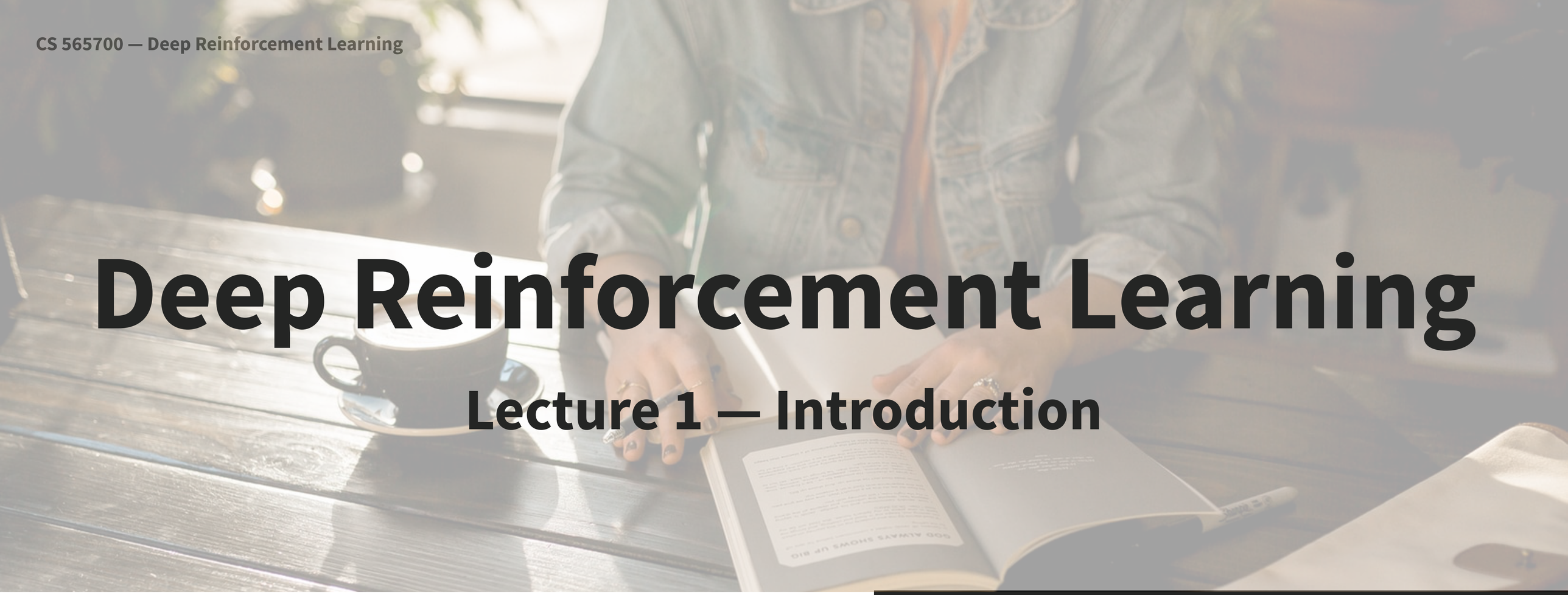


Deep Reinforcement Learning

Lecture 1 — Introduction

國立清華大學
NATIONAL TSING HUA UNIVERSITY

National Tsing Hua University
Department of Computer Science

Prof. Chun-Yi Lee

Outline

- Class information
- What is artificial intelligence (AI)
- What is reinforcement learning
- What reinforcement learning can do
- What we can learn from the Course

Class Information

- **Lecture Hours** : 9:00-12:00 (Every Tuesdays)
- **Location**: Delta 104
- **Course TA's** : 孫偉芳，林士軒，陳澔威，江柏翰，楊炫恭
- **Course Web.** : NTHU iLMS
- **Reference Material** :
  - Reinforcement Learning : An Introduction (2018) (By R. S. Sutton and A. G. Barto),
  - Websites :
    - David Silver (Link)
    - Sergey Levine (Link)
- **Requirements** :
  - Fundamental backgrounds in machine learning (ML) and deep learning (DL)
  - Fundamental backgrounds in Python programming
  - Proficiency in Tensorflow/Pytorch/other DL frameworks
  - Your own computer equipped with NVIDIA GPUs

Class Information

- **Grading Policy**
  - Assignments (70%)
    - Everyone has to submit his/her own homework
  - Final project and presentation (30%)
    - Please form groups of one to two people
- **Submission Policy**
  - You have two days to be used for “late submissions”
  - No copy or cheating, otherwise you will get zero points
- **Exception:** You will get a few bonus points if you satisfies the following conditions
  - You have a full paper on DRL accepted by ICML, CVPR, ICCV/ECCV, or IROS
  - You have a very cool full paper submitted to NeurIPS 2021 together with us!

