Homework 1 Template

Use this template to record your answers for Homework 1. Add your answers using LaTeXand then save your document as a PDF to upload to Gradescope. You are required to use this template to submit your answers. **You should not alter this template in any way** other than to insert your solutions. You must submit all 10 pages of this template to Gradescope. Do not remove the instructions page(s). Altering this template or including your solutions outside of the provided boxes can result in your assignment being graded incorrectly.

You should also export your code as a .py file and upload it to the **separate** Gradescope coding assignment. Remember to mark all teammates on **both** assignment uploads through Gradescope.

Instructions for Specific Problem Types

On this homework, you must fill in blanks for each problem. Please make sure your final answer is fully included in the given space. **Do not change the size of the box provided.** For short answer questions you should **not** include your work in your solution. Only provide an explanation or proof if specifically asked.

Fill in the blank: What is the course number?

10403

Problem 0: Collaborators

Enter your team members' names and Andrew IDs in the boxes below. If you worked in a team with fewer than three people, leave the extra boxes blank.

Name 1:	Joseph Salmento	Andrew ID 1:	jsalment
Name 2:		Andrew ID 2:	
Name 3:		Andrew ID 3:	

Problem 1: Value Iteration & Policy Iteration (30 pts)

1.1: Contraction Mapping (3 pts)

Solution

1. False because just because f maps to a fixed point does not mean it is a contraction mapping. It also needs to converge at a fixed linear rate.

2. False because a contraction mapping does not need to map to itself. It just needs to map to a unique fixed point in the set.

3. True because the Bellman expactation backup operator is a contraction mapping, it will converge at a fixed rate until it reaches the optimal solution. Thus, the $F^{\pi_{k+1}} = F^{\pi_k}$ if and only if it has arrived at the optimal policy ($F^{\pi_k} = F^{\pi_*}$).

1.2.1 Table: Policy Iteration (4 pts)

Environment	**# Policy Improvement Steps**	**Total # Policy Evaluation Steps**
Deterministic-4x4	6	14
Deterministic-8x8	16	29

1.2.2 Optimal Policies for Deterministic-4x4 and 8x8 Maps (2 pts)

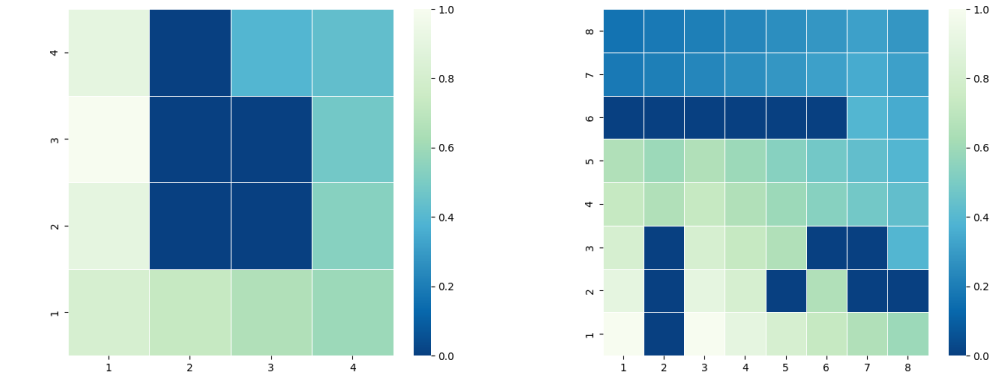
Solution

DLRD
RLLD
ULLD
ULLL

DDDDDDDL
RRRRRRDL
LLLLLLDL
DLDLLLLL
DLDLLLLL
DLDLLLLU
DLDLLDLL
RLLLLLLL

1.2.3 Value Functions of the Optimal Policies (2 pts)

Solution

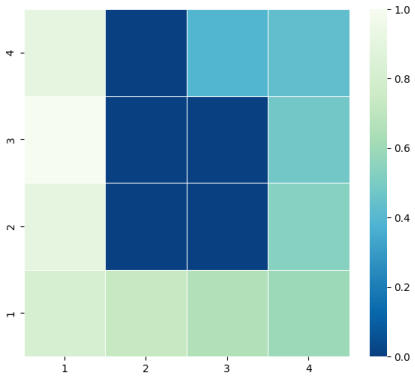


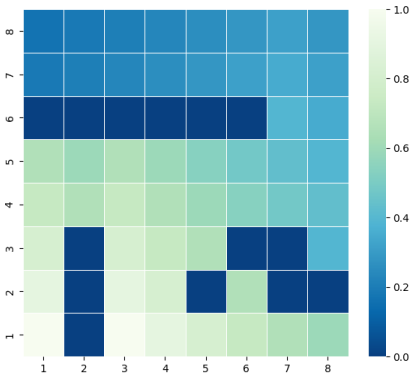
1.3.1 Table: Synchronous Value Iteration (3 pts)

