Welcome to
CSE 571 Robotics

Course Instructor Dieter Fox

Today's lecture by Karthik Desingh

Teaching Assistants

Mohit Shridhar

Wentao Yuan

Organization

- Lectures: T/Th 10:00 – 11:20
  (will also put Zoom recordings on Canvas)

- Office hours
  - Dieter: Fri 9am (Gates 204)
  - Mohit: Wed 3pm (G60)
  - Wentao: Mon 10am (G60)
    - *ping on UW CSE slack to get access to G60*

- Tasks
  - 3 homeworks w/ Python programming, covering Gaussians, particle filters, RRT planning, and deep learning (50%)
  - 2 projects in teams of 2-3 (open-ended or guided) (50%)

- Readings: Papers and chapters from *Probabilistic Robotics*
- Webpage: **https://courses.cs.washington.edu/courses/cse571/22sp/**

Organization

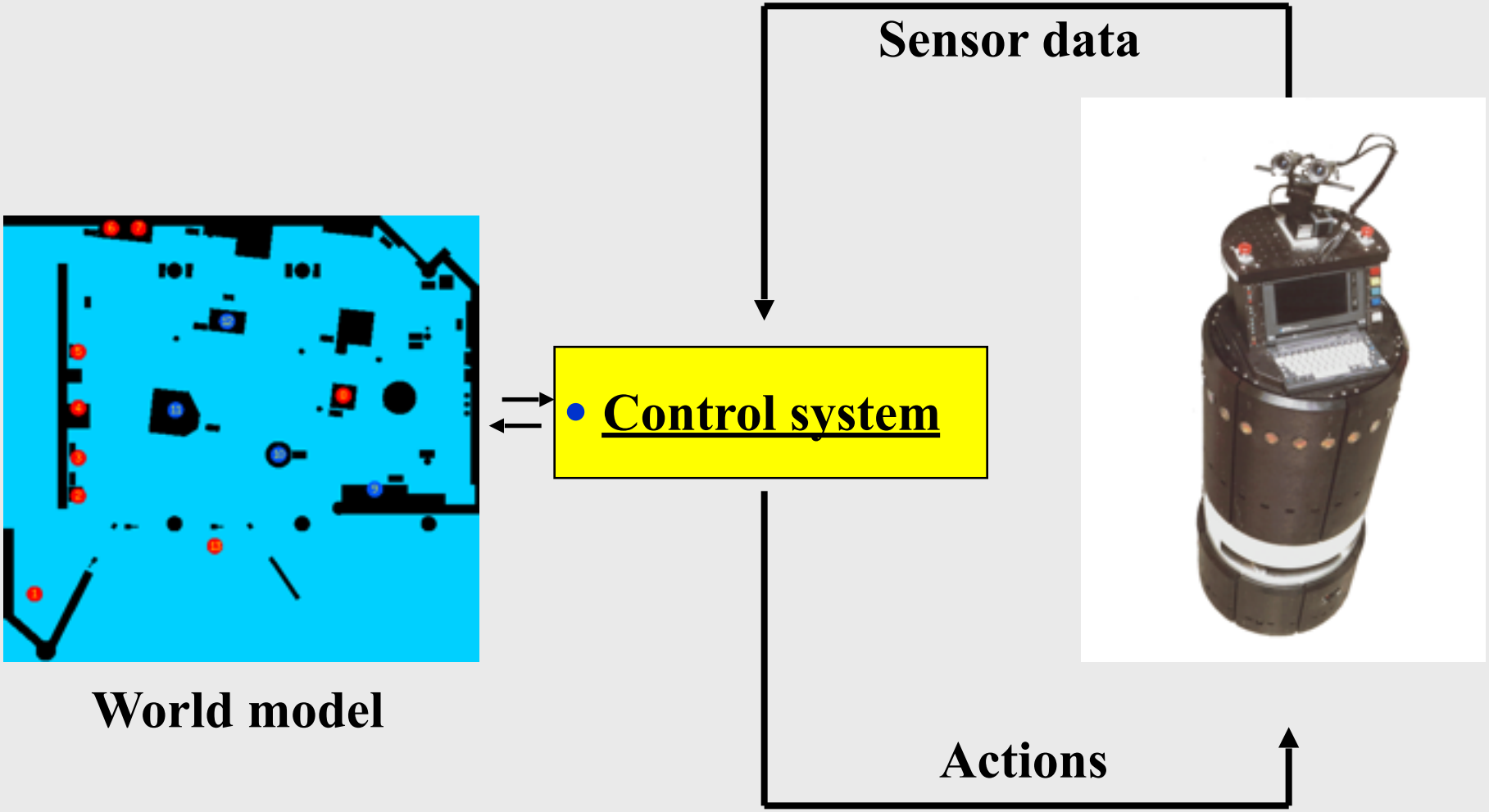
- Late policy