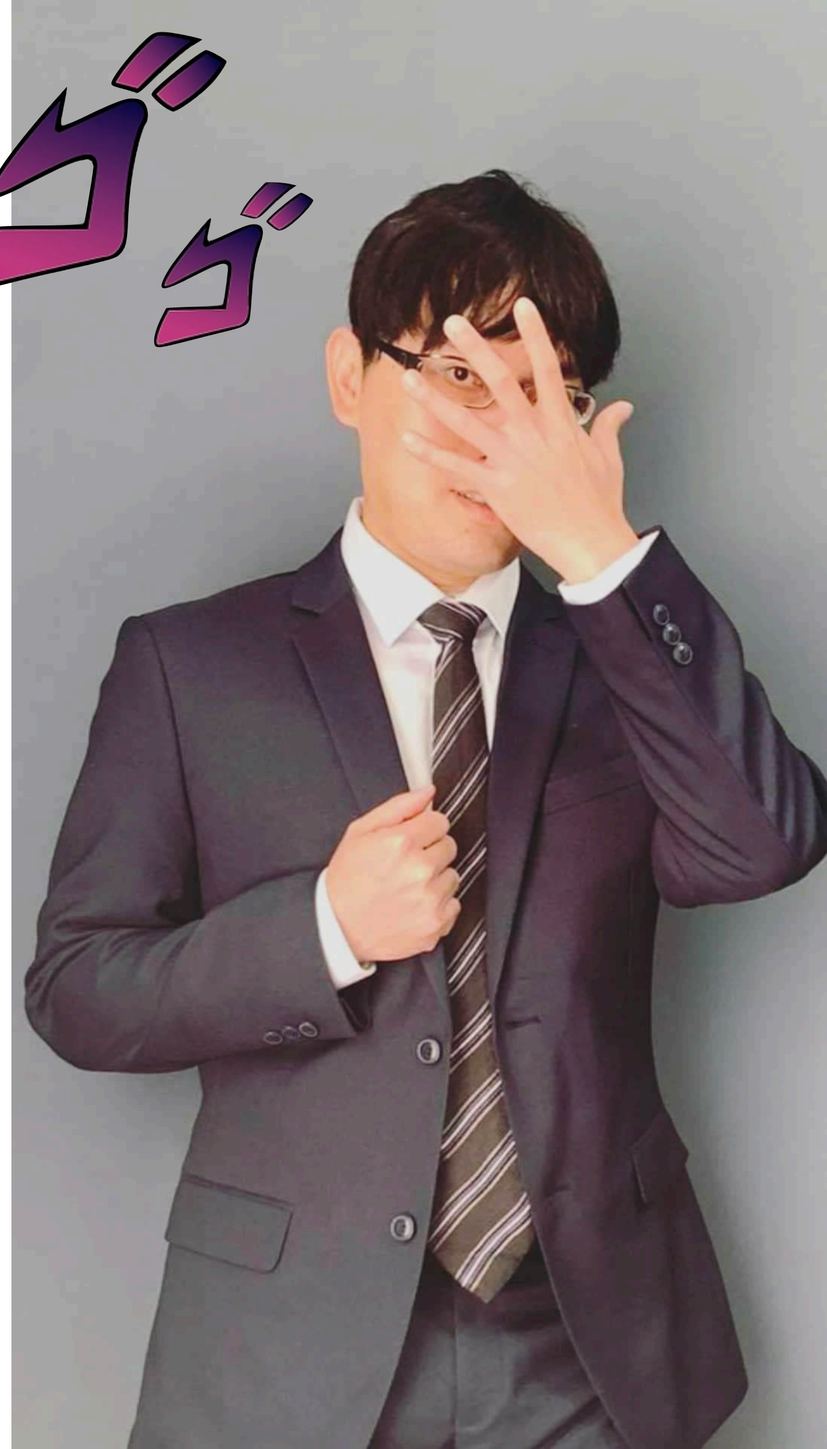
Final Project Specification

- **Scope**
  - Any topics related to DRL. The topic should not be any existing work
  - DRL has to be the primary focus of your project, not CV, NLP, or other subjects
- **Breakdown**
  - Final project proposal (5%) — due on 5/18/2021, 23:59 PM
  - Report written in NeurIPS template (50%) — due on 6/15/2021, 23:59 PM
  - 10 minutes presentation (30%) — 6/15 in class
  - Review comments for at most 5 other teams (15%) — due on 6/22/2021, 23:59 PM
- **Submission format:**
