UNIVERSITY OF GOTHENBURG

PHYSICS

FIM711 Stochastic Optimization, 7.5 higher education credits

Stokastiska optimeringsmetoder, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2016-11-11 and was last revised on 2017-06-19 to be valid from 2017-06-19, spring semester of 2017.

Field of education: Science 100%
Department: Physics

Position in the educational system

The course is part of the program in Complex Adaptive systems.

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

A bachelors degree in physics, mathematics, or similar.

Learning outcomes

The aim of the course is for the students to attain basic knowledge of new methods in computer science inspired by evolutionary processes in nature, such as genetic algorithms, genetic programming, and artificial life. These are both relevant to technical applications, for example in optimization and design of autonomous systems, and for understanding biological systems, e.g., through simulation of evolutionary processes.

Skills and abilities
Implement and use several different classical optimization methods, e.g. gradient descent and penalty methods.
Describe and explain the basic properties of biological evolution, with emphasis on the parts that are relevant for evolutionary algorithms.
Define and implement (using Matlab) different versions of evolutionary algorithms, particle swarm optimization, and ant colony optimization, and apply the algorithms in the solution of optimization problems.
Compare different types of biologically inspired computation methods and identify suitable algorithms for a variety of applications.

Course content
The course consists of the following topics:
- Classical optimization methods. Gradient descent. Convex functions. The lagrange multiplier method. Penalty methods.
- Evolutionary algorithms. Fundamentals of genetic algorithms, representations, genetic operators, selection mechanisms. Theory of genetic algorithms. Analytical properties of evolutionary algorithms. (Linear) genetic programming: representation and genetic operators.
- Particle swarm optimization. Fundamentals and applications.
- Ant colony optimization. Fundamentals and applications.
- Comparison of the different algorithms

Form of teaching
The course is organized as a series of lectures. Some lectures are devoted to problem-solving.

Language of instruction: English

Assessment
If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In cases where a course has been discontinued or has undergone major changes, the student shall normally be guaranteed at least three examination occasions (including the ordinary examination) during a period of at least one year from the last time the course

was given.

Grades
The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation
Web-based course evaluation.

The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.

Additional information
This syllabus was originally established 2008-10-09, but this is the first version to be registered in Gubas.