  You are allowed to use 6 late days throughout the quarter. After this, assignments turned in late will incur a penalty of 20%, for each day. Please plan ahead and don't expect more.

- Academic Honesty Policy

  While we encourage students to discuss homeworks, each student must write up their own solution. It's fine to use a source for generic algorithms (with attribution), but it is not allowed to copy solutions to the problems. Additionally, students may not post their code online. If we determine that a student posted their code online, they will get an automatic 50% reduction on the entire assignment (math + code) and if they copy code for the problems from another student or from online, they will get an automatic 0% for the entire assignment (and possibly reported to the college).

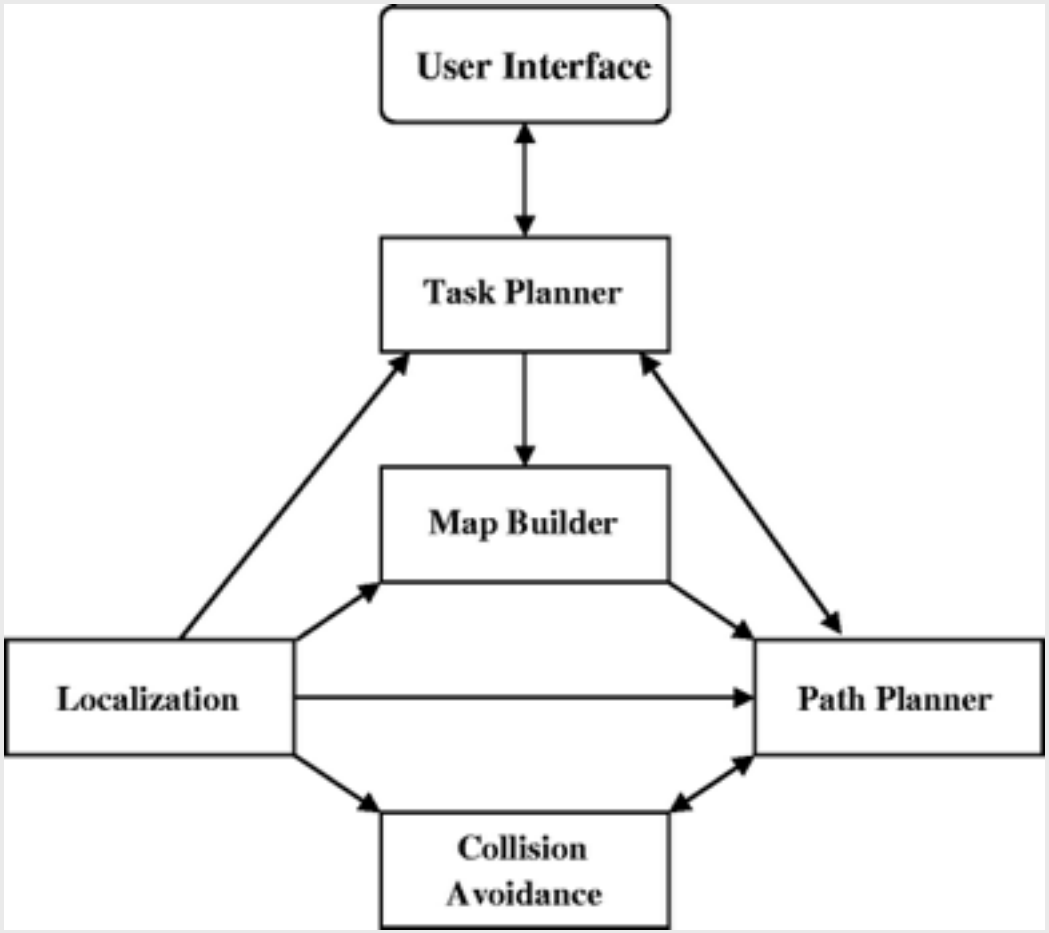
High-level View on Robot Systems



Industrial Robotics Today

Minerva (CMU + Univ. Bonn, 1998)

