1. Introduction & Overview

Modelling Social Interaction in Information Systems (MSIIS)

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What is this course about?

- Modelling social interaction in information systems
- What is Modelling? What is a model?
- What is social interaction?
- What are information systems?
- None of these questions are easy to answer!
- We will reflect on these questions throughout the course

What is this course *NOT* about?

- Optimisation – though we will talk about it
- Prediction – we *might* talk about it
- Mathematics – I will try to avoid it
- Logic – touch on it here and there
- Big data - though we will talk about it
- Politics – though we will touch on it
- Economics – though it might be related to something called "new economics"
- Philosophy – though we will raise some philosophical issues but not spend time on them

What is this course about?

- Simple individual (micro) behaviours can lead to complex collective (macro) outcomes
- Micro: Individual units (people, animals, cells, devices, firms etc. => often called agents)
- Macro: Collective outcomes or patterns (herding, cooperation, organisations, institutions etc. => emergent properties, “stylised facts” – N. Kaldor)
- What is interesting is how social interaction leads to “emergent properties”
- How micro interactions produce emergent macro properties

What use is this course?

- For designing distributed systems in which function emerges from local behaviour such as P2P and Self-* systems
- For designing systems that are applicable to social user behaviour
- For understanding how to model complex systems and gain insights
- Understand how theories and models of society have, and can, shape the world

What is "emergence" ?

- This can get quite philosophical so we will not spend time on it
- Better to just show some examples
- Definitions can be useful but also a waste of time
- If you are interested in this idea see Karl Popper about definitions in science
- "I know it when I see it"
- http://en.wikipedia.org/wiki/I_know_it_when_I_see_it
- *Aside: A colleague of mine from the US told me that it is a rumour that if students want to disrupt a course on complex systems they ask the lecturer "what is emergence?"* ☺

Example: birds flocking

- Craig Reynolds coded “boids” in 1986
- Each bird (boid) follows three basic rules:
  - Separation - avoid crowding neighbors
  - Alignment - steer towards average heading of neighbors
  - Cohesion - steer towards average position of neighbors (long range attraction)
- NetLogo model library: Biology/Flocking, Flock 3D alternative
- https://ccl.northwestern.edu/netlogo/
- Reynolds, Craig (1987). "Flocks, herds and schools: A distributed behavioral model.". SIGGRAPH '87: Proceedings of the 14th annual conference on Computer graphics and interactive techniques (Association for Computing Machinery): 25–34
- http://www.cs.toronto.edu/~dt/siggraph97-course/cwr87/

Example: foraging ants

- Consider each ant follows this simple rule:
  - Leave nest and wander around randomly
  - If you detect a pheromone trail then follow it
  - If you bump into a resource
    - Pick it up
    - Deposit a pheromone trail behind you
    - Go back to nest
- The pheromone trail is a chemical signal left in the environment that other ants can follow
- This kind of environmental feedback termed "Stigmergy"
- NetLogo model library: Biology/Ants
- Bonabeau E., Dorigo M. and Theraulaz G. (1999) Swarm intelligence. From natural to artificial systems. Santa Fe Institute studies in the sciences of complexity. Oxford University Press.

Example: Conway's Game of Life

- Grid of cells each "alive" or "dead"
- Starts with some cells set to alive
- Each cell applies following rule:
  - Cell with exactly 3 live neighbours becomes live
  - Cell with < 2 or > 3 live neighbours dies
  - Cell with 2 live neighbours stays in current state
- Example of a Cellular Automaton (CA)
- Netlogo model library/computer science/CA/Life
- Golly CA simulator: golly.sourceforge.net
- Gardner, Martin (October 1970). Mathematical Games – The fantastic combinations of John Conway's new solitaire game "life". Scientific American 223. pp. 120–123.

Example: Schelling's segregation

- Thomas Schelling (1971)
- Each cell in the CA may contain an agent of one of two colours (black or white) or be empty
- Each agent looks at it's neighbours and moves to a near empty cell if the number of neighbour agents is a different colour above some threshold
- For example, if 30% of my neighbours are not my colour then move to a random empty cell.
- NetLogo model library: social science/segregation
- Schelling, Thomas C. 1971. "Dynamic Models of Segregation." Journal of Mathematical Sociology 1:143-186.

Some other examples

- Granovetter's Riot model: Granovetter (1978) "Threshold models of collective behaviour", American Journal of Sociology, vol 83, No. 6, 1420-1443
- Epstein's Civil Violence (revolution) model: Joshua M. Epstein, "Modeling civil violence: An agent-based computational approach", Proceedings of the National Academy of Sciences, Vol. 99, Suppl. 3, May 14, 2002
- Netlogo model library: social science/rebellion

A sociological note on examples

- These kinds of models and approaches assume what is termed “methodological individualism” in social science
- This is a term used by sociologists to indicate that the models assume behaviour to emerge entirely from individuals (agents)
- This is contrasted with the approach of modelling “social forces” and other non-individual entities that exist externally and “above and beyond” individuals
- Philosophically this distinction is quite contentious and is to do with “reductionism” and “holism” hence we will not spend time on this

Note on examples

- Such processes are often called self-organised, bottom-up or self-*
- As opposed to centrally controlled or top-down planned processes
- There is no central plan or program controlling bottom-up systems
- The collective outcomes *emerge* through self-organising processes

Complex Systems

- Systems that show self-organisation and emergence are sometimes called “complex adaptive systems” (CAS)
- Alternatively “complex systems”
- The study of them is sometimes called “complexity science” or “complex systems science”
- However, some people don’t think it’s a “science”
- What is “science” ? (again too philosophical for this course!)

