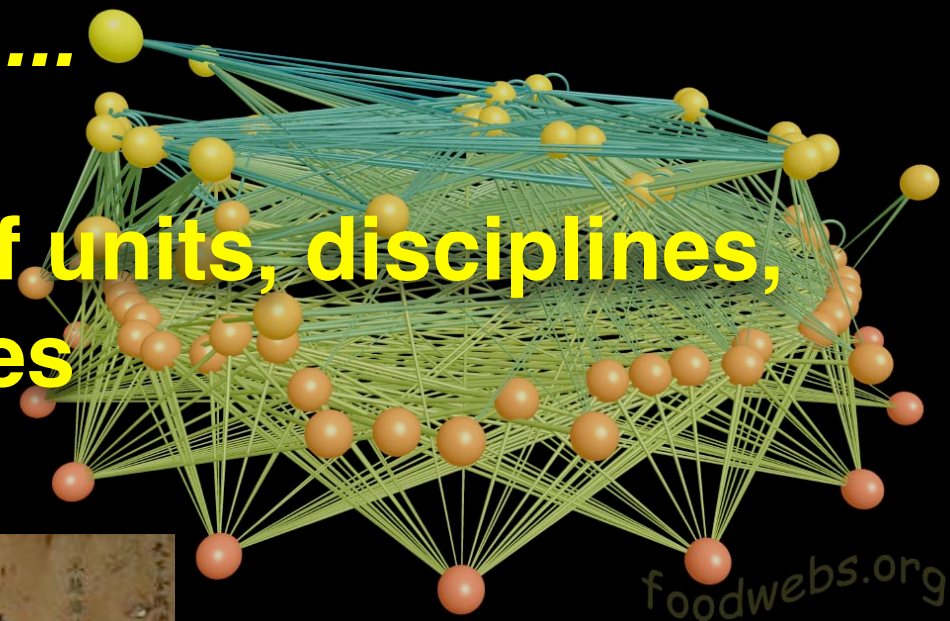
Everyone needs a map ...

Educational mapping of units, disciplines, faculties and universities



Simon Angus & Andrew Newnham
Department of Economics
Monash University

MONASH University
Business and Economics

Agenda

The idea ...

Some associated concepts

  Networks: Quick concept review

Mapping:

  ... a unit

  ... a department

  ... two departments

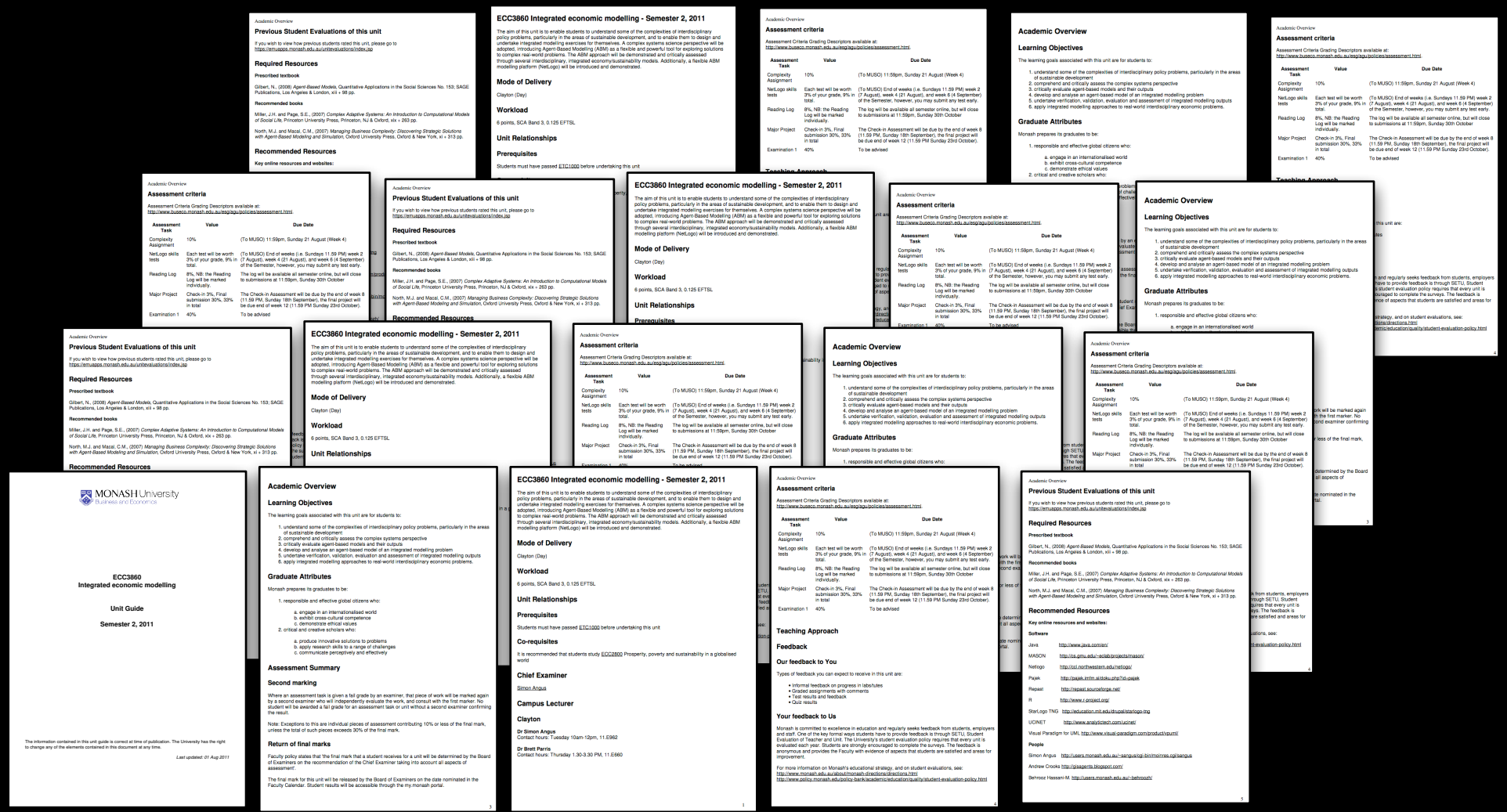
  ... a faculty

  ... (ahem) ... a university

Have we got what we wanted?

The idea ...

This is how we present our unit ...



Angus & Newnham: Everyone needs a map ...

MONASH University
Business and Economics

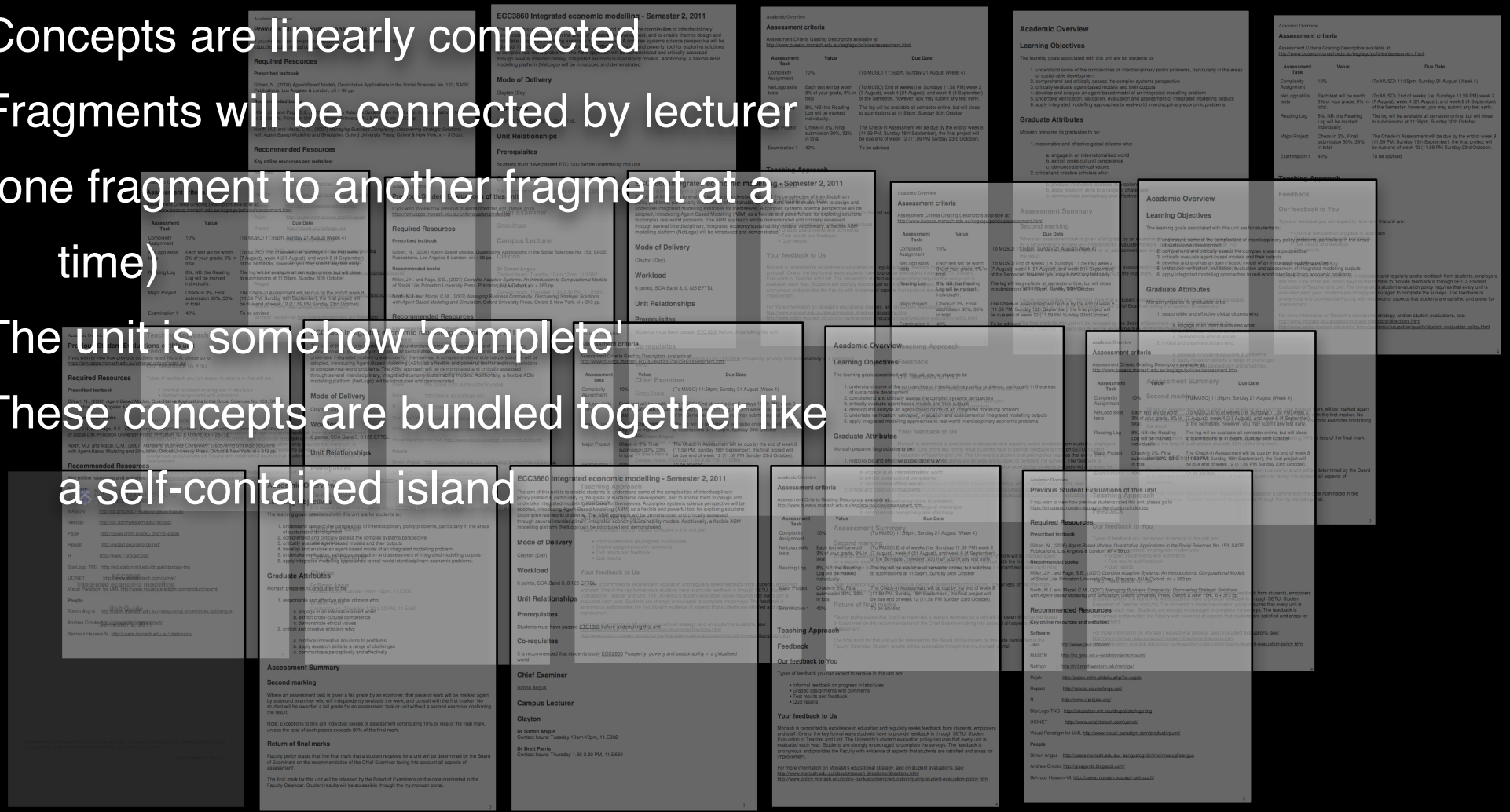
Which says:

