Advanced Course in Machine Learning

1. Course title

Advanced Course in Machine Learning

2. Course code

-Code in Oodi/OTM (upcoming academic administration information system) and other systems

DATA12001

3. Course status: compulsory or optional

-Which degree programme is responsible for the course?

Master's Programme in Data Science

-Which module does the course belong to?

Machine learning

-Is the course available to students from other degree programmes?

Yes

4. Course level (first-, second-, third-cycle/EQF levels 6, 7 and 8)

Advanced studies=second-cycle/EQF level 7

Doctoral level = third-cycle (doctoral) degree/EQF level 8

5. Recommended time/stage of studies for completion

First spring

6. Term/teaching period when the course will be offered

Yearly in spring, fourth period

7. Scope of the course in credits

5

8. Teacher coordinating the course

Nikolaj Tatti

9. Course learning outcomes

The learning outcomes provided to students by the course:

1. Explain the basic formulation of machine learning as minimising the expected risk, and identify alternative formulations for the risk.
2. Explain the core tasks of unsupervised and supervised learning, and identify also more advanced learning setups.
3. Derive practical loss functions starting from the formal definition, and explain the relationship between probabilistic models and loss minimisation.
4. Derive algorithms suitable for unsupervised learning tasks and (regularised) linear methods for classification and regression.
5. Implement algorithms suitable for unsupervised learning tasks and (regularised) linear methods for classification and regression.
6. Implement some non-linear classification methods such as random forests and support vector machines.

10. Course completion methods

The course is completed by completing a set of exercises. Significant part of the exercises involve programming.

11. Prerequisites

Introduction to Machine Learning or equivalent knowledge. Programming skills, especially with python, are highly recommended. Basic knowledge of linear algebra, statistics, and analysis, especially differentiation, is required.

12. Recommended optional studies

-What other courses are recommended to be taken in addition to this course?

Courses in the Machine Learning and Statistical Data Science modules

-Which other courses support the further development of the competence provided by this course?

Advanced Statistical Inference, Advanced Course in Bayesian Statistics, Data Science Project

13. Course content

Formulation of machine learning problems. Different kinds of machine learning tasks. Common optimisation approaches for machine learning. Unsupervised learning methods: clustering, factor analysis, matrix factorisation, non-linear dimensionality reduction. Supervised learning methods: Linear and non-linear classifiers, kernel methods, decision trees and forests, boosting.

14. Recommended and required literature

-What kind of literature and other materials are read during the course (reading list)?

The course material are slides, supported by the course book:

Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

The material is complemented with additional publicly available material, and the course book may change in future.

15. Activities and teaching methods in support of learning

-See the competence map (https://flamma.helsinki.fi/content/res/pri/HY350274).
-Student activities
-Description of how the teacher's activities are documented

The primary mode of instruction consists of lectures and exercise sessions with active guidance, supported by other forms of teaching methods when applicable. The students are encouraged to attend the lectures and the exercise sessions. Support channel (online chat) is provided for students.

16. Assessment practices and criteria, grading scale

Grading scale is 1...5.

The grading is based on the points received from the exercises.