-users", null);
```

With this utility you can save prepared statements in a directory for a JPA Data Store. You can also define some variables for these queries and replace them later on with specific values. Suppose that `list-users.jpql` contains the following code:

```
SELECT u FROM User u WHERE u.id = ${USER_ID}
```

In this query we have defined a variable named `USER_ID`. We can assign a value to this variable to complete the query and then run it in the JPA Data Store. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the JPQL statement.
values.put("USER_ID", new Integer(8375));

// Query the JPA Data Store.
List<User> result = (List<User>) datastoreService.
   query("jpa-datastore", "jpql-provider", "list-users", values);
```

- Update JPA Data Stores

  The `update` method of the Data Store Service Facade allows you to execute `UPDATE` and `DELETE` JPQL statements. With this method it is also possible to store and update entities (Java Beans with JPA annotations) in the database.

  A very important fact to keep in mind about the `update` method in the JPA Data Store is that it automatically begins a transaction with the database if anyone exists. When a database transaction already exists, then Warework forces JPA to join with the active transaction.

Running `UPDATE` and `DELETE` JPQL statements

```
// Update one row.
datastoreService.update("jpa-datastore", null,
   "UPDATE User u SET u.name = 'George Brown' WHERE u.id = 591");

// Delete one row.
datastoreService.update("jpa-datastore", null,
   "DELETE FROM User u WHERE u.id=591");
```

Save or update JPA entities

```
// Create a new entity.
User user = new User();

// Set user attributes.
user.setName("George Brown");

// Create or update the user in the database.
datastoreService.update("jpa-datastore", null,
   user);
```

Execute update or delete statements from text files

Let us say that we want to delete a user from the database, we can define a script named `delete-user.sql` like this:

```
DELETE FROM User u WHERE u.id=${USER_ID}
```

Then replace these variables with the values that you need:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the delete statement.
values.put("USER_ID", new Integer(3));

// Delete the user in the database.
datastoreService.update("jpa-datastore", null, "jpql-provider",
   "delete-user", values);
```

- Commit JPA Data Stores

  You can commit changes just by providing the name of the JPA Data Store:

```
// Commit changes.
datastoreService.commit("jpa-datastore");
```

ORM View for JPA Data Stores

The `JPAViewImpl` class (package: `com.warework.service.datastore.client`) is a View that implements the `ORMView` interface and it provides a facade where to perform relational database operations in a object-oriented way. Now we are going to see how to associate a View of this type with a JPA Data Store and how to perform operations with the View.

- Setting up the View

  There is no need to configure this View with initialization parameters, so just add the View in the stack of Views of the JPA Data Store:

```
// Add the ORM View for JPA Data Stores.
datastoreService.addView("jpa-datastore",
   JPAViewImpl.class, "view-name", null, null);
```

Check it now how to do it with the Data Store Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
```

```
      <datastore name="jpa-datastore"
         connector="com.warework.service.datastore. …
            … client.connector.JPAConnector">
         <parameters>
            <parameter name="persistence-unit"
               value="my-app-pu"/>
            <parameter name="javax.persistence.jdbc.driver"
               value="com.mysql.jdbc.Driver"/>
            <parameter name="javax.persistence.jdbc.url"
               value="jdbc:mysql://host:port/database-name"/>
            <parameter name="javax.persistence.jdbc.user"
               value="the-user-name"/>
            <parameter name="javax.persistence.jdbc.password"
               value="the-password"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. ...
               … client.JPAViewImpl" name="view-name"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

You can also provide short class names to identify Connectors and Views:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="jpa-datastore" connector="JPA">
         <parameters>
            <parameter name="persistence-unit"
               value="my-app-pu"/>
            <parameter name="javax.persistence.jdbc.driver"
               value="com.mysql.jdbc.Driver"/>
            <parameter name="javax.persistence.jdbc.url"
               value="jdbc:mysql://host:port/database-name"/>
            <parameter name="javax.persistence.jdbc.user"
               value="the-user-name"/>
            <parameter name="javax.persistence.jdbc.password"
               value="the-password"/>
         </parameters>
         <views>
            <view class="JPA" name="view-name"/>
         </views>
      </datastore>
   </datastores>

</datastore-service>
```

- Working with the ORM View for JPA Data Stores

  Now we are going to review the methods provided by the `JPAViewImpl` class. This ORM View allows the following operations with objects:

  Save: Stores an instance of a JPA entity in the relational database as a new row in one table. Each entity attribute is associated with each column of the database. For example:

```
// Create a JPA entity.
User user = new User();

// Set some data in the entity.
user.setId(new Integer(8713)); // This is the Primary Key
user.setName("James");
user.setDateOfBirth(new Date());

// Save the JPA entity with the ORM View.
view.save(user);
```

When `save` operation is executed, the JPA engine will create the corresponding SQL code to insert a new record in the database, something like this:

```
INSERT INTO USER (ID, NAME, DATE_OF_BIRTH)
   VALUES (8713, 'John Wood', '2013/03/07')
```

Once the statement is created, JPA runs it in the database and the object is stored in the table.

Update: Updates one row in a table of the database with the values of a given object.

Delete: Removes one row in a table of the database that matches the values of a given object.

Find: Retrieves an object from the database that represents a specific row of a table.

List: Retrieves a list of objects from the table where each object represents one row.

Count: Counts objects in the database.

This ORM View also allows executing query and update statements in JPQL (JPA Query Language) which allows developers to create statements like SQL but in an object-oriented way.

Connect with the database

Even before you perform any of these operations, what you have to do first is to connect to the database:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the JPA Data Store.
view.connect();
```

Begin a transaction in the database

In the following examples we are going to save some information in the database but before that, it is recommended to begin a transaction with the database.

A transaction comprises a unit of work performed within a database management system, and treated in a coherent and reliable way independent of other transactions. Transactions in a database environment have two main purposes:

> To provide reliable units of work that allow correct recovery from failures and keep a database consistent even in cases of system failure, when execution stops (completely or partially) and many operations upon a database remain uncompleted, with unclear status.
>
> To provide isolation between programs accessing a database concurrently. If this isolation is not provided the programs outcome are possibly erroneous.

Transactions provide an "all-or-nothing" proposition, stating that each work-unit performed in a database must either complete in its entirety or have no effect whatsoever. Further, the system must isolate each transaction from other transactions, results must conform to existing constraints in the database, and transactions that complete successfully must get written to durable storage.

To begin a transaction in a relational database management system you have to perform the following actions:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the JPA Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();
```

Save an object

Now it is the right time to perform some CRUD (Create, Read, Update, Delete) operations. First, we are going to save one object in the database (insert one or multiple row):

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));

// Save the Java Bean in the data store.
view.save(user);
```

You can also invoke this method with a callback object. This object will be invoked when the operation is done or fails. Check out the following example

```
// Connect the Data Store.
view.connect();

// Begin a transaction in the database management system.
view.beginTransaction();

// Create a Java Bean.
User user = new User();

// Set some data in the Java Bean.
user.setName("James");
user.setDateOfBirth(new Date());
user.setPassword(new Integer(8713));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Handle successful operation here.
      // 'result' is the object just saved.
      User user = (User) result;

      // Display user name.
      System.out.println("User name: " + user.getName());

   }

});
```

It is also possible to pass objects / attributes to the callback so you can use them at `onSuccess` or `onFailure`. For this purpose, we have to use a `Hashtable` when the callback is created. Check out this example:

```
// Attributes for the callback.
Hashtable attributes = new Hashtable();

// Set the attributes.
attributes.put("color", "red");
attributes.put("password", new Integer(123));

// Save the Java Bean in the data store.
view.save(user, new AbstractCallback(getScope(), attributes){

   protected void onFailure(Throwable t) {
      String color = (String) getAttribute("color");
   }

   protected void onSuccess(Object result) {
      // Retrieve every attribute name with 'getAttributeNames()'.
      Integer password = (Integer) getAttribute("password");
   }

});
```

Now we are going to save multiple objects with just one line of code. You can save an array or a collection of objects like this:

```
// Save three Java Beans in the data store.
view.save(new User[]{user1, user2, user3});
```

With the JPA Data Store, the Framework will start a batch operation automatically when a collection or array is given. Batch operations are very useful because they allow us to track each operation executed. The following example stores a collection of Java Beans and displays data about the batch operation:

```
// We can also save collections.
List<User> users = new ArrayList<User>();

// Set some users in the collection.
users.add(user1);
users.add(user2);
users.add(user3);

// Save the collection in the data store.
view.save(users, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // This callback method is invoked three times, one for.
      // each object to save.

      // Get current object saved.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items saved.
      System.out.println("Total saved: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% saved: " + getBatch().progress());

   }

});
```

Method `getBatch` provides the following useful information about the batch operation in execution:

- `getBatch().count()`: counts the amount of callbacks executed in the batch operation.
- `getBatch().duration()`: gets how long (in milliseconds) is taking the current batch operation.
- `getBatch().id()`: gets the ID of the batch operation.

- `getBatch().progress()`: gets the percentage of completion of the current batch operation.

- `getBatch().size()`: gets the total of callbacks to perform in the batch operation.

- `getBatch().startTime()`: gets the time (in milliseconds) when the batch operation started.

Update objects

Previously stored objects (rows) in the database can be updated later on with new values:

```
// Update some data in the Java Bean.
user.setName("James Jr.");

// Update the object in the data store.
view.update(user);
```

You can also use callbacks and update multiple objects (arrays or collections) with batch operations:

```
// Update three Java Beans in the data store.
view.update(new User[]{user1, user2, user3},
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object updated.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items updated.
      System.out.println("Total updated: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% updated: " + getBatch().progress());

   }

});
```

Delete objects

The following example shows how to delete one object (removes the row from the table):

```
// Delete the object in the data store.
view.delete(user);
```

You can also use callbacks and delete arrays or collections with batch operations:

```
// Delete three Java Beans in the data store.
view.delete(new User[]{user1, user2, user3},
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get current object deleted.
      User user = (User) result;

      // Display user name.
      System.out.println("Current user name: " + user.getName());

      // Display items deleted.
      System.out.println("Total deleted: " + getBatch().count());

      // Display percentage of completion.
      System.out.println("% deleted: " + getBatch().progress());

   }

});
```

To remove every object of a specific type, we have to provide the class:

```
// Delete all users in the data store.
view.delete(User.class);
```

This will delete every row in the table (this operation is executed in just one step because the relational database allows it). The following example shows now how to remove a set of objects specified in a query:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Delete every user which name is 'Carl'.
view.delete(query);
```

We will show soon how to configure `Query` objects. By now just bear in mind that we can delete objects with queries too.

If the query is in the form of an XML file, you can load the query and delete the objects returned like this:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null);
```

This method uses a Provider to load the query from an XML file. Review later on how to list objects with XML files. We explain in detail there how this mechanism works and the same rules apply for `executeDeleteByName`. Also, like we have seen before, you can use callback here:

```
// Delete every user specified by "list-users" query.
view.executeDeleteByName("list-users", null,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }

});
```

If the query accepts parameters, you can update the query with a `Hashtable`:

```
// Attributes for the query.
Hashtable filter = new Hashtable();

// Set the attributes.
filter.put("name", "John");

// Delete every user named "John".
view.executeDeleteByName("list-users", filter,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {
      // Handle each object deleted here.
   }

});
```

Commit or rollback a transaction

Every update operation that we performed in the previous examples is related to the transaction that we created before. Once the work is done, you should either commit or rollback the transaction. If the operations were executed without problems, then you should perform `commit` to register the changes in the database:

```
// Commits changes in the Relational Database Management System.
view.commit();
```

In the other hand, if you find a failure, something unexpected happened or you just do not want to register the changes in the database, then you should perform `rollback` to undo every update operation executed since the transaction was started:

```
// Cancel latest update operations.
view.rollback();
```

Find an object in the database

Now we are going to see how to retrieve objects from the database. Depending on how many objects we want to get, we can perform two different types of operations.

To search for a specific object from the database (one row in a table of the database) you have to invoke the `find` method. This method requires you to provide an object of the same type as the one you want to retrieve, with some data in it so it will be used as a filter to find the object in the database.

Let's see some sample code. Suppose that there is a user named `Steve` in the relational database, we could retrieve an object instance that represents this user like this:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect the JPA Data Store.
view.connect();

// Create the filter to find the object.
User filter = new User();

// Set the primary key.
filter.setId(new Integer(652));

// Search the user by primary key.
User user = (User) view.find(filter);
```

The object that represents that specific row from the database is returned with all its data associated to it. The idea is that developers can search for an object just by providing some of its attributes and retrieve the same object type with the last information it had when it was stored or updated in the database. Bear in mind that an exception is thrown if more than one object is found in the database. This method just searches for a single object in the database. In order to retrieve a collection of objects, you should invoke different methods.

List objects from the database

Warework provides three different ways to retrieve a list of objects from a database. The first one works similar as the `find` method, but this time you will get a collection of objects (instead of one single object). Check it out with an example:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(…);

// Connect with the relational database.
view.connect();

// Create the filter to find the objects.
User filter = new User();
```

```
// Set the data required to find the objects in the database.
filter.setPassword(new Integer(8713));

// List every row from USER table which password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

The main characteristic of this method is that it creates a query where every non-null attribute of the given object is combined with `AND` expressions, for example:

```
// Create the filter to find the objects.
User filter = new User();

// Set the data required to find the objects in the database.
filter.setName("Steve");
filter.setPassword(new Integer(8713));

// Find "User" objects which name is "Steve" and password is "8713".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

When this operation is executed, the JPA engine creates a query that may look like this:

```
SELECT * FROM USER WHERE ((NAME = 'Steve') AND (PASSWORD = 8713))
```

Also, when objects of the data model are related each other (typically, 1:1 relationships), every non-null attribute of the related objects is used to build the query. For example:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("jr@mail.com");

// Create the filter to find User objects.
User filter = new User();

// Set the data required to find User objects in the database.
filter.setName("John");
filter.setContact(contact);

// Find "User" objects which name is "John" and email is "jr@mail.com".
List<User> users = (List<User>) view.list(filter, null, null, -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER A, CONTACT B
   WHERE ((B.USER = A.ID) AND (A.NAME = 'John') AND
          (B.EMAIL = 'jr@mail.com'))
```

While the `AND` expression is always used to create the query (there is no chance to modify this type of expression in this method), you can indicate which specific operation must be performed in the attributes of the object. By default, the equal operator is used when a non-null attribute is found but it is possible to use different ones like: not equals to, greater than, greater than or equals to, less than, less than or equals to, like, not like,

is null or is not null. The following example shows how to list `User` objects which name is `Steve` and password is greater than `100`:

```
// Create the filter to find the objects.
User f = new User();

// Set the data required to find the objects in the database.
f.setName("John");
f.setPassword(new Integer(100));

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("password", Operator.GREATER_THAN);

// Find "User"s which name is "John" and password is greater than "100".

List<User> users = (List<User>) view.list(f, operator, null, -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE ((NAME = 'John') AND (PASSWORD > 100))
```

It is also possible to change the operator in referenced objects:

```
// Create the filter to find an user by its contact.
Contact contact = new Contact();

// Set the data required to find User objects by its email.
contact.setEmail("steve@mail.com");

// Create the filter to find User objects.
User f = new User();

// Set the data required to find User objects in the database.
f.setName("Steve");
f.setContact(contact);

// Define which operators to use.
Hashtable operator = new Hashtable();

// Set which operation to perform for each attribute of the filter.
operator.put("contact.email", Operator.LIKE);

// Find "User" objects which name is Steve and email is like
// "steve@mail.com".
List<User> users = (List<User>) view.list(f, operator, null, -1, -1);
```

This is the generated query:

```
SELECT * FROM USER A, CONTACT B
   WHERE ((B.USER = A.ID) AND (A.NAME = 'Steve') AND
          (B.EMAIL LIKE 'steve@mail.com'))
```

What if you just want to list all the objects of the same type? In this case you can provide just the class instead of an object instance:

```
// List every row from USER table.
List<User> users = (List<User>) view.list(User.class, null, null,
   -1, -1);
```

When you provide a class you can only specify two operators: `IS_NULL` and `IS_NOT_NULL`. This is because you cannot provide the values of the fields in a class. For example:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// List every row from USER table which NAME column is not null.
List<User> users = (List<User>) view.list(User.class, operator, null,
    -1, -1);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE (NAME IS NOT NULL)
```

The same way we did before we can use a callback object in this method. Just bear in mind that now the result of the operation is provided by the callback `onSuccess` method:

```
// Define which operators to use.
Hashtable operator = new Hashtable();

// Set only IS_NULL or IS_NOT_NULL operators.
operator.put("name", Operator.IS_NOT_NULL);

// Find every "User" which name is not null.
view.list(User.class, null, null, -1, -1,
      new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get database query result.
      List<User> users = (List<User>) result;

      // Handle collection here...

