

Welcome to the RL Lecture

Brief Motivation and Orga

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Automated
Machine Learning
Hannover

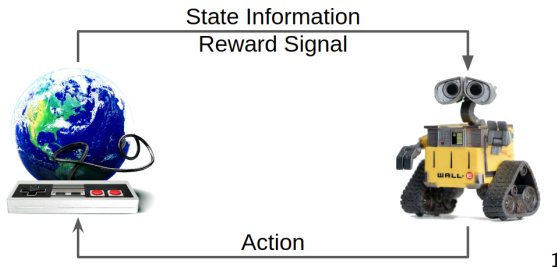
Why are you interested to learn more about reinforcement learning (RL)?

→ use the chat to answer!

“Machine learning is the science of getting computers to act without being explicitly programmed.”

by Andrew Ng

Reinforcement Learning



- Data: Self-acquired observations + rewards
 - Task: Learn how to behave s.t. reward is maximized
- ~> Not a single decision, but a sequence of good decisions

¹Image source: Morning Brew and Marius Haakestad on Unsplash

Goals of the Lecture

You will be able to ...

- 1 understand the basic algorithms in RL
- 2 discuss the assumptions and limitations of RL and its algorithms
- 3 decide which RL algorithm to use on a given environments
- 4 do research on RL yourself
 - ▶ perfect opportunity to do a master project or thesis with us afterwards

Course Overview (tentative)

- 1 Big Picture (Introduction)
- 2 MDP, Policy, Value Iteration
- 3 Policy Evaluation
- 4 Model Free Control
- 5 Linear Function Approximation
- 6 Deep RL
- 7 Policy Gradient
- 8 Exploration
- 9 Meta-RL
- 10 Reproducibility in RL
- 11 Project

- Concepts over details
 - ▶ we provide references and links to papers s.t. you can read up details!
- Interactive lecture and exercise sessions
 - ▶ short inputs (~ 10 min) followed by Q&A
 - ▶ interactive quizzes in exercise sessions to reinforce your knowledge
 - ~> The success of it depends on whether you are willing to talk to us!
- (Mostly) Practical exercises
 - ▶ implement it, use it and play with it!

Team



Prof. Dr.
Marius Lindauer



Theresa Eimer



Frederik Schubert

Organization (Lectures)

- Meeting each week Thursday at 2pm (s.t).
- I will try to limit the lecture to 90min, but since I would like to have an interactive lecture, let's be a bit flexible.
- Each week, the lecture is divided into small parts.
- We will record the lecture and might put the lecture parts online at the end of semester
 - ▶ Bad experience from last semester: Students were thinking that it's fine to watch the recorded videos later and are able to catch up again. That failed horribly: 72% of the students decided to not take the exam last minute!
 - ▶ Even more important for RL: Attend all lectures and learn the concepts on time!
 - ↪ RL concepts build upon each other and sometime look very similar
- Meeting via Zoom – as you already figured out ;-)

Organization (Exercises)

- Every Wednesday at 3pm via BBB/Zoom?
 - ▶ Attending mandatory! (You can be absent at most twice!)
 - ▶ No recording
- Discussion of mini examples (e.g., Mars Robot)
- Interactive Kahoot quiz
- Feedback to exercise sheet
 - ▶ You don't need to achieve any point threshold
 - ▶ But you need to submit something every week

Organization (Exercise Assignments)

- Every week, a new exercise sheet
 - ▶ exercise focus is one week behind the lecture topics
 - ▶ Most exercises will be practical, i.e., you have to implement something
 - ▶ Team work highly recommended, team size at most 3!
 - ▶ Build upon GitHub classroom \rightsquigarrow enables auto-grading
 - ★ There will be an invitation link each week on each exercise sheet.
 - ★ You will have to click on the link on exercise sheet one to be able to form groups.
 - ★ Submit solutions via git
 - ▶ If we catch anyone at obvious cheating (incl. plagiarism), we will kick them out.
- If you need help or have questions, use the chat!

You need help?

Priority list:

- 1 Ask you friends and peers
- 2 Use our chat system via Mattermost (see Stud.IP for invitation link) and post to the “town square” channel
 - ▶ You can also answer the questions of your peers!
 - ▶ We will only reply if we have the feeling that it is necessary.
- 3 If there are organizational questions, contact Theresa or Frederik directly (via Mattermost)
- 4 Only as the very last option, contact me ;-)

Requirements for Attending

- Basics of **AI** (mandatory)
 - ▶ Search, planning, optimization . . . , expectations, . . .
- Basics of **Machine Learning** (mandatory)
 - ▶ Classification, regression, clustering, decision tree, training-test split, cross validation, pre-processing . . .
 - ▶ to catch up (if nec.):
<https://www.coursera.org/learn/machine-learning>
- Knowledge and hands-on exp. in **Deep Learning** (PyTorch) (mandatory)
 - ▶ feed-forward network, recurrent network, convolutions, learning rates, regularization, . . .
 - ▶ to catch up (if nec.): <https://course.fast.ai/>
- Experience in **Python and git** (strongly recommended)
 - ▶ nearly all exercises will require that you implement something in Python and submit the solution to a git repo

- Implement a larger project (worth 1 – 2 weeks full time)
 - ▶ You can propose your own project idea!
 - ★ Hand-in a short summary of the idea (half a page) and we will provide feedback regarding feasibility
 - ▶ Teamwork (at most 3) again possible
 - ★ Larger team → larger scope of the project
- “Exam”
 - ▶ First 15 minutes: Present your project idea and results in the
 - ★ Of course, everyone will present the project on their own
 - ▶ Second 15min: We will ask further questions about your project and how it relates to stuff you learned in the lecture.
- You will have the choice between a virtual and on-site exam.

Bonus Points?

- You can earn bonus points for the exam by finding bugs in our slides and exercises:
 - ▶ You can get at most 10% as a bonus of the overall points in the exam
 - ▶ 0.1% for each typo in the slides or exercise sheet
 - ▶ 0.5% for each non-trivial bug in equations or algorithm outlines
 - ▶ 1.0% for each non-trivial bug in the exercise assignments
- How get to it?
 - 1 Submit a PR with the fix to our GitHub repo:
https://github.com/automl-edu/RL_lecture
 - 2 Send us a message with link to your PR in the corresponding Mattermost channel

Additional Resources

- To get a deep understanding of RL, you should also read some papers
- RL book by Sutton and Barto: <https://www.andrew.cmu.edu/course/10-703/textbook/BartoSutton.pdf>
- Video lectures – click on it!
 - ▶ [Emma Brunskill (2019-20)]
 - ▶ [Sergey Levine (2020)]
 - ▶ [David Silver (2015)]

Opportunities and Risks

RL is an advanced lecture and we present it for the first time

Opportunities:

- RL is a very hot topic these days
- We will start with the basics and go step by step to the more advanced (research) topics
- The course will provide a solid background for doing a master project/thesis in our group

Challenges:

- The research on RL is very active and there is so much progress
 \rightsquigarrow impossible to catch up with state of the art with one course
- The origins of RL go back to robotics, control, theory on bandits and computer science \rightsquigarrow different notations
- You will find some typos and issues in the slides
 \rightsquigarrow please tell us if you find something

→ Give us some feedback and we will improve the course!

Questions?