Notes and links

January 13th, and 14th

What means economy/economics and what these words mean for you.

Home-work

—

A close look to the program:
http://fisica-sc.campusnet.unito.it/do/corsi.pl/Show?_id=gwpc;sort=DEFAULT;search=;hits=59#a_programma_gwpc

My book.

Epstein, J.M. (2014), Agent_Zero: Toward Neurocognitive Foundations for Generative Social Science:
see the Cmap/Readings

—

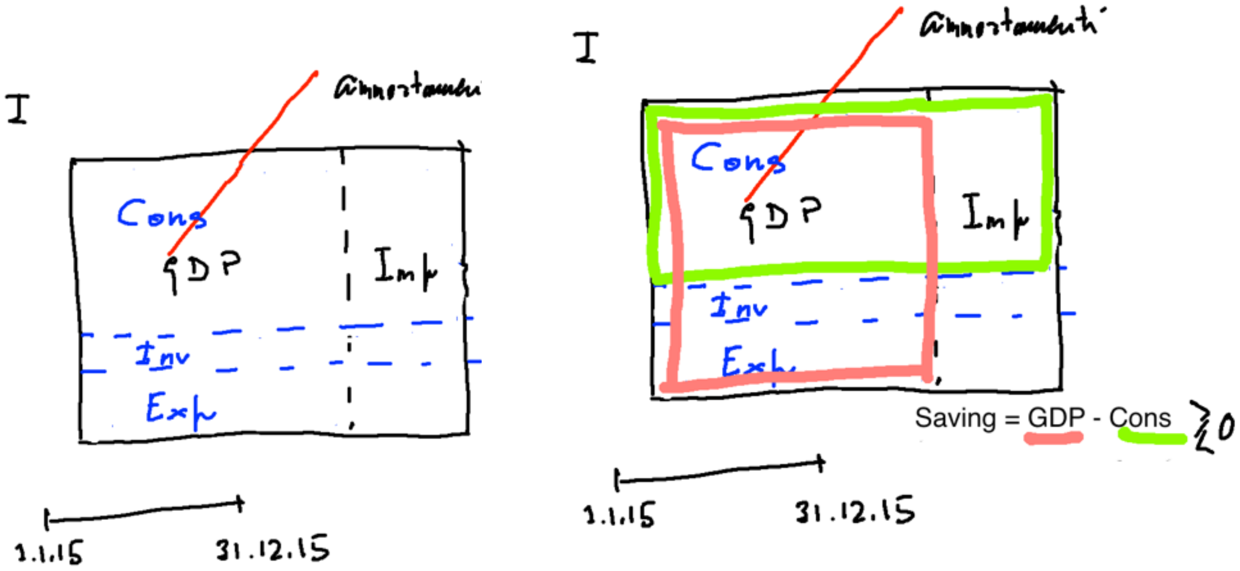
The importance of our Cmap

—

Leibniz's dream.

—

A rectangular pie.



National accounting, look at the online primer (from the program)

China and Krugman, International New York Times, Jan. 9th, 2016 (Cmap)

http://hdr.undp.org/en/content/human-development-index-hdi

—

A short paper on models, Simon and complexity, by Pietro Terna.

From the Cmap look at

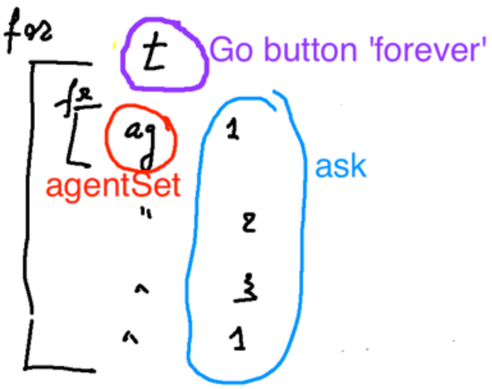
p. 4, three types of models

p. 5, the Axtell and Epstein's definition of ABMs

—

Agent-based models and programming.

A first look to NetLogo



January 19th, 20th, and 21st

Moving the lesson of Wednesday Jan 27th to …

—

Old and current Home-works

—

Notes on the exam

—

Restart from the Terna paper above.

