

IEEE COMPUTER SOCIETY STYLE GUIDE



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Introduction

Mission statement

The IEEE Computer Society Style Guide Committee's mission is to clarify the editorial styles and standards that the Society's publications use. We maintain and periodically update a style guide to clarify those usages not adequately defined in accepted external sources. Our purpose is to promote coherence, consistency, and identity of style, making it easier for CS editors and our authors to produce quality submissions and publications that communicate clearly to all our readers.

General information

This revised (November 2015) edition of the IEEE Computer Society Style Guide complements these primary references:

- **Preferred dictionary:** *Webster's Collegiate Dictionary*, 11th ed., 2003.
- **General style guide:** *The Chicago Manual of Style*, 16th ed., 2010 (called *CMS* in this style guide).

The CS style guide defines and explains unique IEEE Computer Society usages, particularly where they differ from other usages. It also defines specialized terms to help editors determine proper usage and phraseology.

Entries in the alphabetical listing include commonly used acronyms, definitions, and brief remarks on points of style. Entries for terms are listed with their initial letter in lowercase, unless the term is a proper name or conventionally appears with an initial capital letter. A keyword given in italics denotes entries for remarks on style. Where topics can't be covered by short explanations, they're presented in the special sections listed in the Table of Contents.

An * denotes entries in the alphabetical listing that can be used as acronyms on first reference. An individual magazine's editorial staff can make determinations about applying this designation to other acronyms on the list. Because some terms look like acronyms and some acronyms look like terms, the style guide provides overlapping entries to make it easier to use. Likewise, the listings include cross-references where necessary.

This style guide will be updated as required. An electronic version is available at www.computer.org/web/publications/styleguide.

The Style Guide Committee is a permanent body with a mandate to rule on questions of style and to provide guidelines where none exist. If you have a question to pose, or you find an entry that needs to be added or changed, please send your request by e-mail to style@computer.org. The committee will endeavor to reply within 30 days.

Resolving differences with authors

The Style Guide Committee's goal is to direct editors to published works and offer guidelines that they should consider and follow, except when they have good reasons to do otherwise. We recognize that each CS publication has its own minor style variations. Moreover, a good editor knows when to bend a good rule in order to maintain clarity of meaning within a written passage.

Authors provide the technical content for Computer Society publications and, together with referees, bear the major responsibility for ensuring technical accuracy. The editor's job is to present the material in the most effective manner possible, consistent with established CS publishing practices.

Computer Society style isn't intended to alienate authors, universities, or corporations; its goal is to achieve professionalism and consistency while treating all firms, organizations, and individuals equally. This house style is generally supported by US trademark law.

Occasional author–editor disagreements can be expected, and compromises are often necessary. Each party should recognize that the other has a stake in the outcome. The author's name appears on the book or article for all the world (and numerous colleagues) to see, and the editor must follow guidelines established by senior editors, managers, the publisher, and accepted CS editing practices.

Authors frequently feel that a particular usage is correct because it has appeared in a variety of printed communications. However, if these communications are conference proceedings, in-house technical reports, or unpublished papers that haven't been professionally edited, no one has yet applied standard publishing rules. Once in a while, though, CS style might indeed be out of step, and questionable cases should be referred to the Style Guide Committee. Willingness to view a situation from another's vantage point is a big step toward resolving differences.

Editors should be flexible enough to compromise when firm publishing and editing principles aren't being violated. If an author's preference violates strict grammar rules or firm CS guidelines, the editor should make clear what that violation is, explain why it's not good practice, and suggest an alternative.

An editor's decisions shouldn't be, or appear to be, arbitrary. Explaining that the Style Guide Committee has given considerable thought to CS policies and has established guidelines intended to enhance the authority, effectiveness, and prestige of CS publications is usually the best way to enlist an author's cooperation in the search for a solution. Unresolved disputes between an equally adamant author and editor should be referred to the department manager.

Acknowledgments

The participation of the following IEEE Computer Society staff members in revising this manual is gratefully acknowledged: Carrie Clark, Chris Nelson, Lisa O'Conner, Meghan O'Dell, Richard Park, Dennis Taylor, and Rebecca Torres.

Abbreviations

Styles differ on whether periods should be used with particular abbreviations. The Society discourages the use of periods in certain abbreviations, such as those for academic degrees, names of countries, and other abbreviations that are in all capitals. When periods are removed from abbreviations, the internal space should also be removed—for example, MIT, PhD, or US. The internal space is also removed from other abbreviations with internal periods, as with author initials. If an abbreviation also spells a word, removing the following period could cause confusion in some contexts—for example, in. and no.

Although many style manuals decry the use of abbreviations, some words are seldom spelled out. Among these are abbreviations for affiliations or scholarly degrees after a name (BA or PhD), and abbreviations such as AD, CPA, and Ltd. A symbol or figure beginning a sentence, on the other hand, is usually spelled out; if it can't be, the sentence is rewritten—for example, "Two hundred miles," not "200 miles."

Style tips

The abbreviations Jr., Sr., II and so forth don't require a comma because they're part of the person's name (John Smith Jr.).

Mr., Mrs., and Dr. are dropped if another title is also used (not Dr. John Smith Jr., PhD).

The preferred format avoids using a descriptor unless the company name might not be clear without it—for example, Data Co. However, if it's necessary to use Limited, Incorporated, Corporation, or Company, they're abbreviated to Ltd., Inc., Corp., or Co., respectively, and the abbreviation isn't preceded by a comma.

The abbreviations Nat'l and Int'l (for national and international) don't take a period.

The standard abbreviations for most degrees we encounter in our authors' biographies are BS, MS, MSc, and PhD. For additional rules on abbreviating academic degrees, see the entry under *academic degrees* in the alphabetical section.

Centuries use the ordinal symbol—for example, 21st century.

Also see the *References* section; for a more complete discussion of abbreviations, see *CMS*, Chapter 10.

Abbreviations for units of measurement

The following abbreviations don't need to be spelled out when used with numbers, except to avoid possible confusion.

Abbreviation	Meaning
A	ampere
°C	degree Celsius
cm	centimeter
d	day
dB	decibel
dpi	dots per inch

°F	degree Fahrenheit
ft	foot
g	gram
Gbyte	gigabyte
GHz	gigahertz
h	hour
Hz	hertz
in	inch
J	joule
K	(degree) kelvin
kHz	kilohertz
km	kilometer
kmph	kilometers per hour
kW	kilowatt
kWh	kilowatt hour
L	liter
lb	pound
μs	microsecond
m	meter
Mbyte	megabyte
MHz	megahertz
mi	mile
min	minute
mm	millimeter
mo., mos.	month, months
mph	miles per hour
ms	millisecond
mV	millivolt
mW	milliwatt
N	newton
ns	nanosecond
Pa	pascal
s	second
sq ft	square foot
Tbyte	terabyte
V	volt
W	watt
y	year, years

Acronyms and Abbreviated Terms

A true acronym is formed by using the first letter from two or more separate words—for example, *DEC* for Digital Equipment Corporation. Articles or prepositions falling in between (for example, and, of, in, and the) generally aren't part of the acronym. Use all capitals only for true acronyms.

Many acronyms or abbreviated terms used for measurements are traditionally all lowercase—for example, cpi (characters per inch) and dpi (dots per inch). A few are mixed, such as kHz (kilohertz). Capitalization also can differ depending on meaning—for example, MW (megawatt) and mW (milliwatt). See the alphabetical section when in doubt.

As a general rule, spell out all acronyms on first use, but don't use initial capitals just because the letters form the acronym. There must be another reason for the caps; for example, the words constitute a proper noun. In other words, CAD is computer-aided design, not Computer-Aided Design.

Exceptions to the spell-out-on-first-use rule are acronyms so well known to a particular magazine's readers that spelling them out would be insulting. In the alphabetical section, the Style Guide Committee has determined that acronyms marked with an asterisk are so familiar to all our readers that they don't need to be spelled out on first use. Examples include RAM, ROM, and CD-ROM.

Put the acronym in parentheses immediately after the spelled-out term. In long articles with unfamiliar acronyms, it helps to spell out the words occasionally throughout to refresh readers' memories and aid those who browse. If an article includes many unfamiliar acronyms, consider creating a glossary or sidebar.

Use judgment before allowing a short common term to be reduced to an acronym (for example, operating system to OS). Readers have difficulty with articles that read like alphabet soup.

Provided that an acronym isn't visually distracting (use your judgment), capitalize it as the author submitted it, so long as the CS Style Guide doesn't already prescribe a style for it and its formatting agrees with the official version. (For example, the www.flossproject.org provides the project's preferred capitalization: FLOSS.) When deciding whether to revise acronym capitalization, first consider clarity, followed by author preference.

The Style Guide's alphabetical section includes combinations of words and acronyms, such as MiniDIP, which generally follow both capitalization and acronym rules.

For a list of units of measurement that don't need to be spelled out, see the "Abbreviations" section and the related entries in the Style Guide's alphabetical section. For unfamiliar units of measurement, spell them out on first use.

Authors and Affiliations

On an article’s first page, list the authors in the order in which they appeared on the original accepted paper’s first page. (If no names appeared there, use the order of the author bios, if there are any. Otherwise, contact the authors.) If authors listed next to each other share an affiliation, group them together. If authors share an affiliation but aren’t listed next to each other, don’t group them together. For example, note the first and third lines of this list:

Khairi Reda and Alessandro Febretti, *University of Illinois at Chicago*

Aaron Knoll, *University of Texas at Austin*

Jillian Aurisano, Jason Leigh, and Andrew Johnson, *University of Illinois at Chicago*

Michael E. Papka and Mark Hereld, *Argonne National Laboratory*

The author order on the first page and in the bios should be the same. Also, an author’s name on the first page and in the bio should match exactly.

Normally, each author should have only one affiliation on the article’s first page—usually, the affiliation at which the research occurred. (You can list other affiliations in the bio. If an author must have more than one affiliation on the first page, inform Monette Velasco or Jennie Zhu-Mai before the issue ships.) If the affiliation is an institute or organization associated primarily with a university, use just the university name as the affiliation. However, in *IEEE Software*, you can list Software Engineering Institute as the affiliation without listing Carnegie Mellon University. If confusion about an affiliation name is possible (for example, school names that could apply to multiple institutions, such as Concordia University), add the location. Otherwise, the location isn’t necessary.

On the first page, an author’s name and affiliation both take the “AUTHOR” tag (we no longer use the “AUTHOR AFFILIATION” tag). In author bios, the author’s name takes the “vita name” tag, but the affiliation doesn’t get a special tag. After an affiliation first appears in a bio, you can abbreviate subsequent instances of that affiliation (in that or any following bio) to save space. In this case, the abbreviation should appear in parentheses after the first instance of the affiliation.

Best Practices

Here are a variety of guidelines for editing articles conforming to CS style. Some guidelines are specific to particular magazines.

Abstracts

Print abstracts (the short abstracts that appear at the article’s beginning) should have a maximum of 45 words for *Computer* (35 words for department articles), 35 to 40 words for *IEEE Security & Privacy*, and 40 words for *IEEE Software*.

Acknowledgments

We use the plural form for this section heading.

Article titles

Capitalize both parts of a hyphenated compound unless the first part is a prefix; in that case, capitalize only the prefix.

Compound adjectives

For compound adjectives with three or more words, normally use hyphens between each word if the words combine to make one concept—for example, “sparse-time-series tasks” and “near-real-time performance.” Note that in “near-real-time performance,” “near” modifies “real time,” not “performance.”

Figures

For figure callouts, use “(see Figure X)” if the sentence doesn’t already mention the figure. The callout normally shouldn’t give the page number.

For figure captions, the preferred style is to use a phrase to describe the figure and a sentence (or more) to describe the figure’s significance. For example, “Figure 1. Blue marshmallows. The campers mix blue dye with sugar and the mucilaginous root of the marshmallow, thus turning a pink-flowered European perennial herb into a tasty campfire treat.”

For abbreviations in captions, spell them out in the first caption in which they appear (with the abbreviation in parentheses immediately following the related term). Later captions can use just the abbreviation.

To acknowledge outside sources of figures, use this style: “(Source: NameOfSource; used with permission.)”

For program code examples that are part of a figure, input the code into the Word file (and tag it properly) if at all possible. Don’t send the code to the layout artist for input.

File and folder conventions

File names start with a letter specific to the related magazine: r = *Computer*, j = *IEEE Security & Privacy*, and s = *IEEE Software*.

Here are examples of the optional magazines' file name format, using the May/June *IEEE Software* Bellomo article as an example:

- s3bel.org.pdf (original file that the author sent)
- s3bel.tag.docx (original tagged but unedited file)
- s3bel.dt.docx (1st edit by Dennis Taylor)
- s3bel.dt-bb.docx (2nd read by Brian Brannon. This version usually replaces the previous one.)
- s3bel.gal.docx (version sent to author)
- s3bel.au.docx (version with author corrections)
- s3bel.fin.docx (version ready for layout)

Here are the guidelines for naming electronic folders, with examples.

- Theme article (only one theme in the issue): a-Bellomo
- First theme in a multitheme issue: a1-Bellomo
- Second theme: a2-Jones
- Third theme: a3-Smith
- Nontheme: q-Harris (*Computer* also inserts “r” at the beginning of folder names for queue articles—for example, rq-Harris.)
- Column: c-Opinions
- Department: d-Projects
- Track: t-Virtualization

The electronic folder should initially contain the current version of the article, figures, author photos (when necessary), copyright, and a Versions folder that holds all the other files. When the layout is ready, move all the files to the Versions folder except the copyright and figure files. You don't need to clean out the folders before they're archived.

Software uses “Focus” to indicate theme articles and “Feature” to indicate nontheme articles.

Main text

If an article begins with a quote, don't insert a quotation mark before the initial drop cap.

Introductions should be three paragraphs, although a little longer is okay if necessary.

In the optional magazines, use title caps on first- and second-level headings. In *Computer*, first-level headings use all caps, and second-level headings use just an initial cap.

On multiline headings, try to make the lower lines the longer ones.

Don't indent the paragraph immediately following a first- or second-level heading.

When first referring to a group of more than two authors, use this style: "Jane Doe and her colleagues." For two authors, give their first and last names.

When referring to a specific table or figure in the text, use capitalization: Figure 3, Table 2, and so on.

Avoid having a line with a drop cap on the last line of a column.

Use the appropriate punctuation at the end of a display equation.

When referring to a numbered and displayed item in an article, use an initial capital letter (Figure 1, Table 2, Equation 3, Algorithm 4, ...). Otherwise, for nouns accompanied by numbers or letters, don't capitalize the noun (level 5, participant B, step 1, and so on) unless it's a proper noun or it's from a specification or standard.

For a quote that starts in the middle of a sentence, use an ellipsis at the beginning and an initial lowercase letter for the first word.

For names of software patterns, use an initial capital letter for each word and no special formatting.

Use a drop cap, not a heading, to start the conclusion.

Professional-Society Titles

Capitalize terms such as Fellow and Senior Member.

Sidebars

For sidebar titles, use normal title capitalization.

For titles of related-work sidebars, use "Related Work in ...," not "Related Work on"

Tables

We no longer use the TABLE ROWz tag.

When referring to table columns or rows in the main text, normally use quotation marks and no capital letters ("In the 'total characters' column, ...").

For guidelines on aligning table column headings, see *CMS* 3.69.

URLs

If you have to put a URL in parentheses after an acronym, use a semicolon to separate the two.

When referring to URLs in a string of text, don't apply extra formatting.

Don't use "http://" in URLs that start with www.

Verify URLs by copying and pasting them into your browser. Some addresses don't start with http://. Other protocols are also legitimate (for example, ftp:), and some addresses don't need or even won't work with www. Omit the http:// if the URL starts with www. Check URLs that start with https:// to see whether it's required.

Be sure to include all punctuation exactly as supplied (hyphens and tildes, in particular, are very common in Web addresses).

If a URL must run across more than one line, follow these guidelines:

- Break after a colon or double slash. Don't split the double slash.
- Break before a slash, a tilde, a period, a comma, a hyphen, an underline, a question mark, a number sign, or a percent symbol.
- Break before or after an equals sign or an ampersand.
- Don't introduce hyphens to break words (be very careful about this because Word might try to hyphenate automatically).
- Separating the extension (for example, the html at the end) is discouraged.

Some URL examples using www.web-pac.com/mall/pacific/start.html:

Acceptable:

www.web-pac.com/mall/pacific/start.html

www.web-pac
.com/mall/pacific/start.html

www.web
-pac.com/mall/pacific/start.html

www.web-pac.com/mall
/pacific/start.html

www.web-pac.com/mall/pacific/start
.html

Unacceptable:

www.web-
pac.com/mall/pacific/start.html

www.web-pac.com/mall/paci-
fic/start.html

www.web-pac.com/mall/pacific/start.
html

Webpages

When referring to various portions of a webpage in text, use an initial cap for the designated item. Don't set it off with quotes, parentheses, or italics. Thus, a sample reference could be, "The proper way to search the page is to click on the Go button," or "The text can be found in the Publications section of the company's website."

When referring to hypertext links found on a webpage (the highlighted underlined words), put the entire text of the link in quotes. For example, "Click on the 'go here' link to reach the table."

Biographical Sketches

The preferred format for biographical sketches can vary depending on the publication. But full articles should generally follow this format:

//Author Name// is a **//position//** at **//name of institution or company**, with department name if applicable//. **//His/Her//** research interests include **//list three or four topics//**. **//Last name//** received a **//highest academic degree [use an abbreviation if possible]//** in **//name of discipline [use lowercase]//** from **//name of degree-granting institution//**. **//He/She//** has received **//names of awards//**. **//He/She//** is in on the editorial board of **//name of publication//** and has been **//name of volunteer position//** at **//name of conference//**. **//He/She//** is a member of **//list up to three relevant professional organizations [okay to use an acronym or initialism for organizations]//**. Contact **//him/her//** at **//email address//**.

Note: If there are space issues—for example, an unusually large number of authors—the professional organizations and research interests can be deleted (in that order).

For columns and departments, *IEEE Security & Privacy* uses the same format as for regular articles. *Computer* and *IEEE Software* follow this format:

//Author Name// is a **//position//** at **//name of institution or company**, with department name if applicable//. Contact **//him/her//** at **//email//**.

After an affiliation first appears in a bio, you can abbreviate subsequent instances of that affiliation (in that or any following bio) to save space. In this case, the abbreviation should appear in parentheses after the first instance of the affiliation.

If confusion about an affiliation name is possible (for example, school names that could apply to multiple institutions, such as Concordia University), add the location. Otherwise, the location isn't necessary.

Capitalization

The Computer Society style is conservative in the use of capital letters. A company's or public relations firm's wishes about capitalization rarely carry any weight.

For company, product, system, and language names, use an initial capital only. Editors should determine whether the term is really a proper noun or merely descriptive or generic.

Internal capitals

For many years, Computer Society style prohibited the use of internal capitals in words, insisting on an initial capital only for product names, system names, and so forth. Words such as MiniDIP and AutoCAD were accepted as combinations of words and acronyms. This strict approach hasn't been sustainable in the real world. We now permit *one* internal capital when it's the first letter of another word, as in PostScript, MacDraw, or dBase. Only a few exceptions exist—for example, NeXT and LaTeX. If in doubt, see the alphabetical section of this style guide.

Titles

In the titles of articles, books, and so forth, capitalize nouns, pronouns, adjectives, verbs, adverbs, and first and last words. Function words (articles, coordinate conjunctions, and prepositions) aren't capitalized, regardless of their length: “Better Health through Psychotherapy,” “Keeping the Peace without Creating Conflict.” The exception is following a colon—for example, “Along a Different Path: A Case Study.” For hyphenated words in titles, see *CMS* 8.159.

In references, use standard capitalization for titles but don't lowercase internal capitals or improper acronyms that appear as part of a product or system name, even if it conflicts with the style guidelines.

Department names

Names of departments, divisions, laboratories, and so forth are capitalized when used as part of an organization's proper name: the University of Pennsylvania Department of Computer Science; the university's computer science department; the IBM Almaden Research Center; Hewlett Packard's advertising department.

Copyrights

The IEEE owns the copyright for material published by the IEEE Computer Society. Authors must sign the IEEE copyright form, available online along with detailed information about IEEE intellectual property rights at www.ieee.org/copyright.

Authors shouldn't include a copyright notice of their own in published articles or department submissions. Authors transfer copyright to the IEEE as part of the publication agreement. Staff members don't need to complete a copyright agreement because its terms are part of the general conditions of their employment.

Each feature article carries a notice of IEEE ownership of copyright at the bottom of the first page. The two acceptable versions (with the symbol and with text) of the standard format are

- © 2013 IEEE
- Copyright 2013 by IEEE

Address questions regarding copyright issues to:

IEEE Intellectual Property Rights Office
IEEE Service Center
445 Hoes Lane, Piscataway, NJ 08854-1331
Phone: +1 732 562 3966; Fax: +1 732 981 8062
e-mail: copyrights@ieee.org

Trademarks

We don't include the trademark symbol in articles published in IEEE Computer Society periodicals and proceedings. Trademark law doesn't apply to the press because using a product name in the headline or text of an article doesn't constitute an attempt to capitalize on the reputation of the company or the product.

