

Notes and links

January 12th

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

Home-work (please send your homework to pietro.terna@unito.it)

—

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

Leibniz (xi. De scientia universali seu calculo philosophico): ... quando orientur controversiae, non magis disputatione opus erit inter duos philosophos, quam inter duos computistas. Sufficiet enim calamos in manus sumere sedereque ad abbacos et sibi mutuo (...) dicere, calculemus.¹

Calculemus = Simulemus

Artifacts in social science

—

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

From the Cmap look at

Terna p. 4, three types of models

Axtell and Epstein p. 6, the **Axtell and Epstein's definition of ABMs**

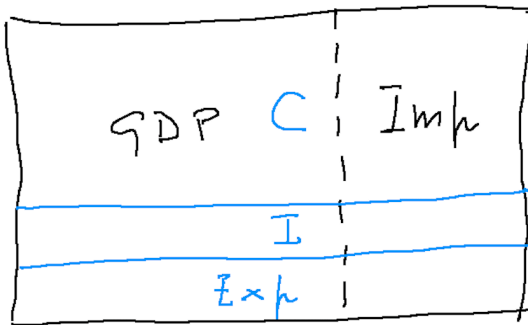
Agent-based models and programming.

January 17th, 18th, and 19th

Cmap novelties

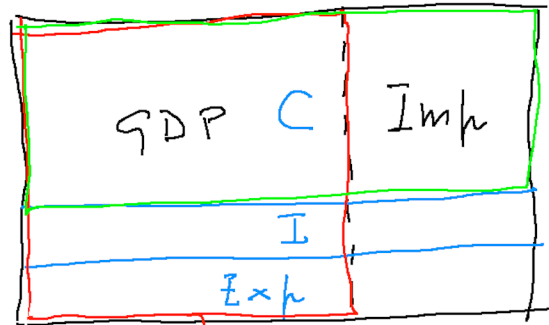
A rectangular pie.

GDP Italia 20



1.1.2016 → 31.12.2016

GDP Italia 2016



GDP ≈ Reddito nazionale

1.1.2016 → 31.12.2016

Risparmio = GDP - C

GDP >> C

Ancora contabilità nazionale

$$GDP + Imp = C + I + Exp$$

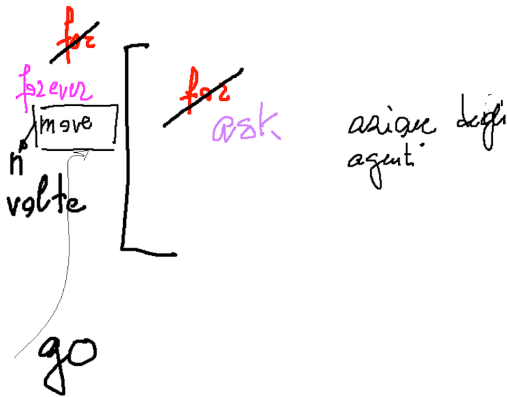
$$GDP - C = I + (Exp - Imp)$$

	Risparmio		
ITA	>0	>0	>0
CINA	>>0	>>0	>>0

National accounting, look at the online primer (from the program, at https://www.bea.gov/national/pdf/nipa_primer.pdf, figure at p.3 and table at p. 4)

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

A first look to NetLogo



The Go button 'forever' (using also reset-ticks, risk and ticks)

Using NetLogo Starter

The content of the **NetLogo box in the Cmap**

—

Using the box *Programming examples* of the Cmap

—

A first look to Python (3)

The content of the **Python box in the Cmap**

—

familiarize with Python live in the IDLE shell or creating a .py file or via IPython and IPython notebook

January 24th, 25th, and 26th

Old and current Home-works

a common exercise from the bottom layer: turtles going around and changing their color if they found closely another turtle of a different color (both change to a third color):

20170124 prova ask.nlogo
with
20170125 prova ask + grafici.nlogo

—

Using again NetLogo Starter

—

SLAPP <https://github.com/terna/SLAPP> (with Python) + Oligopoly model
<https://github.com/terna/oligopoly>

