Faculty of Science

FYTN06, Theoretical Physics: Artificial Neural Networks, 7.5 credits

Teoretisk fysik: Artificiella neuronnätverk, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2008-01-24 to be valid from 2008-01-25, autumn semester 2008.

General Information

The course is an elective course for second-cycle studies for a Degree of Master of Science (120 credits) with a specialisation in physics.

Language of instruction: Swedish and English
If needed the course is given in English.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is to give the student knowledge about artificial neural networks, both theoretical knowledge and how to use them in practical applications such as pattern recognition, function approximation and optimization problems.

The aims of the course are that, upon completion of the course, the student should have acquired the following knowledge and skills:

- Feedforward networks: The student understands and can use the simple perceptron for linear problems. The student understands and can use the multilayer perceptron, including methods for learning, choices of error function, model selection and generalization. The student can describe and handle network ensembles and describe Bayesian training of multilayer perceptrons.
- Feedback networks: The student understands the meaning of feedback networks and its usage within time series analysis. The student understands and can use

various types of feedback networks, such as the FIR-network, networks with time lags, multilayer perceptrons with feedback and networks with context units. The student can describe and handle fully connected feedback networks for associative memories (the Hopfield model) and the simulated annealing optimization technique.
- Self-organizing networks: The student understands and can use networks for principal component analysis, networks for clustering and networks for supervised learning vector quantization (LVQ). The student understands and can use Self-organizing feature maps (SOFM).
- Networks for combinatorial optimization: The student understands and can formulate simple combinatorial optimization problems and use feedback networks to find approximate solutions to such problems. The student understands and can use the mean field approximation in connection with networks for combinatorial optimization.

Examples of problems that the student should be able to solve upon completion of the course:

- Write a computer program that trains a multilayer perceptron for a binary classification problem and be able to evaluate the performance of the network.
- Show why an ensemble of networks often performs better compared to a single network.
- Write a computer program that uses the Hopfield model to find approximate solutions to the graph bisection problem.

Course content

The course consists of the elements described above for a total of 7.5 credits.

Course design

The teaching consists of lectures, exercises and computer exercises. Participation in the computer exercises is compulsory.

Assessment

The examination consists of a written and/or oral test at the end of the course. Students who do not pass the regular exam are offered a re-exam shortly after the regular exam.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, a passed test, passed reports on the computer exercises and participation in all compulsory course elements is required.
The final grade is decided by combining the results in the different parts of the examination, with the test as the dominating part.

Entry requirements

The prerequisites for admission to the course are: English B and knowledge equivalent to 30 credits in mathematics.

Further information

The course may not be credited towards a degree together with FYS228.

Subcourses in FYTN06, Theoretical Physics: Artificial Neural Networks

Applies from V08

0801 Artificial Neural Networks, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction