Agent-Based Modelling and Simulation with NetLogo

Davide Nunes

Agent-Based Modelling and Simulation with NetLogo

Day 1: Session 1

Introduction

Session Outline

- Outline and Objectives for this Course
- Introduction to modelling and simulation.
- What is an Agent? Why agent-based simulation?
- Tools of the trade: about NetLogo.
- NetLogo example model.

Course Outline – Day 1

- Introduction: Modelling, Simulation and Agents
- First contact with NetLogo features and philosophy.
- The NetLogo programming language

Course Objectives

- Provide an introduction to programming and debugging agent-based models (ABM) using NetLogo.
- Create an understanding on how different social phenomena can be represented using ABM.
- Show how to design simulation experiments.
- Give some simulation model examples from the existing literature.

Course Philosophy

- **Hands-on approach:**
  - Learn by experimenting;
  - Explore the existing models;
  - Add features to existing models;
  - Write a simple model from scratch.

- **Follow the documentation**
  - You don't have to remember everything;
  - Learn *where* and *what* to look for;

Course Resources

- **The course materials are available at:** http://davidenunes.com/courses/netlogo/

- **Available Resources:**
  - Slides
  - Example models
  - Links to other useful resources

Introduction: Modelling

- Creation of a **description** of some process or entity in a way that it reflects the functional properties that you want to **observe** or **learn about**.

- **Supported** by **theories** or **data** about the target phenomena to be modelled.

- Different levels of abstraction.

Introduction: Simulation

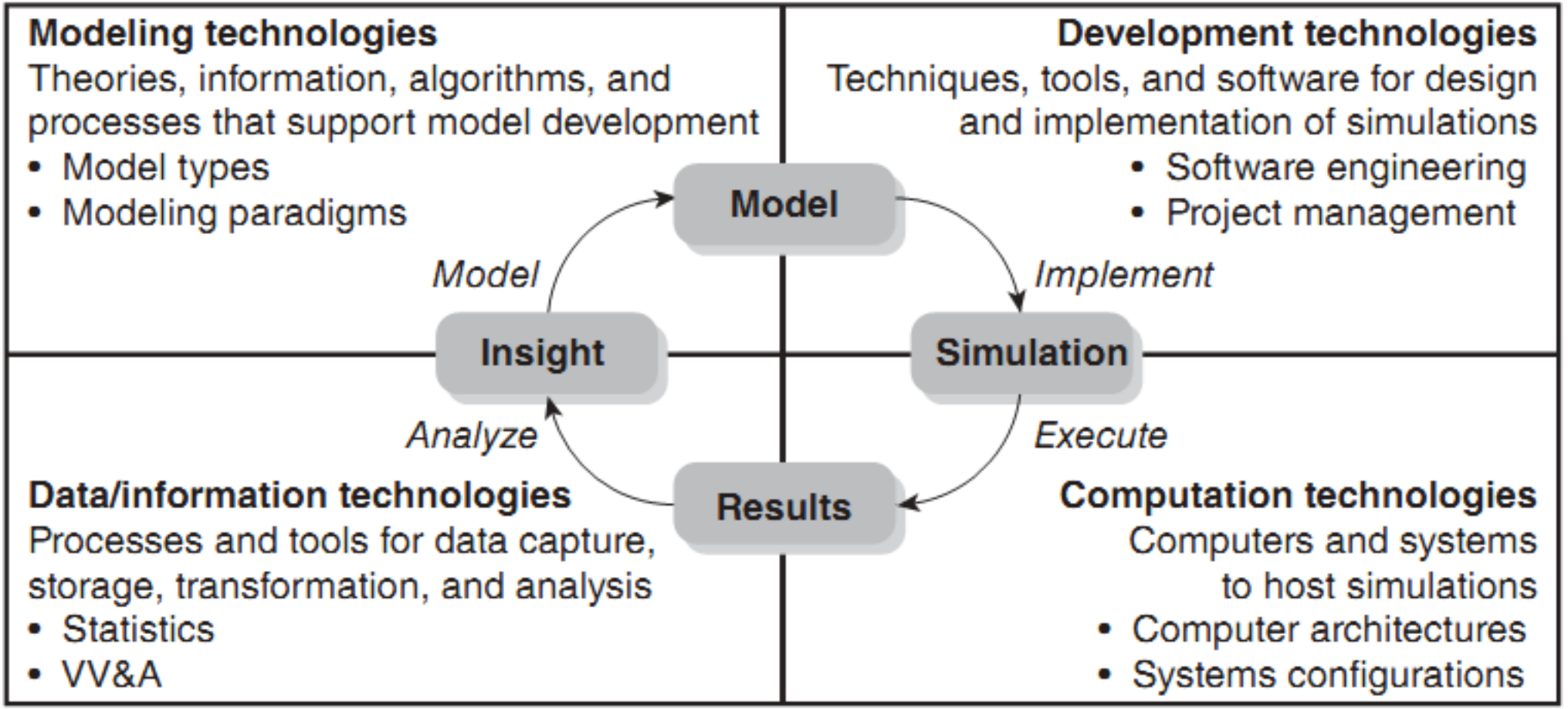
- Technique to **represent** or **abstract** a process or behaviour **for analytical, decision support or learning purposes** (Pitt, 2008).