Complex Systems

- Terms like: self-organisation, emergence and complex systems (and even science) have no generally agreed definitions
- Emergence is particularly controversial and gets rather philosophical
- Some say there are two kinds: “strong” and “weak” emergence
- We are going to focus on things we can simulate in digital computers (often termed “weak”)
- I am not sure about this distinction!

Playing with complex systems

- People who play with / model complex systems use two main techniques:
  - Mathematics (statistical physics etc.)
  - Computer simulations
- We will focus on computer simulations
- There will be no significant mathematics element in this course

What is this course about?

- The idea behind the course is that societies and many distributed information systems can be viewed, *productively*, as complex adaptive systems (CAS)
- We consider ideas and techniques used in CAS
- We will assess social interpretations of CAS
- We will look at some software systems that apply aspects of CAS in various ways

Approach of this course

- Cover a lot of things in overview (a few things in detail)
- Examples will often be shown as running programs that you can play with
- Look at some of the people behind the ideas
- Look at both theoretical and applied models
- Consider some of the wider ideas about society
- I will *try* to make it Interactive, flexible, critical, and not boring (my aspiration!)
- If I say something that does not make sense or is wrong then challenge me! Chances are you'll be right.

What will be covered?

- Cellular Automata
- Evolution of Cooperation
- Game theory, Rationality and economics
- Evolution and co-evolution
- Theories of society before computers
- Multi-Agent Systems
- Artificial Life & Artificial Societies
- Bittorrent and cooperation
- Bitcoin and other applications
- Markets and money

How will the course be assessed?

- Throughout the course some scientific papers will be referenced and be available online at: www.davidhales.name/msiis
- If you are an MSc student you will need to choose one of these (or another you think is interesting and I think is relevant), read it, and make a short (10 min, 5 slide) presentation to the group and answer questions
- If you are a PhD student you will need to do the above and a small programming assignment in a programming language of your choice. This may involve reproducing / modifying a model we have covered in the lectures or producing your own model.

Support materials

- Most materials used in course are available free on the web
- For many of example programs we will use NetLogo
- Cross platform based on a version of LISP (logo) and, behind the scenes, the java VM. It is written in java.
- You do not have to learn NetLogo to do this course but I will use it as an example and you might want to play with it
- I only started using NetLogo recently myself
- If there is enough interest I could give a lecture on it

Support materials

- Course webpage: www.davidhales.name/msiis
- Slides of lectures
- Books / papers
- Software
- Videos

Science is NOT politics (my opinion)

- Some ideas presented in this course have been used to draw political implications
- But the implications we draw are our choice
- Science does NOT dictate political positions
- Politics is NOT reducible to Science and vice versa
- Those who wish to use Science to advance a political position should be challenged

There are no laws of society (my opinion)

- There are no accepted “laws of society”
- I personally do not think they exist
- Society is a negotiation between people who can change their minds, do different things or do almost anything
- People are not means but ends
- People are not algorithms or equations

Models and theories

- Computer models comprise assumptions
- These are debatable
- They are a kind of "theory" or thought experiment
- Simulations don't tell you anything other than the logical implications of the assumptions in the model
- Just because a model is in a computer does not make the interpretations of results true

Convention

- When I am giving *my* opinion on something that people often disagree about I will try to remember to colour the slide background like this (light cyan)
- Let me know if you see a slide you think should be this colour but isn't!
- Consider what I say but be critical

What is a model?

- Covers a lot of different things!
- Different uses
- Different ways of representing models
- We are going to focus on computer models of complex systems of interacting agents
- The *model* is the program we write
- *Simulations* are what we do when we run the model

In general (but not always):

- Models are created to answer questions
- Models should be simpler than the thing we want to model
- A good model is the simplest one that answers the question
- “Keep It Simple, Stupid!” (KISS)
- This is important for complex systems because they are complex(!)

Some different uses of models

- Attempt to predict something [predict]
- Communicate something [communicate]
- Explore / understand something [explore]
- Perform a thought experiment [thought]
- Clarify ideas about something [clarify]
- Epstein, Joshua M. (2008) 'Why Model?' Journal of Artificial Societies and Social Simulation 11(4)12: http://jasss.soc.surrey.ac.uk/11/4/12.html

Some common misconceptions!

- Models that don't predict are no use / wrong
- Models should be a "picture" of "reality"
- More complex models are more "realistic"
- Models must be based on data
- Models based on lots of data are "better" than models based on less data
- Models always represent something "real"
- Data is more "real" than models or models are more "real" than data

“reality” and models

- The relationship between models and “reality” is complex
- It can get quite philosophical, particularly with social phenomena
- The concept of model “validation” or what makes one model better than another is also complicated
- This links to ideas about “science”
- We will only skirt these issues because this is not a “philosophy of science” course!
- But it is worth having an awareness of the issues if only so you can avoid them and not make stupid mistakes

Readings – if you want background

- Gilbert et al (2005) Chapter 1
- Flake (1998) Sections 1.1 – 1.3
- Questions (for fun):
  - Do these readings say things that contradict what I have said here?
  - What does it mean to model something that does not exist?
  - Can a practical engineer avoid models?