Spring 2021 Syllabus

# Agent-Based Modelling of Social Systems

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Lecture: Thursday, 14 – 16, `https://ethz.zoom.us/s/96634122057`
Exercise: Thursday, 18 – 19, `https://ethz.zoom.us/j/98487990589`
Moodle: `https://moodle-app2.let.ethz.ch/course/view.php?id=14491`

*Exercises will be completed by using the programming language* `Python`. *During the exercise classes, assistants will help the students with implementation issues and answer their questions, to help them reach the solution by themselves. Towards the end of the semester the students will work in groups on a project: formulating, implementing and analyzing an Agent Based Model. The project will be graded and will make up* 30% *of the final grade.*

## 1 Introduction

*Lecture 1 – Systems and models* *25.02.2021*

- What are systems and how can we model them?
- ABM implementation: modelling techniques and tools – Python

*Exercise: Learning about Python, installation* (due: 04.03.2021)

*Lecture 2 – ABM across disciplines* *04.03.2021*

- Modelling agents and multi-agents systems
- Capturing social systems

*Exercise: ABM in Python* (due: 11.03.2021)

## 2 Models with Boolean Agents

*Lecture 3 – Cellular Automata* *11.03.2021*

- 1-D and 2-D cellular automata
- Game of Life

*Exercise: Implementation of Game-Of-Life* (due: 18.03.2021)

*Lecture 4 – Systemic Risk and Cascading processes* *18.03.2021*

- models of fragility
- models of cascading failure

*Exercise: Implementation of ABM for cascading failures* (due: 25.03.2021)

*Lecture 5 – Voter Models* *25.03.2021*

- Linear and non-linear voter models
- Social impact theory

*Exercise: Implementation of linear and non-linear Voter models* (due: 15.04.2021)

*Lecture 6 – Polya Urn Models* *15.04.2021*

- path dependence and lock-in effects
- majority and minority games

*Exercise: Implementation of linear and non-linear Polya models* (due: 22.04.2021)

*Lecture 7 – Game Theoretical Interactions* *22.04.2021*

- Game theory and Prisoner's dilemma
- social herding and cooperation

*Exercise: Implementation of prisoner's dilemma game* (due: 29.04.2021)

## 3 Models with Brownian Agents

*Lecture 8 – Opinion Dynamics* *29.04.2021*

- bounded confidence models
- how groups can foster consensus

*Exercise: Implementation of bounded confidence model* (due: 06.05.2021)

*Lecture 9 – Reputation and Competition* *06.05.2021*

- reputation in social network
- reputation model with emergent hierarchy

*Exercise: Implementation of reputation ABM* (due: 20.05.2021)

*Lecture 10 – Emotions Dynamics* *20.05.2021*

- emotions and opinions
- emotional influence: communication as nonlinear interaction

*Exercise: ABM for collective emotions* (due: 27.05.2021)

# 4 Models with Spatial Interactions

*Lecture 11 – Spatial Models with Boolean Agents* *27.05.2021*

- Schelling's segregation model
- prisoner's dilemma with migration

*Exercise: Implementation of Schelling's segregation model* (due: 03.06.2021)

*Lecture 12 – Spatial Models with Brownian Agents* *03.06.2021*

- animal swarming
- pedestrian dynamics
- conclusions and wrap-up of the course

*Exercise: Course project deadline* (due: 01.07.2021)