Continue with the Go button ‘forever’ (using also reset-ticks, risk and ticks) and then with the content of the NetLogo box in the Cmap

and SLAPP (with Python) + Oligopoly model

Python / IPython
with https://tmp39.tmpnb.org/
and https://www.juliabox.org

—

The folder “1 plainProgrammingBug” in SLAPP

—

January 26th, and 27th

—

Old and current Home-works

—

The program
“start 1 plainProgrammingBug.nlogo” in Cmap/Programming Examples

Look at the content of the **boxes**

Agent based models (ABMs) for simulation experiments

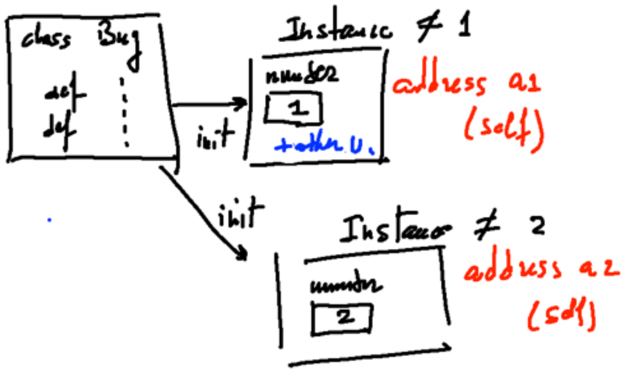
Programming / Python / IPython

—

“2 basicObjectProgrammingBug” in SLAPP

Adding collections

“3 basicObjectProgrammingManyBugs” in SLAPP (with a further step in “start 3 basicObjectProgrammingManyBugsAppend.py” reported in the Cmap)



Class, instances, the *self* concept as a memory address; as a starting point have a look to the file class_instances_self.py, (in the Cmap)

–

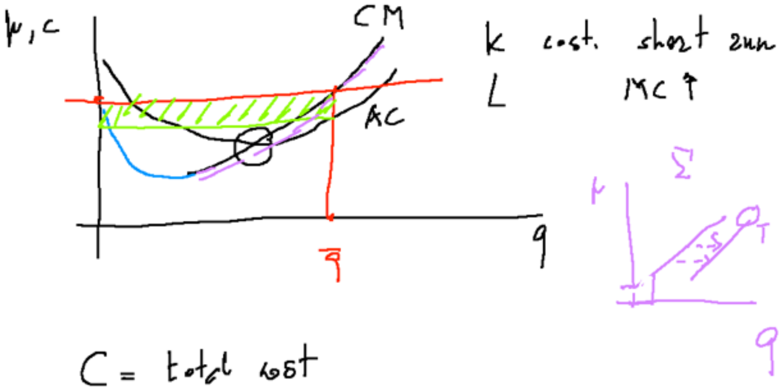
Back to NetLogo, in a parallel way:

start 1 plainProgrammingBug.nlogo
start 2 basicObjectProgrammingBug.nlogo
start 3 basicObjectProgrammingManyBugs.nlogo

–

Economics

Quantity in a perfect competition market



C = total cost
AC = C/q   Average
MC = marginal cost $C_{q_2} - C_{q_1}$

(Economy)

http://www.telegraph.co.uk/news/uknews/theroyalfamily/3386353/The-Queen-asks-why-no-one-saw-the-credit-crunch-coming.html

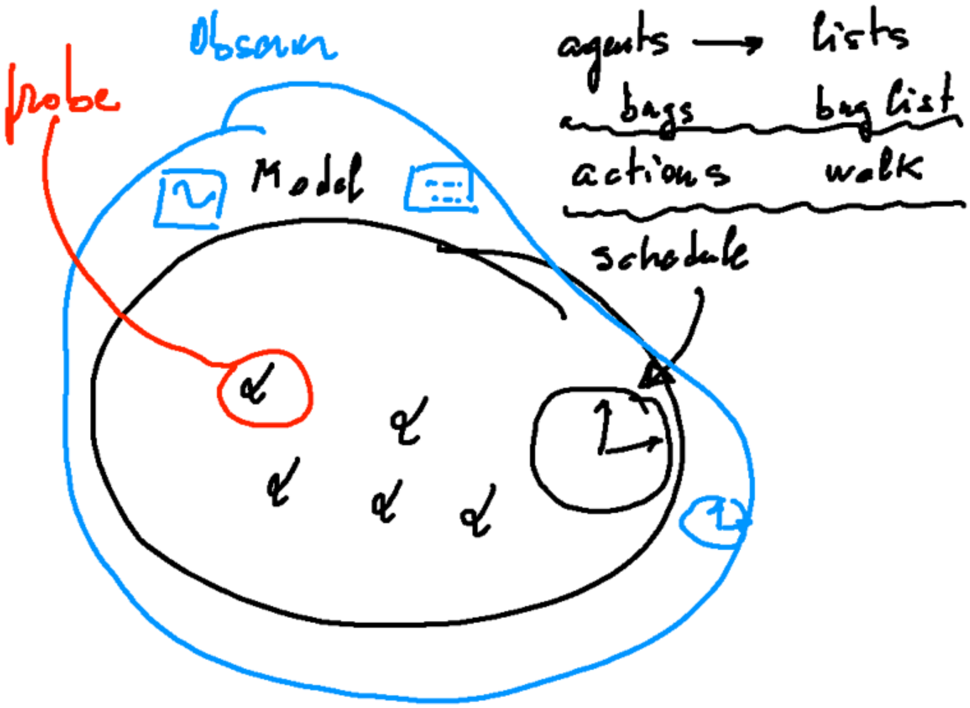
Mario Draghi at Prometeia 40th year celebration (http://www.prometeia.it/home), Dec. 14th, 2015: https://www.youtube.com/watch?v=L0FFCRIskyQ