Python / Python
with <https://tmp59.tmpnb.org>
and <https://juliabox.com>

====

Python 3.6

from python.org download python-3.6.0 installer
run it

libraries

sudo -H pip3 install numpy
Successfully installed numpy-1.12.0

sudo -H pip3 install scipy
Successfully installed scipy-0.18.1
(contains numpy and F2PY for Fortran)

sudo -H pip3 install matplotlib
Successfully installed cycler-0.10.0 matplotlib-2.0.0 pyparsing-2.1.10 python-dateutil-2.6.0 pytz-2016.10
six-1.10.0

sudo -H pip3 install networkx
Successfully installed decorator-4.0.11 networkx-1.11

for SLAPP
sudo -H pip3 install xlrd
Successfully installed xlrd-1.0.0

====

The folder “1 plainProgrammingBug” in SLAPP (Python 2), in program box we have the Python 3 version

HOWTO add agents?

—

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

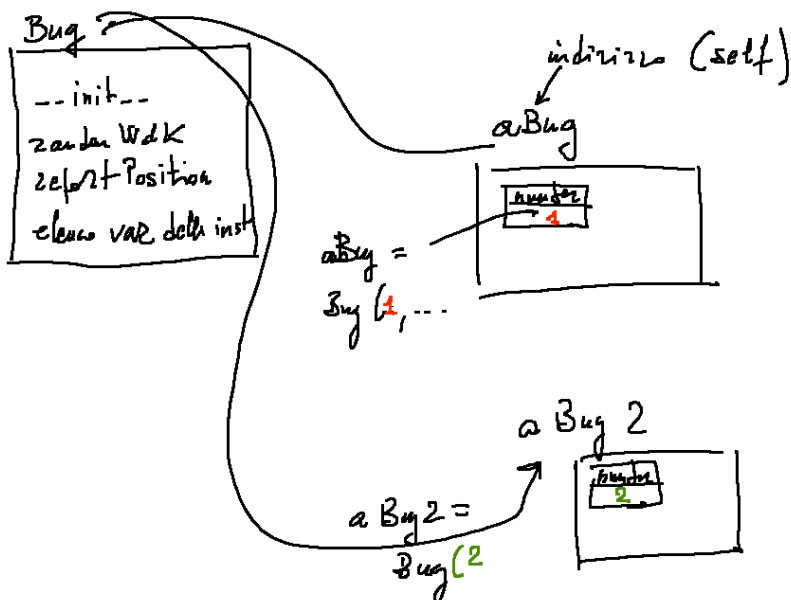
—

"2 basicObjectProgrammingBug" in SLAPP using the P3 v. in Programming Examples box

Adding collections

"3 basicObjectProgrammingManyBugs" in SLAPP (with a further step in "start 3 basicObjectProgrammingManyBugsAppend.py" reported in the Cmap) using always the box Programming examples

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 2 basicObjectProgrammingBug.nlogo

start 3 basicObjectProgrammingManyBugs.nlogo

—

February 16th, Thursday, no lesson

—

Old and current Home-works

Novelties in the Cmap (Readings)

(Economy)

