Agent-Based Modelling and Simulation with NetLogo

Day 2: Session 7

ABM and Social Sciences

Session 7: ABM and Social Sciences - Outline

- ABM and social sciences.
- Different purposes of ABM models.
- Simulation Model levels of Abstraction.
- Auto-organisation, consensus and social norms.
- Exploring a model of consensus formation in social networks.

ABM and Social Sciences

- **Social Simulation**: usage of computational simulation and modelling techniques to the study of human social phenomena.

- Examples:
  - residential segregation (Schelling, 1969).
  - transmission of culture (Axelrod, 1997).
  - population dynamics (Gilbert and Troitzsch, 2005).

ABM purposes: prediction

- There are multiple purposes an Agent-based Model can have:
  - **Prediciton**: (controverse) but prediction can be considered if you try to predict what happens given a **what-if scenario**.
  - In other words, the idea is to predict something unknown from known or possible evidence for known facts.
  - **Example:** trying to predict the results of an election given some evidence or assumptions on how the voters behave.

ABM purposes: explain

- Construct an **explanation**: given some effect or evidence for a process, real or simulated.
- The idea is to use a simulation model to explain observer dynamics given a set of known basic or micro processes.
- In effect constructing a bridge **from micro processes** to **macro behaviours**.
- **Example:** explain why using different types of social spaces with a given consensus game leads to faster or slower convergence to consensus.

ABM purposes: ilustrate

- An ABM model can be used to illustrate an idea of how something might happen.
- The idea is to **create a description of the target system** to ilustrate how it works**.**
- Such models may be based on evidence from social sciences, for example:
  - **"Representing trust in cognitive social simulations" (Pollock 2011).**
- This example can be both descriptive and ilustrative and used to explain target phenomena.

ABM purpose: exploration

- ABM models can also be used to explore scenarios that would be not possible to reproduce or study in real-world scenarios.

- Again, the construction of what-if scenarios can be used to explore different phenomena.

- **Example:** population dynamics

- In other sense it can also shed light on some unkonwn processe that plays an important role in the phenomena being studied.

Levels of abstraction

- ***Model Level:*** It expresses the idea that **small-scale details** can be **abstracted** away when considering phenomena at a more **macroscopic scale** (Gilbert, 1995)
- ***Agent-Based Computational Sociology (Squazzoni 2012)***
  - **Abstract artificial societies:** explore plausible social behaviour in a qualitative form.
  - **Middle-range models:** can generate particular social behavior “qualitatively” and applied to the explanation of a number of social systems.
  - **Applied data-driven models:** approaching reality by introducing more and more empirical data (quantitative model).

Levels of abstraction

"To understand the behaviour of ordinary physical objects, you do not need to know about the composition of atoms. Similarly to understand ecology, you do not need to be familiar with intra-cellular processes"

"When does social simulation need cognitive models?"

(Gilbert 2006)

Auto-organisation, consensus and social norms

- **Self-organisation:** the process where a structure or pattern appears in a system without a central authority or external element imposing it through planning.

- These patterns emerge from local interaction of the elements that make up the system, thus the organisation is distributed by nature.

Consensus and Social Norms

- The problem of acquiring a global consensus is a **self-organisation** phenomenon.
- **Non-linear dynamics** of interacting agents in certain social spaces (2D lattices, Networks, etc).
- **Examples:**
  - dynamics and evolution of opinions (Weisbuch, 2004).
  - language competition (Castelló et al., 2008).
  - consensus games in social networks (Antunes, 2009).

Exercises

Simple consensus game: model 1

- An initial population of agents is created.
- Agents have 2 distinct opinion values.
- Distribute the opinion values equaly throughout the agent population.
- Agents walk randomly in a 2-dimensional grid
- Each time two agents are located in the same patch they interact with each other playing a majority game.

Majority Game

- Uni-lateral interaction, the agent:
  - observes the interaction partner opinion.
  - updates an internal counter on how many agents he has seen with that opinion.
  - if the currently observed opinion is the majority and if it is different from the current agent opinion, the agent adopts the new opinion value.

Consensus formation in social networks: model 2

- The model has an initial population of agents.
- Agents are connected by network structures
- Agents play a simple consensus game:
  - They have to choose between two options
  - They try to achieve arbitrary global consensus.

Majority game in social networks

- On each simulation step:
  - Each agent interacts with a neighbour in its network.
  - The agent observes the neighbour opinion value.
  - It decides to change its opinion using a simple majority rule.

- The simulation stops if a global consensus has been reached or a maximum number of steps have passed.

Questions?