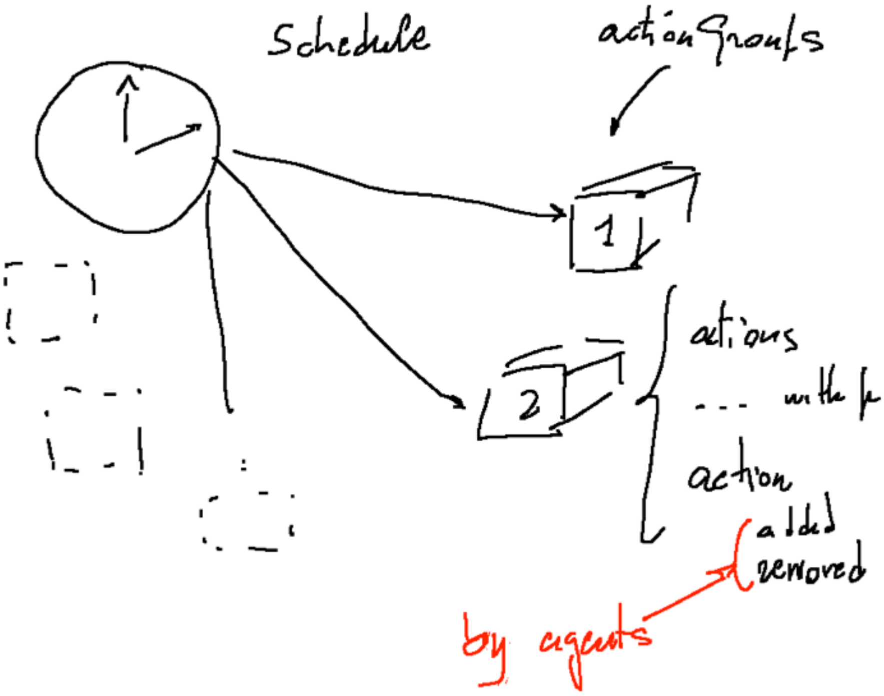
February 2nd, 3rd, and 4th

–

Old and current Home-works

The Swarm protocol and the schedule representation


Probe
Observer
Model
agents → lists
bags bag list
actions walk
schedule
1


Schedule
actionGroups
1
2
actions
... with p
action
added
removed
by agents

—

Novelties in the Cmap (Readings); two cycle of lessons

—

(Economy again)

Basics of consumer choice

$$\max\ U(x_1, x_2, \dots, x_n) = f(x_1, x_2, \dots, x_n)$$

$$\frac{\partial u}{\partial x_1} \dots \frac{\partial u}{\partial n} > 0 \qquad \frac{\partial^2 U}{\partial x_i^2} < 0$$

$$x_1 p_1 + x_2 p_2 + \dots + x_n p_n - \bar{R} = 0$$

$$L = U(x_1, x_2) - \lambda \left[x_1 p_1 + x_2 p_2 - \bar{R} \right]$$

$$\frac{\partial L}{\partial x_1} = \frac{\partial U}{\partial x} - \lambda p_1 = 0 \ ; \quad \boxed{\frac{\partial u / \partial x}{p_1} = \lambda}$$

$$\dots\dots$$

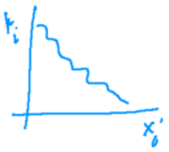
$\frac{\partial L}{\partial \lambda} \rightarrow$ the constrain

$$\frac{\partial u/\partial x_1}{p_1} = \lambda$$

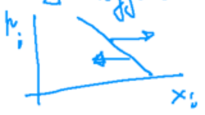
$$\frac{\partial u/\partial x_2}{p_2} = \lambda$$

$$\vdots$$

$p_1 \uparrow \ x_1 \downarrow \ \frac{\partial U}{\partial x} \uparrow \ \lambda$ cost



Σ aggr. dem.



