

Machine Learning for Predictive Maintenance 5 credits

Maskininlärning för prediktivt underhåll 5 hp

Second cycle

Main field: Computer Science and Engineering, Second cycle, has only first-cycle course/s as entry requirements (AIN)

Syllabus is adopted by the Research and Education Board (2022-09-09) and is valid for students admitted for the spring semester 2023.

Placement in the Academic System

The course is given as a single subject course.

Prerequisites and Conditions of Admission

Degree of Bachelor of Science in Engineering, including an independent project 15 credits or Degree of Bachelor of Science including an independent project 15 credits or the equivalent of 180 Swedish credit points or 180 ECTS credits at an accredited university.

7.5 credits machine learning, 7.5 credits data recovery and 7.5 credits programming. Applicants must have written and verbal command of the English language equivalent to English course 6 in Swedish Upper-Secondary School.

Course Objectives

The goal of this course is to introduce the fundamental concepts of predictive maintenance (PdM) and provide hands-on examples of how machine learning methods can be applied to support the predictive maintenance of equipment. The student must develop knowledge of the role of PdM as a cost-effective equipment management strategy in industrial applications as well as the development and evaluation process of PdM methods, given concrete examples and context. Through laboratory and exercise sessions, and guest lectures by industrial practitioners, the student is expected to relate different concepts, design, and apply methods learned to solve real-world PdM problems.

Following successful completion of the course the student should be able to:

Knowledge and understanding

- state and reflect on the fundamental concepts of Predictive Maintenance (PdM)
- understand how machine learning approaches can support decision-making for PdM
- understand and describe different machine learning paradigms, their corresponding limitations, and example applications in industrial PdM applications

- state and describe challenges in the field

Skills and ability

- formulate the industrial problem and setting up the basis for PdM applications
- use programming tools to preprocess datasets for modeling purposes
- use existing machine learning software packages to develop machine learning models, for predicting component failures and estimating the remaining useful life of the equipment

Judgement and approach

- evaluate the suitability of a machine learning model for a PdM application

Primary Contents

The course covers the following topics:

- Definition and terminology of relevant concepts in PdM
- PdM task formulation, i.e. determine approaches and learning settings for given problems
- Data engineering for time series data, including transformation, anomalous value detection, missing value imputation, outlier removal, etc.
- PdM evaluation metric, given concrete applications and its formulation
- Benchmarking the performance with traditional approaches
- Transfer learning for fault detection and remaining useful life prediction
- Survival analysis for PdM focusing on the evaluation metric and specialized cost function learning
- Interpretability of the PdM machine learning models, and hybrid approaches

Teaching Formats

The teaching will be conducted online, via the university's learning platform, with lectures, labs, and seminar sessions. Lectures will be recorded and shared according to the course progression. The course will start with introducing basic concepts, and, afterward, focus on several important topics. Each topic lecture is followed by a lab session, and a seminar, where participants in groups present and discuss research papers. The project assignment will be introduced early in the course, and supervisions are available over the entire study period. Teaching is in English and fully online.

Examination

The overall grades of Fail or Pass will be awarded for the course.

The course has two examination components: Seminar and Project assignment.

Name of the test		Grading
Seminar	2,5 credits	U/G
Project Assignment	2,5 credits	U/G

If there are special reasons, the examiner may make exceptions from the specified examination format and allow a student to be examined in another way. Special reasons can e.g. be a decision on learning support.

For elite sports students according to Riktlinjer för kombinationen studier och elitidrott vid Högskolan i Halmstad, DNR: L 2018/177, the examiner has the right to decide on an adapted examination component or let the student complete the examination in an alternative way.

Course Evaluation

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

Course Literature and Other Study Resources

The course material includes slides, lab scripts, and scientific papers, which will be made available during the course period.