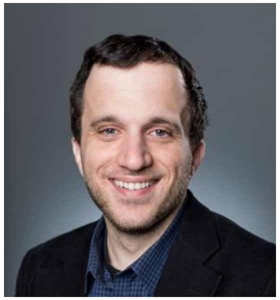
USC Viterbi
School of Engineering

Introduction to Robotics

Instructor: Stefanos Nikolaidis



TAs:

I-Chun Liu

Shihan Zhao

Sophie Hsu

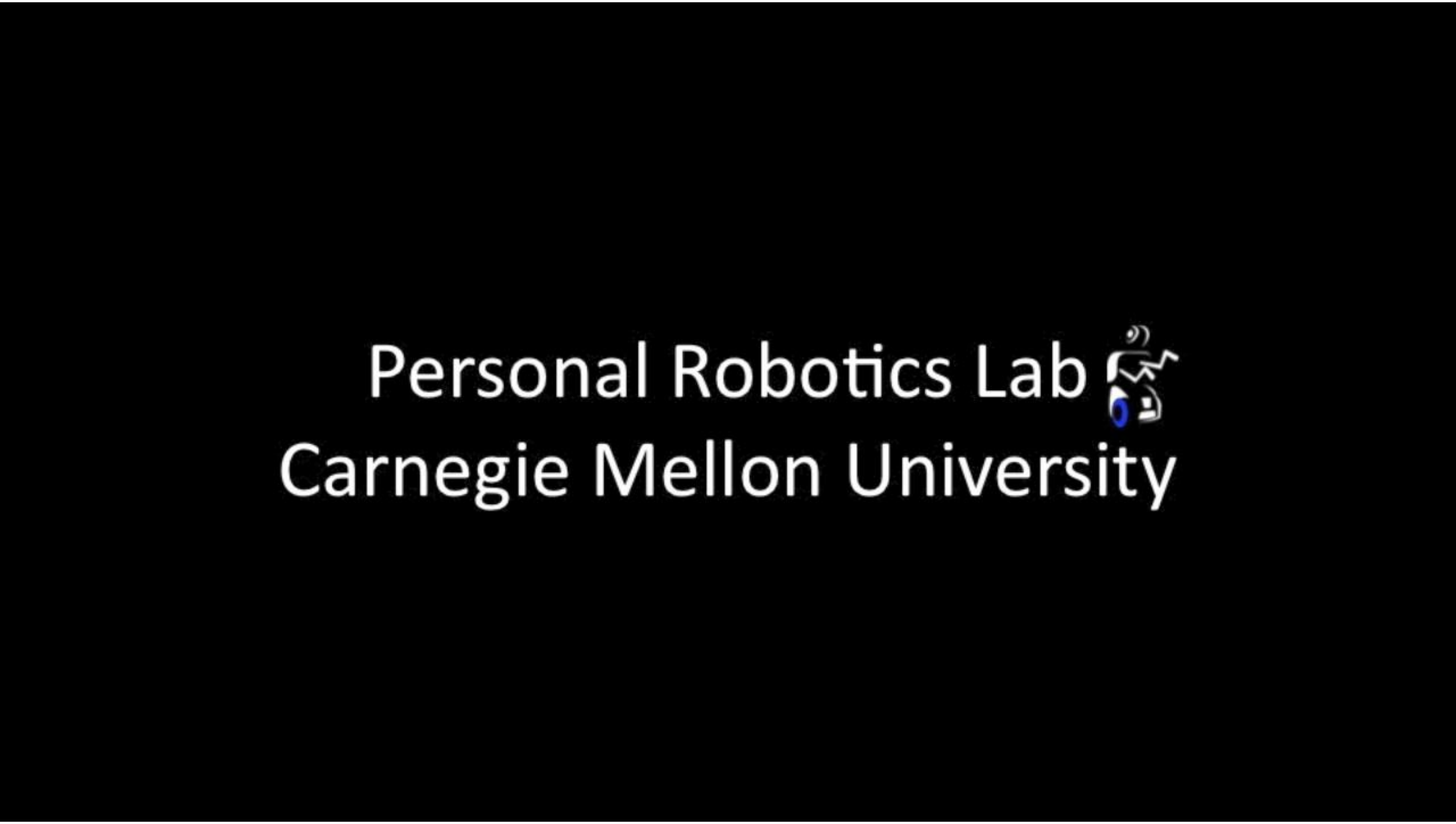
Course Website:
http://www.stefanosnikolaidis.net/robotics2024.html


