



MACHINE LEARNING

Lecture Topics

Basic outline – may be adapted

- Introduction
- Statistics Basics
- Data Analysis for Machine Learning
- Working with Datasets, Cross-Validation and Other Techniques
- General Aspects of Machine Learning
- Machine Learning Algorithms, like e.g.
 - Linear Regression
 - Kernel trick and SVMs
 - Trees and Ensemble Methods
 - PCA
 - Unsupervised Learning - Clustering
 - (Anomaly Detection, Change Point Detection)

Literature

Zweite Headline

- Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, 2nd ed., Springer New York, NY (2009)
- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer (2006)
 - <https://www.microsoft.com/en-us/research/uploads/prod/2006/01/Bishop-Pattern-Recognition-and-Machine-Learning-2006.pdf>
- Tom M. Mitchell, *Machine Learning*, McGraw-Hill (1997)
 - <http://www.cs.cmu.edu/~tom/files/MachineLearningTomMitchell.pdf>
- Andrew Ng, *CS229 Lecture Notes*, updated by Tenguye Ma, Standord, Spring 2022
 - https://cs229.stanford.edu/lectures-spring2022/main_notes.pdf

Quellen:

Moodle

Please sign in to the Moodle space

- <https://moodle.oth-aw.de/course/view.php?id=3823>
 - Please fill in the **Initial questionnaire**
- Via Moodle you will
 - Get relevant information on the lecture during the semester.
 - Get relevant organisational information.
 - Get materials for the lecture.
 - Get announcements.
 - Get the final exam, submit your solution for the exam, and schedule a review meeting.

Organization of Lectures

Theory & Practical Parts

- Lectures are a **mixture** of
 - Theory (presentation)
 - Practical work
 - Maybe journal club for advanced topics.
- We will work with case studies during the lecture.
- I present a certain topic in form of a presentation.
- Then, you will implement different case studies.
- After a time limit, you present your results.

Organization of Lectures

Theory & Practical Parts

- Practical work
 - You should work in groups
 - You present your solutions to the course
 - You complete unfinished tasks at home.
 - **You won't get a perfectly worked-out solution from me for every task!**
- **Machine learning is a practical topic.**

- **Requirements**
 - You need a computer with a running Python environment in every lecture.
 - You need to be fluent in Python!
 - This is **not** a programming course (→ Bridge modules).
 - It is not practical to “ChatGPT everything”
 - You will miss the time limit.
 - You will not learn the subject.

Final Exam

Project Work

- Release in December (planned)
- Announcement of release date and deadline at least 4 weeks before release.
- You will hand in a short report on a complex Machine Learning task.
 - Including documented source code
 - Including figures, tables, ...
- Rules for Grading
 - Effectvity (do the right things)
 - Correctness of your solution (do the things right)
 - Completeness (do all things that are required)
- You need to know why you have to do what in Machine Learning.

Final Exam

Project Work

- You will work on a practical problem and solve it with machine learning.
 - You need to know why you have to do what in Machine Learning.
 - Time frame approx. 4 weeks
 - Deadlines will be announced in November.
 - If you will work alone or in teams will be announced with the deadlines.
- Grading will be based, among other things, on
 - Effectvity (do the right things)
 - Correctness of your solution (do the things right)
 - Completeness (do all things that are required)
 - Documentation quality
 - Code quality
- You can use the internet, ... but
 - A solution with the quality of the solution from an AI tool or below will be graded with 5.0 (fail).

