CS 8803
Deep Reinforcement Learning For Intelligent Control

Sehoon Ha
with Jie Tan at Google

Statement

- The goal of this class is to understand the basics of deep reinforcement learning and conduct the preliminary research.

Brainstorming

- How would you teach a dog to do a trick?

Brainstorming

- How would you a teach a robot to do a useful trick?

Deep Reinforcement Learning

- “Deep reinforcement learning (deep RL) is a subfield of machine learning that combines reinforcement learning (RL) and deep learning. RL considers the problem of a computational agent learning to make decisions by trial and error. Deep RL incorporates deep learning into the solution, allowing agents to make decisions from unstructured input data without manual engineering of the state space.” - Wikipedia.

Sehoon Ha

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Research Scientist at Google

2010~2015
Graduate Student
@ Georgia Tech

2015~2018
Research Scientist
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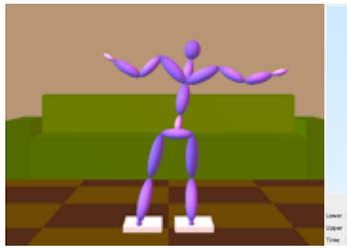



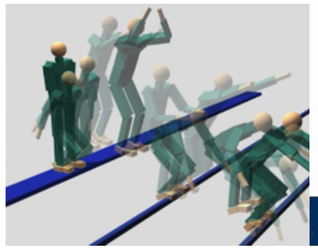
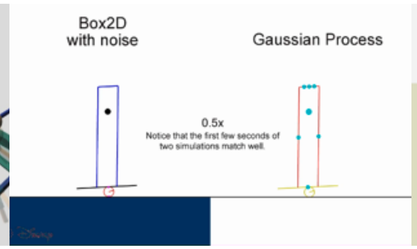

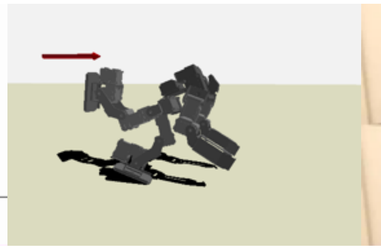
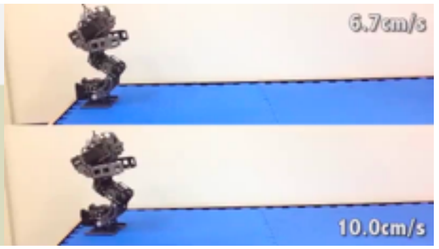


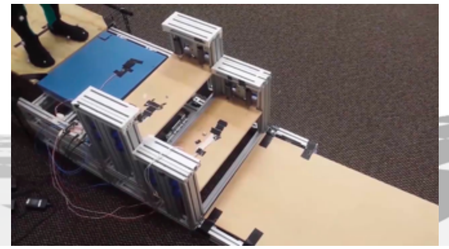
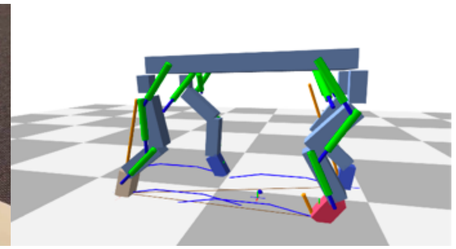
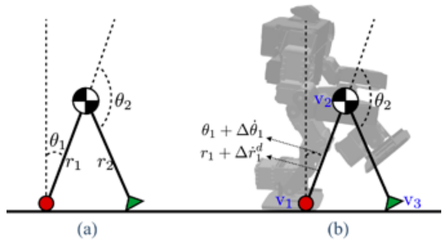


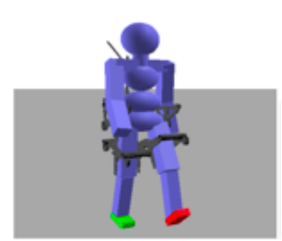
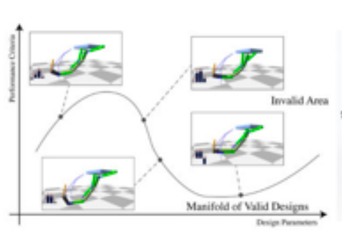