LEONI

Robots interacting with the world

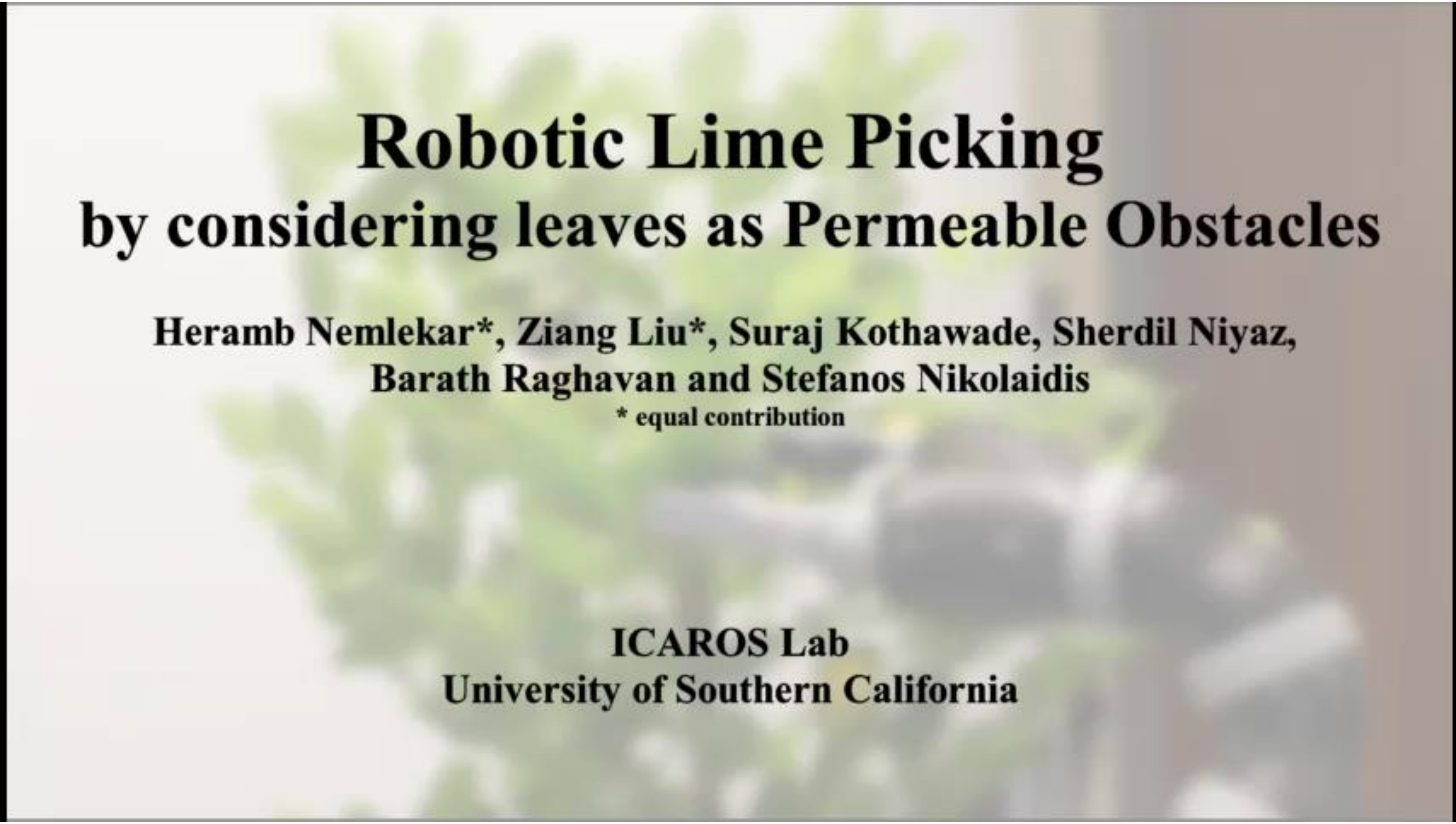
CMU Boss DARPA Urban Challenge 2007, video shared by Geoff Hollinger