completed the picture above

<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=L0FFCRlskyQ>

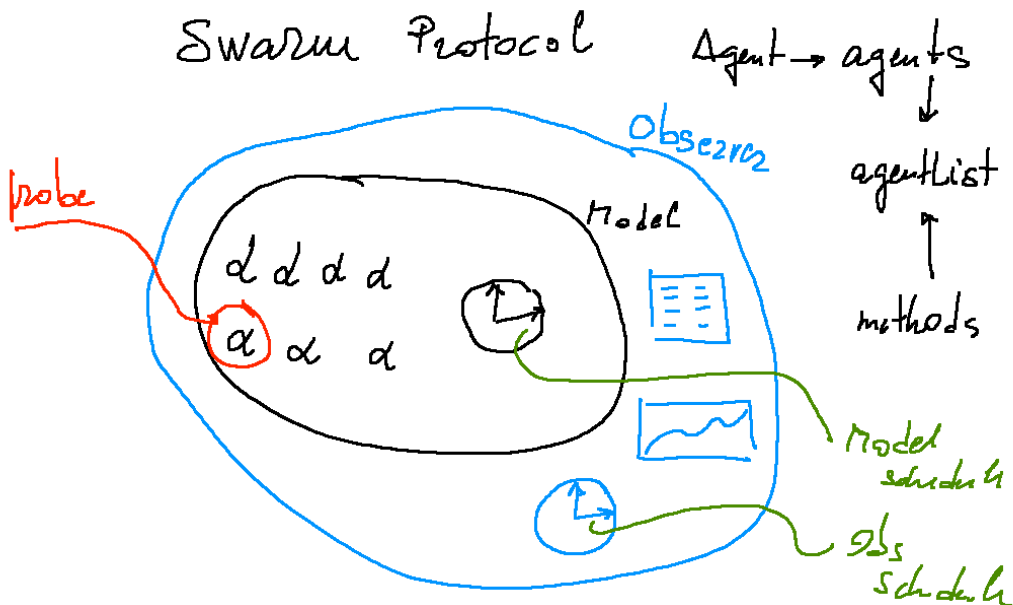
Daron Acemoglu and Pascual Restrepo. Secular stagnation? the effect of aging on economic growth in the age of automation. 2017.

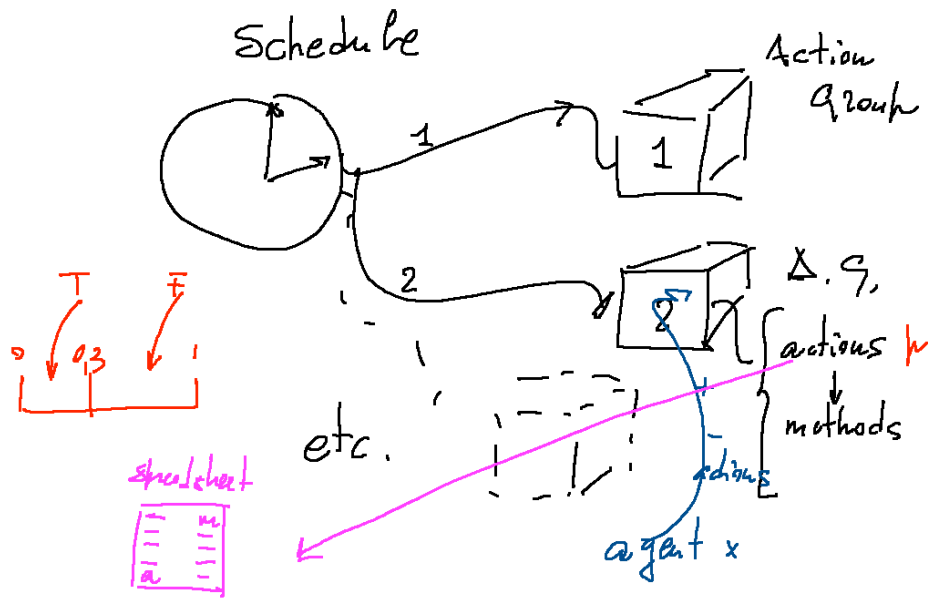
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2899142

Also in Camp readings

—

The Swarm protocol and the schedule representation





—

class Turtle and
 turtlesMovingTalking.py
 turtlesMovingTalking_DISPLAYING.py

—

Python/SLAPP folder 4:
 basicObjectProgrammingManyBugs_bugExternal+_shuffle.py
 Bug.py

start 4 basicObjectProgrammingManyBugs+_shuffle.nlogo
 start 4bis basicObjectProgrammingManyBugs+_shuffle+_ModAttributes.nlogo
 breeds.nlogo

