CS 3630 Introduction to Robotics and Perception

Syllabus - Spring 2026

Course Description

This course covers fundamental problems and leading solutions to autonomous robot behavior – how can a robot perceive the world, and how can it use that information to operate effectively.

The only formal prerequisite is CS1332 Data Structures & Algorithms. Prior knowledge of fundamentals of linear algebra and probability is very helpful, but not required. Background in AI and ML is not assumed. All programming assignments will be completed in Python.

Course Objectives

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

- describe and explain what robots are and what they can do
- describe mathematically the position and orientation of objects and how they move
- design a control architecture for mobile robots
- implement navigation and localization algorithms based on sensor fusion and environment representation
- write programs in Python to control a robot in simulation
- construct, program, and test the operation of robots to perform the specified task.

Reference Material

There is no assigned textbook for this course, but material covered in lectures has significant overlap with the following textbooks:

1. *Introduction to Autonomous Mobile Robots*, by R. Siegwart, I. Nourbakhsh, MIT Press, 2011.
2. *Robotics, Vision and Control*, by Peter Corke, Springer, 2011.
3. *Mobile Robots: Navigation, Control and Remote Sensing*, by G. Cook, Wiley-IEEE Press, 2011.
4. *Introduction to Robotics and Perception*, by Frank Dellaert and Seth Hutchinson, 2021.

The first three books are available in digital form through the Georgia Tech library.

Lecture Format and Logistics

All lectures will be in-person. Recordings will only be available if the in-person lecture is cancelled due to extenuating circumstances.

As noted in the schedule, each exam will be held on different dates for each section, but the due dates for labs are the same for both sections, students will be able to access their assignments via Canvas.

Assignments and Grading

3 Exams (45% of the grade): There will be three exams throughout the semester on the dates designated on the syllabus. Each exam will be worth 15% of the final course grade. We will not be rescheduling exams missed due to unexcused absences (travel, job interviews, etc.). Please discuss any extenuating circumstances with the instructor as soon as possible.

4 Lab Projects (55% of the grade): There will be 4 lab projects throughout the semester, collectively worth 55% of the final grade. All projects must be completed individually. Grades will be determined using the grading rubric provided with each project.
Late Policy: All projects are due at the time and date indicated on the assignment document. Up to two late days are allowed, but a grade penalty of 50% and 75% will be applied at the first and second day, respectively. Late submissions beyond two days will not be accepted.

Extra Credit: You may earn extra credit throughout the semester by making a helpful contribution to your classmates– basically any significant contribution that helps others excel. Extra credit will be assigned as 0.2-0.5% of total class grade (e.g., a final class grade of 89.7 could be bumped up to 90.2), depending on the type of contribution. Submissions should be posted publicly to Piazza. Example contributions include, but are not limited to:

- A tutorial about how to overcome a common issue – 0.2%
- Posting a link to an external library and including a short, general-purpose example of how it could be used in a given setting – 0.2%
- Releasing code for an improved visualization or debugging tool – 0.5%

You may receive extra credit more than once.

Course Policies

The course schedule and policies mentioned in this syllabus may change at any time during the term, but all changes will be clearly documented and announced.

Student Disability Services: If you need course adaptations or accommodations because of a disability, or if you have medical information to share with the instructor, please contact the Office of Disability Services and register with them. In addition, please create a private post on Piazza in the first week of classes so that we can make the necessary arrangements to support you.

Academic Honesty Policy: Review Georgia Tech's Academic Honor Code. Any work you present as your own should represent your own understanding of the material. When external sources were used as significant points of information (sample code, etc.), the source must be referenced in your submission. Following Georgia Tech's guidelines, all suspected cases of academic cheating will be forwarded for review by the Office of Student Integrity.

Student Code of Conduct: Review Georgia Tech's Student Code of Conduct. The Code educates all members of the Georgia Tech Community about the Institute's expectations and Students' rights and creates a standard by which Students are expected to conduct themselves for the purpose of establishing an environment conducive to academic excellence. Georgia Tech Students, Registered Student Organizations, and Groups are responsible for their own behavior, and the Institute has the authority to establish an internal structure for the enforcement of its policies and procedures, the terms of which students have agreed to accept by their enrollment.