US Government Work

When an author is (or all authors are) employed by the US government, the following wording is used instead of the IEEE copyright line: "US Government Work Not Protected by US Copyright." The CCC code must not appear with that notice. Other useful information is at the IEEE Intellectual Property Rights website, www.ieee.org/copyright.

Image Permissions

If an image has been published elsewhere, the author must obtain permission from the publisher or the creator of the image for the IEEE Computer Society to reproduce it in the publication's print and electronic versions. Obtaining permission and paying any fees the publisher requires are the author's responsibility. If permission isn't obtained, the figure shouldn't be used in the article.

File Extensions and Their Meanings

.arj	relatively uncommon archive file	.pcx	PC Paintbrush graphic
.bak	backup file	.pdf	portable document format file—Adobe Acrobat
.bin	binhex file—Macintosh	.pdr	printer description file—Macintosh
.bmp	bitmap file	.pfb	Adobe printer font—binary
.cca	cc:Mail archive file	.pfm	Adobe printer font—metric
.cdr	Corel Draw data file	.pif	program information file—Windows shortcut file
.cfg	configuration file	.png	portable network graphics—image file format
.cnt	MS Office file	.ppa	PowerPoint presentation file
.com	command file	.ppd	PostScript printer definition file
.cpl	current privilege level file for WWW	.ppt	PowerPoint document
.dat	data file	.prn	MS Word print file—PostScript format
.dbf	database file	.ps	PostScript file
.dir	directory	.psd	Adobe Photoshop native format file
.dll	dynamic link library—Windows file system	.pub	MS Publisher document
.doc	MS Word document	.qxp	QuarkXPress document
.dos	DOS file	.reg	registry file—Windows file systems
.dot	MS Word template	.rtf	rich text format—a form of text formatting
.drv	printer driver file	.rul	cc:Mail rule file
.eps	encapsulated PostScript file	.sam	AmiPro file
.exe	executable file—a program	.smi	system management interrupt—Intel
.fon	font file	.sty	LaTeX style file
.ftg	MS Office file	.swp	Windows swap file
.gid	MS Access file	.sys	DOS/Windows system file
.gif	graphics interchange format—an art file	.tar	tape archive file—Unix-based compressed file
.gz	G-zipped file—Unix-based compressed file	.taz	.tar file that has been .z compressed
.hgx	Harvard Graphics file	.tbl	Adobe table editor file
.hlp	help file	.tex	LaTeX file—a form of text formatting
.hqx	BinHex compressed file	.tif	tagged information format file—an image file
.htm or		.tlb	MS Office executable file
.html	hypertext file—WWW page file	.tmp	temporary file—Windows applications
.ico	icon file	.ttf	TrueType font file
.inf	information file	.txt	text file, usually plain ASCII
.ini	initialization file—Windows file	.vbx	Visual Basic file
.jpg	JPEG image file	.vxd	virtual driver file—Windows
.kbd	keyboard layout file	.wav	wave sound file
.lan	local area network file—a Novell system file	.wk1	Lotus 123 spreadsheet file
.lha	relatively uncommon archive file	.wks	MS Works file
.lo	QuarkXPress document—Macintosh	.wmf	Windows metafile—a graphics file
.log	log file	.wpd	WordPerfect document
.lst	list file	.wpg	WordPerfect graphic
.lzh	relatively uncommon archive file	.wq1	Quattro Pro spreadsheet
.mim	mime-encoded file	.wri	MS Write document
.mpl	MS Project data file	.ws2	WordStart 2 document
.mpg	MPEG image file	.xls	Excel spreadsheet file
.msg	message file	.xtg	QuarkXPress document—PC
.nlm	NetWare Loadable Module—Novell	.z	compressed file from a Unix-based system
.nls	NetWare License Server—Novell	.zip	compressed file from WinZip
.pcd	photo CD file	.zoo	relatively uncommon archive file
.pct	PICT graphic		

Lists

How to use punctuation in a list depends on whether the introductory phrase is a dependent clause (it's not a complete sentence) or an independent clause (it's a complete sentence).

If the introductory phrase is a dependent clause, there is no colon.

In the past few months, I've been

- dressing more casually;
- finding unusual combinations of styles, colors, and textures; and
- looking for bargains.

If the introductory phrase is an independent clause, there is a colon.

People describe my wardrobe in many ways:

- sporty,
- colorful, and
- distinctive.

Here's what I think:

- My wardrobe is distinctive.
- I can decide what to wear depending on my mood.
- I need some new clothes.

My wardrobe has many distinct characteristics:

- *Unusual.* Most people wouldn't be comfortable making the same choices.
- *Versatile.* I can dress comfortably for a business meeting or casual Friday.
- *Color-coordinated.* I can mix and match garments to achieve a new look.

The following are examples of formatting alternatives for more complicated lists.

The major architectural components include

- a thin client terminal hosting a Web browser—the client terminals periodically send location updates to the network;
- an application server that delivers Web content prioritized according to user preferences—the application server formats the generated information content and adapts it for display on the client terminal; and
- a context and profile manager (CPM) that tracks the user's dynamic context—the CPM also queries Web services and filters Web content data according to user profile context.

The architecture has three major components:

- A thin client terminal hosts a Web browser. The client terminals periodically send location updates to the network.
- An application server delivers Web content prioritized according to user preferences. The application server formats the generated information content and adapts it for display on the client terminal.
- A context and profile manager (CPM) tracks the user's dynamic context. The CPM also queries Web services and filters Web content data according to user profile context.

The architecture has three major components:

- a thin client terminal,
- an application server, and
- a context and profile manager (CPM).

The client terminal hosts a Web browser and periodically sends location updates to the network. The application server delivers Web content prioritized according to user preferences; it formats the generated information content and adapts it for display on the client terminal. The CPM tracks the user's dynamic context and queries Web services and filters Web content data according to user profile context.

Note: With the exception of running text—where the state name is spelled out—use of the postal abbreviation is preferred (CMS 10.28).

Locations

United States

State	Standard abbreviation	Postal abbreviation
Alabama	Ala.	AL
Alaska	Alaska	AK
Arizona	Ariz.	AZ
Arkansas	Ark.	AR
California	Calif.	CA
Colorado	Colo.	CO
Connecticut	Conn.	CT
Delaware	Del.	DE
District of Columbia	D.C.	DC
Florida	Fla.	FL
Georgia	Ga.	GA
Guam	Guam	GU
Hawaii	Hawaii	HI
Idaho	Idaho	ID
Illinois	Ill.	IL
Indiana	Ind.	IN
Iowa	Iowa	IA
Kansas	Kan.	KS
Kentucky	Ky.	KY
Louisiana	La.	LA
Maine	Maine	ME
Maryland	Md.	MD
Massachusetts	Mass.	MA
Michigan	Mich.	MI
Minnesota	Minn.	MN
Mississippi	Miss.	MS
Missouri	Mo.	MO
Montana	Mont.	MT
Nebraska	Neb.	NE
Nevada	Nev.	NV
New Hampshire	N.H.	NH
New Jersey	N.J.	NJ
New Mexico	N.M.	NM
New York	N.Y.	NY

North Carolina	N.C.	NC
North Dakota	N.D.	ND
Ohio	Ohio	OH
Oklahoma	Okla.	OK
Oregon	Ore.	OR
Pennsylvania	Pa.	PA
Puerto Rico	Puerto Rico	PR
Rhode Island	R.I.	RI
South Carolina	S.C.	SC
South Dakota	S.D.	SD
Tennessee	Tenn.	TN
Texas	Texas	TX
Trust Territories of the Pacific	Trust Territories	TT
Utah	Utah	UT
Vermont	Vt.	VT
Virginia	Va.	VA
Virgin Islands	Virgin Islands	VI
Washington	Wash.	WA
West Virginia	W.Va.	WV
Wisconsin	Wis.	WI
Wyoming	Wyo.	WY

Note: State names with five letters or fewer are never abbreviated. The names of states and territories outside the 48 contiguous US states are abbreviated only when used with a postal code.

Postal code placement: ZIP (Zone Improvement Program) codes follow the state code and are separated by a space: Los Alamitos, CA 90720. The Postal Service has expanded the original five-digit code to nine digits, known as ZIP+4. The added digits follow a hyphen appended to the original code: Los Alamitos, CA 90720-1314.

Canada

Province	Standard abbreviation	Postal abbreviation
Alberta	Alta.	AB
British Columbia	B.C.	BC
Manitoba	Man.	MB
New Brunswick	N.B.	NB
Newfoundland and Labrador	N.L.	NL
Northwest Territories	N.W.T.	NT
Nova Scotia	N.S.	NS
Nunavut		NU
Ontario	Ont.	ON
Prince Edward Island	P.E.I.	PE
Quebec	Que.	QC
Saskatchewan	Sask.	SK
Yukon Territory	Yukon	YT

Note: Quebec used to be abbreviated P.Q. for Province du Québec, but this is now obsolete. Francophones in Québec often use the postal abbreviation Qc.

Postal code placement: Canada's postal code system is similar to the US ZIP code system. Postal codes are placed after the province code. The six-character codes are broken into two groups of three characters separated by a space. The format is letter, number, letter, space, number, letter, number—for example, Kingston, ON K1A 0S2.

United Kingdom

UK postal codes are placed after the country (England, Scotland, Northern Ireland, and Wales) and are separated by a space. Add the nation (UK) after the postal code. The six-character codes are usually broken into two groups of three characters separated by a space. The usual format is letter, letter, number, space, number, letter, letter—for example, Stirling, Scotland FK9 4LA, UK. However, some cities use variations on this format.

Europe

Postal codes are placed before the city name: D-4054 Nettetal, Germany. The number of digits varies among countries. The European postal union includes country prefixes with the postal codes. These prefixes, which are separated from the postal code by a hyphen, include

B	Belgium	I	Italy
CH	Switzerland	N	Norway
D	Germany	NL	Netherlands
DK	Denmark	S	Sweden
E	Spain	UK	United Kingdom
F	France		

Include the state for all US cities except Atlanta, Baltimore, Boston, Chicago, Dallas, Denver, Detroit, Honolulu, Indianapolis, Los Angeles, Miami, Minneapolis, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, St. Louis, Salt Lake City, San Diego, San Francisco, and Seattle.

Don't list the state name or province for cities outside the US and Canada. For most cities outside the US, list the nation after the city. However, don't include the nation for these locations:

Amsterdam	Jerusalem	Taiwan
Athens	Rome	Munich
Bangkok	Kyoto	Tokyo
Barcelona	Seoul	Oslo
Beijing	London	Toronto
Berlin	Shanghai	Ottawa
Brussels	Madrid	Vienna
Budapest	Singapore	Paris
Cairo	Melbourne	Warsaw
Copenhagen	Stockholm	Prague
Edinburgh	Mexico City	Zurich
Geneva	Sydney	Reykjavik
Helsinki	Montreal	Rio de Janeiro
Hong Kong	Taipei	
Istanbul	Moscow	

Mathematical Expressions

Most style manuals don't cover mathematical style well. *CMS* has some good suggestions in Chapter 12 but is insufficient. Another reference source is N.J. Higham, *The Handbook of Writing for the Mathematical Sciences*, Society for Industrial and Applied Mathematics, 1998. Although this book is largely about how to write mathematics clearly, it also has some suggestions about math typography and other stylistic matters.

Miscellaneous math style issues

If authors use punctuation after mathematical expressions, including displayed equations, leave it in (or revise as necessary).

- Include a space on either side of multiplication signs, equals signs, and other operators when they're at full size—for example, 100×100 matrix, and $a + b = c$. MathType automatically inserts thin spaces around these symbols. In subscripts and superscripts, omit these thin spaces unless the formula becomes confusing without them. Also, when $<$ or $>$ precedes a number in text (that isn't a formula), there should be no space after the symbol.
- If line breaks are needed in equations that appear in a paragraph, they should come after a plus sign, equals sign, or similar character.
- Characters with overbars must be set in MathType. If an article has many symbols with overbars or other symbols that make typesetting difficult, consider asking the author if there is an easier alternative.
- Equation numbers are put in parentheses to the right of displayed formulas. They shouldn't be boldface. Generally, only formulas called out in the text need to be numbered.
- Use italic type for lowercase Greek variables; don't use italic type for uppercase Greek variables.
- Variables denoting vectors are set in boldface, not italic. Don't use the small arrows above the variable to denote vectors.
- Set the label that denotes a matrix in italic—for example, A .
- If the vectors are simply mathematical and don't represent physical quantities and direction (that is, they don't need to be clearly differentiated from scalars), boldface is less important, and you can use lightface italic type if the author has styled them that way.

If the author consistently uses another scheme, consider going along with it.

Equation formatting guidelines

Display equations can be broken down a number of ways to fit in a column. First, each line of an equation must be aligned to either a relation symbol or a binary operator in the first line of the equation (if one exists). These symbols work in a hierarchy. Relation symbols are aligned with other relation symbols, binary operators are aligned with other binary operators, and binary operators are indented from relation symbols. For example:

$$\begin{aligned}
 l(s, w) &= \sum_h^x s(x, y) \log(\tau_1) - N_t \theta_t \\
 p(w_1, z_1) &= p(w_1, v_1) + p(v_1, z_1) && - \sum_h^w \log(s(x, y)!) \\
 &= p(w_2, v_2) + p(v_2, z_2) && + \sum_h^v s(x, y) \log(\theta_b) - N_b \theta_b \\
 &= p(w_2, z_2) && - \tau_1(x, y) \log(\phi_1)
 \end{aligned}$$

$$\phi^{(3)}(s) + r(s),$$

$$\phi^{(4)}(s) + \Delta r(s) = \frac{dr(s)}{ds},$$

$$\phi^{(5)}(s) + \Delta^2 r(s) = \frac{d^2 r(s)}{ds^2}$$

If an equation has only one relation symbol or binary operator, break the equation after the relation symbol or binary operator and indent the second line slightly:

$$\frac{d\lambda^{(\alpha)}}{dt} =$$

$$E_{p(\Gamma; \Pi, \Lambda, \Phi)} \left[H^{(\alpha, 1)}(\Gamma^{(2)}) \right] \frac{\mu_{obs}^{(\alpha)} \mu_{syn}^{(\alpha)} K(B - A) p(\Gamma_B; \Phi, \Lambda)}{K(A - B) p(\Gamma_A; \Phi, \Lambda)}$$

If there's room, align the equation like this:

$$\begin{aligned}
 [x_{l+1}] &\leq [M_{n+1}] + d_n z(2 + x - y) \\
 &\quad + (m - 2)(k - 3)
 \end{aligned}$$

If a display equation can't be centered, the first line can be made flush left to the column to allow more room for the following lines of the equation. If an equation number won't fit to the right of an equation, it's acceptable to have the equation number fall one line below the equation and to keep it right-justified to the column.

Math guidelines

When should you italicize, when should you use bold, and when should you do neither? If you edit Computer Society articles, you need to have a good handle on the answers to these questions. The detailed answers below are meant to help you see the logic behind these answers, so that you'll be able to consistently make the right decisions when confronted with a math-heavy article.

Constants

A constant is a letter that represents one distinct value that never changes, no matter what. Don't italicize constants. For example, k often represents Boltzmann's constant, which is always equal to 1.380622×10^{-23} Joules/Kelvin. We use k to avoid having to write out this long number in our equations, but it's not a variable because its value can never change; it remains constant. In most cases, the author will identify the letter as a constant. If he or she doesn't, you can probably assume it's not a constant.

One exception is the speed of light (2.997925×10^8 m/s), a constant typically represented by c . Authors probably wouldn't explicitly refer to it as "a constant," but it is, and you shouldn't italicize it. By the way, this is the same c that appears in Einstein's most famous equation, $E = mc^2$. Written properly, the E (energy) and m (mass) should be italicized (because they're variables), but the c (the speed of light) shouldn't.

Variables

A variable, unlike a constant, is a letter that can represent more than one possible value. Italicize all such letters (except uppercase Greek). For example, you could represent time by t , a variable. Time can be 3, 4, 5, ... seconds. Even when the author is referring to one instance (for example, $t = 4$), or even if the author says something like "we're keeping the time constant," you should still italicize t because it's possible in another situation that t wouldn't be kept constant at 4 ms or whatever. Time isn't a constant that's universally always equal to 4.

Matrices

Matrices represent an array of numbers (columns and rows), like the desks in a classroom. Make them italic and uppercase. The individual matrix elements should be italic (not bold) because they're actually variables.

For example, imagine classroom A , a matrix. The person in the 1st row, 1st column is element a_{11} . Second row, first column is a_{21} . If you sit in the 2nd row from the front, 3rd column from the left, you are a_{23} . Rows go across the classroom (side to side); columns go from front to back (even though, for some reason, in school what people call "rows" are actually columns). The person behind you (3rd row, 3rd column) is a_{33} . The person to your right (second row, fourth column) is a_{24} , and so on.

Vectors

Vectors are variables that have a direction associated with them. However, don't italicize them. Make them bold and lowercase—for example, the vector \mathbf{v} .

Units

Units are letters that stand for words, not numbers. Don't italicize them. For example, when s means second, don't italicize it. The same goes for Greek letters. Italicize lowercase Greek variables, but don't italicize lowercase Greek units, such as the μ in μs (microseconds).

Acronyms disguised as variables

Beware of acronyms disguised as variables. Don't italicize them. Editors sometimes mistakenly italicize a subscript or superscript that looks like a variable but actually isn't.

For example, in V_{DD} , V is a variable and should be italicized, but the letters DD are neither variables nor constants. They're more akin to acronyms. They don't stand for numbers; they stand for words. That's the test. If you can't put a number in for a letter, don't italicize it because it's not a variable. In this case, DD stands for a transistor's drain voltage.

Now, consider V_T . This T probably refers to temperature and thus isn't a variable. You'll have to consider its context. However, usually these subscripts aren't variables. A common exception is n or i (or even t) when it indicates a series of numbers such as V_1, V_2, \dots, V_n . In this case, a number could be inserted in place of n , so you should italicize it.

Here's another example of an acronym in disguise, but one that isn't a subscript: "The NMOS transistor's source (n+), bulk (p-), and drain (n+) terminals form an npn bipolar transistor." In this case, the n and p are neither variables nor constants. They are, once again, more akin to acronyms but typically appear in lowercase. You can't substitute a number for either of these.

Using MathType

If you can easily insert equations into text without using MathType, do so. Otherwise, use MathType.

Non-English Words and Phrases

The IEEE Computer Society is a worldwide organization, but its publications are produced in the US in English. The way Society publications deal with non-English terms and phrases depends on several factors—namely,

- the true “foreignness” of the expression—many non-English expressions have entered mainstream English,
- the availability of appropriate accented fonts,
- the staff’s familiarity with languages other than English, and
- the extent of the non-English readership of a publication and the degree to which the Society desires to appeal to that audience.

Here are some guidelines for using non-English terms:

- Use accents in anglicized foreign terms when they affect pronunciation or will prevent confusion between English words that are spelled the same.
- Italicize terms not commonly accepted in English, but generally use such terms in text only when there’s no suitable English equivalent. The way to determine whether a term is commonly accepted in English is to see whether it’s in the main body of *Webster’s*—if it is, don’t italicize.
- Transliterate non-Roman languages into the Roman alphabet. Use the transliterated phrase, an English translation, or both.
- For non-English institutional names, use the original name for spellings using the Roman alphabet, providing a translation if the reader might not understand. This approach works well with organizations whose acronyms are well known, such as CCITT (Comité Consultatif International de Télégraphique et Téléphonique), because using a translation (International Consultative Committee for Telegraphy and Telephony) followed by the acronym could confuse some readers. This same guideline applies to university names in bylines and references. In some cases, the non-English acronym is well known and always associated with the English translation. An example is the European Center for Nuclear Research, which is widely known by its French acronym, CERN.
- For non-English references, provide the original title first, but follow it with the English translation in brackets so that English-only readers can understand it. Follow English capitalization rules in the translated title. If you don’t have a translation or can’t translate the title, query the article’s author (who presumably has read the work and can translate the title). If the author can’t provide a translation, propose deleting the reference.
- For author names, always follow the author’s preference. However, if the accents required aren’t readily available in the Society font list, ask the author for English equivalents.

Numbers and Symbols

Dates

The *IEEE Policies and Procedures* (Jan. 2000) specify the following formats for dates:

- **Email and formal correspondence:** day, month, year—for example, 6 January 2004.
- **Software applications:** four-digit year, two-digit month, two-digit day—for example, 2004-01-06.
- **Centuries:** Use the symbol for ordinal numbers—for example, 20th century. Note: *CMS* spells out the century—for example, twentieth century.
- **Decades:** The abbreviation is '90s, not '90s.

