DEPARTMENT OF PHYSICS

FIM750 Simulation of Complex Systems, 7.5 credits

Simulation of Complex Systems, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2006-11-01 and was last revised on 2018-08-16 to be valid from 2018-08-16, autumn semester of 2018.

Field of education: Science 100%

Department: Department of Physics

Position in the educational system

The course FIM750 is a programme course in the Complex Adaptive Systems programme, as well as a single subject course at the University of Gothenburg.

The course can be part of the following programmes: 1) Physics and learning, Master's Programme (N2FOL), 2) Applied Data Science Master's Programme (N2ADS), 3) Complex Adaptive Systems, Master's Programme (N2CAS), 4) Physics of Materials and Biological Systems, Master's Programme (N2PMB) and 5) Physics, Master's Programme (N2PHY)

Main field of studies	*Specialization*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

The students are expected to have a background in natural science corresponding to an undergraduate education in mathematics, computer science, physics, chemistry, or biology. Furthermore, the students are expected to have programming experience in C, C++, Pascal, Matlab, or some other equivalent language.

Learning outcomes

After successfully completing this course the students will be able to

- Define the fundamental ideas behind the three simulation methods discussed in the course, i.e., agent based modelling, networks, and cellular automata.
- Implement simulation codes in each of the three simulation methods.
- Analyze and write reports on results from a simulation.
- Plan, manage, execute, and report a small-scale technical simulation project.
- Critically evaluate a scientific text.

Course content

The course introduces the students to three simulation techniques frequently used in complex systems: agent based modelling, networks, and cellular automata. Examples of applications in physics, biology and social science, are discussed. The aim of the course is to give the students a level of understanding for the three methods such that they can decide which method is suited for a specific problem, define and implement a moderate sized simulation project, and evaluate the results from their simulations.

Agent based models

- Boids and flocking behaviour
- Traffic simulations
- Global behaviour from local rules: ants
- Game theory

Networks

- Random networks
- Small world networks
- Scale free networks
- Applications in social science

Cellular automata

- Game of life
- Von Neumann's self-replicating cellular automaton
- Wolfram's classification scheme
- Lattice gases
- Diffusion limited aggregation
- Spin systems

Form of teaching

The examination is based on

- Projects (oral presentation and written report), 50%.
- Homework assignments, 30%.
- Literature review, 20%.

Language of instruction: English

Assessment

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
The examinator must be informed within a week after the course starts if a student would like to receive ECTS grades.

Course evaluation

Web-based course evaluation.