Use of AI: We do not prohibit the use of AI in aiding your learning (e.g., requests for additional explanation of concepts or examples, exploration of related concepts outside the scope of the course, etc.). However, we will not allow the use of AI in completing coding assignments or projects. In each of your submission, students are required to indicate if and how they used AI regarding the assignment. We have automated tools to recognize flag suspected use of AI. Violating this policy will be considered as academic misconduct, lead to disciplinary actions, and referral to the Office of Student Integrity. Finally, please use AI-based tools with appropriate amounts of skepticism: verify answers, explicitly ask for sources and ensure that they are credible.

<u>Tentative</u> Schedule

Date	CS 3630 - B (Mon/Wed)	CS 3630 - A (Tu/Th)	Notes
Mon Jan 12	Introduction		
Tue Jan 13		Introduction	
Wed Jan 14	Sensing: RGB-D and RGB-D		
Thu Jan 15		Sensing: RGB and RGB-D	
Mon Jan 19	**Holiday (MLK Jr Day)**		
Tue Jan 20		Sensing: RGB and RGB-D	
Wed Jan 21	Sensing: RGB and RGB-D		
Thu Jan 22		State, Probability and Actions	Lab 1 Out
Mon Jan 26	State, Probability and Actions		
Tue Jan 27		Sensor Models	
Wed Jan 28	Sensor Models		
Thu Jan 29		Estimation, Bayes Theorem	
Mon Feb 2	Estimation, Bayes Theorem		
Tue Feb 3		Decision Theory	Practice Exam Released
Wed Feb 4	Decision Theory		
Thu Feb 5		Sensing: LIDAR	
Mon Feb 9	Sensing: LIDAR		
Tue Feb 10		**Exam 1**	
Wed Feb 11	**Exam 1**		
Thu Feb 12		Pose representation	
Mon Feb 16	Pose representation		
Tue Feb 17		Mobile Robot Kinematics	
Wed Feb 18	Mobile Robot Kinematics		**Lab 1 Due**
Thu Feb 19		Motion Models with Uncertainty	
Mon Feb 23	Motion Models with Uncertainty		
Tue Feb 24		Particle Filter	
Wed Feb 25	Particle Filter		Lab 2 Out
Thu Feb 26		Kalman Filter	
Mon Mar 2	Kalman Filter		
Tue Mar 3		SLAM, Frontier Based Expl.	Practice Exam Released
Wed Mar 4	SLAM, Frontier Based Expl.		
Thu Mar 5		Path Planning Fundamentals	
Mon Mar 9	Path Planning Fundamentals		
Tue Mar 10		**Exam 2**	
Wed Mar 11	**Exam 2**		
Thu Mar 12		Probabilistic Path Planning: RRT	
Mon Mar 16	Probabilistic Path Planning: RRT		Lab 3 Out
Tue Mar 17		Probabilistic Path Planning: PRM	**Lab 2 Due**

Wed Mar 18	Probabilistic Path Planning: PRM		
Thu Mar 19		No Class	
Mon Mar 23	**Spring Break**		
Tue Mar 24			
Wed Mar 25			
Thu Mar 26			
Fri Mar 27			
Mon Mar 30	PID, Impedance, Hybrid Control		
Tue Mar 31		PID, Impedance, Hybrid Control	
Wed Apr 1	MDP/POMDP Representations		
Thu Apr 2		MDP/POMDP Representations	
Mon Apr 6	RL for Robotics		
Tue Apr 7		RL for Robotics	
Wed Apr 8	RL for Robotics		**Lab 3 Due**
Thu Apr 9		RL for Robotics	
Mon Apr 13	Imitation Learning		Lab 4 Out
Tue Apr 14		Imitation Learning	
Wed Apr 15	Imitation Learning		
Thu Apr 16		Imitation Learning	
Mon Apr 20	Multi-Modal Learning		Practice Exam Released
Tue Apr 21		Multi-Modal Learning	
Wed Apr 22	**Exam 3 (new date)**		
Thu Apr 23		**Exam 3 (new date)**	
Mon Apr 27	Robot Foundation Models		
Tue Apr 28		Robot Foundation Models	
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Sun May 3			**Lab 4 due**