Numerals

Spell out the integers one through nine and use numerals for 10 on, except in these cases:

Generally, use numerals even for one through nine when the integer is coupled with a symbol or unit of measurement (2°, 3 V). Use numerals with percentages even for one through nine (a 5 percent drop; 3 percent responded; 3 to 6 percent). However, in nontechnical passages, numbers less than 10 used with common units, especially time units, might look better spelled out, as do numbers used with approximate measurements:

the program ran in 8 minutes [exact measurement]
but a report from eight years ago said [nontechnical]
he lives eight miles down the road [nontechnical]
about eight or nine centimeters [approximate]

Spell out a number at the beginning of a sentence, or recast the sentence.

For a list of units of measurement that don't need to be spelled out, see the "Abbreviations" section and the related entries in the Style Guide's alphabetical section. For unfamiliar units of measurement, spell them out on first use and abbreviate them thereafter. However, use abbreviations in figures or tables, but explain any unusual or nonstandard abbreviations.

When a sentence includes both an integer less than nine and an integer greater than nine to describe something in the same category, use numerals for consistency—for example, "The network can have 4, 8, or 16 nodes."

Hyphenate a compound adjective consisting of a number and an abbreviation—for example, 24-Kbyte memory.

Numbers with four digits or more have commas: 1,000, 10,000. Exceptions include page numbers and dates (*CMS* 9.55). Precede decimal fractions with values of less than one with a zero to prevent the reader from overlooking the decimal point: 0.1 (however, observe the exceptions in *CMS* 3.70 and 9.19). And remember, they're singular: 0.1 inch, not 0.1 inches.

Use an *s* to create plurals of numerals:

- the early 1920s
- in twos, threes, and zeros

- he had a collection of 386s and 486s

Fonts and computers are inconsistent in the treatment and availability of fraction symbols. So, for in-text fractions, full-size numerals with a slash are usually preferred: 1/2, not ½. In more complicated mathematical expressions set in MathType, built-up fractions are generally used: numerator over denominator, separated by a horizontal line. In mixed numerals, put a hyphen between the integer and the fraction:

- 8-1/2 inches wide
- 24-5/8-mile track

For further reference, see *CMS* Chapter 9, especially the parts on scientific and technical usage.

Symbols and signs

Use symbols in text only when you're certain that readers are familiar with them.

Multiplication symbol: Use the multiplication sign “×” instead of “by” when numerals refer to dimensions: 3 × 5 cm box; 3 in. × 5 ft. board. When indicating the use of “times” with a number, use a multiplication sign instead of x—for example, 2× speedup. However, you may use “times” when it seems appropriate—for example, “The new version has 10 times the memory.”

Spacing of characters for units of measurement and symbols: Abbreviations for units of measurement, even if one letter, are separated from the numeral by a space (3 V, 5 m, 14 mm). Actual symbols, as opposed to abbreviations for units, can be closed up—for example, 42°30' for 42 degrees, 30 minutes latitude.

Use “sq ft,” not “ft².”

Don't use abbreviations when the reference is indefinite or casual—say “several gigahertz,” not “several GHz.” However, where brevity is a key factor—for example, in new product write-ups and tables—use symbols liberally.

When defining variables in run-in text, use “is” rather than “=”—for example, “where *t* is the temperature,” not “where *t* = the temperature.”

Use the word “percent” in text; use the % symbol only in figures and tables.

Don't insert “US” in front of the dollar sign except to avoid confusion.

Telephone and fax numbers

The IEEE Policies and Procedures specify the following format for phone and fax numbers:

In North America: +1 area code xxx xxxx—for example, +1 714 821 8380

Outside North America: +country code city code xxx xxxx—for example, in Belgium, +32 3 770 2242

Program Code

Use the “program code” tag for program code that appears inline; use the “PROGRAM SEGMENT” tag for code that’s set off from the main text.

If the lines of code are longer than a column width and can’t be easily broken, consider turning the code into a figure.

If a program line doesn’t fit on a single printed line, break and indent it to indicate the continuation. Never add extra punctuation. Authors will often request continuation lines to be right-justified or will otherwise express strong preferences on this issue.

In general, try to duplicate the spacing, indentation, punctuation, and capitalization in the author’s manuscript. Programming languages don’t normally recognize boldface or italics, but the author might use them for emphasis.

Spacing is very important because omitting a space will often prevent a computer from recognizing a command or variable.

Indentations often indicate subsets of the program. Although they aren’t necessary to the computer, they make a program easier to understand.

Punctuation

- Don’t substitute two single typesetting quotation marks (‘ ’) or normal double typesetting quotation marks (“ ”) for typewriter quotation marks (").
- Don’t substitute a hyphen (-) for a minus sign (−).
- Don’t substitute a raised asterisk (*) for a multiplication asterisk (*).
- Don’t substitute an em dash (—) for two hyphens (--), which is a comment symbol in some languages.

Capitalization

Words or letters in programming languages generally represent commands (tokens) or variables. In Fortran and Basic, the general convention is to capitalize commands (such as IF, PRINT, FORMAT, GOTO) and variables (often I, N, X(n.)). In C, Algol, and PostScript, these words and letters are lowercase.

Tokens in text

Use the “program code” tag for program commands to distinguish them in text. Resist using boldface, italics, underlining, superscript, or subscript. If the language is case-sensitive (where a compiler doesn’t see “do,” “Do,” “dO,” and “DO” as equivalent), follow the language’s rules. Most popular languages aren’t case-sensitive.

Case-insensitive

Ada, Algol, Anna, APL, assembly, Basic, Clu, Cobol, Fortran, job-control languages, Lisp (including Common Lisp), Logo, MS-DOS and other operating-system-level command interpreters (micro and mainframe), Occam, Pascal, PL/I, Prolog, SISAL, Snobol, and SQL.

Case-sensitive

ABC, C, C++, Eiffel, Interlisp, Loops (including the Common Loops and Concurrent Loops dialects), Modula-2, Prolog, and Smalltalk. Most case-sensitive languages are object oriented, although some (for example, ABC) aren't. Some newer dialects of these languages might not be case-sensitive; check with the author.

Punctuation

In general, punctuation is such a complex topic that referring to the appropriate *CMS* sections is the preferred option. However, here we present some specific guidelines.

Colons

When a colon introduces text within a sentence, the following word starts with a lowercase letter. Otherwise, the following word has an initial cap.

Ellipses

Because the correct use of an ellipsis is sometimes mysterious, we provide these guidelines:

- For omissions within a sentence when using Word, insert a space, the ellipsis symbol, and a space.
- For omissions between sentences, use closing punctuation before an ellipsis if the preceding sentence is grammatically complete. If the preceding sentence isn't grammatically complete, don't use closing punctuation. Place a space directly before and after the ellipsis.

For more complete information about using an ellipsis, see *CMS* 13.48–13.56.

En dashes

Use en dashes for page ranges and other cases where the *CMS* calls for them; see *CMS* 6.78–681.

Quotation marks

Use double quotation marks for quoted text inside block quotations, decks, headings, and interviews. Don't put quotation marks around the entire quotation, deck, and so on.

Slashes (virgules)

Use your judgment regarding the use of slashes. Normally, there should be no space on either side of the slash. For an exception, see *CMS* 6.104.

References

This special section consists of two subsections: sample formats and general style. The first presents examples of most of the reference types that arise in Computer Society publications. The second delineates the policies and style principles underlying the formats.

To save time, ask the authors for any missing reference information. If they don't provide it, then search for it if possible.

Sample formats

Article in a collection

A.J. Albrecht, "Measuring Application-Development Productivity," *Programmer Productivity Issues for the Eighties*, 2nd ed., C. Jones, ed., IEEE CS, 1981, pp. 34–43.

Article in a conference proceedings

In general, delete prepositions in conference titles where the meaning is clear without them (see the "Abbreviations" section). Use the ordinal symbol (2nd, 14th, 23rd) for annual conferences. If available, include the conference initialism in parentheses—for example, (ICDE 98)—following the abbreviated name of the conference. Include the sponsor's name if it's part of the official proceedings title. The publisher's name is unnecessary. Use the page numbers, article number, or DOI.

H. Yuan et al., "Sparse Representation Using Contextual Information for Hyperspectral Image Classification," *Proc. 2013 IEEE Conf. Cybernetics (CYBCONF 13)*, 2013, pp. 138–143.

N. Zhong, "Toward Web Intelligence," *Advances in Web Intelligence: 1st Int'l Atlantic Web Intelligence Conf. (AWIC 03)*, LNCS 2663, 2003, pp. 1–14.

Article in a journal or magazine

Use lowercase for vol. and no. The default is to use the volume and issue number, but for popular publications, you can use the publication date instead. Page numbers through 9999 don't require a comma.

I.E. Sutherland, R.F. Sproull, and R.A. Schumaker, "A Characterization of Ten Hidden-Surface Algorithms," *ACM Computing Surveys*, vol. 6, no. 1, 1974, pp. 1–55.

Blog

To cite the blog itself:

The Official Google Blog, Google; <http://googleblog.blogspot.com>. (Google is listed as the publisher here.)

M. Watson, *Artificial Intelligence Blog*; <http://markwatson.com/aiblog>.

Artificial Intelligence and Robots, blog; <http://smart-machines.blogspot.com>. (no named author or publisher)

Entries in a blog:

M. Sahami, “About the Google Education Summit,” blog, 26 Oct. 2007; <http://googleblog.blogspot.com/2007/10/about-google-education-summit.html>.

M. Watson, “Using the PowerLoom Reasoning System with JRuby,” blog, 2 Oct. 2007; <http://markwatson.com/aiblog>.

“Reinforcement Learning Is Cool,” blog; 24 Oct. 2007; <http://smart-machines.blogspot.com/2007/10/reinforcement-learning-is-cool.html>. (no named author)

Book

W.M. Newman and R.F. Sproull, *Principles of Interactive Computer Graphics*, McGraw-Hill, 1979, p. 402.

M.A. Arbib, ed., *The Handbook of Brain Theory and Neural Networks*, MIT Press, 1998.

Book series

Y. Yao et al., “Web Intelligence (WI): Research Challenges and Trends in the New Information Age,” *Web Intelligence: Research and Development*, LNAI 2198, N. Zhong et al., eds., Springer, 2001, pp. 1–17.

R. Focardi and R. Gorrieri, eds., *Foundations of Security Analysis and Design*, LNCS 2171, Springer, 2001.

Note: According to *CMS* 14.128, if the book can be located without the series title, it can be omitted to save space.

Dissertation or thesis

B. Fagin, “A Parallel Execution Model for Prolog,” PhD dissertation, Dept. Computer Sciences, Univ. of California, Berkeley, 1987.

M. Nichols, “The Graphical Kernel System in Prolog,” master’s thesis, Dept. Computer Science and Eng., Rensselaer Polytechnic Inst., 1985.

Electronic publication

DOIs

Note: If the volume and issue number, date, and page numbers are available, it isn’t necessary to include the DOI. If they aren’t available, use the DOI, if possible.

Article in a journal

D. Kornack and P. Rakic, “Cell Proliferation without Neurogenesis in Adult Primate Neocortex,” *Science*; doi:10.1126/science.1065467.

Article in a conference proceedings

H. Goto, Y. Hasegawa, and M. Tanaka, “Efficient Scheduling Focusing on the Duality of MPL Representation,” *Proc. IEEE Symp. Computational Intelligence in Scheduling (SCIS 07)*, 2007; doi:10.1109/SCIS.2007.367670.

Online-only publication

F. Kaplan, “From Baghdad to Manila: Another Lousy Analogy for the Occupation of Iraq,” *Slate*, 21 Oct. 2003; <http://slate.msn.com/id/2090114>.

Website

R. Bartle, “Early MUD History,” Nov. 1990; www.ludd.luth.se/aber/mud-history.html.

Executive order

B. Obama, “Termination of Emergency with Respect to the Risk of Nuclear Proliferation Created by the Accumulation of a Large Volume of Weapons-Usable Fissile Material in the Territory of the Russian Federation,” Executive Order 13695, *Federal Register*, vol. 80, no. 102, 28 May 2015, p. 30331.

Government report

“Quality Care for Moms and Babies Act,” US Senate Report 114-100, 30 July 2015.

Legal citations

Note: In text, italicize the names of court cases.

US Supreme Court decisions

- *Olmstead v. United States*, *US Reports*, vol. 277, 1928, p. 438.
- *Olmstead v. United States*, *US Reports*, vol. 277, 1928, p. 478 (Justice Brandeis, dissenting).

Lower-court decisions

- *US v. Councilman*, *Federal Supplement*, 2nd Series, vol. 245, 2003, p. 321 (US District Court for the District of Mass.).
- *US v. Councilman*, *Federal Reporter*, 3rd Series, vol. 373, 2004, p. 204 (US Court of Appeals for the First Circuit).

US laws

- US Code, Title 18, section 3123(a)(1),(2), 2000 and 2002 Supplement.
- Uniting and Strengthening America by Providing Appropriate Tools to Intercept and Obstruct Terrorism, Public Law No. 107-56, section 209, *US Statutes at Large*, vol. 115, 2001, p. 285.
- Omnibus Crime Control and Safe Streets Act of 1968, Public Law No. 90-351, sections 801–804, *US Statutes at Large*, vol. 82, pp. 211–223 (codified as amended in *US Code*, Title 18, sections 2510–2522, 2000 and 2002 Supplement).

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J. Butler, “CASE Outlook,” *System Development Newsletter*, Applied Computer Research, Phoenix, Ariz., Nov. 1987, p. 3.

Non-English source

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A.N. Zhirabok and A.E. Shumskii, *Electronnoe Modelirovanie* [Electronic Modeling], Energoatomizdat, Leningrad, 1984 (in Russian).

Original title unprintable

T. Nakayama et al., “NEC Corporation Develops 32-Bit RISC Microprocessor,” *Nikkei Electronics*, vol. 6, no. 12, 1995, pp. 111–121 (in Japanese).

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With patentee information

M. Hoff, S. Mazor, and F. Faggin, *Memory System for Multi-Chip Digital Computer*, US patent 3,821,715, to Intel Corp., Patent and Trademark Office, 1974.

Without patentee information

Digital-to-Analog Converting Unit with Improved Linearity, US patent 5,162,800, Patent and Trademark Office, 1992.

Pending publication

For an article or paper, include the name of the publication and date if known:

R. Lee, “New-Media Processing,” to be published in *IEEE Micro*, Nov./Dec. 2012.

For a book, include the publisher and year of publication:

R. Lee, *Writing New Programs*, McMillan, to be published in 2012.

Personal communication and unpublished materials

These usually aren’t referenced because they aren’t available to the reader. Authors who insist on attributing material obtained through personal communication should identify the source of the information in the main text (for example, “As Maria Youngblood stated during a conference panel, ...”).

Preprint

J.M.P. Martinez et al., “Integrating Data Warehouses with Web Data: A Survey,” *IEEE Trans. Knowledge and Data Eng.*, preprint, 21 Dec. 2007; doi:10.1109/TKDE.2007.190746.

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<http://csdl.computer.org/comp/mags/cs/2003/06/c6toc.htm>.

Standard

Recommendation ITU-R BT.601, Encoding Parameters of Digital Television for Studios, Int'l Telecommunication Union, 1992.

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IETF working draft

L. Martini et al., “Transport of Layer 2 Frames over MPLS,” IETF Internet draft, work in progress, Feb. 2001.

Note: Per IETF guidelines, references to working drafts shouldn't include URLs because they expire after six months; use “work in progress” instead.

Industry specification

C. Evans et al., *Web Services Reliability (WS-Reliability)*, v. 1.0, joint specification by Fujitsu, NEC, Oracle, Sonic Software, and Sun Microsystems, Jan. 2003;
www.developers.sun.com/sw/platform/technologies/ws-reliability.html.

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MPEG-21 Overview, ISO/MPEG N5231, MPEG Requirements Group, Oct. 2002.

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C. Perkins and E. Guttman, *DHCP Options for Service Location Protocol*, IETF RFC 2610, June 1999; www.rfc-editor.org/rfc/rfc2610.txt.

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D. Box et al., *Simple Object Access Protocol (SOAP) 1.1*, W3C note, May 2000;
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K. Xu et al., “Spherical Piecewise Constant Basis Functions for All-Frequency Precomputed Radiance Transfer,” *IEEE Trans. Visualization and Computer Graphics*, vol. 14, no. 2, 2008, pp. 454–467, supplemental material; <http://csdl.computer.org/comp/trans/tg/2008/02/ttg2008020454s.avi>.

Technical memo, technical report, technical or user manual

Include the department name for technical memos, technical reports, and other material that might not be indexed in a company-wide or university-wide library or by an abstracting service.

Technical memo

“Requirements for Software-Engineering Databases,” tech. memo, Imperial Software Technology, London, 1983.

Technical report with report number

C. Hoffman and J. Hopcroft, *Quadratic Blending Surfaces*, tech. report TR-85-674, Computer Science Dept., Cornell Univ., 1985.

Technical report without report number

E. Yarwood, *Toward Program Illustration*, tech. report, Computer Systems Research Group, Univ. of Toronto, 1977.

Technical or user manual

The Unix System V Interface Definition, vol. 1, AT&T Bell Laboratories, Murray Hill, N.J., 1991.

White paper

Consolidating the IT Infrastructure, white paper, Oracle Corp., Dec. 2003.

Wikipedia

Avoid citing as a reference if a more standardized source is available.

General style

Author names

Use each author's initials and last name. Leave no space between initials, but leave a space between the period following the last initial and the first letter of the last name (for example, E.F. Codd). For hyphenated first names, use a period for each initial (for example, J.-L. Picard).

If an entry has more than three authors, use the first author's name and follow it with "et al."—for example, T.G. Lewis et al.

Dates

Include just the year of publication for books. For periodicals, normally include the volume number, issue number, and year. However, for popular periodicals, include the month and year. If a periodical appears more frequently than monthly, include the date with the month—for example, 15 Mar. 2000. If a periodical appears quarterly, use the season or issue number, depending on the periodical's usage. For periodicals that appear irregularly, don't use the month—for example, vol. 16, no. 5, 1997.

Spell out May, June, and July; abbreviate the other months: Jan., Feb., Mar., Apr., Aug., Sept., Oct., Nov., and Dec. Use a slash for bimonthly issues (Aug./Sept. 2000) and an en dash for a quarterly (July–Sept. 2000). Capitalize the names of seasons: Winter, Spring, Summer, and Fall.

Electronic references

References to electronic repositories are acceptable in IEEE Computer Society publications, but they aren't the references of choice for formal archival use. Whenever possible, use references to printed material. However, when this isn't possible, cite the electronic address along with as much additional information as possible. If the address itself becomes invalid in the future, the other information might help researchers find the same document elsewhere on the Internet. At the very least, a reference to an electronic source must include the URL.

When citing an electronic reference simply to give the reader a place to go for more information, instead of including it in a formal reference list, noting it in parentheses in the running text is acceptable. Because such references break the flow of the text, use them sparingly and don't set them off in italic, boldface, or typewriter font. If an article includes many electronic references, consider placing them in a sidebar or a broken-out list.

Page numbers

If a reference's page numbers start with page 1 (for example, "pp. 1–10"), verify that those are the actual page numbers and not just the number of pages. If that information refers to the number of pages, use the DOI instead, if possible.

Publications

Italicize names of books (including collections), magazines, journals, newsletters, technical reports, white papers, and manuals. Use quotation marks to enclose names of articles, papers, theses, dissertations, technical notes, and technical memos.

When listing conference abbreviations in a reference, use the conference abbreviation and the last two digits of the year: AAAI 07.

After the name of a book, thesis, proceedings, or other book-like material, list the publisher, year of publication, and inclusive page numbers if applicable. Delete terms such as Co., & Co., Ltd., S.A., Publisher, and Publishing Co.; retain Press. Where the publisher is a university, add its location if needed for clarity—for example, Miami Univ., Ohio.

Don't include the editor's name for a conference proceedings unless it's an edited volume published as a book.

References for proceedings should tell where an interested reader can find the source, not where the conference took place. If a proceedings didn't use a traditional publisher, provide the sponsoring organization.

Use an en dash to indicate multiple issue numbers—for example, vol. 5, nos. 1–4. If the name of a column is cited in the reference, use initial caps without quotation marks—for example, Embedded Computing.

If a reference's page numbers start with page 1 (for example, pp. 1–10), verify that those are the actual page numbers and not just the number of pages. If that information refers to the number of pages, use the DOI instead, if possible.

Titles

Capitalize the first and last words, and all nouns, pronouns, adjectives, verbs, adverbs, and subordinating conjunctions. Lowercase articles, coordinating conjunctions, and prepositions, regardless of length. Example: “Toward Better Real-Time Programming through Dataflow.”

To make a source easy for researchers to find, use the title as it originally appears. Don't add or remove hyphens, change words to preferred spellings, or lowercase internal capitals.

For foreign-language references, provide the original title first, followed by its English translation (if available) in brackets: *Zur experimentalen Aesthetic* [Toward an Experimental Aesthetic].