Concepts are linearly connected

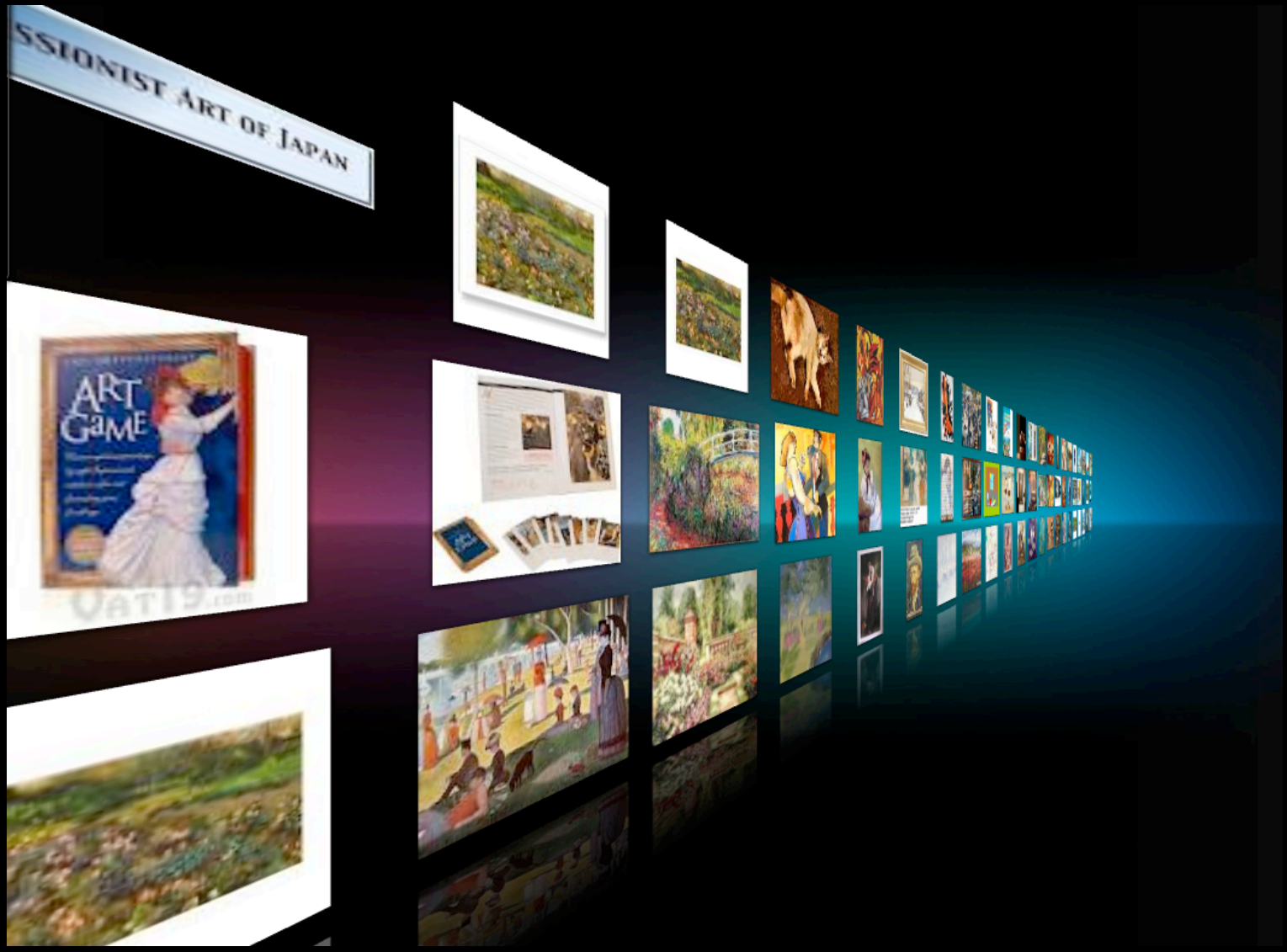
Fragments will be connected by lecturer (one fragment to another fragment at a time)

The unit is somehow 'complete'

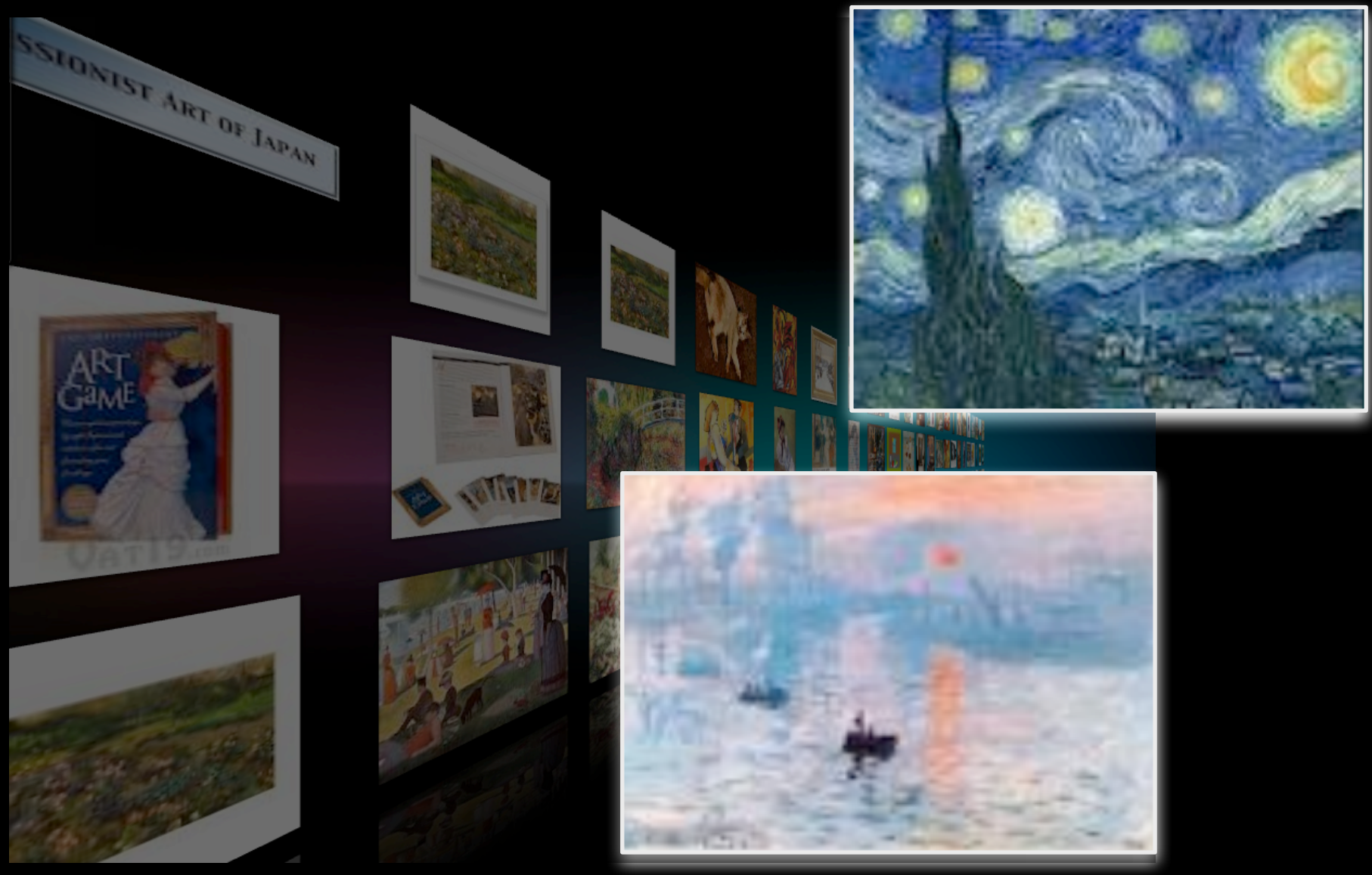
These concepts are bundled together like a self-contained island



A mental model of a lecturer ...



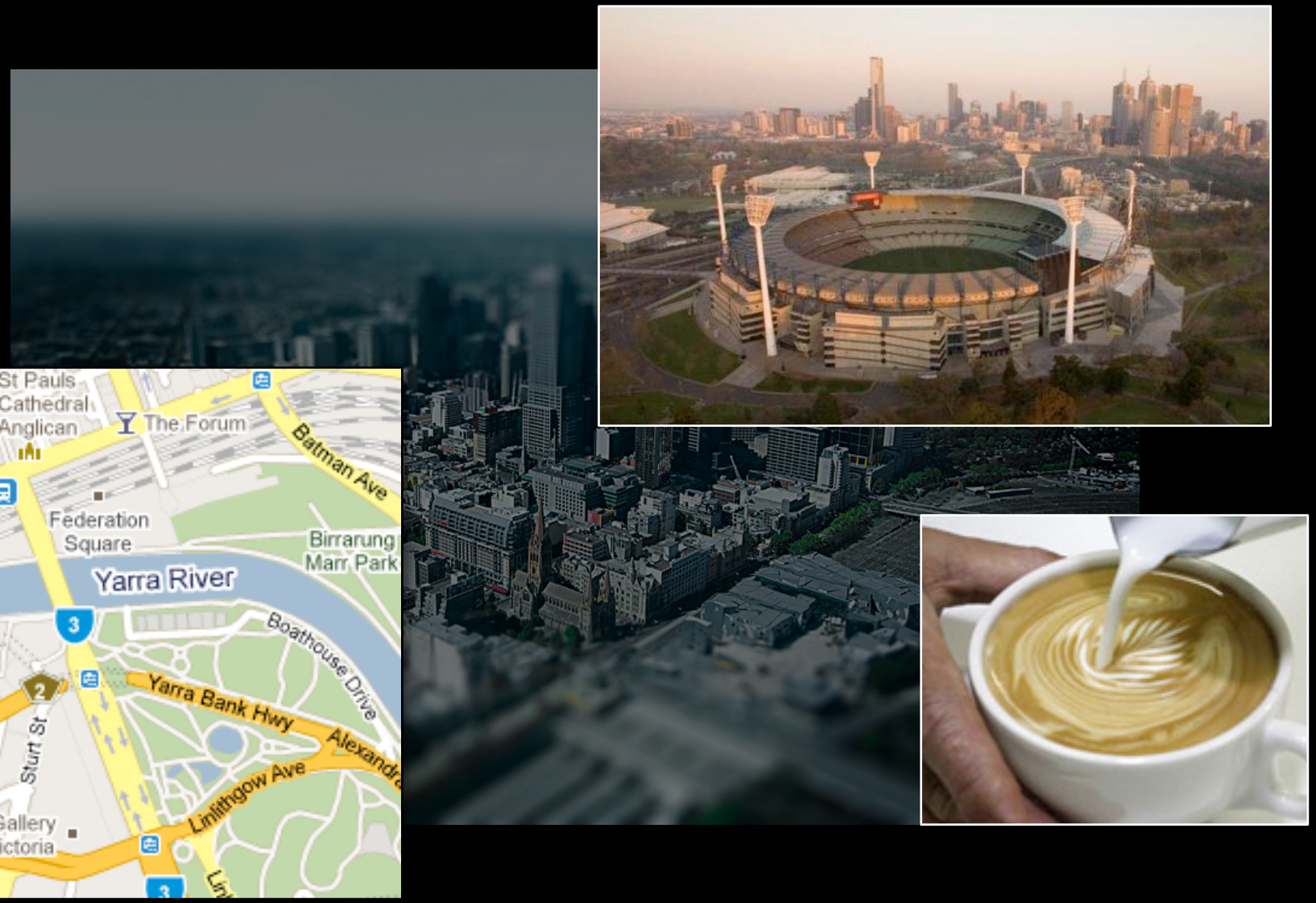
A mental model of a lecturer i ...



A mental model of a lecturer ii ...

Credit: http://www.hojitsu.net/2009/02/tiltshift-test/

A mental model of a lecturer ii ...



Credit: http://www.hojitsu.net/2009/02/tiltshift-test/

So if we are more like this:

Then we need one of these:

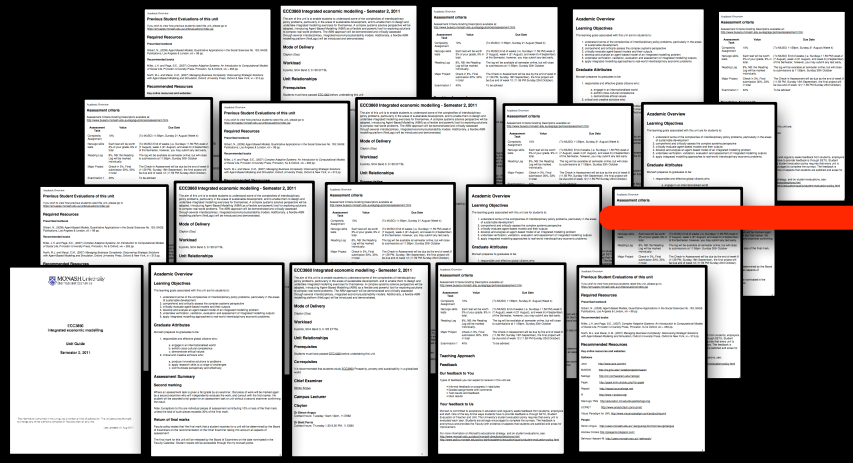
... to help people see where we're going and where we've been (and how everything fits together)

http://www.wildernesstravel.com/leaders/hedges-adam

.. oh, actually, we already have that!

http://www.wildernesstravel.com/leaders/hedges-adam

So our problem is:



http://www.wildernesstravel.com/leaders/hedges-adam

Why would a map of our unit be helpful?