  - The final report has to be submitted in NeurIPS 2021 template, in English
  - 4~8 pages, using LaTeX (LaTeX source files should be submitted)
  - Clearly specify your motivation, novelty, and main contributions
  - The source codes. The results should be reproducible
    - Following this: https://github.com/paperswithcode/releasing-research-code

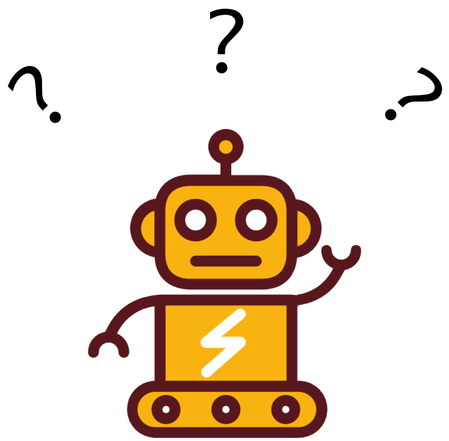
Your Instructor

- Prof. Chun-Yi Lee (李濬屹)
- cylee@cs.nthu.edu.tw

- Office: Delta Building R606
- Office Hours :
  - Appointments by email

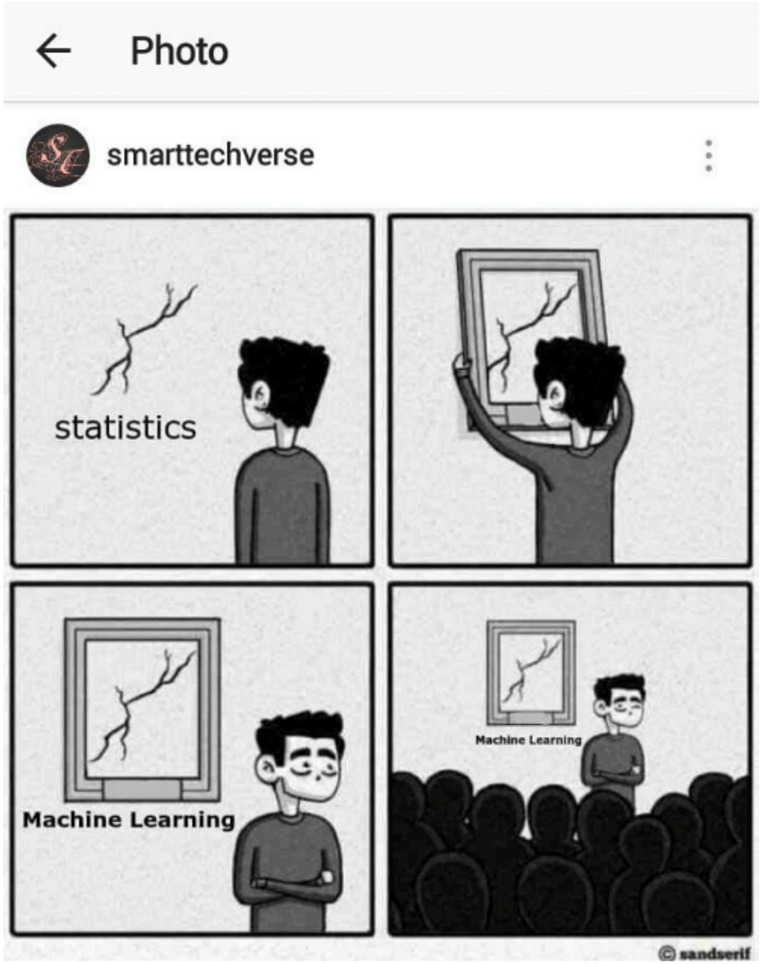


What is artificial intelligence (AI)?