—

—

Economics again

Basics of consumer choice

$$U(x_1, x_2, \dots, x_n) \quad \frac{\partial U}{\partial x_i} > 0 \quad \frac{\partial^2 U}{\partial x_i^2} < 0$$

$$-R + x_1 r_1 + x_2 r_2 + \dots + x_n r_n = 0$$

$$L = U(x_1, x_2) - \lambda [r_1 x_1 + r_2 x_2 - R]$$

$$\frac{\partial L}{\partial x_1} = \frac{\partial U}{\partial x_1} - \lambda r_1 = 0$$

$$\frac{\partial U / \partial x_1}{r_1} = \lambda$$

$$\frac{\partial L}{\partial x_2} = \frac{\partial U}{\partial x_2} - \lambda r_2 = 0$$

$$\frac{\partial U / \partial x_2}{r_2} = \lambda$$

$$\frac{\partial L}{\partial \lambda} \rightarrow \text{violate}$$

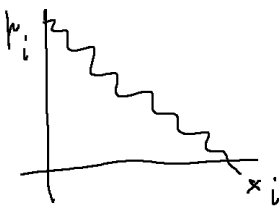
February 7th, 8th, and 9th

Old and current Home-works

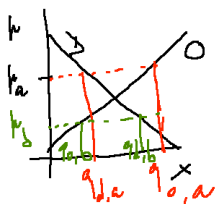
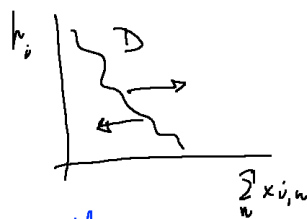
Economics

Price, quantity, global demand

$$p_i \uparrow \quad x_i \downarrow \quad \frac{\partial U}{\partial x_i} = \lambda \rightarrow ?$$



$$x = f(p)$$



surplus



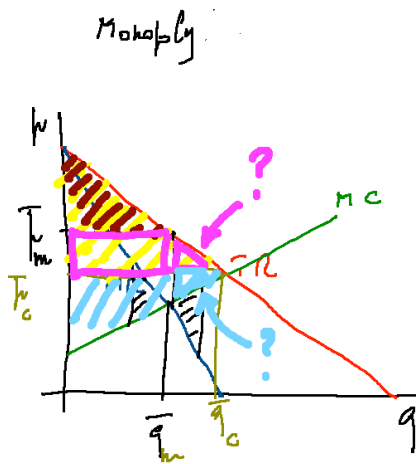
novelties in the Cmap

Old and current Home-works

Trend agents in CDA

Economics

Monopoly



profit count

$$q = d + p \cdot k$$

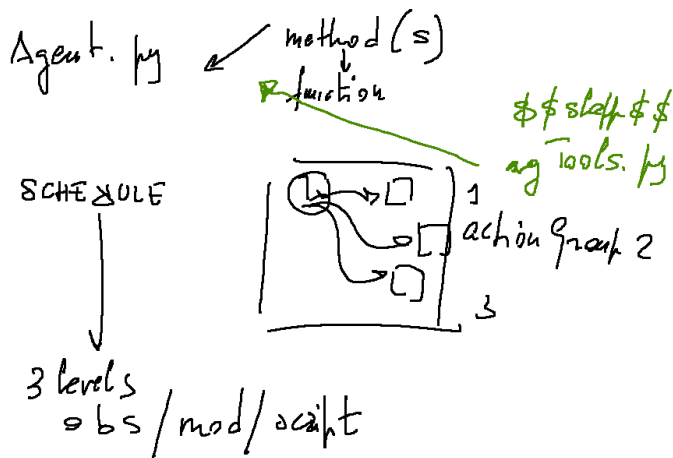
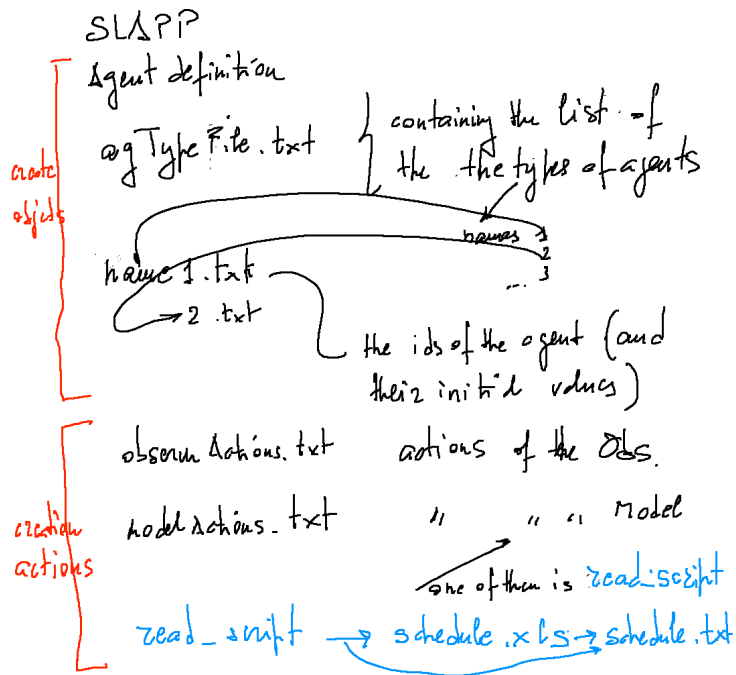
~~$p = a + b \cdot q$~~ demand curve