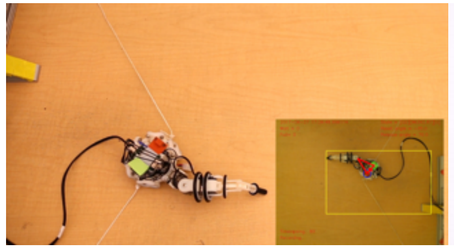
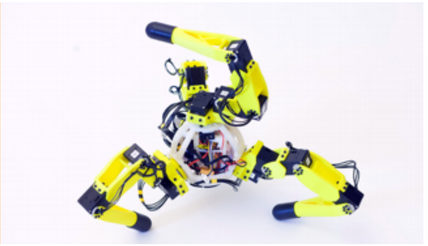
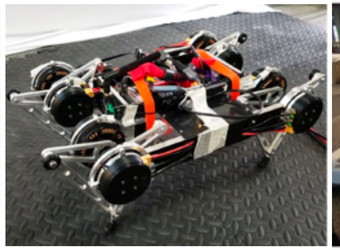
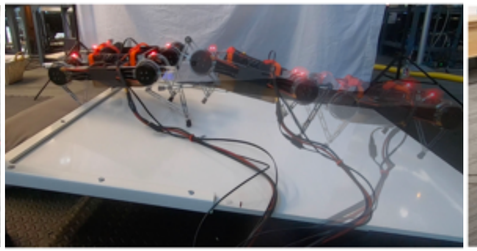
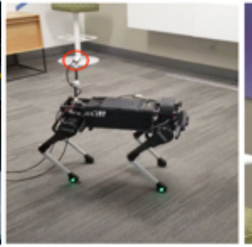
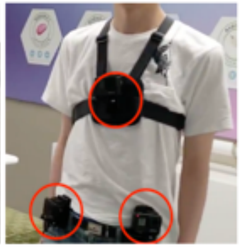

Jie Tan

Staff Research Scientist at Google
Tech-lead of the Locomotion team

2009~2015
Graduate Student
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20015~2016
Member of Technical Staff
@ Lytro

2016~
Research Scientist
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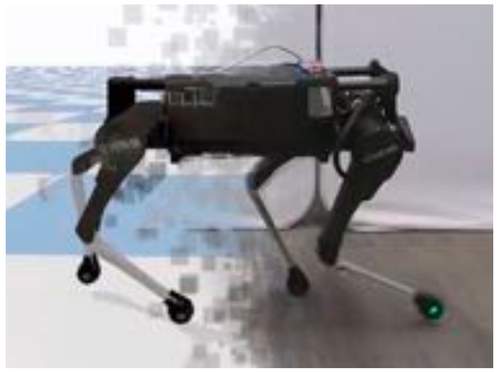
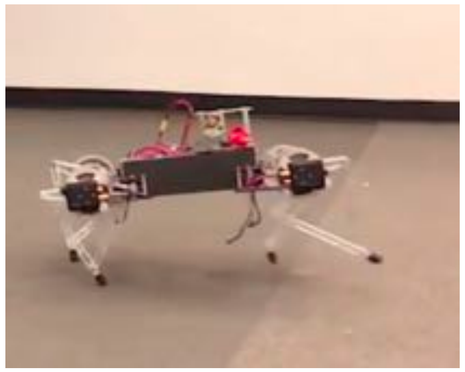
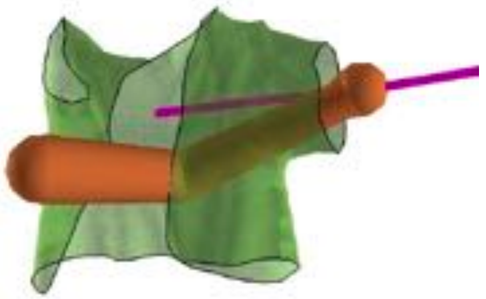
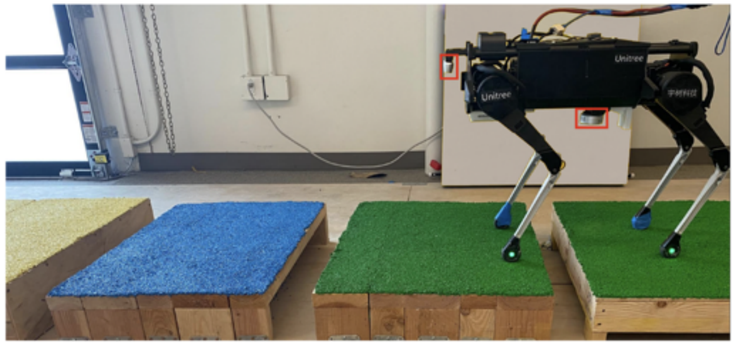
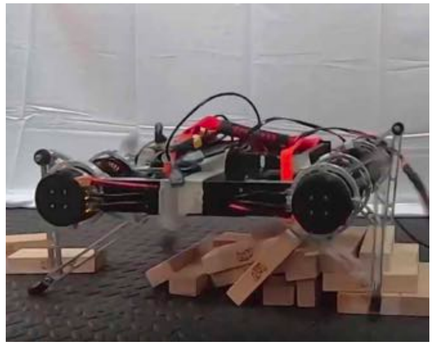