(with Quantity in a perfect competition market, pp. 23–66 of Fenoaltea’s book)

—

class Turtle and
turtlesMovingTalking.py
turtlesMovingTalking_DISPLAYING.py

—

Python/SLAPP folder 4: basicObjectProgrammingManyBugs_bugExternal_+_shuffle

start 4 basicObjectProgrammingManyBugs_+_shuffle.nlogo
start 4bis basicObjectProgrammingManyBugs_+_shuffle_+_ModAttributes.nlogo
breeds.nlogo

—

February 9th, 10th, and 11th

exec("a=2; if a< 3: print ‘phew’") rises and error
exec("a=2\nif a< 3: print ‘phew’")
but exec("a=2\n if a< 3: print ‘phew’") works

; in the indented blocks
exec("a=2\nif a<2:b=11;print b\nelse: b=22;print b")
—

Old and current Home-works

—

Cmap, a link to a lesson of mine

A slide about ABM vs. MAS

—

Python/SLAPP folder: 5 objectSwarmModelBugs

—

Exploring the stock market with

CDA_basic_model.nlogo

—

projects in SLAPP

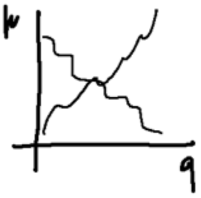
SLAPP in IPython and on line

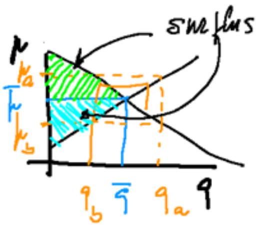
installing the stuff for SLAPP

–

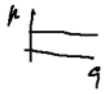
Economics

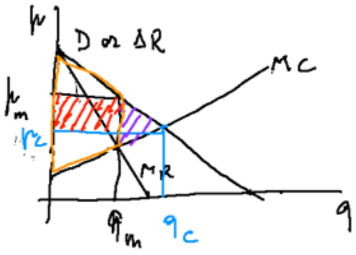
Monopoly





Monopoly





$P = a + \underbrace{b}_{<0} Q$ $\{ q = \alpha + \underbrace{\beta}_{<0} p$

$TR = P \cdot Q = aQ + bQ^2$

$MR = TR' = a + 2bQ$

February 16th (double), 17th, and 18th

–

Old and current Home-works

CDA with a new kind of agents, try together

–

–

Cmap:

R
Scratch, StarLogo TNG

special learning tool for R: swirl

```
install.packages("swirl")
library("swirl")
swirl()
```

a book about

R Programming for Data Science

—

building a data set for an Artificial Neural Network, collecting data

—

How a monopolistic firm behaves

—

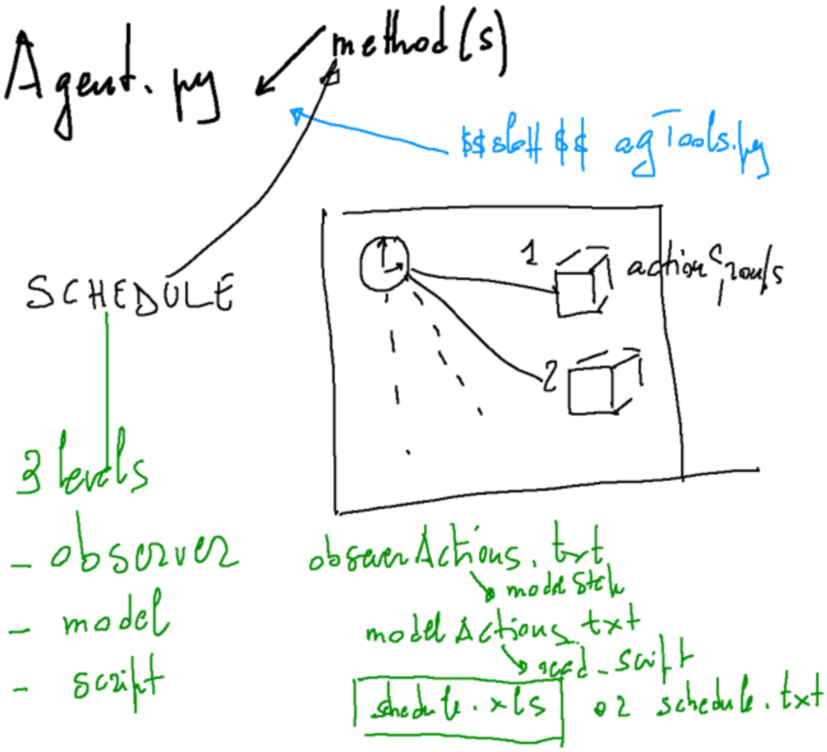
jupyter notebook
use above command line instead of *ipython notebook*

