CS 3630 Introduction to Robotics and Perception

Spring 2025

Instructor: Prof. Sonia Chernova, chernova@gatech.edu
Lectures: Available as recordings on Canvas
Optional Discussion times: M/W 3:30-4:45pm, Ford Environmental Sci & Tech L1255

Teaching Assistants: List of TAs
Office Hours: Calendar Link

Websites:

- Canvas: We will use Canvas for all major announcements, assignments, and quizzes.
- Piazza: All discussions will be carried out via Piazza. (*signup link coming soon*)

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

The course will include a mix of in-person and recorded content:

- **Lectures** – all lectures will be pre-recorded and made available on Canvas
- **Optional In-Person Discussions** – public discussion sessions or Q&A sessions will be held during our normally scheduled class time (M/W 3:30-4:45pm). The session will be structured as an interaction between the instructor and/or course TAs and attending students. This is not a time to get one-on-one help on an assignment, but rather to get answers to more broad questions relating to course content. This is also a great opportunity for quiz prep.
- **Piazza Discussions** – we encourage active discussion on Piazza as a way to get more timely and asynchronous assistance.
- **Office Hours** – we will have a wide range of pre-scheduled office hour sessions available each week designed for private assistance regarding assignments or other concerns.

Assignments and Grading

Projects (6 x 10% each): There will be 6 projects throughout the semester, each worth 10% 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.

Quizzes (5 x 8% each): There will be 7 quizzes throughout the semester at the end of class on the dates designated on the syllabus. For each student, the two quizzes with the lowest grade will be dropped, and the remaining 5 quizzes will each be worth 8% of the final course grade. Because the lowest quiz grades are being dropped, we will not be rescheduling quizzes missed due to unexcused absences (travel, job interviews, etc.).

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 that helps the class – 0.5%

You may receive extra credit more than once. For any questions, please contact the head TA.

Communication with Course Staff and Peers

We will be using Piazza and Canvas for course announcements, questions, and discussion.

For the best and fastest response, we ask that you post your questions on Piazza instead of sending emails. If others are likely to have a similar question or benefit from the answer, make a public Piazza post. Feel free to make private posts to the course staff if your question concerns a solution, your grade, or other private information.

We encourage everyone to actively contribute to discussion, answer each other's questions and generally use Piazza as broadly as possible to make the course run smoothly. We recommend configuring the email settings to send new post notifications in real time, not at the end of the day.

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 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.

Acknowledgements

Assignments, lectures, and ideas in this course are adapted from prior offerings of this course at Georgia Institute of Technology by Profs. Harish Ravichandar, Matthew Gombolay, and Frank Dellaert.

Tentative Schedule

WEEK	TOPIC	DATES	DUE
1	Introduction	Mon Jan 6	
	Sensing	Wed Jan 8	
2	Sensing	Mon Jan 13	
	Sensing	Wed Jan 15	
3		Mon Jan 20	MLK Jr. Day Holiday
	Sensing	Wed Jan 22	Quiz 1
4	State Estimation	Mon Jan 27	
	State Estimation	Wed Jan 29	Project 1
5	State Estimation	Mon Feb 3	
	State Estimation	Wed Feb 5	Quiz 2
6	Prob. Decision Making	Mon Feb 10	
	Prob. Decision Making	Wed Feb 12	Project 2
7	Prob. Decision Making	Mon Feb 17	
	Prob. Decision Making	Wed Feb 19	Quiz 3
8	Planning	Mon Feb 24	
	Planning	Wed Feb 26	Project 3
9	Planning	Mon Mar 3	
	Planning	Wed Mar 5	Quiz 4
10	Learning	Mon Mar 10	
	Learning	Wed Mar 12	Project 4
		Spring Break	
11	Learning	Mon Mar 24	
	Learning	Wed Mar 26	Quiz 5
12	Kinematics & Control	Mon Mar 31	
	Kinematics & Control	Wed Apr 2	Project 5
13	Kinematics & Control	Mon Apr 7	
	Kinematics & Control	Wed Apr 9	Quiz 6
14	Multi-robot Coordination	Mon Apr 14	
	Multi-robot Coordination	Wed Apr 16	Project 6
15	Multi-robot Coordination	Mon Apr 21	Quiz 7