

## An Introduction to modeling social systems with Netlogo

Laboratory for SocioHistorical Dynamics Simulation (LSDS-UAB)

Training Program - Module 1

Update: February 2012



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## Overview

- 1.1. Modeling methodology: physical, mathematical, and computational models
- 1.2. Agent Based Modeling (ABM): Overview, ABM & Social systems, ABM computer tools
- 1.3. *Netlogo*: download, installation, and first steps
- 1.4. *Netlogo tools*: library, dictionary and on-line resources

**Classroom activities:** Downloading, Installing and Sampling NetLogo Models Library: Segregation, Life, Recycling, others.

**Individual activities:** Netlogo testing: Models from NetLogo Library / Earth Science, and / Social Science.

**Reading:** MACY, Michael W. & WILLER, Robert (2002) "From Factors to Actors: Computational Sociology and Agent-Based Modeling", *Annual Review of Sociology*, 28: 143-166 (doi: 10.1146/annurev.soc.28.110601.141117).

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## What is "a model"?



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## What is "modelling"?

An abstraction from real word phenomena, with explanatory aims.

ABSTRACTION

EXPLANATORY

Why it is that way?

Why it changes?

How the whole process works?

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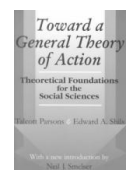
## Typology of models: Narrative

### Narrative Models:

Frequent in everyday life...



...and in Social Sciences and Humanities

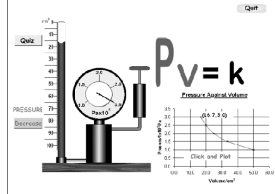


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## Typology of models: Formal / Mathematical

### Formal / Mathematical Models:

Frequent in Physics  
(e.g., Boyle's Law)...



...also present in Natural and Social Sciences

(e.g., Lotka-Volterra population growth)

$$\text{Growth rate for species 1} \\ \frac{dN_1}{dt} = r_1 N_1 \left( 1 - \frac{N_1}{K_1} - \frac{\alpha_{12} N_2}{K_1} \right)$$

$$\text{Growth rate for species 2} \\ \frac{dN_2}{dt} = r_2 N_2 \left( 1 - \frac{N_2}{K_2} - \frac{\alpha_{21} N_1}{K_2} \right)$$

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## Typology of models: Physical

### Physical Models:

Frequent in engineering research  
(e.g., testing "dummies", birth  
simulators)...



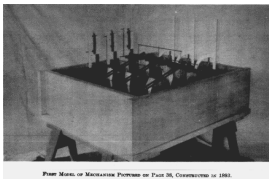
...also present in Social Sciences (e.g., Economy "water"  
simulators)

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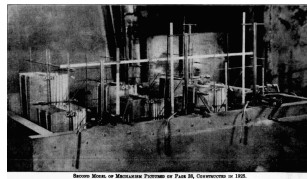
## Typology of models: Physical SS.CC.

### Physical Models in Social Sciences

Economy simulators constructed by Irving Fisher,  
Monetary flux == Water flux



1893

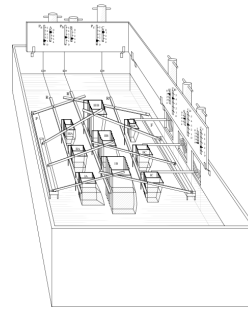


1925

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## Typology of models: Physical SS.CC.

Economy simulators (Irving Fisher, Bill Phillips)



1925



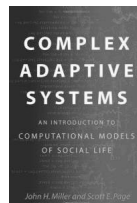
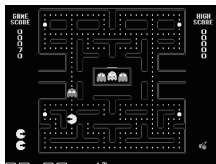
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## Typology of models: Computational

### Computational Models:

Frequent in Engineering, Art and Entertainment..

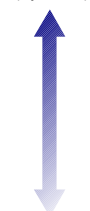


...also present in any other research domains.

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## Typology of models

(Symbolic)



(Material)

INFORMATIONAL MODELS


Narrative  
Formal  
Mathematical

COMPUTATIONAL MODELS


ENERGETIC MODELS

Physical

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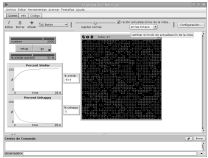


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## Computational Models

Informational + Energetic  
CODE + DYNAMICS





Rules + Interaction Outcomes  
Foundations + Emergence  
Model + Simulation

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## Computational Models: CODE

```


clear-all
set-default-shape 'turtle' 'person'

to setup
  clear-all
  if number > count patches
    [ user-message (word "This pond only has room for " count patches " turtles.")
    stop ]
  create-turtles number
  [ set color red ]
  [ turn 180 ]
  [ set color green ]
  [ set color green ]
  update-variables
  reset-ticks
end


to go
  if all? turtles (happy?) [ stop ]
  move-unhappy-turtles
  update-variables
  tick
end
  
```

The code of Th. Schelling's "Segregation" NetLogo Model

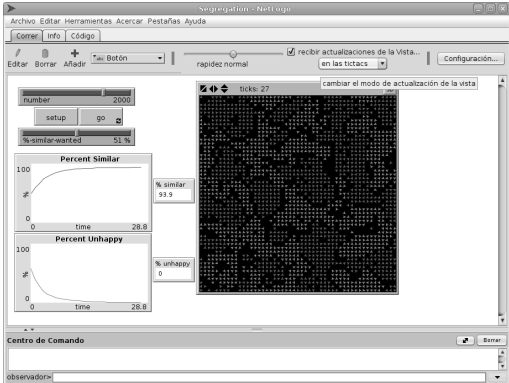
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## Computational Models: DYNAMICS




Execution (run) of Th. Schelling's "Segregation" NetLogo Model

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## Computational Models: DYNAMICS


A quick example of simulation run:

Schelling's "Segregation" NetLogo Model could be "played" online on your own browser, by accessing this URL:


<http://ccl.northwestern.edu/netlogo/models/Segregation>

- Wait until your web browser runs your JAVA machine (if the computer does not have Java Runtime, the simulation could not work)
- Wait until your web browser downloads the NetLogo model.
- Set the number of people, and the % of "homophily", or accept default values.
- Click on [ Setup ] button, to initialize the simulation (t=0)
- Click on [ Go ] button, to start the simulation.

