Course syllabus

Modellering och inlärfning från data
Modelling and Learning from Data

FRTN65, 7,5 credits, A (Second Cycle)

Valid for: 2020/21
Decided by: PLED F/Pi
Date of Decision: 2020-04-01

General Information

Main field: Machine Learning, Systems and Control.
Compulsory for: MMSR1
Language of instruction: The course will be given in English

Aim

The course provides an introduction to the problem of learning from data, focusing on the basic concepts behind data analysis. The aim of the course is that students should learn principles and fundamental limitations of what can be learned from data, with techniques coming both from the machine learning and system identification domains.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to define the basic concept behind data analysis.
- understand the limitations of the learning paradigm and the guarantees and confidence in the learning process.
- have knowledge about the different model types and alternatives that can be used to describe the data.
- understand and follow the different phases in the process of building models, from the design of the learning process to its application to a set of data, and validation of the obtained model.
- describe and motivate basic properties of both machine learning models (such as regression, neural networks, and classifiers) and system identification methods (such as least squares, prediction error methods, and recursive identification procedures).
Competences and skills
For a passing grade the student must

- be able to implement machine learning algorithms and reason about the best choice for a given set of data.
- be able to implement system identification procedures and perform model selection and determine how to analyze a given set of data.
- be able to simulate and understand the obtained models.
- solve learning problems by writing and using computer programs.

Judgement and approach
For a passing grade the student must

- understand the confidence that it is possible to achieve with data analysis.
- master teamwork and collaboration in laboratory exercises.

Contents
Learning from data is important and has many applications. The field of machine learning is very dynamic and changes extremely fast, with new techniques emerging and old techniques fading and being replaced. However, the fundamentals of learning can be clearly defined. The course gives a solid foundation to every student that wants to approach data analytics and wants to understand the problem of learning. The course covers the fundamental limitations of learning, and the transition from the deterministic space to the probabilistic space. The course introduces supervised and unsupervised learning. It discusses different types of models and learning techniques.

The first part of the course is dedicated to machine learning problems and algorithms. In the supervised learning framework the course treats classification and regression. In the unsupervised learning framework the course includes clustering techniques. We describe different types of models, like neural networks and decision trees.

The second part of the course is dedicated to system identification problems and describes the concepts of gray-box and black-box models and techniques to perform the identification procedure. In particular, the course treats linear regression, maximum likelihood estimation, prediction error methods, and experiment design.

Laboratories: Analysis of user preferences for songs; Weather forecast based on historical data; Identification of dynamical systems models.

Examination details
Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam (5 hours), three laboratory exercises including three hand-in assignments. In the case of less than 5 registered students, the retake exams may be given in oral form.
The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts

**Code**: 0120. **Name**: Modelling and Learning from Data.
**Credits**: 4.5. **Grading scale**: TH. **Assessment**: Written exam

**Code**: 0220. **Name**: Laboratory Work 1.
**Credits**: 1. **Grading scale**: UG. **Assessment**: Completed laboratory work and hand-in assignment.

**Code**: 0320. **Name**: Laboratory Work 2.
**Credits**: 1. **Grading scale**: UG. **Assessment**: Completed laboratory work and hand-in assignment.

**Code**: 0420. **Name**: Laboratory Work 3.
**Credits**: 1. **Grading scale**: UG. **Assessment**: Completed laboratory work and hand-in assignment.

Admission

**Assumed prior knowledge**: Courses equivalent to the admission criteria for the master programme in Machine Learning, Systems and Control.

**The number of participants is limited to**: No

**The course overlaps following course/s**: FRTN35, FRT041

Reading list


Contact and other information

**Course coordinator**: Martina Maggio, martina.maggio@control.lth.se
**Course coordinator**: Bo Bernhardsson, bo.bernhardsson@control.lth.se
**Director of studies**: Anton Cervin, anton.cervin@control.lth.se
**Course homepage**: http://www.control.lth.se/course/FRTN65

**Further information**: The course in the fall of 2020 is open only to the students in the master programme in Machine Learning, Systems and Control.