**Content**

| Course Code | Course Name | Semester | Theory | Practice | Lab | Credit | ECTS |
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| VM 532 | Machine Learning | 2 | 4 | 0 | 0 | 3 | 8 |

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| Prerequisites | |
| Admission Requirements | |

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| Language of Instruction | English |
| Course Type | Compulsory |
| Course Level | Masters Degree |
| Objective | The objective of this course is to provide students with a solid foundation in machine learning and deep learning. By covering both theoretical concepts and practical applications, students will learn to design, implement, and evaluate various machine learning models for solving real-world problems. |
| Content | Course content includes an introduction to machine learning, mathematical foundations, the deep relationship between optimization and machine learning, problems encountered in optimization and their solutions, training processes of different models, frequently encountered problems and their solutions, and practical project work. |
| References | https://udlbook.github.io/udlbook/<br>https://www.amazon.com/Hundred-Page-Machine-Learning-Book/dp/199957950X<br>https://www.di.ens.fr/appstat/spring-2023/ |

**Theory Topics**

| Week | Weekly Contents |
|---|---|
| 1 | Overview of machine learning, types of learning, and applications. |
| 2 | Minimal reusable ML data pipeline and data leakage |
| 3 | Optimization foundations |
| 4 | Training = minimizing a loss |
| 5 | Gradient descent for univariate functions |
| 6 | Gradient descent for multivariate functions |
| 7 | Saddle point problem and higher order methods |
| 8 | Regularization |
| 9 | Model Toolbox I : Regression, forecasting and binary classification |
| 10 | Model Toolbox II : Multiclass classification, decision trees and random forests |
| 11 | Model Toolbox III : Gradient boosting with trees, XGBoost, LightGBM and Clustering / Segmentation |