$$TR = p \cdot q = a \cdot q + b \cdot q^2$$
$$MR = TR' = a + 2b \cdot q$$

getting closer to

the running shell of SLAPP, folder

6 objectSwarmObserverAgents_AESOP_turtleLib_NetworkX



using iPython and Jupyter
<https://ipython.org>
<https://jupyter.org>

pip wheel jupyter

(pip, pip2, pip3)

—

SLAPP again

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.

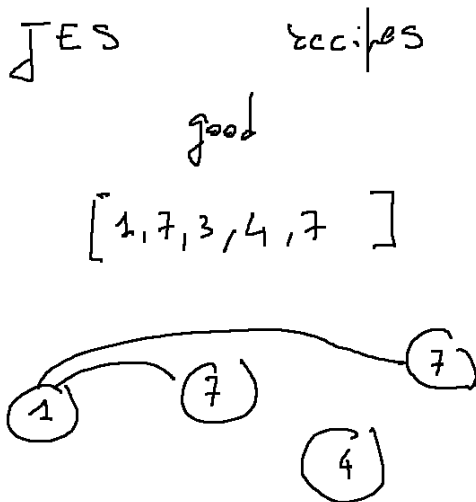
If we create a xls file, this is used instead of the txt one.

explore projects:

basic

production

a short explanation about production (which is deeply explained in my 2015 book):



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>

—

related to the production, a first step in Python with NetworkX <http://networkx.github.io>

aFirstStepWithNetworkX.py

aFirstStepWithNetworkX_&_agents.py

February 21st, 22nd and 23th

Jacopo Pellegrino in GAMA and Jade on Wednesday 22nd

—

Old and current Home-works

—

Exam

—

—

launching
jupyter notebook

—

Cmap

Scratch, StarLogo TNG

—

NetworkX again
with the betweenness example

betweennessWithNetworkX_&_agents.py
betweennessWithNetworkX_&_agents_large.py

(later, with NetLogo and NW extension)

—

R

special learning tool for R: swirl

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

a book about
R Programming for Data Science

examples in the Camp

a_R_demand_offer.R

a first look to ANNa (box Artificial Neural Networks, annBasics).

```
b_nnet_xor.R  
c_nnet_1_o.R  
d_nnet_2_o.R
```

