CSCI 445 Introduction to Robotics

Course Syllabus, Fall 2020 (last updated July 29, 2020)

Time: Lecture T/Th 11:00am– 12:20pm, Lab Sections T/Th: 1:00pm-3:50pm

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

Teaching Assistants: Yang Chen (chen716@usc.edu)

Xin Zhu (xinzhu@usc.edu)

Course Producer: TBD

Office Hours: Wednesday 2pm-4pm

Website: piazza.com/usc/fall2020/csci445 (please sign up, this will be the main mode of communication)

Zoom Links: TBD - (lecture will be live, recordings available)

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.
5. Recent magazine and technical articles will also be used for assignments. All USC students have access (via the library website) to the digital archives that will be used.

Homework

Homework is graded on a scale of 100 points each. Homework is expected to be turned in on Blackboard **before class** 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 in simulation. The lab will be virtual and be conducted through Zoom. Students will be working in groups of three. Software will be available to facilitate virtual collaboration.

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. Most lab sessions will begin with a quiz to ensure you have prepared for that day's lab. Failing the quiz (including if you miss the quiz because you are late to lab) will result in a 20% deduction in your grade for that week's 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 in the 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	20%
Final Exam	20%

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. The phone number for DSP is (213) 740-0776. Information regarding accommodating in virtual classes can be found here: https://dsp.usc.edu/coronavirus-update-students/

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 2020

Week	Date	Topic	Readings	Lab Schedule	HW	due date
1	18-Aug	Introduction, Defining Robotics				
	20-Aug	Defining Robotics + Motors & Gears	EOR 1			
2	25-Aug	Introduction to Sensors, Sonar	EOR 2	Intro	Programming Assignment	3-Sep
	27-Aug	Actuators, Effectors, & Locomotion	EOR 5.10-12			
3	1-Sep	Simple Sensors II-Encoders	EOR 5	Sonar intro and		
	3-Sep	Odometry		Characterization	HW1	10-Sep
4	8-Sep	Feedback Control	EOR 6	Odometry		
	10-Sep	Feedback and Sensor Processing				
5	15-Sep	Simple Sensors III - Optical		Wall Follower	HW 2	24-Sep
	17-Sep	Complex Sensors	EOR 12			
6	22-Sep	Control Architectures		Go-to-goal		
	24-Sep	Representation	EOR 3, RA 4			
7	29-Sep	**Midterm**		Go-to-goal With		
	1-Oct	Representation & Reactive Control	EOR 4	Obstacles Part 1	HW 3	8-Oct
8	6-Oct	Hybrid & Behavior Based Control	EOR 4, RA 3,4,6	Go-to-goal With		
	8-Oct	Particle Filter	EOR 8	Obstacles Part 2		
9	13-Oct	Manipulation	EOR 16.1-2	Particle Filter	Programming Assignment 2	22-Oct
	15-Oct	Planning and Discrete Search	EOR 10	Part 1		
10	20-Oct	Configuration Space Planning	SL 3, EOR 10.2	Particle Filter		
	22-Oct	Sampling Based Planning	SL 5	Part 2	HW 4	9-Apr
11	27-Oct	Task Planning		Motion Planning		
	29-Oct	Potential Fields & Obstacle Avoidance	EOR 7			
12	3-Nov	Multirobot Systems	EOR 15	Project 1		
	5-Nov	Learning			HW 5	12-Nov
13	10-Nov	Haptics	HC	Project 2		
	12-Nov	Human-robot interaction				
Final	17-Nov	Final Exam 11am-1pm				

References:

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