

L1: Introduction

Hao Su



- <https://www.youtube.com/watch?v=fn3KWM1kuAw>

Agenda

- Why this class?
- Logistics
- High-level Overview of Embodied AI

From Passive AI to Active AI

Passive AI

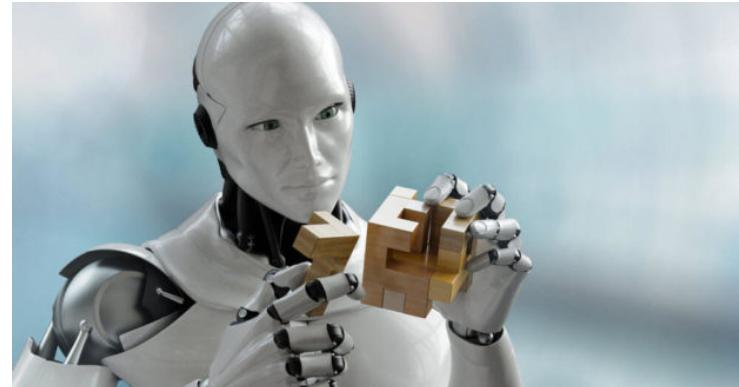


Active AI

- Human builds dataset
- Machine learns to predict labels



- Machine collects data autonomously
- Machine learns from experiences



Learning by Doing



Image source: <https://www.thesoccerstore.co.uk/blog/football-goals/best-kids-garden-football-goals/>

Learning by Doing

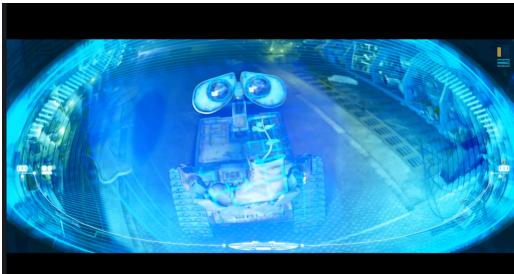
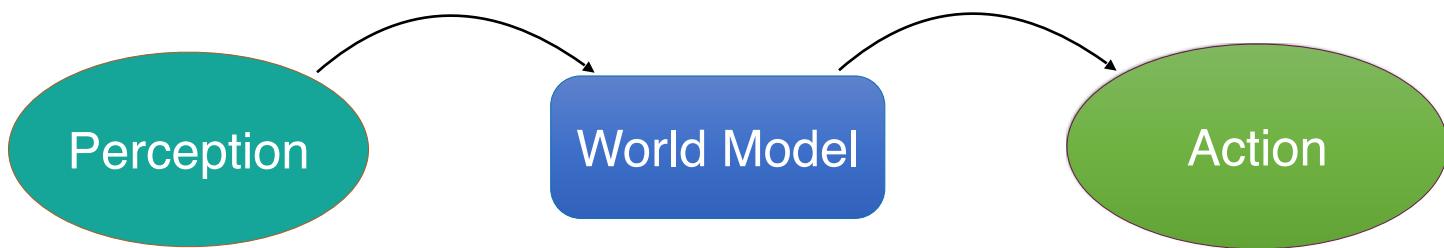


Perception, cognition, and action
are intimately coupled,
and form a closed loop.



