



# CS 460 Reinforcement Learning

Winter 2024

**Course Credits:** 4

**Contact Hours:** 56 hours

**Instructor:** TBA

**Email:** TBA

## **COURSE OBJECTIVES**

As a subfield of machine learning, Reinforcement Learning (RL) focuses on developing intelligent agents capable of making sequential decisions to maximize cumulative rewards. This course provides an in-depth exploration of the theory, algorithms, and applications of reinforcement learning. Topics covered include Markov decision processes, dynamic programming, Monte Carlo methods, Temporal-Difference Learning, planning, and learning with tabular methods.

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

1. Develop a thorough understanding of the core concepts and principles that underlie Reinforcement Learning.
2. Grasp the mathematical foundations of reinforcement learning, including Markov Decision Processes (MDPs), Bellman equations, and dynamic programming.
3. Implement key RL algorithms, including Monte Carlo methods and Temporal-Difference Learning, and assess their effectiveness in different contexts.
4. Acquire skills in planning and learning using tabular methods, understanding how these methods contribute to intelligent decision-making.
5. Develop problem-solving skills in RL contexts and evaluate the performance of various algorithms in terms of efficiency, convergence, and adaptability.

## **PREREQUISITES**

CS 198 Artificial Intelligence I

## **GRADING**

Grades will be determined by accumulating points, with 100 points being the



maximum, as follows:

ITEM	POINTS
Quizzes	10 Points
Programming Exercises	30 Points
Midterm 1	15 Points
Midterm 2	15 Points
Final Project	30 Points
Total	100 Points

Late submissions will be graded at the end of the course. Grades will be assigned according to the following rule:

$$A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F.$$

We reserve the right to make adjustments to the overall grading policy.

## COURSE MATERIALS

### **Required Texts:**

Richard S. Sutton, Andrew G. Barto, *Reinforcement Learning: An Introduction*, 2<sup>nd</sup> Edition, MIT Press, Cambridge, 2018.

### **Recommended (Optional) Texts or Other Materials:**

Additional readings and materials will be assigned throughout the course to supplement the textbook.

## COURSE TOPICS

MODULE	TASKS
Module 1	<p><b>Topics:</b>            Topic 1: Introduction and Course Overview            Topic 2: Reinforcement Learning: Definition and Scope            Topic 3: Historical Perspective and Key Developments            Topic 4: Applications</p> <p><b>Assessments:</b>            Quiz#1</p>



Module 2	<b>Topics:</b> Topic 5: Multi-arm Bandits Topic 6: Markov Decision Processes (MDPs) Topic 7: Bellman Equation and Optimality Topic 8: Applications of MDPs in Decision Making <b>Assessments:</b> Quiz#2 Programming Exercise#1
Module 3	<b>Topics:</b> Topic 9: Dynamic Programming Topic 10: Policy evaluation and improvement Topic 11: Value Iteration and Policy Iteration Topic 12: Monte Carlo Methods <b>Assessments:</b> Midterm#1 Programming Exercise#2
Module 4	<b>Topics:</b> Topic 13: Temporal-Difference Learning Topic 14: Eligibility Traces Topic 15: Models and Planning Topic 16: Integrating Planning, Acting, and Learning <b>Assessments:</b> Midterm#2 Programming Exercise#3
Module 5	<b>Topics:</b> Topic 17: On-policy Approximation of Action Values Topic 18: Off-policy Approximation of Action Values Topic 19: Policy Approximation Topic 20: Applications and Case Studies <b>Assessments:</b> Final Project

## ATTENDANCE

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1) Class attendance is required. Missing classes without permission will lead to decrease in overall grade.

Missing less than two classes: no penalty.

Missing more than two classes: 7% will be taken off from the overall grade.

If the instructor reports a student's frequent missing of class to the Soochow University Academic Administration Office, the student might get a written warning



and might be prohibited from attending final exam.

2) Participants in this course are expected to arrive in class promptly and adequately prepared. The primary objective of this course is to critically engage with the readings and the subject matter. Therefore, course participants are expected to have completed the reading prior to class and prepare thoughtful reflections/commentaries to share with fellow colleagues.

### **LEARNING REQUIREMENTS**

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- 1) Late assignments are not acceptable and are subjected to grade deductions.
- 2) Assignments submitted in the wrong format will be counted as not submitted.
- 3) Failure to submit or fulfill any required course component results in failure of the class.
- 4) Make-up for midterm and final exams only with valid excuses, as defined by the University.
- 5) In order to earn a Certificate of Completion, participants must thoughtfully complete all assignments by stated deadlines and earn an average quiz score of 50% or greater.

### **TECHNOLOGY POLICY**

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The use of electronic devices in class is distracting, both for the user and for the rest of the class. Only non-programmable calculators can be used in the tests and exam. Any attempts to use cell phones and other electronic communication devices will be seemed as cheating. Laptops are discouraged, unless you use them for activities DIRECTLY related to the course (e.g., note taking, reading course documents).

### **ACADEMIC INTEGRITY POLICY**

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Soochow University highly values the academic integrity and aims to promote the academic fairness, honesty and responsibility. Any academic dishonesty behaviors and any attempts to cheats and plagiarism will be reported to the university administration office. A written warning and the relevant penalties will be imposed. The record might be shown on the official university transcript.



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## **DISABILITY ACCOMMODATION**

Soochow University is committed to maintaining a barrier-free environment so that students with disabilities can fully access programs, courses, services, and activities at Soochow University. Students with disabilities who require accommodations for access to and/or participation in this course are welcome.

Note:

Please contact the University Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material.