Teaching Assistant

Ren Liu

Office Hours

- Office hours will be announced soon.
- There will be a sign-up sheet with 10-min time slots.

Administrations

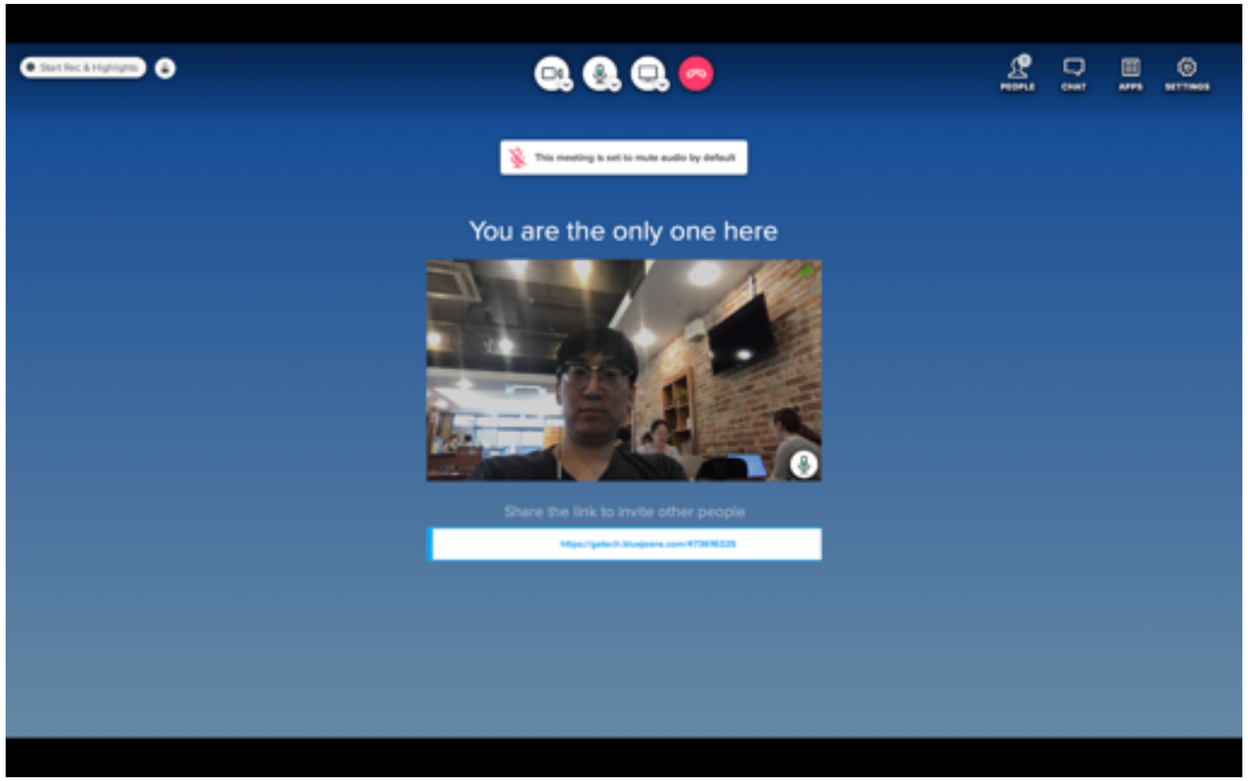
- Canvas: syllabus, lecture slides, additional reading materials, project instructions, grades can all be found on Canvas.
- Piazza: Q&A and discussions led by students.
  - The sign up link will be accessible from Canvas.