Architecture of the Control System



RoboCup: Integrated System Research

- Focus on addressing all problems at once
  - Hardware development
  - Perception
  - Low level control
  - High level planning and decision making
  - Multi robot systems

RoboCup-99, Stockholm, Sweden

RoboCup: Standard Platform

DARPA Urban Challenge 2007

Self-Driving Cars

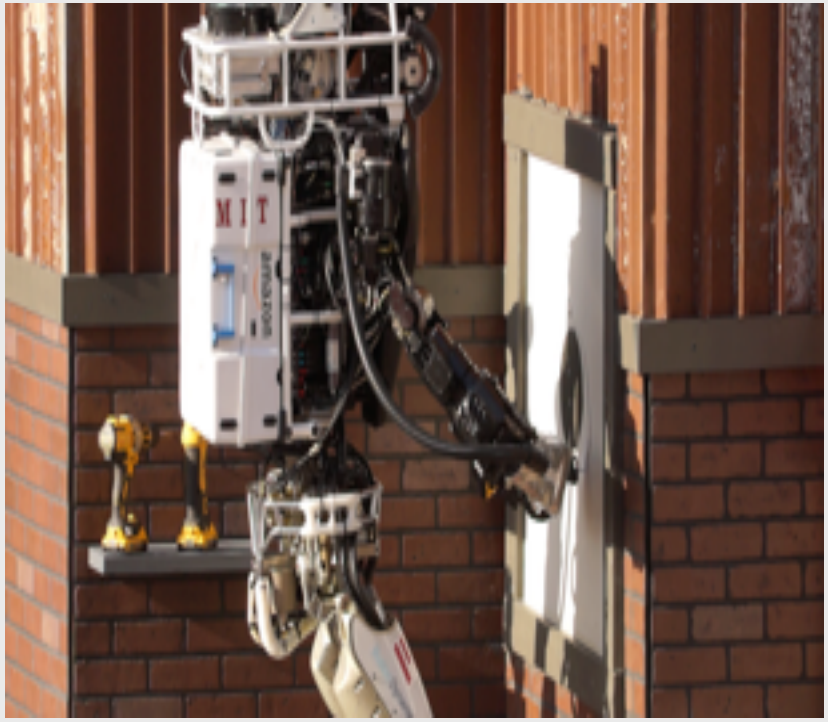
Robots in Warehouses
(Kiva@Amazon)