For a complete treatment of titles, see *CMS* 8.154-8.195.

Abbreviations in references

Use the following abbreviations in the titles of periodicals and proceedings and when naming publishing institutions:

Am.	American
Ann.	Annual
Assoc.	Association
Bull.	Bulletin
Comm.	Communications (of)
Conf.	Conference (on)
CS	Computer Society
Dept.	Department (of)
ed.	edition, editor
Eng.	Engineering
Fed.	Federal
Govt.	Government
Inst.	Institute
Int'l	International
J.	Journal (of)
Lab(s)	Laboratory (Laboratories)
Math.	Mathematics, Mathematical
Nat'l	National
no.	Number
Org.	Organization
Proc.	Proceedings (of)
Q.	Quarterly
Rev.	Review
Soc.	Society
Symp.	Symposium (of or on)
Trans.	Transactions (on)
Univ.	University
vol.	Volume

Use “Comm.” (for Communications) when the term refers to the type of periodical (and is part of the periodical’s name), not when it refers to the topic of communications.

Use “Eng.” (for Engineering) in the titles of periodicals and conference proceedings and in the names of professional organizations, not in article or book titles.

Drop the “on” from “Workshop on” constructions. When abbreviating institution names, drop “of” except in “University of” constructions—for example, Inst. Systems Research, Univ. of Wisconsin.

Use “ch.” for “chapter” (of a book).



*** Denotes entries for which it's okay to use the acronym or abbreviated term on first use**

- * **A:** ampere—for example, 25 A (n.); 25-A current (adj.)
- AAAI:** American Association for Artificial Intelligence
- AAAS:** American Association for the Advancement of Science
- AACP:** American Association of Computing Professionals
- ABET:** Accreditation Board for Engineering and Technology
- * **AC:** alternating current
- academic degrees:** BS, MS, and PhD are the standard abbreviations for the bachelor's, master's, and doctoral degrees that we encounter in most of our authors' biographies. However, if an author insists, using BSME or BSEE instead of "BS in mechanical engineering" or MSc instead of MS is acceptable. These and other variants have the sanction of being included in the *Webster's* list of abbreviations. In general, reproduce non-US degrees as authors submit them (except for periods)—for example, BEng, BTech, and DPhil. See also *bachelor's, master's, doctorate*.
- accents:** Use accents in anglicized non-English terms when important for pronunciation, to avoid confusion with another word, or where context makes it unclear. Use accents in non-English names, especially names of individuals. In general, lean toward the author's preference. See also the "Non-English Words and Phrases" section.
- ACE:** Advanced Computing Environment
- ACID:** atomicity, consistency, isolation, and durability (a test)
- ACK:** acknowledgment
- Acknowledgments:** not Acknowledgements. Use the plural form for the section of the same name at the end of an article.
- ACL:** Association for Computational Linguistics
- ACM:** Association for Computing Machinery; includes several special-interest groups (SIGs). With the exception of Siggraph and Sigmod, use the ACM style for each SIG in text or references. See www.acm.org/sigs for a current listing. Use "is a Member of ACM" in bios. In references, use ACM instead of ACM Press (old format). Don't insert "the" before ACM.
- acronyms:** See the "Acronyms and Abbreviated Terms" section for general style guidelines.
- ACS:** Australian Computer Society
- ActiveX:** software technology from Microsoft
- A/D:** analog/digital
- Ada:** a programming language (named for Augusta Ada Lovelace) developed by the US Defense Department
- ADAPSO:** Association of Data Processing Service Organizations; renamed as Information Technology Association of America (ITAA) in 1991

- ADC:** analog-to-digital converter
- add-in board**
- Addison-Wesley** or **Addison Wesley Longman; Addison-Wesley Professional**
- add-on** (adj.)
- address mode** (n.): the way the processor is addressed. It includes sequential, forward, and backward addressing, among other modes; hyphenate it when it's used as an adjective.
- ADSL:** asymmetric digital subscriber line (for fast Internet access)
- admin:** okay to use instead of “administration” in appropriate cases
- AEA:** American Electronics Association
- AEC** (adj.): architecture-engineering-construction; no hyphens in the acronym
- AES:** Advanced Encryption Standard; NIST standard for symmetric key encryption
- AFCET:** Association Française pour la Cybernétique Économique et Technique
- AFIPS:** American Federation of Information Processing Societies (no longer exists)
- agile:** not capitalized when it refers to programming techniques
- * **AI:** artificial intelligence
- AIAA:** American Institute of Aeronautics and Astronautics
- AIChE:** American Institute of Chemical Engineers
- AIIM:** Association for Information and Image Management
- AIM:** advanced instruction module
- AIP:** American Institute of Physics
- Ajax:** Asynchronous JavaScript and XML
- A K Peters:** Publisher (no periods after initials)
- Algol:** stands for algorithmic language
- ALPG:** algorithmic pattern generator (hardware and software)
- Al Qaeda**
- ALU:** arithmetic logic unit
- * **a.m.:** ante meridiem “before noon” (also includes 12:00 midnight). See also *p.m.*
- ampersand:** Retain the symbol in proper names when the name owner uses it that way; otherwise avoid it.
- Amazon.com**
- Amazon Mechanical Turk (MTurk)**
- AMS:** American Mathematical Society
- AMU:** Association of Minicomputer Users
- analog:** not analogue
- and/or:** Avoid this construction.
- ANOVA:** analysis of variance; a statistical test
- * **ANSI:** American National Standards Institute
- Ansys:** finite-element analysis software by Swanson Analysis Systems
- anti-:** not hyphenated as a compound modifier unless the root word is a proper noun or begins with “i”—for example, antialiasing, anti-intellectual
- apa:** all points addressable

- APDA:** Apple Programmers and Developers Association
- * **API:** application programming interface
- * **APL:** A Programming Language
- appendices:** not appendixes
- Apple IIe, IIgs; Macintosh IIc, IIcx, IIfx,** and so on
- apps:** acceptable abbreviation for applications
- Arcnet:** Attached Resource Computer Network; developed by Datapoint Corp.
- ARO:** after receipt of order; Army Research Office (preceded by US if spelled out)
- ARPA:** Advanced Research Projects Agency, a part of the US Defense Department; DARPA is the preferred usage.
- Arpanet:** the oldest of the networks on the Internet; initial capital only
- artificial intelligence:** AI is acceptable on first reference if the context makes it clear. The term loosely includes expert systems, knowledge bases, natural-language interfaces, pattern recognition (voice, image, and signal), and neural networks.
- ASC:** American Society for Cybernetics
- ASCI:** Accelerated Strategic Computing Initiative
- * **ASCI:** American Standard Code for Information Interchange
- ASIC:** application-specific integrated circuit.
- ASIS:** American Society for Information Science and Technology
- ASME:** American Society of Mechanical Engineers
- ASP:** application service provider; application-specific processor; Active Server Pages
- ASPLOS:** Architectural Support for Programming Languages and Operating Systems; the name of a conference
- assembly language** (lowercase; not “assembler”): a computer language that assembles the assembly-language code, as a compiler compiles high-level code
- ASTI:** Association for Science, Technology, and Innovation
- ATE:** automatic test equipment
- ATM:** asynchronous transfer mode
- ATPG:** automatic test-pattern generation
- AutoCAD:** software from Autodesk Inc.; exception to normal style because of common usage
- Autoprobe**
- avatar:** a graphical image that represents a person
- Awk:** a language based on the authors’ names—Aho, Weinberger, and Kernighan

B

B2B: business-to-business

B2C: business-to-consumer

bachelor's degree

back door (n.), **backdoor** (adj.)

back end (n.), **back-end** (adj.)

backplane (n.): an electronic circuit board containing circuitry and sockets into which additional electronic devices on other circuit boards or cards can be plugged; generally synonymous with or part of a computer motherboard

backup (n., adj.): for example, “the system served as a backup;” “a backup copy”

back up (v.): as in, “you can back up the database”

bandwidth

bar code

Basic: a programming language; allegedly stands for “beginner’s all-purpose symbolic instruction code,” but this is etymologically suspect

BasicA: Microsoft advanced Basic; known as “GW-Basic” on non-IBM, MS-DOS computers

baud (sing. or pl.): transmission speed in units per second, originally used to measure telegraph transmission. In computing, the units are usually bits, hence the common practice of using baud and bps interchangeably. However, this is technically inaccurate because the unit in a baud can be any discrete element.

BCS: British Computer Society

BDI: beliefs, desires, intentions—a model of human reasoning

BEEP: Blocks Extensible Exchange Protocol

Beijing: the Pinyin form used instead of “Peking”

benchmark: a standardized problem, test, or suite of tests that serves as a basis for the repeatable, objective comparison of hardware or software. Examples include Dhrystone, Mflops, Sim, and Whetstone.

beta site: the secondary (hence beta) site

Beta-spline (n., adj.): not the same as a B-spline

beta test (n., v.)

Bezier: no accent mark on the first syllable

BFL: buffered field-effect transistor logic

BIFS: binary format for scenes

BGP: Border Gateway Protocol

“Big Blue”: informal name for IBM

big data (n.), **big-data** (adj.): not capitalized

BIOS: basic input/output system; operating system software that handles communications with devices, including monitors, keyboards, disk drives, processors, and ports

Birkhäuser Boston: North American branch of the Swiss publisher, Birkhäuser Publishing

BIST: built-in self-test

bit: a binary digit, 0 or 1; the basic element making up digital data

-bit (suffix): Adjectives formed with numbers and bit are hyphenated—for example, “64-bit processor.”

bitblt: Previous CS Style Guide versions defined this term as “bit block-level transfer,” but some authors insist on “bit block transfer.”

bitline

bitmap: a digital representation of an image in which bits are mapped into pixels; in color graphics, a different bitmap is used for each red, green, and blue value

bitmapped graphics

Bitnet: a communications network between universities and research centers. Although it’s reputed to stand for “Because It’s Time Network,” the term isn’t a true acronym.

bit rate

bit-slice processor

bit-sliced (adj.)

bitstream (n., adj.)

bitwise (n.): dealing with bits rather than a larger structure such as a byte. Bitwise operators are programming commands or statements that work with individual bits.

black-and-white (adj.)

BlackBerry

black box: a complicated electronic device whose internal mechanism is usually hidden from or mysterious to the user

BLAS: basic linear algebra subroutines

blog: a shared online journal

Bluetooth

Blu-ray

BNF: Backus-Naur Form, a metalanguage

boldface: Strictly limit its use as an emphasis technique; italic type is preferred and should be used whenever possible.

Boolean: from George Boole; spelling with a capital *B* is preferred

bootup (n.), boot up (v.): more commonly just boot

botnet: jargon term for a collection of software robots, or bots, that run autonomously

bottom-up design: design that starts at the system level as opposed to top-down design, which starts at the logic level and works down. In middle-out design, design starts at the middle level and proceeds up or down.

boundary scan: a self-test technique; not synonymous with scan

BPEL4WS: Business Process Execution Language for Web Services

bpi: bits per inch—for example, 1,600-bpi magnetic tape unit; 1,600 bpi

BPML: Business Process Modeling Language

BPMN: Business Process Model and Notation

bps: bits per second, as in 1,200 bps; see also *baud*

BPSS: Business Process Specification Schema

BRDF: bidirectional reflectance distribution function

B-rep: boundary representation

broadband (n.): a technique for high-speed data transmission

broadcast bus: sends a single data item to all bus destinations in a unit of time

brute-force attack

BSA: Business Software Alliance

Bsafe: encryption software

BSD: Berkeley Software Distribution, an extended and modified version of AT&T Unix from the University of California, Berkeley

B-spline (n., adj.): not the same as a Beta-spline

Bsquare

b-trieve: random-access search technique used in databases

burn-in (n., adj.), **burn in** (v.)

bus, bused, busing, buses: The *s* isn't doubled.

byte: an eight-bit string that a processor reads as a group. Generally, one byte equals one alphanumeric character.

bytecode: one word



- * °C: degree Celsius
- C: a programming language
- C++: a programming language based on C and extended to include object-oriented features (++ is not super- or subscripted)
- C³: command, control, and communications
- C³I: command, control, communications, and intelligence
- C^x: (*x* is an integer or an algebraic representation of an integer); a mathematical notation referring to the continuity of a function and therefore its differentiability (in calculus) because derivatives are undefined where functions are discontinuous. Less formally, continuity refers to the “smoothness” of a function or curve. C⁰ means the function is continuous but its derivatives aren’t. C¹ means both the function and its first derivative are continuous, but the second derivative might not be. More complicated forms, such as C^{k-1}, also occur. Some authors make the *C* calligraphic, but this isn’t necessary.
- * CAD: computer-aided design
- CADAM: computer graphics augmented design and manufacturing system
- * CAD/CAM: computer-aided design and computer-aided manufacturing
- CADD: computer-aided design and drafting
- CAE: computer-aided engineering
- CAGD: computer-aided geometric design
- CAI: computer-assisted instruction or computer-aided instruction
- CalArts: California Institute of the Arts; abbreviated term acceptable only on second reference
- Calcomp, Calcomp IGS-500, Calcomp 960 plotter**
- CALM: Common Assembly Language for Microprocessors
- Caltech: California Institute of Technology
- CAM: contact addressable memory
- CAM-I: Computer-Aided Manufacturing International
- Carnegie Mellon University**: The Pittsburgh-based university removed the hyphen from its name in 1986.
- Cartesian**: initial capital
- CASE: computer-aided software engineering
- CASA/SME: Computer and Automated Systems Association of the Society of Mechanical Engineers
- CAT: computer-aided testing (not computerized axial tomography); see *CT*
- catalog** (not catalogue)
- CAVE: Cave Automatic Virtual Environment
- CavernSoft**: note internal cap
- CBEMA**: Computer Business Equipment Manufacturers Association
- CCALI**: Center for Computer-Assisted Legal Instruction

CCD: charge-coupled device

CCIA: Computer and Communications Industry Association

CCITT: Comité Consultatif International de Télégraphique et Téléphonique (International Consultative Committee for Telegraphy and Telephony), a Geneva-based division of the International Telecommunications Union, a New York-based United Nations organization; rarely spelled out. Now ITU-T; see the listing in the “I” section.

CDA: DEC’s compound document architecture

CD-I: compact disc-interactive

CDMA: code division multiple access—a wireless communications technology

* **CD-ROM:** compact-disc read-only memory. The preferred spelling is with the hyphen.

Cedar: a Xerox programming language

Cedex: a French postal pickup station, used in addresses

cel: a clear acetate sheet onto which animators’ drawings are traced and painted for photographing

cell phone

century: Use the symbol for ordinal numbers—for example, 20th century. Note: *CMS* spells out the century (twentieth century).

CerDIP: trademark name for a ceramic dual in-line package

* **CERN:** Centre Européen des Recherches Nucléaires (European Center for Nuclear Research)

CERT Coordination Center: CERT/CC, a center of Internet security expertise, located at the Software Engineering Institute, Carnegie Mellon University

CGA: color graphics adapter (or array); an IBM color-display standard allowing eight colors

CGI: common gateway interface

CGS: Computer Graphics Society

CHI: The annual Conference on Human Factors in Computing Systems.

child: one of several family words used to describe relationships among nodes in databases. The terms are legitimate—don’t edit them out.

chipmaker, chipset

CHMOS: Intel’s CMOS

CIDR: classless interdomain routing

CIE: International Commission on Illumination (Commission Internationale de l’Eclairage)

CIELUV: perceptually based color space

CIM: computer-integrated manufacturing

ciphertext: no hyphen; *i* not *y*

CIPS: Canadian Information Processing Society

CISC: complex-instruction-set computing

CLB: configurable logic block

cleanroom: a software development approach aimed at producing software with the minimum number of errors

cleanup (n., adj.), **clean up** (v.)

cleartext (n.)

client-server: Use a hyphen, not a slash.

clk: clock

clock cycle: the time it takes the CPU to fetch and execute an instruction. Don't substitute "clock."

closed-loop (adj.)

(the) cloud, cloud computing

CLUT: color lookup table

* **cm**: centimeter

CMM: Capability Maturity Model, Levels 1–5. Don't spell this out in *IEEE Software*.

* **CMOS**: complementary metal-oxide semiconductor

co-: Compounds formed with this prefix generally aren't hyphenated. Exceptions are compounds that result in a double *o* (co-op, co-official) and a compound such as co-edition that could be confusing or suggests infelicitous reading. However, this doesn't apply to words such as coincidence or cooperate where the first two letters, through long-standing use, are viewed more as an integral part of the word than as prefixes. See *Webster's* and *CMS 7.85*, Table 4, for other examples.

Co.: abbreviated when used in text as part of a company name. Avoid using it unless a company's name might not be clear without it—for example, Data Co.

CO₂e: equivalent carbon dioxide

Cobol: Common Business-Oriented Language; Cobol on all references

CoCom: an informal abbreviation for Coordinating Committee for Multilateral Expert Controls

* **Cocomo**: Cost Constructive Model, a project-estimation system developed by Barry Boehm

Codasyl: Conference on Data Systems Languages, an obsolete organization devoted to developing a universal data system language for business; active from 1959 to about 1971

code base

codesign; hardware-software codesign

Codiac: centralized operation deterministic interface access control

colocate: locate together, as in putting two things close together to share common facilities

COM: Component Object Model

compiler: a program that translates code in a high-level language into instructions a machine can execute

complex-instruction-set computing; also **CISC**

compute: Resist the tendency to use this as an adjective or adverb. Use "computationally intensive" instead of "compute-intensive" and "computation server" instead of "compute server."

Computer (magazine): not *IEEE Computer*

computer games: Italicize the names of computer games but not the names of other types of games.

Computer Science Press: an imprint of W.H. Freeman. Spell out the name to avoid confusion with CS Press.

Computer Society: Use "the IEEE Computer Society" on first reference; "Computer

Society” without “IEEE” is acceptable on second reference. The executive staff often uses IEEE-CS in its official communications.

Computer Society publications: Use IEEE CS in references.

cooltown: a ubiquitous-computing initiative sponsored by Hewlett Packard. Don’t call it “CoolTown.”

copyleft: a general method for making a software program free and requiring all modified and extended versions of the program to be free software as well

copyright, ©: See the “Copyrights, Trademarks, and Image Permissions” section.

Corba: common object request broker architecture. Don’t spell this out in *IEEE Software*.

Corp.: abbreviated when used in text as part of a company name; spelled out when used in a byline or biography. Generally used only if a company’s name might not be clear without it—for example, Logic Corp.

Cosmic Cube: a supercomputer at the University of Illinois

cost-effective: always hyphenated

* **COTS:** commercial off-the-shelf

counter-: prefix, not hyphenated

Courant Institute of Mathematical Sciences: an institute at New York University

CPA: Computer Press Association

CP/M, CP/M-86: two of many early operating systems

cpi: characters per inch

cpl: characters per line; spell it out

cps: characters per second, as in *125-cps printer*

* **CPU:** central processing unit; plural is CPUs

Cray-1, Cray-2, Cray X-MP/24, Cray X-MP/48, Cray-MP: parallel processors from Cray Research (now Cray Inc.)

CRM: customer relationship management

cross-assembler, cross-compiler: an assembler or compiler that assembles or compiles code on one machine for use on another, normally incompatible, machine

crossbar (adj.)

cross-hair cursor

cross section (n.), **cross-section** (adj.)

Crosstalk: communications software

cross validation (n.), **cross-validation** (adj.)

crowdfunding

crowdsource

* **CRT:** cathode-ray tube; acceptable on first reference; use VDT when talking about video displays in general

CS: informal acronym for IEEE Computer Society; rarely used alone in publications

CSCW: computer-supported cooperative work

CSE: computational science and engineering; also, “computer science and engineering”

CSG: constructive solid geometry

CSI: Computer Security Institute

CSIC: customer-specific integrated circuit; pronounced “seasick”

CSMA/CA: carrier sense multiple access with collision avoidance

CSnet: Computer Science Network. It was established to connect institutions that have Arpanet to each other and to those that don’t. Merged with Bitnet in 1989.

CS Press: no longer used except for books as of 2011.

CSS: Cascading Style Sheets; a style sheet language

* **CT:** computerized tomography; a 3D-scanning technique (not CAT)

CUDA: (Compute Unified Device Architecture) Not commonly spelled out.

CURE: an algorithm

CUT: circuit under test

cyber: (adj.) relating to computers or computer networks

cyber- (prefix): cyberattack, cyberinfrastructure, cybersecurity, cyberworld

cyber-physical systems

D

d: day (unit of measurement)

DA: design automation

D/A: digital/analog

DAC: digital–analog converter; Design Automation Conference

DAG: directed acyclic graph; a data structure for representing computer graphics

daisy chain (n.), **daisy-chained** (adj.)

daisywheel

DAML: DARPA Agent Markup Language

DAML+OIL: DARPA Agent Markup Language + ontology inference layer. Spell this out on first use.