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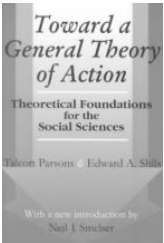
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## Why use "qualitative" models?

Narrative Models are:


- 1) Easy to understand (use to tell a story)
- 2) Difficult to probe or falsify
- 3) Words and relations not so precise (ambiguity):
  - Who much is "little"?
  - How can you measure "influence"?



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## Why use "quantitative" models?

Formal models are:

- 1) Difficult to understand (use formalisms)
- 2) Easy to probe or falsify
- 3) Terms and Connectors are precise (NO ambiguity)

**Growth rate for species 1**

$$\frac{dN_1}{dt} = r_1 N_1 \left( 1 - \frac{N_1}{K_1} - \frac{\alpha_{12} N_2}{K_1} \right)$$

**Growth rate for species 2**

$$\frac{dN_2}{dt} = r_2 N_2 \left( 1 - \frac{N_2}{K_2} - \frac{\alpha_{21} N_1}{K_2} \right)$$

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## Why use “computational” models?

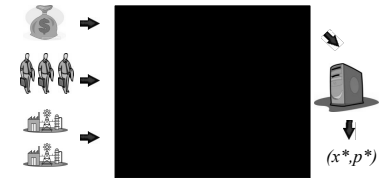
- 1) Easy to understand (use to generate a story, or many)
- 2) More or less easy to probe or falsify
- 3) Terms and Connectors are precise (*otherwise, simulation did NOT run*)
  - Display changes for one dimension / variable over time
  - Display changes for one dimension / variable in space (e.g., GIS and dynamic mapping)
    - => Some “simple” models, in equation system format, could be algebraically solved, BUT “extended” models are difficult to simulate without a lot of computability power.
  - Changes over time and space, in a number of variables...
    - => Almost impossible to display or compute as an equation or equation system.
    - => Can be displayed as outcome of algorithms recursively triggered

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## Computation versus Simulation

**Computation:** Find solutions to problems using computational techniques and / or algorithms for calculation of these solutions

- Black box
- The final result is important
- The interest is in efficiency, convergence, and the correct solution

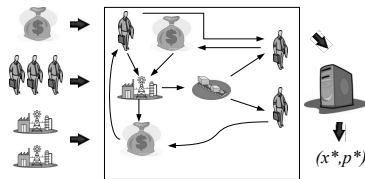


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## Computation versus Simulation

**Simulation:** To study the behavior of a system by means of computational techniques that simulate the behavior of its components.

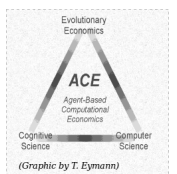
- Glass Box
- The whole process is important
- The interest lies in the complexity of the system, in the fitting of the simulations, in the regular patterns that appear



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## Computation Vs. Simulation: A.C.E. Case

- “Agent-Based Computational Economics” proposes a synthesis of Economic Analysis criticisms and a new method: computer simulation.
- ACE is a specialized application of “agent-based modelling” (*a type of modelling*).
- ACE is based on simulation of the economic behaviour for individual agents.
- ACE is based on a model of “man” with limited, or bounded, rationality (H. Simon, 1954).
- ACE is still a minority practice in Economics.
- ACE does not have to replace the standard economic analysis, but help to improve it and to complement it.



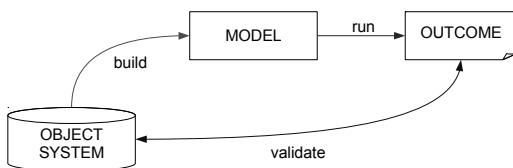
Leigh Tesfatsion

<<http://www2.econ.iastate.edu/tesfatsi/ace.htm>>

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## What can you do with models?

- Building a model == “Theorization”
- Running / Executing == “Observation”
- Validating a model == “Testing” / “Experimentation”
- Using a model == “Prediction” / “Problem solving”



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## Main uses of model simulation

(Gilbert & Troitzsch, 2006) Reordered by aim of control

- Tool (expert systems)
- Prediction (prospective scenarios)
- Understanding (of real world phenomena)
- Formalization (precision, coherence, and completeness in representation)
- Learning (flying simulators, ...)
- Discovering (unpredictable consequences of artificial systems)
- Entertainment (Games: SymCity, MUDs)

Gilbert, G. N. & Troitzsch, K. G. (2006). Simulación para las ciencias sociales: Una guía práctica para explorar cuestiones sociales mediante el uso de simulaciones informáticas. Madrid: McGraw Hill, 2ª ed.

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## Utility of models?

Entering a city you'd never been before... what's more useful for you?



A travel guide?



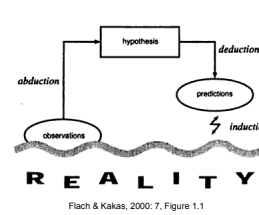
A city map?

- Both are "models" of the city.
- If you want to know WHAT place to visit...
- If you want to know HOW to reach THIS place...