- Understand the behaviour of complex systems by exploring different model and experimental designs

- These systems would be very **difficult to manipulate and directly experiment with in real-life** (El Sheikh et al., 2007).

Simulation and Modelling Process

(Sokolowski and Banks, 2010)



What Is An Agent? (Jennings, 2000)

- Autonomous software entity displaying a given behaviour.

- Its behaviour can range from **primitive reactiveness** to **complex adaptive intelligence**.

- It is an **identifiable** and **discrete individual** entity (has a boundary and one can determine whether something is or not part of an agent)

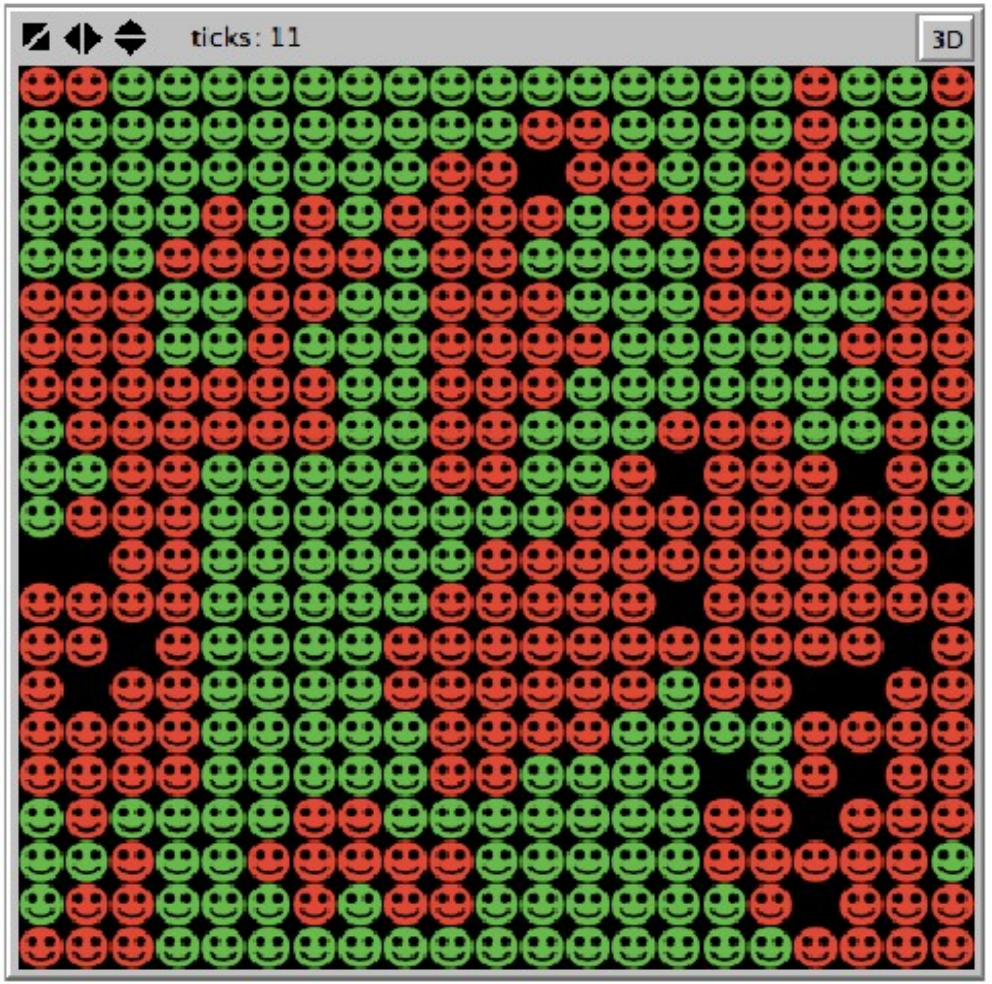
Why Model with Agents?

- We can abstract a human social actor as an agent.
- We need to model and analyse social systems.
- The phenomena to be addressed are **complex** in terms of their interdependencies.
- Traditional modelling tools may not be as applicable to these complex system (it is **difficult** to create a description of the **system behaviour as a whole**).

Tools of the trade: NetLogo

- NetLogo is a **multi-agent** programmable modeling environment.
- Well suited for **modelling complex systems**.
- Modelling and debugging a simulation model is very **“visual”** in NetLogo (instant feedback).
- Easy to construct interfaces for the simulation models.

Example Model: **Schelling's Segregation Model**



- **Schelling, Thomas C. 1971**
- **Model:** in each iteration, each agent looks at its neighbourhood and if less than 40% are the same colour as itself, it moves to a random empty square.
- 40% here is a simulation parameter one can change and see how it affects the model behaviour.
- **Segregation appears even for high values of tolerance.**

Next session…

- The NetLogo **features** and the **interface**.
- Interact with an existing model.
- NetLogo components: **observer**, **turtles**, **patches** and **links**.
- NetLogo **programming** environment.
- **Documentation** and how to use it.