Reinforcement Learning

2025 - 2026

Is part of the next programmes:

- M0012004 Master of Computer Science: Software Engineering
- M0012005 Master of Computer Science: Data Science and Artificial Intelligence
- M0012006 Master of Computer Science: Computer Networks
- M0048004 Master of Computer Science: Software Engineering
- M0048005 Master of Computer Science: Data Science and Artificial Intelligence
- M0048006 Master of Computer Science: Computer Networks
- M0090004 Master of Teaching in Science and Technology: Computer Science
- M0119000 Master of Digital Business Engineering
- M0119000 Master of Digital Business Engineering
- U0001008 Courses open to exchange students in Sciences

Course Code:	2001WETDCP
Study Domain:	Computer Science

Semester:	2E SEM
Contact Hours:	45
Credits:	6
Study Load (hours):	168
Contract Restrictions:	No contract restriction
Language of Instructions:	ENG
Lecturer(s):	T Kevin Mets
Examperiod:	exam in the 2nd semester

1. Prerequisites *

speaking and writing of:

- English

extra commentary:

This course is thought in English. A thorough knowledge of the English language is thus necessary.

specific prerequisites for this course

This course requires knowledge on Artificial Intelligence. For students who did their bachelor at the University of Antwerp, this means that you must have succesfully completed the course "Artificial Intelligence" in the bachelor programme. Moreover, the course requires knowledge on deep neural networks. If you do not yet have this background, it is important that you also participate in the course "data mining" as these aspects will be taught in parallel in that course.

Additionally, this course requires knowledge of programming and a broad programming experience (with different languages).

2. Learning outcomes *

- You are able to define the key characteristics of reinforcement learning and how it differs from other AI solutions
- Given an AI problem, you are able to identify whether this can be modeled as a reinforcement learning problem or not. If so, you are able to recommend and apply the most appropriate technique within the RL family (deep RL or not, which type of deep RL algorithm, etc.)
- You are able to implement an RL algorithm successfully so that it can effectively solve a control task.
- You have a thorough understanding of when RL can be applied, when not to apply it and what type of problems you might run into.
- You have theoretical knowledge of the fundamentals of reinforcement learning such as theoretical convergence, computational complexity, etc.
- You have a good view on the recent breakthroughs of reinforcement learning and the open research challenges.
- You are able to apply reinforcement learning in a distributed setting.

3. Course contents *

In a distributed world, consisting of multiple sensors and actuators, there is often a need to automate processes and design strategies to control the "knobs in the world". Examples are:

- How can we configure industrial processes in a factory setting through AI?
- How can we navigate properly in a self-driving car?
- How can we design certain strategies in a competitive game so that we get a better advantage?

Reinforcement learning provides a promising approach to this: based on trying out actions in a clever way, it learns the best strategy for making good decisions.

Recently, reinforcement learning has been successfully applied to application domains such as board games (the Google AlphaGo program), robotics, etc.
In this course, we will cover the basics of reinforcement learning and explain the recent breakthroughs in successfully scaling up reinforcement learning to high-dimensional environments (deep reinforcement learning). Moreover, we will explain how reinforcement learning is applied in practical applications and how it can be integrated into distributed environments.

4. International dimension *

- This course stimulates international and intercultural competences.

5. Teaching method and planned learning activities

5.1 Used teaching methods *

Class contact teaching

- Lectures
- Seminars/Tutorials
- Laboratory sessions

Personal work

Assignments

- Individually

Project

- In group

5.2 Planned learning activities and teaching methods

The theoretical part mainly consists of lectures, explaining the basics of reinforcement learning and deep reinforcement learning. Active participation will be encouraged through in-class exercises and small-scale projects.
The practical part consists of individual lab sessions, where small scale reinforcement learning applications will be built in the form of a number of programming excercies. These programming exercises can partly be performed during the weekly lab sessions, but a continuation of this work at home will also be required.
A detailed overview of the course schedule, combining lab sessions and lectures, is uploaded on Blackboard and discussed during the first lecture.

5.3 Facilities for working students *

6. Assessment method and criteria *

6.1 Used assessment methods *

Examination

- Written examination without oral presentation

Continuous assessment

- Exercises

6.2 Assessment criteria *

The theory and lab session part (=programming exercises) are given an equal weight in the evaluation. However, a score of 8/20 or higher is required for each part in order to achieve a global score and potentially pass. If this score is not met, your score is divided by 2.
During the year, partial exemptions are possible as follows:

- You can receive a partial exemption of the project if you receive **more** than 10 out of 20. In that case, you do not need to retake the project again during the summer if you fail for the theory part.
- You can receive a partial exemption of the theory if you receive **more** than 10 out of 20. In that case, you do not need to retake the theory exam again during the

summer if you fail for the project.
Partial exemptions are only valid in the same academic year. If you need to redo the course, any partial exemptions are

The theoretical exam will be in a closed book and written form. The lab sessions (= programming exercises) consists of applying the theoretical material to hands-on cases. A resit (theory and project) is offered during the regular re-examination periods. If you need to resit the project, you will receive a modified assignment.

7. Study material

7.1 Required reading *

The course material for the lectures consists of the lecture slides and documents to which is referred in the slides. Additionally, we require the book: Reinforcement Learning: An Introduction, by Richard Sutton and Andrew Barto (http://incompleteideas.net/book/the-book-2nd.html)
The assignment of lab sessions will be made available on Blackboard. All communication regarding the lab sessions occurs through Blackboard.

7.2 Optional reading

8. Contact information *

Questions regarding the theoretical part
- Steven Latré - Steven.Latre@uantwerpen.be
- Kevin Mets - Kevin.Mets@uantwerpen.be

Questions regarding the lab sessions: To be announced

9. Tutoring

Both the lecturer and the teaching assistant are available for additional questions (see above).

The lab session is considerable and complex because of the interaction between different technologies. Please make sure that you start early and do not postpone.