Environment	# Iterations
Deterministic-4x4	7
Deterministic-8x8	15

1.3.2 Value Functions from Synchronous Value Iteration (2 pts)

Solution





1.3.3 Optimal Policies from Synchronous Value Iteration (2 pts)

Solution

	DDDDDDDL
	RRRRRRDL
DLRD	LLLLLLDL
RLLD	DLDLLLLL
ULLD	DLDLLLLL
ULLL	DLDLLLLU
	DLDLLDLL
	RLLLLLLL

1.4.1 Table: Asynchronous Policy Iteration (4 pts)

Heuristic	Policy Improvement Steps	Total Policy Evaluation Steps
Ordered	15	29
Randperm	14	33.9

1.5.1 Table: Asynchronous Value Iteration (4 pts)

Heuristic	# Iterations
Ordered	15
Randperm	9

1.5.2 Asynchronous VI with Domain-specific Heuristic (4 pts)

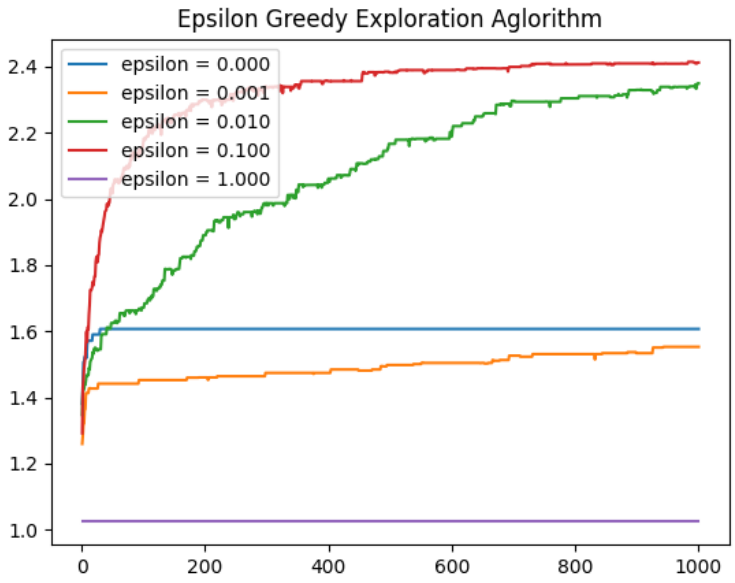
Solution

Env	# Iterations
Deterministic-4x4	6
Deterministic-8x8	13

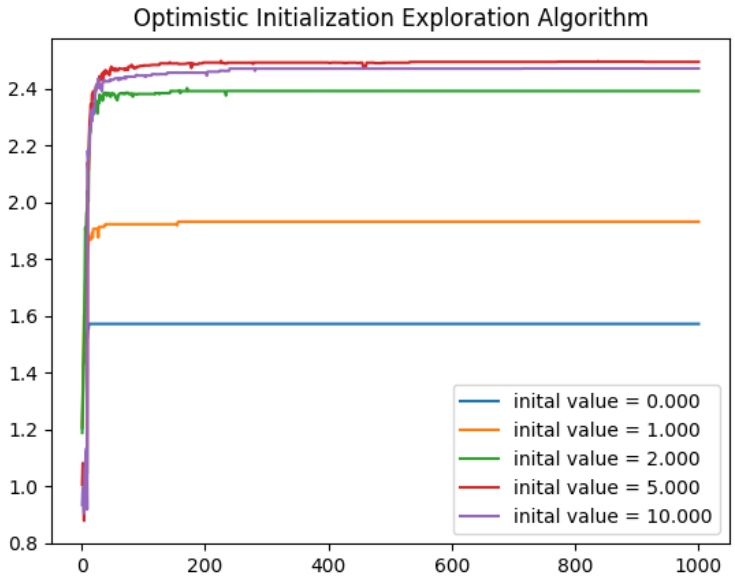
This "goal-distance" heuristic will perform better when the start and and goal are not blocked from each other by non-goal terminal states.