It depends on the aims, objectives, context.

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## Simulation models in researching



Scientific research process	
GENERAL	SIMULATION
Observations	observational and/or theoretical expert knowledge
Abduction	specification / testing / validating / extending
Hypothesis	model (computer system)
Deduction	simulation runs (experimental initial conditions)
Predictions	output results data-sets
Induction	empirical checking

The aim of building simulations is to obtain the best model (*i.e.*, a *systematic set of explanatory hypothesis "in silico"*) out from observational or theoretical expert knowledge.

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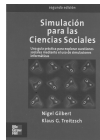
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## ABM, Where to start?

- A PAPER <[www.casos.cs.cmu.edu/education/phd/classpapers/Macy\\_Factors\\_2001.pdf](http://www.casos.cs.cmu.edu/education/phd/classpapers/Macy_Factors_2001.pdf)> An introduction to computational agent-based models of human social interaction as a theory-building strategy.
- A BOOK <<http://cress.soc.surrey.ac.uk/s4ss/>> Gilbert, N. & Troitzsch, K. (2005) *Simulation for the Social Scientist* (2nd edition)
- A JOURNAL <<http://jasss.soc.surrey.ac.uk/JASSS.html>> Journal of Artificial Societies and Social Simulation
- A LIST OF RESOURCES <<http://www.openabm.org/>> OpenABM Consortium (Includes a growing collection of tutorials on computational modeling, frequently asked questions about computational modeling, a modeling library intended to provide a locus for authors and modelers to share their models, and forums for modeling related discussion and job postings.)
- AN UPDATED BLOG <<http://www.agent-based-models.com/blog/>> (Aims to become an information hub for ABM, and also to promote discussion of the methodological and philosophical foundations of agent-based modeling. [University of California, Davis, Psychology])
- A FORMAL ASSOCIATION <<http://www.essa.eu.org/>> European Social Simulation Association (Promotes the development of social simulation research, education and application in Europe)