Amazon Prime Air

DARPA Robotics Challenge 2015

Getting out of Car

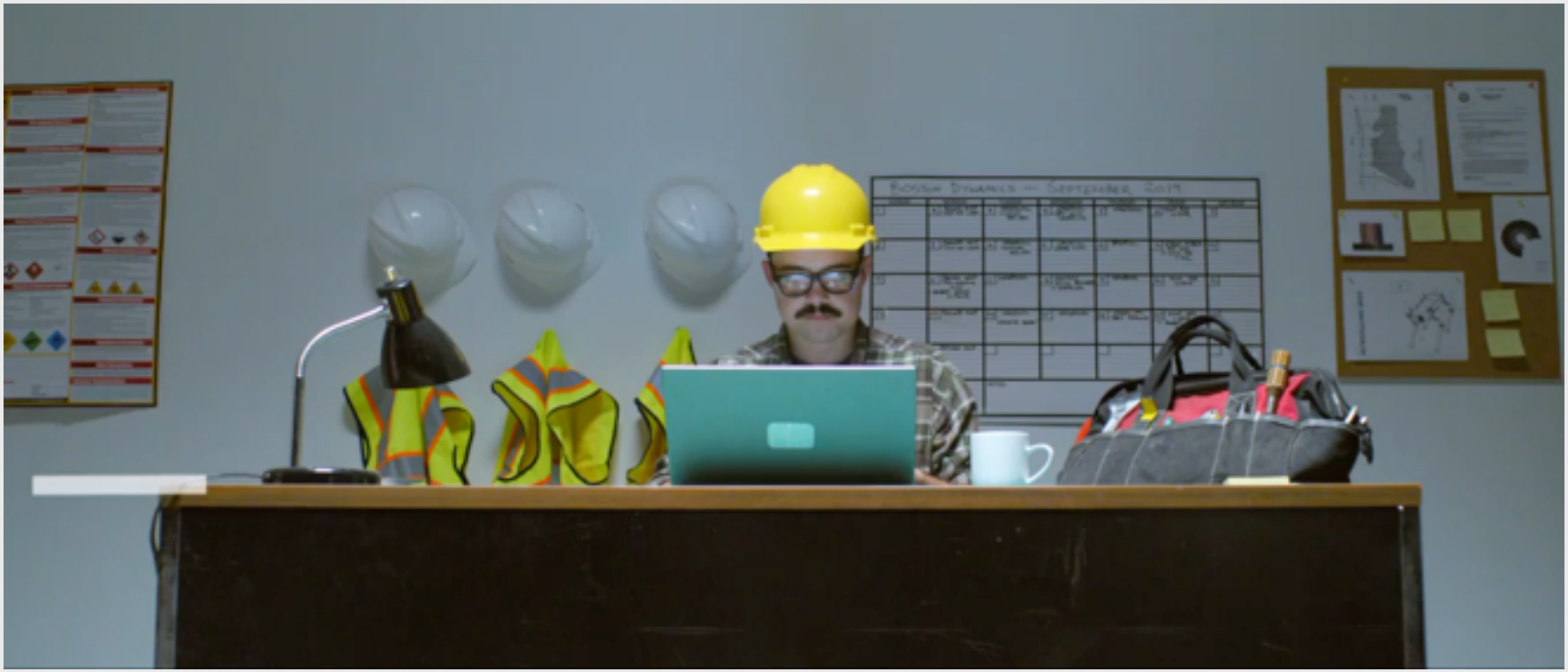