Hybrid teaching

- The lecture can be attended in both in-person/live streaming.
- Discussion is important in this class: NO video recording by default.
- Please let the instructors know if you need accommodation.

Bluejeans

- All lectures and office hours will happen at Bluejeans.
  - The link is accessible from the Bluejeans tab at Canvas.



Prerequisites

- No explicit prerequisite courses, but…
  - You need a good understanding of deep learning and statistics.
  - Can be synergetic with robotics and control backgrounds.
  - Strong math and programming skills are required.
  - Consult with the instructors if you are not sure.

Textbooks

- No official text books.
- Many lectures and tutorials out there, such as Berkeley CS 285, Open AI Gym and Spinning Up, DeepMind Tutorial at ICML, and so on.
- We will read a lot of papers.

Statement

- The goal of this class is to understand the basics of deep reinforcement learning and conduct the preliminary research.

You will learn how to…

- Formulate your control problem for deep reinforcement learning.
- A lot of learning algorithms.
- Various techniques for better performance.

Keywords

- off-policy RL, on-policy RL, model-based RL, imitation learning, sim-to-real, curriculum learning, safety-aware RL, scalable RL, and their applications.

Components

- The class consists of the three main components.
  - Lecture: give you a brief overview of new concepts.
  - Paper presentation: each student presents a paper to the class.
  - Term project: develop a research project throughout the semester.

Grading

- Term project: 60% = Proposal 20% + Midterm 20% + Final 20%
- Paper Presentation: 30%
- Class participation: 10%

Lecture

- The lecture will be given by Sehoon, Jie, or a guest lecturer.
  - Give you an overview of new concepts.
  - Roughly, one lecture per week.
  - Special lecture of “how to write a robotics paper”.

Paper Presentation

- Each lecture will be followed by a few student paper presentations.
  - Two presentations per lecture (12 min presentation + 10 min discussion)
  - The schedule will be posted at the end of the first week: please sign up.
  - The presenter should prepare 2~3 pop-up quizzes for engagement.

Term Project

Warning: This class can be time-demanding!

- We wi project through the semester.
- Implement the easy base mall idea on top of it.
- Conclude with a four-page paper.
- A couple of best papers might be extended to six pages for

Term Project

- Example Projects:
  - Implement a control problem in your own domain, apply DRL.
  - Implement a baseline paper, and improve it a bit.

Example

- Finite State Machine Policies Modulating Trajectory Generator (Ren Liu, Nitish Sontakke, Sehoon Ha)

Term Project

- Teams:
  - Basically, two persons per team. Exception can be made with approvals.
  - We will have a team matching period on the piazza.

Term Project

- Expected Schedule:
  - ~ Week 4: Research proposal
  - ~ Week 10: Midterm report (2 pages) and presentation
  - ~ Week 16: Final report (4 pages) and presentation

Attendance

- Time to time, TA will check the attendance.
  - Expected it to be once a week- not regular.
  - In-person students: attendance check sheets.
  - Remote students: Bluejeans names.

Attendance

- The estimated number of attendance check = 10
  - The attendance score = 100 - 10 * {# number of missing classes} + α
  - α will be able to obtained from the special session (TBD).

Questions?