



DEPARTMENT OF PHYSICS

FIM720 Neural Networks, 7.5 credits

Artificiella neurala nätverk, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2016-11-10 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 is part of the program in Complex Adaptive systems.

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

Physics

Specialization

A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

A bachelors degree in physics, mathematics, or similar.

Learning outcomes

Neural networks are distributed computational models inspired by the structure of the human brain, consisting of many simple processing elements which are connected in a network. Neural networks are increasingly used in the engineering sciences for tasks such as pattern recognition, prediction and control. The theory of neural networks is a inter-disciplinary field (neurobiology, computer science and statistical physics).

The course gives an overview and a basic understanding of neural-network algorithms.

Knowledge and understanding

understand and explain strengths and weaknesses of the neural-network algorithms discussed in class
 determine under which circumstances neural networks are useful in real applications
 distinguish between supervised and unsupervised learning and explain the key principles of the corresponding algorithms
 efficiently and reliably implement the algorithms introduced in class on a computer, interpret the results of computer simulations
 describe principles of more general optimisation algorithms
 write well-structured technical reports in English presenting and explaining analytical calculations and numerical results
 communicate results and conclusions in a clear and logical fashion

Course content

Introduction to neural networks (McCulloch Pitts neurons, associative memory problem, Hopfield model and Hebb's rule, storage capacity, energy function)
 Stochastic neural networks (noise, order parameter, mean-field theory for the storage capacity)
 Optimisation
 Supervised learning: perceptrons and layered networks (feed-forward networks, multilayer perceptrons, gradient descent, backpropagation, conjugate-gradient methods, performance of multilayer networks)
 Unsupervised learning (Hebbian learning, Oja's rule, competitive learning, topographic maps)
 Recurrent networks and time-series analysis (recurrent backpropagation, backpropagation in time)
 Reinforcement learning

Form of teaching

Lectures, set homework problems, examples classes.

Language of instruction: English

Assessment

The final grade is based on homework assignments as well as on a written examination.

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 2006-10-25, but this is the first version to be registered in Gubas.