Niveau of the Course

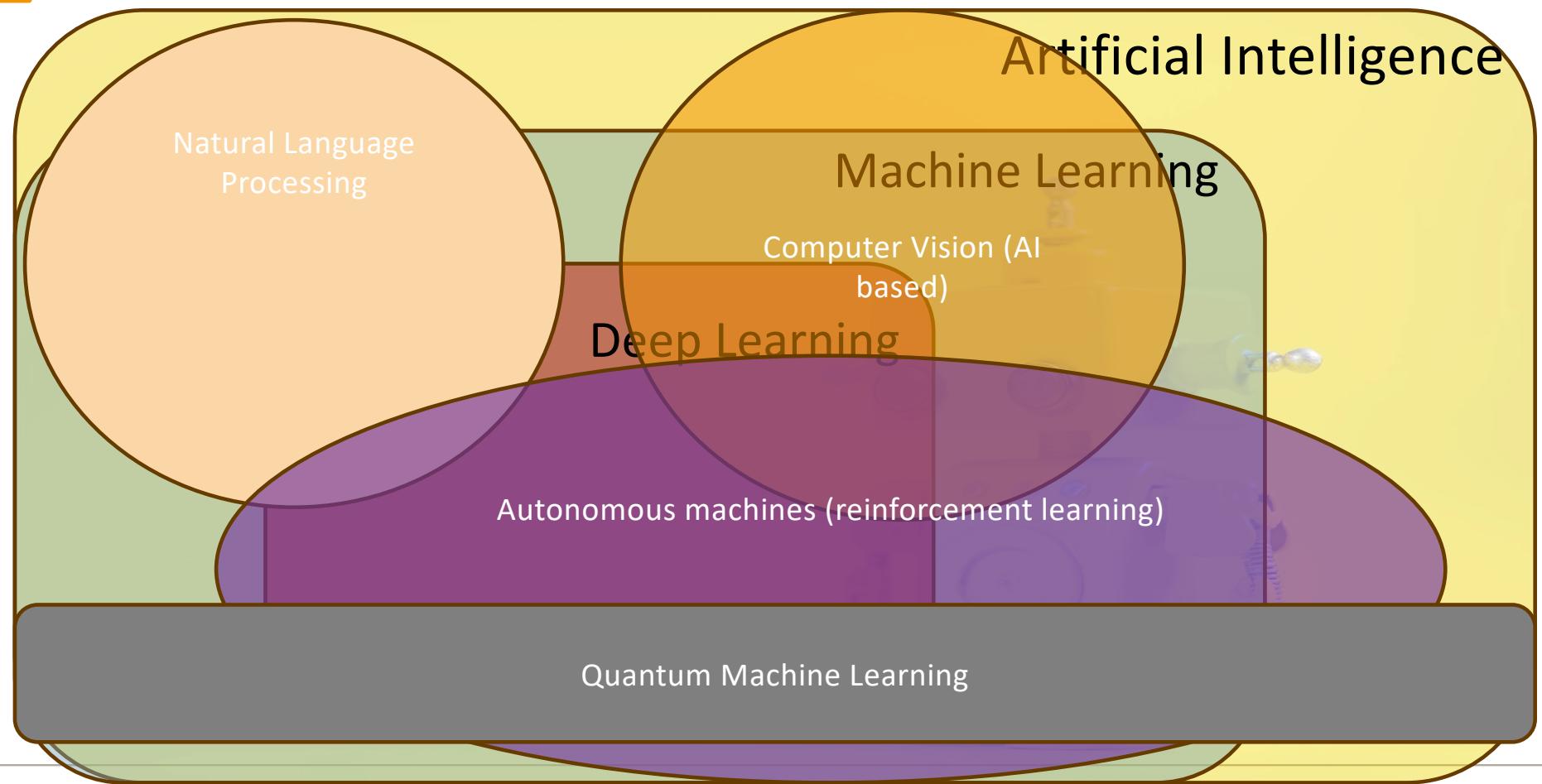
- This is a **Master's** course in Machine Learning for industrial applications.
- You need to be **fluent in Python** programming.
 - This is why we test it in the application exam.
- You need **solid math knowledge** (calculus and linear algebra).
- If you do not have these competences: Please go to the **bridge modules** first.
- This is a difficult course!
- But, it is the **fun** part of your studies, why you are here!
- You will learn a lot, but only if you are able to follow the class.
- Being able to do Machine Learning is a **high-valued skill**.
 - Nobody will pay you > \$5000 a month if they get the same from ChatGPT for \$50



QUESTIONS REGARDING ORGANIZATION?

Your Experience with Machine Learning? Or Statistics





Three Types of Machine Learning

01

Learning by examples:
Supervised Learning

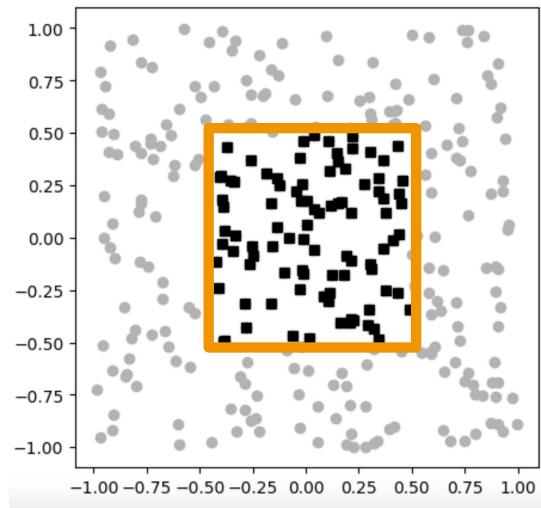
02

Finding patterns without labeling:
Unsupervised Learning

03

Learning by rewards:
“Reinforcement Learning”

Unsupervised Learning



Supervised Learning



dog



Images: Pixabay

cat

Our Scope

- Methods of Machine Learning
 - Supervised and unsupervised learning
 - Reinforcement learning is out of scope: Mobile Robotics
 - Deep learning: dedicated lecture (summer)
- Focus on basics
 - Dedicated lectures for applications, e.g. computer vision, NLP
- Goal of the lecture: You will be able to familiarize with new methods, algorithms, topics yourself



PYTHON SETUP



Python Setup

Basics

- Please create a virtual environment for Python
 - E.g. using the venv package: <https://docs.python.org/3/library/venv.html>
 - You can at anytime create a new env for new tasks or re-create your environment if it is broken
- Python version should be at least 3.8
- We will also work with Jupyter Notebooks since they integrate coding and presentation
 - <https://jupyter.org>
 - To work with your virtual env in Jupyter you need to create a kernel first

```
python -m ipykernel install --user --name=<your venv name>
```

Quellen:

Python Setup

Packages

- You can work on the OTH computers or on your own laptop or even work on both.
 - In the latter case a version control like git is recommended, we will come to that point later.
- In your venv please install the following packages
 - Numpy, pandas, matplotlib
 - Scikit-learn
 - We will continuously add packages with new tasks
- You can at any time create a snapshot of your environment to reproduce it using
 - Pip freeze > requirements.txt
 - Reinstall it with pip install –r requirements.txt

Quellen:

Python Setup

Requirements.txt

- You can at any time create a snapshot of your environment to reproduce it using
 - Pip freeze > requirements.txt
 - Reinstall it with pip install –r requirements.txt
- If you work with version control
 - Regularly commit the requirements.txt file
 - Especially before changes, it enables you to roll back to the last (working) environment

Quellen:



PANDAS 101