Problem 2: Bandits (36 pts)

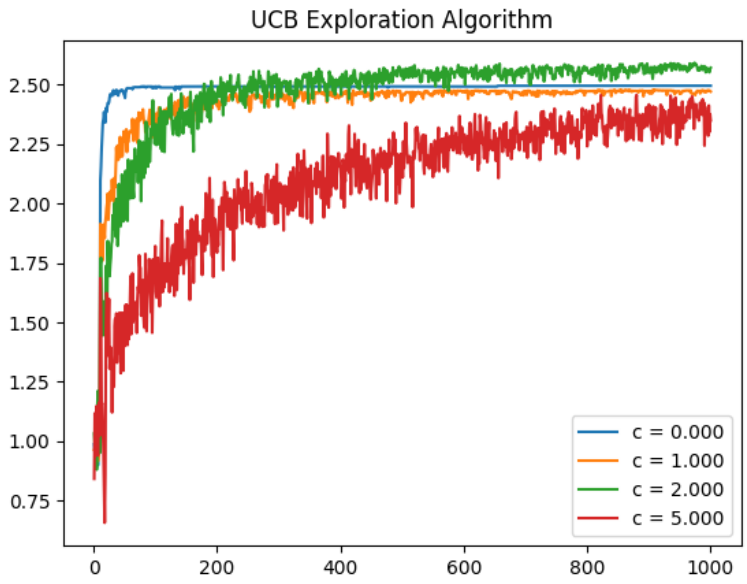
2.1 ϵ-Greedy Plot (8 pts)



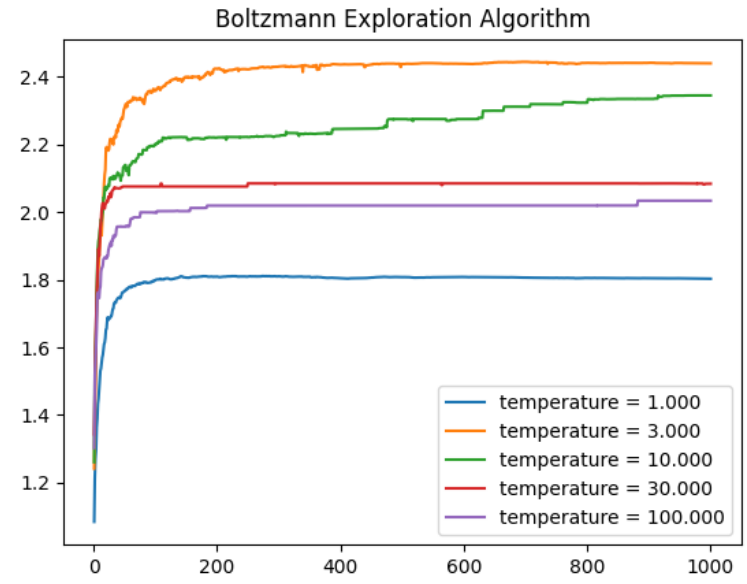
2.2 Optimistic Initialization Plot (8 pts)



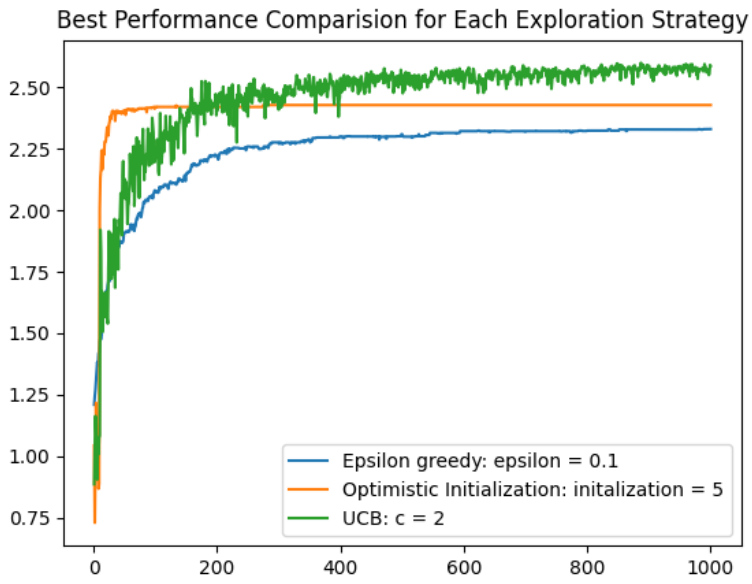
2.3 UCB Exploration Plot (8 pts)



2.4 Boltzmann Exploration Plot (8 pts)



2.5 Comparison Plot (8 pts)



2.6 Why not use the best-performing exploration strategy? (2-3 sentences) (4 pts)

It takes UCB c=2 approximately 200 steps to out perform an optimistic initalization of 5. If you are playing bandits less than 200 times your probably would want to optimistic initialization intead.

Problem 3: Feedback

Feedback: You can help the course staff improve the course by providing feedback. What was the most confusing part of this homework, and what would have made it less confusing?

N/A. I thought the homework was well explained and very easy to understand and implement.

Collaboration: Detail the work division amongst your group in detail below.

I completed this assignment entirely on my own and did nor recieve or give any help to anyone.

Time Spent: How many hours did you spend working on this assignment? Your answer will not affect your grade.

Alone	8
With teammates	0
With other classmates	0
At office hours	0