   }

});
```

Sort results

The third argument of the `list` method allows us to define how to sort the results. It is fairly easy:

```
// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for column "NAME".
order.addAscending("name");

// List every row from USER table sorted by name.
List<User> users = (List<User>) view.list(User.class, null, order,
    -1, -1);
```

The result of this operation will be a list of all users sorted in ascending order. The query generated looks like this:

```
SELECT * FROM USER ORDER BY NAME ASC
```

Pagination

Sometimes you may need to limit the number of objects returned by the JPA engine when a query operation is performed. Let us say that there are 26 rows in `USER` table and that we just expect to retrieve the first 10 rows/objects. We can write something like this:

```
// Get the first 10 objects.
List<User> users = (List<User>) view.list(User.class, null, null,
    1, 10);
```

What is going on right now? When you specify the number of objects that you want in the result of a database, Warework automatically calculates the number of pages that hold this number of objects. In the previous example we specified 10 objects per result and with this information Warework estimates that the size of each page is 10 objects and that there are three pages: page 1 with 10 objects, page 2 with 10 objects and page 3 with 6 objects. If now we need to retrieve the next ten objects, we have to indicate that we want the second page:

```
// Get objects from 11 to 20.
List<User> users = (List<User>) view.list(User.class, null, null,
    2, 10);
```

If we request page number three, we get the last 6 objects from the database. The important fact to keep in mind here is that the number of objects remains as 10:

```
// Get objects from 21 to 26.
List<User> users = (List<User>) view.list(User.class, null, null,
    3, 10);
```

Creating custom queries with `Query` object

Warework also gives the possibility to create `Query` objects where to specify all the characteristics we had seen before. These `Query` objects allows to define `AND`, `OR` and `NOT` expressions as well, so they are more useful in certain cases. The following example shows how to run a simple query with this object:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// List every row from USER table.
List<User> users = (List<User>) view.list(query);
```

This example retrieves every row from `USER` table of the database. To filter the results, we have to create a `Where` clause for the query. Let's see how to filter the query by specifying a value for the `name` attribute of the `User` object:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause. You must provide an instance of ScopeFacade.

Where where = query.getWhere(true);

// Set an expression like: (name = 'Steve').
where.setExpression(where.createEqualToValue("name", "Steve"));

// List every row from USER table which name is 'Steve'.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE (NAME = 'Steve')
```

One great feature about `Query` objects is that you can assign values from different sources to the attributes of the object that define the search criteria. This is handled with Warework Providers, that is, you have to create an expression for the `Where` clause which gets the value from a Provider and assigns this value to the attribute of the object. For example, suppose that we have a Provider named "`password-provider`" which returns the password for a given user name. To search for a user which matches the password given by the Provider, we can create a query like this:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Filter by password; assign to password the value of the Provider.
where.setExpression(where.createEqualToProviderValue("password",
   "password-provider", "steve"));

// List "User" objects which name is 'Steve'.
List<User> users = (List<User>) view.list(query);
```

This time, the value for the attribute is not directly assigned by the developer; instead, it is assigned with the value returned by the Provider. So, if "`password-provider`" returns `8713` for "`steve`", then the query created looks like this:

```
SELECT * FROM USER WHERE (PASSWORD = 8713)
```

Now we are going to create one `AND` expression to filter the query with two attributes. Check it out with the following example:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(where.createLikeValue("name", "Steve"));
and.add(where.createGreaterThanValue("password", new Integer(1000)));

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" which name is like 'Steve' and password is greater
// than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates a query like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') AND (PASSWORD > 1000))
```

`OR` expressions with `Query` objects

With `Query` objects you can also specify `OR` expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create one OR expression.
Or or = where.createOr();

// Filter by name and password.
or.add(where.createLikeValue("name", "Steve"));
or.add(where.createGreaterThanValue("password", new Integer(1000)));

// Set the OR expression in the WHERE clause.
```

```
where.setExpression(or);

// List "User" which name is like 'Steve' or password is greater
// than 1000.
List<User> users = (List<User>) view.list(query);
```

This operation creates this query:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') OR (PASSWORD > 1000))
```

Of course, you can create more complex queries. The following example shows you how to mix multiple `AND`, `OR` and `NOT` expressions:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Create OR expression.
Or or1 = where.createOr();

// Filter by name.
or1.add(where.createLikeValue("name", "Arnold"));
or1.add(where.createLikeValue("name", "David"));

// Create NOT expression.
Not not = where.createNot(or1);

// Create another OR expression.
Or or2 = where.createOr();

// Filter by password.
or2.add(where.createGreaterThanValue("password", new Integer(1000)));
or2.add(where.createLessThanValue("password", new Integer(5000)));

// Create one AND expression.
And and = where.createAnd();

// Filter by name and password.
and.add(not);
and.add(or2);

// Set the AND expression in the WHERE clause.
where.setExpression(and);

// List "User" objects.
List<User> users = (List<User>) view.list(query);
```

And this is the query representation:

```
SELECT * FROM USER WHERE (NOT ((NAME LIKE 'Arnold') OR
    (NAME LIKE 'David')) AND ((PASSWORD > 1000) OR (PASSWORD < 5000)))
```

Order and pagination with `Query` objects

`Query` objects also allow you to define the order of the results and which page to retrieve from the database. The following example shows you how to list the first ten users sorted by name in ascending order:

```
// Define the query.
Query query = new Query(getScope());

// Set the type of objects to look for.
query.setObject(User.class);

// Define the order of the results.
OrderBy order = new OrderBy();

// Set ascending order for field "name".
order.addAscending("name");

// Set order by.
query.setOrderBy(order);

// Set which page to get from the result.
query.setPage(1);

// Set maximum number of objects to get in the result.
query.setPageSize(10);

// List the first ten "User" objects sorted by name in ascending order.
List<User> users = (List<User>) view.list(query);
```

List objects with XML queries

Making queries with `Query` object is very useful when you have to dynamically create the query (you are free to create the query the way you need it) but, in certain cases, it is better for the programmer to create queries in separate XML files because they can be managed outside the Java code and they are easier to understand.

A very convenient way to keep object queries in separate files consist of keeping each statement in an independent XML file, for example: `find-user.xml`, `list-users.xml`, etc. Later on we can read these XML files with an Object Query Provider and use this Provider to read the statements for the JPA engine. Remember that you can define a default Provider for a View when you associate a View to a Data Store:

```
// Add a View and link a Provider to it.
datastoreService.addView("jpa-datastore", JPAViewImpl.class,
   "view-name", "object-query-provider", null);
```

The `object-query-provider` now can be used in the View as the default Provider to read XML queries from a specific directory. Let us say we have the following content for `find-steve.xml`:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
```

```
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

If `object-query-provider` is the default Provider in an ORM View, we can read the content of this file with the following code:

```
// Read the content of 'find-steve.xml' and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-steve",
    null, -1, -1);
```

When `executeQueryByName` is invoked, these actions are performed:

The ORM View requests the `find-steve` object to `object-query-provider`.

`object-query-provider` reads the content of `find-steve.xml` and returns it (as a `Query` object).

The ORM View executes the statement included at `find-steve.xml` in the relational database.

The ORM View and the Object Query Provider are perfect mates. Both, in combination, will simplify a lot the process of executing query statements in your database. Just write simple XML files and let Warework execute them for you. It is recommended that you check out the documentation associated to the Object Query Provider to fully take advantage of this feature.

Operators

In XML queries you can specify operators like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
```

```
   </where>

</query>
```

And you can also use short keywords to identify them:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQ</operator>
         <value-operand>
            <type>java.lang.String</type>
            <value>Steve</value>
         </value-operand>
      </expression>
   </where>

</query>
```

Previous examples perform the same operation. Check out the following table to review which operators are supported and which short names you can use:

OPERATOR	FULL NAME	SHORT NAME
=	EQUAL_TO	EQ
!=	NOT_EQUAL_TO	NE
<	LESS_THAN	LT
<=	LESS_THAN_OR_EQUAL_TO	LE
>	GREATER_THAN	GT
>=	GREATER_THAN_OR_EQUAL_TO	GE
IS NULL	IS_NULL	IN
IS NOT NULL	IS_NOT_NULL	NN
LIKE	LIKE	LK
NOT LIKE	NOT_LIKE	NL

Value types

In XML queries you can specify different value types and some of them with short names. For example, the previous query can be written as:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
```

```
            <operator>EQ</operator>
            <value-operand>
               <type>string</type>
               <value>Steve</value>
            </value-operand>
         </expression>
      </where>

   </query>
```

The following table summarizes which data types can be used with short names:

OBJECT TYPE	SHORT NAME
`java.lang.Boolean`	boolean
`java.lang.Byte`	byte
`java.lang.Short`	short
`java.lang.Integer`	int or integer
`java.lang.Long`	long
`java.lang.Float`	float
`java.lang.Double`	double
`java.lang.Character`	char or character
`java.lang.String`	string
`java.util.Date`	date

`AND`, `OR` and `NOT` expressions in XML queries

With XML Object Queries you can write the same queries as the one you will code with `Query` objects. These XML queries also allow defining `AND`, `OR` and `NOT` expressions as well, for example:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <and>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </and>
   </where>

</query>
```

This XML query is converted into something like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') AND (PASSWORD > 1000))
```

Check it out now with an OR expression:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <or>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </or>
   </where>

</query>
```

Now, this XML query looks like this:

```
SELECT * FROM USER WHERE ((NAME LIKE 'Steve') OR (PASSWORD > 1000))
```

The following example shows a more complex query with AND, OR and NOT expressions:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <not>
         <and>
            <expression>
               <attribute>name</attribute>
               <operator>NOT_LIKE</operator>
```

```
            <value-operand>
               <type>java.lang.String</type>
               <value>James</value>
            </value-operand>
         </expression>
         <or>
            <expression>
               <attribute>name</attribute>
               <operator>NO_LIKE</operator>
               <value-operand>
                  <type>java.lang.String</type>
                  <value>Arnold</value>
               </value-operand>
            </expression>
            <expression>
               <attribute>name</attribute>
               <operator>IS_NOT_NULL</operator>
            </expression>
         <or>
      </and>
   <not>
</where>

</query>
```

This is the output for the query:

```
SELECT * FROM USER WHERE NOT ((NAME NOT LIKE 'James') AND
    ((NAME NOT LIKE 'Arnold') OR (NAME IS NOT NULL)))
```

Setting date values in XML queries

Before we proceed with more different examples, keep in mind that it is also possible to assign date values to the attributes:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>EQUAL_TO</operator>
         <value-operand>
            <type>java.util.Date</type>
            <value>1967/08/12</value>
            <format>yyyy/MM/dd</format>
            <locale>en_US</locale>
            <time-zone>europe/london</time-zone>
         </value-operand>
      </expression>
   </where>

</query>
```

With this information, Warework will try to parse the date and assign its value to the attribute. While `locale` and `time-zone` are not mandatory, you should always provide the `format` to properly parse the date. Check out some available locale codes here:

http://docs.oracle.com/javase/1.4.2/docs/guide/intl/locale.doc.html

Review how to retrieve `time-zone` codes in the following location:

http://docs.oracle.com/javase/1.4.2/docs/api/java/util/TimeZone.html

In XML queries it is also possible to assign values to attributes which come from defined variables or Providers.

Creating variables in XML queries

First we are going to review how to define a variable for an attribute. It is simple: by one side, you have to create an expression in the XML query and define in there a name for a variable. This variable will be replaced later on at runtime with the values specified by the developer. The following `find-user.xml` query file defines a variable for the `name` attribute of the `User` object:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>name</attribute>
         <operator>LIKE</operator>
         <variable-operand name="USER_NAME"/>
      </expression>
   </where>

</query>
```

Now that we have defined a variable for the `name` attribute, we can replace this variable with a specific value as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the query.
values.put("USER_NAME", "Steve");

// Read 'find-user.xml', replace variables and execute it.
List<User> users = (List<User>) view.executeQueryByName("find-user",
    values, -1, -1);
```

Once the value is assigned to the variable, the output query looks like this:

```
SELECT * FROM USER WHERE (NAME LIKE 'Steve')
```

We can perform a similar action with a Provider. With Providers, instead of defining a variable in the query, we specify an object from a Provider that will be used as the value for the attribute. For example, suppose that we have a Provider named `password-provider` which returns user's passwords, that is, if we request object "`steve`", the Provider will return something like "`3425`". The following query shows how to assign the object named "`steve`" in Provider "`password-provider`" to the "`password`" attribute.

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.1.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <expression>
         <attribute>password</attribute>
         <operator>EQUALS_TO</operator>
         <provider-operand>
            <provider-name>password-provider</provider-name>
            <provider-object>steve</provider-object>
         </provider-operand>
      </expression>
   </where>

</query>
```

After the value "`3425`" is retrieved from the Provider and it is assigned to "`password`", this query is shown as follows:

```
SELECT * FROM USER WHERE (PASSWORD = 3425)
```

<u>Running JPQL statements</u>

This ORM View also allows executing JPQL `UPDATE` and `DELETE` statements. The following fragment of code shows how to execute a JPQL `UPDATE` statement in the relational database with the JPA engine:

```
// Get an instance of an ORM View interface.
ORMView view = (ORMView) datastoreService.getView(...);

// Connect with the relational database.
view.connect();

// Begin a transaction in the relational database.
view.beginTransaction();

// Create the JPQL statement to execute.
String jpql = "UPDATE User u SET u.name = 'Alfred' WHERE u.id = 591";

// Run the JPQL update statement.
view.executeUpdate(jpql, null);
```

```
// Commit changes.
view.commit();
```

Another option is to execute multiple statements at once. You can do it by specifying a separator character which delimits each statement:

```
// JPQL statement to update first user.
String jpql1 = "UPDATE User u SET u.name = 'Alfred' WHERE u.id = 591";

// JPQL statement to update second user.
String jpql2 = "UPDATE User u SET u.name = 'John' WHERE u.id = 8";

// JPQL statement to update third user.
String jpql3 = "UPDATE User u SET u.name = 'Marcus' WHERE u.id = 63";

// Execute three JPQL update statements at once.
view.executeUpdate(jpql1 + ";" + jpql2 + ";" + jpql3,
   new Character(';'));
```

Running JPQL scripts

If you define a default Provider for this View that reads plaint text files, like Warework FileText Provider, you can read `.jpql` scripts and execute them in the database very easily. This time, instead of setting up the View with the Object Query Provider, we specify that the default Provider is a FileText Provider that reads `.jpql` statements from a specific directory:

```
// Add a View and link a Provider to it.
datastoreService.addView("sample-datastore", SampleViewImpl.class,
   "view-name", "jpql-provider", null);
```

The `jpql-provider` Provider now can be used in the View as the default Provider to read text files from a specific directory. Let us say we have the following content for `update-user.jpql`:

```
UPDATE User u SET u.name = 'John' WHERE u.id = 8
```

If `jpql-provider` is the default Provider in an ORM View, we can read the content of this file with the following code:

```
// Read the content of 'update-user.jpql' and execute it.
view.executeUpdateByName("update-user", null, null);
```

When `executeUpdateByName` is invoked, these actions are performed:

The ORM View requests the `update-user` object to `jpql-provider`.

`jpql-provider` reads the content of `update-user.jpql` and returns it (as a `String` object).

The ORM View executes the statement included at `update-user.jpql` in the relational database.

Defining variables in JPQL scripts

Now we are going to create a generic statement to delete users in the database. We can define the script `delete-user.sql` with a variable like this:

```
DELETE FROM User u WHERE u.id=${USER_ID}
```

Then replace this variable with the value that you want:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the statement.
values.put("USER_ID", new Integer(3));

// Delete a user in the relational database.
view.executeUpdateByName("delete-user", values, null);
```

When your script contains multiple `UPDATE` and / or `DELETE` statements, you also have to indicate the character that delimits each statement. Suppose we have the following `delete-user.sql` script:

```
DELETE FROM User u WHERE u.id=${USER_ID};
DELETE FROM Contact c WHERE c.user=${USER_ID};
```

Now we can replace variables in multiple statements with this code:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables for the statements.
values.put("USER_ID", new Integer(3));

// Delete a user in the database.
view.executeUpdateByName("delete-user", values, new Character(';'));
```

Running JPQL queries

Now we are going to focus on JPQL query operations to know how to retrieve data from the database with JPQL. The following code is an example to perform this action:

```
// Execute the JPQL statement to retrieve some data.
List<User> users = (List<User>) view.
   executeQuery("SELECT u FROM User u", -1, -1);
```

This code executes the JPQL query statement into the relational database and returns a list of JPA entities that represent the result of the JPA engine.

Pagination with JPQL queries

It is also possible to specify the page and size for the result set. In the following example, 1 represents the page to retrieve and 10 is the size of the result:

```
// Get the first 10 rows.
List<User> users = (List<User>) view.
   executeQuery("SELECT u FROM User u", 1, 10);
```

Running JPQL queries from scripts

With queries, you can also write `SELECT` statements in separate text files (this time, just one statement per file). Suppose that the following code is the content of the `list-users.jpql` file:

```
SELECT u FROM User u
```

If `jpql-provider` still is our default Provider, we can read the script like this:

```
// Read the content of 'list-users.jpql' and execute it in the database.

