

Final Project

Due Date: Week of May 4, 2025

CMPE 471/ CMPS 497: Reinforcement Learning
Total = 100 points

Project Overview

- Students will conduct a reinforcement learning (RL) project **comparing tabular and function approximation methods covered up to Chapter 10**
- Your project must explore various exploration strategies, learning rate impacts, and reward structures. You are expected to implement and critically analyze both tabular method(s) and function approximation method(s) even if tabular methods do not perform optimally.
- The project accounts for **20%** of your total course grade.
- The number of students per group is 3. However, groups of 2 are also allowed.

Project Timeline

Group Enrollment

- **Student must join a group before the due date below. Please use the provided Excel Sheet to enroll in a group.**
- **Submit a half-page report indicating a short Abstract about your selected project and its deliverables.**
- One submission per group.
- Make sure to include the Group ID number, and names of all group members and their IDs in your submission.
- **The due date is Sunday, April 13th.**

Project Presentation

- Presentation schedule will be shared later on the same excel sheet.
- Presentation slots will be during the week of May 4th, 2025.
- Along with the presentation, there will be an oral discussion assessing individual contributions, and understanding of concepts and their implementation.
- **Students will be graded individually on the presentation and oral discussion.**

Final Report Requirements

The final report should include the following sections:

- **Abstract:** A concise summary of the work.
- **Literature Review:** A comprehensive review of related work and background material.
- **System Model and Problem Definition:** A detailed explanation of the problem, the environment, ..., etc.
- **Methodology:** Explanation of the models used and why they were selected
- **Results and Discussion:**
 - Presentation of results with thorough analysis and critical evaluation.
 - Exploration strategies attempted and rationale behind the final choice.
 - Justification for the selected tabular reinforcement learning methods.
 - Justification for the chosen function approximation method.
 - Analysis of learning rate effects.
 - Description and reasoning behind the reward structures used.
- **Conclusions and Discussion:** Summary of key findings, limitations, and potential directions for future work.

Assessment Components

- **Final Report:** 35%
- **Final Presentation & Oral Discussion:** 45%
- **Code:** 20%

Assessment Rubric (Total: 100 Points)

Final Report (35 Points)

Criteria	0	1-2	3	4
Structure, format, and referencing				
Introduction and background clarity				
Explanations of methods and concepts				
Analysis of results and discussion				
Quality of conclusions				

Presentation and Oral Discussion (45 Points)

Criteria	0	1-2	3	4
Clear presentation of basic concepts				
Depth of conceptual knowledge				
Discussion and analysis of results				
Clarity in answering questions				

Implementation and Results (20 Points)

Criteria	0	1-2	3	4
Design appropriateness				
Implementation quality				
Tools and methods appropriateness				
Comprehensiveness of scenarios				
Quality and clarity of results				

Project Topics

- You may choose one of the following projects or choose your own project.
- You can use an environment from Farama Gymnasium, GitHub or create your own environment.
- You cannot choose a simple gridworld example.
- You cannot choose from Farama/toy text environments; we already used them in our coding exercises before.
- Conduct your proper research to make sure that your project (even from the list below) can be conducted without Deep Reinforcement Learning methods.
- Each project explicitly requires implementation and comparison of tabular methods and function approximation methods from Chapters 9-10.
- The following are suggested project topics. **Each project may only be selected by one group; duplication across groups is not permitted.** Check the Excel Sheet to make sure your project is not selected by another group. If so, you need to select a different project.
- Remember:** Your project must explore various exploration strategies, learning rate impacts, and reward structures. You are expected to implement and critically analyze both tabular methods and function approximation methods even if tabular methods do not perform optimally.

#	Title	Environment	Short Description
1	Mountain Car Continuous	MountainCarContinuous-v0	Drive an underpowered car up a steep hill.
2	Acrobot Swing-Up	Acrobot-v1	Control a two-link pendulum to swing up to a target height.
3	Lunar Lander	LunarLander-v2	Land a spaceship safely on the lunar surface.
4	Pendulum Control	Pendulum-v1	Swing a pendulum upright and keep it balanced.
5	Highway Lane-Keeping	Highway-v0	Control a vehicle to maintain lane and avoid collisions in highway driving.
6	Electric Motor Control	EMotorSim	Control electric motor dynamics under different loads.
7	Racecar Navigation	RacecarGym	Navigate a miniature racecar on a racing track.
8	Car Racing	CarRacing-v2	Drive a car around procedurally generated racing tracks.
9	Bipedal Walker	BipedalWalker-v3	Train a bipedal robot to walk forward on uneven terrain.
10	Reacher Arm Control	Reacher-v4	Move a two-joint robotic arm to reach target locations.
11	Inverted Pendulum	InvertedPendulum-v4	Balance an inverted pendulum mounted on a cart.
12	Stock Trading Simulation	gym-anytrading	Develop a trading agent that decides on buying, selling, or holding stocks based on historical price data.

Submission Guidelines

- All submissions via Blackboard.

- Adhere strictly to provided final report template.
- Similarity reports will be generated; plagiarism results in a zero grade.
- Add a cover page to the report with all group member names and student IDs and project ID number.

Important Instructions

- Clearly explain exploration strategies, learning rate settings, reward system decisions, and their effects on your results.
- Prepare thoroughly for your oral presentation, including the oral discussion assessing your depth of understanding.
- Ensure your report and code are clearly structured, well-documented, and properly formatted.