MACHINE LEARNING FOR AUTONOMOUS ROBOTS

Organisation and Introduction

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University of Bremen

German Research Center for Artificial Intelligence

Course Organisation

Today's Goal

Today, we will:

- Explain how this course is organised
- Outline the semester schedule

Who are we?

Meet the team:

- Prof. Frank Kirchner
- Melvin Laux (organiser, main point of contact)
- Dr. Alexander Fabsich
- Dr. Bilal Wehbe
- Dr. Su-Kyoung Kim
- Vamsi Origanti
- Marc Otto
- Chandandeep Singh

- Student Tutors: Philipp Lahmeyer

What will you learn during this course?

- Fundamental concepts of machine learning
- Gain hands-on experience by working through exercise sheets

Prerequisites

Programming:

- Python 3

Some fundamental maths:

- Statistics + Probability theory
- Linear Algebra

Language:

- All materials (Lectures, Exercises, Tutorials) are in English

Interest in:

- Artificial Intelligence
- Machine Learning
- Robotics

None of these are hard requirements, but catching up on everything might be too much!

Course Communication

StudIP is the main communication channel:

- Activate notifications: (minimal recommendation: forum, files, **announcements**)
- Activate e-mail forwarding

How to ask questions:

- General questions about admin issues or lecture content → forum on StudIP
- Highly specific admin questions → contact Melvin directly (`laux@uni-bremen.de`)

Course Format

Course Format

In this course, we offer:

- Video lectures
- Q&A Sessions
- Tutorials

Video Lectures

Why video lectures?

- Live lectueres require a lot more preparation than videos
- Video lectures can be watched multiple times
- You get to choose when to watch the lecture

How does it work?

- Pre-recorded video lectures
- Released on StudIP every Friday via Courseware plugin
- Watch the videos at your own time, **but do it before the tutorials!**
- We want to improve the videos, your feedback helps!
- There will be two live lectures at the end of the semester

Q&A Sessions

What are Q&A Sessions?

- Opportunity to ask individual questions about lecture content in person
- Every Tuesday, from 10:15 to 11:45 in RH1 B0.10
- Test phase for first two weeks: If participation is low, making an appointment may become a requirement

Tutorials

Every Thursday, from 14:15 to 15:45 in RH1 B0.10:

- Builds on the content of the week's video lecture
- Content and style depends on tutor
- **No "demonstration"** of exercise sheets
- Discussion and clarification of open questions and issues
- Wrap-up and repetition
- Practical examples and applications
- In-depth discussion of important aspects
- It's your tutorial: participation is key

Format Summary

- Video lectures: Released every Friday, watch on-demand
- Q&A sessions: Tuesdays, 10:15 – 11:45, RH1 B0.10
- Tutorials: Thursdays, 14:15 – 15:45, RH1 B0.10

Exercises and Grading

Examination

To complete the course, you must pass the final exam at the end of the semseter:

- Coursework: hands-on programming exercises based on every week's lecture content in groups of up to 3 (optional, as bonus)
- Written exam: Final exam after the semester, focus on theory

Preliminary exam date: 15.02.2024

To be eligble for the exam, you must be register in PABO!

Coursework

- Six exercise sheets in a two week cycle.
- Two exercises per sheet with a total of 20 points
- Participation is optional, but you can gain a bonus

Exercises in groups of max. **three** students (**StudIP**)

Course Grading

- Six exercise sheets

- Gain points by working on exercise sheets
- Points will be translated into bonus on your final exam grade

Bonus

Percentage	**Bonus**
$[0; 50)$	no bonus
$[50; 70)$	0.3/0.4
$[70; 90)$	0.6/0.7
$[90; 100)$	1.0

Example:

- 2.3 in written exam
- 73 percent of exercise points
- final grade: 1.7

Important: Bonus is only applied on passing exam grades!

Group Sign-Up

Form Groups via StudIP:

- Group size of up to three students
- Sign-up starts Friday, 20.10.2023, 10:00

Exercise Submission

Submissions are handled via StudIP's DoIT Plugin:

- Download exercise materials from the tab "Exercise sheets"
- Upload your solution in the same place
- Submit your Python code as a .py file
- Notebooks are not accepted

Exercise Remarks

- Structure, modularize and document your code
- Be precise with maths! (errors due to rounding)
- Code efficiency matters
- Think about your plots

Remarks on Plagiarism

- Plagiarism is a serious offence!
- The internet is a great resource, but **cite your sources!**
- Don't copy off other groups!