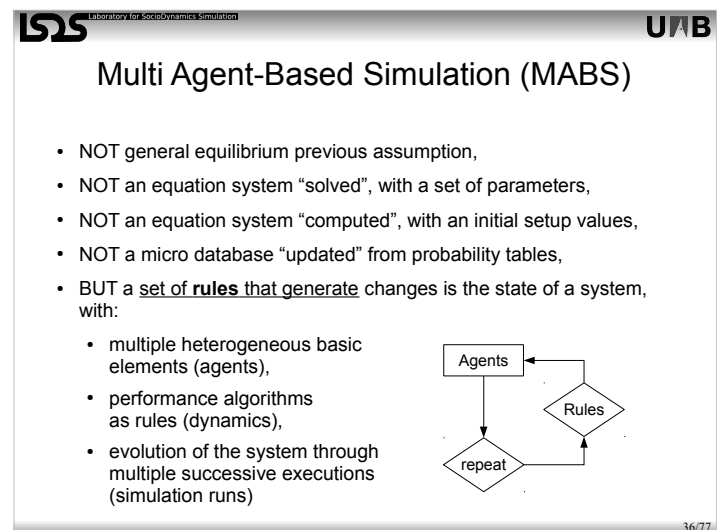
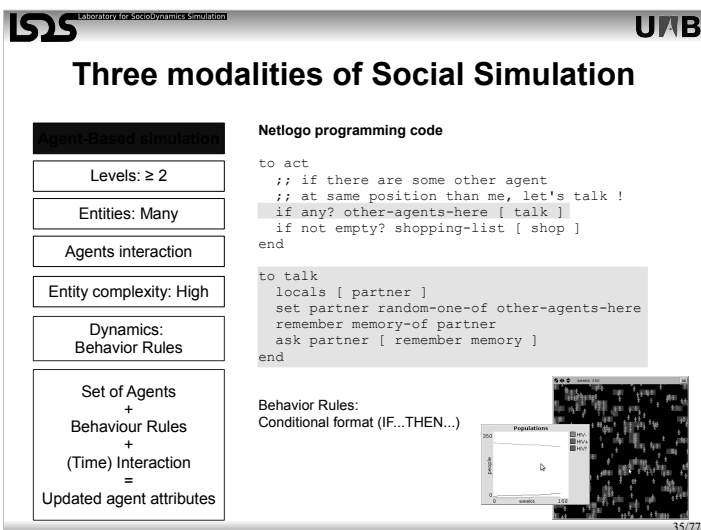
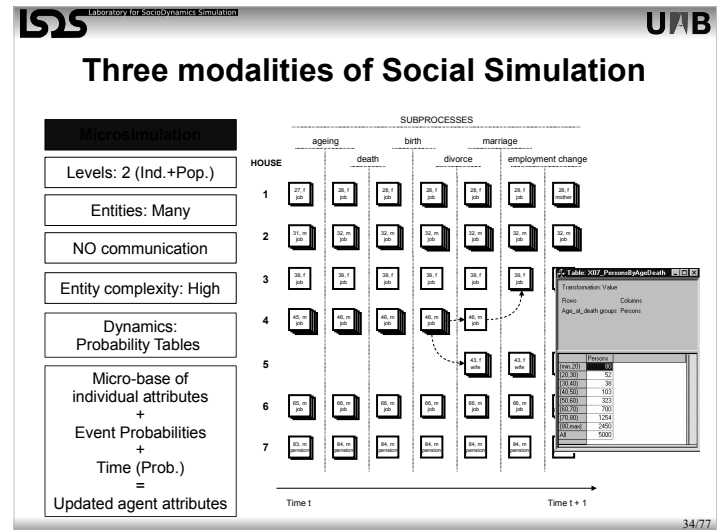
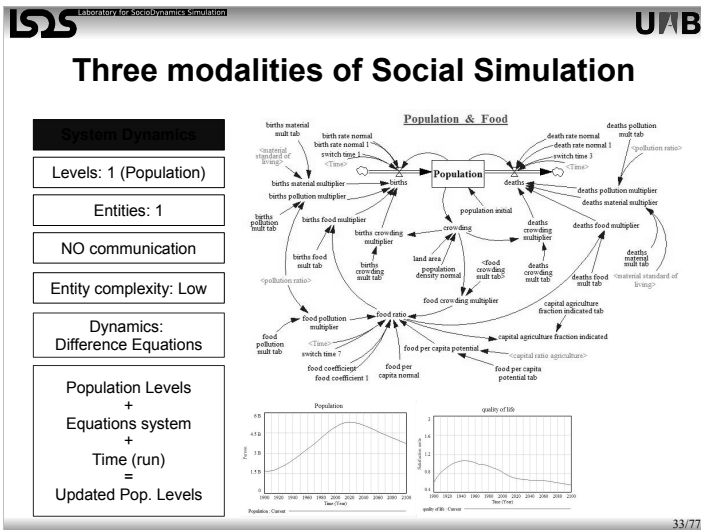
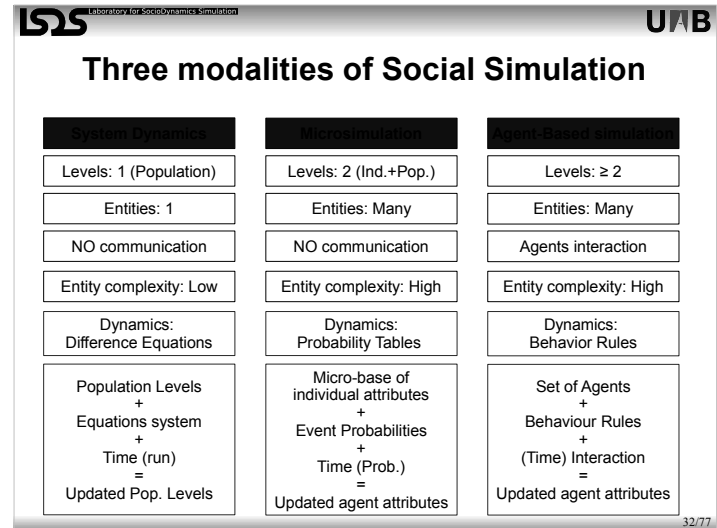
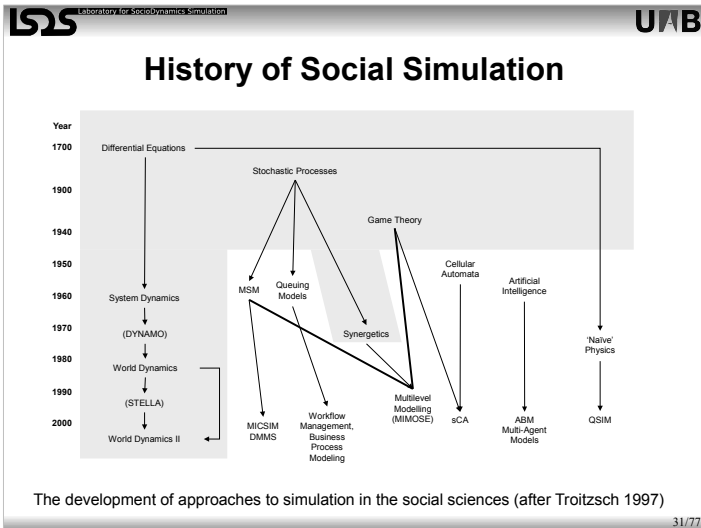
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## Modalities of Social Simulation

A comparison of social science simulation techniques (after Gilbert & Troitzsch, 2006)

	Number of levels	Communication between agents	Complexity of agents	Number of agents
System dynamics	1	No	Low	1
Microsimulation	2	No	High	Many
Queuing models	1	No	Low	Many
Multilevel simulation	>1	Maybe	Low	Many
Cellular automata	2	Yes	Low	Many
Multi-agent models	>1	Yes	High	Few
Learning models	>1	Maybe	High	Many

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## Complex adaptive systems (CAS)

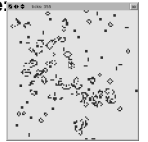
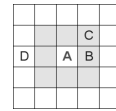
- **complexity:** Dynamic networks of interactions and relationships, not just aggregations of static entities. Emergent causation, decentralized system behaviour.
- **adaptation:** Individual and collective behaviour changes over time as a result of the system outcomes ("experience", "learning", ...).
- **massive:** Number of components so large that conventional descriptions (ex., a system of differential equations) are impractical and useless in understanding the system.
- **rich-interactivity:** Components do interact dynamically. Any element in the system is affected and affects several other systems (co-evolution). Interactions can involve both physical or informational exchange.
- **locality:** Interactions are primarily (not exclusively) with immediate neighbours, and components are ignorant of the behaviour of the system as a whole.
- **recurrence:** Interactions can feed back onto itself; directly or after a number of intervening stages, varying in quality.
- **non-linearity:** Small causes => large results (causal cascades, or butterfly effect), extended changes => no result (resilience).
- **sub-optimality:** Far from equilibrium conditions (need of a constant flow of energy to maintain the organization of the system).

