



# FEP3302 Majorize-Minimization (MM) Optimization with Machine Learning Applications 7.0 credits

Majorisera-Minimerings (MM) optimering med tillämpningar inom maskininlärning

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

## Establishment

Course syllabus for FEP3302 valid from Spring 2022

## Grading scale

P, F

## Education cycle

Third cycle

## Specific prerequisites

Multi variable analysis, probability theory

## Language of instruction

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

## Intended learning outcomes

LO1: Recognize the concept of MM Principle.

LO2: Incorporate techniques for majorization and minorization into the design of MM optimization algorithms.

LO3: Implement numerically the MM optimization algorithms in various application.

## Course contents

Introduction (Lecture 1)

- o MM principle
- o A geometric interpretation
- o Convexity for Majorization
- o Examples

Key Inequalities for MM (Lecture 2 and 3)

- o Applications of Jensen's inequality
- o Applications of the Cauchy-Schwarz inequality
- o Applications of supporting hyperplane inequality
- o Application of quadratic upper bounds
- o Application of arithmetic-geometric mean inequality

Majorization and Partial Optimization (Lecture 4)

- o Main principle
- o Examples

Application in Engineering (Lecture 5 and 6)

- o EM algorithm
- o Regression
- o Estimation with missing data
- o Total variation denoising of images

- o Factor analysis
- o Matrix completion

## Examination

- EXA1 - Examination, 7.0 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.

A take-home exam (4-5 problems) or/and group presentations of a simple implementation

## 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.