* **DARPA:** US Defense Advanced Research Projects Agency

DASD: direct-access storage device

DASH: Design Aid Schematic Helpmate

data: Follow the author’s preference for use as singular or plural, but maintain consistency within an article (unless the context clearly demands inconsistency).

database, datacenter, datapath, dataset, datatype

data-entry (adj.): as in “data-entry switch”

dataflow (n., adj.)

data mining

Data General: The Westboro, Mass.-based company’s products include the Eclipse MV/8000, Eclipse MV/1000 superminicomputer, Eclipse S130, and GW/4000 graphics workstation.

daughter: one of several family words used in computer-based relationships. Although the preferred usage is the gender-neutral “child,” the term is legitimate; don’t edit it out.

Davic: Digital Audio Video Interactive Council

* **dB:** decibels (40 dB)

dBase II, dBase III, dBase III+: database products produced by Ashton-Tate

DBMS: database management system. The plural form is DBMSs.

* **DC:** direct current

DCE: Distributed Computing Environment

DCFL: direct coupled field-effect transistor logic

DCOM: Distributed Component Object Model

DCT: discrete cosine transform

DDL: document-description language

DDN: Defense Data Network

DDN PMO: Defense Data Network Program Management Office

DEC: Use Digital Equipment Corp. on first reference in text; DEC or Digital is acceptable for subsequent references.

DEC 10: The DEC 10 is the same computer as the PDP-10. Digital Equipment Corp.

changed the name to DEC 10 around 1973.

decimals: See the “Numbers and Symbols” section.

decision maker (n.), **decision making** (n.), **decision-making** (adj.)

DECnet: A Digital Equipment Corp. facilities’ network

DECsystem-10

DECUS: Digital Equipment Corp. Users Society; absorbed into Encompass, an HP users group

deep-submicron (adj.)

degrees: Spell this out in text when it’s used as a unit of measure. For educational degrees, see *academic degrees*. Use the degree symbol for temperatures.

Denelcor: a defunct company famous for making the HEP, a parallel processor no longer in production

denial-of-service (adj.): The abbreviation is DoS.

depth buffer: see *z-buffer*

DES: Data Encryption Standard

design by contract (n.)

desktop

device-independent (adj.): capable of making I/O requests without regard for the characteristics of I/O equipment

* **DevOps:** a portmanteau of “development” and “operations”

DFM: design for manufacturability

DFT: discrete Fourier transform; design for testability

DHCP: dynamic host configuration protocol

Dhrystone: a benchmark

DHTML: Dynamic HTML

dialog: as in “dialog box”

dialogue: a conversation. Be consistent regarding spelling if dialogue and dialog appear in proximity.

dial-up (adj.)

Diffserv: differentiated services

Digital Equipment Corp.: Spell this out on first reference in text; use DEC or Digital for subsequent references.

dimensions: Whether you spell out the term or use abbreviations, be consistent: 8 ft. × 5 ft. or eight feet by five feet. See the “Numbers and Symbols” section.

DIMM: dual inline memory module

DIP: dual in-line package; also, **MiniDIP** with no hyphen

disk: preferred, as in “floppy disk.” However, “disc” is the standard in optics, farming, and medical applications.

display-list (adj.)

Disspla: initial cap only; product of Computer Associates Int’l

distributed computing system: a system in which storage and processing facilities are dispersed and loosely coupled by transmission media; also a system in which many processors perform a computation in parallel

- DIVE:** Distributed Interactive Virtual Environment
- DLL:** dynamic linked library
- DMA:** direct memory access
- * **DNS:** Domain Name System
- doctorate:** preferred over “doctor’s degree”
- DoD:** Use Department of Defense on first reference; consider using Defense Department instead. Add US if the context isn’t clear.
- DoD-Std:** Department of Defense standard; not the same as Mil-Std
- DoE:** Use Department of Energy on first reference; consider using Energy Department instead. Add US if the context isn’t clear.
- DOF:** degrees of freedom
- * **DOI:** digital object identifier
- DoJ:** Use Department of Justice on first reference; consider using Justice Department instead. Add US if the context isn’t clear.
- dollar sign:** Don’t place “US” in front of the dollar sign except to avoid confusion.
- DOM:** document object model
- * **DOS:** disk operating system
- DoS:** see *denial-of-service*
- dot-com:** Internet-based business
- dot matrix printer:** no hyphen
- double-buffer** (adj.): as in “a double-buffer scheme”
- double buffering**
- download** (v.)
- downtime** (n.)
- DPA attack:** differential power analysis
- * **dpi:** dots per inch
- DPMA:** Data Processing Management Association
- DPMI:** DOS protected-mode interface
- * **DRAM:** dynamic RAM (pronounced “dee-ram”)
- DRAM module:** a group of dynamic RAM chips packaged together
- DRM:** digital rights management
- * **DSL:** digital subscriber line
- DSL:** domain-specific language
- DSP:** digital signal processor (chips); digital signal processing (applications, systems).
- DSS:** decision support system
- DSSS:** direct sequence spread spectrum
- DTD:** document type definition; an SGML term
- DTF:** dielectric thin film (filters)
- DTR:** data terminal ready
- DUT:** device under test
- * **DVD:** digital video disc or digital versatile disc

DXF: data exchange file (format)

E

E.: “east” in addresses

e-: prefix denoting “electronic,” as in e-commerce, e-health, e-learning, e-publishing, e-science, but not in email. When using in an article title or headings, capitalize both the “e” and the word following the hyphen, as in “E-Commerce in Asia.”

on **Earth** (planet), of the **earth** (soil)

EasyLiving: a ubiquitous-computing project of the Vision Group at Microsoft Research. Don’t call it “easy living.”

eBay

EBCDIC: extended binary-coded decimal-interchange code; compare with ASCII

ECC: error-correcting code

ECL: emitter-coupled logic

E/D: enhancement/depletion mode

EDI: electronic data interchange

editor in chief (n.), **editor-in-chief** (adj.): Editor in Chief Bill Smith; Bill Smith, the magazine’s editor in chief; editor-in-chief position

EDSAC: Electronic Delay Storage Automatic Calculator

EDVAC: Electronic Discrete Variable Automatic Computer

Eeprom: electrically erasable programmable read-only memory

e.g.: *exempli gratia*; substitute “such as” or “for example”

EGA: extended graphics adapter or array; an IBM color-display standard allowing 16 colors

EIA: Electronic Industries Alliance

EIAJ: Electronic Industries Association of Japan

eigen-: prefix meaning “characteristic”

EISA: extended international standard architecture

Eispack: benchmark

EJB: Enterprise JavaBeans

E-JFET: *n*-channel enhancement mode junction field-effect transistor

electron beam (n.), **electron-beam** (adj.)

ellipsis: See the “Punctuation” section or *CMS* 13.48-13.56.

email: electronic mail. Use curly brackets to list multiple persons at the same email address—for example, {jsmith, pjones, abrown}@computer.org.

EMS: Expanded Memory Specification; a standard developed by Lotus Development, Intel, Microsoft, and AST Research for configuring and addressing memory above the MS-DOS direct-address 640-Kbyte limit. Also known as LIM EMS, from the companies’ names. AST became a development partner after the acronym was coined.

end-fire coupling

endpoint (n.): Use this in a geometric context and when referring to networks; otherwise, use two words: **end point**.

end user (n.), **end-user** (adj.): the ultimate user or customer. Use just “user” unless distinguishing different types of users, such as a testing user or support user. Consider substituting “customer.”

- * **ENIAC**: Electronic Numerical Integrator and Computer; an early-generation computer
- * **EPFL**: Ecole polytechnique fédérale de Lausanne
- Eprom**: erasable programmable read-only memory
- * **EPS**: encapsulated PostScript
- ERP**: enterprise resource planning
- Esprit**: European Strategic Programme for Research and Development; retain the spelling of Programme
- et al.**: et alia. Use this for more than three authors in a bibliography, including a period after al.; it’s okay to substitute “and colleagues” or “and coauthors” in text.
- etc.**: et cetera. Substitute “and so forth” or “and so on.”
- Ethernet**: LAN technology; also, Fast Ethernet and Gigabit Ethernet
- * **EU**: European Union, formerly the European Community
- euclidean**: lowercase in most uses except when referring to the Euclidean algorithm
- Euler**: an adjective describing a mathematical concept. It’s pronounced “oiler” and takes “an” as its article.
- Euler–Poincaré formula**: a graphics algorithm
- euro**: European monetary unit
- EuroASIC**: European Conference on Application Specific Integrated Circuits
- EuroDAC**: European Design Automation Conference
- European Federation of National Engineering Associations**
- EuroVHDL**: European Conference on VHSIC Hardware Description Language
- EUUG**: European Unix Users Group; now known as EurOpen
- * **Extensible Markup Language**: XML; okay to use acronym on first use
- Extreme Programming (XP)**: not eXtreme Programming

F

- * °F: degree Fahrenheit
- fail-soft-features**
- fan-in, fan-out** (n., adj.): types of logic networks
- fan in, fan out** (v.)
- * **FAQ**
- farad**: unit of capacitance
- Fastbus**: an IEEE standard
- Fast Ethernet**
- fast Fourier transform (FFT)**: (not hyphenated) decoding algorithm
- father**: one of several family words used to describe relationships among nodes in databases. Although the preferred usage is the gender-neutral “parent,” both terms are legitimate; don’t edit them out.
- fault tolerance** (n.), **fault-tolerant** (adj.): a system’s capability to keep executing in the presence of a limited number of faults
- * **fax**: document facsimile, document facsimile telecommunications equipment
- FDDI**: Fiber Distributed Data Interface
- FDM**: frequency-division multiplexing
- FEA**: finite-element analysis; also the acronym for Fast Ethernet Alliance
- Fellow**: always uppercase in “IEEE Fellow” and other similar titles—for example, “she’s a Fellow of IEEE”
- FEM**: finite-element method
- femtosecond**: one quadrillionth of a second
- FET**: field-effect transistor; also occurs in combinations, such as MESFET
- ff**: femtofarad
- FF**: flip-flop. Spell this out in text.
- FFT**: fast Fourier transform
- Fhourstone**: a benchmark
- FHSS**: frequency hopping spread spectrum
- Fibre Channel**: a computer communications protocol for high-performance information transfer
- fiber optic** (n.), **fiber-optic** (adj.)
- field testing** (n.), **field-testing** (adj., v.), **field-test** (v.)
- FIFO** (adj.): first-in, first-out—for example, “first-in, first-out accounting”
- filename**: can be used as two words when not relevant to computers
- file system**
- finite-element analysis**
- FIPA**: Foundation for Intelligent Physical Agents
- FIPS**: federal information-processing standard

FIR: finite-length impulse response

FireWire: trademarked name for IEEE 1394, an external bus standard

fixed-bubble memory

fixed-length field

fixed point (n.): notation in which the position of the point is fixed in relation to the numerals, according to some convention

fixed-point (adj.): as in “fixed-point arithmetic”

fJ: femtojoule

Flash: a proprietary Adobe software platform

flash memory

flat-panel display

Flex/32: a system from Flexible Computer Corp.

flip-flop (n.): a circuit or device capable of assuming one of two states at a given time; abbreviated FF

flits: flow-control digits

floating point (n.); **floating-point** (adj.): notation in which a point’s location isn’t fixed but is regularly recalculated. The location is usually expressed as a power of the base.

floorplan

flops: floating-point operations per second; never “flop,” except when quoting the use of this incorrect form. For example, the 1993 Branscomb Report is titled “From Desktop to Teraflop ...” Don’t change the title, but the report talks about building a teraflops, not teraflop, computer.

flowchart

flow control (n.), **flow-control** (adj.): the sequence of operations performed in the execution of an algorithm

flowgraph

flowtime

FOAF: Friend-of-a-Friend Protocol

focused, focusing

follow-up (n., adj.), **follow up** (v.)

footprint: loosely defined as the amount of space a machine takes on a surface (usually a floor or desktop) or as the system resources an application uses in a computer

foreign: Because the IEEE is an international society, “foreign” isn’t truly applicable in our publications when referring to nationalities; use “non-US” or “international” instead. Italicize terms that aren’t commonly accepted in English, but use such terms only when there’s no suitable English equivalent. See the “Non-English Words and Phrases” section and *CMS 7.49-7.53*.

formulas: not formulae

Forth: a programming language

Fortran: for *formula translator*, a programming language. Dialects include Fortran 77.

FOTS: fiber-optics transmission system

FPGA: field-programmable gate array.

fps: frames per second.

fractions: Use slash notation (1/1,000) for a general, rounded-off measurement; use decimals (0.001) for a specific, precise measurement. See the “Numbers and Symbols” section and appropriate sections in *CMS*.

frame buffer (n.)

Free Software Foundation: supports GNU Linux

front end (n.): usually refers to a small computer that serves as an interface between the host system and its peripherals

front-end (adj.): as in “front-end processing”

FSM: finite-state machine

* **ft:** foot

FTAM: file transfer and management

F-test

* **FTP:** File Transfer Protocol

full-scale (adj.)

full-screen (adj.)

Futurebus (n.): IEEE Standard 896 bus

fuzzy set (n.), **fuzzy-set** (adj.)

G

- G:** giga; standard prefix meaning one billion
- * **g:** gram
- g:** gravity (“6-g acceleration”; “passengers in a BMW are exposed to 2 g”). The gravitational notation, *g*, is often italicized to differentiate it from “g” for “gram” or “grams”
- GaAs:** gallium arsenide; a semiconducting material, like silicon, used for integrated circuits. Spell this out on first use.
- Game Boy; Game Boy Advance; GameCube**
- gameplay**
- GB:** gigabyte. Use Gbyte (instead of GB) or spell it out.
- Gbit:** gigabit. Use Gbit or spell it out.
- Gbps:** gigabits per second.
- GBps:** gigabytes per second.
- * **Gbyte:** gigabyte—for example, 25 Gbytes and 25-Gbyte memory
- GEM:** Digital Research’s Graphics Environment Manager, an operating environment for MS-DOS PCs
- general-purpose processors**
- genlock:** to superimpose computer-generated graphics over videotaped images (from a camera, VCR, or VTR)
- Georgia Tech**
- Gflops:** gigaflops
- * **GHz:** gigahertz
- * **GIF:** graphic interchange format—an electronic file format
- giga-:** standard prefix meaning one billion
- Gigabit Ethernet**
- GIGI:** DEC’s General Imaging Generator and Interpreter
- GIGO:** garbage in, garbage out
- GIPS:** billion instructions per second
- GIS:** geographic information system
- GKS:** Graphical Kernel System, an international graphics standard
- GlobeCom:** an IEEE conference
- * **GNP:** gross national product
- GNU:** supports GNU Linux; GNU’s not Unix
- googling**
- * **GOPS:** giga operations per second
- GPL:** General Public License
- GPRS:** general packet radio service
- * **GPS:** Global Positioning System; a constellation of 24 satellites used for navigation and precise geodetic position measurements

- * **GPU:** graphics processing (or processor) unit
- graftal:** an image constructed using parallel graph grammars to define complex objects
- grandparent, grandmother, grandfather:** a group of family words used to describe relationships among nodes in databases. The terms are legitimate—don't edit them out. Use the gender-neutral "grandparent" when possible.
- grand challenge:** a difficult problem at the leading edge of a computing field
- Grappa:** a Java graph-drawing package from AT&T
- gray:** not "grey," except in quoted material
- Gray code:** a binary sequence in which two contiguous numbers differ in only one bit. Capitalize Gray because it's the inventor's name.
- gray scale** (n.), **gray-scale** (adj.): for example, "displayed in gray scale," "a gray-scale display"
- grid; grid computing**
- GSM:** Global System for Mobile Communications.
- * **GUI:** graphical user interface
- GW-Basic:** the Microsoft version of Basic for MS-DOS computers; BasicA is the IBM version

H

- * **h:** hour (unit of measurement)
- hacker:** an expert who explores the details of programmable systems to stretch their capabilities
- halfword:** half a computer word
- halftone:** an image reproduced from a photo or similar original medium, comprising a series of lines arrayed in a screen, to facilitate sharp, clear printing of images when producing books. Also the preferred format for images in electronic text for camera-ready and other forms. A 100- to 110-line screen is best; lines per inch is the US unit of measure.
- handheld** (adj., n.)
- handshaking:** identification protocol for modems
- hard copy** (n.), **hard-copy** (adj.)
- hardwired:** describes circuits with only wire and terminal connections, with no intervening switching (no resistors, inductors, or capacitors)
- HarperBusiness, HarperCollins**
- hashtag**
- HCI:** human-computer interaction.
- HD** (adj.): high-definition
- HDL:** hardware description language—any language from a class of computer languages
- * **HDTV:** high-definition TV
- head-mounted display**
- healthcare**
- help desk**
- hertz:** see *Hz*
- Hewlett Packard Labs**
- hexadecimal:** A numbering system with a base of 16. “A” through “F” represent the decimal numbers 10 through 15.
- HID:** human interface device
- hidden-line removal**
- hidden Markov model**
- hidden-surface algorithm**
- hidden-surface removal:** in computer graphics, removing from the display the surfaces that ordinarily would be obscured by the rest of the object.
- high level** (n.), **high-level** (adj.)
- high-performance computing**
- high-speed** (adj.): for example, “high-speed computing” and “high-speed switch,” but “very high speed switch”; also, *International Journal of High Speed Computing*.
- HiperLan2**
- Hippi:** high-performance parallel interface; also written as HiPPI and HIPPI—be prepared to negotiate

hither, yon: in computer graphics, the near and far clipping planes.

HMM: hidden Markov model

homepage

The Hong Kong University of Science and Technology (HKUST): “the Hong Kong University of Science and Technology” in text

hostname

HPC: high-performance computing

***HPCwire*:** an online weekly publication about high-performance computing. Paper copy doesn’t exist. Italicize it as with the name of any periodical.

HPGL: Hewlett-Packard Graphics Language

* **HTML:** Hypertext Markup Language

* **HTTP:** Hypertext Transfer Protocol. In Web addresses, use lowercase—`http://`.

HVAC: heating, ventilation, and air conditioning. Always spell this out on first occurrence.

hyper- (prefix): not hyphenated when used to form a compound

hypercube: a parallel computer architecture

***hyphenation*:** If you can’t resolve a hyphenation question by consulting *Webster’s*, review *CMS 7.77-7.85*. If you feel a word that technically doesn’t require hyphenation (for example, *reallocate*) might be confusing, consider hyphenating it.

* **Hz:** hertz; the standard term for cycles per second

I

- IAB:** Internet Architecture Board
- IAMA:** Internet Assigned Members Authority
- IANA:** Internet Assigned Numbers Authority
- IAP:** Internet access provider
- IBE:** identity-based encryption
- * **IBM:** International Business Machines Corporation; sometimes informally called “Big Blue”
- IBM 3740-formatted disk, IBM 370-type controllers** (note the hyphenation)
- IBM PC, IBM PC AT, IBM PC XT, IBM RT PC, IBM PS/2** (Models 25, 30, 50, 60, and 80): no hyphens. **IBM PC AT-compatible** (adj.).
- IBM System/360, IBM System/370:** IBM mainframes
- IBM T.J. Watson Research Center**
- IC:** integrated circuit; acceptable on first reference if context warrants
- * **ICANN:** Internet Corporation for Assigned Names and Numbers
- ICASE:** Institute for Computer Applications in Science and Engineering, at NASA’s Langley Research Center
- ICCC:** International Council for Computer Communication, Washington, D.C.
- ICOT:** Japan’s Institute of New Generation Computer Technology, the so-called Fifth Generation project. The initials refer to the Japanese transliteration of the program, not the English translation.
- * **ICQ:** an instant-messaging program
- ICT:** information and communications technology
- * **ID:** identification
- IDC:** formerly International Data Corp.
- * **I_{DDQ}**
- IDE:** integrated drive electronics; also, integrated development environment. Don’t spell this out in *IEEE Software* when it means the latter.
- IDL:** Interface Definition Language
- i.e.:** that is—spell it out
- IEC:** International Electrotechnical Commission—an international standards organization
- IEE:** Institution of Electrical Engineers, UK; as of May 2006, renamed as Institution of Engineering and Technology (IET)—merged with Institution of Incorporated Engineers
- IEEE 488 bus**
- * **IEEE:** Institute of Electrical and Electronics Engineers. When it’s used to refer to a document’s publisher, it’s no longer IEEE Press—just IEEE. Also, don’t insert “the” in front of it.
- IEEE Computer Society:** Insert “the” in front of this in text.
- IESG:** Internet Engineering Steering Group
- IET:** Institution of Engineering and Technology, formerly IEE (see *IEE*)
- IETF:** Internet Engineering Task Force

IFIP: International Federation for Information Processing

IGES: International Graphics Exchange Standard

iff: if and only if. Spell this out.

if-then

III: integrated interconnection logic

-ility, -ilities: This is an *IEEE Software*-related term. On its first appearance in an article, use quotes (“-ilities”) but no italics. On subsequent appearances, drop the quotes but keep the hyphen.

