EURO PhD School "Reinforcement Learning Applied to Operations Research"

When: 17-24 July 2022 (http://stochmod.eu/EPS)

Where: IBZ Schloss Gimborn, Marienheide, Germany (https://www.ibz-gimborn.de/)

Organized by EURO Working Group on Stochastic Modeling (http://stochmod.eu)

Supported by

EURO (https://www.euro-online.org/)

GOR (https://www.gor.de/)

Overview

Goal: Make PhD students in stochastic modeling familiar with Reinforcement Learning techniques by DIY in a hackathon-like workshop.

Background: Markov decision processes are a familiar technique in stochastic modeling. Variants of many stochastic models of decision-making problems lend themselves for an analysis using Reinforcement Learning (In the operations research and control literature, Reinforcement Learning is often called Approximate Dynamic Programming). Examples are inventory and controlled queueing models with unknown arrivals distribution, or high-dimensional revenue management problems with unknown demand function. By learning the

Reinforcement Learning techniques and applying them directly to simple problems we hope that participants will obtain hands-on knowledge of Reinforcement Learning in the context of stochastic modeling problems.

Attendees: PhD students, mainly from European countries (members of the EURO), are expected to have familiarized themselves with the basics of (finite) Markov decision processes, stochastic dynamic programming and Monte Carlo simulation before the start of the workshop.

Format: Tutorials and lectures by specialists, a mixture of in-person and online, with time to work in small groups on various operations research problems. Specialists will actively support the groups during implementation sessions.

Speakers and Organizers

Shipra Agrawal

Columbia University

USA

Pierre-Luc Bacon

Université de Montréal
& Mila

Canada

Vincent François-Lavet

VU Amsterdam

Netherlands

Joren Gijsbrechts

Universidade Católica
Portuguesa

Portugal

Peter Jacko

Lancaster University
& Berry Consultants

UK

Odysseas Kanavetas

Leiden University

Netherlands

Emilie Kaufmann

CNRS
& Université de Lille

France

Ger Koole

VU Amsterdam

Netherlands

Tor Lattimore

DeepMind

UK

Gerhard Neumann

Karlsruhe Institute of
Technology

Germany

Katharina Senz

University of Mannheim

Germany

Raik Stolletz

University of Mannheim

Germany

Schedule

Sunday 17 July

16:15 Shuttle from Cologne main train station
17:15-18:15 Accommodation check-in
18:30-19:30: Dinner
19:30 Program starting
21:30 Program ending

Monday 18 July - Saturday 23 July

07:30-08:30: Breakfast
09:00 Program starting
10:30-11:00: Coffee & biscuits
13:00-14:00: Lunch
15:30-16:00 or 16:00-16:30: Coffee & pastries
18:30-19:30: Dinner
21:30 Program ending

Sunday 24 July

7:30-08:30 Breakfast
9:30-10:00 Accommodation check out
10:00 Program starting
11:30 Program ending
11:30-12:30: Lunch
12:45 Shuttle to Cologne central train station

Social Events

Monday 18 July

11:00-13:00 Walk

Thursday 21 July

16:30-21:30 Walk & dinner at Wiesengrund (www.gasthaus-wiesengrund.de/18.html) & bus

Saturday 23 July

19:30-21:30 Free time

Program

(Asterisk * means "online" attendance):

Sunday 17 July

- 19:30-20:30: Intro to RL and summer school program (Ger, Raik, Odysseas)
- 20:30-21:30: Discussion of OR problems tractable by RL (Ger, Odysseas)

Monday 18 July

- 09:00-10:30: 3 minutes presentation by each participant & Making groups (Ger, Odysseas)
- 11:00-13:00: Social event (Ger, Raik, Odysseas)
- 14:00-15:30: MDPs & OR/RL Problems - Tutorial (Shipra*)
- 16:00-18:00: MDPs & OR/RL Problems - Implementation in groups (Ger, Odysseas)
- 19:30-21:00: Value-based Methods I: Temporal Difference - Tutorial (Pierre-Luc*)

Tuesday 19 July

- 09:00-10:30: Value-based Methods I: Temporal Difference - Implementation in groups (Ger, Odysseas)
- 11:00-12:30: Value-based Methods II: Policy Gradient & Actor-Critic - Tutorial (Gerhard*)
- 14:00-16:00: Value-based Methods II: Policy Gradient & Actor-Critic - Implementation in groups (Ger, Odysseas)
- 16:30-18:00: Value-based Methods - Preparation of presentations
- 19:30-21:30: Value-based Methods - Group presentations (Ger, Odysseas)

Wednesday 20 July

- 09:00-10:30: Deep Reinforcement Learning I - Tutorial (Vincent)
- 11:00-12:30: Deep Reinforcement Learning I - Discussion of OR problems & implementation in groups (Joren*, Vincent, Odysseas)
- 14:00-15:30: Deep Reinforcement Learning II - Tutorial (Vincent)
- 16:00-18:00: Deep Reinforcement Learning II - Implementation in groups (Vincent, Odysseas)
- 19:30-21:30: Further group work

Thursday 21 July

- 09:00-10:30: Deep Reinforcement Learning III - Tutorial (Vincent)
- 11:00-12:00: Deep Reinforcement Learning III - Implementation in groups (Vincent, Odysseas)
- 12:00-12:30: Deep Reinforcement Learning - Preparation of presentations
- 14:00-16:00: Deep Reinforcement Learning - Group presentations (Vincent, Odysseas)
- 16:30-21:30: Social event & Dinner (Vincent, Odysseas, Emilie)

Friday 22 July

- 9:00-10:30: Multi-armed Bandits I: Stochastic - Tutorial (Emilie)
- 11:00-12:30: Multi-armed Bandits I: Stochastic - Discussion of OR problems & implementation in groups (Emilie, Odysseas)
- 14:00-15:30: Multi-armed Bandits II: Bayesian - Tutorial (Emilie)
- 16:00-18:00: Multi-armed Bandits II: Bayesian - Implementation in groups (Emilie, Odysseas)
- 19:30-21:30: Further group work

Saturday 23 July

- 9:00-10:30: Multi-armed Bandits III: Contextual - Tutorial (Tor)
- 11:00-12:30: Multi-armed Bandits III: Contextual - Implementation in groups (Tor, Odysseas)
- 14:00-15:00: Multi-armed Bandits - Advanced lecture (Tor) - not meant for implementation
- 15:00-16:00: Multi-armed Bandits - Preparation of presentations
- 16:30-18:30: Multi-armed Bandits - Group presentations (Tor, Odysseas)

Sunday 24 July

- 10:00-11:30: Evaluation & potential next steps (Tor, Odysseas)