For students

See the key concepts in one place

See how they relate to each other (in 'concept-space')

Identify adjacent concepts to their interests, or difficulties

For staff

Make what is in our heads public

A key reference within our teaching to orientate the students our present 'location'

Enables us to keep the 'map' in mind and structure our teaching

Get away from purely linear/serial views of the knowledge landscape

http://www.wildernesstravel.com/leaders/hedges-adam

Some concepts ...

Maps as networks 1

Components of a network

nodes: concepts, locations,
airports, people

links:

'is similar to'

'is located near'

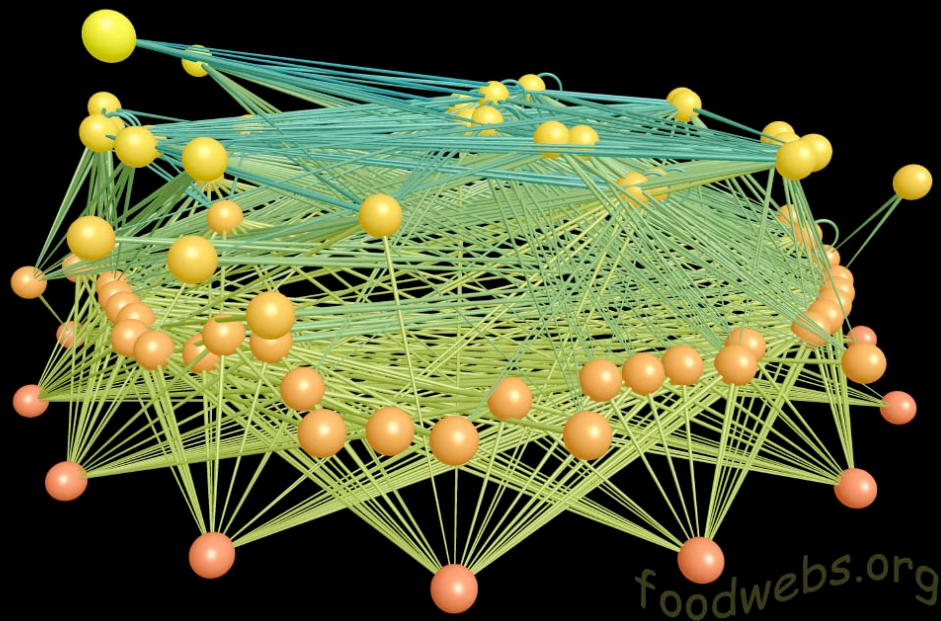
'has a transport link to'

'is in a sexual relationship with'

'is a parent of'

'is a trading partner of'

'is a predator of'



Dunne, J.A., R.J. Williams, N.D. Martinez. 2004. Network structure and robustness of marine food webs. Marine Ecological Press Series, vol. 273, pp. 291-30; Image produced with FoodWeb3D, written by R.J. Williams and provided by the Pacific Ecoinformatics and Computational Ecology Lab (www.foodwebs.org, Yoon et al. 2004).

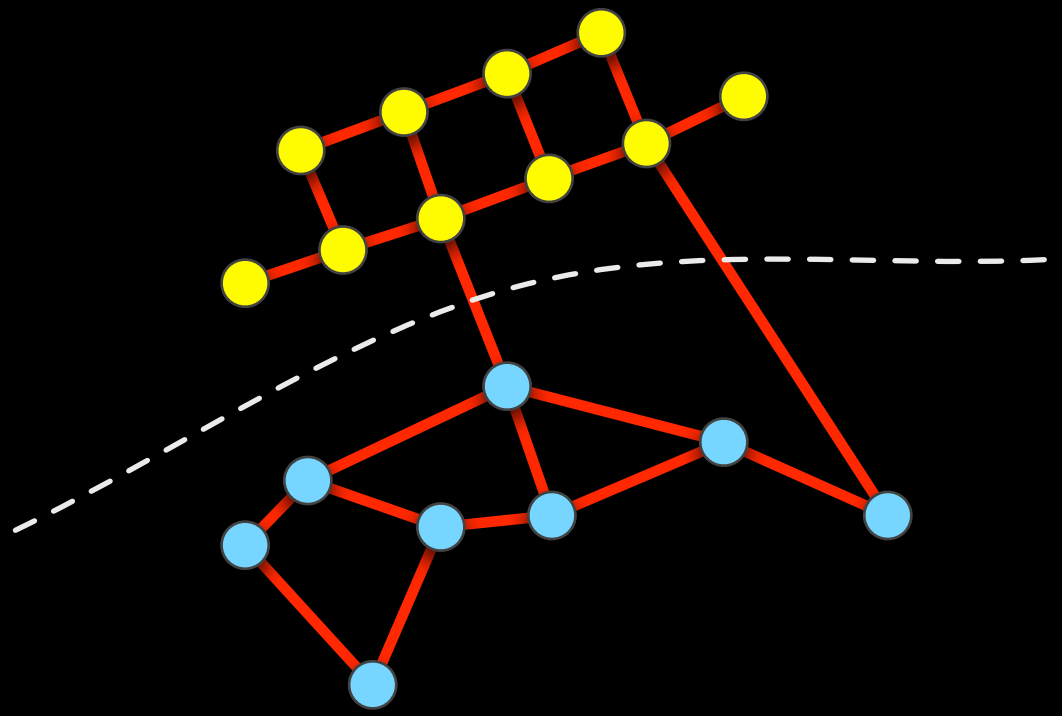
Maps as networks 2

Clustering ...

Sub-sets of nodes which are 'similar' in some way may be called a *cluster*

'cluster':

- 'are from the same family'
- 'share the same predator'
- 'are in the same country'
- 'are in the same ecology'
- 'share high connectivity with each other'



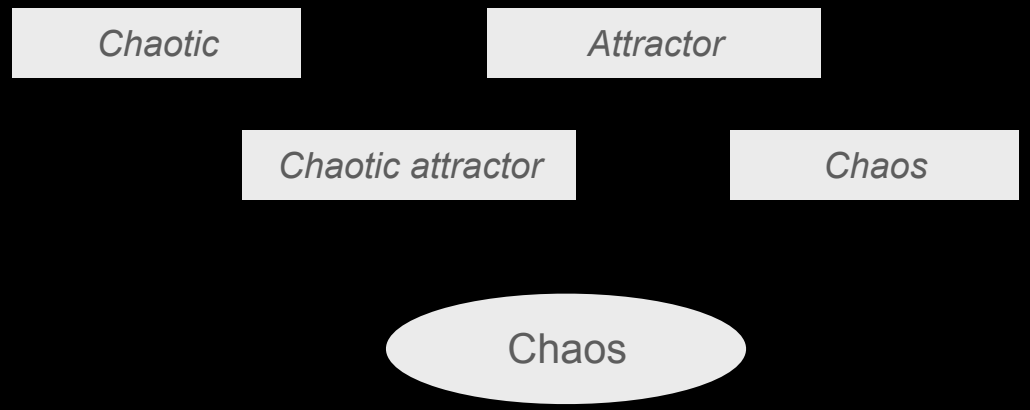
Mapping a unit ...

ECC/ETC 3860 Integrated Economic Modelling

Methods

1. Write down key concepts in the unit;
2. Collate the list into *root-concepts* (e.g. 'complex-systems' ~ 'complex system');
3. For each root-concept, identify related root-concepts

ECC/ETC 3860 Integrated Economic Modelling



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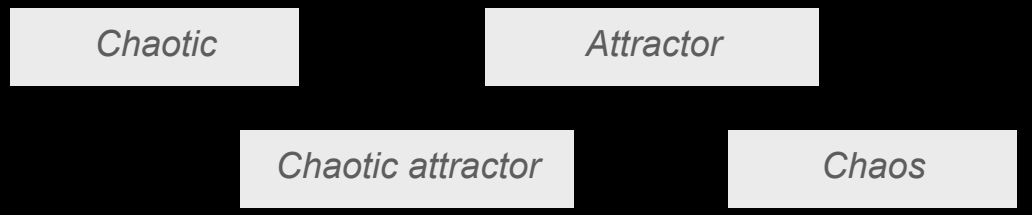
ECC/ETC 3860 Integrated Economic Modelling



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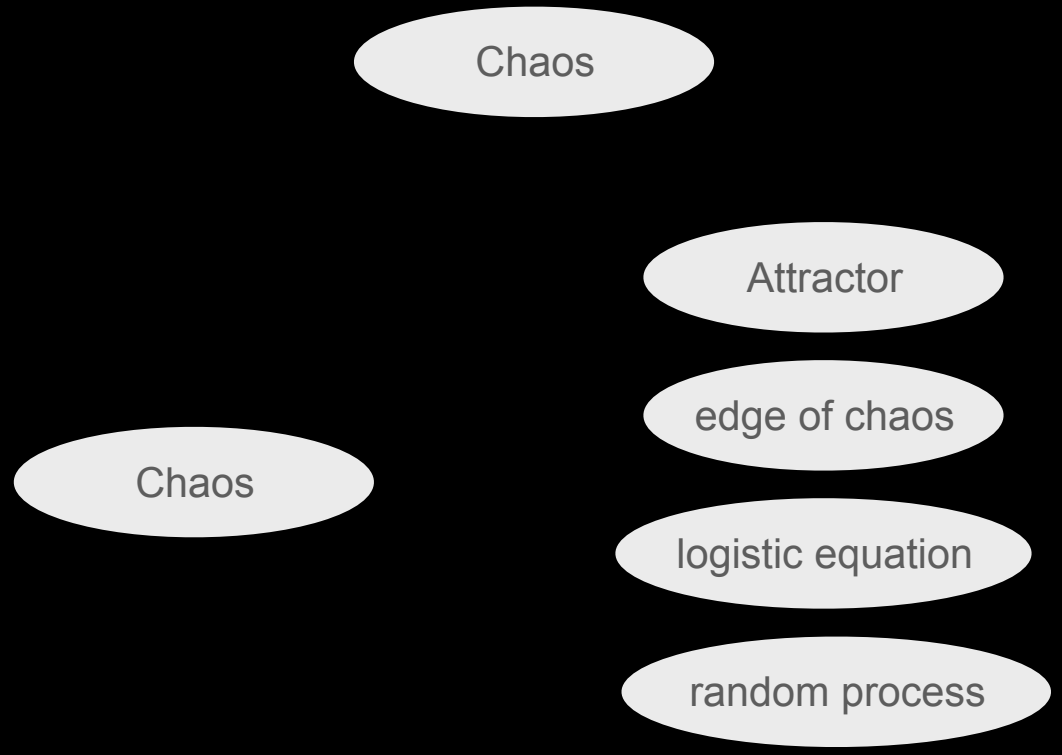
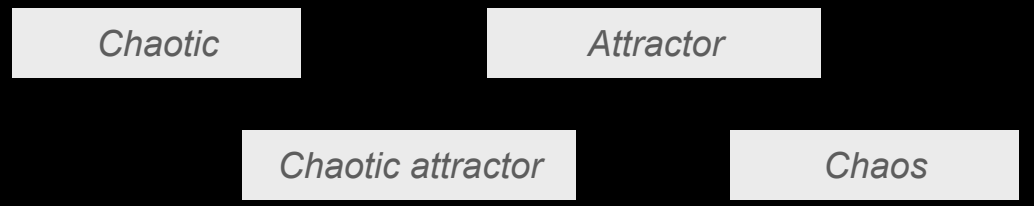