List<User> users = (List<User>) view.
   executeQueryByName("list-users", null, -1, -1);
```

Defining variables in a JPQL query script

There is also the possibility to define variables in the JPQL query:

```
SELECT u FROM User u.id = ${USER_ID}
```

Now we can assign a value to this variable to complete the query. This is done as follows:

```
// Values for variables.
Hashtable values = new Hashtable();

// Set variables to filter the query.
values.put("USER_ID", new Integer(8375));

// Read 'list-users.jpql', replace variables and execute the statement.
List<User> users = (List<User>) view.
   executeQueryByName("list-users", values, -1, -1);
```

The two last arguments allow you to define the page and the maximum number of objects to retrieve. The following example shows how to get the second page with a fixed size of 10 objects per page:

```
// Get the second page with no more than 10 registries in it.
List<User> users = (List<User>) view.
```

```
   executeQueryByName("list-users", null, 2, 10);
```

Count database objects

To count every object of a specific type we have to invoke the following operation:

```
// Count all users.
int count = view.count(User.class);
```

We can also use callbacks in count operations:

```
// Count users.
view.count(User.class, new AbstractCallback(getScope()){

   protected void onFailure(Throwable t) {
      // Handle error here.
   }

   protected void onSuccess(Object result) {

      // Get count.
      Integer count = (Integer) result;

   }

});
```

It is also possible to count the results of a query:

```
// Define the query.
Query query = new Query(getScope());

// Search for User objects.
query.setObject(User.class);

// Define the WHERE clause.
Where where = query.getWhere(true);

// Set an expression like this: (name = 'Carl').
where.setExpression(where.createEqualToValue("name", "Carl"));

// Count users which name is 'Carl'.
int count = view.count(query);
```

With `executeCountByName` we can count the objects that an XML query returns:

```
// Count result of "list-users" query.
int count = view.executeCountByName("list-users", null);
```

Close the connection with the database

As always, when the work is done, you have to disconnect the Data Store:

```
// Close the connection with the Data Store.
view.disconnect();
```

Chapter 10: Pool Service

Warework Pool Service is a manager for Clients that implement the Object Pool design pattern and it provides the necessary methods to retrieve objects from pools in a very easy way.

An object pool is a set of initialized objects that are kept ready to use, rather than allocated and destroyed on demand. Object pooling can offer a significant performance boost in situations where the cost of initializing a class instance is high, the rate of instantiation of a class is high, and the number of instances in use at any one time is low. The pooled object is obtained in predictable time when creation of the new objects (especially over network) may take variable time. These benefits are mostly true for objects which are expensive with respect to time, such as database or socket connections.

Create and retrieve a Pool Service

To create the Pool Service in a Scope, you always need to provide a unique name for the Service and the `PoolServiceImpl` class that exists in the `com.warework.service.pool` package:

```
// Create the Pool Service and register it in a Scope.
scope.createService("pool-service", PoolServiceImpl.class, null);
```

Once it is created, you can get it using the same name (when you retrieve an instance of a Pool Service, you will get the `PoolServiceFacade` interface):

```
// Get an instance of the Pool Service.
PoolServiceFacade poolService = (PoolServiceFacade) scope.
   getService("pool-service");
```

The following example shows how to define the Pool Service in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="pool-service"
            class="com.warework.service.pool.PoolServiceImpl"/>
   </services>

</scope>
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. Review the next section to know how to define Poolers/Clients with these parameters.

Add and connect Poolers

Now the Pool Service is running but you need at least one Client or Pooler where to perform operations. To add a Pooler into the Service you have to invoke method `createClient()` that exists in its Facade. This method requests a name for the new Pooler and a Connector which performs the creation of the Pooler. Let's see how to register a sample Pooler in this Service:

```
// Add a Pooler in the Pool Service.
poolService.createClient("sample-pooler", SampleConnector.class,
   null);
```

The `SampleConnector` class creates the Sample Pooler and registers it in the Pool Service. After that, we have to tell the Pool Service that we want to perform operations with the Sample Pooler. We do so by connecting the Pooler:

```
// Connect the Sample Pooler.
poolService.connect("sample-pooler");
```

To configure Poolers in XML you need to create a separate XML file for the Pool Service and reference it from the Scope XML file. The following example shows how to define a Pool Service and the configuration file that it requires for the Poolers. The first thing you have to do is to register the Service as we did before, but this time with initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="pool-service"
            class="com.warework.service.pool.PoolServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/pool-service.xml" />
      </service>
   </services>

</scope>
```

Once it is registered in the Scope we proceed with the creation of the Pool Service configuration file. Based on the previous example, this could be the content of the **`pool-service.xml`** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-pooler"
      connector="com.warework.service.pool.client.connector.SampleConnector"/>
   </clients>

</proxy-service>
```

You can define as many Poolers as you need for the Pool Service. Once the Scope is started, you can work with Poolers like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of the Pool Service.
PoolServiceFacade poolService = (PoolServiceFacade) scope.
   getService("pool-service");

// Connect the Client.
poolService.connect("sample-pooler");

// Perform operations with the Client.
…

// Disconnect the Client.
poolService.disconnect("sample-pooler");
```

Some Poolers may require configuration parameters. The following example shows how a Pooler specifies one initialization parameter:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-pooler" connector="…">
         <parameter name="…" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Pooler to know which parameters it accepts.

Perform Pool operations

Each Pooler exposes its functionality in the PoolServiceFacade interface and it is where you can find the necessary method to retrieve objects from pools. This interface is really simple. As it represents a Proxy Service, you can handle multiple Poolers and you have to identify each one by name. So, if you need to retrieve an object from a pool, you just have to specify the name of the Pooler/Client to use:

```
// Get an object from the pool.
Object pooledObject = poolService.getObject("sample-pooler");
```

And that's it. The previous line of code simply indicates the Pooler to use to retrieve a pooled object. Each Pooler returns a specific type of pooled object, for example: if your Pooler represents a pool of database connections, it will provide a reusable database connection.

c3p0 Pooler

c3p0 is an excellent Java Framework that minimizes the time needed to retrieve connections from relational databases by implementing the Object Pool design pattern with traditional JDBC drivers. For enterprise level applications, c3p0 is one of the best solutions you can find in the open source market: it is very stable in stressful situations, takes care quite well about memory consumption and clearly improves the overall performance of a software application.

Warework Pooler for c3p0 wraps this Framework to integrate its functionality with the Pool Service. It lets you configure c3p0 with XML files and interact with other Warework Services, principally with the Data Store Service. Prior to work with this Pooler, you should review the c3p0 documentation, especially the section related with the configuration properties. There you will find specific parameters for c3p0 to make it work as you require.

Add a c3p0 Pooler

To add a c3p0 Pooler into the Pool Service you have to invoke method `createClient()` that exists in its Facade with a name, a c3p0 Connector class and a configuration for the Pooler. This configuration has to specify two parameters, one for the JDBC URL and another for the database driver class. Check this out with the following example:

```
// Create the configuration for the Logger.
Hashtable config = new Hashtable();

// Set the driver class and JDBC URL.
config.put(C3P0Connector.PARAMETER_JDBC_URL,
   "jdbc:derby:derbyDB;create=true");
config.put(C3P0Connector.PARAMETER_DriverClass,
   "org.apache.derby.jdbc.EmbeddedDriver");

// Create the c3p0 Pooler.
poolService.createClient("c3p0-pooler", C3P0Connector.class, config);
```

This code shows how to create a c3p0 Pooler for an Apache Derby database. You should download a specific JDBC driver for your database and review the URL required to connect with the database plus the class that represents the driver.

You should also consider using the `PARAMETER_ConnectOnCreate` parameter. It is very handy to automatically connect this Pooler after it is created. If you plan to use this Pooler in a Data Store, it is recommended to set the value for this parameter to `TRUE`:

```
// Create the configuration for the Logger.
Hashtable config = new Hashtable();

// Set the driver class and JDBC URL.
config.put(C3P0Connector.PARAMETER_JDBC_URL,
   "jdbc:derby:derbyDB;create=true");
config.put(C3P0Connector.PARAMETER_DriverClass,
   "org.apache.derby.jdbc.EmbeddedDriver");
config.put(C3P0Connector.PARAMETER_ConnectOnCreate,
   "true");

// Create the c3p0 Pooler.
poolService.createClient("c3p0-pooler", C3P0Connector.class, config);
```

c3p0 provides a very good default configuration (just with the parameters defined in the previous example the Pooler works very well) but sometimes you may need to define specific parameters for the pool to make it work as you require. Review these parameters in the c3p0 documentation and define those that you need like any other parameter:

```
// Create the configuration for the Logger.
Hashtable config = new Hashtable();

// Set the driver class and JDBC URL.
config.put(C3P0Connector.PARAMETER_JDBC_URL,
   "jdbc:derby:derbyDB;create=true");
config.put(C3P0Connector.PARAMETER_DriverClass,
   "org.apache.derby.jdbc.EmbeddedDriver");
config.put(C3P0Connector.PARAMETER_ConnectOnCreate,
   "true");
config.put("acquireIncrement", "3");
config.put("acquireRetryAttempts", "30");
config.put("acquireRetryDelay", "1000");
config.put("autoCommitOnClose", "false");
config.put("breakAfterAcquireFailure", "false");
config.put("checkoutTimeout", "0");
…

// Create the c3p0 Pooler.
poolService.createClient("c3p0-pooler", C3P0Connector.class, config);
```

Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="c3p0-pooler"
            connector="com.warework.service.pool.client.connector. …
            … C3P0Connector">
         <parameter name="jdbc-url" value="jdbc:derby:derbyDB;create=true"/>
         <parameter name="driver-class"
            value="org.apache.derby.jdbc.EmbeddedDriver"/>
         <parameter name="acquireIncrement" value="3"/>
         <parameter name="acquireRetryAttempts" value="30"/>
         <parameter name="acquireRetryDelay" value="1000"/>
         <parameter name="autoCommitOnClose" value="false"/>
         <parameter name="breakAfterAcquireFailure" value="false"/>
         <parameter name="checkoutTimeout" value="0"/>
      </client>
   </clients>

</proxy-service>
```

Working with the c3p0 Pooler

You can perform operations with the c3p0 Pooler in the Pool Service Facade. You just have to invoke the `getObject` method with the name of the c3p0 Pooler to use:

```
// Get an object from the pool.
Connection connection = (Connection) poolService.getObject("c3p0-pooler");
```

This line of code retrieves a pooled `java.sql.Connection` object from c3p0. Now you can configure the Data Store Service to use this database connection object in a JDBC Data Store. Simply configure the Pooled Object Provider to retrieve objects from c3p0 Pooler and register this Provider in the configuration of the JDBC Connector.

Chapter 11: Mail Service

Warework Mail Service is a Proxy Service responsible of email operations. You can handle different implementations of Mail Clients, like JavaMail, and perform email operations in different platforms with them. Each Mail Client can be configured with an XML file to work with a specific mail server, so this Service is quite handy when you have to connect to multiple mail servers.

Sending an email requires you to write just one line of code. You only have to indicate which Mail Client to use (it holds the information required to connect with the mail server) plus the subject, the message and the recipients of the email. You can also include attachments very easily.

This Service integrates with the Framework to offer you some interesting features. For instance, a Mail Client can retrieve connections via a JNDI Provider. This feature allows you store the configuration for your email connections in an application server.

Create and retrieve a Mail Service

To create the Mail Service in a Scope, you always need to provide a unique name for the Service and the `MailServiceImpl` class that exists in the `com.warework.service.mail` package:

```
// Create the Mail Service and register it in a Scope.
scope.createService("mail-service", MailServiceImpl.class, null);
```

Once it is created, you can get it using the same name (when you retrieve an instance of a Mail Service, you will get the `MailServiceFacade` interface):

```
// Get an instance of the Mail Service.
MailServiceFacade mailService = (MailServiceFacade) scope.
   getService("mail-service");
```

The following example shows how to define the Mail Service in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="mail-service"
            class="com.warework.service.mail.MailServiceImpl"/>
   </services>

</scope>
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. Review the next section to know how to define Mail Clients with these parameters.

Add and connect Mail Clients

Now the Mail Service is running but you need at least one Client where to perform operations. To add a Mail Client into the Service you have to invoke method `createClient()` that exists in its Facade. This method requests a name for the new Client and a Connector which performs the creation of the Mail Client. Let's see how to register a sample Client in this Service:

```
// Add a Mail Client in the Mail Service.
mailService.createClient("sample-client", SampleConnector.class,
   null);
```

The `SampleConnector` class creates the Sample Mail Client and registers it in the Mail Service. After that, we have to tell the Mail Service that we want to perform operations with the Sample Mail Client. We do so by connecting the Mail Client:

```
// Connect the Sample Mail Client.
mailService.connect("sample-client");
```

To configure Mail Clients in XML you need to create a separate XML file for the Mail Service and reference it from the Scope XML file. The following example shows how to define a Mail Service and the configuration file that it requires for the Mail Clients. The first thing you have to do is to register the Service as we did before, but this time with initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="mail-service"
            class="com.warework.service.mail.MailServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/mail-service.xml" />
      </service>
   </services>

</scope>
```

Once it is registered in the Scope we proceed with the creation of the Mail Service configuration file. Based on the previous example, this could be the content of the **`mail-service.xml`** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-client"
      connector="com.warework.service.mail.client.connector.SampleConnector"/>
   </clients>
```

```
</proxy-service>
```

You can define as many Mail Clients as you need for the Mail Service. Once the Scope is started, you can work with Mail Clients like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of the Mail Service.
MailServiceFacade mailService = (MailServiceFacade) scope.
   getService("mail-service");

// Connect the Client.
mailService.connect("sample-client");

// Perform operations with the Client.
…

// Disconnect the Client.
mailService.disconnect("sample-client");
```

Some Mail Clients may require configuration parameters. The following example shows how a Mail Client specifies one initialization parameter:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-client" connector="…">
         <parameter name="…" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Mail Client to know which parameters it accepts.

Perform Mail operations

Each Mail Client exposes its functionality in the `MailServiceFacade` interface and it is where you can find the necessary method to perform Mail operations.

Now we are going to check out how to send an email with the `send` method. The minimum information you have to provide to this method is shown below:

- Mail Client name: Mail Service is a Proxy Service so you have to identify each Mail Client by name.

- Subject: A brief summary of the topic of the message.

- From: The email address of the sender. In many email clients it is not changeable except through changing account settings.
- To: List with the email addresses of the message's recipients.
- Message: The content of the email message. This is exactly the same as the body of a regular letter.

This is the minimum line of code required to send an email:

```
// Send an email.
mailService.send("sample-client", "subject", "from@mail.com", "to@mail.com",
   null, null, null, "mail message");
```

If you require sending the message to multiple recipients, you can separate each email address with a semicolon like this:

```
// Send an email to multiple recipients.
mailService.send("sample-client", "subject", "from@mail.com",
   "to1@mail.com;to2@mail.com;to3@mail.com", null, null, null,
   "mail message");
```

You can perform the same action with an array of `String` objects:

```
// Send an email to multiple recipients.
mailService.send("sample-client", "subject", "from@mail.com",
   new String[]{"to1@mail.com", "to2@mail.com", "to3@mail.com"},
   null, null, null, "mail message");
```

If you prefer a `java.util.Vector` instead of an array of `String` objects, you can use it too:

```
// Create a list for the recipients of the message.
Vector to = new Vector();

// Add each recipient.
to.addElement("to1@mail.com");
to.addElement("to2@mail.com");
to.addElement("to3@mail.com");

// Send an email to multiple recipients.
mailService.send("sample-client", "subject", "from@mail.com", to,
   null, null, null, "mail message");
```

You can also specify the following optional arguments in this method:

- CC (Carbon Copy): Allows you to simultaneously send multiple copies of an email to secondary recipients.
- BCC (Blind Carbon Copy): Addresses added for the delivery list but not (usually) listed in the message data, remaining invisible to other recipients.

- Attachments: Email messages may have one or more files/resources associated to it. They serve the purpose of delivering binary or text files of unspecified size.

The following example shows how to send an email with CC and BCC recipients:

```
// Send an email to multiple recipients.
mailService.send("sample-client", "subject", "from@mail.com",
   new String[]{"to1@mail.com", "to2@mail.com", "to3@mail.com"},
   new String[]{"cc1@mail.com", "cc2@mail.com", "cc3@mail.com"},
   new String[]{"bcc1@mail.com", "bcc2@mail.com", "bcc3@mail.com"},
   null, "mail message");
```

For attachments, you need to bear in mind that each Mail Client may accept a specific type of object to represent the attachment. Review the documentation of the Mail Client that you require and use any of the objects type that it supports. If our `sample-client` supports `java.io.File` objects then we can add attachments like this:

```
// Create a list for the attachments.
Vector attachments = new Vector();

// Add attachments.
attachments.addElement(new File("file1.txt"));
attachments.addElement(new File("file2.jpg"));
attachments.addElement(new File("file3.zip"));

// Send an email with attachments.
mailService.send("sample-client", "subject", "from@mail.com", "to1@mail.com",
   null, null, attachments, "mail message");
```

JavaMail Client

This Mail Client allows you to work with JavaMail, the standard software library used to perform email operations in Java. Warework wraps JavaMail and simplifies its usage by providing a very simple interface, for instance: to send an email requires you to write just one line of code.

As a Client of the Mail Service, this component perfectly integrates with the Framework to configure your mail accounts in XML files and create the necessary connections without requiring the intervention of the developer. It is also possible to retrieve from a JNDI Provider the information required to create a connection with a mail server, so this information can be stored in an application server for example.

Add a JavaMail Client

To add a JavaMail Client into the Mail Service you have to invoke method `createClient()` that exists in its Facade with a name, a JavaMail Connector class and a configuration for the Client.

By now, there is only one Connector that is suitable for sending emails. It is represented with the `JavaMailSenderConnector` class and you can use the following initialization parameters to configure it:

- `PARAMETER_Host`: server where to connect to send the email.
- `PARAMETER_Port`: port of the server where to connect to send the email.
- `PARAMETER_User`: user name required to create a connection with the mail server.
- `PARAMETER_Password`: user password required to create a connection with the mail server.
- `PARAMETER_TransportProtocol`: protocol used to send the email, like SMTP.

