SYLLABUS

Neural networks and learning machines 7.5 credits D7046E

Neuronnät och lärande maskiner

Course syllabus admitted: Autumn 2024 Sp 1 - Present

DECISION DATE
2024-02-15

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LULEÅ TEKNISKA UNIVERSITET

Neural networks and learning machines 7.5 credits D7046E

Neuronnät och lärande maskiner

Second cycle, D7046E

Education level	Grade scale	Subject	Subject group (SCB)
Second cycle	G U 3 4 5	Datateknik	Computer Technology

Main field of study

Computer Science and Engineering

Entry requirements

Understanding of mathematical analysis and linear algebra; ability to develop and apply computer programs to solve mathematically formulated problems, eg D0009E Introduction to Programming or D0017E Introduction to Programming for Engineers; understanding of basic mathematical statistics including probability distributions, expectation and variance, such as S0001M Mathematical Statistics or S0008M Probability Theory and Statistics; understanding of basic signal processing including sampling, time-discrete processing of time-continuous signals, linear and time-invariant systems, such as S0001E Signal Analysis or S0004E Signals and Systems; understanding of basic electrical theory including RC circuits, eg E0003E Electric Circuit Theory or E0013E Fundamentals of Electrical Engineering.
Good knowledge in English equivalent to English 6.

More information about English language requirements [http://www.ltu.se/edu/bli-student/Application-process/English-language-requirements-1.109316?l=en]."

Selection

The selection is based on 30-285 credits

Course Aim

After completion of the course, the student should be able to:

- Describe and differentiate artificial intelligence, machine learning, artificial neural networks, and neuromorphic engineering.
- Describe the function of formal neuron models and neural network architectures, including spiking neural networks, feedforward networks, convolutional networks and recurrent networks.
- Demonstrate how neural networks can be trained, validated and tested with supervised and unsupervised methods and analyse how different hyperparameters and regularization affect model generalisation.
- Evaluate strengths and weaknesses of neural network models and make comparisons with other machine learning methods like linear and logistic regression, including the aspects of computing requirements, data requirements, bias, variability, sensitivity and generalisation.
- Give examples of learning machines involving neural network processors and neuromorphic systems and describe their properties and motivation, including ethical considerations.
- Develop and evaluate a neural network model that address a particular engineering problem, which involves for example pattern recognition, clustering, regression, anomaly detection, recommender systems, or reinforcement learning.
- Formulate and implement derivations of basic neural network concepts introduced in the course material and assess the validity of the results.

Contents

Neural network models and processors are used to solve pattern recognition, data modelling and automatic control problems that are difficult to address with other modelling approaches. This course introduces concepts and methods required to design, train and validate neural networks, and to determine when the use of such models is motivated. Furthermore, similarities and differences between artificial and biological neural networks are described. The course introduces concepts and methods needed for further studies of advanced neural network topics and implementations for learning machines and neuromorphic systems.

Realization

Each course occasion´s language and form is stated and appear on the course page on Luleå University of Technology's website.
Lectures, read and view self-study material, laboratory work in the form of simulation exercises, self-assessment of learning with peer-review, and project work with oral presentation. Projects can include industrially related problems and datasets.

Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided.
Oral examination and written self-assessment with differentiated numerical grades as well as approved computer exercises and project assignments that are oraly examined.

Unauthorized aids during exams and assessments

If a student, by using unauthorized aids, tries to mislead during an exam or when a study performance is to be assessed, disciplinary measures may be taken. The term “unauthorized aids” refers to aids that the teacher has not previously specified as permissible aids and that may assist in solving the examination task. This means that all aids not specified as permissible are prohibited. The Swedish version has interpretative precedence in the event of a conflict.

Remarks

The laboratory exercises require basic knowledge of Python. Guidance for preparatory self-studies are available in the course room.

Course offered by

Department of Computer Science, Electrical and Space Engineering

Modules

Code	Description	Grade scale	Cr	Status	From period	Title
0003	Project work	U G#	2	Mandatory	A21	
0004	Computer exercises	U G#	2	Mandatory	A21	
0005	Self-assessment and oral exam	G U 3 4 5	3.5	Mandatory	A21	

Study guidance

Study guidance for the course is to be found in our learning platform Canvas before the course starts. Students applying for single subject courses get more information in the Welcome letter. You will find the learning platform via My LTU.

Last revised

by Robert Brännström 2024-02-15

Syllabus established

by Jonny Johansson, HUL SRT 2019-02-15