Machine Learning I

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Machine Learning for Computer Vision
TU Dresden

Winter Term 2022/2023

Welcome

- Online course consisting of
  - Lectures in TRE/PHYS on Fri, 09:20–11:10
  - Exercise groups **starting October 26th**:

Online	Wed, 09:20–11:10
In VMB/0302/U	Fri, 14:50–16:40
In VMB/0302/U	Fri, 16:40–18:30

  - Self-study and moderated discussion in a forum
  - Final examination (covering lectures and exercises)
- https://mlcv.inf.tu-dresden.de/courses/22-winter/ml1/index.html
- **Registration**:
  - All participating students need to register through **OPAL**
  - Those enrolled in the study program Computational Modeling and Simulation (CMS) need to register additionally via **SELMA**.
- **Textbooks**:
  - Barber, Bayesian Reasoning and Machine Learning
  - Bishop, Pattern Recognition and Machine Learning
  - Shai, Understanding Machine Learning
- **No recordings/reproductions of the lectures or exercises!**

Machine Learning is a branch of computer science devoted to the *study* and *development* of mathematical models and algorithms for understanding and interpreting data, as well as for deciding and acting wrt. data.

- Poses challenging problems
- Combines insights and methods from
  - Mathematics (esp. optimization, probability theory, statistics)
  - Computer Science (esp. algorithms, complexity, software engineering)
- Provides an opportunity for applying analytical and engineering skills
- Has impact on applications (medical, robotic, consumer)
- Grows dynamically
- Offers excellent career opportunities (esp. in tech companies and startups)

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- Leading scholarly journal:
  - Journal of Machine Learning Research (JMLR)
- Leading academic conferences:
  - International Conference on Machine Learning (ICML)
  - Neural Information Processing Systems (NeurIPS)
  - International Conference on Learning Representations (ICLR)
- Closely related scientific communities:
  - Learning theory (e.g. ALT, COLT)
  - Artificial Intelligence (e.g. IJCAI, AAAI, UAI, AISTATS)

Contents

- **Supervised learning**
  - Disjunctive normal forms
  - Binary decision trees
  - Linear functions
  - Artificial neural networks
- **Semi-supervised and unsupervised learning**
  - Partitioning
  - Clustering
  - Ordering
- **Supervised structured learning**
  - Conditional graphical models
- **Density estimation**
- **Embedding**

Prerequisites

- Mathematics
  - Linear algebra
  - Multivariate calculus (basics)
  - Probability theory (basics)
- Computer Science
  - Algorithms and data structures (basics)
  - Theoretical computer science (basics of complexity theory)

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- For any $m \in \mathbb{N}$, we define $[m] = \{0, \ldots, m-1\}$.