These are common parameters that you may require for your mail connections. They are not mandatory and there is also the possibility to specify more initialization parameters without the constants of a Connector. Check this out with the following example. It shows how to setup the Client to send emails with GMail:

```
// Create the configuration for the Mail Client.
Hashtable config = new Hashtable();

// Set the mail server configuration.
config.put(JavaMailSenderConnector.PARAMETER_Host, "smtp.gmail.com");
config.put(JavaMailSenderConnector.PARAMETER_Port, "587");
config.put(JavaMailSenderConnector.PARAMETER_User, "abc@gmail.com");
config.put(JavaMailSenderConnector.PARAMETER_Password, "123");
config.put(JavaMailSenderConnector.PARAMETER_TransportProtocol, "smtp");
config.put("mail.smtp.auth", "true");
config.put("mail.smtp.starttls.enable", "true");

// Create the JavaMail Client.
mailService.createClient("javamail-client", JavaMailSenderConnector.class,
   config);
```

Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="javamail-client"
            connector="com.warework.service.mail.client.connector. …
            … JavaMailSenderConnector">
         <parameter name="mail.host" value="smtp.gmail.com"/>
         <parameter name="mail.port" value="587"/>
         <parameter name="mail.transport.protocol" value="smtp"/>
         <parameter name="mail.user" value="abc@gmail.com"/>
         <parameter name="mail.password" value="123"/>
         <parameter name="mail.smtp.auth" value="true"/>
         <parameter name="mail.smtp.starttls.enable" value="true"/>
      </client>
   </clients>

</proxy-service>
```

You can also configure the JavaMail Client to connect with an mail server via JNDI. In many application servers you can store the information required to create connections with a mail server.

This information is accessible with a JNDI Provider and it can be used by Warework to connect with the mail server. To achieve this you have to specify at least two initialization parameters:

- `PARAMETER_ConnectionSourceProviderName`: name of the Provider, typically a JNDI Provider, that retrieves the mail connection information from an application server.
- `PARAMETER_ConnectionSourceProviderObject`: name used to get a `javax.mail.Session` object. This is the object that the application server provides and it represents the mail connection information.

The following example shows you how to use these two parameters plus another two to complement the information locally:

```
// Create the configuration for the Mail Client.
Hashtable config = new Hashtable();

// Set the mail server configuration.
config.put(JavaMailSenderConnector.PARAMETER_ConnectionSourceProviderName,
   "jndi-provider");
config.put(JavaMailSenderConnector.PARAMETER_ConnectionSourceProviderObject,
   "mail/myApp");
config.put(JavaMailSenderConnector.PARAMETER_User, "abc@gmail.com");
config.put(JavaMailSenderConnector.PARAMETER_Password, "123");

// Create the JavaMail Client.
mailService.createClient("javamail-client", JavaMailSenderConnector.class,
   config);
```

Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="javamail-client"
            connector="com.warework.service.mail.client.connector. …
            … JavaMailSenderConnector">
         <parameter name="connection-source-provider-name"
            value="jndi-provider"/>
         <parameter name="connection-source-provider-object"
            value="mail/myApp"/>
         <parameter name="mail.user" value="abc@gmail.com"/>
         <parameter name="mail.password" value="123"/>
      </client>
   </clients>

</proxy-service>
```

Working with the JavaMail Client

You can perform operations with the JavaMail Client in the Mail Service Facade. If you plan to send an email, please review the Mail Service documentation because the arguments for this operation are defined there in detail (all of them, except `attachments`, work in the same way for every Mail Client). Check out with this example how to send a quick email with JavaMail:

```
// Send an email.
mailService.send("javamail-client", "subject", "from@mail.com", "to@mail.com",

   "cc@mail.com", "bcc@mail.com", null, "mail message");
```

For attachments, you need to bear in mind that JavaMail Client accepts a `Vector` with `javax.mail.BodyPart` objects in it. Each `BodyPart` object allows you to define an attachment for the email in many different ways. For instance, the following code shows how to directly reference a local file for an attachment:

```
// Create an attachment.
BodyPart bodyPart = new MimeBodyPart();

// Set the file to include in the email.
bodyPart.setDataHandler(new DataHandler(new FileDataSource("file2.jpg")));

// Set the name for the file.
bodyPart.setFileName("file2.jpg");

// Create a list for the attachments.
Vector attachments = new Vector();

// Add the attachment.
attachments.addElement(bodyPart);

// Send an email with attachments.
mailService.send("sample-client", "subject", "from@mail.com", "to@mail.com",
   null, null, attachments, "mail message");
```

Chapter 12: Converter Service

Warework Converter Service is an extremely powerful Service with a very simple purpose: perform object transformations. Software developers can provide object instances into this Service to convert them. The result of the operation is a new instance of an object (or an updated one) that represents the transformation of the source object.

The conversion of the object can be a basic operation like formatting a string or a complex one like translating a given text to another language. As this Service is a Proxy Service, developers are free to define what sorts of operations are supported by this Service. They just need to include the Client that performs the task they are looking for.

Any process that implies a conversion fits in this Service: compressors, unit conversions, translations, updaters, formatters, etc. Possibilities are unlimited. That is why Clients in this Service have different names but in general, they all are known as "Converters".

Create and retrieve a Converter Service

To create the Converter Service in a Scope, you always need to provide a unique name for the Service and the `ConverterServiceImpl` class that exists in the `com.warework.service.converter` package:

```
// Create the Converter Service and register it in a Scope.
scope.createService("converter-service", ConverterServiceImpl.class, null);
```

Once it is created, you can get it using the same name (when you retrieve an instance of a Converter Service, you will get the `ConverterServiceFacade` interface):

```
// Get an instance of the Converter Service.
ConverterServiceFacade converterService = (ConverterServiceFacade) scope.
   getService("converter-service");
```

The following example shows how to define the Converter Service in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="converter-service"
            class="com.warework.service.converter.ConverterServiceImpl"/>
   </services>

</scope>
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. Review the next section to know how to define Converter Clients with these parameters.

Add and connect Converters

Now the Converter Service is running but you need at least one Client (remember, Clients in this Service are known as Converters) where to perform operations. To add a Converter into the Service you have to invoke method `createClient()` that exists in its Facade. This method requests a name and a Connector which performs the creation of the Converter. Let's see how to register a sample Converter in this Service:

```
// Add a Converter in the Converter Service.
converterService.createClient("sample-client", SampleConnector.class,
   null);
```

The `SampleConnector` class creates the Sample Converter and registers it in the Converter Service. After that, we have to tell the Converter Service that we want to perform operations with the Sample Converter. We do so by connecting the Converter:

```
// Connect the Sample Converter.
converterService.connect("sample-client");
```

To configure Converters/Clients in XML you need to create a separate XML file for the Converter Service and reference it from the Scope XML file. The following example shows how to define a Converter Service and the configuration file that it requires for the Convertes. The first thing you have to do is to register the Service as we did before, but this time in the Scope XML file with initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="converter-service"
            class="com.warework.service.converter.ConverterServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/converter-service.xml" />
      </service>
   </services>

</scope>
```

Once it is registered in the Scope we proceed with the creation of the Converter Service configuration file. Based on the previous example, this could be the content of the **`converter-service.xml`** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
```

```
   service-1.0.0.xsd">

   <clients>
      <client name="sample-client"
      connector="com.warework.service.converter.client.connector.Sample...
         Connector"/>
   </clients>

</proxy-service>
```

You can define as many Converters/Clients as you need for the Converter Service. Once the Scope is started, you can work with Converters like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of the Converter Service.
ConverterServiceFacade converterService = (ConverterServiceFacade) scope.
   getService("converter-service");

// Connect the Client.
converterService.connect("sample-client");

// Perform operations with the Client.
…

// Disconnect the Client.
converterService.disconnect("sample-client");
```

Some Converters may require configuration parameters. The following example shows how a Converter specifies one initialization parameter:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="sample-client" connector="…">
         <parameter name="…" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Converter to know which parameters it accepts.

Perform object transformations

Each Converter Client exposes its functionality in the `ConverterServiceFacade` interface and it is where you can find the necessary methods to perform transformations with objects.

Now we are going to check out how to transform an object into another one with the `transform` method. The minimum information you have to provide to this method is the object you want to transform:

```
// Object to transform.
Object source = ...

// Transform the object to another object.
Object result = converterService.transform("sample-client", source);
```

You can also retrieve the object to transform from a specified Provider:

```
// Transform an object from a Provider.
Object result = converterService.transform("sample-client", "providerName",
   "providerObject");
```

String Formatter

This Converter allows you to format strings so you can transform them to upper case, lower case, remove empty spaces, etc.

Add a String Formatter

To add a String Formatter into the Converter Service you have to invoke method `createClient()` that exists in its Facade with a name, the `StringFormatterConnector` class and a configuration for the Converter.

The configuration must declare the operation to perform. Use the `PARAMETER_OperationMode` constant (defined in the `StringFormatterConnector` class) with any of the following values to specify the operation:

- `OPERATION_MODE_ToUpperCase`: transforms a string to upper case. In XML configuration files use "`to-upper-case`".
- `OPERATION_MODE_ToLowerCase`: transforms a string to lower case. In XML configuration files use "`to-lower-case`".
- `OPERATION_MODE_Trim`: removes white spaces from both ends of a string. In XML configuration files use "`trim`".
- `OPERATION_MODE_FirstLetterToLowerCase`: transforms the first letter of a string to lower case. In XML configuration files use "`first-letter-to-lower-case`".
- `OPERATION_MODE_FirstLetterToUpperCase`: transforms the first letter of a string to upper case. In XML configuration files use "`first-letter-to-upper-case`".

The following example shows how to create a String Formatter in the Converter Service to transform strings to upper case:

```
// Create the configuration for the String Formatter.
Hashtable config = new Hashtable();

// Set the formatter configuration.
config.put(StringFormatterConnector.PARAMETER_OperationMode,
   StringFormatterConnector.OPERATION_MODE_ToUpperCase);

// Create the String Formatter.
converterService.createClient("uppercase-formatter",
   StringFormatterConnector.class, config);
```

Check it now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="uppercase-formatter"
            connector="com.warework.service.converter.client.connector. …
            … StringFormatterConnector">
         <parameter name="operation-mode" value="to-upper-case"/>
      </client>
   </clients>

</proxy-service>
```

Working with the String Formatter

You can perform operations with the String Formatter in the Converter Service Facade. Check out with this example how to format a string to upper case:

```
// Transform 'hello' to upper case.
String text = (String) converterService.transform("uppercase-formatter",
   "hello");
```

Base64 Converter

This Converter allows you to encode / decode strings and byte arrays with Base64. Base64 is an encoding scheme that encodes binary data by treating it numerically and translating it into a base 64 representation.

Base64 encoding scheme are commonly used when there is a need to encode binary data that needs to be stored and transferred over media that are designed to deal with textual data. This is to ensure that the data remains intact without modification during transport. Base64 is used commonly in a number of applications including email via MIME, and storing complex data in XML.

Add a Base64 Converter

To add a Base64 Converter into the Converter Service you have to invoke method `createClient()` that exists in its Facade with a name, the `Base64ConverterConnector` class and a configuration for the Converter.

The configuration has to specify what kind of operation to perform (encode or decode with Base64). Use the `PARAMETER_OperationMode` constant (defined in the Connector class) with any of the following values to specify the operation:

- `OPERATION_MODE_Encode`: encodes a string or a byte array with Base64. In XML configuration files use "`encode`".
- `OPERATION_MODE_Decode`: decodes a string or a byte array with Base64. In XML configuration files use "`decode`".

The following example shows how to create a Base64 Converter in the Converter Service:

```
// Create the configuration for the Converter.
Hashtable config = new Hashtable();

// Set the Converter configuration.
config.put(Base64ConverterConnector.PARAMETER_OperationMode,
   Base64ConverterConnector.OPERATION_MODE_Encode);

// Create the Base64 Converter.
converterService.createClient("base64-encoder",
   Base64ConverterConnector.class, config);
```

Check it out now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="base64-encoder"
            connector="com.warework.service.converter.client.connector. …
            … Base64ConverterConnector">
         <parameter name="operation-mode" value="encode"/>
      </client>
   </clients>

</proxy-service>
```

Working with the Base64 Converter

You can perform operations with the Base64 Converter in the Converter Service Facade. Check out with this example how to encode a string with Base64:

```
// Encode 'Hola' with Base64.
String text = (String) converterService.transform("base64-encoder", "Hola");
```

The result of this operation will be that variable `text` equals to "`SG9sYQ==`". Base64 encoders / decoders are also very useful when you need to transform an array of bytes to plain text whose characters are in an ASCII string format (for example, transform an image to ASCII text).

The following fragment shows how to encode with Base64 a byte array:

```
// Source array with binary data.
byte[] source = ...;

// Encode the array of bytes with Base64.
byte[] result = (byte[]) converterService.transform("base64-encoder", source);

// Get the binary data in ASCII string format.
String asciiSource = new String(result);
```

The important fact to keep in mind about this is that you will get a string when you pass a string to the Base64 Converter. On the other hand, if you pass a byte array then you will get a byte array.

Now we are going to perform the opposite operation. The following snippet shows how to decode a string:

```
// Create the configuration for the Converter.
Hashtable config = new Hashtable();

// Set the Converter configuration.
config.put(Base64ConverterConnector.PARAMETER_OperationMode,
   Base64ConverterConnector.OPERATION_MODE_Decode);

// Create the Base64 Converter.
converterService.createClient("base64-decoder",
   Base64ConverterConnector.class, config);

// Decode with Base64. The result is 'Hola'.
String text = (String) converterService.transform("base64-decoder",
   "SG9sYQ==");
```

JavaScript Compressor

This Converter allows you to minimize strings with JavaScript or JSON code. The result is a new string where comments and unnecessary spaces and characters are removed so it is much smaller in size.

Suppose that we have the following JavaScript code in a string:

```
/**
 * Pops up an alert box and displays 'Hello'.
 */
function sayHello() {

   // Show message
   alert('Hello');
```

```
}
```

We can provide this string to the JavaScript Compressor to retrieve something like this:

```
function sayHello(){alert('Hello');}
```

As you can see, it is the same code (works exactly the same way) but unnecessary characters were removed. The main benefit of compressing JavaScript code is that it speeds up network communications; it is very useful when you plan to send requests to end points (APIs) that support JavaScript / JSON because messages are much smaller in size.

Add a JavaScript Compressor

To add a JavaScript Compressor into the Converter Service you have to invoke method createClient() that exists in its Facade with a name and the JavaScriptCompressorConnector class. This Converter is so simple to use that no configuration is needed in order to make it work.

The following example shows how to create a JavaScript Compressor in the Converter Service:

```
// Create the JavaScript Compressor.
converterService.createClient("js-compressor",
   JavaScriptCompressorConnector.class, null);
```

Check it out now how to do it with the Proxy Service XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="js-compressor"
            connector="com.warework.service.converter.client.connector. …
            … JavaScriptCompressorConnector"/>
   </clients>

</proxy-service>
```

Working with the JavaScript Compressor

You can perform operations with the JavaScript Compressor in the Converter Service Facade. Check out with this example how to compress JavaScript code:

```
// Create a string with the JavaScript code.
String code = "WRITE YOUR JAVASCRIPT CODE HERE";

// Compress the JavaScript code.
String js = (String) converterService.transform("js-compressor", code);
```

PART III: PROVIDERS

Chapter 13: Standard Provider

Warework Standard Provider is responsible for creating objects instances from a predefined list of classes. Each of those classes is assigned a name at configuration time and, later on, new instances of those classes can be retrieved by name. Objects instances are not singleton so you will get a new one every time you request an object.

Configure and create a Standard Provider

To configure this Provider you just need to give a name to each class in a `java.util.Hashtable` collection.

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put("map", Hashtable.class);
parameters.put("list", Vector.class);
```

It is very important to know that every indicated class must have a default constructor (without parameters). Also that you can specify each class with a string that represents the name of the class.

```
// Configure the Provider.
parameters.put("map", "java.util.Hashtable");
parameters.put("list", "java.util.Vector");
```

Once it is configured, you can create and register the Standard Provider in a Scope as follows:

```
// Create the Provider.
scope.createProvider("standard-provider", StandardProvider.class,
   parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="standard-provider"
               class="com.warework.provider.StandardProvider">
         <parameter name="map" value="java.util.Hashtable" />
         <parameter name="list" value="java.util.Vector" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a Standard Provider

At this point the Standard Provider is running and we can request objects from it. To do so, we just need to use any given name at configuration time.

```
// Create a new list.
Vector list = (Vector) scope.getObject("standard-provider", "list");
```

This line of code creates a new `java.util.Vector` every time it is invoked. Based on the previous example, to get a new `java.util.Hashtable` simply change the name of the object to create:

```
// Create a new map.
Hashtable map = (Hashtable) scope.getObject("standard-provider", "map");
```

Chapter 14: Singleton Provider

Warework Singleton Provider implements a factory that creates unique instances of objects in a specific scope. The first time you request an object for a specific class, a new instance is created, stored (inside the Provider) and returned to the user. If you request the same object later on, it will return the stored instance, so, that is why every object of the same class will be the same.