(pip jupyter install)

—

getting closer to

the running shell of SLAPP, folder
6 objectSwarmObserverAgents_AESOP_turtleLib_NetworkX



Agent definition

agTypeFile.txt { files containing the agents (their initial data)

script (using < Agent.py (methods)
< agTypeFile (type of ag.))

↓

schedule.xls (or .txt if .xls lacking)

[The AESOP (Agents and Emergencies for Simulating Organizations in Python) implementation, has the capability of reading the schedule from a text file.
The test file is schedule.txt and its contents are read if we have "read_script" steps activated in the schedule of the model.
If the file is finished, further attempt to "read_schedule" have no effect.
We can read more than one command per step.
If we create a xls file, this is used instead of the txt one.]

explore projects:

basic
production

NB practice with terminal/power shell/command prompt
It is highly useful to familiarize with the Unix-like commands of the Linux/Mac OS Terminal and Windows PowerShell, e.g., at
https://en.m.wikipedia.org/w/index.php?title=Command-line_interface&redirect=no
and with the DOS-like commands of Command Prompt of Windows, e.g., at
http://pcsupport.about.com/od/termsc/p/command-prompt.htm

February 23rd, 24th, and 25th

–

Old and current Home-works

–

CDA trend again, self-fulfilling prophecies

–

markets again:
the **a_R_demand_offer.R model** (in R just to exercise) vs. the **interactingBuyersAndSellers.nlogo** model in NetLogo examples, with the interactingB&S_pictures.zip collection

—

a first look to an ANN (box Artificial Neural Networks).

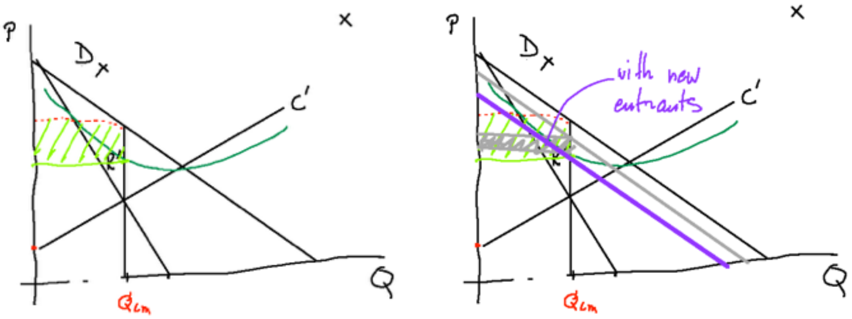
the examples in http://terna.to.it/econophysics16/R_examples/ repository, with our class

(and the old RNA code).

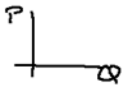
—

Monopolistic competition

(with pp. 67–88 and 121-128 of Fenoaltea's book)



Oligoply → Duopoly



Demand c. $P = A - Q$

$$Q = Q_1 + Q_2$$

$$MC = c_1' = c_2' = 0$$

$$TR - R_1 = PQ_1 = [A - (Q_1 + Q_2)]Q_1 =$$

$$= AQ_1 - Q_1^2 - Q_1 Q_2 \quad (*)$$

$$R_1' \qquad = A - 2Q_1 - Q_2 = 0$$

with $R_1' = C_1' = 0$

reaction function $Q_1 = \frac{A}{2} - \frac{1}{2}Q_2; \quad Q_2 = \frac{A}{2} - \frac{1}{2}Q_1$

Oligoply of Stackelberg

$P = A - \varphi$

$R_1 = A\varphi_1 - \varphi_1^2 - \varphi_1 \underline{\varphi_2}$ (ϑ)

$\varphi_2 = \frac{A}{2} - \frac{1}{2}\varphi_1$

$R_1 = \frac{A}{2}\varphi_1 - \frac{1}{2}\varphi_1^2$

$R'_1 = \frac{A}{2} - \varphi_1 \longrightarrow 0 \quad c'_1$

$\varphi_1 = \frac{A}{2} \qquad \varphi_2 = \frac{A}{2} - \frac{1}{2}\frac{A}{2} = \frac{A}{4}$