Illiac IV: An early computer, retired from NASA use at Ames Research Center, Moffett Field, Calif., in 1985

IMACS: International Association for Mathematics and Computers in Simulation

i-mode: a wireless service

IMP: interface-message processor

implementer

* **in:** inch

Inc.: Abbreviate this when it’s used in text as part of a company name, but avoid using it unless a company’s name might not be clear without it (for example, Lisp Inc.). Don’t set it off with a comma.

inches: Whether you use symbols or spell them out, be consistent when describing dimensions—for example, “three inches by five inches” or “3” × 5”.” See also the “Numbers and Symbols” section.

indexes: use “indices” in mathematical contexts

informatics: a term often used to refer to computer science

Information Age

INFORMS: the Institute for Operations Research and the Management Sciences; formed in 1995 when the Operations Research Society of America (ORSA) merged with the Institute of Management Sciences (IMS)

infoserver

in-house (adj.)

ink-jet printers

inline (adj.)

in queue: Hyphenate this when using it as an adjective—for example, “an in-queue directory.”

* **INRIA:** Institut National de Recherche en Informatique et en Automatique (French National Institute for Research in Computer Science and Control)

in-service (adj.)

INSPEC: Information Services for Physics, Electronics, and Computing; an IET database of English-language research papers. Not a true acronym, but handle as one.

integrated circuit: IC is acceptable on first reference.

Intel’s XScale processor

interconnect or interconnection (n., adj.): Either is acceptable, but follow the author’s usage and be consistent throughout an article.

International standard: use “ISO standard”

- Internet:** normally “the Internet”; **Internet 2**
- Internet Stream Protocol:** ST
- intranet:** internal network
- * **I/O** (n., adj.): input/output
- IOP:** Internetworking Operating System
- IoT:** Internet of Things
- IP:** Internet Protocol; intellectual property
- iPhone:** acceptable at the beginning of a sentence.
- iPSC:** a parallel processor from Intel
- IPsec:** Internet Protocol security
- IPv6:** Internet Protocol version 6
- IPX:** internetwork packet exchange
- IR:** infrared.
- IrDA:** Infrared Data Association.
- IRDS:** information-resource dictionary system, a de facto CASE standard
- IRQ:** interrupt request
- ISAM:** indexed sequential access method
- iSBX bus:** an Intel product
- ISDN:** Integrated Services Digital Network, a telecommunications service
- ISM band:** Industry, Science, Medicine band
- ISMM:** International Society of Mini- and Microcomputers
- ISO:** International Organization for Standardization (ISO). Use ISO when referring to standards (for example, ISO 9000 or “an ISO standard”), but use the entire name with the letters in parentheses when referring to the organization. ISO was originally a true acronym for the International Standards Organization, but the name has been changed and the letters are now only an identifier. Don’t spell this out in *IEEE Software*.
- * **ISP:** Internet service provider
- italics:** Use sparingly for emphasis or to introduce new terms; use also for foreign expressions not commonly accepted in English (that is, not found in the main body of *Webster’s*), single-letter variables, longer variables that might be confused with text if not in italics, book titles (including manuals), movie titles, and TV-series titles.
- * **IT:** information technology
- ITC:** International Test Conference
- item set;** some publications use **itemset**
- iterator** (n.): a programmed action that sets up a counter to control the number of times the action is performed
- ith:** Note: no space, no hyphen, no superscript.
- ITU-T:** International Telecommunication Union-Telecommunication Standardization Sector; formerly, CCITT

J

- * **J:** Joule
 - J2EE:** Java 2 Enterprise Edition; **J2ME:** Java 2 Micro Edition; **J2SE:** Java 2 Standard Edition. For more information on emerging Java technologies, see <http://java.sun.com>.
 - Jabber:** streaming XML protocol
 - Java:** cross-platform programming language from Sun Microsystems
 - JavaOne, JavaBeans, JavaScript, JavaServer Pages (JSP)**
 - Java RMI:** Java remote method invocation
 - JDK:** Java development kit
 - JEDEC:** the JEDEC Solid State Technology Assoc., once known as the Joint Electron Device Engineering Council
 - JEIDA:** Japan Electronic Industry Development Association
 - JFIF:** J-PEG file interchange format
 - jif:** an electronic file format
 - Jini:** Java wireless technology
 - JMS:** Java Message Service
 - John Wiley & Sons**
 - Josephson junction** (n.): an electronic switching device
 - Jossey-Bass:** a subsidiary of John Wiley & Sons
 - joystick**
- * **JPEG:** Joint Photographic Experts Group; also an electronic-file format
- * **JPL:** Jet Propulsion Laboratory
 - Jr.:** doesn't require a preceding comma
 - JSON:** JavaScript Object Notation
 - JTAG:** Joint Test Action Group; founders of the boundary scan standard
 - jth**
 - just-in-time (jit):** an inventory management method; no capitals needed. It's almost always used as a modifier.
 - JVM:** Java virtual machine
 - JXTA:** a platform-independent peer-to-peer distributed networking protocol developed by Sun
 - Jython**

K

K: (degree) Kelvin

K: 1,024, the binary thousand (25 Kbytes, 25-Kbyte memory); also used as temperature designator for Kelvin scale, as in 273 K. However, when used as \$10K (with no space), “K” means 1,000. The use of “K” when referring to monetary quantities is discouraged.

k: 1,000, the decimal thousand (164 km); used in metric designations; see *CMS 10.57*

KAoS: knowledgeable agent-oriented system (nonstandard, but accepted acronym)

KB: kilobyte; use Kbyte (25 Kbytes, 25-Kbyte memory)

Kb: kilobit; use Kbit or spell out, but use Kbps for kilobits per second

KBES: knowledge-based expert system (as opposed to rule-based)

Kbit: kilobit; use Kbit or spell out

Kbps: kilobits per second, preferred over Kb/s; spell out on first use

Kbyte: kilobyte (25 Kbytes, 25-Kbyte memory). Don’t use KB.

KEE: Knowledge Engineering Environment, an Intellicorp product

keiretsu: a group of companies

kernel: the central part of a program or operating system that does the bulk of the calculations; not to be confused with the mathematical meaning

keyboard, keyframe, keyshare, keystore, keyword

Kflops: thousand floating-point operations per second. Spell this out or convert it to Mflops notation.

Khornerstone: benchmark

* **kHz:** kilohertz (50 kHz)

kiloWhetstone: measure of floating-point capacity. See *benchmarks*.

KIPS: thousand instructions per second. Spell this out or convert it to MIPS notation.

* **KLOC:** thousands of lines of code

kludge (n.), **kludgy** (adj.): a quick fix on a computer or in code

Kluwer Academic Publishers

KM: knowledge management

* **km:** kilometer

km²: okay to use instead of “square kilometers”

k-means: a type of algorithm

* **kmph:** kilometers per hour

knowledge base

KSR1: no internal hyphen; a parallel supercomputer from Kendal Square Research

kVA: kilovoltampere

* **kW:** kilowatt

* **kWh:** kilowatt hour

L

- * **L:** liter
- LALR(1):** left-to-right scan with one look-ahead token; compare to *LL(1)*
- * **LAMP:** an open source Web server software bundle
- * **LAN:** local area network
- Lapack:** a benchmark. See also *ScaLapack*.
- large-scale integration:** See *LSI*.
- laser disk:** preferred spelling over “laser disc” (unless the word appears as a trademark)
- LASSO:** least absolute shrinkage and selection operator
- LaTeX (TeX, PCTeX, PCLaTeX):** a formatting language for typesetting math-heavy articles; pronounced “lah-tech” or “lay-tech.” Don’t set this in small caps or shift any characters above or below the baseline. LaTeX is a superset of TeX, the original format devised by Donald Knuth.
- * **lb:** pound
- * **LCD:** liquid crystal display
- LCCC:** leadless ceramic-chip carriers; chip packaging
- LDAP:** Lightweight Directory Access Protocol
- Lear Siegler:** hardware manufacturer
- least worst:** an acceptable term in decision theory
- * **LED:** light-emitting diode
- LiDAR:** light detection and ranging (scanning technology)
- life cycle (n.), life-cycle (adj.):** the software product-development process, usually divided into typical phases: requirements specification, design, validation, development, testing (verification), implementation, and maintenance
- LIFO (adj.):** last-in, first-out
- light pen**
- LIM EMS:** Lotus/Intel/Microsoft/AST Research expanded memory specification, a standard for configuring and addressing memory above the MS-DOS direct-address 640-Kbyte limit. AST became a development partner after the acronym was coined.
- Lincages:** Linkage Interactive Computer Analysis and Graphically Enhanced Synthesis package (not a true acronym, but handle as one); a synthesis program for mechanism design developed at the University of Minnesota
- Linpack:** See *benchmark*.
- Linux:** an open operating system based on the Unix platform
- LIPS:** logical inferences per second
- Lisp:** from “list processing”; a programming language used mainly in artificial intelligence
- liveness:** the quality of making sure that something good happens (not just ensuring that nothing bad happens). Liveness ensures, for example, that a calculation’s results are returned for use, not just calculated. Don’t use this term without an explanation. Compare with *safety*
- LL(1):** left-to-right scan with one look-ahead token producing a leftmost derivation; short

for “leftmost LALR(1)”; see *LALR(1)*

* **LNAI**: Lecture Notes in Artificial Intelligence

* **LNCS**: Lecture Notes in Computer Science. Use this abbreviation in reference lists.

* **LOC**: lines of code

LOCS: lines of code in service

LoD: learning on demand

login, logon, logout, logoff (n., adj.), **log in, log on, log out, log off** (v.)

look-ahead (adj.)

lookaside

lookup (n., adj.); **look up** (v.): the process of matching by computer the words of a text with material stored in memory

LOTOS: logic of temporal ordering system

low-cost (adj.)

low-end (adj.)

lowercase (n., adj.)

lpi: lines per inch (300-lpi resolution, 300 lpi)

lpm: lines per minute (145-lpm printer, 145 lpm)

LSI: large-scale integration, about 1,000 to 10,000 circuits per chip

LUT: lookup table. Avoid using this acronym.

M

μ: mu. See *mu* and *micro-*.

* **μs**: microsecond

M: SI prefix for million or mega (40-Mbyte hard disk, 12 Mbytes of memory)

* **m**: meter

m: one one-thousandth or milli- (18 mm)

mA: milliampere (20-mA current loop, 20 mA)

MAA: Mathematical Association of America

MAC: media access control

MacDraw, MacPaint, MacWrite

Macintosh: computer from Apple

Macro II: Digital Equipment Corp. assembly language

macro- (prefix): not hyphenated when used to form a compound (macroassembler). An exception is when a double “o” occurs—for example, macro-object.

Macsyma: a symbolic manipulation program developed at MIT

mainframe: a computer housed in a large frame or cabinet, usually used for multiuser applications, which usually requires a temperature-controlled environment and special power supply. Examples are the Digital Equipment Corporation VAX and IBM System 370 computers; saying “mainframe computer” is redundant.

makefile

MAN: metropolitan area network

manet: mobile ad hoc network

man-hour, man-month, man-year (n.): Try to use a non-gender-specific term, such as staff-hour.

man-in-the-middle attack; MITM attack

MAP: Manufacturing Automation Protocol; **MAP/TOP**: Manufacturing Automation Protocol/Technical Office Protocol; communications standards supported by General Motors and Boeing. Both standards follow OSI (Open Systems Interconnection) protocols.

marked up: When it’s used as an adjective, hyphenate it when it comes before the word it modifies but not when it comes after.

market research firm

markup (adj., n.)

mashup (n.); **mash up** (v.)

master’s degree

master slice (n.): a nonmetalized wafer containing arrays of circuit elements interconnected to perform different functions

matrices: preferred over “matrixes” in a mathematical context. In other contexts such as structural composition, use “matrixes”—for example, “matrixes of materials.”

Matlab

matrix, -es: See *matrices*.

MB: megabyte. Use Mbyte—for example, 40-Mbyte hard disk, 12 Mbytes of memory.

Mb: megabit. Use Mbit or spell it out.

Mbit: megabit. Use Mbit or spell it out.

Mbps: megabits per second (spell out on first use); Mbps, not MBPS.

Mbone: multicast backbone; Internet broadcasting technology

* **Mbyte:** megabyte (40-Mbyte hard disk, 12 Mbytes of memory)

MCAE: mechanical computer-aided engineering

MCM: multichip module

MDA: Model Driven Architecture

MEMS: microelectromechanical systems

MEPS: millions of events per second

meta- (prefix): not hyphenated when used to form a compound (for example, metarule) unless it looks weird, as when the second term starts with a vowel (for example, meta-analysis)

Mflops: megaflops; million floating-point operations per second

MHEG: Multimedia and Hypermedia Experts Group

* **MHz:** megahertz (50-MHz channel, 50 MHz)

* **mi:** mile

micro, micros: acceptable as nouns when referring to microcomputers

micro- (prefix): one-millionth part of a specified unit (for example, microgram); not hyphenated when used to form a compound (for example, microelectronics)

micro-BGA: micro-ball-grid array

microCAD, microCADD: computer-aided design and computer-aided design and drafting performed on a microcomputer—no longer relevant because most CAD or CADD is performed on microcomputers

microelectromechanical: one word, no hyphens or capitals; often seen as “microelectromechanical systems,” abbreviated as MEMS

micrometer (μm): SI abbreviation for one-millionth part of a meter. The accepted abbreviation is μ.

micron: millionth part of a meter. However, the SI term is “micrometer.” Usage varies; for example, “micron” is used in integrated circuit production. Can also be written as μ.

microphotograph: a small photograph normally magnified for viewing (such as microfilm). The field is called micrographics. Do not confuse with “photomicrograph,” a magnified picture of small things.

microsecond (μs): The letter “u” isn’t a replacement. If a Greek font isn’t available, spell the greek letter out as “mu.” In magazines, the spelled-out form is preferred, at least on first reference, except perhaps in tables and figures.

MicroVAX, MicroVAX II, MicroVMS

mid: Check *Webster’s* for the preferred format.

middle-out design

midframe: a computer housed in a small frame or cabinet, usually used for multiuser applications, that doesn’t require a temperature-controlled environment or special power

- supply. Saying “midframe computer” is redundant.
- * **MIDI:** musical instrument digital interface
 - millisecond:** the abbreviation is ms
 - Milnet:** along with Arpanet, the main constituent of the Defense Data Network (DDN). Minet is the European split-off from Milnet.
 - Mil-Std:** military standard; not the same as DoD-Std
 - MIMD:** multiple instruction, multiple data. Pronounced “mimdee” and takes “a” as its article. Spell it out on first use unless the context dictates otherwise; add hyphens when it’s used as a modifier.
 - * **MIME:** Multipurpose Internet Mail Extensions
 - MIMO:** multiple input, multiple output
 - * **min:** minute
 - mini-** (prefix): not hyphenated when used to form a compound (for example, minicartridges)
 - MiniDIP:** trademark name for a dual in-line package
 - MINX:** Multimedia Information Network Exchange
 - MIP mapping:** multiple texture mapping technique
 - MIPS:** million instructions per second; also, MIPS Technologies Inc., a subsidiary of SGI. Use the full name when the context requires it.
 - * **MIT:** Massachusetts Institute of Technology. Spell this out on first use if the context dictates it.
 - MITI:** Japan’s Ministry of International Trade and Industry
 - MITRE:** the preferred format for this company’s name
 - mL:** millilambert
 - ml:** milliliter (5-ml strip, 0.5 ml)
 - * **mm:** millimeter (35-mm film, 0.5 mm)
 - MMOG:** massively multiplayer online game
 - MMU:** memory management unit
 - * **mo., mos.:** month, months
 - MobiCom:** For 1999 and before, the conference acronym format is MobiCom 99; for 2000 and afterwards, the format is MobiCom 2000. The full conference name is, for example, 6th Ann. Int’l Conf. Mobile Computing and Networking (MobiCom 2000), 2000.
 - mobile phone:** not hyphenated, even when it’s an adjective
 - mockup:** (n., adj.)
 - MODFET:** modulation doped field-effect transistor
 - molecular dynamics:** hyphenated when it’s an adjective
 - Moore’s law:** a theory predicting that the number of transistors on a chip doubles as technology advances
 - MOPS:** million operations per second
 - Morgan Kaufmann:** publisher
 - MOS** (adj.): metal-oxide-semiconductor
 - MOSFET:** metal-oxide-semiconductor field-effect transistor

MOSI: Microprocessor Operating Systems Interface, IEEE Standard 855-1990

mother: one of several family words used to describe relationships among nodes in databases. The preferred usage is gender-neutral “parent”; however, don’t change this without checking with the author.

motherboard: a circuit board into which various processor boards are plugged

Motorola: Don’t follow this with “Inc.” because confusion exists in the company about whether “Inc.” or “Corp.” is appropriate, even though company stationery uses “Inc.” Use the prefix “MC” when referring to the specific microprocessor from Motorola—for example, MC68030. Use “M68000” when referring to the family of devices that share the M68000 architecture.

Moving Picture Experts Group (MPEG): a family of standards for coding audio-visual information

* **MP3, MP4:** audio file formats

* **MPEG-1, MPEG-2, MPEG-3, MPEG-4**

* **mph:** miles per hour

MPI: message passing interface

MPU: microprocessing unit

MPW: an Apple development environment for the Mac

* **MRI:** magnetic resonance imaging

* **ms:** millisecond

* **MS-DOS:** Microsoft’s version of DOS; see also *DOS*

MSI: medium-scale integration

MSPS: million searches per second

MTBF: mean time between failures

MTTR: mean time to repair, mean time to restore

MTU: maximum transmission unit

mu (μ): Greek letter used as a symbol for *micron*

multi- (prefix): Don’t hyphenate this when it’s used to form a compound, except with “double-i” combinations—for example, multimeter and multi-integral.

Multibus, Multibus II: Intel trademarks. IEEE 796 is the multibus standard.

multiplexer (n.)

multiplication symbol: Use the multiplication sign “ \times ” instead of “by” when numerals refer to dimensions—for example, 3 \times 5 cm box, 3 in \times 5 ft board. When indicating the use of “times” with a number, use a multiplication sign instead of \times —for example, 2 \times speedup. However, you may use “times” when it seems appropriate—for example, “The new version has 10 times the memory.”

MUT: module under test

mux: multiplexer; **muxes** (pl.): Spell this out on first reference.

* **mV:** millivolt

MVP: matrix-vector product, the primary operation around which supercomputers are designed

MVS: an IBM mainframe operating system

MW: megawatt (2 MW, 2-MW system)

- * **mW**: milliwatt (200 mW, 200-mW system)
Mycin: an expert system that can be programmed with knowledge databases for different domains

N

9/07 Xen: open source virtualization software

9/11; September 11, 2001

* **N:** Newton (unit of measurement)

N.: “north” in addresses

n: SI prefix for one billionth or nano (100 ns)

***n*:** variable designation for an integer; italicized

N/A: not applicable

NAA: formerly the National Association of Accountants; reincarnated as the Institute of Management Accountants (IMA)

naive

namespace

nano- (prefix): one billionth. Don’t use a hyphen—for example, nanoseconds, 100 ns.

narrow band (n.), **narrow-band** (adj.): However, according to the *IEEE Dictionary of Electrical and Electronic Terms*, **narrowband** or **narrow band** are used as adjectives in some contexts.

* **NASA:** National Aeronautics and Space Administration, Washington, D.C.

Ames Research Center, Moffett Field, Calif.

Dryden Research Center, Edwards AFB, Calif.

Goddard Space Flight Center, Greenbelt, Md.

Jet Propulsion Lab (JPL), Pasadena, Calif.

Johnson Space Flight Center, Houston

Kennedy Space Flight Center, Cape Canaveral, Fla.

Langley Research Center, Hampton, Va.

Lewis Research Center, Cleveland, Ohio

Marshall Space Flight Center, Huntsville, Ala.

NASA Massively Parallel Processor

NAT: network address translator

***national laboratories*:** The names of US national laboratories (for example, Los Alamos National Laboratory) don’t have a “the” before them in text.

NBS: National Bureau of Standards, an agency of the US Commerce Dept.; obsolete, now called NIST

NC: numerical control

NCCCD: National Center for Computer Crime Data

NCGA: National Computer Graphics Association

n-channel; n-channel device: insulated-gate field-effect transistor where source and drain are regions of *n*-type conductivity

NCSA: National Center for Supercomputing Applications

nCube: in preference to nCUBE or nCUBE

NCP: Network-Control Protocol

near real time (n.), **near-real-time** (adj.)

Net: short name for the Internet

.NET

NetBIOS: a product that provides basic I/O services for a network. Don't use this as a synonym for "network BIOS" or "LAN BIOS," which are generic terms for a BIOS designed for a local area network

Netherlands: use "the" in front

netlist (n., adj.): a list of the pin connections (pin network) that appear on a printed circuit board

newsfeed

Newton-Raphson: a well-known algorithm for solving equations

NFS: Network File System (from Sun Microsystems' application, SunSoft)

NGSCB: Microsoft's next-generation secure computing base

NIST: National Institute of Standards and Technology; formerly NBS

nm: nanometer

NMOS: *n*-channel metal-oxide semiconductor

no.: the abbreviation for number; **nos.** (pl.)