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## A CAS example: Conway's Game of Life

<<http://ccl.northwestern.edu/netlogo/models/Life>>

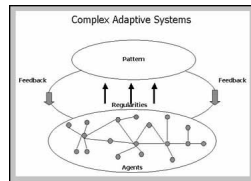
- The "world" is represented by a discrete 2D space, an orthogonal lettuce of "cells".
- Each cell can be in one of two states: "alive" (=black) or "dead" (=white).
- Each cell (A) have 8 surrounding
- "neighbour" cells (B, C, not D).
- Time advances in a discrete scale. For each new "turn", the state of each cell depends on the neighbourhood states.
- Every cell updates the state synchronously. **The rules are:**
  - A cell "dies", in a turn, if there are least that 2, or more than 3, live neighbours.
  - A cell gets "alive", in a turn, if there are 3 live neighbours.
  - A cell with exactly 2 live neighbours keeps the state.



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## Societies modelled as CAS

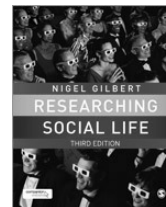
- Any "society" (at any scale) can be understood as a social CAS (with some cognitive components).



- **Autopoietic systems:** Some societies have a distinct feature, call immurgence, not present in Physics:  
The system dynamics generates macro-effects with direct causation over the micro-level, or agents cognition, so that the macro-effect will be "reinforced". (e.g., *Ants.nlogo*, *Social Norms*).
- ABMS allows to representing, modelling and simulating social CAS.

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## Social life is a Complex System?



- A massive number of elemental entities as system components,
- Simple algorithms rules the behaviour of entities (could be formalized as IF...THEN...),
- Heterogeneity: Elemental entities have different capacities and behaviour-rules,
- Interaction: Local causality between close components (both, in space and in time),
- Adaptation: Self-adjustment as a result of environmental interaction.

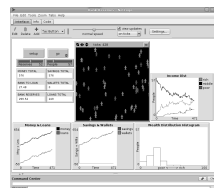
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## Social life as Emergent patterns

- When we put flour, eggs and sugar mixture in the oven we get "more than" a mass heated.



- When we put buyers, sellers and goods in a market we get "more than" a group of agents loaded with goods going from one place to another.



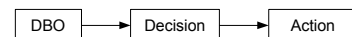
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## Emergence: Levels of Social Life

- Macroscopic level (aggregate dynamics)



- Microscopic Level (individual dynamics)

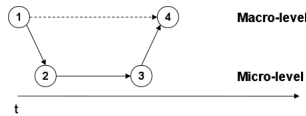


- First Order emergence: When the properties of the macro-level are generated by micro-agents interactions. (in this sense, "temperature" is similar to "movement in screen")
- Second Order emergence ("Immurgence"): Agents are able to build a representation of the emergent macro-properties that have contributed to create, and use them to guide their actions and to ensure that the macro-effect is played back (Dennett 1995, Gilbert 2001)

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## Multilevel modelling of Social Life

"Coleman's methodological Boat" (1990, p.8)



- A set of mechanisms rules the social system dynamics.
- "Sub-intentional" (1-2): Causal configuration of individuals believes (information), desires (goals), and opportunities.
- "Intentional" (2-3): Decision making under constrictions, and individuals action.
- "Supra-intentional" (3-4): Causal aggregation of effects out from multiple inter-actions.

Coleman, J.S. (1990) *Foundations of Social Theory*. Cambridge, MA: Harvard Univ. Press.

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## Modelling sub-systems

A case, DBO model for explaining agent behavior

Bratman's model: Modelling action from Desires, Believes, and Opportunities.

Today it's raining...

Why Mr. Smith did not get his umbrella this morning?

D-explanation

B-explanation

O-explanation



Mr. Smith believes that today will be a rainy day, and he buy a new umbrella last week, BUT walking under heavy rain makes he feel like Gene Kelly and he likes this emotional state.

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## Modelling sub-systems

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Bratman's model: Modelling action from Desires, Believes, and Opportunities.

Today it's raining...

Why Mr. Smith did not get his umbrella this morning?

D-explanation

B-explanation

O-explanation



Mr. Smith's desire its not to get wet, and he buy a new umbrella last week, BUT early this morning he had read a weather forecast from a last week newspaper and so he believes that today will be a sunny day.

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## Modelling sub-systems

A case, DBO model for explaining agent behavior

Bratman's model: Modelling action from Desires, Believes, and Opportunities.

Today it's raining...

Why Mr. Smith did not get his umbrella this morning?

D-explanation

B-explanation

O-explanation



Mr. Smith's desire its not to get wet, and he believes that today will be a rainy day, and he buy a new umbrella last week, BUT this morning his child take this umbrella to go to school, and Mr. Smith found no other umbrella at home.

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## Modelling Social Life as a set of sub-systems

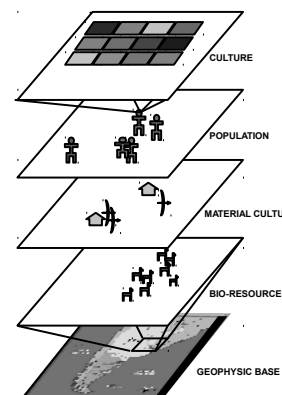
- The environment sub-system imposes constrictions to human actions.
- The "social environment" (others actions) also imposes constrictions.
- The outcomes of previous own actions also imposes constrictions.
- All this constrictions (or filters) became "motivational" causality for the new actions performed by agents.

=> Need to implement:

- Rules about physical or ecological environmental dynamics,
- Rules about environment "material" constrictions to action, and about environment effects from actions,
- Rules about social network dynamics (interaction effects, institutional emergence),
- Rules about "biographical", "adaptive learning" or "ego" dynamics (path-dependence).