Drilling Hole



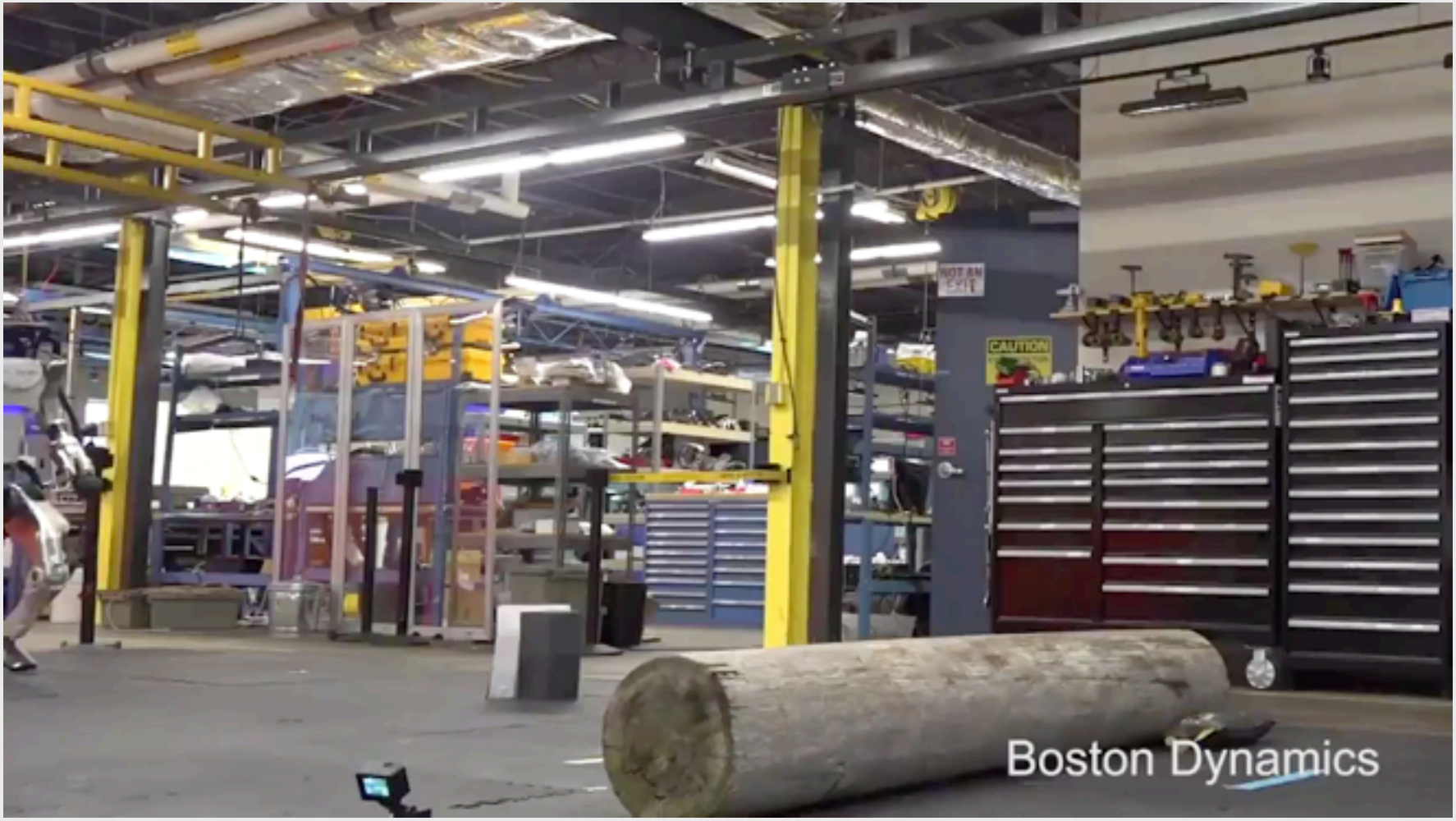
Humanoid robots

Boston Dynamics BigDog (2008)