Configure and create a Singleton Provider

This Provider does not require to be configured, so we just need to create and register it in a scope as follows:

```
// Create the Provider.
scope.createProvider("singleton-provider", SingletonProvider.class,
   null);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="singleton-provider"
               class="com.warework.provider.SingletonProvider"/>
   </providers>

</scope>
```

Retrieve objects from a Singleton Provider

At this point the Singleton Provider is running and we can request objects from it. To do so, we just need to use the name of a class to retrieve its instance:

```
// Get an instance of a map.
Hashtable map1 = (Hashtable) scope.getObject("singleton-provider",
   "java.util.Hashtable");
```

This line of code creates a new `java.util.Hashtable` the first time it is invoked. It is very important to know that every indicated class must have a default constructor (without parameters). If we invoke it again, we will get the same instance:

```
// Get the same instance as map1.
Hashtable map2 = (Hashtable) scope.getObject("singleton-provider",
   "java.util.Hashtable");
```

Chapter 15: Service Provider

This Provider retrieves objects instances from Services and it is useful when you want a Provider to invoke a method in a Service that returns something. The way it works is simple; just specify which Service to use and which method of the Service to call, then the Provider executes this method and the object that it returns is the object that you will get from the Provider.

Configure and create a Service Provider

To configure this Provider you need to set at least two parameters, both of them located in the `ServiceProvider` class, at `com.warework.provider package`:

- `PARAMETER_ServiceName`: Specifies the name of the Service where to retrieve the objects instances.
- `PARAMETER_GetInstanceMethod`: Specifies the name of the method that retrieves one instance of an object in the Service. The method to invoke in the Service must accept one `String` argument.

If we want to retrieve objects from a Service named "sample-service", we can write something like this:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(ServiceProvider.PARAMETER_ServiceName, "sample-service");
parameters.put(ServiceProvider.PARAMETER_GetInstanceMethod, "get");
```

This Provider will look for a Service named `sample-service` and then invoke method `get(String)` on it. The value for the `String` argument is the name you give to retrieve the object in the Provider. This is reviewed in the next section.

Once it is configured, you can create and register the Service Provider in a Scope as follows:

```
// Create the Provider.
scope.createProvider("service-provider", ServiceProvider.class, parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
```

```
      <provider name="service-provider"
               class="com.warework.provider.ServiceProvider">
         <parameter name="service-name" value="sample-service" />
         <parameter name="get-instance-method" value="get" />
      </provider>
   </providers>

</scope>
```

There is a third parameter defined with the constant `ServiceProvider.`[`PARAMETER_ListNameMethod`]. It references a method in the Service that retrieves the names of the objects managed by the Service. This parameter is optional but if you want to load all objects from the Provider (with [`PARAMETER_CreateObjects`]) on startup then you have to define it. The method in the Service referenced with this parameter must be without arguments and it have to return an `Enumeration` of `String` values (the name of each object to retrieve). Check this out with the following example:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(ServiceProvider.PARAMETER_ServiceName, "sample-service");
parameters.put(ServiceProvider.PARAMETER_GetInstanceMethod, "get");
parameters.put(ServiceProvider.PARAMETER_ListNameMethod, "list");
parameters.put(ServiceProvider.PARAMETER_CreateObjects, Boolean.TRUE);

// Create the Provider.
scope.createProvider("service-provider", ServiceProvider.class, parameters);
```

When the Provider is created, it gets the Sample Service and executes the `list()` method to list the names. Each of these names is used to register an Object Reference in the Scope so every object that the Service can retrieve is accessible with the `scope.getObject(String)` method.

This is the XML version of the previous example:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="service-provider"
               class="com.warework.provider.ServiceProvider">
         <parameter name="service-name" value="sample-service" />
         <parameter name="get-instance-method" value="get" />
         <parameter name="list-names-method" value="list" />
         <parameter name="create-objects" value="true" />
      </provider>
   </providers>

</scope>
```

Retrieve objects from a Service Provider

At this point the Service Provider is running and we can request objects from it. To do so, we just need to use any object name registered by the Service:

```
// Get an instance of an object that exist in the Sample Service.
Object object = scope.getObject("service-provider", "service-object");
```

This line of code performs the following actions:

1. The Provider retrieves the Sample Service because the value of `PARAMETER_ServiceName` is `sample-service`.
2. The Provider executes the `get` method in the Sample Service with the value `"service-object"` for the `String` argument; something like:

   ```
   service.get("service-object")
   ```

3. The Provider returns the object from the `get` method of the Sample Service.

If you defined `PARAMETER_ListNameMethod` and `PARAMETER_CreateObjects` in the configuration of the Provider then this object can be retrieved like this:

```
// Get an instance of an object that exist in the Sample Service.
Object object = scope.getObject("service-object");
```

Chapter 16: Data Store View Provider

Warework Data Store View Provider is responsible of retrieving Views from a Data Store Service. The way it works is quite simple: you provide the name of a Data Store that exists in the Data Store Service and this Provider will return a View associated to this Data Store (if there is any).

Configure and create a Data Store View Provider

You can configure this Provider in two different ways. First, you can give just the name of the Data Store Service where to retrieve the default View from Data Stores:

```
// Create the configuration of the Provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(DatastoreViewProvider.PARAMETER_ServiceName,
   "datastore-service");

// Create the Provider.
scope.createProvider("datastore-view-provider", DatastoreViewProvider.class,
   parameters);
```

When this Provider is configured like this, you will retrieve Views by specifying the name of the Data Store. That is, you provide the name of the Data Store and it will return the default View of the Data Store. This configuration is better when you need only one View from multiple Data Stores.

Another way to configure this Provider is by specifying also the name of the Data Store:

```
// Create the configuration of the Provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(DatastoreViewProvider.PARAMETER_ServiceName,
   "datastore-service");
parameters.put(DatastoreViewProvider.PARAMETER_DatastoreName,
   "my-data-store");

// Create the Provider.
scope.createProvider("datastore-view-provider", DatastoreViewProvider.class,
   parameters);
```

If the name of the Data Store is given then you will retrieve Views by name (every object that you request to the Provider will be a View that exists in a specific Data Store). This configuration is better when you need to work with different Views from just one Data Store.

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="datastore-view-provider"
               class="com.warework.provider.DatastoreViewProvider">
         <parameter name="service-name" value="datastore-service" />
         <parameter name="view-name" value="datastore-view" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a Data Store View Provider

At this point the Data Store View Provider is running and we can request objects from it. If we configured the Provider just with the name of the Data Store Service, we can request objects by providing the name the Data Store:

```
// Get the View associated to the 'jdbc-datastore'.
RDBMSView view = (RDBMSView) scope.getObject("datastore-view-provider",
   "jdbc-datastore");
```

This line of code performs the following actions:

1. The `datastore-view-provider` gets an instance of the Data Store Service named `datastore-service`.
2. The `datastore-view-provider` gets the Current View associated to `jdbc-datastore` and returns it. If this Data Store does not have any View in its stack of Views, then this Provider will return `null`.

If we configured this Provider with the name of the Data Store then we have to provide the name of the View that exists in the Data Store:

```
// Get the View associated to the 'jdbc-datastore'.
RDBMSView view = (RDBMSView) scope.getObject("datastore-view-provider",
   "rdbms-view");
```

Now, this line of code performs these actions:

1. The `datastore-view-provider` gets an instance of the Data Store Service named `datastore-service`.
2. The `datastore-view-provider` gets the "`rdbms-view`" View associated to `jdbc-datastore` and returns it. If this Data Store does not have this View in its stack of Views, then this Provider will return `null`.

Chapter 17: Key-Value Data Store Provider

Warework Key-Value Data Store Provider allows you to retrieve values associated to keys that exist in a Data Store. Every Data Store which has a Key-Value View can be used by this Provider, so you can get values associated to keys that exist in relational databases or properties files, for example.

Configure and create a Key-Value Data Store Provider

To configure this Provider you have to indicate the following parameters:

- Service name: this parameter represents the name of the Data Store Service where to perform the operations.
- Data Store name: this one is to identify the target Data Store that exists in the Data Store Service.
- Data Store View implementation: this parameter must be the name of the class that implements the `com.warework.service.datastore.view.`**`KeyValueView`** interface.

Suppose that we have a JDBC Data Store in the Service and a View on top of it that is an instance of the `KeyValueJDBCViewImpl` class (this class is provided with the Warework JDBC Data Store). We can configure this provider like this:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(KeyValueDatastoreProvider.PARAMETER_ServiceName,
   "datastore-service");
parameters.put(KeyValueDatastoreProvider.PARAMETER_DatastoreName,
   "jdbc-datastore");
parameters.put(KeyValueDatastoreProvider.
   PARAMETER_DatastoreViewImplementation, KeyValueJDBCViewImpl.class);

// Create the Provider.
scope.createProvider("key-value-datastore-provider",
   KeyValueDatastoreProvider.class, parameters);
```

Optionally, you can also enable cache so when a key is requested more than one time, instead of retrieving it from the Data Store, you will get a copy that resides on your local machine / memory. You can achieve this task by specifying the `enable-cache` parameter:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
```

```
parameters.put(KeyValueDatastoreProvider.PARAMETER_ServiceName,
   "datastore-service");
parameters.put(KeyValueDatastoreProvider.PARAMETER_DatastoreName,
   "jdbc-datastore");
parameters.put(KeyValueDatastoreProvider.
   PARAMETER_DatastoreViewImplementation, KeyValueJDBCViewImpl.class);
parameters.put(KeyValueDatastoreProvider.PARAMETER_EnableCache,
   Boolean.TRUE);

// Create the Provider.
scope.createProvider("key-value-datastore-provider",
   KeyValueDatastoreProvider.class, parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="key-value-datastore-provider"
               class="com.warework.provider.KeyValueDatastoreProvider">
         <parameter name="service-name" value="datastore-service" />
         <parameter name="datastore-name" value="jdbc-datastore" />
         <parameter name="datastore-view-impl"
          value="com.warework.service.datastore.client.KeyValueJDBCViewImpl"/>
         <parameter name="enable-cache" value="false" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a Key-Value Data Store Provider

At this point the Key-Value Data Store Provider is running and we can request objects from it. To do so, we just need to provide a key that exists in the Data Store to retrieve the value associated to it:

```
// Get the value of a property from the database.
String userName = (String) scope.getObject("key-value-datastore-provider",
   "user.name");
```

This line of code searches for the value of `user.name` in the JDBC Data Store using the specified View. Remember that Key-Value Views can return other types of result different than Strings:

```
// Get the value associated to a key from the database.
Date dateOfBirth = (Date) scope.getObject("key-value-datastore-provider",
   "user.dateOfBirth");
```

Chapter 18: FileText Provider

The FileText Provider is responsible for returning the content of text files as `String` objects. The idea is that with a given file name (without the extension) this Provider is capable to return a `String` with the content of the file.

It allows you to read any kind of text file (`.txt`, `.sql`, `.csv`, etc.) and it is very useful when you have to load resources for your project, like query or update statements for a Database Management System (for instance, you can read SQL statements from text files and execute them later on in the database) .

With this Provider you can also specify a set of characters that will be used to filter the output. You can for example, setup this Provider to read `.sql` files without the new line character.

Configure and create a FileText Provider

To configure this Provider you just need to give the base directory where to read the text files and the extension for these files (for example: `.txt`, `.sql`, `.csv`, ...):

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(FileTextProvider.PARAMETER_ConfigTarget, "/META-INF");
parameters.put(FileTextProvider.PARAMETER_FileExtension, "txt");

// Create the Provider.
scope.createProvider("filetext-provider", FileTextProvider.class,
   parameters);
```

The above example shows how to read `.txt` files from `/META-INF` directory. It is very important to bear in mind that only files with the `.txt` extension will be processed.

The specific place where resources can be loaded for your project is specified in each Warework Distribution. Typically, in a Desktop Distribution the `/META-INF` directory is located in the source folder of your own project.

With this Provider you can also specify a set of characters that will be used to filter the output. You can for example, setup this Provider to read `.sql` files without the new line character. Review the constants defined at `FileTextProvider` class, those with the `PARAMETER_Remove<character>Character` pattern, and check out which characters can be removed from the loaded text.

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="filetext-provider"
```

```
                class="com.warework.provider.FileTextProvider">
            <parameter name="config-target" value="/META-INF" />
            <parameter name="file-extension" value="txt" />
        </provider>
    </providers>
</scope>
```

Retrieve objects from a Key-Value Data Store Provider

At this point the FileText Provider is running and we can request objects from it. To do so, we just need to provide the name of a text file that exists in the directory and with the extension specified in the configuration.

```
// Get a String with the content of 'notice.txt'.
String notice = (String) scope.getObject("filetext-provider", "notice");
```

When this line of code is executed, the `filetext-provider` performs the following actions:

1. Looks for a file named `/META-INF/notice.txt`.
2. Reads the content of the file and places it in a String object.
3. Filters unwanted characters (if it is specified in the configuration).
4. Returns a String with the content of the file filtered.

Chapter 19: Pooled Object Provider

Warework Pooled Object Provider is responsible for retrieving pooled objects from the Pool Service. The way it works is very simple: you have to specify the name of a Pooler/Client that exists in the Pool Service and this Provider will return the pooled objects that this Pooler can provide.

Configure and create a Pooled Object Provider

To configure this Provider you just need to give the name of the Pool Service where to retrieve pooled objects from Poolers:

```
// Create the configuration of the Provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(PooledObjectProvider.PARAMETER_ServiceName, "pool-service");

// Create the Provider.
scope.createProvider("pooled-object-provider", PooledObjectProvider.class,
   parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="pooled-object-provider"
            class="com.warework.provider.PooledObjectProvider">
         <parameter name="service-name" value="pool-service" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a Pooled Object Provider

At this point the Pooled Object Provider is running and we can request objects from it. To do so, we just need to provide the name of a Pooler that exists in the Pool Service.

```
// Get a pooled object from 'sample-pooler'.
Object pooledObject = scope.getObject("pooled-object-provider",
   "sample-pooler");
```

This line of code performs the following actions:

1. The `pooled-object-provider` gets an instance of the Pool Service named `pool-service`.

2. The `pooled-object-provider` gets a pooled object from `sample-pooler` and returns it.

Chapter 20: JNDI Provider

The JNDI Provider is responsible for locating objects from naming services. A naming service maintains a set of bindings, which relate names to objects and provide the ability to look up objects by name.

JNDI allows the components in distributed applications to locate each other. For instance: a client can retrieve from an application server a Data Source object via JNDI to connect with a database. Warework JNDI Provider wraps the JNDI API to provide these features and integrate them into the Framework.

Configure and create a JNDI Provider

The configuration of this Provider is optional. Typically, in Server platforms you will not configure JNDI to locate data sources, EJBs, JMS, Mail Sessions, and so on in the network (by default, the JNDI context is connected to the local naming service). So, to start working with this Provider is fairly simple:

```
// Create the Provider.
scope.createProvider("jndi-provider", JNDIProvider.class, null);
```

If you are not working in a Server platform or, for example, you have to connect with a remote naming service, you can then specify some initialization parameters for the configuration of the JNDI Provider. The following example shows how to connect with a remote LDAP server:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(Context.INITIAL_CONTEXT_FACTORY,
   "com.sun.jndi.ldap.LdapCtxFactory");
parameters.put(Context.PROVIDER_URL, "ldap://ldap.test.com:389");
parameters.put(Context.SECURITY_PRINCIPAL, "james wood");
parameters.put(Context.SECURITY_CREDENTIALS, "password");

// Create the Provider.
scope.createProvider("jndi-provider", JNDIProvider.class, parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="jndi-provider"
               class="com.warework.provider.JNDIProvider">
         <parameter name="java.naming.factory.initial"
            value="com.sun.jndi.ldap.LdapCtxFactory" />
```

```
         <parameter name="java.naming.provider.url"
            value="ldap://ldap.test.com:389" />
         <parameter name="java.naming.security.principal"
            value="james wood" />
         <parameter name="java.naming.security.credentials"
            value="password" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a JNDI Provider

At this point the JNDI Provider is running and we can request objects from it. To do so, we just need to provide the name of an existing object in the naming service. For example, suppose that your program is running on an application server and that you want to retrieve a Data Source from it, you would write code that looks as follows:

```
// Get a Data Source to connect with a database.
DataSource ds = (DataSource) scope.getObject("jndi-provider", "jdbc/MyApp");
```

Chapter 21: Spring Provider

This Provider uses the core functionality of the Spring Framework to create instances of Java beans which are defined in XML files. Spring provides an advanced configuration mechanism capable of managing beans (objects) of any nature. It is very useful because it allows you to:

- Define in an XML file how an object must be created.
- Initialize the values of a Java bean when it is created.
- Manage multiple object instances, each one associated with an ID.
- Replace the implementation class of an interface very easily.

The Spring Provider grants to you access to the most complete Inversion of Control container that exists for Java and integrates it with the Warework Framework. Before you proceed with this Provider, you should review the Spring Framework documentation to understand how objects are defined in XML files.

Configure and create a Spring Provider

To configure this Provider you just need to give the location of the bean definitions file:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(SpringProvider.PARAMETER_ConfigTarget,
   "/META-INF/beans.xml");

// Create the Provider.
scope.createProvider("spring-provider", SpringProvider.class,
   parameters);
```

You can also specify multiple files (separate each one with a semi-colon):

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(SpringProvider.PARAMETER_ConfigTarget,
   "/META-INF/beans1.xml;/META-INF/beans2.xml;/META-INF/beans3.xml;");

// Create the Provider.
scope.createProvider("spring-provider", SpringProvider.class,
   parameters);
```

URL, URL[], File and File[] objects are supported as well:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(SpringProvider.PARAMETER_ConfigTarget,
   new File[]{new File("beans1.xml"), new File("beans2.xml")});

// Create the Provider.
scope.createProvider("spring-provider", SpringProvider.class,
   parameters);
```

The specific place where resources can be loaded for your project is specified in each Warework Distribution. Typically, in a Desktop Distribution the /META-INF directory is located in the source folder of your own project.