Robots interacting with the world



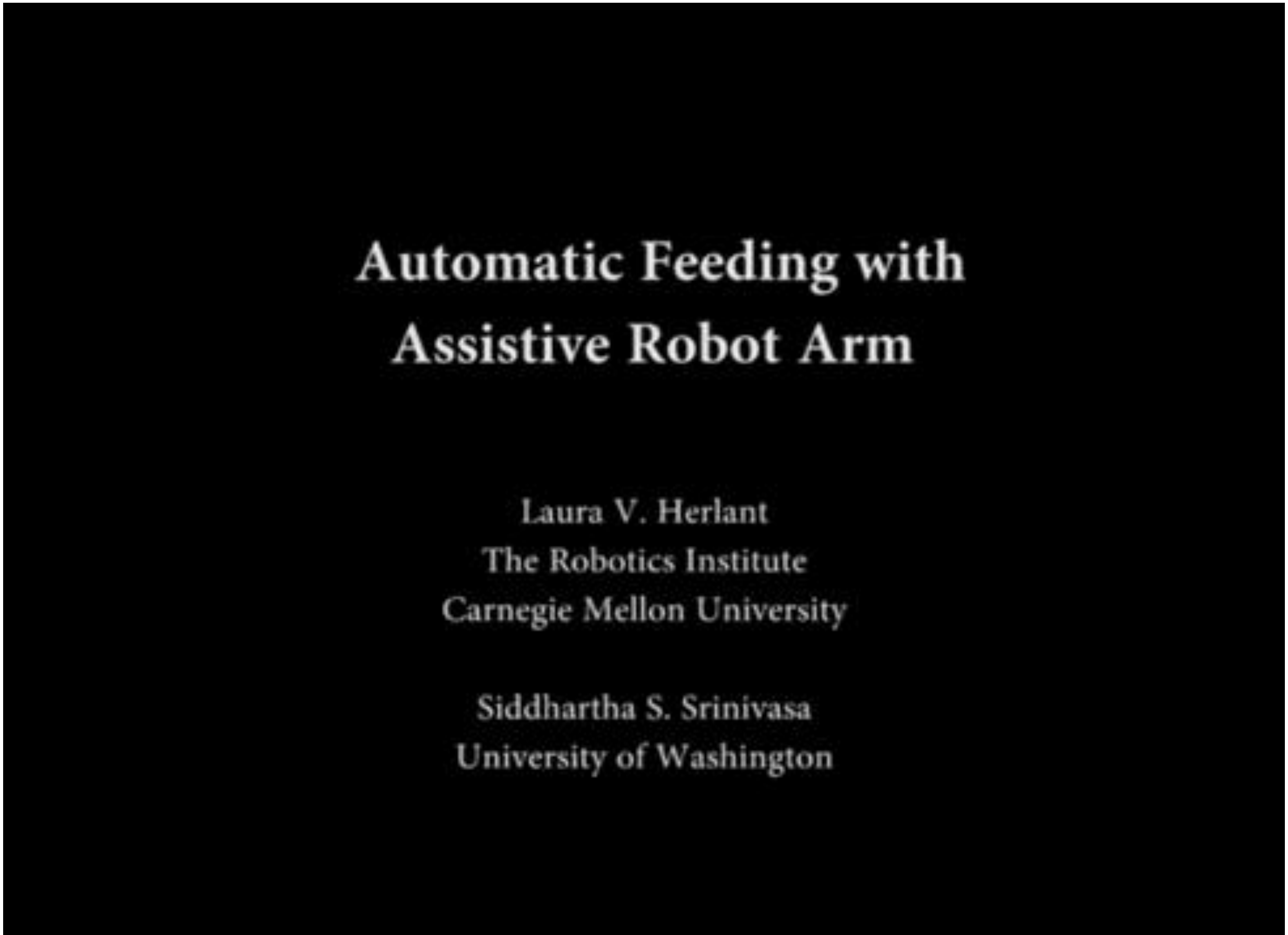
Video by Personal Robotics Lab, Carnegie Mellon University & University of Washington

