Western Science

Department of Computer Science

Course Outline
Reinforcement Learning (4453B)

1. Course Information

Course Information

Reinforcement Learning (4453), Winter 2025

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Apurva Narayan	apurva.narayan@uwo.ca		519 661-2111 x81138	

Students must use their Western (@uwo.ca) email addresses when contacting their instructors. Please start the subject as 'Reinforcement Learning'.

Office hours will be via Zoom and set up on a need basis via email.

3. Course Syllabus, Schedule, Delivery Mode

This course will provide a broad introduction to the foundational concepts and algorithms of reinforcement learning, one of the largest and most active areas in machine learning. The main focus will be on fundamental algorithms and their applications, and will end with an introduction to deep reinforcement learning. Knowledge of probability theory, logic, expectation, and basic machine learning principles (e.g., gradient descent) will be very helpful.

Upon successful completion of this course, students will be able to:

- Define the core features of reinforcement learning, and explain how RL differs from other artificial intelligence / machine learning approaches.
- Determine if a given problem should be approached as a reinforcement learning problem. Compare different algorithms to select the most appropriate for a particular application/problem space.
- Implement (in code) various common/classic reinforcement algorithms from scratch in Python.
- List and define the various criteria for evaluating reinforcement learning algorithms (e.g., regret, sample efficiency, sample complexity, …).
- List and define the major weaknesses and complications that come with a reinforcement learning approach (e.g., sample in efficiency).

In-person

Thursday: 10:30am – 11:20pm
Fri: 10:30am – 12:30pm

Prerequisite(s): Data Science 3000A/B.

Table of Contents and Schedule

Week	Topics
1	Introduction and Motivation
2-3	Markov Processes and MDPs
3-4	Dynamic Programming
4	Model Free Prediction
5	Model Free Control
6-7	Value Function Approximation
7-8	Policy Gradient
9	Actor-Critic Method
10	Exploration vs Exploitation
11	More Advanced Topics
12	Project Presentations

4. Course Materials

Sutton, R. S., & Barto, A. G. (2011). Reinforcement learning: An introduction.
This is the text on reinforcement learning, written by Richard Sutton and Andrew Barto from the University of Alberta and made available for free online. It is roughly split into two parts: Part 1 covers the fundamentals of reinforcement learning, namely core concepts, multi-armed bandits, dynamic programming, temporal difference (TD) learning, Q-learning, Monte-Carlo techniques, and the classic SARSA and Dyna algorithms. Part 2 delves into function approximation, eligibility traces, and policy gradient methods, while Part 3 covers the conceptual cross-field foundations of reinforcement learning with chapters on psychology, neuroscience, and classic case studies.
Additional readings will be provided through OWL as they arise.

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: https://westernu.brightspace.com/

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Methods of Evaluation

Grading Scheme and Assessment Dates
The overall course grade will be calculated as listed below:

Assignments (2)	20%
Midterm Test	20%
Project Presentation	10%
Project	50%

NOTE: NO FINAL EXAM

Use of Generative AI Tools
Use of Generative AI tools is permitted in each assessment, however the candidate will need to mandatorily state what parts were generated by AI and what was done by the student.

General information about missed coursework
Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs,* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/
All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course.

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Late assessments without illness self-reports will be subject to a late penalty 5%/day

- Late assessments with illness self-reports should be submitted within 24 hours of submission of the last illness self-report
- An assessment cannot be submitted after it has been returned to the class; an alternate assessment will be assigned.
- A make-up test will be offered
- If a make-up assessment is missed, the student will receive an INC and complete the task the next time the course is offered
- If permission to waive the requirement that students receive evaluation on work totaling 10 % of their final grade at least three days prior to the deadline for withdrawal without academic penalty has been obtained from the Dean's Office, a statement to this effect must be made.

6. Additional Statements

6.1 Religious Accommodation

When conflicts arise with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible, but not later than two weeks prior to the writing of the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays - https://www.edi.uwo.ca

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formerly known as "appeals")

Policy on Request for Relief from Academic Decision:

https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Procedures on Request for Relief from Academic Decision (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

Learning-skills counsellors at Learning Development and Success (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.