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="spring-provider"
               class="com.warework.provider.SpringProvider">
         <parameter name="config-target" value="/META-INF/beans.xml" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from a Spring Provider

At this point the Spring Provider is running and we can request objects from it. To do so, we just need to provide the ID of a bean specified in the bean definitions file. For example, suppose that your beans.xml file looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans-2.5.xsd">

   <bean id="user-bean" class="com.mycompany.beans.UserBean">
      <property name="name" value="John" />
   </bean>

</beans>
```

To retrieve an instance of UserBean, you should write something like this:

```
// Get a new instance of UserBean class.
UserBean user = (UserBean) scope.getObject("spring-provider", "user-bean");
```

Chapter 22: Object Query Provider

The Object Query Provider is responsible for returning as `Query` objects the content of XML files that represent queries for Object Data Stores. That is, this Provider allows you to:

- Create queries for Data Stores with XML files like this one:

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/...
      ...object-query-1.0.0.xsd">

   <object>com.mycompany.beans.User</object>

   <where>
      <and>
         <expression>
            <attribute>name</attribute>
            <operator>LIKE</operator>
            <value-operand>
               <type>java.lang.String</type>
               <value>Steve</value>
            </value-operand>
         </expression>
         <expression>
            <attribute>password</attribute>
            <operator>GREATER_THAN</operator>
            <value-operand>
               <type>java.lang.Integer</type>
               <value>1000</value>
            </value-operand>
         </expression>
      </and>
   </where>

</query>
```

- Read these XML files and transform them into Java `Query` objects.
- Execute each query defined in the XML files in the target Data Store.

You can review how to create object queries with XML files in the ODBMS View and ORM View documentation.

This Provider is typically used with the Data Store Service. You have to define in a View of a Data Store that the Object Query Provider is the one who will read the statements for the View. But before that, you must configure this Provider in a Scope.

Configure and create an Object Query Provider

To configure this Provider you just need to give the base directory where to read the XML files:

```
// Create the configuration of the Provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(ObjectQueryProvider.PARAMETER_ConfigTarget,
   "/META-INF/statement/xoq");

// Create the Provider.
scope.createProvider("object-query-provider", ObjectQueryProvider.class,
   parameters);
```

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="object-query-provider"
               class="com.warework.provider.ObjectQueryProvider">
         <parameter name="config-target" value="/META-INF/statement/xoq" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from an Object Query Provider

At this point the Object Query Provider is running and we can request `Query` objects from it. To do so, we just need to provide the name of an XML file that exists in the target path specified with `PARAMETER_ConfigTarget`. Keep in mind that you do not need to give the `.xml` file extension, just provide the name of the file. For example, suppose that we have a file named `find-steve.xml`, we can parse the XML and get its contents like this:

```
// Read '/META-INF/statement/xoq/find-steve.xml' and get the Query object.
Query query = (Query) scope.getObject("object-query-provider",
   "find-steve");
```

Once we have a Query object, we can use it to query the Data Store.

Chapter 23: Object Deserializer Provider

The Object Deserializer Provider is responsible of deserializing an object stored in a file and returning it.

Serialization is the process of converting an instance of a Java object into a format that can be stored (for example, in a file) and recovered later in the same or another computer environment. In the other hand, deserialization is the process of recovering the object that was serialized.

In Java, to make an object serializable, the object must implement the `java.io.Serializable` interface. This is a very important step you must take in order to serialize Java objects. If the object to serialize does not implement this interface, it won't be possible to serialize the object.

Suppose that you have a bean named `UserInfo` and that you set the `name` and `address` fields in it. You can save this object instance into a file with the following code:

```
// Create the user bean. It must implement 'java.io.Serializable'.
UserInfo user = new UserInfo();

// Fill the bean with some data.
user.setName("Arnold");
user.setAddress("Green Lane St.");

// Setup the target file where to store the bean.
ObjectOutput out = new ObjectOutputStream(new FileOutputStream("arnold.ser"));

// Serialize the object (save the content in a file).
out.writeObject(user);

// Close the serialization process.
out.close();
```

This code stores the `UserInfo` bean in a file named "`arnold.ser`". When you have one or multiple serialized files in a directory, you can use Warework Object Deserializer to read and deserialize each file. This Provider is very useful for deserialization because it allows you to:

- Define a repository where to store serialized files, for example, a directory in your file system or a package in your project.
- Access each serialized object with a key, where the key is the name of the file without the extension (for example: `arnold`).
- Deserialize an object by just providing a key.

Configure and create an Object Deserializer Provider

To configure this Provider you just need to give the base directory where to read the serialized files:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(ObjectDeserializerProvider.PARAMETER_ConfigTarget,
   "/META-INF/system/data/ser");

// Create the Provider.
scope.createProvider("object-deserializer-provider",
   ObjectDeserializerProvider.class, parameters);
```

By default, this Provider looks for ".ser" files in the specified directory. You can specify a different file extension, like ".dat" for example, in the configuration as follows:

```
// Create the configuration of the provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(ObjectDeserializerProvider.PARAMETER_ConfigTarget,
   "/META-INF/system/data/ser");
parameters.put(ObjectDeserializerProvider.PARAMETER_FileExtension, "dat");

// Create the Provider.
scope.createProvider("object-deserializer-provider",
   ObjectDeserializerProvider.class, parameters);
```

With this configuration, the Provider will search only for ".dat" files in the "`/META-INF/system/data/ser`" directory.

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="object-deserializer-provider"
               class="com.warework.provider.ObjectDeserializerProvider">
         <parameter name="config-target" value="/META-INF/system/data/ser" />
         <parameter name="file-extension" value="dat" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from an Object Deserializer Provider

At this point the Object Deserializer Provider is running and we can request objects from it. To do so, we just need to provide the name of an existing file that exists in the specified directory. For example, suppose that there is a serialized object in a file named "`my-object.ser`" at directory "`/META-INF/system/data/ser`"; to deserialize and return this object you would write something like this:

```
// Get an object from a serialized file at '/META-INF/system/data/ser'.
MyObject mo = (MyObject) scope.getObject("object-deserializer-provider",
   "my-object");
```

Chapter 24: Properties Provider

The Properties Provider is responsible for returning properties from a properties file. Properties files are mainly used in Java related technologies to store the configurable parameters of an application. A properties file is a simple text file that may contain multiple key-value pairs (properties) like this:

```
# This is a comment
app.cache.enable=true
app.cache.refresh=6000
app.url.help=/help/index.html
```

To retrieve with this Provider the value of a property that exists in the file you have to use the key that is associated to the value. For example, to get `/help/index.html` you will need to provide the key `app.url.help`. If you are new with properties files, please keep in mind that:

- Keys should be unique in the same properties file.
- Keys and values are `String` objects so this Provider always returns strings.

Configure and create an Properties Provider

To configure this Provider you just need to give the location of a properties file:

```
// Create the configuration of the Provider.
Hashtable parameters = new Hashtable();

// Configure the Provider.
parameters.put(PropertiesProvider.PARAMETER_ConfigTarget,
   "/META-INF/system/data/properties/config.properties");

// Create the Provider.
scope.createProvider("properties-provider", PropertiesProvider.class,
   parameters);
```

The above example shows how to read the `config.properties` file from `/META-INF/system/data/properties` directory.

The specific place where resources can be loaded for your project is specified in each Warework Distribution. Typically, in a Desktop Distribution the `/META-INF` directory is located in the source folder of your own project. Other types of Distributions may read your resources from `/WEB-INF` for example, so please review the documentation associated to your Distribution to know where your resources context is.

If you plan to configure this Provider on startup with an XML file then follow this template:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">
   <providers>
      <provider name="properties-provider"
               class="com.warework.provider.PropertiesProvider">
         <parameter name="config-target"
            value="/META-INF/system/data/properties/config.properties" />
      </provider>
   </providers>
</scope>
```

Retrieve objects from an Properties Provider

At this point the Properties Provider is running and we can request string values from it. To do so, we just need to provide the key of a property that exists in the properties file:

```
// Get the string value of a key defined in the properties file.
String cache = (String) scope.getObject("properties-provider",
   "app.cache.enable");
```

PART IV: TEMPLATES

Chapter 25: FULL Template

This Template provides everything that you need to quickly start up a software application with the Framework.

It is fully configured to provide you an environment where to perform operations with a relational database, that is, you do not have to install any database neither configure the connection with it (user, password, JDBC Driver and so on); you just have to focus on writing and executing SQL statements.

Additionally, this Template also sets up a default logging mechanism with the well-known Log4j Framework. It is completely configured to perform log operations in the console so you do not have to worry about how to format the output with the Log4j configuration file.

If you have to send emails, you can do it too with the Framework but this time you have to indicate in an XML file the configuration required to connect with a mail server. It is very simple, just place an XML file in a specific directory and define in it a few parameters like host, user and password.

The FULL Template is a good base for many different types of software applications. There is also the possibility to override the default configuration by creating custom XML files or serialized configuration Java Beans for the Services provided by the Framework (Log, Pool and Data Store Services). This is a better option when you need to perform log operations in a specific way (for example: write the log in text files) or connect with remote relational databases.

Quick start

Start up your application with the FULL Template

To create a new Scope based in a FULL Template, you have to invoke method `createTemplate()` in the `ScopeFactory` class (package: `com.warework.core.scope`) with a context class (any class that exists in your project), the FULL Template name and a name for the Scope (the name that you will use to retrieve the Scope later on):

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create a fully configured Scope.
         ScopeFactory.createTemplate(MySampleApp.class, "full", "system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Create Lists, Sets and Maps

Almost every Warework Distribution include by default a convenient way to retrieve new instances of Collections. It is useful when you have to create Lists, Sets and Maps without worrying about the underlying implementation of the Collection:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create a fully configured Scope.
         ScopeFactory.createTemplate(MySampleApp.class, "full", "system");

         // Get the Scope.
         ScopeFacade system = ScopeContext.get("system");

         // Create a new ArrayList.
         List list = (List) system.getObject("list");

         // Create a new HashSet.
         Set set = (Set) system.getObject("set");

         // Create a new HashMap.
         Map map = (Map) system.getObject("map");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Log messages

To perform log operations with Log4j, just invoke method `log()` in the Scope Facade with the level of the log and the message to display (logs will be displayed in the console by default):

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Log messages in different levels.
         system.debug("Debug message");
         system.info("Info message");
         system.warning("Warning message");
         system.log("Fatal message", LogServiceConstants.LOG_LEVEL_Fatal);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

If you want to use your own Log4j configuration file, you can place it in the /META-INF/<scope-name>/log directory. The following picture shows the directory structure in [Eclipse IDE](#):

```
warework-samples
  src
    com.warework.examples
      MySampleApp.java
    META-INF
      system
        log
          log4j.properties
  JRE System Library
  Referenced Libraries
    warework-java-dist-cloud-desktop-x.y.z-full.jar
```

The most important fact to bear in mind about this file is that it should have a Logger named default-client (configure the rest of the file as you need):

```
log4j.logger.default-client=DEBUG, consoleApp
log4j.appender.consoleApp=org.apache.log4j.ConsoleAppender
log4j.appender.consoleApp.layout=org.apache.log4j.PatternLayout
log4j.appender.consoleApp.layout.ConversionPattern=[%d]-[%-5p] - %m%n
```

If you prefer to configure Log4j with an XML file instead of a properties file, you can also place a Log4j XML configuration file in the same directory:

```
warework-samples
  src
    com.warework.examples
      MySampleApp.java
    META-INF
      system
        log
          log4j.xml
  JRE System Library
  Referenced Libraries
    warework-java-dist-cloud-desktop-x.y.z-full.jar
```

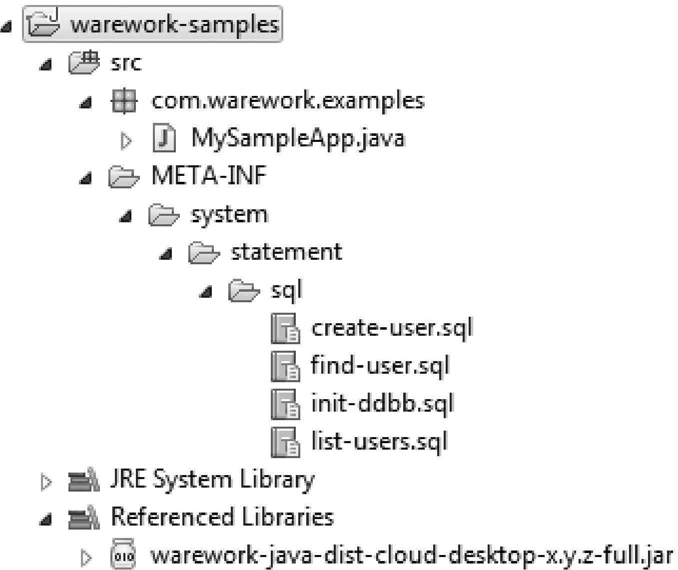
Review the documentation of Log4j to better understand how to configure this Logging Framework with properties or XML files.

Execute SQL statements in embedded database

Warework includes by default the H2 Database Engine in this Distribution. The FULL template automatically configures this relational database so you do not have to install the database, the drivers or configure anything to start working with it in your local machine.

When you startup the database for the first time in a specific Scope, H2 creates a new file for the data with the name of the Scope (in the previous example, it should be `/system.h2.db`) and places it in the user home directory. If you require customizing the configuration of the database, please review the documentation of the H2 database and configure the Pool and Data Store Services with the parameters that you need.

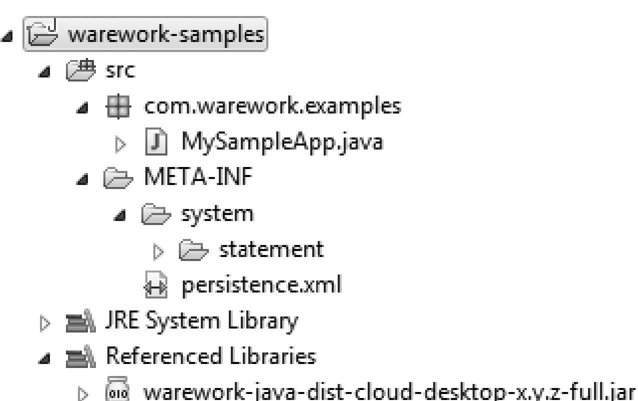
If you are going to write SQL scripts, you should place them in the `/META-INF/<scope-name>/statement/sql` directory of your project, for example:



Review the Quick examples of database operations with the FULL Template at the beginning of this tutorial and the documentation of the Data Store Service and the JDBC Data Store for further details.

Execute ORM operations with JPA in embedded database

EclipseLink, one of the best JPA implementations, is configured by default with the FULL template, so you do not have to install additional libraries or configure anything to start working with it. The only requisite to activate JPA in Warework is to include the `persistence.xml` file in the `/META-INF` directory of your project:



Remember to set the name of the persistence unit at persistence.xml file with the name of your Scope:

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.0"
   xmlns="http://java.sun.com/xml/ns/persistence"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
   http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd">

   <persistence-unit name="system">
      <class>model.HomeUser</class>
   </persistence-unit>

</persistence>
```

In this case, your Scope should be "system":

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

If you are going to write JPQL scripts, you should place them in the /META-INF/<scope-name>/statement/jpql directory of your project, for example:

```
warework-samples
   src
      com.warework.examples
         MySampleApp.java
      META-INF
         system
            statement
               jpql
                  update-user.jpql
               sql
         persistence.xml
   JRE System Library
   Referenced Libraries
      warework-java-dist-cloud-desktop-x.y.z-full.jar
```

If you prefer writing XML queries instead of JPQL scripts then you should place the XML files in the /META-INF/<scope-name>/statement/xoq directory of your project, for example:

- warework-samples
  - src
    - com.warework.examples
      - MySampleApp.java
    - META-INF
      - system
        - statement
          - sql
          - xoq
            - find-user.xml
      - persistence.xml
  - JRE System Library
  - Referenced Libraries
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

Review examples of JPA operations with the FULL Template and the documentation of the Data Store Service and the JPA Data Store for further details.

Configure a remote relational database

The FULL template automatically configures the Framework to perform operations with one relational database. If you do not provide any configuration about the database, the FULL template will setup by default the embedded H2 database (as seen before). Otherwise, if a configuration is provided, the FULL template will setup the Data Stores specified in the configuration file.

You can configure a default remote database that you want just by placing an XML file named `pool-service.xml` in the `/META-INF/<scope-name>` directory, for example:

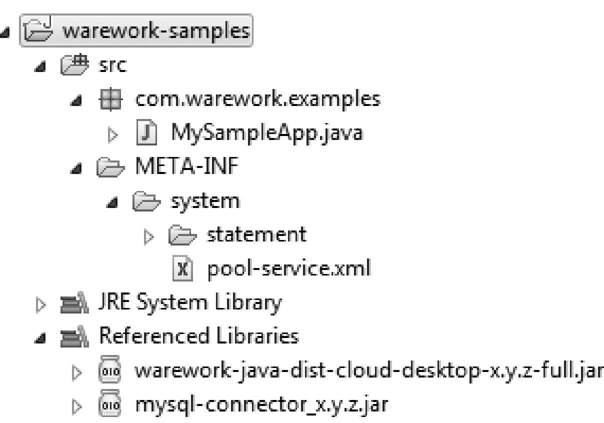
- warework-samples
  - src
    - com.warework.examples
      - MySampleApp.java
    - META-INF
      - system
        - statement
        - pool-service.xml
  - JRE System Library
  - Referenced Libraries
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

The file named `pool-service.xml` holds all the information required to connect with the database. It defines parameters like user name, password, host, port and database type. For example, suppose that we want to connect with MySQL; the content for `pool-service.xml` should be something like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="c3p0-client"
            connector="com.warework.service.pool.client.connector. …
            … C3P0Connector">
         <parameter name="driver-class" value="com.mysql.jdbc.Driver"/>
         <parameter name="jdbc-url" value="jdbc:mysql://host:port/ddbb-name"/>
         <parameter name="user" value="the-user-name"/>
         <parameter name="password" value="the-password"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
   </clients>

</proxy-service>
```