NOAA: National Oceanic and Atmospheric Administration, an agency in the US Dept. of Commerce. Although sometimes pronounced "noah," it takes "an" as an article, as if each letter were pronounced ("an NOAA study").

NoD: news on demand

node: Family words—mother, daughter, child—describe relationships among nodes in databases. The terms are legitimate; don't try to edit them out.

non- (prefix): not usually hyphenated. Be flexible with words that are difficult to read—for example, non-negligible, non-real-time mode.

non-von Neumann: See *von Neumann*. In this case, an en dash is recommended over a hyphen.

NoSQL: not SQL; a generic term

NP-hard, NP-complete: classes of difficult problems

***n*-queen's solver**

* **ns:** nanoseconds (3,000 ns)

NSA: National Security Agency

NSERC: Natural Sciences and Engineering Research Council; a Canadian research agency similar to the US National Science Foundation

NSF: US National Science Foundation. NSF is acceptable on second reference or on first reference in the acknowledgments section of a feature when used with a grant number.

NSFnet

NSPE: National Society of Professional Engineers

NuBus

numbers and symbols: See the related section and *CMS* Section 9.

NTSC: National TV Standards Committee. The committee and standard use the same acronym.

Nurbs: nonuniform rational B-spline

Nvidia

NW: northwest in addresses, no periods

NYU/IBS Ultracomputer

O

OASI: Office Automation Society International

OASIS: Organization for the Advancement of Structured Information Standards;
www.oasis-open.org

Object Management Group: OMG

Object Modeling Technique: OMT

object orientation

object-oriented (OO): An approach to programming that stresses the creation of functions (objects) that are linked in various relationships, usually in hierarchies, to provide the desired functionality. Compare this with traditional approaches such as imperative programming, which stresses actions to be taken rather than relationships between objects.

Objective-C: a computer language

Occam: the language used by Inmos for its transputer chip

OCR: optical character recognition. The machine is an OCR scanner.

octree: a tree structure that describes the division of a cubic region into smaller cubes

OCX: optical cross-connect

ODBC: open database connectivity

* **OEM:** original equipment manufacturer

OFDM: orthogonal frequency-division multiplexing

off-chip (adj.)

offline: all uses—for example, “the printer is offline” and “offline equipment”

offload, offscreen, offsite

The Ohio State University: “the Ohio State University” in text

ohm (n.): a unit of electrical resistance

OIL: ontology inference layer; see also *DAML+OIL*

okay

OLAP: online analytical processing

OLE: object linking and embedding; a Microsoft item

OLED: organic light-emitting diode

OLTP: online transaction processing

OMG: Object Management Group

Omnimax (n., adj.): a stereoscopic, eggshell-shaped theater

OMT: object modeling technique

ONA: Open Network Architecture

onboard: all uses—for example, “onboard regulation”

on-chip (adj.): as in on-chip logic

on-demand: (adj.)

online: all uses—for example, “the printer is online” and “online equipment”

ONR: US Office of Naval Research

onscreen, onsite

OO: object-oriented

op amp: operation amplifier. Spell this out in text on first use.

opcode (n.): operation code

OpenGL: a graphics programming language

open-loop (adj.): for example, “an open-loop program”

open loop (n.): A system in which there is no feedback mechanism for self-correction as there is in a closed loop

open source (n., adj.): Don’t use this as a verb (instead, consider wording such as “released X as open source”).

order-of-magnitude (adj.)

ORB: object request broker

ORSA: merged with the Institute of Management Sciences in 1995 to become the Institute for Operations Research and the Management Sciences (INFORMS)

orthogonal: In linear algebra, the term describes a set of vectors that are independent, in that no element is a linear combination of the others. In programming, the term is used more loosely to refer to independent—although possibly related—concepts.

* **OS:** operating system

OSI: open systems interconnection; a concept whereby different vendors’ products work together

OSPF: Open Shortest Path First Protocol

OS X

out queue (n.), **out-queue** (adj.)

OWL: Web Ontology Language

P

P2P: peer-to-peer

P3P: Platform for Privacy Preferences; a W3C standard

p: italicized; usually indicates probability

p: SI prefix for one trillionth or pico (3 ps)

p.: abbreviation for page when referred to in text; use pp. for multiple pages

* **Pa:** pascal (unit of measurement)

PABX: private automated branch exchange, a telephone system

packet: a packed block of data for data transmission

PAD: packet assembler/disassembler

PADL: Part and Assembly Description Language, developed at the University of Rochester

pairwise

PAL: phase alternating line—a European video standard; also the acronym for Paradox Application Language

Palm Pilot

PAN: personal area network

PAR: project authorization request

parameterization: not “parametrization.” To split this at the end of a line, note that “parameter” and like words are split after the *m*—for example: param-eter; but “parametric” is split before the *m*: para-metric. Automatic hyphenation programs tend to split “parameter” incorrectly.

PARC: Palo Alto Research Center

ParcTab: the first context-sensitive computer, developed at Xerox PARC. Note the capitalization.

parseable (alternate spelling: parsable)

PASC: Portable Applications Standards Committee

Pascal: a programming language (named for mathematician Blaise Pascal)

pascal: a unit of measurement. The abbreviation is Pa (no period).

parent: one of several family words used to describe relationships among nodes in databases. The terms are legitimate; don’t try to edit them out.

pass/fail

pathname

Pbps: petabits per second

p-channel (adj.)

* **PC:** personal computer; see also *IBM PC*

PC-DOS: IBM’s version of MS-DOS

PCB: printed circuit board. The plural form is PCBs.

* **PCI:** peripheral component interconnect

PCM: pulse-code modulation

PCMCIA: Personal Computer Memory Card International Assoc.

- * **PDA:** personal digital assistant
- * **PDF:** portable document format
- PDL:** page-description language
- PDP-11, PDP-11/03, PDP-11/70:** Digital Equipment Corporation computers
- percent:** Spell it out; don't use %. Don't use it without a number as a replacement for "percentage."
- * **Perl:** Practical Extraction and Report Language
- pervasive computing** (n.), **pervasive-computing** (adj.)
- PET:** positron emission tomography
- peta:** a thousand trillion (petaflops = a thousand teraflops)
- petabit**
- Petri net** (n.): a graphical model of information flow, showing static and dynamic properties of a system; named after Karl Petri, a German mathematician
- pF:** picofarad; a unit of capacitance equal to one-trillionth of a farad
- PhD:** no periods
- PHIGS:** Programmer's Hierarchical Interactive Graphics System, an ANSI and ISO standard
- photo-:** no hyphen when used as a modifier—for example, "photomultiplier"
- photomicrograph:** a magnified picture of small things. Don't confuse it with "microphotograph."
- * **PHP:** recursive acronym for Hypertext Preprocessor, a scripting language
- pico-** (prefix): one trillionth, no hyphen—for example, "pictogram" and "picosecond"
- Pict:** an image-file format (generally produced by Apple Macintosh programs); not the same as a .PIC graphics file, which is produced primarily by MS-DOS spreadsheet programs
- PID:** proportional, integral, derivative
- PIM:** peripheral interface module; Protocol-Independent Multicast (SM = Sparse Mode; SSM = Single-Source Multicast)
- * **PIN:** personal identification number. Don't use "PIN number."
- pinout**
- Pisces:** parallel implementation of scientific computing environments
- Pittsburgh Supercomputing Center:** one of the four US national supercomputer centers funded by the National Science Foundation
- pixel** (n.): Derived from "pix" (short for "picture") and "element," it's the smallest resolvable dot in an image display.
- PKI:** public-key infrastructure
- PL/I:** a programming language developed by IBM (roman "I" per textbook by developer)
- PLA:** programmable logic array
- plaintext:** the intelligible form of an encrypted text—for example, "Plaintext contains routing information." Use "plain text" when referring to unencrypted text—for example, "User entries are in italics; the computer's response is in plain text."
- PlayStation**
- plug-in** (n., adj.)

plurals: The general rule is to add an “s”—for example, 1980s (year), 40s (temperature), HP-1000s (name), and Apple IIs (name). See *CMS* 7.14 and 9.54.

* **p.m.:** post meridiem, meaning “after noon” (also includes 12:00 noon); see also *a.m.*

PMU: processor management unit

PMOS: p-channel metal-oxide semiconductor

PNG: portable network graphics

PnP: plug and play

PO: post office. In addresses, use no periods—for example, “PO Box 33.”

PocketPC: brand name; **pocket PC:** generic term

podcast

policymaker

* **POP3:** Post Office Protocol, version 3

popup

Posix: The IEEE standard for a portable operating systems interface. The initial standard deals with portability standards for C programs on computers running Unix.

post-: no hyphen unless the root is based on a proper noun—for example, “postprocessing” and “post-Victorian”)

postmortem

PostScript: a graphics- and font-description language from Adobe Systems, used primarily in desktop publishing

power down (v.)

PowerPC

pp.: the abbreviation for multiple pages. Single-page references are denoted by p.

PPP: Point-to-Point Protocol

pre-: no hyphen unless the root is based on a proper noun—for example, “preeminent” and “pre-Columbian”)

prefixes: see *CMS* 7.85, Table 4

Prentice Hall

prepositions in titles: See the “Capitalization” section.

president: Capitalize this only when it refers to the president of a country and comes before that person’s name—for example, “President George Washington” and “George Washington, first president of the United States.”

prettyprinting: the process of reformatting source code so that it has a consistent layout

price/performance ratio: written with a slash (“/”), not a hyphen

printed circuit board: the board on which most components are connected by printed circuitry. **PCB** or **PCBs** is acceptable on second reference.

printout

Prism: parallel reduced-instruction-set multiprocessing (Apollo architecture)

programs and tokens: See the “Program Code” section.

Prolog: a logic programming language

PROM: programmable read-only memory

pronouns: Instead of “he” or “she,” try to use a gender-neutral alternative—for example, a plural pronoun (and verb), “he or she,” or “the user.”

ps: picosecond

PS/2: Personal System/2, an IBM PC family based on Intel 80286/80386 processors. Unlike the IBM PC AT, it has a proprietary Micro Channel bus; it can run OS/2 or MS-DOS.

PSB: parallel system bus

pseudo- (prefix): no hyphen when used to form a compound—for example, “pseudorandom.” Word processors might hyphenate after “pseu,” but be careful to hyphenate after “pseudo.”

PSN: packet-switch node

PSP: Personal Software Process or PlayStation Portable

PSTN: public switched telephone network

***p* test**

pulsewidth: not the same as pulse duration

PUMA: programmable universal mechanical assembly

***p* value**

PWB: printed wiring board

Q

Q-bus: from Digital Equipment Corp.

QCD: quantum chromodynamics

QED: quantum electrodynamics; also *quod erat demonstrandum*, “which was to be demonstrated,” commonly used at the end of mathematical proofs.

QoS: (n.) quality of service; (adj.) quality-of-service

* **QR code** (n.) quick response code

quadword: a 48-bit or 32-bit piece of data

quasi, quasi-: This is hyphenated for adjectives—for example, “quasi-parenthetical.” It’s open for nouns, except for some established closed compounds—for example, “quasi system” and “quasiparticle.”

Quel: a relational calculus language

quicksort routine: memory sorting

QuickTime: the Macintosh movie/animation application

quotation marks: Use them around direct quotations, chapter titles, episode titles, words when referred to as words, and letters when referred to as letters. In an article that begins with a quotation, don’t use an opening quotation mark with the initial drop cap (an oversized, boldface capital at the beginning of a paragraph), but close the quotation with a quotation mark. Block quotations don’t take quotation marks. For more information, see *CMS* 13.20-13.22 and 13.37-13.41.

QVGA: quarter VGA

qwerty: the standard typewriter or computer keyboard, with the letters *q, w, e, r, t,* and *y* at the upper left; no initial capital

R

R8000: a 64-bit RISC microprocessor introduced in 1994 by MIPS Technologies Inc. It was formerly code-named TFP. Other processors made by MIPS include the R4400 and R4600.

rackmount (adj.): computer equipment that's standardized to 19 inches in width

* **RAID**: redundant array of independent disks (originally "inexpensive" disks)

* **RAM**: random-access memory

RAND Corp.: the official format for the name of the nonprofit research corporation. In *IEEE Security & Privacy*, use "Rand Corporation" in affiliations and bios.

* **R&D**: research and development

raster (n.): the scan lines that form the graphic output on a computer display; also referred to as bitmap

raster-op: raster operation

ray tracer (n.): an algorithm for drawing computer-generated shaded or highlighted images (also, a ray-tracing algorithm)

RC: resistance-capacitance

RCS: radar cross-section

RDBMS, RDBMSs (pl.): relational database management system

RDF: Resource Description Framework

RDFS: RDF Schema

re-: no hyphenation in most cases. See *Webster's* for individual examples; watch the context for words such as resign (to quit a job) or re-sign (to sign again).

readback: a way to ensure the accuracy of output by comparing the transmitted data with the original data

readout (n.): a visual display of data stored electronically; **read out** (v.)

read/write

RealNetworks

real time (n.), **real-time** (adj.): the actual time during which something takes place

reengineer: to examine and alter a subject system to reconstitute it into a new form and to subsequently implement the new form; contrast with "reverse engineering"

registered trademark (®): See *trademark*.

register-transfer (adj.): for example, "register-transfer level"

relational database: a database with data organized into tables

REST: Representational State Transfer, an XML protocol

reverse engineering (n.), **reverse-engineering** (adj.), **reverse-engineer** (v.): to deduce the plans of something already built as opposed to reengineering an entity

Rexx: IBM's Restructured Extended Executor

* **RF**: radio frequency

* **RFC**: request for comments

* **RFID**: radio frequency identification

- RFP:** request for proposal. Spell this out on first use.
- RGB:** red, green, blue; an additive color model used in TV and raster displays
- RISC:** reduced-instruction-set computing or computer
- RMI:** remote method invocation. See *Java RMI*.
- road map**
- ROI:** return on investment
- rollout** (n.), **roll out** (v.)
- * **ROM:** read-only memory (nonerasable)
- roman:** a type style that isn't italic or boldface; no initial capital when referring to the type style
- round-off error**
- royalty-free images**
- * **RPC:** Remote Procedure Call; a protocol
- RPF:** reverse path forwarding
- rpm:** revolutions per minute
- RS-232, RS-232C:** hardware interface protocols
- RS/6000:** RISC System/6000, a workstation from IBM. It comes in a variety of models, such as the IBM RS/6000 Model 350.
- RSCS:** Remote Spooling and Communications Subsystem, the spooling protocol used in Vnet and Bitnet
- * **RSS:** Really Simple Syndication, Rich Site Summary, or RDF Site Summary—a method of describing Web content that's available for distribution or syndication from an online publisher to Web users
- RSVP:** Resource Reservation Protocol
- RT:** register transfer
- RT-11:** the operating system for Digital Equipment Corp. PDP-11 computers
- RTCP:** Real-Time Control Protocol
- RTL:** register transfer level or Register Transfer Language
- RTP:** Real-Time Transfer Protocol
- RTSP:** Real-Time Streaming Protocol
- RTTP:** Real-Time Transport Protocol; also seen as **RTP**
- rubberbanding:** a computer graphics technique that lets lines in an image be stretched and moved as if elastic
- rule set**
- runtime** (n., adj.)

S

- * **s**: SI abbreviation for second—for example, 30 s and 30 ns. See *sec*.
- S.**: “south” in addresses
- SaaS**: software as a service. It takes “a” when used as an adjective.
- SAE**: Society of Automotive Engineers
- safety**: In some computing contexts, this is a technical term meaning the quality of making sure that nothing bad happens. Safety, for example, ensures that a calculation is performed but not that the calculation’s results are actually returned to a user or program module. Don’t use this term without an explanation; compare with *liveness*.
- SAML**: Security Assertion Markup Language; an OASIS standard
- SAN**: storage area network; system area network
- SATAN**: Security Administrator Tool for Analyzing Networks. Don’t lowercase the acronym.
- SAX**: Simple API for XML
- scalable**
- ScaLapack**: a benchmarking package. See also *Lapack*.
- scan-in; scan-out** (n.)
- scan line** (n.): one of the lines that make up a graphics display
- scatterplot**
- Scene**: Scientific Computation Environment for Numerical Experimentation; a scientific visualization environment developed at Rutgers
- schema**: a term used in artificial intelligence and in modeling to represent an approach, scheme, or relation precisely and usually diagrammatically. Ensure that the generic “scheme” is inappropriate before using “schema.” The plural is “schemas,” not the Greek *schemata*.
- Scheme**: an artificial intelligence language
- Schrödinger equation**: Spell this with an umlaut, not oe.
- SCI**: scalable coherent interface
- scratchpad**: a fast auxiliary computer memory, usually used for temporary data storage
- screen dump** (n.), **screenshot** (n.), **screensaver** (n.)
- scroll bar** (n.)
- Scrum**: a framework for software development
- SCSI**: Small Computer System Interface. It’s pronounced “skuzzy” and takes “a” as its article.
- SDI**: serial digital interface
- SDK**: software developer’s kit
- SDRAM**: synchronous DRAM (dynamic random access memory)
- SE**: “southeast” in addresses
- SEBoK Guide**: This is the preferred abbreviated form when referring to the *Systems Engineering Body of Knowledge*. Don’t confuse this with the *SWEBOK Guide*.

sec.: nontechnical abbreviation for second. Use “s” unless confusion could result.

second sourcing (n.): in manufacturing, the practice of using an alternate company to produce something that the original manufacturer designed and produces itself—for example, when the original manufacturer can’t make enough to meet demand

SEI: Software Engineering Institute, a US Defense Dept. research arm (managed by the US Navy) based at Carnegie Mellon University. In *IEEE Software*, SEI doesn’t need CMU with it.

Semantic Web: an extension of the current Web using standards such as RDF along with ontologies and other mechanisms to define meaning for abstract data to facilitate machine–machine communication

semi (prefix): Don’t hyphenate this.

Senior Fellow, Senior Member

September 11, 2001 (9/11)

Serial ATA

Series 1000: but “the 1000 series”

servocontroller: “Servo” by itself isn’t sufficient.

servomechanism: an automatic feedback system that monitors an operation and makes necessary adjustments. “Servo” by itself isn’t sufficient.

set-top box: an interactive television device that sits on top of the television

setup (n.), **set up** (v.)

SGI: formerly Silicon Graphics Inc.

SGML: Standard Generalized Markup Language

SGMP: Simple Gateway-Monitoring Protocol

shar: shell archive; a file combination protocol

shrink-wrapped

SI: an acronym for the French version of International System of Units, a scientific method of expressing the magnitude or quantity of seven specific natural phenomena

SIA: Semiconductor Industry Association

SIAM: Society for Industrial and Applied Mathematics

SID: Society for Information Display

SIG: special-interest group. See *ACM*.

Siggraph; Sigmod

Sigma: a project to develop a software development workstation environment, staffed by a consortium of companies working under the direction of Japan’s Ministry of International Trade and Industry (MITI) through the Information-Processing Technology Agency (IPA)

signs: See the “Numbers and Symbols” section.

SIIA: Software Information Industry Assoc.

Sim: a benchmark

SIMD: single instruction, multiple data—the simplest form of parallel architecture. It’s pronounced “sim-dee” and takes “a” as its article. Spell it out on first use if necessary for contextual clarity. Use hyphens when it’s written out and used as a modifier.

* **SIMM:** single, in-line memory module

Simox: separation by implanted oxygen

single-sign-on

single-stuck-at fault model: See *stuck-at*.

the singularity: Note the lowercase *s*.

SIP: Session Initiation Protocol

SITA: Société Internationale de Télécommunications Aéronautiques

sizeable: *Webster's* also uses “sizable.”

SkinnyDIP: a trademark name for thin-packaged DIP chips. DIP stands for “dual in-line package.”

Slim: Software Life-Cycle Management, a project-estimation system developed by Lawrence Putnam

SLOC: source lines of code. Don't spell this out in *IEEE Software*.

SLP: Service Location Protocol

small-scale (adj.)

smart card (n.)

smart home (n.), **smart-home** (adj.)

smartphone (n.)

SMD: surface-mount device

SME: Society of Manufacturing Engineers; small and medium enterprise

SMEs: small and medium enterprises

SMIL: Synchronized Multimedia Integration Language. Use “a” before the acronym. It's pronounced “smile.”

S/MIME: secure MIME

SMS: short message service

SMT: surface-mount technology

SMTP: Simple Mail-Transfer Protocol

SNAP: scalable networks and platforms; a phrase coined by Gordon Bell and Jim Gray at the University of California, Berkeley

SNMP: Simple Network-Management Protocol

SNR: signal-to-noise ratio

SOA: service-oriented architecture. It's pronounced “soh-uh,” as in “a SOA.”

* **SOAP:** a Web services messaging protocol. Originally the acronym for Simple Object Access Protocol, the term is no longer defined in common use.