ECC/ETC 3860 Integrated Economic Modelling



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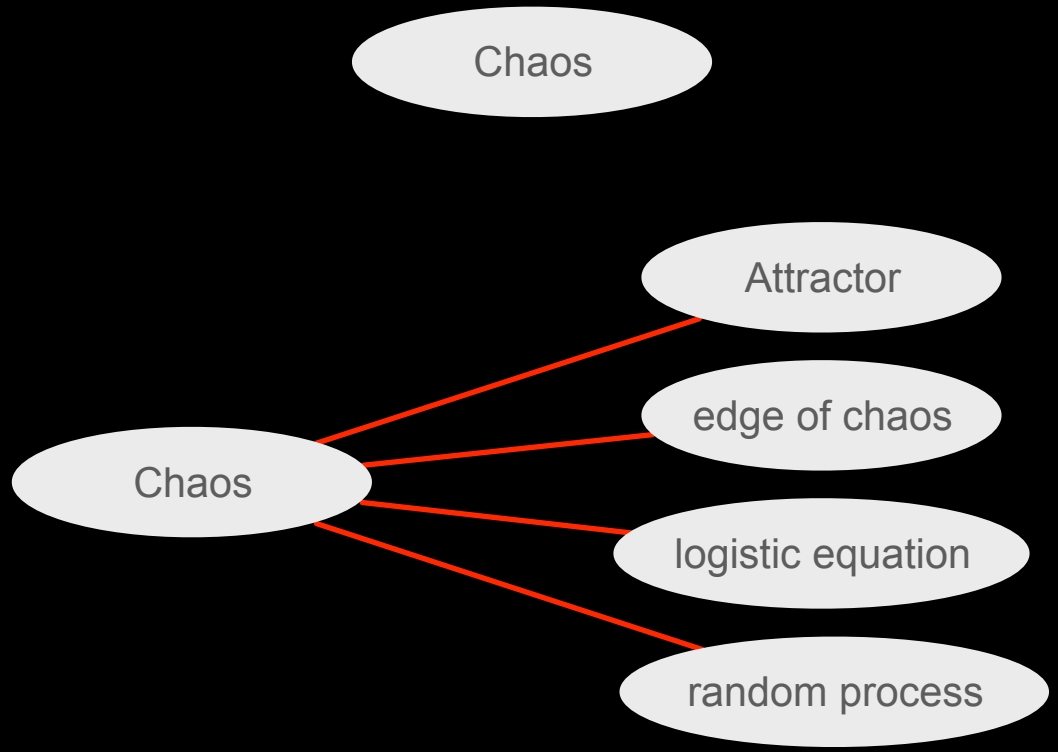


ECC/ETC 3860 Integrated Economic Modelling

Results ...

