CS 395T - Planning, Search and Reasoning Under Uncertainty, Spring 2023

This course will serve as an introduction to three key foundational problems in AI: planning, search, and reasoning under uncertainty. We will investigate how to define planning domains, including representations for world states and actions, covering both symbolic and path planning. We will study algorithms to efficiently find valid plans with or without optimality, and partially ordered, or fully specified solutions. In transitioning from classical to modern approaches to planning, we will cover decision-making processes and their applications to real-world problems with complex autonomous systems. We will investigate how in planning domains with finite state lengths, solutions can be found efficiently via search. Finally, to effectively plan and act in the real world, we will study how to reason about sensing, actuation, and model uncertainty. Throughout the course, we will relate how classical approaches provided early solutions to these problems, and how modern machine learning builds on, and complements such classical approaches.

Suggested text books:
Artificial Intelligence: A Modern Approach
Planning Algorithms

Links

- Piazza (For Q&A, Announcements): https://piazza.com/utexas/spring2023/cs395t
- Canvas (For report submissions, and grading): https://utexas.instructure.com/courses/1331843

Lectures, Office Hours

Lectures: Tuesdays and Thursdays, 9:30 - 10:50 AM, GDC 2.210

Instructor
Joydeep Biswas, joydeepb@cs.utexas.edu
Office hours: Mondays 9-10AM, GDC 3.512

Teaching Assitant
Eric Hsiung, ehsiung@utexas.edu
Office hours: Tuesdays 11AM-12PM, GDC 5.802C

Assignments and Course Project

Assignments and the course project will be completed in groups of two.

The project will require instructor approval, and must consist of either original research or a reproduction study of a topic on either planning, adversarial search, or reasoning under uncertainty.

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Grading

Assignments 1-4: 40% Total (10% each) Quizzes 1-5: 30% Total (The best 4 scores will be considered, for 7.5% each) Course Project: 30% Total

Academic Honesty

- All work that you submit must **entirely be your own** team's work.
- You may discuss the algorithms for the homework with other students, but all code, written solutions, and mathematical derivations that you turn in must be your team's alone.
- If you referred to an online, printed, or otherwise external resource to solve a problem, you must cite it in your writeup. If you reproduce matter from a resource without citing it, it will be considered plagiarism.
- Engaging in academic dishonesty will result in a failing grade in the course. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, please visit the Student Conduct and Academic Integrity website at: http://deanofstudents.utexas.edu/conduct.

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Schedule - S2023 : Schedule

Lecture	Date		Lecture Material	Assignments / Quizzes /
1	1/10/2023	Tue. Lec.	Introduction to planning, planning domain descriptions	
2	1/12/2023	Thu. Lec.	Classical Planning Strategies, GraphPlan	
3	1/17/2023	Tue. Lec.	Search- based planning: Dijkstra + A*	
4	1/19/2023	Thu. Lec.	Accelerating Search-based planning: JPS	
5	1/24/2023	Tue. Lec.	Dynamic Replanning: D*	Assignment 1
6	1/26/2023	Thu. Lec.	Configuration-Space Planning, Sample-Based Planning	Quiz 1
7	1/31/2023	Tue. Lec.	RRT + PRM Extensions	
8	2/2/2023	Thu. Lec.	Completeness of Geometric RRTs	
9	2/7/2023	Tue. Lec.	Representation Learning for Planning	Assignment 2
10	2/9/2023	Thu. Lec.		Quiz 2
11	2/14/2023	Tue. Lec.	Adversarial planning: Alpha Beta pruning	
12	2/16/2023	Thu. Lec.	Monte-Carlo Tree Search, Winning Strategies	Project proposal due
13	2/21/2023	Tue. Lec.	Introduction to probabilistic reasoning; Bayesian filtering	
14	2/23/2023	Thu. Lec.	Discrete Bayesian Robot Localization	
15	2/28/2023	Tue. Lec.	Particle Filtering: A practical guide	Quiz 3
16	3/2/2023	Thu. Lec.	Particle Filtering: A theoretical guide	
17	3/7/2023	Tue. Lec.	Particle Filtering: Challenges and Extensions	
18	3/9/2023	Thu. Lec.	From Perception To Planning: Mobile Robot Navigation	Assignment 3
	3/14/2023	Spring Break		
	3/16/2023	Spring Break		
19	3/21/2023	Tue. Lec.	Task and Motion Planning	
20	3/23/2023	Thu. Lec.	Introduction to MDPs, Q-Learning	
21	3/28/2023	Tue. Lec.	Planning and Control Theory	Quiz 4
22	3/30/2023	Thu. Lec.	POMDPs	
23	4/4/2023	Tue. Lec.	POMDPs In the real world: Scaling and exception handling	Assignment 4
24	4/6/2023	Thu. Lec.		
25	4/11/2023	Tue. Lec.		
26	4/13/2023	Thu. Lec.	Project Lightning Talks: 1	Quiz 5
27	4/18/2023	Tue. Lec.	Project Lightning Talks: 2	

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