FDD3437 Artificial Neural Networks and deep Architectures 7.5 credits

Artificiella neuronnät och djupa arkitekturer

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FDD3437 valid from Spring 2020

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

PhD students at KTH

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course the student should be able to

- describe the structure and function of the most common artificial neural network (ANN) types, e.g. multi-layer perceptron, recurrent network, self-organizing maps, Boltzmann machine, deep belief network, autoencoder, and provide examples of their applications
- explain mechanisms of supervised/unsupervised learning from data and information processing in different ANN architectures, and also account for derivations of the basic ANN algorithms discussed in the course
- demonstrate when and how deep architectures lead to increased performance in pattern recognition and data mining problems
- quantitatively analyse the process and outcomes of learning in ANNs, and account for their shortcomings, limitations
- apply, validate and evaluate suggested types of ANNs in typical small problems in the realm of regression, prediction, pattern recognition, scheduling and optimisation
- devise and implement ANN approaches to selected problems in pattern recognition, system identification or predictive analytics using commonly available development tools, and critically examine their applicability

in order to

- obtain an understanding of the technical potential as well as advantages and limitations of today's learning, adaptive and self-organizing systems
- acquire the ANN practitioner’s competence to apply and develop ANN based solutions to data analytics problems.

Course contents

The course is concerned with computational problems in massively parallel artificial neural network (ANN) architectures, which rely on distributed simple computational nodes and robust learning algorithms that iteratively adjust the connections between the nodes heavily using the available data samples. The learning rule and network architecture determine specific computational properties of the ANN. The course offers an opportunity to develop the conceptual and theoretical understanding of computational capabilities of ANNs starting from simpler systems and progressively studying more advanced architectures, and hence exploring the breadth of learning types – from strictly supervised to purely explorative unsupervised mode. The course content therefore includes among others multi-layer perceptrons (MLPs), self-organising maps (SOMs), Boltzmann machines, Hopfield networks and state-of-the-art deep neural networks (DNNs) along with the corresponding learning algorithms. An important objective of the course is for the students to gain practical experience of selecting, developing, applying and validating suitable networks and algorithms to effectively address a broad class of regression, classification, temporal prediction, data modelling, explorative data analytics or clustering problems. Finally, the course provides revealing insights into the principles of generalisation capabilities of ANNs, which underlie their predictive power.

Course structure

12 lectures, 4 labs, 1 project and exam

Course literature

1. Stephen Marsland. Machine Learning, an Algorithmic Perspective, 2009,CSC-Press.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep learning., 2016, MIT press.

Further recommended reading will be announced on the course's website.

Examination

- EXA1 - Written exam, 7.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

To pass the course, the students should complete the following tasks:

- pass a written exam (TEN1: A-F, 2 hp)
- pass all 4 labs: hand-in a lab report and present labwork for each lab (LAB1: P/F, 4 hp)
- get project work approved on the basis of a written report (PRO1: P/F, 1.5 hp)

Other requirements for final grade

Godkänt skriftlig tentamen (TEN1: 2hp), godkänd labmoment (LAB1: 4hp) och projekt (PRO1: 1.5 hp)

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.