Robots interacting with the world

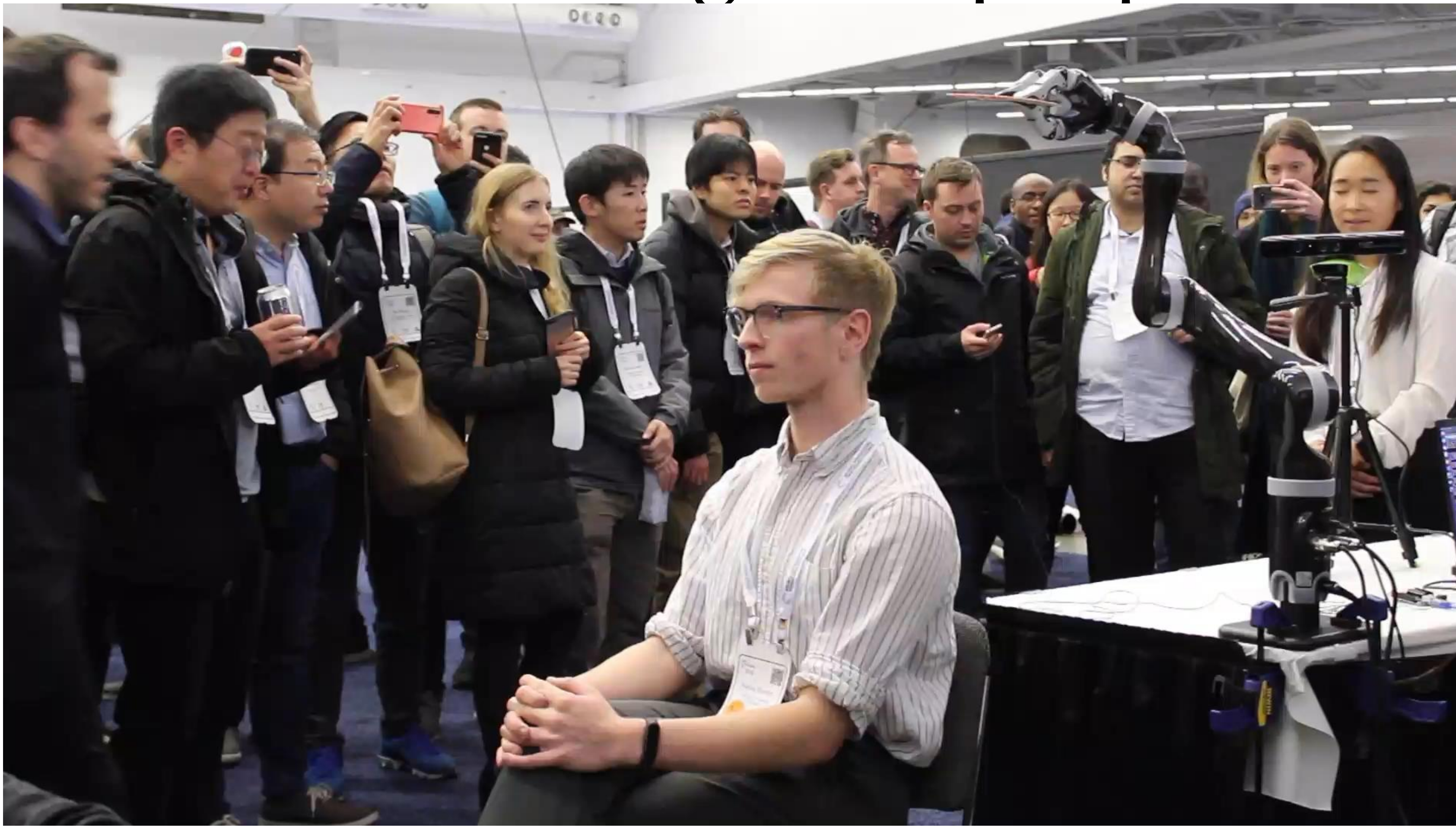


Video by ICAROS Lab, University of Southern California

Robots interacting with people



Robots interacting with people



Robots interacting with people