—

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

—

—

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

February 28th, March 1st, and 2nd

Novelties in the Cmap

—

Old and current Home-works

—

the ANN of the class

e_people_20170221.zip

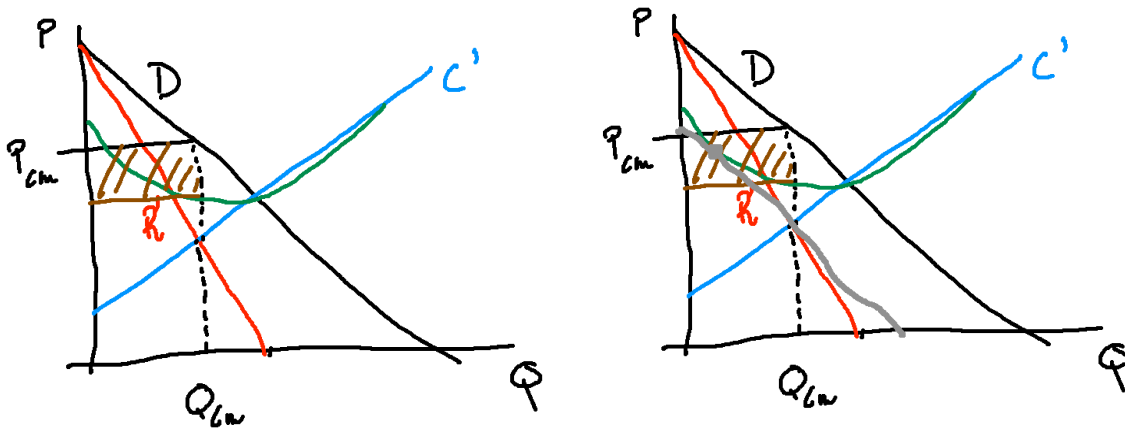
(and the old RNA code).

—

—

Economics

Monopolistic competition



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

—

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> (within branch 5.x)
look at the Network Extension General Demo
with the info sheet and to its weblinks

reported also in our repository

d) an emerging network: productionWorld.nlogo

Python and the NetworkX library

NetworkX use (as already seen):

Look at

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

<https://networkx.github.io/documentation/networkx-1.10/reference/algorithms.html>

—

Economics

Summarizing

Consumer

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

$$\frac{\partial U}{\partial x_i} > 0 \quad \frac{\partial^2 U}{\partial x_i^2} < 0$$

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

$$S = \hat{R} - \bar{R} \leftrightarrow \text{Inv.}$$

$$\frac{\partial U}{\partial x_1} = \lambda$$

$$\frac{\partial U}{\partial x_2} = \lambda$$

Perfect competition ∞ prod

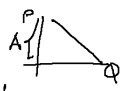
 Monopoly

 Non competition

—
Oligopoly

oligopoly \rightarrow Duopoly 'Cournot' P
 Demand curve $P = A - Q$
 $C'_1 = C'_2 = c$
 $Q = Q_1 + Q_2$
 $TR_1 = P Q_1 = [A - (Q_1 + Q_2)] Q_1 = A Q_1 - Q_1^2 - Q_1 Q_2$
 $\max R_1 = A - 2Q_1 - Q_2 = 0$
 $Q_1 = \frac{A}{2} - \frac{Q_2}{2}$; $Q_2 = \frac{A}{2} - \frac{Q_1}{2}$ } reaction functions

Oligopoly \rightarrow Duopoly (Stackelberg) $P = A - Q$
 1 big firm

$R_1 = A - Q_1 - Q_2 - Q_1^2 - Q_1 Q_2$ (x) 

reaction function $Q_2 = \frac{A}{2} - \frac{1}{2} Q_1$ (previous Q_i)

$R_1 = \frac{A}{2} Q_1 - \frac{1}{2} Q_1^2$

$R_1' = \frac{A}{2} - Q_1 \rightarrow 0$ max profit

$Q_1 = \frac{A}{2}$ $Q_2 = \frac{A}{2} - \frac{1}{2} \cdot \frac{A}{2} = \frac{1}{4} A$

—

Oligopoly model with Marco Mazzoli and Matteo Morini

The slides are in Readings and Links:

<http://terna.to.it/econophysics17/cmap/An%20oligopolistic%20model%20wih%20SLAPP.pdf>

March 7th and 8th

Novelties in the Cmap

Last Home-work

—

Pandas (have also a look to the other projects via Numfocus)

Quandl

about Quandl, look at myFirstQuandlExample.ipynb from the Camp (Python_examples)

—

connecting R to NetLogo

using R extension (NetLogo 6 or more)

Within R

only once (and it is not necessary to keep R running)