SOC: service-oriented computing; service-oriented collaboration

SoC: system-on-chip (adj.); system on chip (n.); systems on chip (n. pl.). The abbreviated plural noun form is SoCs.

social media (n., adj.)

social network

soft copy (n.), **soft-copy** (adj.)

software engineering (n., adj.)

software-hardware development (n.)

Softwire

soho: small office/home office

SOJ: small-outline, J-lead

solid modeling (n.), **solid-modeling** (adj.).

son: one of several family words used to describe relationships among nodes in databases. The term is legitimate; don't edit it out.

Sonet: Synchronous Optical Network; a Bellcore standard

Sony PlayStation

source code (n., adj.): no hyphen

SPA: Software Publishers Association, now part of SIIA (see the related entry); also "scratchpad area" (from IEEE)

spam: junk email

Sparc: Sun Microsystems' scalable processor architecture; a RISC-based CPU used primarily in engineering workstations

Sparcstation: Examples are Sparcstation IPX and Sparcstation 2.

SPC: Software Productivity Consortium, a research group

SPEC: Standard Performance Evaluation Corporation (formerly System Performance Evaluation Cooperative); a vendor-sponsored source of the SPEC benchmarks. Examples are the SPECint92 and SPECfp92.

Speedup (n.)

Spice: a simulation program with integrated circuit emphasis

- * **SPIE:** Society of Photo-Optical Instrumentation Engineers. The organization now styles itself "the international society for optical engineering."

Spreadsheet (n.)

Springer: a book publisher. Use this in all references (instead of Springer-Verlag, for example).

- * **sq ft:** square foot

- * **SQL:** Structured Query Language

squash-and-stretch (n.): a function that enlarges and reduces, not necessarily in proportion to all dimensions; also called *rubberbanding*

SRAM: static RAM. Takes "an" when used as an adjective.

SRI: Stanford Research Institute

SSH: Secure Shell or Secure Socket Shell; a security protocol

SSI: small-scale integration, typically from one to four circuits

- * **SSL:** Secure Sockets Layer; a security protocol

stand-alone (adj.)

Staran

Stars: Software Technology for Adaptable, Reliable Systems; a US Defense Dept. project

Star Tap

StartTLS

start-up (n., adj.)

statechart: not state chart or state-chart

state of the art (n.), **state-of-the-art** (adj.): represents the highest level of available technology (as compared with "state of the practice," which is the highest level in general use). It's an overworked phrase; consider substituting "current technology."

state-transition (adj.)

stereo pair (n.): two pictures that produce a 3D image

stuck-at (adj.), **stuck-at fault** (n.): a type of circuit defect in which a gate can be stuck at either 1 or 0—for example, “stuck-at-1 fault” or “stuck-at-0 fault”; can also be abbreviated as SA1 and SA0

stuck-open fault (n.): not synonymous with *stuck-at fault*

stylesheet (n., adj.)

Styrofoam: use “foam” or “plastic foam” when referring to generic consumer or packaging products. Capitalize this term when it’s used as a trademark.

subsystem (n.)

Sun OS: Sun Microsystems’ version of the Unix operating system

SunSoft: a division of Sun Microsystems that provides system software

Sun workstation: initial capital on “Sun”; from Sun Microsystems

Sunmos: a Sandia / University of New Mexico operating system; an operating system for the Intel Paragon parallel supercomputer

super: no hyphen when used to form a compound word—for example, supercomputer

supercomputer (n.): There’s no fixed processing speed definition for a supercomputer; it changes with advances in technology.

supermini: short for superminicomputer, which is the preferred usage

surface: Don’t use this as a transitive verb in the sense of “bringing to the top.” A whale surfaces, but a speaker doesn’t surface an idea. If you must give buoyancy to ideas, “float” them. However, “surface” can be used as a transitive verb in the sense of “refining or smoothing a physical surface,” as in “surfacing lumber.”

surface-mount device, surface-mount technology: a board manufacturing method in which chips are “glued” to boards

SW: “southwest” in addresses

SWEBOK Guide: The preferred abbreviated format to use when referring to the *Guide to the Software Engineering Body of Knowledge*.

SWIG: simplified wrapper and interface generator

system on chip (n.); **system-on-chip** (adj.); **systems on chip** (n. pl.): The abbreviations are SoC (sing.) and SoCs (pl.).

systemwide

T

- * **2D**: two-dimensional, no hyphen
- * **3D**: three-dimensional, no hyphen
- 3DES**: (say “triple DES”)
- T1**: digital transmission at 1.544 Mbits per second; T3 is a faster line
- tape out**
- tar**: tape archive; file combination protocol
- task ID**: Use the one-word form, taskid, only in program statements.
- task type**: Use the one-word form, tasktype, only in program statements.
- * **Tbyte**: terabyte; one billion bytes
- TC**: technical committee. Spell this out on first use.
- Tcl/Tk**: a computer language developed by John Ousterhout of UC Berkeley. The elements can also be separate—Tcl and Tk.
- * **TCP**: Transmission Control Protocol
- TCPA**: Microsoft’s Trusted Computing Platform Architecture, formerly called Palladium
- * **TCP/IP**
- TDM**: time-division multiplexing
- TDMA**: time division multiple access
- telephone numbers**: See the “Numbers and Symbols” section and *CMS* 6.77.
- teletext**: a noninteractive (broadcast) text and graphics communications system
- Teletype**: use only when describing Teletype Corp. equipment. The generic word is *teletypewriter*.
- teletypewriter**: See above; abbreviated TTY.
- television**: okay to abbreviate as TV
- telex**: the acronym for teletype exchange, a service that permits the transmission of data using commercial telecommunication facilities comprising a network of teletypewriters
- Tell-A-Graf**: graphics software by Computer Associates International
- Telenet** (n.): Terminal Emulation Protocol; US Sprint’s switching network originally developed for Arpanet
- testbed** (n.): an environment containing all the components necessary for testing a system
- tests** (statistical): F-test; *t*-test, chi-square test; *p* value; Wilcoxon rank sum test
- TeX**: see *LaTeX*; pronounced “tech”
- Tflops**: teraflops; one billion flops
- TFT**: thin-film transistor
- the**: Normally, when referring to the name of an academic institution or corporate entity that starts with “the” (such as “the University of Texas”), lowercase or delete “the.” Delete “the” in a byline (except for “The Ohio State University” and “The Hong Kong University of Science and Technology”).
- ThinDIP**: a trademark name for thin-packaged DIP chips; “DIP” stands for dual in-line package

Thomas J. Watson Research Center, T.J. Watson Research Center: an IBM facility; refer to as the “IBM T.J. Watson Research Center” on first use

Thomas J. Watson: When referring to the persons, distinguish between Jr. and Sr.

three-space, three-dimensional space: a mathematical term; also 3-space. It can be written as S^3 or R^3 .

throughput

tif: an electronic file format

* **TIFF:** tagged image-file format; graphics-file format. Even though the filename extension is .tif, the acronym is TIFF.

tiling: a nonoverlapping approach to window management

time-consuming

time frame

time line: a description of events during a particular historical period; **timeline:** a schedule of events or procedures

time-multiplexed (adj.)

time-out (n.), **time out** (v.)

times: When indicating the use of “times” with a number, use a multiplication sign instead of x—for example, 2× speedup. However, you may use “times” when it seems appropriate—for example, “The new version has 10 times the memory.”

time-shared (adj.)

time-sharing (n.): simultaneous use of a central computer by many users at remote locations

time sheet (n.)

time stamp (n.)

time step (n.), **time-step** (adj.)

time to market

TI OMAP: Texas Instruments Open Multimedia Applications Platform

TIP: terminal interface processor

TLB: translation look-aside buffer

TLS: Transport Layer Security

TMS32010, TMS34010: processors from Texas Instruments; no space between the letters and numbers

toolbox (n.), **toolkit** (n.), **toolset** (n.): one word when used in computer contexts

tonnes: Use “metric tons” instead.

TOP: Technical Office Protocol. See *MAP/TOP*.

top-down design

touch pad (n.): a touch-sensitive user interface

touchscreen (n.): a touch-sensitive user interface

TP0-TP4: Transport Protocol Class 0 to 4; a set of transmission protocols in the ISO protocol suite

traceable; traceback; traceroute

trackball (n.)

trademark: The registered-trademark (®) symbol indicates that the trademark is registered in the US Patent and Trademark Office; (™) indicates that it's pending. Avoid using trademark symbols in text. However, oblige an author who owns a trademark and insists on its use. In this case, use the company's name before the product on first reference to establish ownership—for example, Sun's Sbus. Thereafter, use the product name by itself.

tradeoff (n.); **trade off** (v.)

transition: Don't use this as a verb.

transputer (n.) (*transister computer*): a microprocessor with local memory and communication links. It's both an Inmos product and a generic term.

troff: text run-off; a Unix text-format front-end (coding) and output (printing) processor. It's pronounced "tee-roff." Variations include nroff and ditroff (device-independent troff)

Trojan horse

TRON: The Real-Time Operating-System Nucleus; a Japanese computer project to develop hardware and software technology to run household systems that are independent but communicate with each other for smart homes and the like. Modules include MTRON, BTRON, ITRON, CTRON, and ITRON.

TSR: terminate-and-stay-resident

TTL: transistor-transistor logic

TTS (adj.): text-to-speech

t-test: a statistical test that deals with the problems associated with inference based on small samples

-tuple: a suffix for a set of <<so many>> elements

turnaround

turnkey (adj.): describes a system delivered ready to run without adding any hardware or software; a synonym for "off the shelf"

* **TU Wien**

* **TV:** the abbreviation for television

TWAIN: technology without an interesting name; a programming interface that lets a graphics application activate a scanner or other image-capturing device

U

UBE: unsolicited bulk e-mail

ubicomput: abbreviation for ubiquitous computing

ubiquitous computing (n.), **ubiquitous-computing** (adj.)

UCE: unsolicited commercial email

UCS: universal character set

* **UDDI:** universal description, discovery, and integration

UDP: User Datagram Protocol

UHD: ultra-high-definition

UI: unit interval; a measure of time

UIMS: user-interface management system; **UIMs** (pl.)

UIP: user-interface presentation

UIST: user-interface software and technology

UK: United Kingdom (no periods), comprising England, Scotland, Northern Ireland, and Wales; not synonymous with Britain. Don't use UK if the country name is sufficient.

ULSI: ultralarge-scale integration; can be used as a stand-alone noun when referring to the concept but not to physical objects—for example, “ULSI circuit” or “ULSI chip”

Ultracomputer: IBM and New York University's supercomputer

ultra-high-definition (adj.): The abbreviation is UHD.

Ultraneet

ultrawideband (adj.): See also *UWB*.

UML: Unified Modeling Language. Don't spell this out in *IEEE Software*.

UMTS: Universal Mobile Telecommunications System

UN: United Nations (no periods)

underway (adv.), **under way** (adj.)

Uni (prefix): not hyphenated—for example, uniprocessor

unicode

UniForum

Univac: Universal Automatic Computer

University X at Y, or University X, Y, or University X–Y: Follow the specific institution's usage. Although some universities capitalize “the” and consider it part of their name, Computer Society style either deletes or lowercases the word when the name appears in regular text. So, it's “the Ohio State University” (not “The Ohio State University”) and “the University of Kansas” (not “The University of Kansas”). Also delete “the” in a byline (except for “The Ohio State University” and “The Hong Kong University of Science and Technology”). It's “the University of California at Santa Barbara,” but all other UC campuses use this format: University of California, Berkeley.

Unix: a multilanguage operating system developed at AT&T Bell Laboratories. Various versions exist.

upgradable

- UPnP**: universal plug and play
- uppercase**
- * **URI**: uniform resource identifier
 - * **URL**: uniform resource locator
 - URN**: uniform resource name
 - * **US** (n., adj.): United States; no periods
 - US\$**: Don't place "US" in front of the dollar sign except to avoid confusion.
 - * **USB**: Universal Serial Bus
 - USENIX**
 - user-friendly** (adj.): frequently overused; avoid unless appropriate to the context
 - username**
 - USRA**: Universities Space Research Association
 - UTF-8**: Unicode Transformation Format-8
 - UUCPnet**: Unix-to-Unix copy network
 - * **UV**: ultraviolet
 - UWB**: ultrawideband, a wireless communication technology



- * **V**: volts—for example, 45 V (n.) and 45-V (adj.) power supply
- v.**: the abbreviation for “versus” in a legal context—for example, Smith v. Jones. See also *vs.*
- Vac**: volts of alternating current—for example, 25 Vac.
- validation**: testing a product or product specification to ensure that it meets the requirements (that it has the specified functions); compare with *verification*
- Vanet**: vehicular ad hoc network
- VAR**: value-added reseller
- variable-length field**
- VAX**: a mainframe made by Digital Equipment Corp. The plural is VAXs; “VAX” reportedly comes from “virtual address extension” (to the PDP-11)
- VAX 11/725, 11/730, 11/750, 11/780, 11/782, 11/785, 8600**: Note the slash, not a hyphen.
- VAX/VMS**: an operating system for VAX computers. VMS stands for VAX Management System.
- VCCS**: voltage-controlled current source
- * **VCR**: videocassette recorder
- Vdc**: volts of direct current—for example, 25 Vdc
- VDI**: video display terminal; a generic term; not interchangeable with *CRT*
- verification**: determining whether a product meets its requirements (whether it does what it’s supposed to); compare with *validation*
- Versabus**
- VersaDOS**
- version**: Capitalize it only when it’s used with the name of a product—for example, Microsoft Word Version 6.0. An acceptable informal abbreviation (except at the beginning of a sentence) is *v*, closed up next to a number—for example, Macsyma v2.0. The word “version” or its abbreviation isn’t always necessary—for example, “Word 6.0 is a major release.”
- versus**: see *v.* and *vs.*
- vertices**: the plural of vertex
- * **VGA**: video graphics adapter (or array); an IBM color-display standard allowing 256 colors
- VHDL**: very high density logic; also VHSIC Hardware Description Language.
- VHSIC**: very high speed integrated circuit
- via**: Use this word sparingly (It means “by way of,” “through the medium or agency of,” or “by means of.”) Often, “through” works just as well and sounds less formal.
- VIC**: video interface chip
- vice president**: see *CMS 8.21*; capitalize when referring to the Vice President of the United States
- videocassette, videocassette recorder**
- videoconference, videoconferencing**

videodisk; video game

video on demand (n.), **video-on-demand** (adj.), **VoD** (abbrev.)

videotape (n., v.)

videotex: an interactive text and graphics communications system; also called “viewdata”

video over IP

viewport

virtual memory

virtual reality (n.), **virtual-reality** (adj.): The abbreviation is VR.

VisiCalc: a financial spreadsheet program from now-defunct Software Arts Products

* **VLSI**: very large-scale integration. VLSI can be used as a stand-alone noun when referring to the concept but not to physical objects—for example VLSI circuit or VLSI chip. VLSI also is acceptable for VLSI Technology Inc.

VM: virtual machine; also JVM or Java virtual machine

VMEbus

VMS: VAX Management System, an operating system for DEC VAX computers

Vnet: an IBM internal network

VoD (n.): video on demand

voice over IP (n.), **voice-over-IP** (adj.), **VoIP** (abbrev.)

von Neumann (adj.): refers to the concept of storing data and the instructions that apply to that data together; the stored-program concept (for example, “von Neumann sort” or “non–von Neumann architecture”). Note that the second example takes an en dash, not a hyphen.

voxel: loosely speaking, a 3D pixel

VPE: visual programming environment

VPL: visual programming language

VPN: virtual private network

VRAM: video random-access memory

Vrije Universiteit, Amsterdam: Free University, Amsterdam. The commonly used acronym (VU University Amsterdam) doesn’t work—it’s redundant.

VRML: Virtual Reality Modeling Language

vs.: the normal abbreviation for versus, except in a legal context (see *v.*). Spell it out in text; the abbreviation is acceptable elsewhere.

VT52, VT100, VT101, VT102, VT131, VT220: Digital Equipment Corp. video display terminals



- * **W**: watts—for example, 25-W dissipation
- W.**: “west” in addresses
- * **W3C**: World Wide Web Consortium
- wafer-scale integration**
- WAN**: wide area network. Don’t spell this out in *IEEE Software* or *IEEE Security & Privacy*.
- WAP**: Wireless Application Protocol
- Washington, DC**
- watts**
- waveform**
- wave front**
- wave function**
- WCGA**: World Computer Graphics Association
- WDM**: wavelength-division multiplexing
- WDP**: World Data Processing
- Web**: the short name for the World Wide Web. Net is the short name for the Internet.
- Web browser, Web services**
- webcam, webcast, weblog, webmaster, webpage, webserver, website**
- well**: a well-defined concept; the concept is well defined. (Don’t hyphenate “well” words following being verbs.)
- WG**: see *working group*
- Whetstone**: benchmarks
- whiteboard**
- white list, white pages**
- wide** (*suffix*): see *CMS 7.85*, Table 3
- wideband** (adj.)
- Wi-Fi**: wireless products certified by the Wi-Alliance to be interoperable
- Wii Remote**
- wiki**: computer software for creating, editing, and linking webpages
- Wikipedia**: a multilingual, Web-based encyclopedia project operated by the Wikimedia Foundation.
- wild cards**
- John Wiley & Sons**
- WiMax**
- WIMP**: windows, icons, menus, pointing devices
- Windows 95/98/NT/2000/Me**
- WinZip**: a file compression program
- wireframe** (adj.): refers to a line drawing of a 2D or 3D object (a wireframe image)

wire wrap (n.): a method of making an electrical connection in a circuit by wrapping wires around terminals

wire-wrapping (adj.): as in “wire-wrapping techniques”

WISC: writable-instruction-set computing

WLAN: wireless local area network

word: a sequence of bits that a processor can act on simultaneously. More bits per word let the processor work on more data simultaneously. A word can be defined in terms of bytes (a two-byte word equals a 16-bit word), but bits are the more common unit. See also *Mword* and *Kword*.

word-slice processor

workaround

working group: Use initial capitals if in a title—for example, “Working Group on Posix Definitions.” Lowercase the term if it’s generic.

workflow, workload, workplace, worksheet

workspace: the amount of memory a program requires, over and above the amount necessary to store the program itself

workstation

worldwide

World Wide Web: abbreviated WWW. See *Web* and *WWW*.

WORM: write-once, read-many (times)

WoZ

wrap-up (n.), **wrap up** (v.)

WSCl: Web service choreography interface

WSDL: Web Services Description Language; pronounced “whizdle”

WSN: wireless sensor network

WVGA: wide VGA

WWW: see *World Wide Web* and *Web*. Depending on the context, the abbreviated form is acceptable on first reference.

WYSIWYG: stands for “what you see is what you get.” The abbreviation is acceptable on first reference in departments, but spell it out on first reference in regular articles.



9/07 Xen: open source virtualization software

X.25: the network layer protocol in the ISO protocol suite

X.400: an ISO mail protocol

x-axis (n., adj.)

Xbox

X client (n.), **X-client** (adj.): See also *X Window System*.

XDR: External Data Representation; a protocol

Xenix: an operating system similar to Unix from Microsoft for PCs based on the Intel 8088, 80286, and 80386 chips

Xerox PARC: now just PARC

XGA: extended graphics array; a high-resolution graphics standard that IBM introduced in 1990

XLANG

XLink: XML Linking Language

XMI: XML Metadata Interchange

Xmodem: the abbreviation of cross-modem, an error-free file-transfer protocol

* **XML:** Extensible Markup Language

XMPP: Extensible Messaging and Presence Protocol

XMS: extended memory specification; used to address memory greater than 1 Mbyte in the 80286 and later CPUs

XMT: extensible MPEG-4 textual format

XNS: Xerox Network Services

XOR: the exclusive-OR operation used in cryptography

XPath: XML Path Language

XPointer: XML Pointer Language

x-ray (n., adj., v.)

XHTTP, XHTML, XML

XT: See *IBM PC*.

XScale: an Intel processor

X Window System, X Windows: a graphics environment from MIT for Unix workstations. No hyphens.

X11 Windows

xy-plane: also yz-plane and xz-plane

XSL: Extensible Style Sheet Language

XSLT: Extensible Style Sheet Language Transformation



* **y:** year (unit of measurement)

Y2K Problem: the crisis that didn't happen in 2000

YACC: a compiler compiler; a Unix tool

Yahoo

y-axis: (n., adj.)

years: to form the plural, add *s*—for example, 1990s. When referring to just the decade, spell it out—for example, nineties.

yellow pages

Ymodem: file transfer protocol

Z

Z80: a microprocessor from Zenith Data Systems

Z80-A

z-axis: (n., adj.)

z-buffer: storage for z-axis values for 3D images; sometimes called the “depth buffer”

Zadeh, Lotfi: a pioneer in fuzzy logic. Note the first name, which is often misspelled.

zero-day: refers to the timing of viruses released the same day as a patch. Don’t use “0-day.”

ZIP: zigzag in-line package; a file-compression technique; ZIP code

Zmodem: successor to Xmodem and Ymodem