Video by ICAROS Lab, University of Southern California

Robots interacting with people

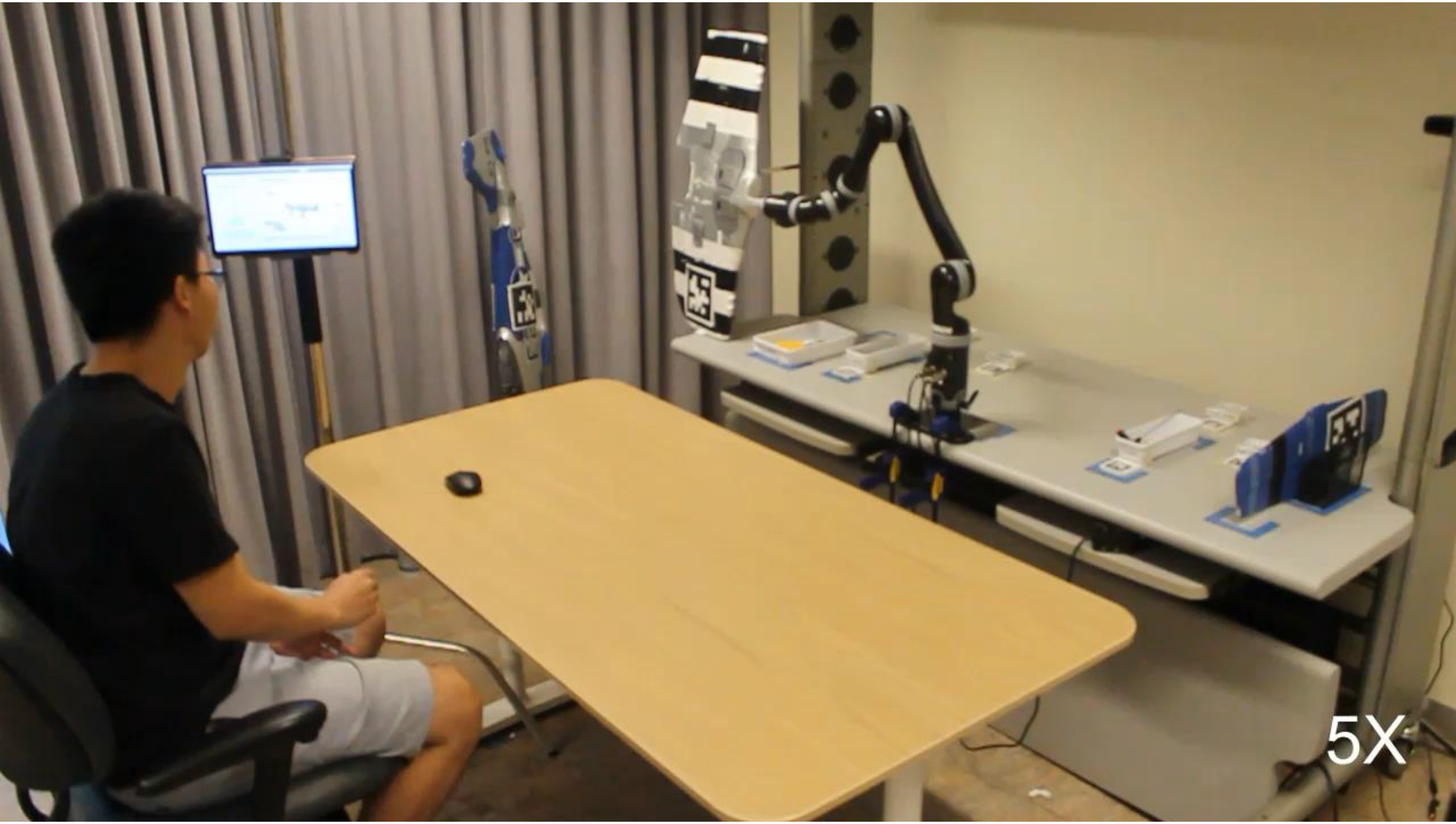
Two-Stage Clustering of Human Preferences for Action Prediction in Assembly Tasks