—

March 1st, 2nd and 3rd

Novelties in the Cmap and in Digressions and Quirks

—

Old and current Home-works

—

Oligopoly model with Marco Mazzoli and Matteo Morini

—

connecting R to NetLogo
http://rserve-ext.sourceforge.net/
download rserve_v0.1beta_for_NL5beta4_R2.12-and_higher
and place the unzipped folder in NetLogo extensions

search for examples in /NetLogo\ 5.3/extensions/rserve/examples

example1.nlogo
plot-example.nlogo

connecting R to Python
http://terna.to.it/econophysics16/cmap/pyRserve_Rserve%20(difficult).pdf

Within R
> install.packages("Rserve")

using Serve
>library(Rserve)

```
>Rserve()
                              >Rserve(args="--no-save") in Mac OSX
```

now you can quit R

```
>q()
```

In Python, interactvely

```
import pyRserve
cn=pyRserve.connect(host="localhost")
cn.r('a=2')
cn.r.a

cn.r('v<-c(1,2,1,3,-1,22,-7)')
cn.r('x11()')
cn.r('plot(v)')

cn.r('dev.off()')

cn.close()
```

a complete example is timeSeriesNNs.zip
in our repository http://terna.to.it/econophysics16/Python_examples/

—

Production function and long run production

Decreasing returns?

Production function Cobb-Douglas $\alpha, \beta > 0$

$\alpha + \beta \gtrless 1$

$$P_t = f(L_t, K_t) = \underbrace{A_{(t)} L_t^{\alpha} K_t^{\beta}}$$

$$\frac{\partial P}{\partial L}, \frac{\partial P}{\partial K} > 0$$

marginal productivity of labor, being $\frac{P}{L}$ the productivity of labor

$$\frac{\partial P}{\partial L} = \alpha L_t^{\alpha-1} K_t^{\beta}$$

$$\frac{\partial^2 P}{\partial L^2} = \underbrace{(\alpha - 1)}_{<0} L^{\alpha-2} K^{\beta}$$

$\Big\}$ idem for K

$$\frac{\partial^2 P}{\partial L^2}; \frac{\partial^2 P}{\partial K^2} < 0$$

min $C = wL + zK$ with $\bar{P} = P(L,K) = A L^{\alpha} K^{\beta}$ as constrain

so $\bar{P} - P(L,K) = 0$

with $\Lambda = C + \lambda(\bar{P} - P(L,K))$

$$\frac{\partial \Lambda}{\partial L} = w - \lambda \frac{\partial P}{\partial L} = 0; \quad \frac{\partial \Lambda}{\partial K} = z - \lambda \frac{\partial P}{\partial K} = 0 \quad \text{giving} \quad \boxed{\frac{\partial P / \partial L}{w} = \frac{\partial P / \partial K}{z}}$$

$$P_0 = A L^{\alpha} K^{\beta}$$

$\alpha + \beta = 1$ ①

$\boxed{\alpha + \beta > 1}$ ②

$\alpha + \beta < 1$

$L \rightarrow \lambda L$

$K \rightarrow \lambda K$

$$P_1 = A (\lambda L)^{\alpha} \cdot (\lambda K)^{\beta} = A \underbrace{\lambda^{\alpha+\beta}}_{\substack{\text{if ①} \\ \text{if ②}}} L^{\alpha} K^{\beta} \rightarrow \lambda P$$

if ①

if ② $\rightarrow > \lambda P$

(with pp. 90-106 of Fenoaltea’s book)

Let us recapitulate from the beginning, about economics

—

Network analysis

NetLogo and the NW extension.