49 Root-concepts (nodes)

280 links

Avg. Degree: 5.714

Layout the network

Graphviz http://www.graphviz.org/

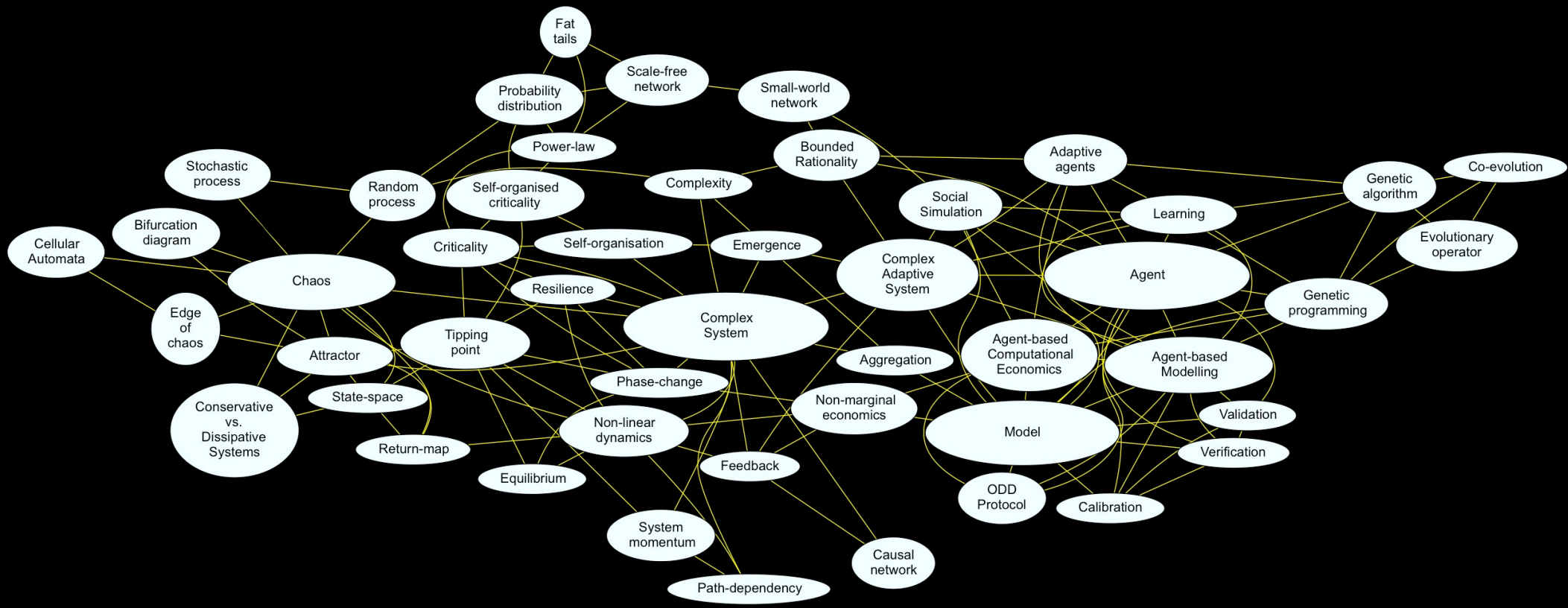
sfdp

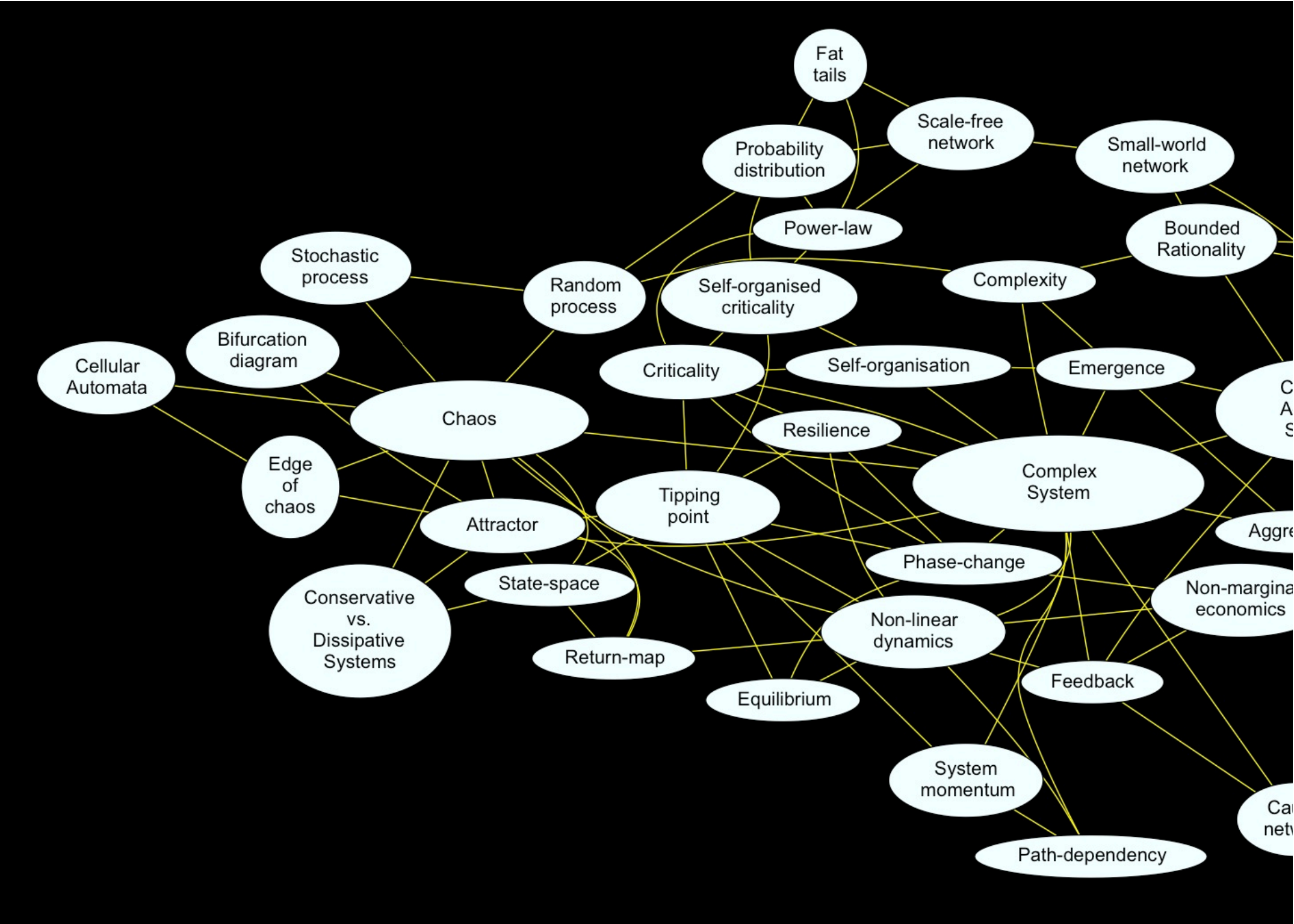
gvmap

See also

Gephi
makes graphs handy

http://gephi.org/


Fat tails
Scale-free network
Probability distribution
Small-world network
Power-law
Bounded Rationality
Adaptive agents
Co-evolution
Stochastic process
Random process
Self-organised criticality
Complexity
Social Simulation
Learning
Genetic algorithm
Bifurcation diagram
Cellular Automata
Criticality
Self-organisation
Emergence
Complex Adaptive System
Agent
Evolutionary operator
Chaos
Resilience
Genetic programming
Edge of chaos
Complex System
Tipping point
Agent-based Computational Economics
Agent-based Modelling
Attractor
Aggregation
Phase-change
State-space
Non-marginal economics
Validation
Conservative vs. Dissipative Systems
Non-linear dynamics
Model
Return-map
Verification
Feedback
Equilibrium
ODD Protocol
Calibration
System momentum
Causal network
Path-dependency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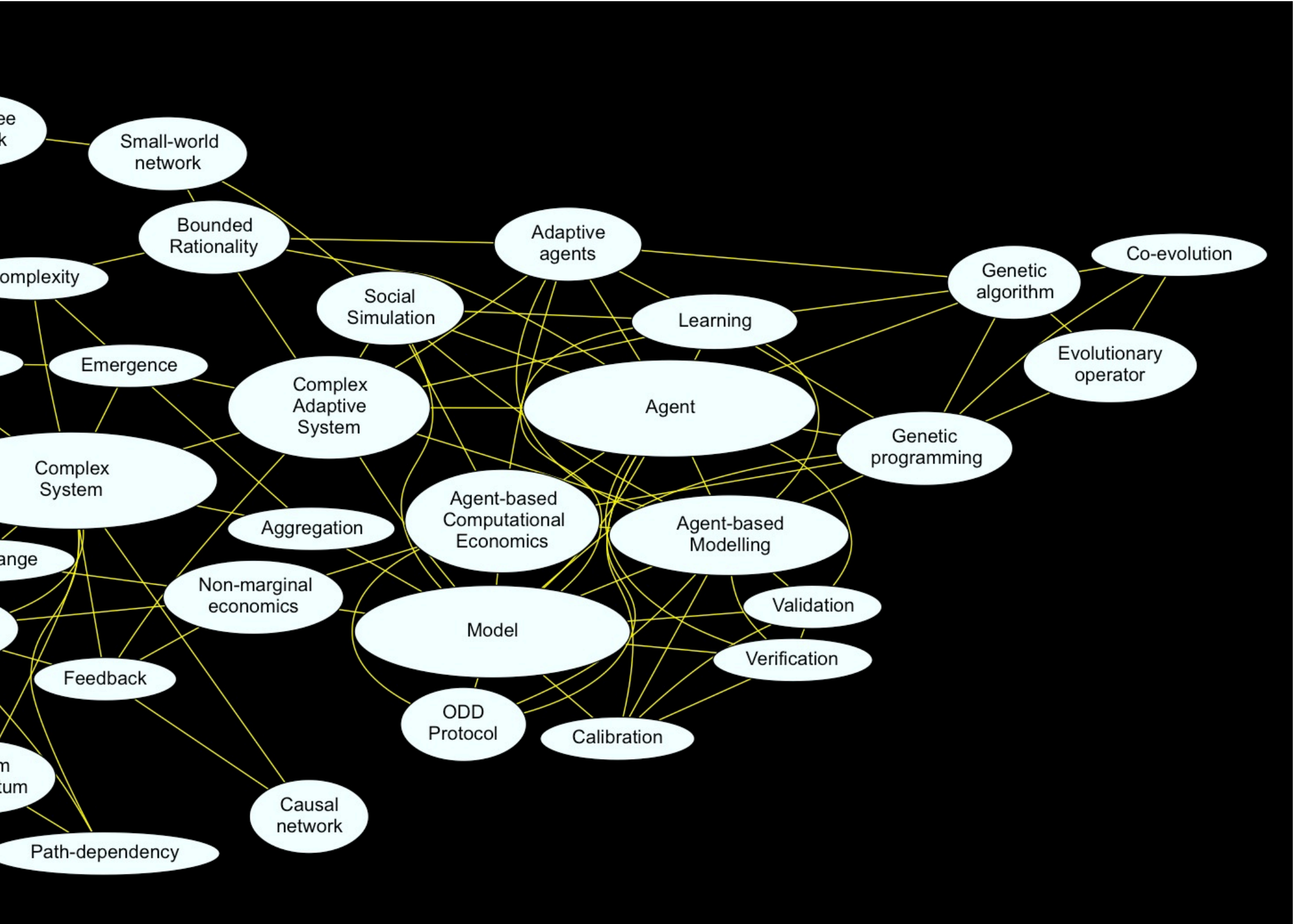
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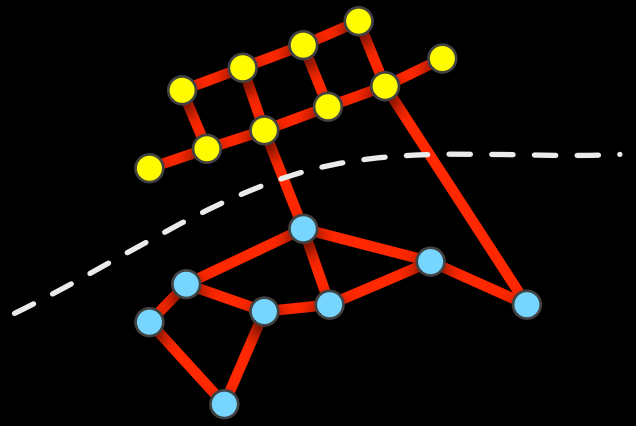
Network .. now map?

We need to identify

associated nodes ... call

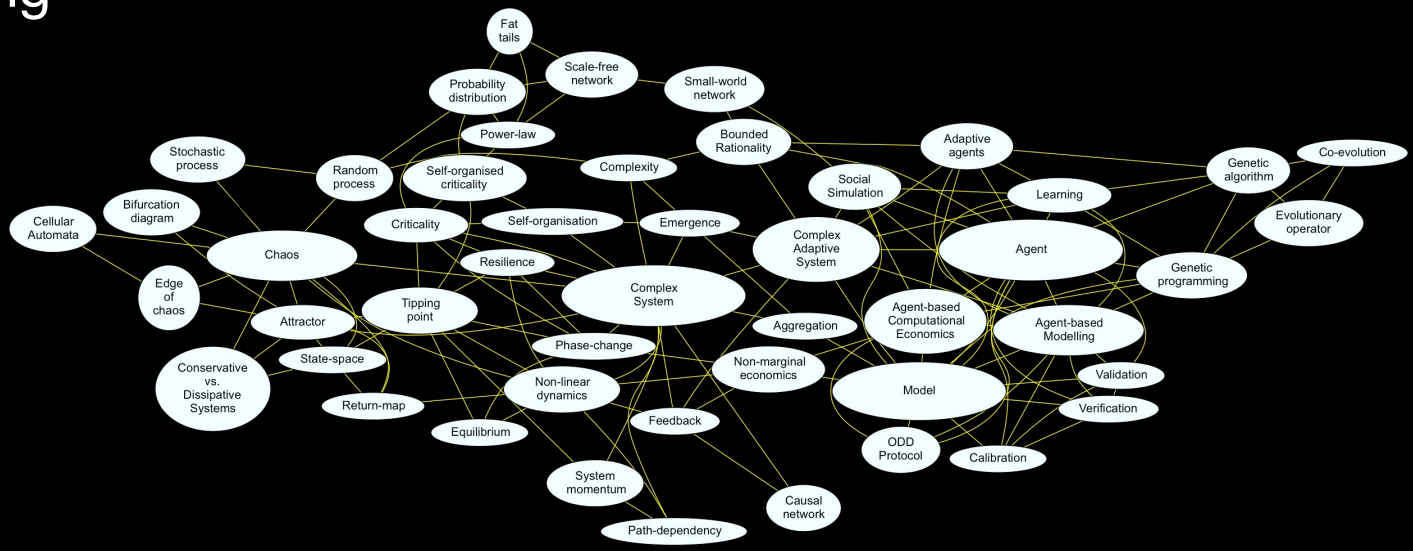
these 'countries'.

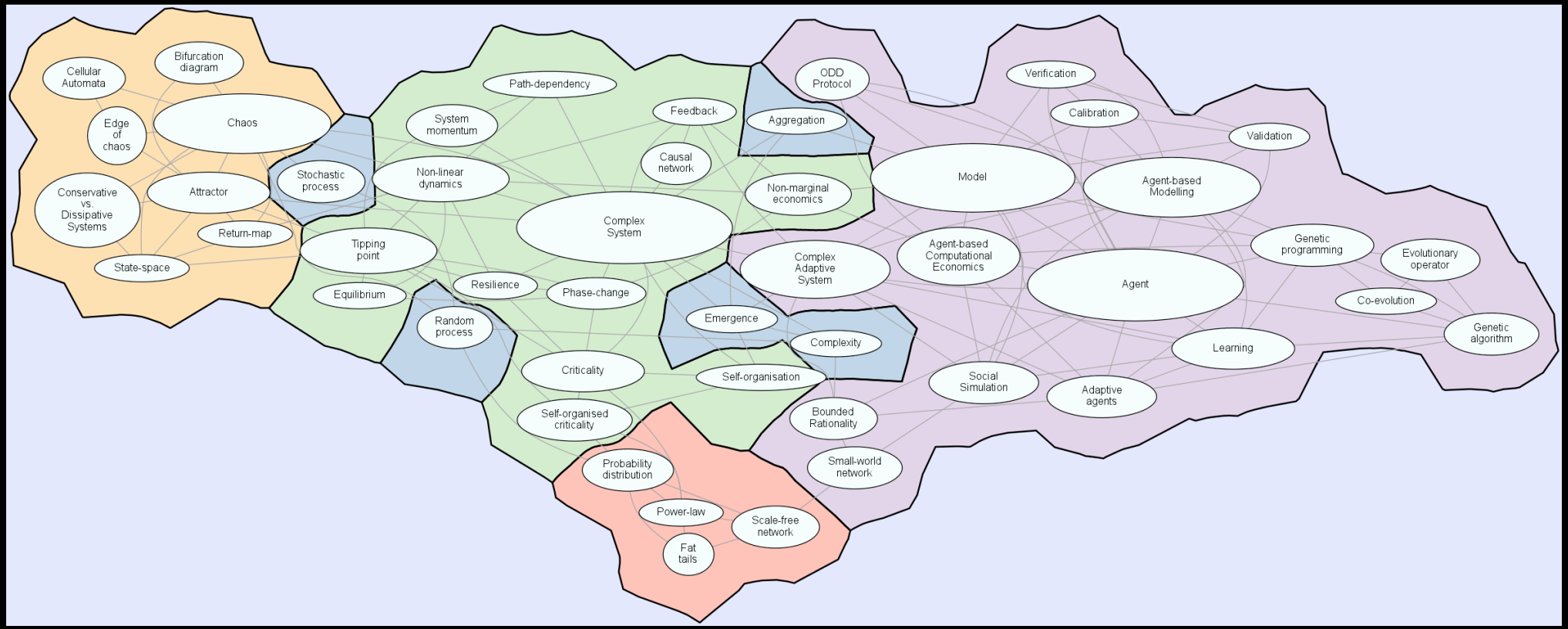


To do this, layout in 2D, and

apply clustering

algorithm





What did we learn?

... 4 main countries:

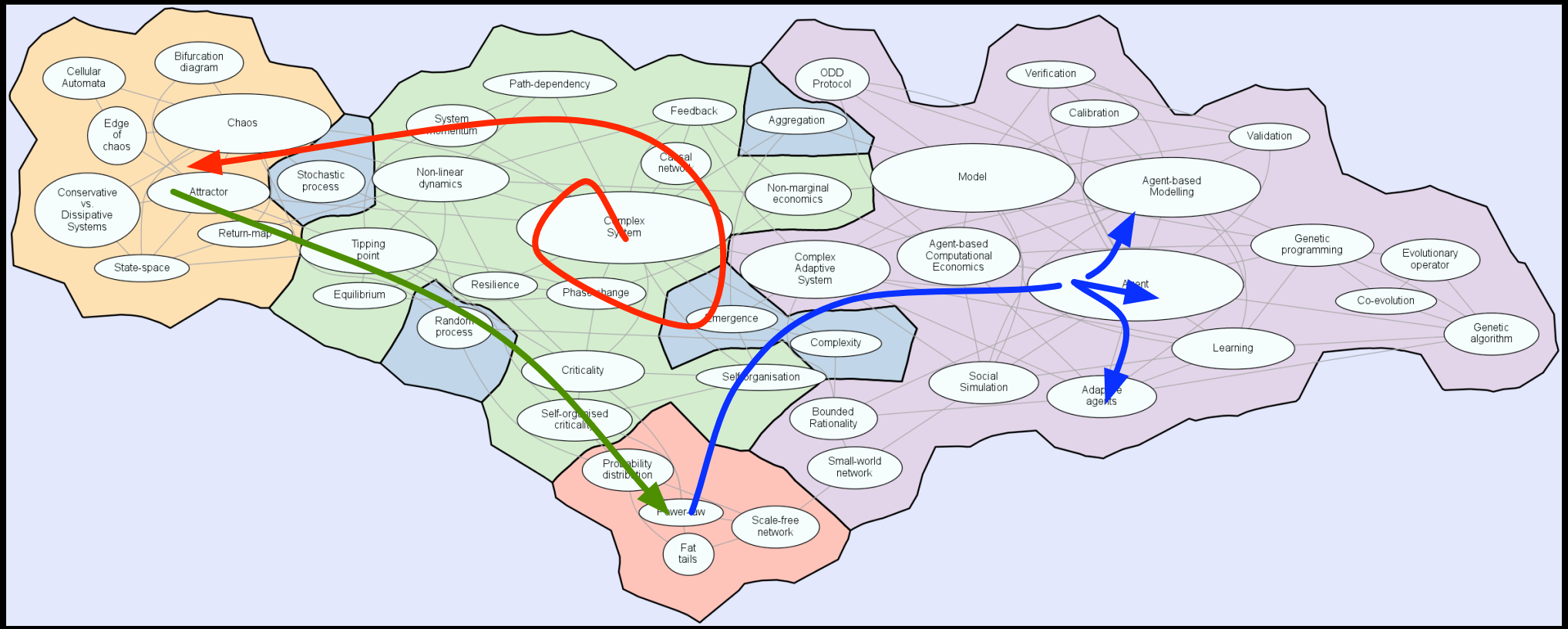
- 'Chaos-land'
- 'Complex Systems-land'
- 'Agent-land'
- 'Networks-land'