In this configuration file just place the values required to connect with your database (to avoid problems, keep `connect-on-create` equal to "`true`" and the name of `client` always to "`c3p0-client`"). Also, you will need to download and install the database driver in your classpath. As we are using MySQL in our example, we need to install Connector/J, the Java database driver for MySQL:



After that, you can have a connection with MySQL the same way as we did before:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the object where to perform database operations.
         RDBMSView ddbb = (RDBMSView) system.
            getObject("relational-database");

         // Connect with the database.
         ddbb.connect();

         // Perform database operations with MySQL.
         ...;

         // Disconnect with the database.
```

```
            ddbb.disconnect();

         } catch (Exception e) {
            e.printStackTrace();
         }
      }
   }
```

If you plan to use JPA with a remote database, you should also place an XML file named `datastore-service.xml` in the `/META-INF/<scope-name>` directory:

```
warework-samples
   src
      com.warework.examples
         MySampleApp.java
      META-INF
         system
            statement
            datastore-service.xml
            pool-service.xml
         persistence.xml
   JRE System Library
   Referenced Libraries
      warework-java-dist-cloud-desktop-x.y.z-full.jar
      mysql-connector_x.y.z.jar
```

In this file you will need to configure the JDBC and JPA Data Stores. Use the following code as a template to configure both Data Stores with remote databases:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="relational-database"
         connector="com.warework.service.datastore. …
            … client.connector.JDBCConnector">
         <parameters>
            <parameter name="client-connection-provider-name"
               value="ddbb-connection-provider"/>
            <parameter name="client-connection-provider-object"
               value="c3p0-client"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. …
               … client.JDBCViewImpl" name="rdbms-view"
               provider="sql-statement-provider"/>
         </views>
      </datastore>
      <datastore name="orm-database"
         connector="com.warework.service.datastore. …
            … client.connector.JPAConnector">
         <parameters>
            <parameter name="persistence-unit" value="system"/>
            <parameter name="javax.persistence.jdbc.driver"
```

```
                value="com.mysql.jdbc.Driver"/>
             <parameter name="javax.persistence.jdbc.url"
                value="jdbc:mysql://host:port/ddbb-name"/>
             <parameter name="javax.persistence.jdbc.user"
                value="the-user-name"/>
             <parameter name="javax.persistence.jdbc.password"
                value="the-password"/>
             <parameter name="eclipselink.cache.shared.default"
                value="false"/>
          </parameters>
          <views>
             <view class="com.warework.service.datastore. …
                … client.JPAViewImpl" name="orm-view"
                provider="object-query-provider"/>
          </views>
       </datastore>
    </datastores>

</datastore-service>
```

Bear in mind that you do not have to include any configuration parameter at `persistence.xml` file. Once both Data Sources are configured, you can retrieve them as always:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the Relational Database View.
         RDBMSView ddbb1 = (RDBMSView) system.
            getObject("relational-database");

         // Get the Object-Relational Mapping View.
         ORMView ddbb2 = (ORMView) system.getObject("orm-database");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Send emails

To send emails you have to create a configuration file for the Mail Service first. Place an XML file named `mail-service.xml` in the `/META-INF/<scope-name>` directory like this:

```
◢ warework-samples
   ◢ src
      ▷ com.warework.examples
      ◢ META-INF
         ◢ system
              log
            ▷ statement
              mail-service.xml
   ▷ JRE System Library
   ◢ Referenced Libraries
      ▷ warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Review the documentation of the Mail Service to know how to define a custom configuration file and how to specify the JavaMail Client in it. The following is an example for the content of the `mail-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="java-mail"
            connector="com.warework.service.mail.client.connector. …
            … JavaMailSenderConnector">
         <parameter name="mail.host" value="smtp.host.com" />
         <parameter name="mail.port" value="587" />
         <parameter name="mail.transport.protocol" value="smtp" />
         <parameter name="mail.user" value="sample@mail.com" />
         <parameter name="mail.password" value="password" />
         <parameter name="mail.smtp.auth" value="true" />
         <parameter name="mail.smtp.starttls.enable" value="true" />
         <parameter name="mail.message.charset" value="utf-8" />
         <parameter name="mail.message.subtype" value="html" />
      </client>
   </clients>

</proxy-service>
```

Once the Mail Service is configured, you can send an email with the following code:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the Mail Service.
         MailServiceFacade service = (MailServiceFacade) system.
            getObject("mail-service");

         // Connect client to send the email .
         service.connect("java-mail");

         // Send an email to multiple recipients.
```

```
            service.send("java-mail", "subject", "from@mail.com",
               "to1@mail.com;to2@mail.com;to3@mail.com", null, null, null,
               "mail message");

            // Disconnect client.
            service.disconnect("java-mail");

         } catch (Exception e) {
            e.printStackTrace();
         }
      }
   }
```

Enable Spring in your project

Using [Spring]() with the FULL template is fairly simple. You just have to create a file named `applicationContext.xml` in the `/META-INF/<scope-name>` directory and define in there every Java Bean that Spring should manage, for example:

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans-2.5.xsd">

   <bean id="user-bean" class="com.warework.beans.UserBean">
      <property name="name" value="John" />
   </bean>

</beans>
```

Once you create this file and define the beans that you require, you should see a picture like this in your project:

```
warework-samples
   src
      com.warework.beans
         UserBean.java
      com.warework.examples
         MySampleApp.java
      META-INF
         system
            statement
            applicationContext.xml
   JRE System Library
   Referenced Libraries
      warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Warework will automatically detect this file and it will set up everything for you, so you will be able to start using it with just two lines of code:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get a new instance of UserBean class.
         UserBean user = (UserBean) system.getObject("spring-provider",
            "user-bean");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Review the documentation of the Spring Provider for further details.

Load serialized files

Deserializing objects in Warework is really simple. Just place your serialized files in the `/META-INF/<scope-name>/data/ser` directory, for example:

- warework-samples
  - src
    - com.warework.examples
    - META-INF
      - system
        - data
          - ser
            - john-brown.ser
            - paul-seaman.ser
            - rita-smith.ser
        - statement
  - JRE System Library
  - Referenced Libraries
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

Now you can deserialize objects from this directory by providing the names of the files that you want to load (just the name, without the file extension) and the name of the Provider in charge of this task (`object-deserializer-provider`):

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Deserialize user data.
         UserBean john = (UserBean) system.
```

```
            getObject("object-deserializer-provider", "john-brown");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Base64 encoder and decoder tool

To perform Base64 operations you need to retrieve first the Converter Service. The FULL template automatically configures this Service to encode and decode with Base64. Check out the following example:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the Converter Service.
         ConverterServiceFacade converter = (ConverterServiceFacade) system.
            getService("converter-service");

         // Encode some text.
         String encoded = (String) converter.
            transform("base64-encoder", "text to encode");

         // Decode some text.
         String decoded = (String) converter.
            transform("base64-decoder", "aGVsbG8=");

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Compress JavaScript

You can also compress JavaScript code with the Converter Service. Most of the code remains the same:

```
public class MySampleApp {
   public static void main(String[] args) {
      try {

         // Create and get a fully configured Scope.
         ScopeFacade system = ScopeFactory.createTemplate(MySampleApp.class,
            "full", "system");

         // Get the Converter Service.
         ConverterServiceFacade converter = (ConverterServiceFacade) system.
```

```
            getService("converter-service");

         // JavaScript code to compress.
         String uncompressed = "function sayHello() {" +
            "// Show message" +
            "alert('Hello');" +
            "}";

         // Compress JavaScript code.
         String compressed = (String) converter.
            transform("js-compressor", uncompressed);

      } catch (Exception e) {
         e.printStackTrace();
      }
   }
}
```

Overriding the default configuration

For illustration purposes, we are going to show in the following sections how to override the default configuration of the FULL template with XML files. Keep in mind that you can perform the same action with serialized files, that is, the Framework can load the configuration for each service from a serialized file the same way it is done with an XML file. For example: if you want to override the configuration of the log service, you can create the `log-service.xml` file or the `log-service.ser` file. The Framework will try to load the serialized file first and after that, if it does not exist, it will try to load the XML file. If you plan to use serialized files for the configuration of the Framework, review the Configuration chapter for further details.

Customize the Log Service

To override the default configuration of the Log Service you have to create a custom XML file named `log-service.xml` in the `/META-INF/<scope-name>` directory, for example:

warework-samples
src
com.warework.examples
MySampleApp.java
META-INF
system
statement
log-service.xml
JRE System Library
Referenced Libraries
warework-java-dist-cloud-desktop-x.y.z-full.jar

Review the documentation of the Log Service to know how to define a custom configuration file and how to specify the Log4j Logger in it. The following is an example for the content of the `log-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client"
            connector="com.warework.service.log.client.connector. …
            … Log4jPropertiesConnector">
         <parameter name="config-target"
            value="/META-INF/system/log/log4j.properties"/>
      </client>
   </clients>

</proxy-service>
```

This XML file registers the Log4j Logger and a .properties file for it that configures Log4j. Check out this code as an example for the content of the log4j.properties file:

```
log4j.logger.default-client=DEBUG, consoleApp
log4j.appender.consoleApp=org.apache.log4j.ConsoleAppender
log4j.appender.consoleApp.layout=org.apache.log4j.PatternLayout
log4j.appender.consoleApp.layout.ConversionPattern=[%d]-[%-5p] - %m%n
```

The final picture for your resources in an Eclipse IDE should be like this:

```
warework-samples
   src
      com.warework.examples
         MySampleApp.java
      META-INF
         system
            log
               log4j.properties
            statement
            log-service.xml
   JRE System Library
   Referenced Libraries
      warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Customize the Pool Service

To override the default configuration of the Pool Service you have to create a custom XML file named pool-service.xml in the /META-INF/<scope-name> directory, for example:

```
warework-samples
  src
    com.warework.examples
    META-INF
      system
        log
        statement
        log-service.xml
        pool-service.xml
  JRE System Library
  Referenced Libraries
    warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Review the documentation of the Pool Service to know how to define a custom configuration file and how to specify the c3p0 Pooler in it. The c3p0 Pooler is responsible of creating database connections that are used by Data Stores. The following is an example for the content of the `pool-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="c3p0-client"
            connector="com.warework.service.pool.client.connector. …
            … C3P0Connector">
         <parameter name="driver-class" value="org.h2.Driver"/>
         <parameter name="jdbc-url" value="jdbc:h2:~/system;USER=system"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
   </clients>

</proxy-service>
```

Customize the Data Store Service

To override the default configuration of the Data Store Service you have to create a custom XML file named `datastore-service.xml` in the `/META-INF/<scope-name>` directory, for example:

- warework-samples
  - src
    - com.warework.examples
    - META-INF
      - system
        - log
        - statement
        - datastore-service.xml
        - log-service.xml
        - pool-service.xml
  - JRE System Library
  - Referenced Libraries
    - warework-java-dist-cloud-desktop-x.y.z-full.jar

Review the documentation of the Data Store Service to know how to define a custom configuration file and how to specify Data Stores in it. The following is an example for the content of the `datastore-service.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<datastore-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/ …
   … xsd/datastore-service-1.1.0.xsd">

   <datastores>
      <datastore name="relational-database"
         connector="com.warework.service.datastore. …
            … client.connector.JDBCConnector">
         <parameters>
            <parameter name="client-connection-provider-name"
               value="ddbb-connection-provider"/>
            <parameter name="client-connection-provider-object"
               value="c3p0-client"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. …
               … client.JDBCViewImpl" name="rdbms-view"
               provider="sql-statement-provider"/>
         </views>
      </datastore>
      <datastore name="orm-database"
         connector="com.warework.service.datastore. …
            … client.connector.JPAConnector">
         <parameters>
            <parameter name="persistence-unit" value="system"/>
            <parameter name="javax.persistence.jdbc.driver"
               value="org.h2.Driver"/>
            <parameter name="javax.persistence.jdbc.url"
               value="jdbc:h2:~/system"/>
            <parameter name="javax.persistence.jdbc.user"
               value="system"/>
            <parameter name="eclipselink.cache.shared.default"
               value="false"/>
         </parameters>
         <views>
            <view class="com.warework.service.datastore. …
               … client.JPAViewImpl" name="orm-view"
               provider="object-query-provider"/>
         </views>
      </datastore>
   </datastores>
```

```
</datastore-service>
```

Customize the Converter Service

To override the default configuration of the Converter Service you have to create a custom XML file named converter-service.xml in the /META-INF/<scope-name> directory, for example:

```
warework-samples
  src
    com.warework.examples
    META-INF
      system
        log
        statement
        converter-service.xml
        datastore-service.xml
        log-service.xml
        mail-service.xml
        pool-service.xml
  JRE System Library
  Referenced Libraries
    warework-java-dist-cloud-desktop-x.y.z-full.jar
```

Review the documentation of the Converter Service to know how to specify Converters in it. The following is an example for the content of the converter-service.xml file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="base64-encoder"
            connector="com.warework.service.converter.client.connector. …
            … StringFormatterConnector">
         <parameter name="operation-mode" value="encode"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
      <client name="base64-decoder"
            connector="com.warework.service.converter.client.connector. …
            … StringFormatterConnector">
         <parameter name="operation-mode" value="decode"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
      <client name="js-compressor"
            connector="com.warework.service.converter.client.connector. …
            … JavaScriptCompressorConnector"/>
         <parameter name="connect-on-create" value="true"/>
      </client>
   </clients>

</proxy-service>
```

PART V: CONFIGURATION

Chapter 26: XML configuration

This chapter is about how to configure Scopes and Proxy Services with XML files. It is recommended to keep the configuration of your applications in separate files where you can easily manage how your Scopes must behave. CORE Extension Module (included in this Distribution) handles this task by providing specific Loaders that transforms XML files into configuration objects required by the Framework.

You will find in this section how to:

- Create a configuration file for an application.
- Define global parameters for a specific Scope.
- Specify Providers, Services and Object References to be ready when a Scope starts up.
- Handle Clients for Proxy Services.
- Manage custom XML configuration files for Services.

Scopes

Now we are going to see how to configure a Scope with an XML file. The first thing you need to check out is the format and content of this file. Here it is:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

An XML file like this allows you to define which Providers, Services, Object References and initialization parameters a Scope will have when it is created. Later on, we will review how each of these components are defined.

In Desktop Distributions, it is recommended to place the XML files at /META-INF directory but, of course, you can place them wherever you need.

Initialization parameters

Sometimes you may need to specify a set of parameters to configure how a Scope will be created and how it will behave once it is created. Initialization parameters are very useful too when you need to define constants (they are read only) for Services, Providers or the entire application. It is also important to know that you can use pre-defined parameters as well as custom ones. The following code shows how to define initialization parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      <parameter name="name" value="John"/>
   </parameters>

</scope>
```

This is an example of a custom initialization parameter. We can define unlimited initialization parameters and retrieve them any time we want with the following code:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the value of the initialization parameter ("John").
String name = (String) scope.getInitParameter("name");
```

Keep in mind that initialization parameters defined in XML files are always String values and they will not change along the life of the Scope (you cannot delete or update any of them once the Scope is started). Services and Providers can read these parameters too.

There are predefined initialization parameters that are used to configure Scopes. Most of them are handled automatically by the factories included in the Distributions, those that are responsible of the creation of the Scopes. You can review each one in the ScopeL1Constants class that exists in the com.warework.core.scope package.

Providers

The following example shows how to define multiple Providers in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="sample1-provider"
```

```
              class="com.warework.provider.Sample1Provider" />
      <provider name="sample2-provider"
              class="com.warework.provider.Sample2Provider" />
      …
   </providers>

</scope>
```

These Providers do not have parameters. That is, just with the name and the class, the Provider should be ready to run.

To retrieve an object from these Providers we can write something like:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get an object from "Sample1" Provider.
Object obj = scope.getObject("sample1-provider", "object-name");
```

Most of the times, you will need to specify a set of parameters that configure how the Provider must work. This is an example of a Provider configured with parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="standard-provider"
              class="com.warework.provider.StandardProvider">
         <parameter name="default-set" value="java.util.HashSet" />
         <parameter name="default-map" value="java.util.HashMap" />
         <parameter name="default-list" value="java.util.ArrayList" />
      </provider>
   </providers>

</scope>
```

In this example, the Standard Provider accepts parameters to define which classes it can create. You will need to review the parameters that a Provider can accept with the implementation class of the Provider (in this example, the `StandardProvider.class`).