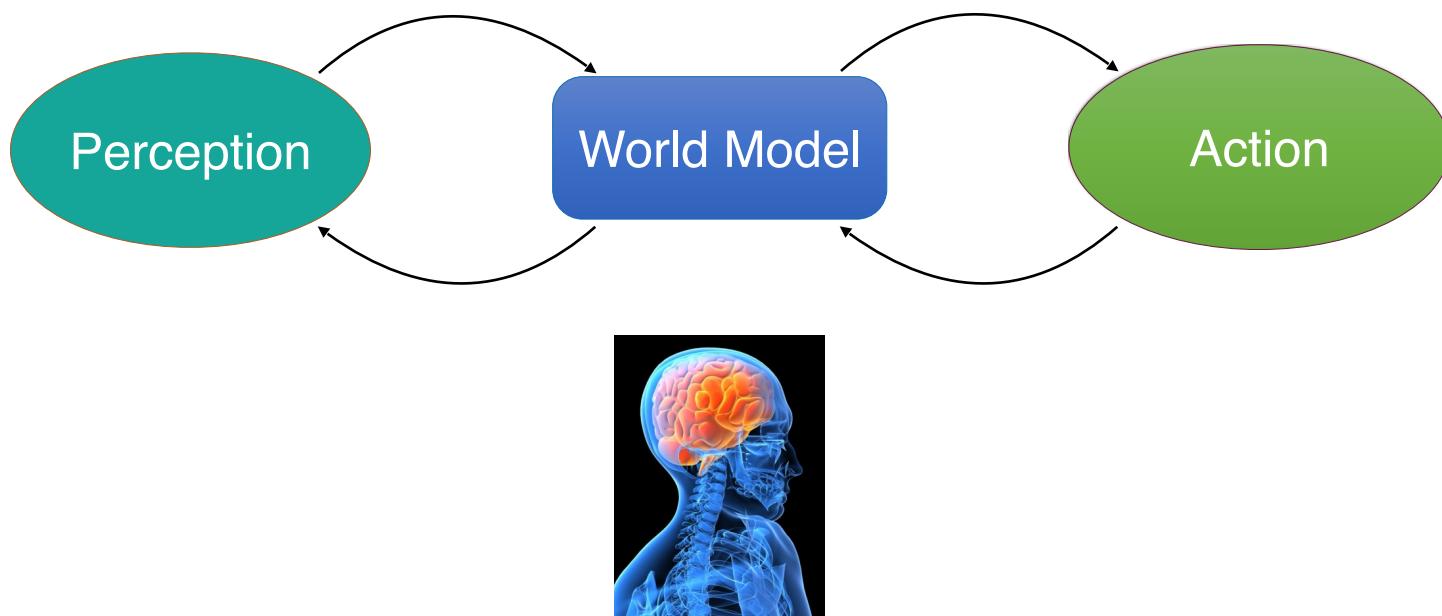
Image source: <https://www.thesoccerstore.co.uk/blog/football-goals/best-kids-garden-football-goals/>