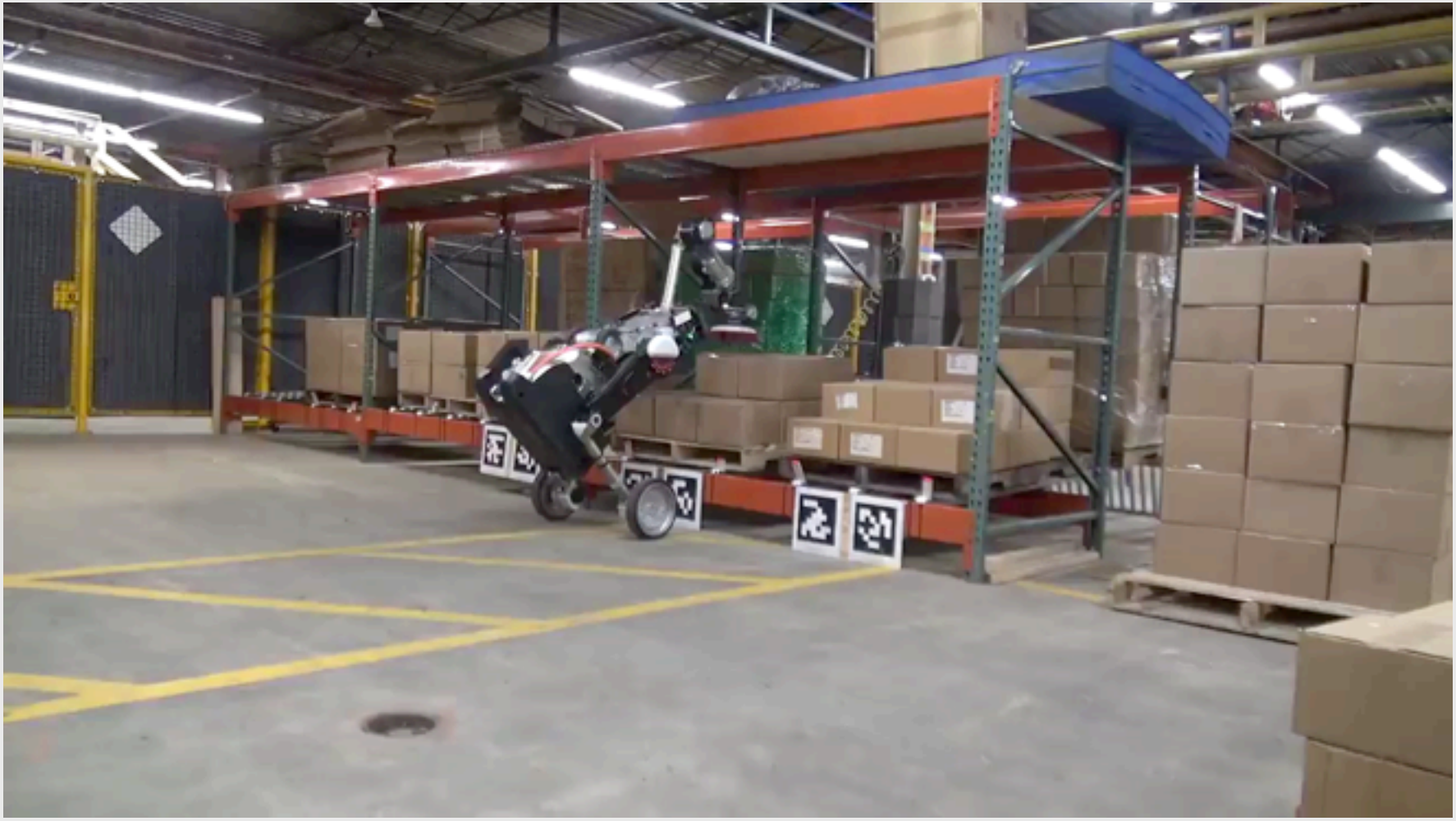
Boston Dynamics Spot



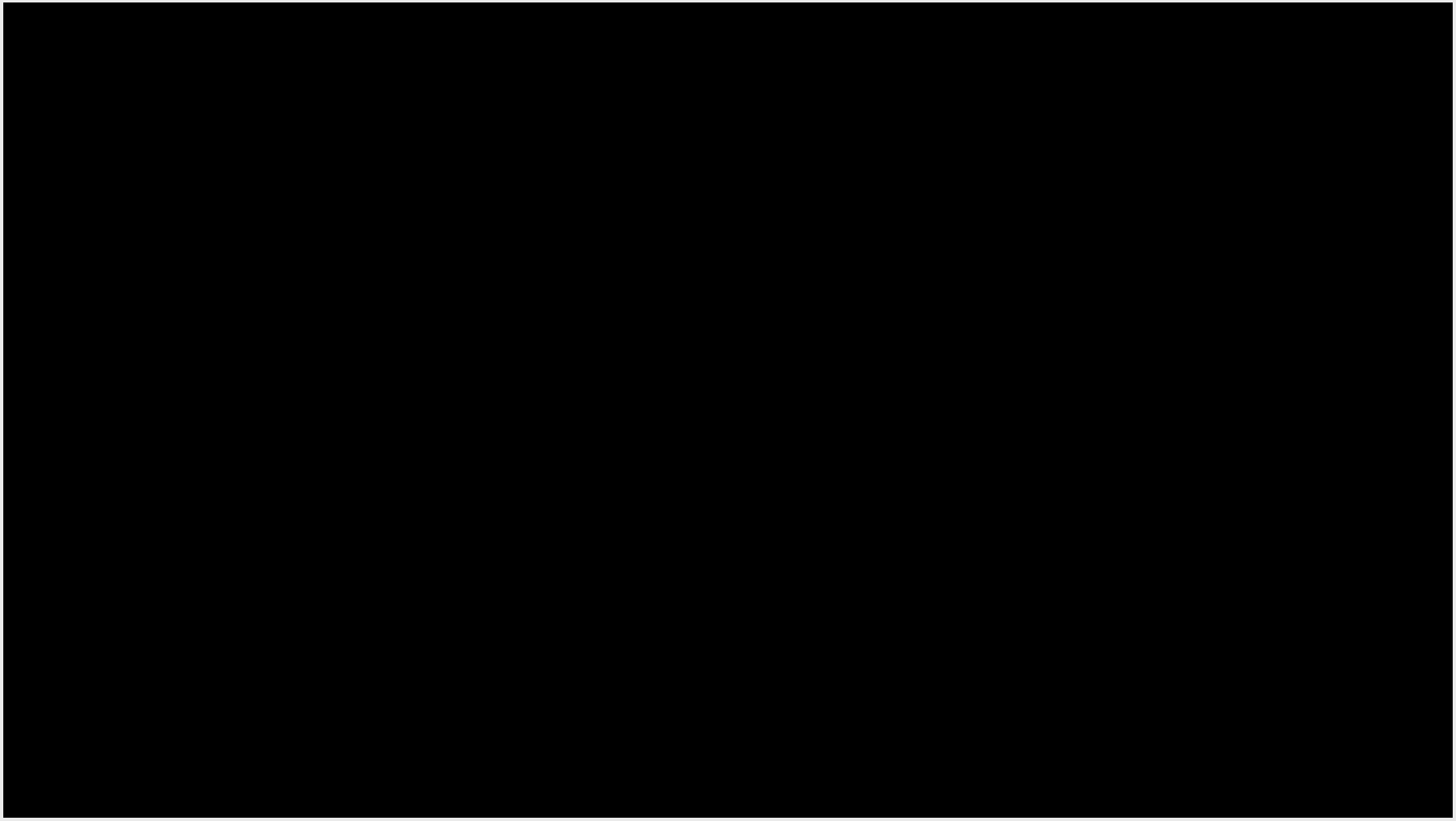
Boston Dynamics Atlas



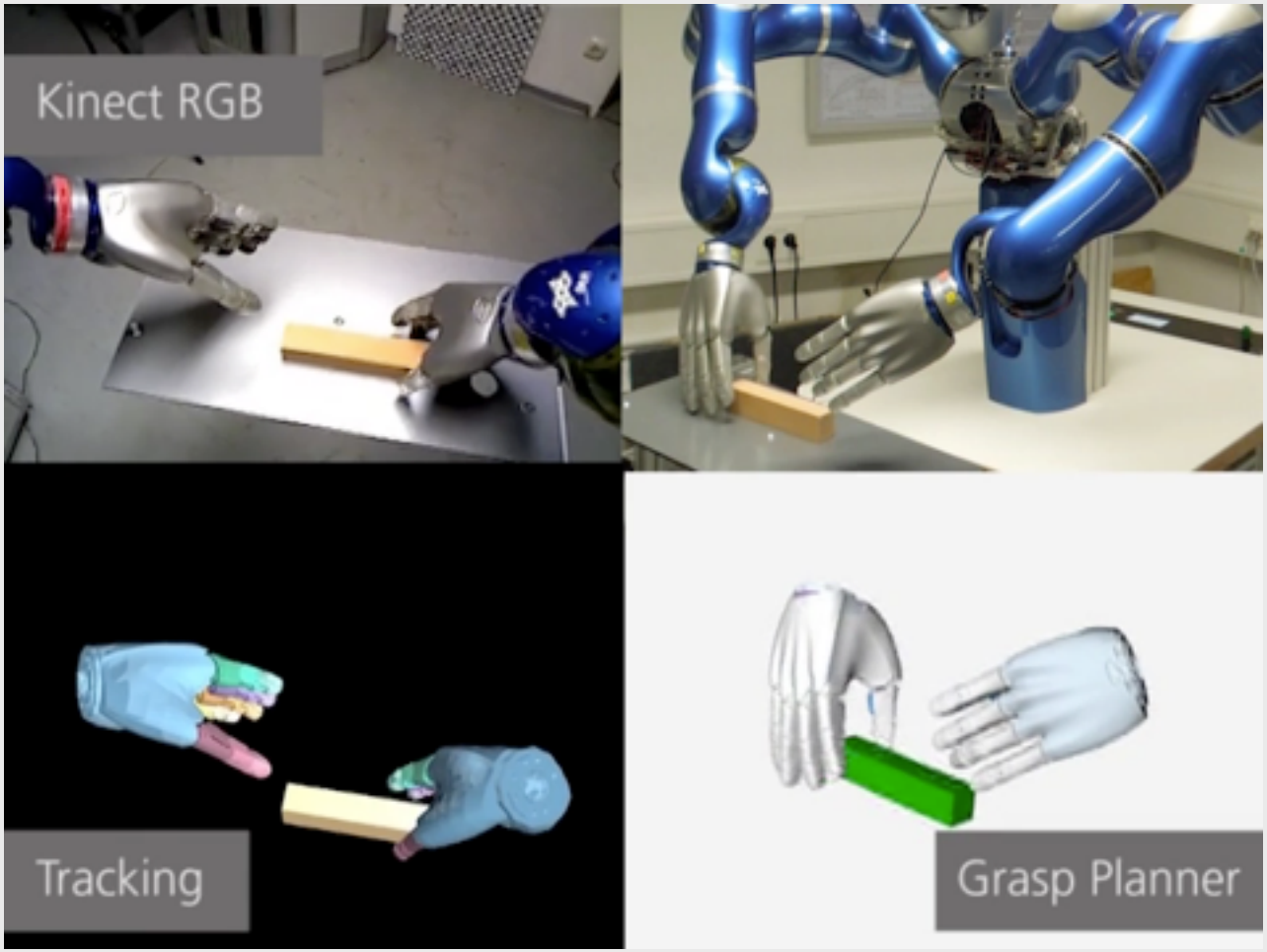
Boston Dynamics Handle



Industrial Pick and Place



Manipulation

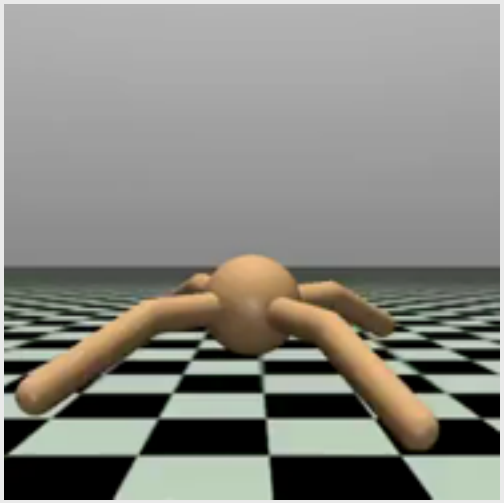


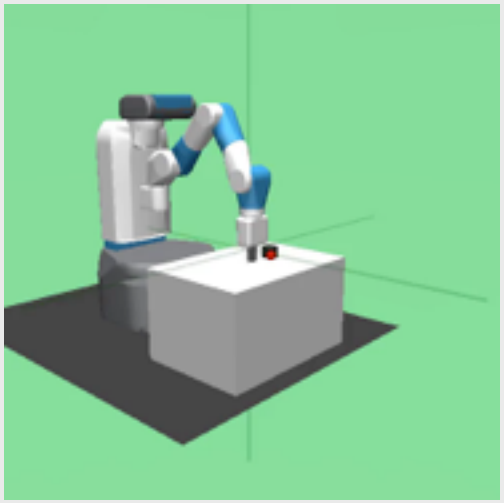
Service Robots

Dexterous Manipulation

HaptX Dataglove

Simulation





Current Trends / Topics

- Self-driving cars, sidewalk delivery robots, warehouses, manufacturing sites, …
- Drones
- Industrial pick and place
- Manipulation of everyday objects
- Complex household tasks (cooking, cleaning, …)

- Object detection, 3D mapping, tracking, interaction
- Cobots, human robot interaction
- Deep learning for perception, control, imitation learning, recognition

Goal of this course

- Provide an overview of fundamental problems / techniques in robotics
- Understanding of estimation and decision making in dynamical systems
  - Probabilistic modeling and filtering
  - Deterministic and non-deterministic planning
  - Learning for perception and modeling

Course Outline

Week	Content	HW / Project
#1	Introduction / Probabilities	
Probabilistic Models / State Estimation		
#2	Gaussian processes, Bayesian filtering	
#2	Motion and sensor models	
Filtering (localization, tracking, mapping)		
#3	Localization: grid, particle filters, EKF, UKF	
#4 / 5	Mapping: SLAM, RGBD 3D Mapping	
Planning / Control		
#6 / 7	Deterministic and sampling-based planning, exploration	
#8	Markov decision processes, inverse RL	
Deep Learning		
#9	Model learning, visual navigation	
#10	Grasping	