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## Modelling Social Life as multilevel sub-systems



- Each level is composed by different types of agents.
- Each level has endo-rules governing its endogenous dynamics (i.e., climate, predation, use attrition, reproduction, social labelling)
- There are exo-rules governing the effects from one level into any others.

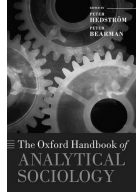
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## ABMS and Social Sciences: Sociology

"When we write a set of computational algorithms (the program), formalizing the generative hypotheses..., what we are doing is hypothesizing a series of generative mechanisms. When we execute the program...we engender the process deriving from the set of posited generative mechanisms. With the technical distinction between program "writing," "compilation," and "execution" it becomes clear that a "process" is nothing more than the dynamic aspect of one (or several) mechanism(s): it is what the mechanism can trigger" (Manzo, 2007, pp. 5-6).

- ABMS methods provide a technical infrastructure tightly coupled to the theoretical agenda of analytical sociology. (Hedström & Ylikoski, 2010: 49-67)
- ABM is not only a useful tool for Analytical Sociology, but there is a natural affinity between the components of mechanism-based explanations and agent-based simulation models.
- Analytical Sociology is a minority practice in Sociology.



Hedström, P., & Ylikoski, P. (2010). "Causal Mechanisms in the Social Sciences". Annual Review of Sociology, 36(1), 49-67.

Manzo, G. (2008). "Review of Gilbert (2007) Agent-Based Models, Sage Publications: London, 2007". Retrieved from <http://jasss.soc.surrey.ac.uk/11/2/reviews/manzo.html>

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## ABMS and Social Sciences: Economics

"Agent-based models potentially present a way to model the financial economy as a complex system, as Keynes attempted to do, while taking human adaptation and learning into account, as Lucas advocated. Such models allow for the creation of a kind of virtual universe, in which many players can act in complex — and realistic — ways. In some other areas of science, such as epidemiology or traffic control, agent-based models already help policy-making." (Framer, D. and Foley, D. Nature. Vol. 460 August 2009)

- Agent-based models are not a panacea. The major challenge lies in specifying how the agents behave and, in particular, in choosing the rules they use to make decisions. Creating a carefully crafted agent-based
- Creating a carefully crafted agent-based model of the whole economy is, like climate modelling, a huge undertaking. It requires close feedback between simulation, testing, data collection and the development of theory.

Conventional economic models failed to foresee the financial crisis. Could agent-based modelling do better? Agent-based modelling does not assume that the economy can achieve a settled equilibrium. No order or design is imposed on the economy from the top down. Unlike many models, ABMs are not populated with "representative agents": identical traders, firms or households whose individual behaviour mirrors the economy as a whole. Rather, an ABM uses a bottom-up approach which assigns particular behavioural rules to each agent. (Editorial. The Economist, July 22, 2010)

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## ABMS and Social Sciences: Pre/History

- ...

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## ABMS and Social Sciences: Archeology

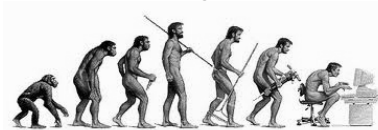
- ...

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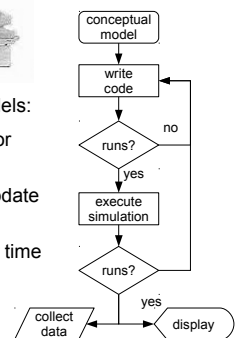
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## ABM "generic" software



Allows working with ABM computational models:

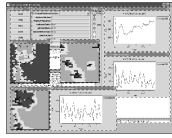
- To build computer code, that represents or models a virtual society.
- To execute or run computer code, that update over time steps an initial setup state.
- To display the updated system state over time and in space.
- To record system state data, that can be analysed later.



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## ABM "specific" tools: Economics / Markets

- JASA: Java Auction Simulator API (Steve Phelps, U. of Liverpool)
- jES: Java Enterprise Simulator (Pietro Terna, University of Torino)
- TNG: A C++ Framework for Studying the Formation and Evolution of Trade Networks (Leigh Testfason, Iowa State University)
- AMES Market Package: Agent-Based Modeling of Electricity Systems (Iowa State University)
- Santa Fe Artificial Stock Market (Santa Fe Institute - Paul E. Johnson, U. of Kansas)



... Business Games, Logistics Simulators, Decision Support Systems, etc.

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## ABM generic software: Platforms

<<http://www.openabm.org/platforms>>

Some ABM PLATFORMS (2011)	Build	Run	Display	Record
Breve: <a href="http://www.spiderland.org/">http://www.spiderland.org/</a>	*	*	***	
Ascape: <a href="http://ascape.sourceforge.net/">http://ascape.sourceforge.net/</a>	*	**	**	
Cormas: <a href="http://cormas.cirad.fr/en/outil/outil.htm">http://cormas.cirad.fr/en/outil/outil.htm</a>	**	*		
Envision: <a href="http://envision.bioe.orst.edu/">http://envision.bioe.orst.edu/</a>	**	**	***	
Repast Suite: <a href="http://repast.sourceforge.net/">http://repast.sourceforge.net/</a>	**	***	*	**
MASS: <a href="http://mass.aitia.ai/home">http://mass.aitia.ai/home</a>	**	***	***	***
EcoLab: <a href="http://ecolab.sourceforge.net/ecolab.html">http://ecolab.sourceforge.net/ecolab.html</a>	**	***	***	**
SOARS: <a href="http://soars.jp/en/">http://soars.jp/en/</a>	***		*	***
AnyLogic: <a href="http://www.xjtek.com/anylogic/overview/">http://www.xjtek.com/anylogic/overview/</a>	***	*	***	**
Modelling4All: <a href="http://m.modelling4all.org/">http://m.modelling4all.org/</a>	***	**	**	
Mimosa: <a href="http://sourceforge.net/projects/mimosa/">http://sourceforge.net/projects/mimosa/</a>	***	**	**	
SeSAM: <a href="http://www.simsesam.de/">http://www.simsesam.de/</a>	***	***	*	***
Jason: <a href="http://jason.sourceforge.net/Jason/">http://jason.sourceforge.net/Jason/</a>	***	***	*	***
Netlogo	**	*	***	***

