Model Predictive Control and Reinforcement Learning
– Project Instructions –

Joschka Boedecker and Moritz Diehl

University Freiburg

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Time Table

	Tuesday 4.10.	Wednesday 5.10.	Thursday 6.10.	Friday 7.10.
09:00-09:30	**Welcome + Q&A 1** Prerequisite lecture 1-3 *Joschka Boedecker, Moritz Diehl*	**Lecture 2** Practical Aspects of Nonlinear MPC *Moritz Diehl*	**Lecture 4** Alternative Views on Dynamic Programming *Moritz Diehl*	**Micro Exam**
09:30-10:00				
10:00-10:30				
10:30-11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00-11:30	**Q&A 2** Prerequisite lecture 4-5 *Joschka Boedecker, Moritz Diehl*	**Acados Workshop** *Jonathan Frey*	**Lecture 5** Function Approximation & Actor Critic *Joschka Boedecker*	Project Work
11:30-12:00				
12:00-12:30				
12:30-13:00				
13:00-13:30	Lunch break	Lunch break	Lunch break	Lunch break
13:30-14:00				
14:00-14:30	**Lecture 1** Technologies behind AlphaGo *Joschka Boedecker*	**Lecture 3** Monte Carlo & Temporal Difference *Joschka Boedecker*	**MPC&RL - Differences, Similarities and Synergies**	Project Work
14:30-15:00				
15:00-15:30				
15:30-16:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break
16:00-16:30	Project Brainstorming	Project Work / Tutorials	Project Work / Tutorials	**Spot Light Presentations (Voluntary)** *Preliminary project results*
16:30-17:00	**Project Pitches**			
17:00-17:30				

Projects

- Projects can be either application- or algorithm-oriented.
  - For application-based projects you formulate and solve a self chosen optimal control or reinforcement learning problem. The focus should be on the mathematical description of your problem (the modeling), its numerical solution and the interpretation of the results.
  - For algorithm-based projects, you choose a scheme for the solution of optimal control problems or a reinforcement learning algorithm. The focus is then on the implementation of the scheme and an investigation of its performance, using several test problems/benchmarks. They should illustrate the properties of the algorithm, but need not necessarily have a real-world interpretation.
- The project can be done in groups of up to three students.
- To register your team please fill out the following form:
  `https://cloud.syscop.de/apps/forms/z7eqp3xTWLkA65Kf`

Spot Light Presentations

- On Friday, there will be an opportunity for projects to present there preliminary results.
- If you think a project should be spotlighted you can make a suggestion to the organizers.
- Please make suggestions in time such that we can notice potential presenters early enough!
- Presentations should be 5-10 minutes long.
- For the presentation, you can either send the tutors a pdf.
- Or, if you want to show animations or videos, we will provide a Zoom session for screen sharing.

Project Report

- The report must be a new and self-written document and may not contain any copy of other text or figures. The report must be solely written by the author(s).
- The report must include a short, interesting title, the name(s) of the author(s) and an abstract. The content should be clearly structured in sections. It should start with an introduction and conclude with a short summary and critical discussion of the results.
- The report should contain at least one (selfmade) sketch of the modeled system or implemented algorithm.
- The report must cite all external sources as references at the end and other people's contributions must be acknowledged. Using other people's ideas and help is allowed, even encouraged. But not citing or acknowledging them properly is fraud.
- The report should be 4 to 5 pages.
- We strongly recommend using LaTeX. You can consider using the official IEEE template for conferences that can be downloaded here:
  `www.ieee.org/conferences_events/conferences/publishing/templates.html`
- Please send your report as pdfs to both tutors, Florian and Jasper, until November 8.

Formalities

- To get ECTS for this course you need to pass the micro exam (Studienleistung) and the project report (Prüfungsleistung).
- Students of the University of Freiburg must register to the exam with the following form on the first day of the course (i.e., today: October 4)
  `https://cloud.syscop.de/apps/forms/ny49MP3bEfxAjAYP`