

# CS391R: Robot Learning

## Perception and Decision Making: Architectures, Algorithms, and Applications

### Course Description

Robots and autonomous systems have been playing a significant role in the modern economy. Custom-built robots have remarkably improved productivity, operational safety, and product quality. However, these robots are usually programmed for specific tasks in well-controlled environments, unable to perform diverse tasks in the real world. How can we take robots out of constrained environments to our daily life, to assist us in a variety of real-world tasks as our companion and assistant? It demands a new form of general-purpose robot autonomy that robots understand the world through the lens of its perception and make informed decisions accordingly. This course studies modern machine learning and AI algorithms for autonomous robots as an embodied intelligent agent. It covers advanced topics that center around the principles and techniques on 1) how robots **perceive** the unstructured environments from raw sensory data, 2) how robots **make decisions** based upon its perception, and 3) how robots **learn and adapt** actively and continually in the physical world.

### Course Time and Location

Lecture: 9:30-11:00am, Tuesdays and Thursdays

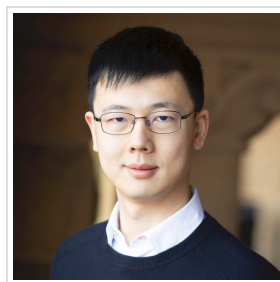
Location: [GDC 4.302](#) (in-person) and [Zoom](#) (online)

### Online Platforms

[Canvas](#) for Zoom access and grading

[Piazza](#) for announcements and discussions

### Instructor



**Yuke Zhu**

OH: Monday 3-4pm or by appointment

Office: GDC 3.422 (or via Zoom)

[Website](#)

### Teaching Assistant



**Zhenyu Jiang**

OH: Wednesday 4-5pm

Location: GDC 3.516 (or via Zoom)

[Website](#)

### Learning Objective

This class is intended for graduate students and ambitious undergraduates who are passionate about the emerging technologies at the intersection of Robotics and AI, especially for those who seek research opportunities in this subject area. Through this course, students will:

- understand the potentials and societal impacts of general-purpose robot autonomy in the real world, the technical challenges arising from building it, and the role of machine learning and AI in addressing these challenges;
- get familiar with a variety of model-driven and data-driven principles and algorithms on robot perception and decision making;
- be able to evaluate, communicate, and apply advanced AI-based techniques to problems in robotics.

## Prerequisites

Students are expected to have the following backgrounds:

- Knowledge of basic data structures and algorithms as well as practical skills of computer programming. Proficiency in Python is required and high-level familiarity with C/C++ is a plus.
- Familiarity with calculus, statistics, and linear algebra. Strong mathematical skills are required.
- Coursework and/or equivalent experience in AI and Machine Learning (CS342, CS391L, and CS394R) are preferred.
- Be passionate, patient, and fearless when working with Robotics + AI systems.

**Note:** This course is an advanced graduate-level course. If you are unclear whether you meet these requirements, please consult the instructor in advance. Undergraduates must obtain **explicit approval** from the instructor (email your CV and transcript) prior to enrollment.