Embodied AI: Build Agents that Live in the Physical Space



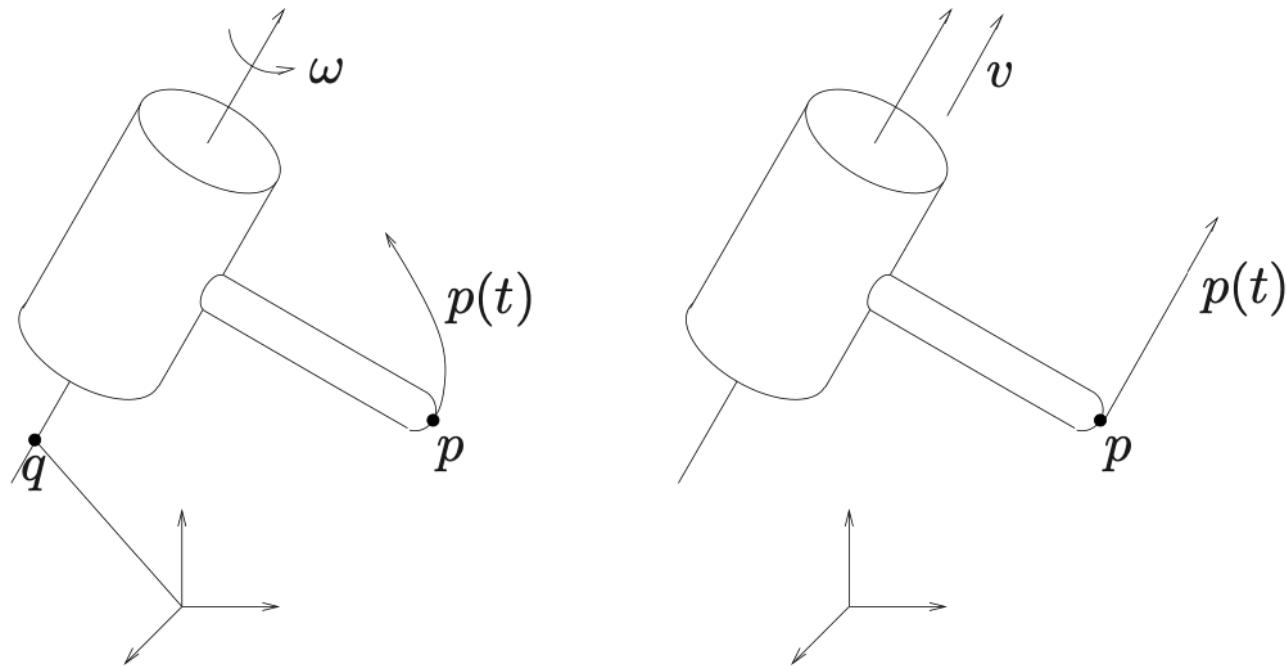
Video clips from WALL-E

Embodied AI: Build Agents that Live in the Physical Space



Topics Covered in This Course

- Modeling Robots by Rigid-Body Geometry



Topics Covered in This Course

- Deep RL Frameworks

Playing Atari with Deep Reinforcement Learning

Volodymyr Mnih Ko

Trust Region Policy Optimization

{vlad, koray, david, a

John Schulman

Sergey Levine

Philipp Moritz

Michael Jordan

Pieter Abbeel

We present the first directly from high-dimensional model is a convolutional neural network whose input is raw sensor data and rewards. We apply our model to the Mountain Car Environment, where we find that it outperforms a human expert on a task that requires planning.

Abs

We describe an iterative policies, with guarantee. By making several theoretically-justified practical algorithm, called Optimization (TRPO).

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Soft Actor-Critic: Off-Policy Maximum Entropy Deep Reinforcement Learning with a Stochastic Actor

Tuomas Haarnoja¹ Aurick Zhou¹ Pieter Abbeel¹ Sergey Levine¹

Abstract

Model-free deep reinforcement learning (RL) algorithms have been demonstrated on a range of challenging decision making and control tasks. However, these methods typically suffer from two major challenges: very high sample complexity and brittle convergence properties, which necessitate meticulous hyperparameter tuning. Both of these challenges severely limit the applicability

of these methods in real-world domains has been hampered by two major challenges. First, model-free deep RL methods are notoriously expensive in terms of their sample complexity. Even relatively simple tasks can require millions of steps of data collection, and complex behaviors with high-dimensional observations might need substantially more. Second, these methods are often brittle with respect to their hyperparameters: learning rates, exploration constants, and other settings must be set carefully for different problem settings to achieve good results. Both of these challenges

Course Logistic

Instructors

Instructor: Hao Su



TA: Zhiwei Jia



Teaching Goal

- Foundational
 - Programming problems ask you to **implement low-level modules from scratch**
- Hands-on
 - **Heavy** programming assignments to exercise what are taught in class

Pre-requisite: Technique

- **Skilled** in Linear Algebra, Multi-variable Calculus, and Deep Learning
- **Familiar** with Probability and Numerical Methods
- **Strong** programming skills
 - Familiar with Linux Toolchain
 - Familiar with python, numpy, and pytorch
- Course/project experiences in deep learning

Background Check

- On Piazza now (HW0)
 - Visible to enrolled and waitlist students
- 5 points in your final grade
- **Mandatory!** We will not grade your subsequent homeworks without seeing your HW0.
- If you are in the waitlist and intend to enroll, you need to submit HW0 by this deadline
- Due: 01/17/2023

Pre-requisite: Resources

- This course requires deep learning resources (to run reinforcement learning challenges)
- Ideally, you should have your own computing machine with the following configuration:
 - ≥ 50G disk space
 - ≥ 1 GPU for deep learning
- Google Colab can satisfy most needs

Exam Policy

- No mid-term/final exams

Projects & Assignments

- (80 pts) Course project (one big project to solve in teams)
 - To release in the 4th week
 - Biweekly report, final presentation & writeup
- Homeworks
 - Biweekly
 - (20 pts) First two homeworks (HW0 & HW1) are mandatory
 - (40 pts) Later homeworks are optional (as bonus)
- We estimate **>=15 hrs per week** (out of class) solid time commitment

Collaboration Policy

- You can form teams of at most two members for homeworks and projects can work in
- But HW0 has to be completed **independently**
- Each team submits a single copy of the solution/project paper

Course Resources

- Course website: <https://haosulab.github.io/ml-for-robotics/WI23/index.html> (Google “Hao Su” → Prof. Homepage → Teaching → this link)
 - Lecture slides
 - Office hour and location
- Piazza
 - Homework/Solution release
 - Discussions
- Homework
 - Gradescope

Office Hour

- Check course website

Questions?

Knowledge from Here

- https://docs.google.com/presentation/d/1xIxwfeEyWyqjBdbhkIH0IX3O-VosE2iHFFmEc_zF-BI/edit#slide=id.g132e6c0ce7c_22_144