Classes inside `com.warework.provider` package ending with `Provider` keyword can also be specified with short names. The following XML configures the Standard Provider exactly as we saw in the previous example:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="standard-provider" class="Standard">
         <parameter name="default-set" value="java.util.HashSet" />
         <parameter name="default-map" value="java.util.HashMap" />
         <parameter name="default-list" value="java.util.ArrayList" />
      </provider>
   </providers>
```

```
</scope>
```

Object References

Once you have defined at least one Provider, you can also define in an XML file references to objects that exist in a Provider. Check this out with the following code:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <providers>
      <provider name="standard-provider"
            class="com.warework.provider.StandardProvider">
         <parameter name="load-objects" value="false"/>
         <parameter name="default-set" value="java.util.HashSet"/>
         <parameter name="default-map" value="java.util.HashMap"/>
         <parameter name="default-list" value="java.util.ArrayList"/>
      </provider>
   </providers>

   <objects>
      <object name="map" provider="standard-provider" object="default-map"/>
   </objects>

</scope>
```

This time, you can retrieve new `HashMap` instances just by writing this:

```
// Get a new Map from the Standard Provider.
HashMap map = (HashMap) scope.getObject("map");
```

Every time this line of code is executed you will get a new `HashMap`. Review how the Provider works because it may retrieve unique instances (singleton) or objects from remote machines.

Services

The following example shows how to define multiple Services in an XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="sample1-service"
         class="com.warework.service.sample1.Sample1ServiceImpl"/>
      <service name="sample2-service"
         class="com.warework.service.sample2.Sample2ServiceImpl"/>
      …
   </services>
```

```
</scope>
```

These Services do not have parameters. That is, just with the name and the class, the Service should be ready to run.

To retrieve a Service from a Scope we can write something like:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;

// Get the facade of Service "Sample1".
Sample1ServiceFacade service = (Sample1ServiceFacade) scope.
   getService("sample1-service");
```

Most of the times, you will need to specify a set of parameters that configure how the Service must work. This is an example of a Service configured with parameters:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>

</scope>
```

In this example, the Log Service accepts parameters to define where to load an XML file for the configuration of the Service. You will need to review the parameters that a Service can accept with the class that defines the constants of the Service (in this example, the `LogServiceConstants.class`).

Classes inside `com.warework.service.<service-name>` package with `<service-name>ServiceImpl` class name can also be specified with a short name. The following XML configures the Log Service exactly as we saw in the previous example:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service" class="log">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>
```

```
</scope>
```

Proxy services

The way to configure a Proxy Service is slightly different. You need to create a separate XML file for the Proxy Service and reference it from the Scope XML file. The following example shows how to define a Proxy Service and the configuration file that it requires. The first thing you have to do is to register the Service:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="log-service"
            class="com.warework.service.log.LogServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.ProxyServiceSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/log-service.xml" />
      </service>
   </services>

</scope>
```

This XML file defines a Log Service and a configuration file for it. You specify the configuration file for the Service with two special parameters:

- **`config-class`**: this parameter represents the class that reads the XML configuration for the Service. The most common value for this parameter is `com.warework.core.-loader.ProxyServiceSAXLoader` as it is a generic loader of configuration files for Proxy Services. Anyway, some Services may use their own Loaders for XML files or simply skip the configuration process by removing this parameter. Review the value for this parameter in the documentation of each Service.

- **`config-target`**: this parameter represents the location of the XML file to load. You should place this file under `/META-INF` directory.

Once it is registered in the Scope we proceed with the creation of the Proxy Service configuration file. Based on the previous example, this could be the content of the **`log-service.xml`** file:

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client"
      connector="com.warework.service.log.client.connector.ConsoleConnector"/>
   </clients>

</proxy-service>
```

You can define as many Clients as you need for the Proxy Service. Once the Scope is started, you can work with clients like this:

```
// Get an instance of a Scope.
ScopeFacade scope = ...;


// Get the facade of the Log Service.
LogServiceFacade service = (LogServiceFacade) scope.getService("log-service");

// Connect the Client.
service.connect("default-client");

// Perform operations with the Client.
...

// Disconnect the Client.
service.disconnect("default-client");
```

Some Clients may require configuration parameters. The following example shows how a Client specifies a configuration file for it.

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client" connector="…">
         <parameter name="config-target" value="…"/>
      </client>
   </clients>

</proxy-service>
```

Remember to review the documentation of each Client to know which parameters it accepts.

```
<?xml version="1.0" encoding="UTF-8"?>
<proxy-service xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/proxy-
   service-1.0.0.xsd">

   <clients>
      <client name="default-client" connector="Console"/>
   </clients>

</proxy-service>
```

Parent Scopes

You can define the Parent Scope for a specific Scope in an XML file. It is useful when you need to start up a Parent Scope (or reuse it, if it already exists) for the main Scope that you want to create. A Scope factory that parses an XML file like this automatically creates the Parent Scope

and assigns it to the main Scope (the Scope instance that you will get with the factory). It is important to keep in mind that only one Parent Scope can be defined per Scope. Check out in the following example how to define a Parent Scope:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parent name="parent-scope">

      <parameters>
         // Specify here the initialization parameters for the Parent Scope.
      </parameters>

      <providers>
         // Specify here the Providers for the Parent Scope.
      </providers>

      <objects>
         // Specify here the object references for the Parent Scope.
      </objects>

      <services>
         // Specify here the Services for the Parent Scope.
      </services>

   </parent>

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

Once the main Scope is created, you can retrieve its Parent Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get the Parent of the Scope.
ScopeFacade parent = scope.getParent();
```

Domains

You can also define the Domain Scope for a specific Scope in an XML file. It is useful when you need to create a Domain Scope (or reuse it, if it already exists) for the main Scope that you

want to create. Keep in mind that only one Domain Scope can be defined per Scope. Check out in the following example how to define it:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <domain name="domain-scope">

      <parameters>
         // Specify here the initialization parameters for the Domain Scope.
      </parameters>

      <providers>
         // Specify here the Providers for the Domain Scope.
      </providers>

      <objects>
         // Specify here the object references for the Domain Scope.
      </objects>

      <services>
         // Specify here the Services for the Domain Scope.
      </services>

   </domain>

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

</scope>
```

Once the main Scope is created, you can retrieve its Domain Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get the Domain of the Scope.
ScopeFacade domain = scope.getDomain();
```

Context of a Scope

The XML configuration file allows you to define a set of Scopes that exist in the context of a Scope. This time, you can define as many Scopes as you need in the context of another Scope. Check this out with the following example:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parameters>
      // Specify here the initialization parameters for the Scope.
   </parameters>

   <providers>
      // Specify here the Providers for the Scope.
   </providers>

   <objects>
      // Specify here the object references for the Scope.
   </objects>

   <services>
      // Specify here the Services for the Scope.
   </services>

   <context>

      <scope name="scope-1">

         <parameters>
            // Specify here the initialization parameters for the Scope.
         </parameters>

         <providers>
            // Specify here the Providers for the Scope.
         </providers>

         <objects>
            // Specify here the object references for the Scope.
         </objects>

         <services>
            // Specify here the Services for the Scope.
         </services>

      </scope>

      <scope name="scope-2">...</scope>
      <scope name="scope-3">...</scope>

   </context>

</scope>
```

Once the main Scope is created, you can retrieve a Scope from the context of the main Scope like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get a Scope from the context of the main Scope.
ScopeFacade contextScope = scope.getContext().get("scope-1");
```

Example

The following example shows a combination of multiple Scopes in just one XML configuration file:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <parent name="p1">

      <parent name="p2">

         <domain name="p2-d">…</domain>

         <context>
            <scope name="p2-c1">…</scope>
            <scope name="p2-c2">…</scope>
         </context>

      </parent>

      <domain name="p1-d">…</domain>

      <parameters>…</parameters>
      <providers>…</providers>
      <objects>…</objects>
      <services>…</services>

   </parent>

   <parameters>…</parameters>
   <providers>…</providers>
   <objects>…</objects>
   <services>…</services>

   <context>

      <scope name="c1">…</scope>
      <scope name="c2">…</scope>

      <scope name="c3">

         <parent name="c3-p">

            <context>
               <scope name="c3-p-c1">…</scope>
               <scope name="c3-p-c2">…</scope>
            </context>

         </parent>

         <parameters>…</parameters>
         <providers>…</providers>
         <objects>…</objects>
         <services>…</services>

      </scope>

   </context>
```

```
</scope>
```

To retrieve Scopes from the main Scope, you can perform operations like this:

```
// Get the main Scope.
ScopeFacade scope = ...;

// Get Scopes from the main Scope.
ScopeFacade p2 = scope.getParent().getParent();
ScopeFacade p2_d = scope.getParent().getParent().getDomain();
ScopeFacade p2_c1 = scope.getParent().getParent().getContext().get("p2-c1");
```

Custom XML Loaders for Services

You can create custom XML Loaders for your own Services. The first thing you need to do is to create the Loader that reads the XML file and parses it into a Java object. Just create a class that extends the `AbstractSAXLoader` class that exists in the `com.warework.core.loader` package, like this:

```
public class SampleSAXLoader extends AbstractSAXLoader {

   public void startElement(String uri, String localName, String qName,
         Attributes attributes) throws SAXException {
      // Parse every XML tag here with the "qName" argument.
      // Each value for the object to return is set here.
      // This method is executed when <> open tag is found.
   }

   public void endElement(String uri, String localName, String qName)
      throws SAXException {
      // Parse every XML tag here with the "qName" variable.
      // Each value for the object to return is set here.
      // This method is executed when </> close tag is found.
   }

   protected Object getConfiguration() {
      // Return here the object that represents the content of the XML file.
      return null;
   }

}
```

In general, you have to perform the following steps to properly implement this class:

4. Create an object/attribute that represents the XML. It will store the values from the XML file in it.

5. Parse the XML file with SAX methods `startElement` and `endElement`. In these methods you have to fill the attribute with the values you find in the XML file.

6. Return the attribute at `getConfiguration` method when the work is done.

Here it is an example:

```
public class SampleSAXLoader extends AbstractSAXLoader {

   // Object that represents the XML file.
   private ServiceConfig config;

   public void startElement(String uri, String localName, String qName,
         Attributes attributes) throws SAXException {
      if ((qName.equals("firstTag")) ||
          (localName.equals("firstTag"))) {

         // Create the object that represents the XML file.
         config = new ServiceConfig();

      } else if ((qName.equals("anotherTag")) ||
          (localName.equals("anotherTag"))) {
         config.setName(attributes.getValue("name"));
      } else if (...) {
         ...
      }
   }

   // "endElement" method is optional.

   protected Object getConfiguration() {
      return config;
   }

}
```

Finally, we have to reference the new Loader in the Service:

```
<?xml version="1.0" encoding="UTF-8"?>
<scope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:noNamespaceSchemaLocation="http://repository.warework.com/xsd/scope-
   1.0.0.xsd">

   <services>
      <service name="sample-service"
            class="com.warework.service.sample.SampleServiceImpl">
         <parameter name="config-class"
            value="com.warework.core.loader.SampleSAXLoader" />
         <parameter name="config-target"
            value="/META-INF/system/sample-service.xml" />
      </service>
   </services>

</scope>
```

Chapter 27: Serialized configuration

Warework allows you to configure the Framework with serialized objects. The idea is simple. First, you create the objects required to configure the Framework and after that, you serialize these objects into files. Once the configuration is stored in files, the Framework can boot up by loading these files.

In this chapter we are going to show you how to create and fill the Framework configuration objects. It is very important to you to know that you must use only those objects that exist in the "`com.warework.core.model.ser`" package; otherwise, they cannot be serialized.

Review the following code to save into files the objects that represent the configuration of the Framework:

```
// Create the configuration.
Scope scope = new Scope();

// Configure your application.
…

// Setup the target file where to store the configuration.
ObjectOutput out = new ObjectOutputStream(new FileOutputStream("system.ser"));

// Serialize the object (save the content in the file).
out.writeObject(scope);

// Close the serialization process.
out.close();
```

One of the main advantages of using serialized files is that you can store all the configuration of the Framework in just one single file (Scope and Services configuration is stored together in the same file). This is really useful when you need to share the configuration of your application with someone else. Anyway, it is also possible to store the configuration in multiple serialized files like it is done with XML files.

Scope and initialization parameters

The following code shows how to create a Scope and how to set the name for it:

```
// Create a Scope named "system".
Scope scope = new Scope("system");
```

Once the Scope is created, we can add some initialization parameters:

```
scope.setInitParameter("app-desc", "This is a demo app");
```

Remember that you can store initialization parameters of any type:

```
scope.setInitParameter("color-enabled", Boolean.TRUE);
```

Providers and object references

Now we are going to register a Provider in the Scope. To do so, we have to set the name and the class of the Provider:

```
// Register a Provider in the configuration of the Scope.
scope.setProvider("my-provider", SampleProvider.class, null);
```

Once the Provider exists in the Scope, we can configure the Provider if it is required:

```
// Configure the Provider.
scope.setProviderParameter("my-provider", "param1", "text value");
scope.setProviderParameter("my-provider", "param2", Boolean.TRUE);
scope.setProviderParameter("my-provider", "param3", new Date());
```

To create an object reference we need to specify the name of the reference, the name of the Provider and the name of the object in the Provider:

```
// Create an object reference.
scope.setObjectReference("my-object", "my-provider", "object-name");
```

Services

To create a Service we have to set the name and the implementation class of the Service:

```
// Register a Service in the configuration of the Scope.
scope.setService("my-service", SampleServiceImpl.class, null, null);
```

Once the Service exists in the Scope, we can configure the Service like this:

```
// Configure the Service.
scope.setServiceParameter("my-service", "param1", "text value");
scope.setServiceParameter("my-service", "param2", Boolean.TRUE);
scope.setServiceParameter("my-service", "param3", new Date());
```

For Proxy Services you can create Clients directly with the `Scope` object. You have to provide the name of the Service, the name of the Client to create in the Service and the Connector of the Client:

```
// Create a Client for the Service.
scope.setClient("my-service", "my-client", SampleConnector.class, null);
```

Now that one Client exists in the Service, you can configure the Client with initialization parameters like this:

```
// Configure the Client (parameters for the Connector).
scope.setClientParameter("my-service", "my-client", "param1", "value1");
scope.setClientParameter("my-service", "my-client", "param2", Boolean.TRUE);
scope.setClientParameter("my-service", "my-client", "param3", new Date());
```

This is useful if you want to store the configuration of Services and Clients together with the configuration of the Scope (one main object, the `Scope` object, holds everything). If you prefer to configure the Service in a separate file, you need to set two parameters in the configuration of the Service: one to define which class loads the external configuration and another one to specify where is the configuration. The following code shows how to configure the Log Service to load an external XML file:

```
// Register a Service in the configuration of the Scope.
scope.setService("log-service", LogServiceImpl.class, null, null);

// Configure the Service.
scope.setServiceParameter("log-service", "config-class",
   ProxyServiceSAXLoader.class);
scope.setServiceParameter("log-service", "config-target",
   "/META-INF/system/log-service.xml");
```

You can also perform the same action like this:

```
// Register the Service and specify the class that loads the configuration.
scope.setService("log-service", LogServiceImpl.class, null,
   ProxyServiceSAXLoader.class);

// Set the location of the configuration file.
scope.setServiceParameter("log-service", "config-target",
   "/META-INF/system/log-service.xml");
```

If you plan to load the configuration from a serialized file, you have to set a different loader:

```
scope.setService("log-service", LogServiceImpl.class, null,
   ObjectDeserializerLoader.class);
scope.setServiceParameter("log-service", "config-target",
   "/META-INF/system/log-service.ser");
```

Another way to store the configuration of Services and Clients together with the configuration of the Scope consists of creating and configuring a `ProxyService` object. We can configure the Clients of the Service in a separate object and after that we can bind this object into the Service. Check out the following code:

```
// Create the object to configure the Proxy Service.
ProxyService service = new ProxyService();

// Create a Client for the Service.
service.setClient("my-client", SampleConnector.class, null);

// Configure the Client (parameters for the Connector).
service.setClientParameter("my-client", "param1", "value1");
```

```
service.setClientParameter("my-client", "param1", Boolean.TRUE);
service.setClientParameter("my-client", "param1", new Date());

// Set the configuration for the Service.
scope.setServiceParameter("my-service", "config-target", service);
```

You can also configure Services like this with different configuration objects. The Data Store Service is a good example:

```
// Create the configuration for the Data Store Service.
DatastoreService service = new DatastoreService();

// Configure the Data Store Service.
…
// Set the configuration for the Service.
scope.setServiceParameter("datastore-service", "config-target", service);
```

Parents, domains and the context of a Scope

Like in XML files, you can also define the Parent Scope for a specific Scope in a configuration object. Check it out:

```
// Create Parent Scope.
Scope parent = new Scope("parent-system");

// Configure Parent.
…

// Create Main Scope.
Scope system = new Scope("main-system");

// Set Parent Scope.
system.setParent(parent);
```

You can also define the Domain Scope for a specific:

```
// Create Domain Scope.
Scope domain = new Scope("domain-system");

// Configure Domain.
…

// Create Main Scope.
Scope system = new Scope("main-system");

// Set Domain Scope.
system.setDomain(domain);
```

To include Scopes in the context of a Scope follow this code:

```
// Create two Scopes.
Scope scope1 = new Scope("sub-system1");
Scope scope2 = new Scope("sub-system2");
```

```
// Create Main Scope.
Scope system = new Scope("main-system");

// Set Scopes in the context of the Main Scope.
system.setContextScope(scope1);
system.setContextScope(scope2);
```