Some 'Strasburgs'

- Random/Stochastic Processes
- Aggregation
- Emergence
- Complexity

... interfaces between countries:

- Chaos --- Complexity
- Complexity --- Networks
- Complexity --- Agent
- Agent --- Networks



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- Aggregation
- Emergence
- Complexity

... interfaces between countries:

- Chaos --- Complexity
- Complexity --- Networks
- Complexity --- Agent
- Agent --- Networks

... Possible framework for teaching the unit:

Start in Complex Systems-land
- introduce other countries, key linking concepts

Then take on 'theory' in Chaos-land and 'Network-land'

Then move to practice .. Agent-land

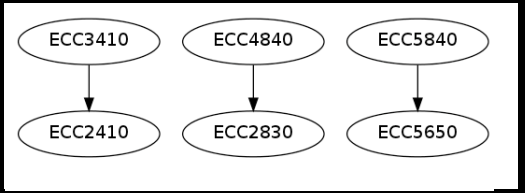
... taking it further

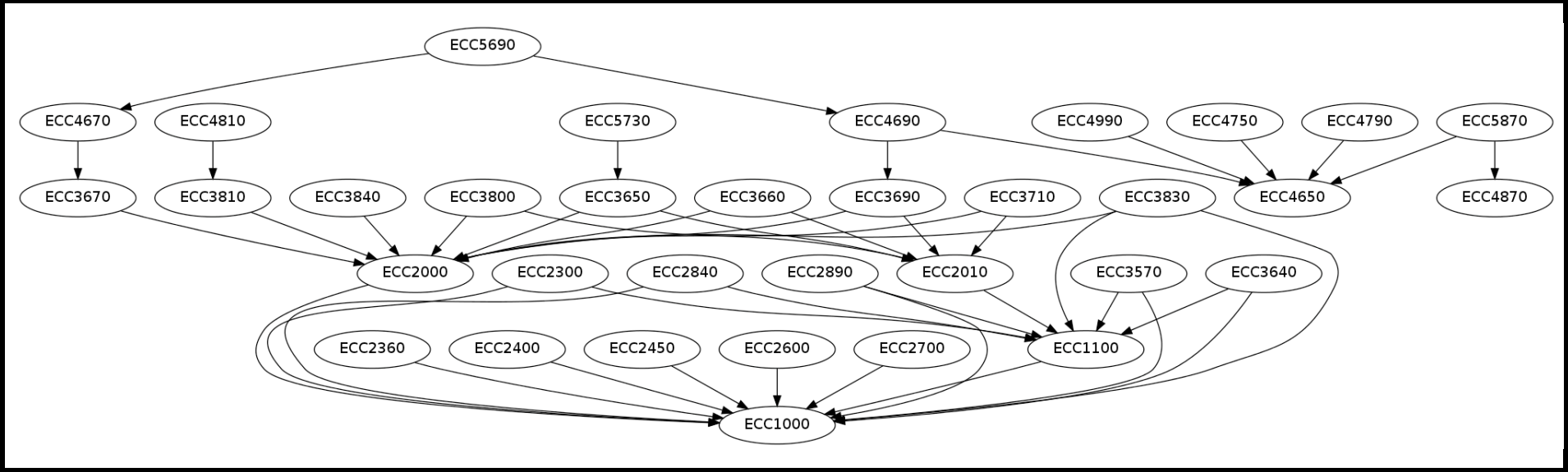
... mapping a unit in its context ....

... mapping one or more departments ...

Department of Economics ...

... we could do this:





Department of Economics ...

... or we could repeat the Unit method

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v. Time-consuming!!

(need to ask every lecturer to give us (say) 10 concepts ... ... then collate ... then ask them to give us relational links to other root-concepts ... then put together)

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Answer: We need SCALABILITY

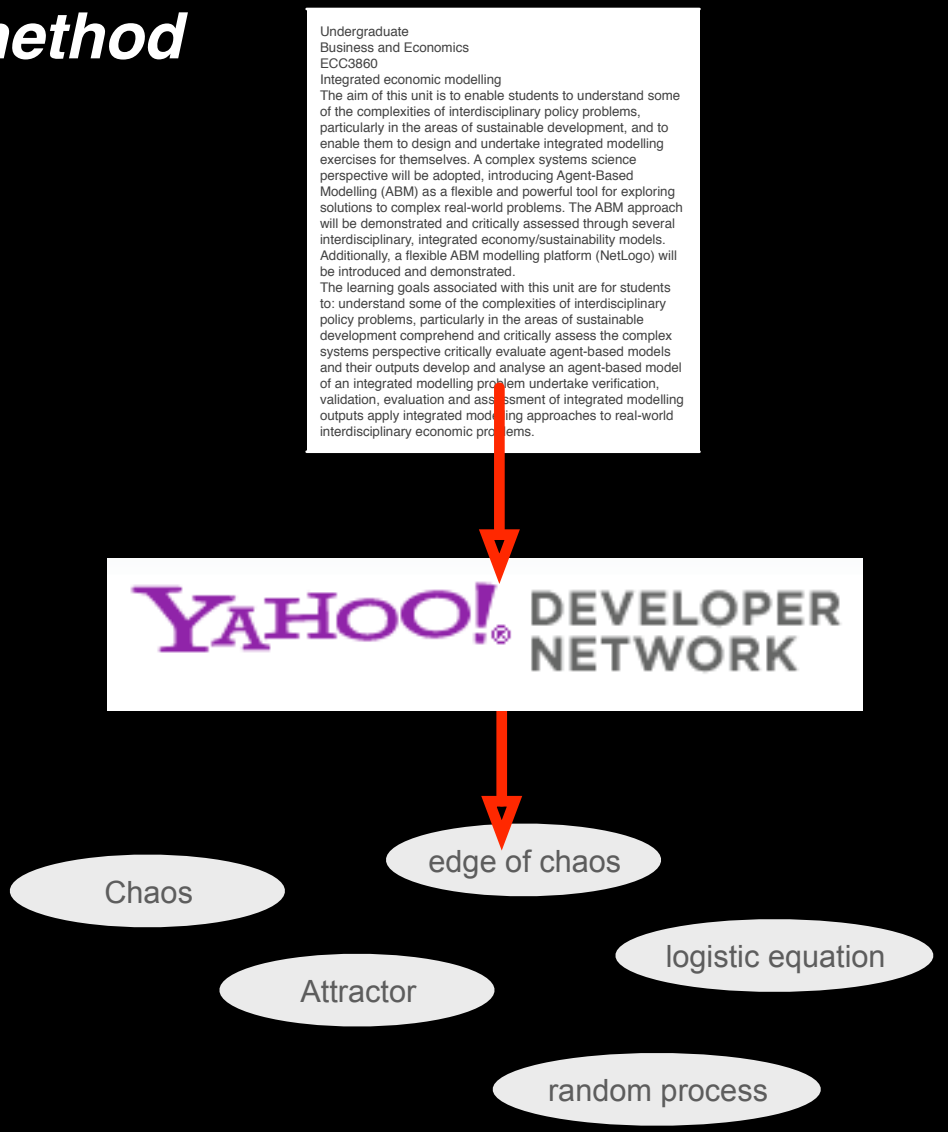
(that means, 'automation')

... enter the bots

... or we could repeat the Unit method

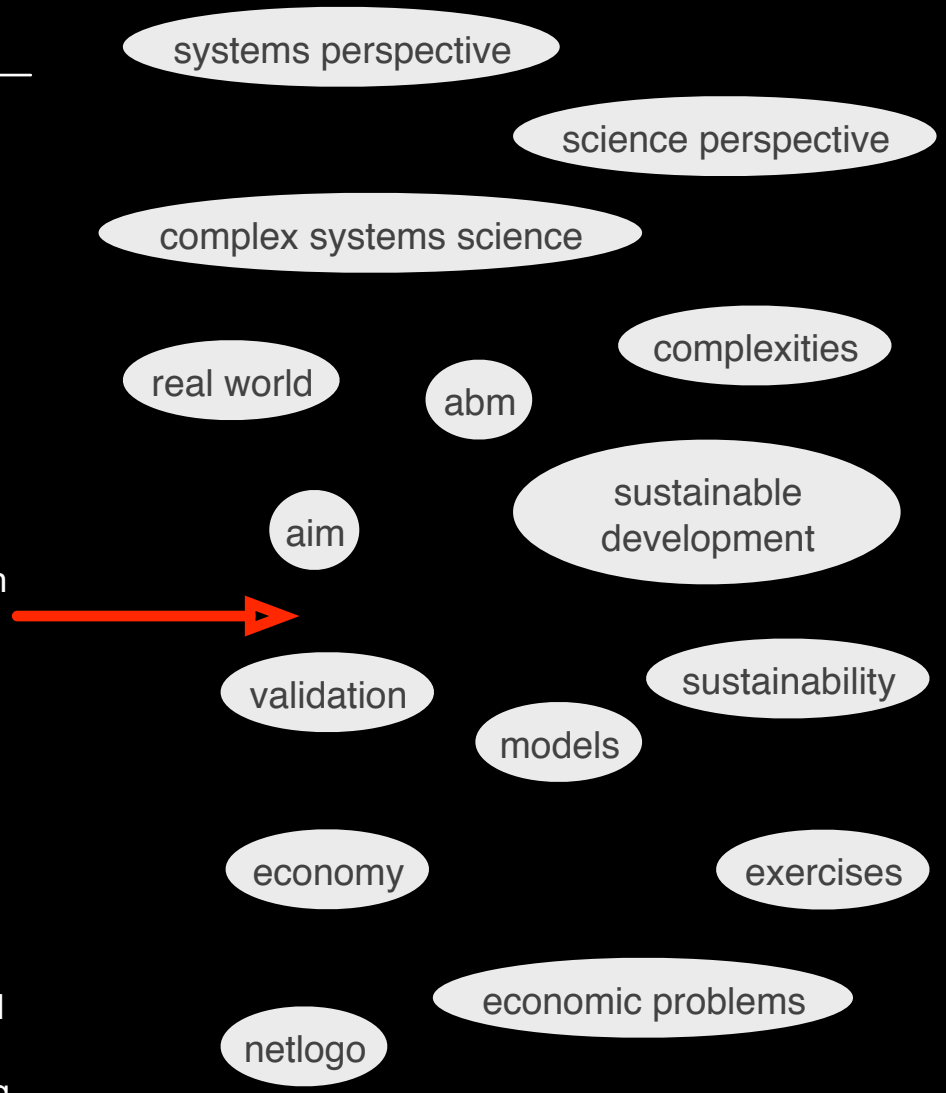
NEW method

1. Get a database (from the faculty, or ...) of unit *synopsis* and *objectives*;
2. Send this text to Yahoo's key-word finder API;
3. Receive back key-words for *every unit* in Economics;
4. Now link two units if ...



... output

Undergraduate
Business and Economics
ECC3860
Integrated economic modelling
The aim of this unit is to enable students to understand some of the complexities of interdisciplinary policy problems, particularly in the areas of sustainable development, and to enable them to design and undertake integrated modelling exercises for themselves. A complex systems science perspective will be adopted, introducing Agent-Based Modelling (ABM) as a flexible and powerful tool for exploring solutions to complex real-world problems. The ABM approach will be demonstrated and critically assessed through several interdisciplinary, integrated economy/sustainability models. Additionally, a flexible ABM modelling platform (NetLogo) will be introduced and demonstrated.
The learning goals associated with this unit are for students to: understand some of the complexities of interdisciplinary policy problems, particularly in the areas of sustainable development comprehend and critically assess the complex systems perspective critically evaluate agent-based models and their outputs develop and analyse an agent-based model of an integrated modelling problem undertake verification, validation, evaluation and assessment of integrated modelling outputs apply integrated modelling approaches to real-world interdisciplinary economic problems.



