



CSCI 699: Robotic Perception

Units: 4.0

Fall 2024 — Wednesdays — 2:00-5:20PM

Location: DMC 205

Instructor: Yue Wang

Office: PHE223

Office Hours: TBD

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Catalogue Description

Advanced topics in robotic perception: multi-view reconstruction, visual reasoning, visual centric manipulation and locomotion, 3D deep learning for robotics.

Course Description

This course aims to tackle robotics from a perception perspective. Our focus is to study state-of-the-art method for robotic perception and scene understanding. We will bring together different disciplines of computer vision, including Visual Recognition, Multi-View Reconstruction, and recent topics such as Visual Reasoning. We will explore the applications of recently developed tools such as Neural Fields, Generative Models, and Foundation models in the context of robotics. We want to show how embodied agents learn to see and sense our physical environments.

Learning Objectives

By learning this course, students will be able to understand and implement recent deep learning-based visual perception methods. In addition, students can design novel visual scene representations for robotics. Finally, students should be able to perform research in 3D perception and robot learning after taking this course.

Recommended Preparation

Familiarity with recent deep learning techniques on the level of CSCI 566 and basic robotic algorithms on the level of CSCI 445.

Course Notes

This course is web-enhanced and materials will be uploaded to Brightspace. This course will use letter grade.

Technological Proficiency and Hardware/Software Required

Students are expected to be familiar with Pytorch, TensorFlow, and other deep learning tools.

Required Readings and Supplementary Materials

Deep learning for computer vision <https://cs231n.stanford.edu>

Optional Readings and Supplementary Materials

[TBD]

Description of Assignments and How They Will Be Assessed

Assignments will be assessed based on the correctness of results produced by students. Course project will be assessed according to technical novelty and soundness. The project should justify students successfully meet the learning objective and possess enough skills to start research at the intersection of computer vision and robotics.

Participation

In-class participation is required since this course requires a significant amount of discussions.

Grading Breakdown

This course will be graded according to three major assignments (each 15%), a course project (50%), and course participation.

Assessment Tool (assignments)	% of Grade
Assignment 1	15
Assignment 2	15
Assignment 3	15

Assessment Tool (assignments)	% of Grade
Project	50
Participation	5
TOTAL	100

Assignment Submission Policy

The assignments will be submitted using Brightspace.

Course-Specific Policies

5 lates days in total, at most 3 late days can be used in a single assignment or project.

Attendance

Students are expected to attend the class in person.

Academic Integrity

Unless otherwise noted, this course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). The general USC guidelines on Academic Integrity and Course Content Distribution are provided in the subsequent “Statement on Academic Conduct and Support Systems” section.

For this class, we expect

- Collaboration: In this class, you are expected to submit work that demonstrates your individual mastery of the course concepts.
- Group work: Unless specifically designated as a ‘group project,’ all assignments are expected to be completed individually.
- Computer programs: Plagiarism includes the submission of code written by, or otherwise obtained from someone else. Reuse of existing libraries and packages is allowed with clear reference.

Please ask the instructor [and/or TA(s)] if you are unsure about what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

You may not record this class without the express permission of the instructor and all other students in the class. Distribution of any notes, recordings, exams, or other materials from a university class or lectures — other than for individual or class group study — is prohibited without the express permission of the instructor.

Use of Generative AI in this Course

Generative AI permitted but limited as follows: In this course, you are permitted to use artificial intelligence (AI)-powered programs to help you. However:

- You should also be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses; thus, their answers may not meet the standards of this course.
- To adhere to our university values, *you must cite any AI-generated material (e.g., text, images, and other content) included or referenced in your work and provide the prompts used to generate the content.* Using an AI tool to generate content without proper attribution will be treated as plagiarism and reported to the Office of Academic Integrity.

Please review the instructions (if specified) in each assignment for more details on how and when to use AI Generators for your submissions.

Course Evaluations

Course evaluation is based on the assignments and a final project.

Course Schedule

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Introduction		
Week 2	Robotic perception		Assignment 1 out.
Week 3	3D detection		
Week 4	3D segmentation		Project proposal due.
Week 5	3D visual reasoning		Assignment 1 due. Assignment 2 out
Week 6	Scene representations		
Week 7	Point clouds		
Week 8	Depth maps		Assignment 2 due. Assignment 3 out
Week 9	Neural radiance fields		Project midterm check-in
Week 10	Gaussian splatting		
Week 11	Visual navigation		Assignment 3 due
Week 12	Manipulation		
Week 13	Generative AI for robotics		
Week 14	Final presentation		Final project presentation
Week 15	Final presentation		Final project presentation
FINAL	Final Project Report		Final project report due on the university-scheduled date of the final exam.

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

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

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

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

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

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

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 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) 740-0411

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

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

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) 442-1200 – 24/7 on call

Non-emergency assistance or information.

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

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) 442-2850 or otfp@med.usc.edu

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