CSCI 445 Introduction to Robotics

Course Syllabus, Fall 2021 (last updated August 25, 2021)

Time: Lecture T/Th 11:00am– 12:20pm (GFS 223), Lab Sections T/Th: 1:00pm-3:50pm (RTH 419)

Lecture Zoom: https://usc.zoom.us/j/91823613507?pwd=Nlc1Qk5ZVDNWbDJ2N002UGZHRjk2QT09

Lecture recordings will be available on Piazza.

Instructor: Professor Heather Culbertson (hculbert@usc.edu)

Teaching Assistants: Nathan Dennler (dennler@usc.edu)

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Course Producer: John Rogers (jr_473@usc.edu)

Office Hours: Wednesday 2pm-4pm (RTH 403)

Website: piazza.com/usc/fall2021/csci445 (please sign up, this will be the main mode of communication)

Course Description

This course is an introduction to robotics, focusing on basic building blocks such as motors, sensors, and algorithms. Students will get hands-on experience with building robots, integrating sensors and actuators, and developing algorithms for robot control.

It is an explicit goal of this course to advance students' critical thinking and communication skills. This is achieved through laboratories, group work, and discussions.

Course Texts and Readings

Students are expected to read the weekly reading material prior to attending lecture. This is the best way to (1) ensure you have properly understood the material, (2) follow along in the lecture, (3) get a high score in class participation, and (4) do well on the exams. Students are expected to attend lecture, as there are many insights that will be shared and discussed in class that are not on the lecture slides.

The course will use multiple texts. Assigned readings (including articles and other supplemental readings) are *not optional*. They are meant to help you understand the course material.

1. The main text for the course is Elements of Robotics (Mordechai Ben-Ari and Francesco Mondada), and is available for free download here: https://www.springer.com/gp/book/9783319625324
2. Planning Algorithms (Steve LaValle) is available online for free at http://planning.cs.uiuc.edu
3. Behavior Based Robotics (Ron Arkin), chapters will be posted on Piazza.
4. Introduction to Autonomous Mobile Robots (R. Siegwart, I.R. Nourbakhsh, D. Scaramuzza, 2nd Edition) is available through the library website as an e-resource for free.

Homework

Homework is graded on a scale of 100 points each. Homework is expected to be turned in on Blackboard **by midnight** on the due date. **Unless a student has obtained special permission for extraordinary circumstances, late homework assignments will be penalized, 20 points per day.**

Laboratory Component

The laboratory is an integral component of this course. It reinforces concepts discussed in lecture by giving students the opportunity to apply these concepts on hardware.

LAB ATTENDANCE IS REQUIRED. Any absences from lab must be excused in advance by the teaching staff, and arrangements must be made to make up the lab. You must come to lab prepared, having read the lab handout and reviewed the relevant topics. A pre-lab component will be due at the beginning of most labs, and will be checked by the TAs. Failure to prepare for the lab will result in a 10% deduction in your grade for that week's lab. Being >10 minutes late will also result in a 10% deduction for that week's lab.

If you are attending the course remotely this semester and are not able to attend the lab in person, please contact Dr. C within the first week of the semester to discuss options for a virtual lab.

Course Project

The course project provides students with an opportunity to incorporate all the concepts learned in class and all tools developed in lab into a final project. Details will be released towards the end of the semester.

Exams

Exams will be taken remotely during the scheduled class time and will be open book/note. The final exam will not be cumulative, and will focus on material covered after the midterm. The teaching staff will make every effort to return graded exams within one week of the exam date. **From the date the exams are returned, students have ONE WEEK to bring up and reconcile issues related to grading of the exam.**

Grading

	% of Final Grade
Homework (5 problem sets and 1 evaluation)	20%
Labs (including Programming Assignments)	30%
Course Project	10%
Midterm (October 12)	20%
Final Exam (December 14, 8-10 am)	20%
Participation (on Piazza)	3%
	103%/100%

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with the Office of Student Accessibility Services (OSAS) each semester. A letter of verification for approved accommodations can be obtained from OSAS. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. OSAS is located in GFS 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for OSAS is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus,* the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

CSCI 445 Class Schedule

Fall 2021

Week	Date	Topic	Readings	Lab Schedule	HW	due date
1	24-Aug	Introduction, Defining Robotics		**(no lab)**		
	26-Aug	Defining Robotics + Motors & Gears	EOR 1			
2	31-Aug	Actuators, Effectors, & Locomotion	EOR 5.10-12	Intro	Programming Assignment	9-Sep
	2-Sep	Introduction to Sensors, Sonar	EOR 2			
3	7-Sep	Simple Sensors II-Encoders	EOR 5	Sonar intro and Characterization	HW1	16-Sep
	9-Sep	Odometry				
4	14-Sep	Feedback Control	EOR 6	Odometry		
	16-Sep	Feedback and Sensor Processing				
5	21-Sep	Simple Sensors III - Optical		Wall Follower	HW 2	30-Sep
	23-Sep	Complex Sensors	EOR 12			
6	28-Sep	Control Architectures		Go-to-goal		
	30-Sep	Representation	EOR 3, RA 5			
7	5-Oct	Representation & Reactive Control	EOR 4	Go-to-goal With Obstacles Part 1		
	7-Oct	Hybrid & Behavior Based Control	EOR 4, RA 3,4,6			
8	12-Oct	**Midterm**		**(no lab)**		
	14-Oct	**Fall Recess (no class)**				
9	19-Oct	Particle Filter	EOR 8	Go-to-goal With Obstacles Part 2	HW 3	28-Oct
	21-Oct	Manipulation	EOR 16.1-2			
10	26-Oct	Planning and Discrete Search	EOR 10	Particle Filter Part 1	Programming Assignment 2	4-Nov
	28-Oct	Configuration Space Planning	SL 3, EOR 10.2			
11	2-Nov	Sampling Based Planning	SL 5	Particle Filter Part 2		
	4-Nov	Potential Fields & Obstacle Avoidance	EOR 7			
12	9-Nov	Task Planning		Motion Planning	HW 4	18-Nov
	11-Nov	Emergent Behaviors & Group Robotics				
13	16-Nov	Multirobot Systems	EOR 15	Project 1	HW 5	23-Nov
	18-Nov	Learning				
14	23-Nov	Soft Robotics	HC 1	**(no lab)**		
	25-Nov	**Thanksgiving (no class)**				
15	30-Nov	Haptics	HC 2	Project 2		
	2-Dec	Human-robot interaction				
Final	14-Dec	Final Exam 8am-10am				

References:

EOR	Elements of Robots, Ben-Ari, Mondada
RA	Behavior Based Robotics, Ron Arkin
SL	Planning Algorithms, Steven LaValle
HC	Supplementary Chapters, Heather Culbertson