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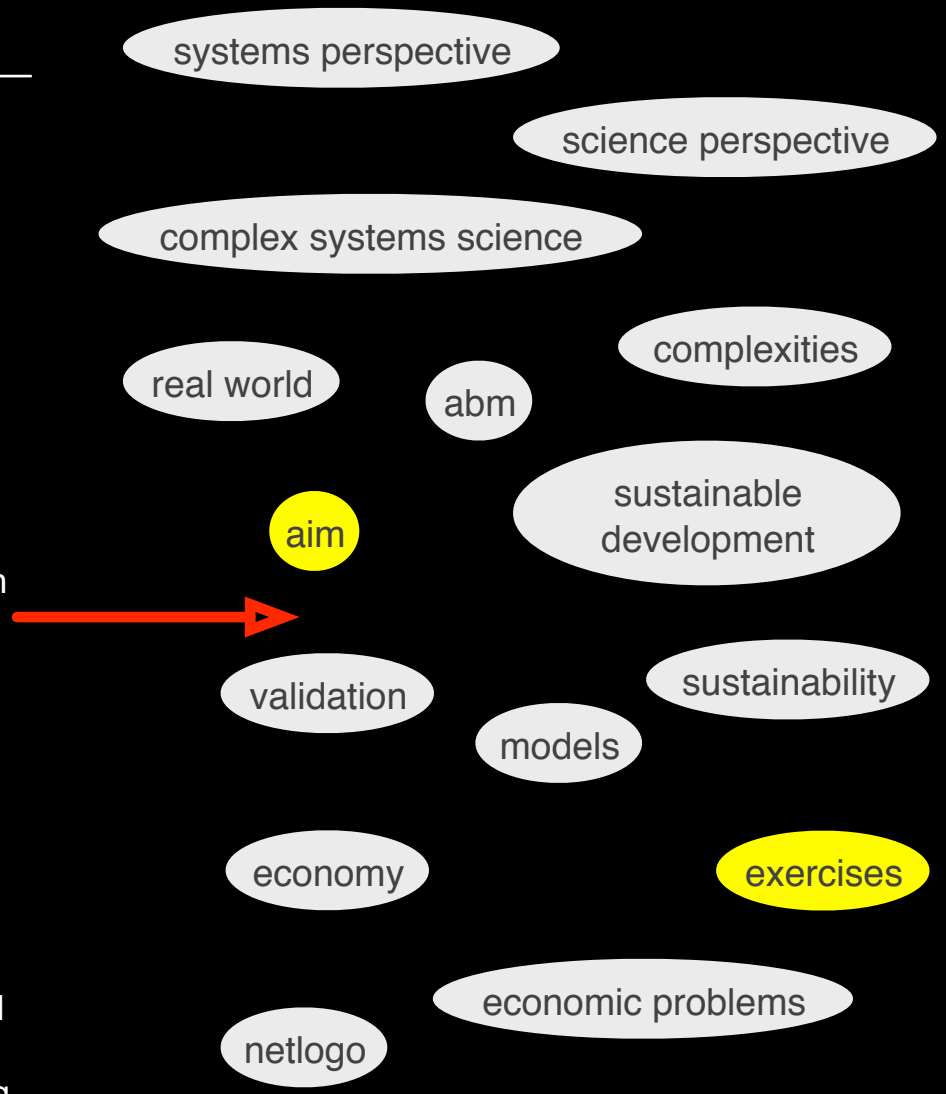


Refining the method ...

3. Keyword cleaning:

a) Take out a 'black-list' set of keywords;

b) Take out any keyword mentioned just once across all units;

c) Take out the 5% most common remaining keywords

The Black-List

clayton
clayton-day
gippsland
assessment-task
caulfield
australia
assessment-tasks
summative-assessment
berwick
peninsula
analytical-skill
analytical-skills
safrica
sem
fourth-year
insight
key-role
critical-assessment
malaysia
exercises
assessment

Links ...

What defines a link?

1. Share >= 1 keyword in common;
2. Share >= 2 keywords in common;
3. Weight for abundance ...

Latent meaning considerations

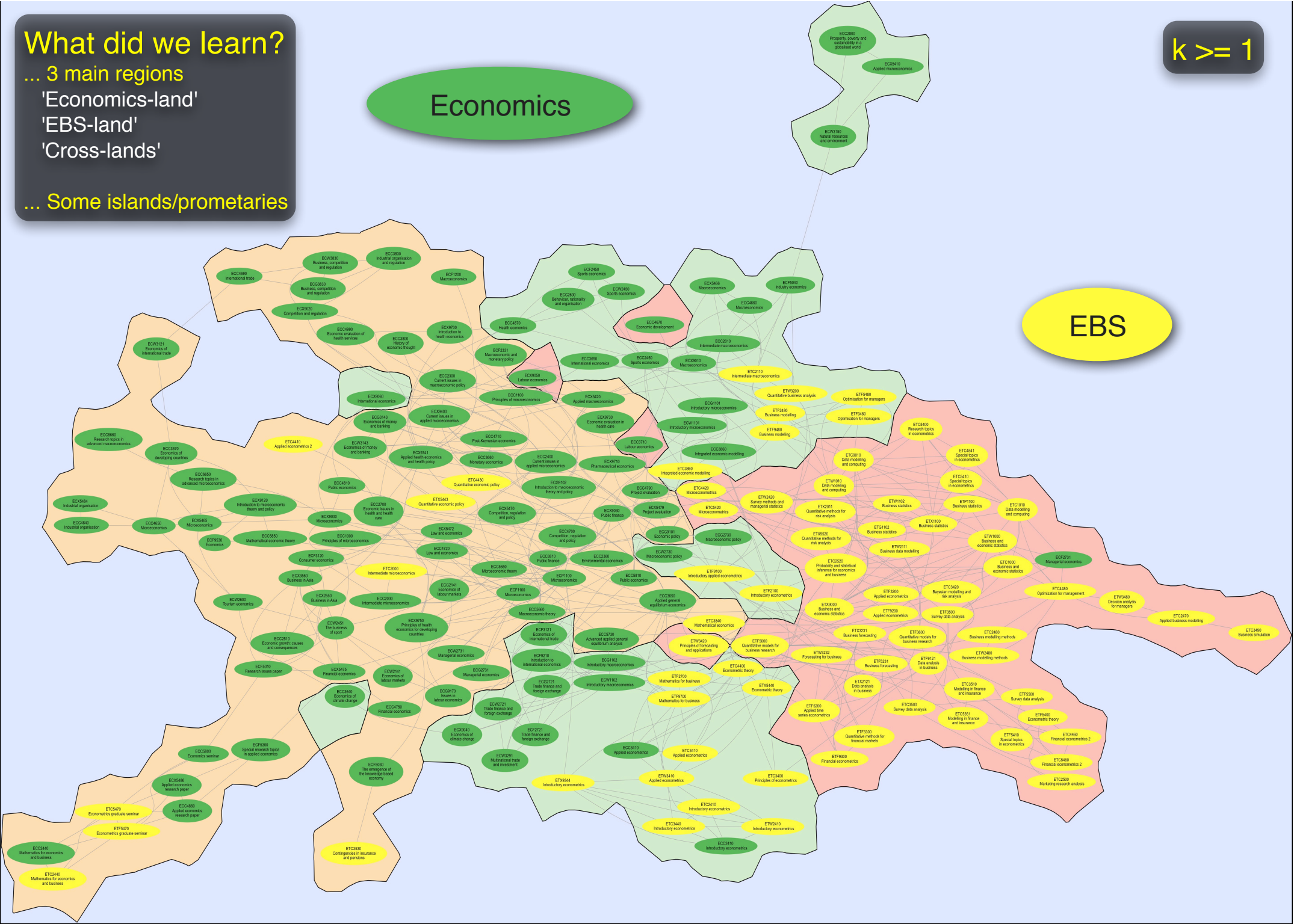
Written text are signs, signifying underlying meanings which are not textual

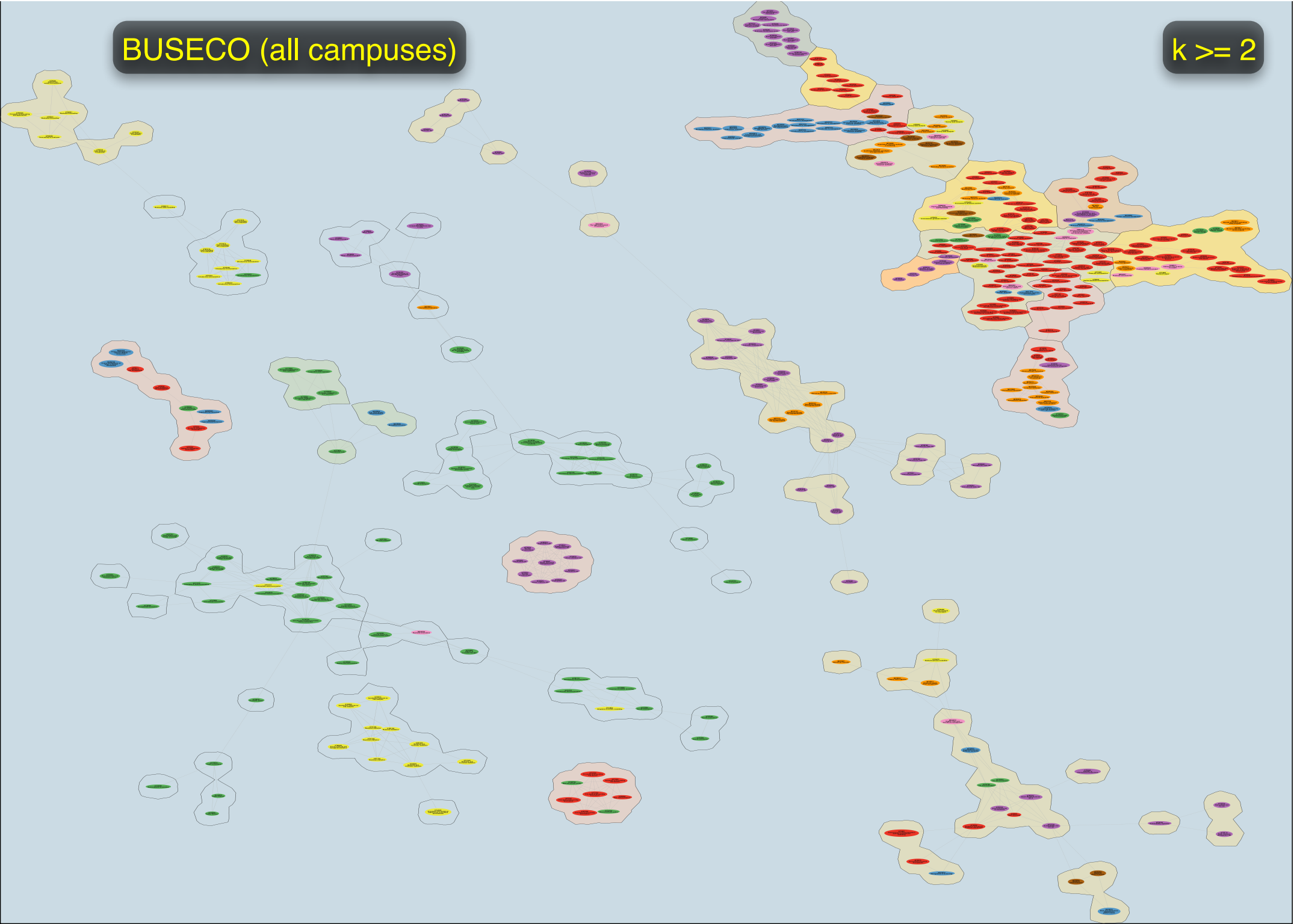
Example: "efficiency"