Heramb Nemlekar, Jignesh Modi, Satyandra K. Gupta, and Stefanos Nikolaidis

ICAROS lab
University of Southern California

Video by ICAROS Lab, University of Southern California

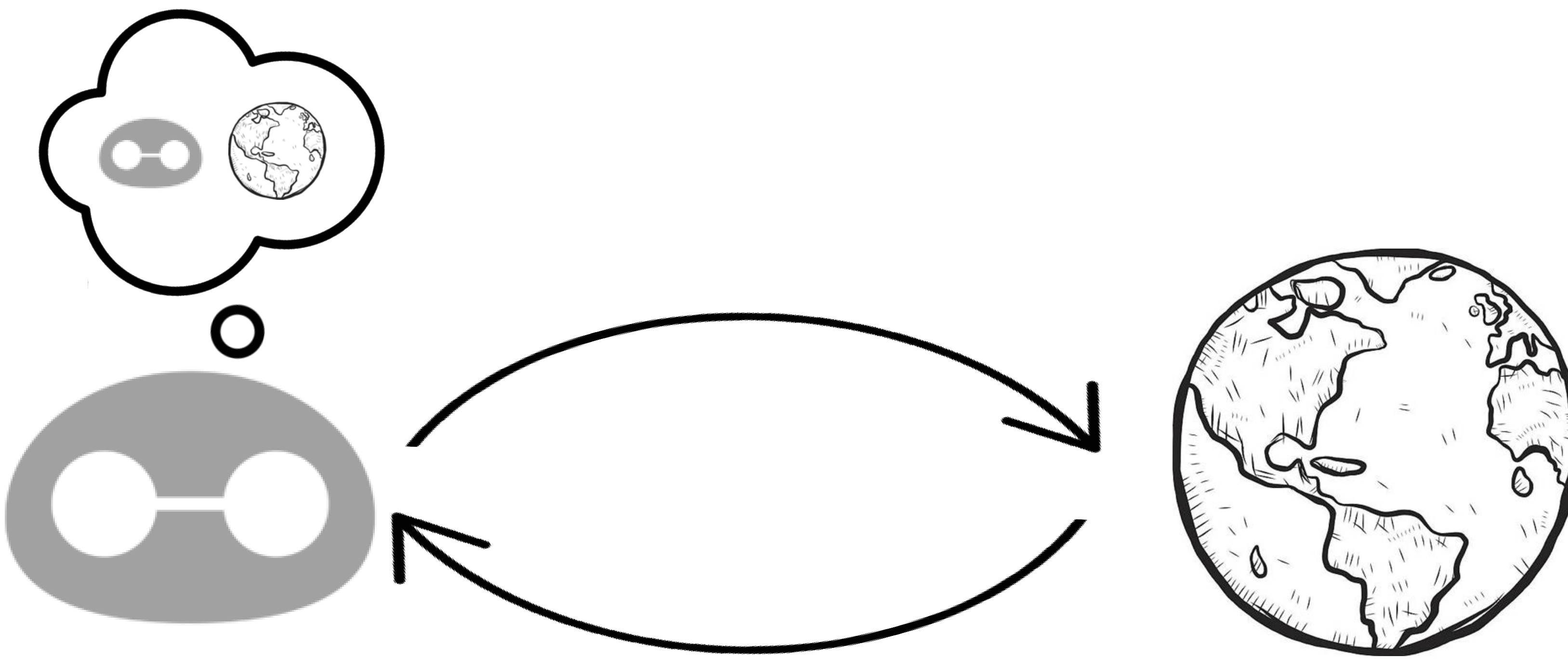
Robots interacting with people

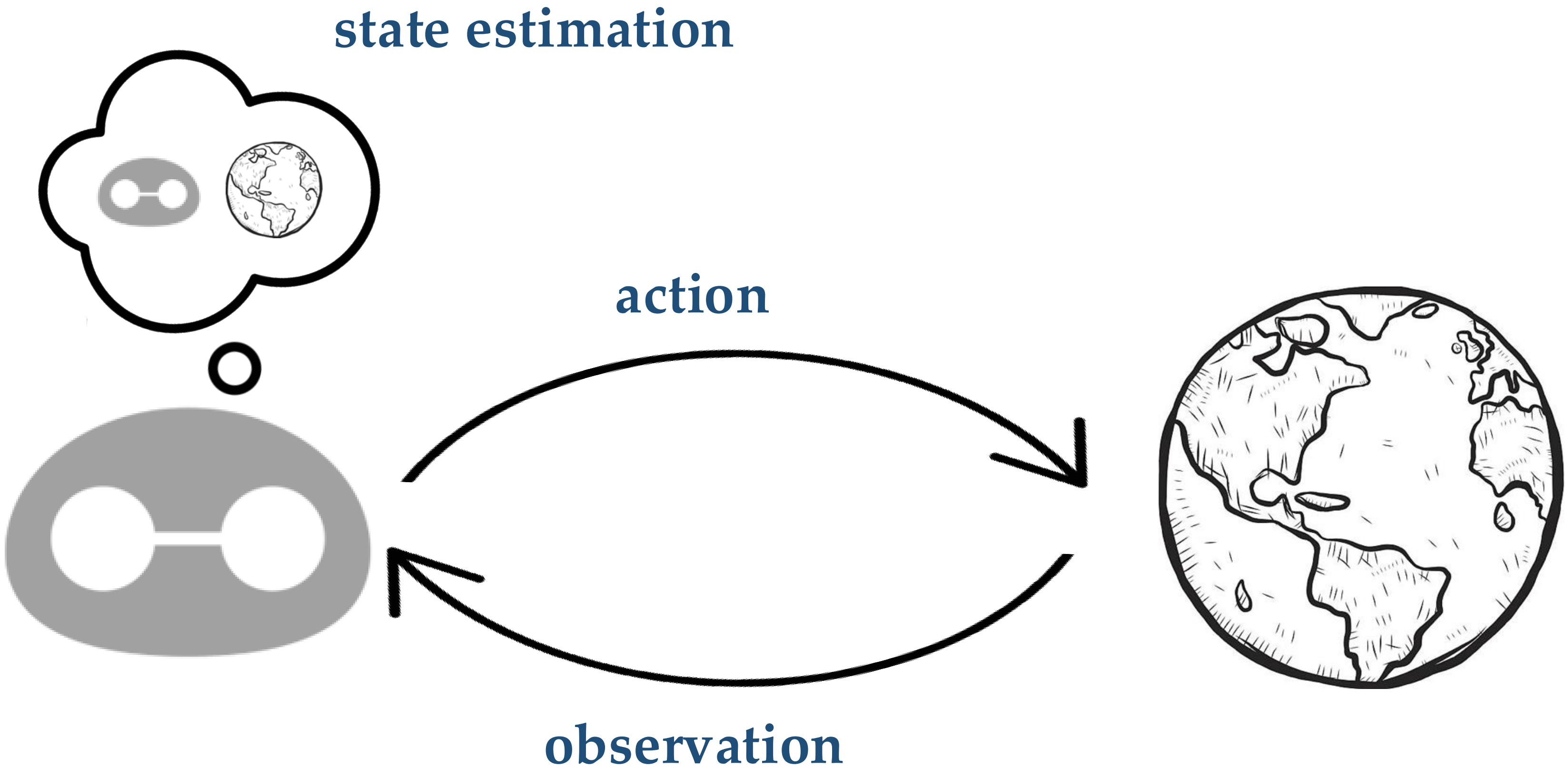


Video by ICAROS Lab, University of Southern California

Robots interacting with robots

Video by ICAROS Lab, University of Southern California




state estimation
action
observation

Learning Objectives

- demonstrate proficiency in the theoretical tools that support state estimation, manipulation and planning with sensor and modeling noise.

- implement these techniques and test them with real-world datasets.

- integrate your algorithms with state-of-the-art simulation environments

Schedule

Matrix Algebra Refresher Probability Theory Python / ROS Tutorial Bayesian Networks Linear Dynamical Systems	**Math Fundamentals for Robotics**
Bayesian and Kalman Filters EKF and Particle Filters Motion and Sensor Models Localization and Mapping SLAM	**Robustness in State Estimation**
Mathematical Programming Configuration Spaces Kinematic Transformations Combinatorial Motion Planning Sampling-based Motion Planning Constraint-based Planning	**Motion Planning**
Dynamics Non-Linear Control Data-Driven Manipulation Human-Robot Interaction	**Robustness in Planning**

Required Prerequisites

- Probability Theory
- Linear Algebra
- Calculus
- Python

Office Hours

- Stefanos Nikolaidis: Wed, 4:00 – 5:00
- TAs: 1h / week, TBD

- Things you should ask:
  - Technical material
  - Help with lab setup
  - Genuine concerns about team

- Things you should not ask:
  - Debugging Python
  - Questions covered in the prerequisites
  - Solving the assignments
  - Extensions

Lab Assignments (40%)

HW Assignments (30%)

Final (30%)

Note

- Regardless of the grading system, you are required to submit all homework assignments, lab assignments and take the final exam to receive a passing grade for the class.