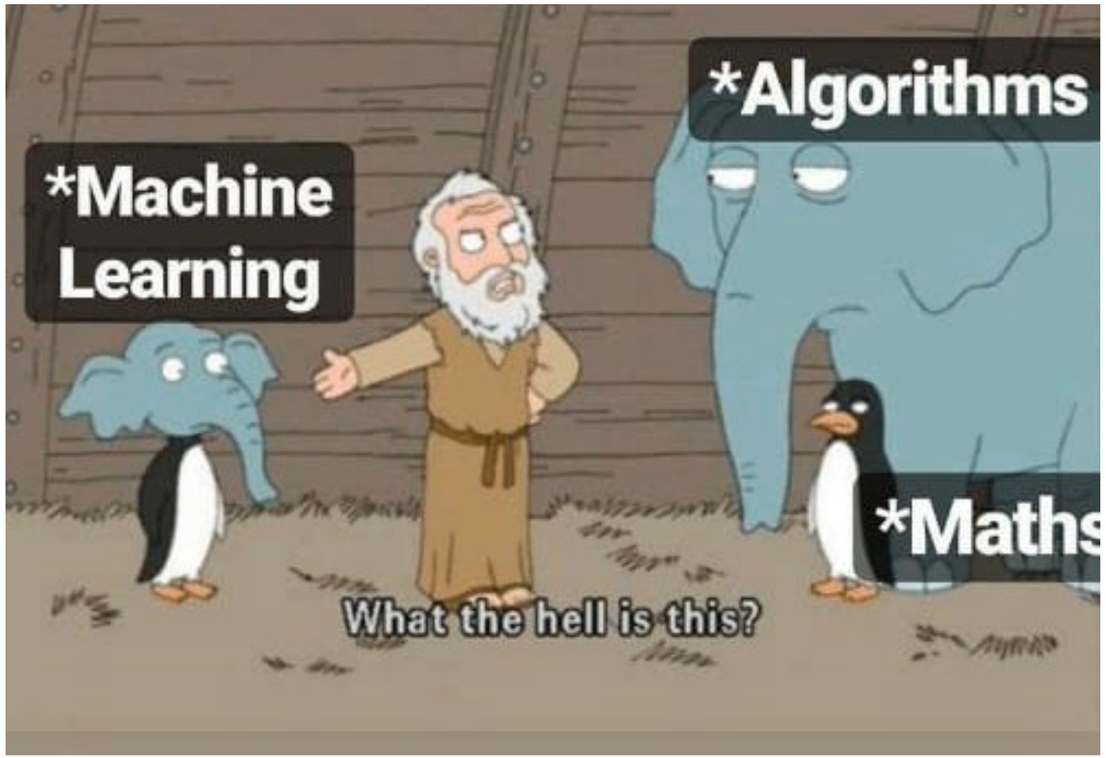
What is Artificial Intelligence

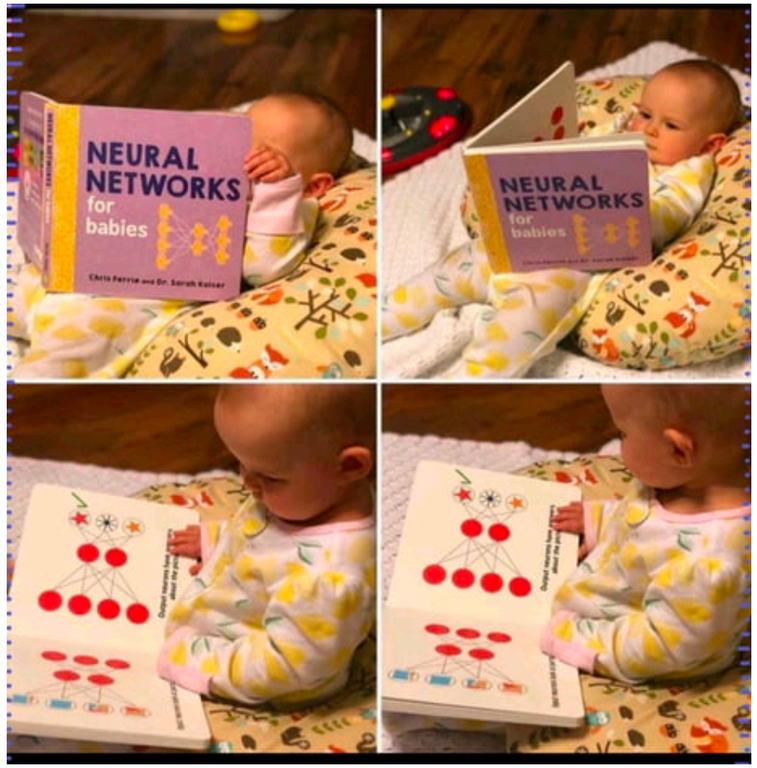
Me wondering why my AI is classifying my cat as a dog