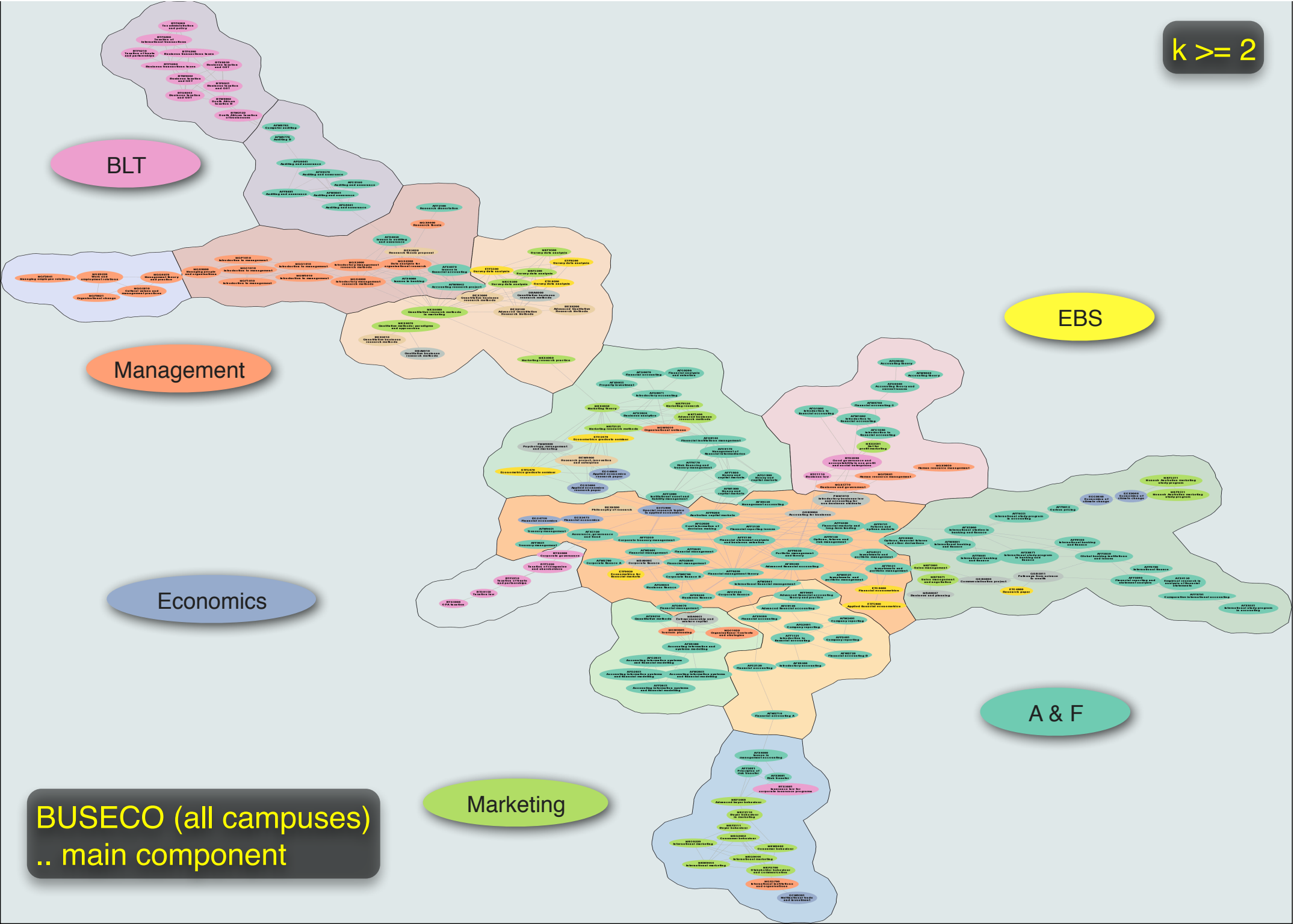
Economics ...

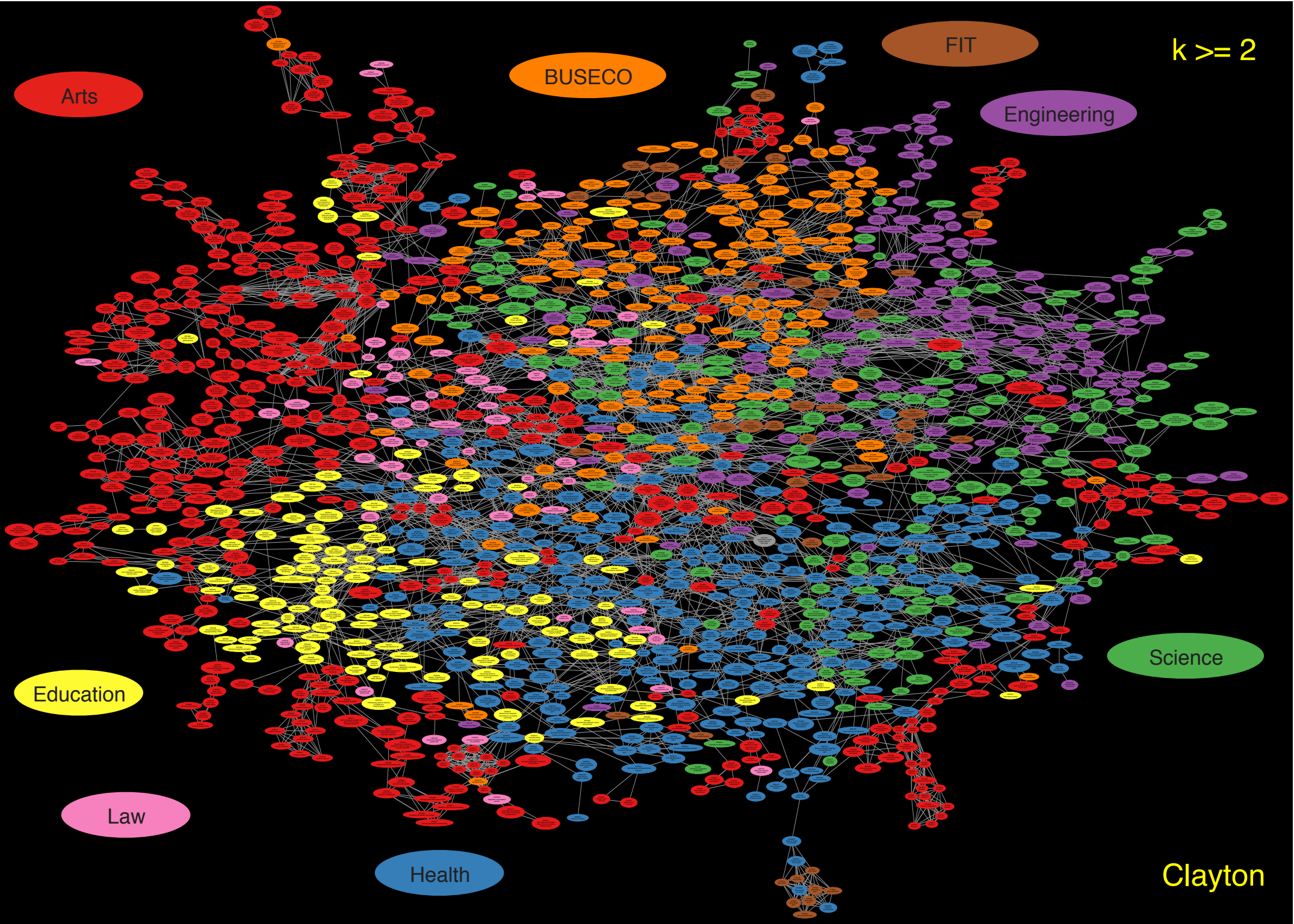
Physics ...

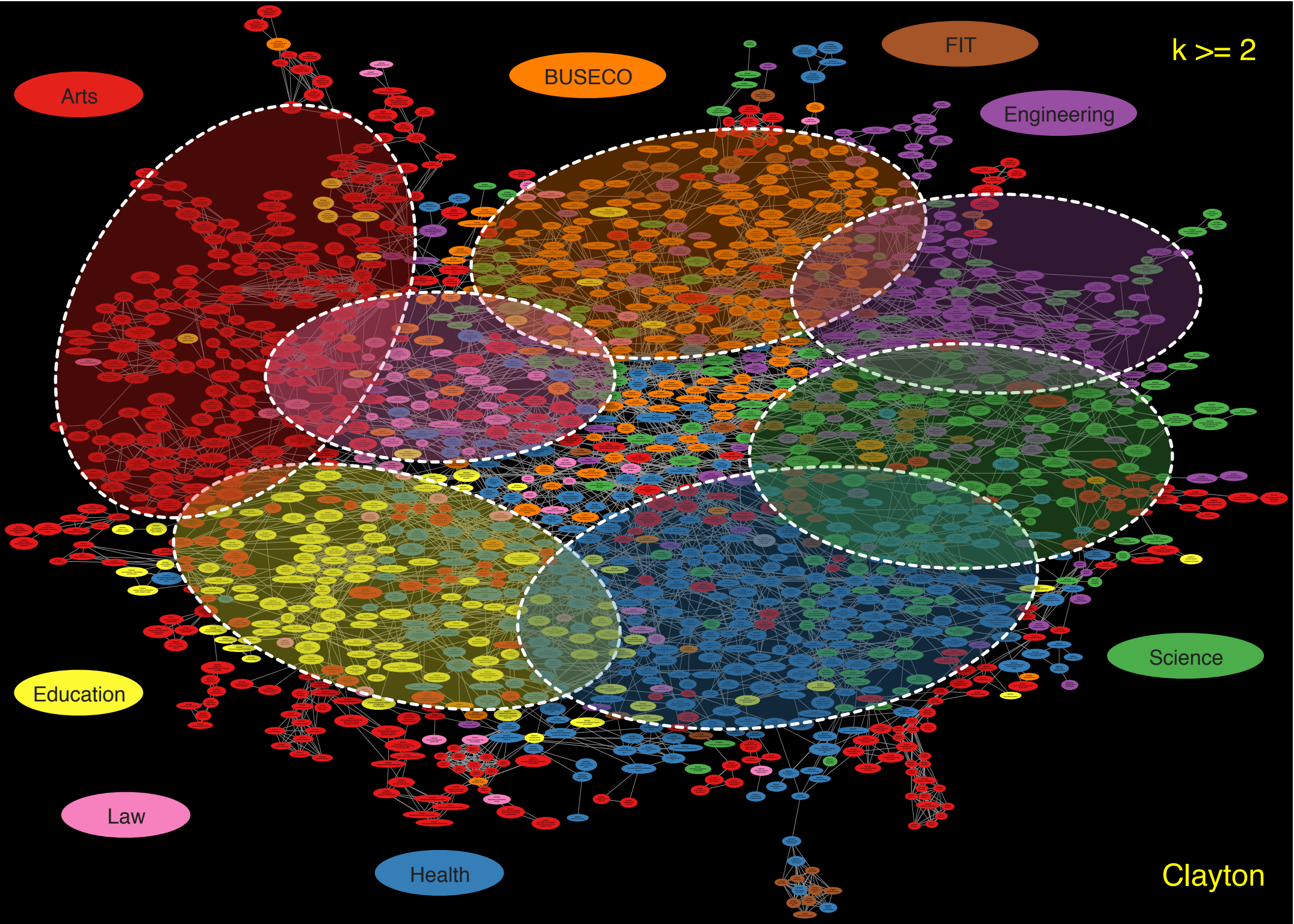
Chemistry ...


What did we learn?
... 3 main regions
'Economics-land'
'EBS-land'
'Cross-lands'
... Some islands/prometaries
Economics
EBS
k >= 1


BUSECO (all campuses)
k >= 2


k >= 2
BLT
Management
EBS
Economics
A & F
Marketing
BUSECO (all campuses)
.. main component


Arts
BUSECO
FIT
Engineering
k >= 2
Science
Education
Law
Health
Clayton


Arts
BUSECO
FIT
Engineering
k >= 2
Science
Education
Law
Health
Clayton

Further work ...

1. Validation:
   -> Keywords
   -> Links

2. Clustering algorithms
   -> plenty of choices

3. Quantitative output
   -> clusters, nodes gained/lost, density
   -> network properties ...