Indicative Grading Scheme

check++ : >110%, extra credit

check+ : ~100%, meeting expectations without errors

check: ~90%, a few minor errors

check-: ~80%, multiple minor errors or a major error

check--:~70%, multiple major errors or large missing parts

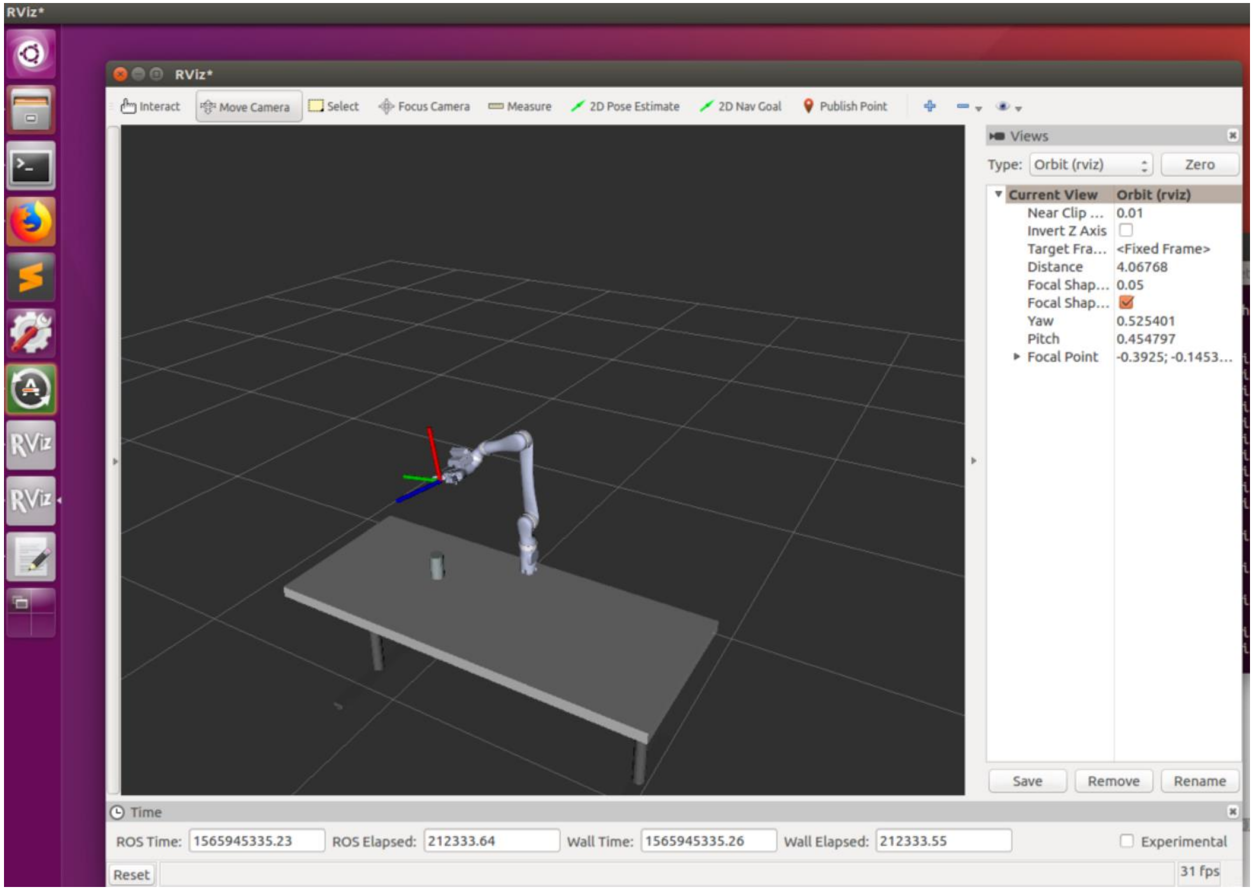
0: no submission

Lab Assignments (40%)

HW Assignments (30%)

Final (30%)

Lab Assignments



Lab Assignments

- For Windows and Linux users, download the free version of VMWare Workstation.
- For Mac users, download the free version of VMWare Fusion
- Download link is here: https://viterbiit.usc.edu/services/software/vmware-academic-program/
- Assign multiple cores and large RAM for the VM if possible
- Start installation of VM early

Lab Assignments

- Groups of ~5 students, one implementation-based solution per group:

https://docs.google.com/spreadsheets/d/1Za1Gh043v5-Ij6JU330ACn26aWXBTe2Hl4cW3UvmOXg/edit?usp=sharing

- Post solutions to your team's private repo in github

- Solutions should include code and report

- Lab 4 builds on Lab 3

Mac M1/M2 Users

- Separate VM needed for Mac M1/M2 users (instructions will be provided

- There are some code differences between the two VMs because of python 2 vs python 3 versions, thus some code resolution may be required if merging code between the two different VMs.

Lab Assignments (40%)

HW Assignments (30%)

Final (30%)

HW Assignments

- Individual assignments including theory and implementation
- Ok to discuss HW assignments with others but should write your own solutions and cite all resources / collaborators
- Upload solutions to provided google form
- Solutions should include report only (no need to upload code)
- Some Labs will build on HW

Late Assignment Policy

- Each students get 7 “slip” days in total (for the whole term) for late submission of Labs / HWs.
- We will not accept late submissions after the 7 days have been spent.

Plagiarism Policy

- Labs: We will assign 0 points to all groups involved in code sharing between groups or for uncited code retrieved online.
- HWs: We will assign 0 points to all students involved in solution sharing or if solution is retrieved online without proper reference.
- We encourage you to use generic code (e.g., ROS commands, plotting) found online, cited in the comments, and to look online for additional resources that help with the assignments.
- Ask the TAs when in doubt!
- You can use LLMs for helping functions, e.g., plotting, but not for the answers of the questions.

Lab Assignments (40%)

HW Assignments (30%)

Final (30%)

Final Exam

- 1 double-sided cheat sheet of size Letter or A4.
- Based on lectures, HW and Lab assignments
- We will provide indicative list of topics near the end of the term