Remarks on Teamwork

- Meet regularly!
- Ask each other for help
- Communicate problems **early**!
- Distribute tasks, but discuss your solutions
- Consider using collaboration tools (Github, Gitlab, Overleaf, etc...)
- Start work on assignments early

Remarks on Effective Studying

- Study both own your own and in groups
- Use outside material, e.g., online lectures from other universities
- Take notes (digital or physical)
- Organise your materials for the future
- Study smart, not hard $\rightarrow$ Consistency is key!

Semester Schedule

Tentative Schedule

	Date	Topic	Tutor
Tutorial #0	29.10.23	Maths & Python Tutorial	Melvin & Robin
Tutorial #1	26.10.23	Preprocessing	Marc
Tutorial #2	02.11.23	Metrics and Evaluation	Su
Tutorial #3	09.11.23	Classification 1	Vamsi
Tutorial #4	16.11.23	Classification 2	Vamsi
Tutorial #5	23.11.23	Regression 1	Bilal
Tutorial #6	30.11.23	Regression 2	Bilal
Tutorial #7	07.12.23	Ensemble Learning	Melvin
Tutorial #8	14.12.23	Clustering	Alexander
Tutorial #9	21.12.23	Neural Networks & Backpropagation	Alexander
Tutorial #10	11.01.24	Deep Learning	Chandandeep
Tutorial #11	18.01.24	Recurrenct Neural Networks	Vamsi
Lecture #11	23.01.24	Research and Applications	TBD
Tutorial #11	25.01.23	Research and Applications	Alexander
Lecture #12	30.01.24	Intro to Reinforcement Learning	Frank
Tutorial #12	01.02.24	Wrap-Up	Melvin

Key Literature

Key Literature

- Machine Learning: A probabilistic perspective, Kevin P. Murphy, 2012.
- Pattern Recognition and Machine Learning, Christopher M. Bishop, 2009.
- Artificial Intelligence: A modern approach, Stuart Russell and Peter Norvig, 2010.
- Deep Learning, Ian Goodfellow and Aaron Courville and Yoshua Bengio, 2016.

Courses at the Robotics Group

Other Courses

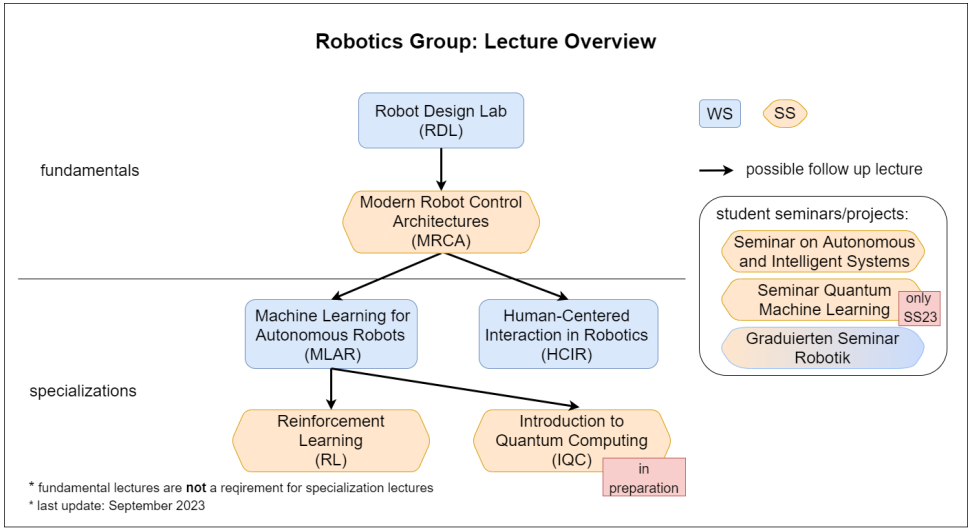
Courses, Seminars & Projects:

- Robot Design Lab (WiSe) → Bachelor
- Modern Robot Control Architectures (SoSe) → Bachelor/Master
- Reinforcement Learning (SoSe) → Master
- Human-Centered Interaction in Robotics (WiSe) → Master
- Seminar on Autonomous and Intelligent Systems (SoSe) → Master

Theses:

- Check our website
- Contact Melvin directly

Overview


Robotics Group: Lecture Overview
Robot Design Lab (RDL)
fundamentals
Modern Robot Control Architectures (MRCA)
Machine Learning for Autonomous Robots (MLAR)
Human-Centered Interaction in Robotics (HCIR)
specializations
Reinforcement Learning (RL)
Introduction to Quantum Computing (IQC)
in preparation
WS
SS
possible follow up lecture
student seminars/projects:
Seminar on Autonomous and Intelligent Systems
Seminar Quantum Machine Learning
only SS23
Graduierten Seminar Robotik
* fundamental lectures are **not** a reqirement for specialization lectures
* last update: September 2023

Thank You! Any Questions?