Department of Mathematics
(incl. Math. Statistics)

Stockholm University

Syllabus

for course at advanced level

Statistical Deep Learning
Statistiska aspekter av djupinlärning

7.5 Higher Education Credits
7.5 ECTS credits

Course code:	MT7042
Valid from:	Spring 2022
Date of approval:	2021-01-11
Department	Department of Mathematics (incl. Math. Statistics)
Main field:	Mathematical Statistics
Specialisation:	A1N - Second cycle, has only first-cycle course/s as entry requirements

Decision

This syllabus has been approved by the Board of Faculty of Science at Stockholm University 2021-01-11.

Prerequisites and special admittance requirements

To qualify for the course, knowledge equivalent to Probability Theory II, 7,5 hp (MT5002), Statistical Inference Theory, 7,5 hp (MT5003), Programming Techniques for Mathematicians, 7,5 hp (DA2004), and English B/English 6, is required.

Course structure

Examination code	Name	Higher Education Credits
THEO	Theory	3.5
INLU	Hand-in assignments	4

Course content

a. The course treats basic as well as modern concepts of statistical learning in terms of artificial neural networks (deep learning), with applications in statistical data analysis. Topics treated include feedforward networks, regularization and optimization of networks with many layers, convolutional networks, recurrent networks and validation methods. In addition, mathematical interpretations of networks are given, such as nonlinear regression with different link functions for the outcome variable. The course includes some of the following topics; autoencoders, representation learning, deep generative methods, and information theoretic concepts of deep learning.

b. The course consists of two parts: Part 1, Theory (Theory) 3,5 hp. Part 2, Hand-in assignments (Hand-in assignments), 4 hp.

Learning outcomes

Upon completion of the course, the student is expected to be able to:
- explain basic and modern concepts of deep learning in mathematical and statistical terms,
- choose an appropriate method of deep learning, apply the corresponding statistical software in order to solve a given problem and describe their strenghts and weaknesses,
- in a concrete way interpret results of analyses performed using methods of deep learning,
- present results of analyses in terms of a written report.

Education

Instruction is given in the form of lectures, exercise sessions and supervision. The course is given in English.

Forms of examination

a. The course is examined in the following manner: Part 1, Theory, 4 hp: measurement of knowledge is carried out through a written exam. Part 2, Hand-in assignments, 3,5 hp: measurement of knowledge is carried out through home assignments. These home assignments will not be examined in case of a delayed hand-in, although the examiner will take into consideration special reasons of delay. Examination is in English. The examiner is authorized to decide about alternative forms examination for students with disabilities.

b. The course has no mandatory teaching.

c. Grading is carried out according to a 7-point scale related to the learning objectives of the course:

A = Excellent
B = Very Good
C = Good
D = Satisfactory
E = Sufficient
Fx = Fail (some more work is required)
F = Fail (a lot more work is required)

The two parts of the course are graded according to a 7-point scale. In order to pass, a grade of at least E is required for all parts of the course. The final grade combines the grades of the different parts of the course, weighted according to their numbers of credits.

d. Grading criteria for the course will be distributed at course start.

e. Students who fail an ordinary examination are entitled to take additional examinations as long as the course is offered. There is no restriction on the number of examinations. The term "examination" here is used to denominate also other compulsory elements of the course. Students who have achieved a pass grade on an examination may not retake this examination in order to attempt to achieve a higher grade. Students who have failed to reach a pass grade on a course, or on a part of a course, on two occasions have the right to request that a different teacher be appointed to grade the next exam, unless there are special reasons against it. A request for such an appointment must be sent to the departmental board. A course typically has three examinations for an academic year in which instruction is provided. Intervening years include at least one examination.

f. An opportunity to make up from grade Fx to grade E is given. The examiner decides which assignments should be carried out to make up and the criteria for passing said assignments. This making up must take place before the next examination.

Interim

Students may request that the examination is carried out in accordance with this syllabus even after it has ceased to apply. This right is limited, however, to a maximum of three occasions within a two-year-period after the end of the course offering. A request for such examination must be sent to the department board. This provision is also valid in the case of revision of the syllabus.

Misc

The course can be taken within the Master Programmes in Actuarial Mathematics and Mathematical Statistics. It can also be taken as an individual course.

Required reading

Course literature is decided by the department board and it is published on the web site of the Department of Mathematics (www.math.su.se) at the latest 2 months before course start.