Machine Learning (S403011)

Spring 2022

Contacts:

- Lecturer: Prof. Sebastian Engelke
- Teaching assistants: Nicola Gnecco, Olivier Pasche, Jonathan Mendieta

Schedule:

- Course: Wednesday 10h15 - 12h00, UniMail M R160
- Seminar: Thursday 14h15 - 16h00, UniMail M 1170

Objectives: Upon success the student will be able to:

- Choose appropriate machine learning methods among the ones enumerated in the content.
- Perform the corresponding statistical analysis using the computer program Python.
- Discuss advantages and drawbacks of each method.
- Discuss mathematical issues associated to each method.

Description: This course provides the background necessary for a competent application and interpretation of machine learning approaches supporting business analytical decision processes. It first overviews the most broadly used methods for supervised learning in regression and classification tasks. It then discusses the problem of model selection and how this can be tackled with methods such as cross-validation. The course than overviews more recent methodologies related to flexible classification, bagging and boosting, support vector machines and tree-based methods. Modern techniques such as deep neural networks and reinforcement learning will also be studied. After these courses, students should be able to evaluate with a critical mindset the findings of machine learning methods, and to assess their applicability, as well as their advantages and limits in applications. After the course students should possess a good understanding both of the underlying statistical ideas and the main theoretical properties of these methods.

Grading Policy: Semester project (40%), Final Exam written 2h (60%), Hand in at least 80% of the weekly practicals (bonus)

Tentative Course Outline:

Week	Topic	Events
21 Feb – 27 Feb	Introduction + Motivation	
28 Feb – 6 Mar	Regression Framework + Linear Regression + Gradient Descent	
7 Mar – 13 Mar	Training/Test error + Cross-validation	
14 Mar – 20 Mar	Lasso/Ridge + Classification Framework	
21 Mar – 27 Mar	LDA/QDA + Logistic Regression	Start of Project
28 Mar – 3 Apr	Image recoginition + Decision trees	
4 Apr – 10 Apr	Bagging + Random Forest	
11 Apr – 17 Apr	Boosting + Maximal Margin Classifier	
18 Apr – 24 Apr	Easter Break	
25 Apr – 1 May	Support Vector Classifier + Support Vector Machine	
2 May – 8 May	Neural Networks + Deep Neural Networks	
9 May – 15 May	Back-propagation + Regularization of Neural Networks	
16 May – 22 May	CNN + further topics	
23 May – 29 May	Q&A	End of Project
Exam session	Final exam (2h; open book; date to be announced)	