Preliminary steps with the NW library following:

a) ourFirst_NW_Example.nlogo

b) the Usage section in
https://github.com/NetLogo/NW-Extension
with:

- nw:context (our file contexts.logo)

- Special agentsets vs. normal agentsets (look at ourFirst_NW_Example+SIZE.nlogo)

c) from https://github.com/NetLogo/NW-Extension/tree/5.x/demo
look at the Network Extension General Demo
with the info sheet and to its weblins

d) an emerging network: productionWorld.nlogo

Python and the NetworkX library

NetworkX use:

aFirstStepWithNetworkX.py

aFirstStepWithNetworkX_&_agents.py
betweennessWithNetworkX_&_agents.py
betweennessWithNetworkX_&_agents_large.py

The use of draw_networkx() instead of draw()
as at http://networkx.lanl.gov/_modules/networkx/drawing/nx_pylab.html

Look at

http://networkx.github.io/documentation/latest/index.html

https://www.wakari.io/sharing/bundle/nvikram/Basics%20of%20Networkx (very important)

http://networkx.github.io/documentation/latest/reference/algorithms.html

—

March 8th

—

Last Home-work

—

Novelties in the Cmap and in Digressions and Quirks

In Readings and Links,
Jan C. Thiele, Winfried Kurth, and Volker Grimm. Facilitating parameter estimation and sensitivity analysis of agent-based models: A cookbook using netlogo and ’r’. Journal of Artificial Societies and Social Simulation, 17(3):11, 2014. ISSN 1460-7425.

Numpy

Genetic Algorithms and NetLogo

In NetLogo box

__includes
BehaviorSpace
eXtraWidgets

—

DSGE

https://en.wikipedia.org/wiki/Dynamic_stochastic_general_equilibrium
browsing it …

The virtues and vices of equilibrium and the future of financial economics
COMPLEXITY

Volume 14, Issue 3, January/February 2009, Pages: 11–38, J. Doyne Farmer and John Geanakoplos
http://onlinelibrary.wiley.com/doi/10.1002/cplx.20261/abstract

Giorgio Fagiolo and Andrea Roventini. Macroeconomic Policy in DSGE and Agent-Based Models. Revue de l'OFCE, (5):67–116, 2012
http://www.cairn.info/load_pdf.php?ID_ARTICLE=REOF_124_0067

—

A Python to play with complexity: PyCX
http://pycx.sourceforge.net
with a new problems

—

As a (controversial) conclusion
Mauro Gallegati, Steve Keen, Thomas Lux, Paul Ormerod
Physica A 370 (2006) 1–6
Worrying trends in econophysics
http://www.sciencedirect.com/science/article/pii/S0378437106004420 (from Unito network)

browsing it …

Digressions and quirks

—

JEP 1/2016 https://www.aeaweb.org/articles.php?doi=10.1257%2Fjep.30.1

with

Power Laws in Economics: An Introduction
https://www.aeaweb.org/articles.php?doi=10.1257/jep.30.1.185
with a data set

Retrospectives: What Did the Ancient Greeks Mean by *Oikonomia*?
https://www.aeaweb.org/articles.php?doi=10.1257/jep.30.1.225

—

quite new for Python: A Complete Tutorial to Learn Data Science with Python from Scratch

http://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/

—

Lynne Hamill, Nigel Gilbert (2015), Agent-Based Modelling in Economics, Wiley
http://onlinelibrary.wiley.com/book/10.1002/9781118945520

—

Frédéric Abergel, Hideaki Aoyama, Bikas K. Chakrabarti, Anirban Chakraborti, and Asim Ghosh (eds.) (2014), Econophysics of Agent-Based Models. New Economic Windows. New York and Heidelberg: Springer, 2014

Blake LeBaron review on JEL, https://www.aeaweb.org/articles.php?doi=10.1257/jel.52.3.851.r3 (working from unito network)

—

http://quant-econ.net with
http://quant-econ.net/about_lectures.html#python-or-julia
http://quant-econ.net/py/index.html
http://quant-econ.net/jl/index.html

https://github.com/FRBNY-DSGE/DSGE.jl

—

A neural network learning to play chess

http://www.macitynet.it/giraffe-un-sistema-dintelligenza-artificiale-72-ore-imparato-giocare-scacchi-battere-chiunque/

http://qz.com/502325/an-ai-computer-learned-how-to-beat-almost-anyone-at-chess-in-72-hours/

http://arxiv.org/abs/1509.01549v1

https://chessprogramming.wikispaces.com/Matthew+Lai

—

A light ABM tool in JavaScript, Json

http://ncase.me/simulating/
—

Neural networks to play Go (AlphaGo (Google Deepmind)

https://en.wikipedia.org/wiki/AlphaGo

http://www.economist.com/news/science-and-technology/21689501-beating-go-champion-machine-learning-computer-says-go?frsc=dg%7C

http://www.readcube.com/articles/10.1038%2Fnature16961

—

Blockchain, the view of the UK Government Office for Science:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf

Journal of Economic Perspectives: Vol. 29 No. 2 (Spring 2015)

