ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Prof. Frank Schweitzer, Dr. Giacomo Vaccario:
FS 2022 Syllabus: Agent-Based Modelling of Social Systems
See `www.sg.ethz.ch/teaching` for more information.

Spring 2022 Syllabus

Agent-Based Modelling of Social Systems

Prof. Frank Schweitzer, Dr. Giacomo Vaccario

Chair of Systems Design, ETH Zurich

Lecture: Thursday, 14 – 16, HG E 1.2
Exercise: Thursday, 18 – 19, HG E 33.3
Moodle: `https://moodle-app2.let.ethz.ch/course/view.php?id=17211`

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

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Lecture 1 – Systems and models   *24.02.2022*

- What are systems and how can we model them?

- ABM implementation: modelling techniques and tools – Python

Exercise: Learning about Python, installation (due: 03.03.2022)

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Lecture 2 – ABM across disciplines   *03.03.2022*

- Modelling agents and multi-agents systems

- Capturing social systems

Exercise: ABM in Python (due: 10.03.2022)

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2 Models with Boolean Agents

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Lecture 3 – Cellular Automata *10.03.2022*

- 1-D and 2-D cellular automata

- Game of Life

Exercise: Implementation of Game-Of-Life (due: 17.03.2022)
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Lecture 4 – Systemic Risk and Cascading processes *17.03.2022*

- models of fragility

- models of cascading failure

Exercise: Implementation of ABM for cascading failures (due: 24.03.2022)
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Lecture 5 – Voter Models *24.03.2022*

- Linear and non-linear voter models

- Social impact theory

Exercise: Implementation of linear and non-linear Voter models (due: 31.03.2022)
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Lecture 6 – Polya Urn Models *31.03.2022*

- path dependence and lock-in effects

- majority and minority games

Exercise: Implementation of linear and non-linear Polya models (due: 07.04.2022)

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Lecture 7 – Game Theoretical Interactions   *07.04.2022*

- Game theory and Prisoner's dilemma

- social herding and cooperation

Exercise: Implementation of prisoner's dilemma game (due: 28.04.2022)

3   Models with Brownian Agents

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Lecture 8 – Opinion Dynamics   *28.04.2022*

- bounded confidence models

- how groups can foster consensus

Exercise: Implementation of bounded confidence model (due: 05.05.2022)
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Lecture 9 – Reputation and Competition   *05.05.2022*

- reputation in social network

- reputation model with emergent hierarchy

Exercise: Implementation of reputation ABM (due: 12.05.2022)
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Lecture 10 – Emotions Dynamics   *12.05.2022*

- emotions and opinions

- emotional influence: communication as nonlinear interaction

Exercise: ABM for collective emotions (due: 19.05.2022)

4 Models with Spatial Interactions

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Lecture 11 – Spatial Models with Boolean Agents *19.05.2022*

- Schelling's segregation model

- prisoner's dilemma with migration

Exercise: Implementation of Schelling's segregation model (due: 02.06.2022)

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Lecture 12 – Spatial Models with Brownian Agents *02.06.2022*

- animal swarming

- pedestrian dynamics

- conclusions and wrap-up of the course

Exercise: Course project deadline (due: 01.07.2022)