\* poor, \*\* sufficient, \*\*\* excellent

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## ABM generic software: "Historical" platforms



**SWARM:**  
<[http://www.swarm.org/wiki/Main\\_Page](http://www.swarm.org/wiki/Main_Page)>  
Santa Fe Institute, New Mexico, USA.  
Chris Langton (from mid-1990's on)

**MASON:**  
<<http://cs.gmu.edu/~eclab/projects/mason/>>

Evolutionary Computation Laboratory (George Mason Univ.),  
and the GMU Center for Social Complexity.  
(from 2002 on)

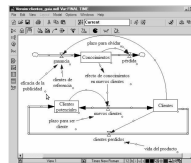
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## Alternatives to ABM (just 3 examples)

[System Dynamics]

Vensim PLE

<http://www.vensim.com/software.html>



[Microsimulation]

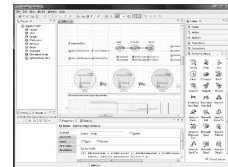
ModGen

<http://www.statcan.gc.ca/microsimulation/modgen/modgen-eng.htm>

[Hybrid systems: SD, Discrete Events, MABS]

Anylogic

<http://www.xjtek.com/>



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## An Introduction to modeling social systems with Netlogo

- 1.1. Modeling methodology: Physical, mathematical, and computational models
- 1.2. Agent Based Modeling (ABM): What is ABM?, ABM & Social systems, ABM computer tools
- 1.3. Netlogo:
  - Download, installation, and first steps
- 1.4. Netlogo tools: library, dictionary and on-line resources

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## NetLogo



*“... a programmable modeling environment for simulating natural and social phenomena. It was authored by Uri Wilensky in 1999 and has been in continuous development ever since at the Center for Connected Learning and Computer-Based Modeling.”*

- Discrete simulation environment: Discrete space (world grid) and discrete time (ticks).
- Agent-Based simulation: Behaviour rules apply to individual entities (turtles, patches, links)

Website: <http://ccl.northwestern.edu/netlogo/>  
 Presentation video: <http://youtu.be/AJXFiO-ULv0>


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## Downloading NetLogo

Netlogo is freely available (but the code is not open / public)  
 Download the most recent version from:  
<http://ccl.northwestern.edu/netlogo/download.shtml>

- Registration NOT required.
- You can just select Version,
- then click [ Download ]




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## Installation of NetLogo

Netlogo can run on a number of computer platforms (Unix, MacOS, Windows,...)

- For MacOS you get a .dmg file (install from "virtual disk")
- For Windows you get an .exe file (application installer)
- For Other/Unix you get a .tar.gz file (zip folder with executable java source)

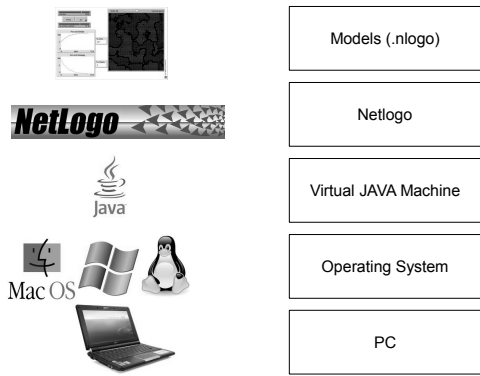


- Netlogo runs on a Java "Virtual Machine" so that it is platform independent. BUT, depending of your hardware, the Java VM will be installed if necessary (extra time).

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## NetLogo architecture

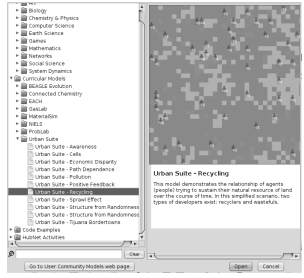


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## First Steps with NetLogo

- Open the Netlogo environment (OS-dependent)
- Select from "File" menu the option "Models Library" (or use Ctrl+M)
- Select, from "Curricular Models" folder, the "Urban Suite" sub-folder
- Single-click on "Urban Suite - Recycling" model, to display an overview.
- Double-click, or [ Open ] to open the selected model into Netlogo environment.



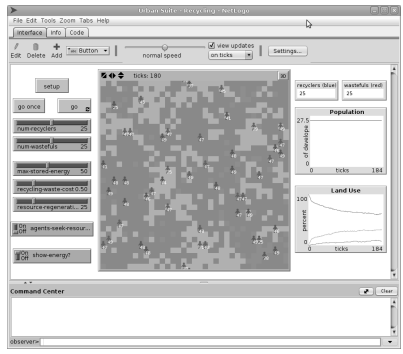
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## NetLogo: The main screen

Parts of the Netlogo environment (Interface):

- (1) Tabs: Interface, Info, Code
- (2) World
- (3) Run Controls
- (4) Interface Elements
- (5) Output log, and Command Center



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# NetLogo: The main screen

Parts of the NetLogo environment (Info):

- (1) Tabs
- (2) Edit toolbar
- (3) Text space

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# NetLogo: The main screen

Parts of the NetLogo environment (Code):

- (1) Tabs
- (2) Verify button
- (3) Procedures menu
- (4) Programming Code (auto-colored)

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# Read [ Info ] & explore the model...

