MARYLAND APPLIED GRADUATE ENGINEERING

Cognitive Robotics

ENPM808Z and Spring/2023

Course Overview

This course will provide an overview of cognitive robotics with a focus on cognitive robot learning, a cutting-edge subfield at the intersection among artificial intelligence, cognitive psychology, and robotics. The course will focus selectively on a number of subjects of current research interest. A likely division is about 50% of the lectures on introduction, background, and standard topics, and about 50% on research oriented topics in the state-of-the-art connections between robot learning and cognitive science.

Learning Outcomes

After successfully completing this course you will be able to:

- Students will understand the fundamentals of human cognitive intelligence like perception, attention, language, planning, memory, and meta-reasoning
- Students will explore the state-of-the-art connections between robotics and cognitive science
- Students can design cognitive robot learning architectures – that can be trained and deployed in a simulator like Meta-Habitat 2.0

Dr. Yantian Zha
ytzha@umd.edu

Class Meets
Thursday
4:00 pm – 6:40 pm
Location TBA

Office Hours
IRB 4220
and by appointment

Teaching Assistants
TBA

Prerequisites
Any fundamental robotics courses like ENPM809Y Introductory Robot Programming and ENPM809E Python Applications for Robotics.

Course Communication

I will send time-sensitive information to students thorough ELMS announcement. Students who want to contact me please feel free to send your messages to ytzha@umd.edu.

Required Resources

Course website:

Course website: elms.umd.edu

Readings:

My course slides

Hardware/Software:

A Desktop/Laptop

Supplemental Resources

Readings:

Nolfi, Stefano. Behavioral and cognitive robotics: an adaptive perspective. Stefano Nolfi, 2021.

Deep Learning for Robot Perception and Cognition

Hardware/Software:

None

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Please visit https://academiccatalog.umd.edu/graduate/policies/academic-record/ for the Office of Graduate Studies' list of campus-wide policies.

Activities, Learning Assessments, and Expectations

Assignments 30%

The assignments would involve simple coding tasks and written tasks.

Paper Presentation 10%

Each student would present a paper

Group Projects 40%

The grading of your group project depends on your presentation, the novelty and quality of your project report, and your contribution rate in your group.

Participation/Attendance 20%

The grading of your Participation/Attendance could be in the form of Class Quizzes

Expectations:

Every effort has been made to evenly distribute the course requirements, and to support your understanding of the course material. However, it is likely that some weeks will require more effort on your part, and some material will require additional help beyond what is immediately available. Please reach out to me or your TA for these course-related questions, and please be prepared to put in the additional effort.

Course Specific Policies

Late-work:

Late submissions will be accepted with a 10% penalty of your assignment score per day.

Absences/excused absences:

Please send me an email to explain why you must miss a class.

Prohibited devices in class (cellphones, laptops, etc.): You are allowed to use laptops and cell phones in my class only for learning purposes.

Accessibility and Reasonable Accommodations

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The University of Maryland provides reasonable accommodations to qualified individuals. Reasonable accommodations shall be made in a timely manner and on an individualized and flexible basis.

Discrimination against individuals on the grounds of disability is prohibited. The University also strictly prohibits retaliation against persons arising in connection with the assertion of rights under this Policy.

Accessibility & Disability Service (ADS) facilitates reasonable accommodations to qualified individuals. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301.314.7682, or adsfrontdesk@umd.edu. More information is available from the Counseling Center.

Get Some Help!

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting http://ter.ps/learn (there are specific resources for graduate students under handouts, but please explore to find what you need). Sharpen your communication skills (and improve your grade) by visiting https://gradschool.umd.edu/graduate-school-writing-center and schedule an appointment with the campus Graduate Writing Center. Finally, if you just need someone to talk to, visit http://www.counseling.umd.edu.

Everything is free because you have already paid for it, and **everyone needs help**… all you have to do is ask for it.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Grades

Assignments:

There will be three assignments which will improve both your theoretical understanding and your practical skills. All assignments will contain programming parts and written questions.

Paper Presentation:

Each student would present a paper that is relevant to the course or a group project. The presentation would be graded based on the quality of the slides/presentations, and student's understanding of the paper.

Group Project:

Each group would be graded based on the novelty, completeness, and presentation quality. Each group member would submit an estimate of the contribution rate of other group members. The project grade for each group member would be weighted accordingly.

Attendances:

Your attendance will be counted for each class.

Learning Assessments	#	Points Each	Category Total	Category Weight
Assignments: coding/written questions submitted on ELMS	3	100	300	30%
Paper Presentation	1	10	10	10%
Group Project	1	100	100	40%
Attendances	14	1	14	20%

Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone I have to establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same this as making the cut ($89.99 \neq 90.00$). It would be unethical to make exceptions for some and not others.

Final Grade Cutoffs							
+	97.00%	+	87.00%	+	77.00%	+	67.00%

A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	<60.0%
-	90.00%	-	80.00%	-	70.00%	-	60.00%		

Course Schedule

Date	Class	Class Topics
Thu 1/26	**1**	**The Overview of Cognitive Robotics**
Thu 2/2	**2**	**Neural Basis for Cognitive Robot Learning**
Thu 2/9	**3**	**Visual Perception**
Thu 2/23	**5**	**Sequential Decision Making**
Thu 3/2	**6**	**Deep Reinforcement Learning**
Thu 3/9	**7**	**Imitation Learning**
Thu 3/16	**8**	**Paper Presentation (Midterm)**
Thu 3/23		**Spring Break**
Thu 3/30	**9**	**Perception-Acting Coupling**
Thu 4/6	**10**	**Learning Language Models**
Thu 4/13	**11**	**Symbolic Planning**
Thu 4/20	**12**	**Planning and Learning in Robotics**
Thu 4/27	**13**	**Self-Explanation Guided Robot Learning**
Thu 5/4	**14**	**Project Presentation (Final)**

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.