`install.packages("rJava")`

`install.packages("JavaGD")` # Optional

`install.packages("CommonJavaJars")` # Optional

in case of troubles look at the NetLogo User Manual (Extensions, R, Configuring the R extension)

Within NetLogo
extensions/r/models

example1.nlogo

install.packages("spatstat"), then
plot-example1.nlogo

plot-example2.nlogo

—

connecting R to Python
http://terna.to.it/econophysics17/cmap/pyRserve_Rserve.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, interactively

```
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?

Cobb-Douglas

$$P_t = A L_t^\alpha K_t^\beta$$

$$\alpha > 0$$

$$\beta > 0$$

$$\alpha + \beta \stackrel{?}{=} 1$$

$$\frac{P_t}{L_t} = \frac{P_t}{K_t}$$

$$\frac{\partial P}{\partial L} = \alpha A L^{\alpha-1} K^\beta$$

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

idem
K

$$\alpha + \beta \stackrel{?}{=} 1$$

$$\bar{P} = A L^\alpha K^\beta \quad \min C = wL + zK$$

$$\Delta = C + \lambda (\bar{P} - P(L, K)) \quad \frac{\partial \Delta}{\partial L} = w - \lambda \frac{\partial P}{\partial L} = 0$$

$$\frac{\partial \Delta}{\partial K} = z - \lambda \frac{\partial P}{\partial K} = 0$$

$$\frac{\partial P / \partial L}{w} = \frac{\partial P / \partial K}{z} = \lambda$$

$$P = A L^\alpha K^\beta \quad \gamma$$

$$P_2 = A (\gamma L)^\alpha (\gamma K)^\beta = A \gamma^{\alpha+\beta} L^\alpha K^\beta$$

$$P_2 = \gamma P$$

returns of scale \rightarrow constant
 $\left. \begin{array}{l} = 1 \\ < 1 \\ > 1 \end{array} \right\}$
 ? denesting
 ? increasing

(with pp. 90-106 of Fenoaltea's book)

Let us recapitulate from the beginning, about economics: the role of prices

—

In NetLogo box

__includes
 BehaviorSpace
 eXtraWidgets

—

March 14th

—

Novelties in the Camp:
NumPy Cheat Sheet in NumPy (SciPy) box
Ipython Or Jupyter (?) in Ipython / Jupyter box

—

tutormagic extension for the Jupyter notebook (in Ipython / Jupyter box)

to consolidate Python knowledge

follow <https://github.com/kikocorreoso/tutormagic>
and install the magic tutor with
pip install tutormagic

use it as in tutormagicExample.ipynb
in Python_examples
from the Cmap

—

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.

Links in Reading and Links to the
Centre for Research in Social Simulation (Nigel Gilbert)
and to the
Agent-Based Computational Economics web site (Leigh Tesfatsion)

—

Genetic Algorithms and NetLogo
in the specific box we have the link to <http://www.behaviorsearch.org/index.html> where, under Download, we read: “**ALERT:** BehaviorSearch currently only works with Netlogo 5.2.x and earlier. We are working on a new version of BehaviorSearch that will work with Netlogo 5.3.x and above...”

but, within the NetLogo 6.0 folder, we have the “Behaviorsearch 6.0.app” for Mac (or proper executables for the other operating systems) and
a folder of examples
a folder of documentation (with a tutorial)

let's see the Example_Flocking_Convergence.bsearch example (via File / Open Example)
we are using models/Sample Models/Biology/Flocking.nlogo

what if we want to evolve a specific agent, not a model?

—

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 Special Issue: Econophysics
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>

Also interesting the whole number of Complexity, on Econophysics
<http://onlinelibrary.wiley.com/doi/10.1002/cplx.v14:3/issuetoc>
also in readings and links

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 project to play with complexity: PyCX
<http://pycx.sourceforge.net>
(in my computer the folder pycx-0.32 is in Documents, to be used with Python 2.7)

—

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 ...

—

The future about work: a jobless society?

A conference of Pietro Terna in Biella a few weeks ago at
http://terna.to.it/materiale/Biella_20170202.pptx (> 100Mb)