Bitcoin: Economics, Technology, and Governance
https://www.aeaweb.org/articles.php?doi=10.1257/jep.29.2.213

OECD
Disruptive innovations and their effect on competition
http://www.oecd.org/daf/competition/disruptive-innovations-and-competition.htm

open source and blockchain:
http://www.zdnet.com/article/blockchain-as-a-service-the-global-database-goes-mainstream/

—

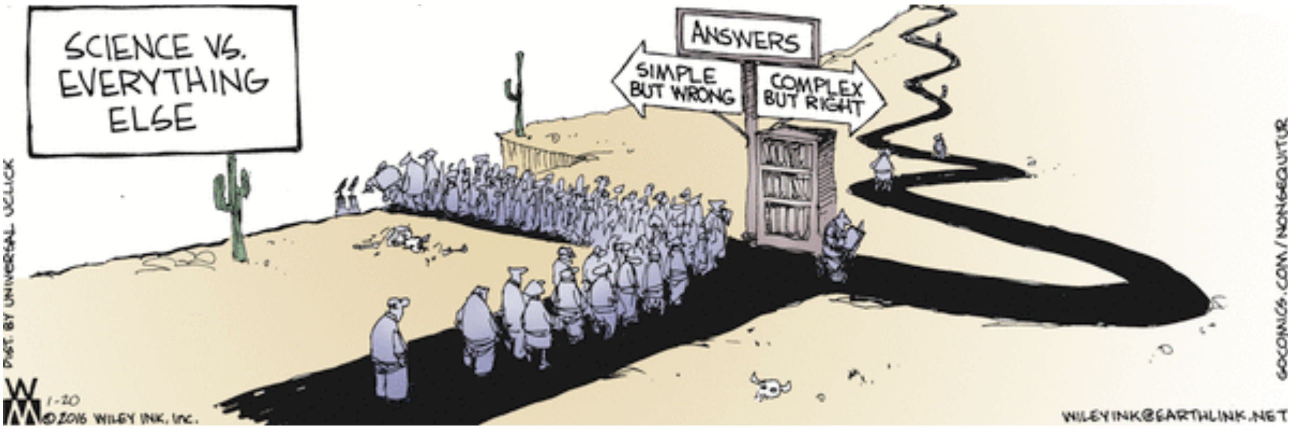
www.santafe.edu

SFI Update: January/February 2016
http://www.santafe.edu/media/update_pdf/SFI_Update_Jan_Feb_2016_FNL.pdf

—

Non Sequitur by Wiley Miller

http://www.gocomics.com/nonsequitur/2016/01/20



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http://hplusmagazine.com/2010/11/04/precognition-real-cornell-university-lab-releases-powerful-new-evidence-human-mind-can/

http://www.pnas.org/content/early/2016/01/14/1523834113
The brain's predictive prowess revealed in primary visual cortex

—

Disconnected! The parallel streams of network literature in the natural and social sciences
http://arxiv.org/abs/1511.03981

—

Microsoft R Open: The Enhanced R Distribution
https://mran.revolutionanalytics.com/open/

—

Knowledge and development

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2717414
The Great Divergence: A Network Approach

—

SymPy is a Python library for symbolic mathematics.
http://www.sympy.org/en/index.html

—

High Frequency Trading

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1953524
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2122716
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2294526
http://www.smallake.kr/wp-content/uploads/2014/11/The-Good-the-Bad-and-the-Ugly-of-Automated-High-Frequency-Trading.pdf

—

no offense (if you have young relatives …):
https://code.org
—

about Complexity

Gianni Riotta, former director La Stampa:
http://www.lastampa.it/2016/02/19/cultura/riotta-cheDHhucoAK6coyBtiiF6H/pagina.html

Riccardo Sabatini, theoretical physicists:
Complexity, smart data and food: https://www.youtube.com/watch?v=inYpXdRX31o

—

Subdominant Dense Clusters Allow for Simple Learning and High Computational Performance in Neural Networks with Discrete Synapses
http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.115.128101

—

An Italian research perspective:

http://www.scienzainrete.it/contenuto/articolo/cristina-da-rold/cingolani-ce-lha-fatta-parte-human-technopole/febbraio-2016

http://terna.to.it/econophysics16/downloadable/ISIforHumanTechnopole.pdf

—

Robots and agents:

https://www.youtube.com/watch?v=6b4ZZQkcNEo

https://www.youtube.com/watch?v=xK54Bu9HFRw

https://www.youtube.com/watch?v=rVlhMGQgDkY

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An endogenous network model of banking systems
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