Linnæus University

Dnr: LNU-2024/243

Course syllabus

Faculty of Technology
Department of Mathematics

4MA903 Förstärkningsinlärning, 7,5 högskolepoäng
Reinforcement learning, 7.5 credits

Main field of study
Mathematics

Subject
Mathematics

Level
Second cycle

Progression
A1N

Date of Ratification
Approved 2024-01-29.
The course syllabus is valid from autumn semester 2024.

Prerequisites
Courses in mathematics totalling at least 45 credits, including courses in linear algebra, probability theory and statistics, multivariable analysis, and at least 6 credits in programming or equivalent.

Objectives

After completing the course, the student should be able to:
Knowledge and Understanding

- A.1 show in-depth knowledge and understanding within the parts of mathematical modeling and probability theory included in the course,

Skills and Abilities

- B.1 demonstrate in-depth ability to plan within given time limits and with

adequate methods carry out qualified tasks with relevance to the content of the course as well as report and critically analyze the results, as well as
- B.2 demonstrate ability to clearly explain and discuss theory and methods included in the course and the knowledge and arguments that underlie these.

Content

The purpose of the course is to introduce the mathematical mathematical framework and methods of reinforcement learning and some areas of application. Implementation in the form of programming is also an important element of the course, which includes the following:

- Introduction to problem formulations in reinforcement learning and history.
- Multi-armed bandits.
- Finite Markov Decision Processes: Agents, Goals and Rewards, Markov Decision Processes, Value Functions, Bellman Equations, Optimal Value Functions, Optimality and Approximation.
- Tabular methods. Dynamic optimization. Value iteration, policy iteration and Q-learning.
- Orientation on areas of application.
- Theoretical deepening and analysis of algorithms and methods.

Type of Instruction

Lectures, teacher-led labsessions and seminars related to assignments. Assignments are performed in groups and reported orally and in writing.

Examination

The course is assessed with the grades A, B, C, D, E or F.

The grade A is the highest grade level, the remaining grades follow in descending order where the grade E is the lowest grade level to be passed. The grade F means that the student's performance has been assessed as failing.

For a passing grade on the course, at least grade G is required on Lab 1, Lab 2, Lab 3 and assignment and grade E on Theory and method. The final grade is determined by the grade on Theory and method.

All graded examination elements consist of two or more result notes for written and oral presentations, which together form the basis for grading the graded examination element.

For submissions, results from both written and oral presentation of submissions are noted. The work with the written presentation is carried out in groups. Oral presentation of the submission tasks is examined individually.

For each laboration, the results of the program code and an oral account of this are noted. The laboratorations are carried out and examined only individually.

For the theory and method part, results from both oral and written reports are noted. The part is examined individually.

Resit examination is offered in accordance with Linnaeus University’s Local

regulations for courses and examination at the first- and second-cycle levels. In the event that a student with a disability is entitled to special study support, the examiner will decide on adapted or alternative examination arrangements.

Objectives achievement

The examination of the course is divided as follows:
Module 2401 Assignment 2.0 credits with the grading system UG
Module 2402 Computer Lab 1 1.0 credits with the grading system UG
Module 2403 Computer Lab 2 1.0 credits with the grading system UG
Module 2404 Computer Lab 3 1.0 credits with the grading system UG
Module 2405 Theory and method 2.5 credits with the grading system AF

The examination elements are linked to the course objectives in the following ways:
Module 2401 links to the course objectives: A.1, B.1
Module 2402 links to the course objectives: A.1, B.1
Module 2403 links to the course objectives: A.1, B.1
Module 2404 links to the course objectives: A.1, B.1
Module 2405 links to the course objectives: A.1, B.1, B.2

Course Evaluation

A course evaluation should be conducted during the course or in connection with its conclusion. The results and analysis of the completed course evaluation should be promptly communicated to students who have completed the course. Students participating in the next course instance should be informed of the results of the previous course evaluation and any improvements that have been made, no later than at the start of the course.

Other Information

The course is conducted in such a way that the course participants' experiences and knowledge are made visible and developed. This means, for example, that we have an inclusive approach and strive for no one to feel excluded. This can manifest itself in different ways in a course, for example by the teacher using gender-neutral examples.

Required Reading and Additional Study Material

Required Reading

- Sutton, Richard och Barto, Andrew: Reinforcement Learning: An introduction, senaste upplagan, MIT Press, (200) 338 pages.
- Complementary mathematical study material from the department (max 100 pages) as well as a selection of sources available on the web portal of the course.

Optional Reading

- Howard, Ronald A. (1960). Dynamic Programming and Markov Processes. The M.I.T. Press.