

CSCI 445 Introduction to Robotics

Course Syllabus, Fall 2023 (last updated June 20, 2023)

Time: Lecture T/Th 11:00am– 12:20pm (DMC 210), Lab Sections T/Th: 1:00pm-3:50pm (RTH 419)

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

Teaching Assistants: TBD

Course Producer: TBD

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

Website: <https://piazza.com/usc/fall2023/csci445/>

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.

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 during the scheduled class time. 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)	20%
Labs (including Programming Assignments)	30%
Course Project	10%
Midterm (October 10)	20%
Final Exam (December 12, 8-10 am)	20%
Participation (in class and on Piazza)	3%

103%/100%

Class Schedule

Week	Date	Topic	Readings	Lab Schedule	HW	due date
1	22-Aug	Introduction, Defining Robotics		(no lab)	Programming Assignment 1	1-Sep
	24-Aug	Defining Robotics + Motors & Gears	EOR 1			
2	29-Aug	Actuators, Effectors, & Locomotion	EOR 5.10-12	Lab 1: Intro		
	31-Aug	Introduction to Sensors, Sonar	EOR 2			
3	5-Sep	Simple Sensors II-Encoders	EOR 5	Lab 2: Sensors	HW 1	15-Sep
	7-Sep	Odometry				
4	12-Sep	Feedback Control	EOR 6	Lab 3: Odometry		
	14-Sep	Feedback and Sensor Processing				
5	19-Sep	Simple Sensors III - Optical	EOR 12	Lab 4: Feedback (PD)	HW 2	29-Sep
	21-Sep	Complex Sensors				
6	26-Sep	Control Architectures	EOR 3, RA 5	Lab 5: Feedback (PID)		
	28-Sep	Representation				
7	3-Oct	Representation & Reactive Control	EOR 4, EOR 4, RA 3,4,6	Lab 6/7: Combining controllers		
	5-Oct	Hybrid & Behavior Based Control				
8	10-Oct	Midterm		(no lab)		
	12-Oct	Fall Recess (no class)				
9	17-Oct	Particle Filter	EOR 8	Lab 6/7: Combining controllers	HW 3	27-Oct
	19-Oct	Emergent Behaviors & Group Robotics				
10	24-Oct	Multirobot Systems	EOR 15 EOR 16.1-2	Lab 8/9: Particle Filter		
	26-Oct	Manipulation				
11	31-Oct	Planning and Discrete Search	EOR 10			10-Nov

	2-Nov	Configuration Space Planning	SL 3, EOR 10.2	Lab 8/9: Particle Filter	Programming Assignment 2	
12	7-Nov	Sampling Based Planning	SL 5	Lab 10: Mapping	HW 4	22-Nov
	9-Nov	Potential Fields & Obstacle Avoidance	EOR 7			
13	14-Nov	Task Planning		Project		
	16-Nov	Learning				
14	21-Nov	Soft Robotics	HC 1	(no lab)	HW 5	1-Dec
	23-Nov	Thanksgiving (no class)				
15	28-Nov	Haptics	HC 2	Project		
	30-Nov	Human-robot interaction				
Final	12-Dec	Final Exam 8am-10am				

References:

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

Statement on Academic Conduct and Support Systems**Academic Conduct:**

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

eeotix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symlicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776

osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.