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# An Introduction to modeling social systems with NetLogo

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- 1.2. Agent Based Modeling (ABM): What is ABM?, ABM & Social systems, ABM computer tools
- 1.3. *Netlogo*: Download, installation, and first steps
- 1.4. *Netlogo tools*:
  - Models Library,
  - Dictionary, and
  - on-line resources


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# Netlogo: Help system


- Web pages, locally installed with Netlogo,
- Code-context help (while in Code tab)
  - Help / Look Up In Dictionary,
  - [F1],
  - Rigth-clc / Quick Help
- Documentation and Tutorials:
  - Help / User Manual
- Reference for Netlogo Commands:
  - Help / Dictionary

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# Netlogo: Dictionary



**NetLogo**  
User Manual  
version 5.0RC2  
October 5, 2011

Navigation: Home, What's New?, Basics, Models, Party, Learning NetLogo, Tutorial #1: Models, Tutorial #2: Commands, Tutorial #3: Procedures, Reference, Interface Guide, Info Link Guide, Programming Guide, Translating Guide, NetLogo Dictionary

**NetLogo Dictionary**

Alphabetical: [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

Categories: [Turtle](#) [Patch](#) [Agentset](#) [Color](#) [Control/Logo](#) [Visual](#) [Procedures](#)  
[Input/Output](#) [File](#) [Link](#) [Stamp](#) [Math](#) [Printing](#) [Units](#) [Where](#) [System](#) [Tutorial](#)

[Special](#) [Variables](#) [Keywords](#) [Constants](#)

**Categories**

This is an approximate grouping. Remember that a turtle-related primitive might still be used by patches or the observer, and vice versa. To see which agents (turtles, patches, links, observer) can actually run a primitive, consult its dictionary entry.

**Turtle-related**

back (b) <breed>-all <breed>-here <breed>-on can-move? clear-turtles (c) create <breed>-<create ordered>-<breed>-<create ordered>-turtles (co) create-turtles (ct) die distance distancxy downhill downhill4 dy face facexy forward (f) hatch hatch-<breed>-hide-turtle (h) home inspect is-<breed>-? is-turtle? jump layout-circle left (l) move-to myself nobody no-turtles of other patch-ahead patch-at patch-at-heading-and-distance patch-here patch-left-and-ahead patch-right-and-ahead pen-down (pd) pen-erase (pe) pen-up (pu) random-xcor random-ycor right (r) self set-default-shape \_set-line-thickness setxy shapes show-turtle (s) sprout sprout-<breed>-<stamp stamp-erase subxy subtract-heading be towards towardsxy turtle turtle-set turtles turtles-at turtles-here turtles-on turtles-own until up!tilt

**Patch-related**


clear-patches (cp) diffuse diffused distance distancxy import-pcolors rgb inspect is-patch? myself neighbors neighbord no-patches of other patch patch-at patch-ahead patch-at-heading-and-distance patch-here patch-left-and-ahead patch-right-and-ahead patch-set patches patches-own random-xcor random-ycor self sprout sprout-<breed>-subxy turtles-here

**Agentset**

all? any? ask ask-concurrent all-points <breed>-at <breed>-here <breed>-on count in-com in-radius is-agent? is-agentset? is-patch-set? is-turtle-set? link-heading link-length link-set link-shapes max-of max-one-of min-of min-one-of n-of neighbors neighbord no-patches no-turtles of one-of other patch-set patches sort sort-by sort-on turtle-set turtles with with-max with-min turtles-at turtles-here turtles-on


**Color**

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# Netlogo Models




- Models installed with Netlogo, also found at <<http://ccl.northwestern.edu/netlogo/models/>> (high quality in documentation and useful training resources, specially those from File / Models Library / Code Exemples)
- Other models uploaded by community members (high heterogeneity in quality and documentation)
- OpenABM: <http://www.openabm.org/>
- Many A.I. Models: <http://files.bookboon.com/ai/>

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# Netlogo: Other on-line resources




- Users community support group, searchable Yahoo! Group (Help/Users Group)
- <http://ccl.northwestern.edu/netlogo/models/community/>
- <http://online.sfsu.edu/~jjohnson/NetlogoTranslation/NetLogoTranslationWelcome.htm>
- [http://www.insisoc.org/introduccion\\_a\\_netlogo.html/](http://www.insisoc.org/introduccion_a_netlogo.html/)
- <http://www.public.asu.edu/~cmbarton/files/valencia2010>
- Introductory video-lecture by Gabriel Wurzer (1 h. 49 min): <<http://youtu.be/nGEYV4BEZEM>>


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# Netlogo Internationalization (Spanish)

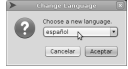





- In Netlogo v5, most of the GUI (graphical user interface) and some of its error messages, are now "internationalized", but only supports English and Spanish.
- The Spanish translation is preliminary and incomplete. Text in the interface that hasn't been internationalized yet will still be displayed in English.
- By default, NetLogo uses the language of your operating system, if that language is supported by NetLogo.



- In case of malfunction of the language auto-detection at installation, it is possible to change language:
  - Into the Command Center, **typing** the primitive **"\_\_change-language"** (no quotes).




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# Thanks for your attention



Find more at our website  
<<http://sct.uab.cat/llds>>



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*We acknowledge all previous participants in SSASA, LSDS and Netlogo training activities to help improving these materials.*

*Originally developed by Francesc Miquel and Xavier Vilà at the "Laboratory for SocioHistorical Dynamics Simulation" LSDS-UAB.*

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