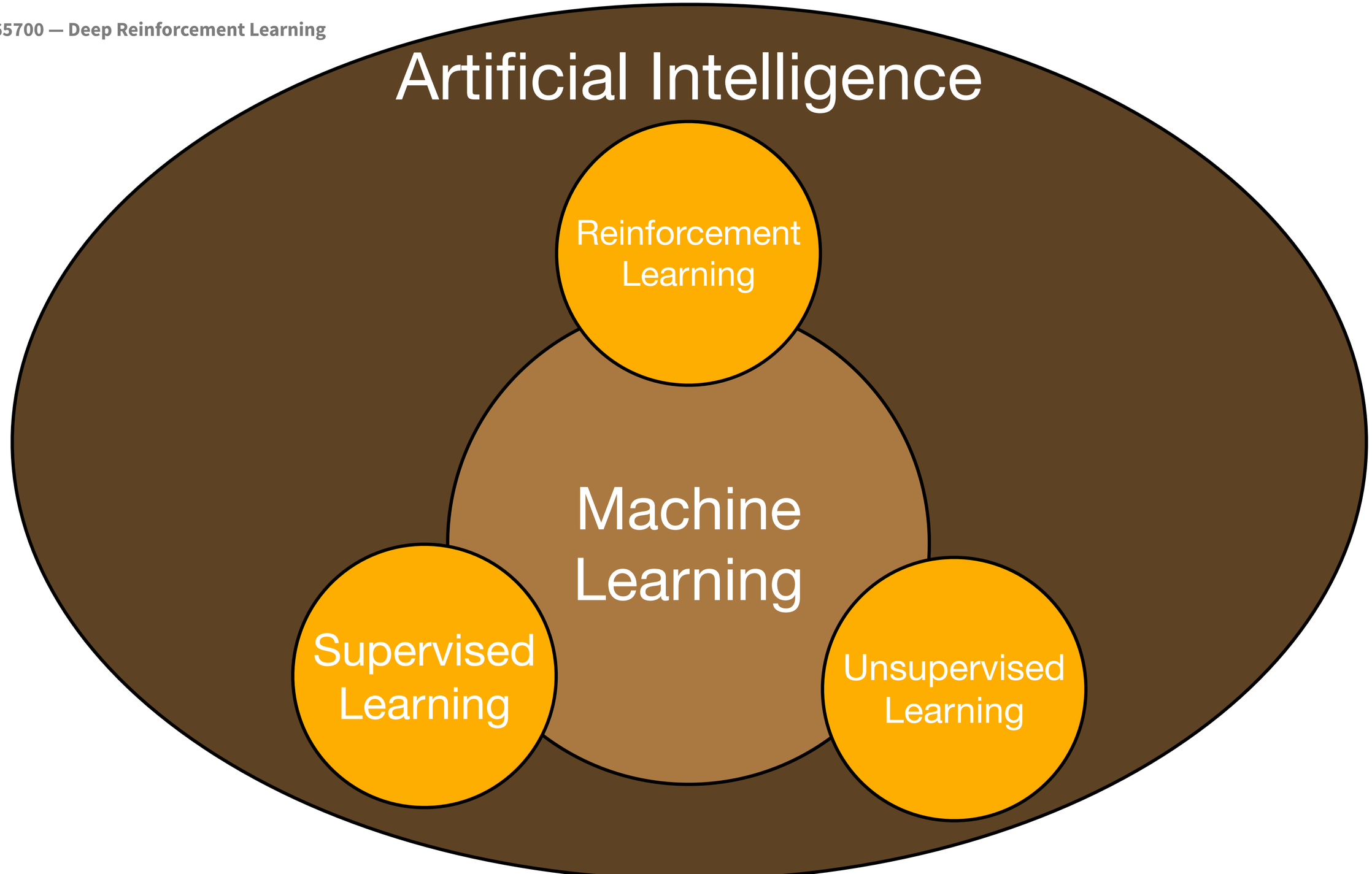


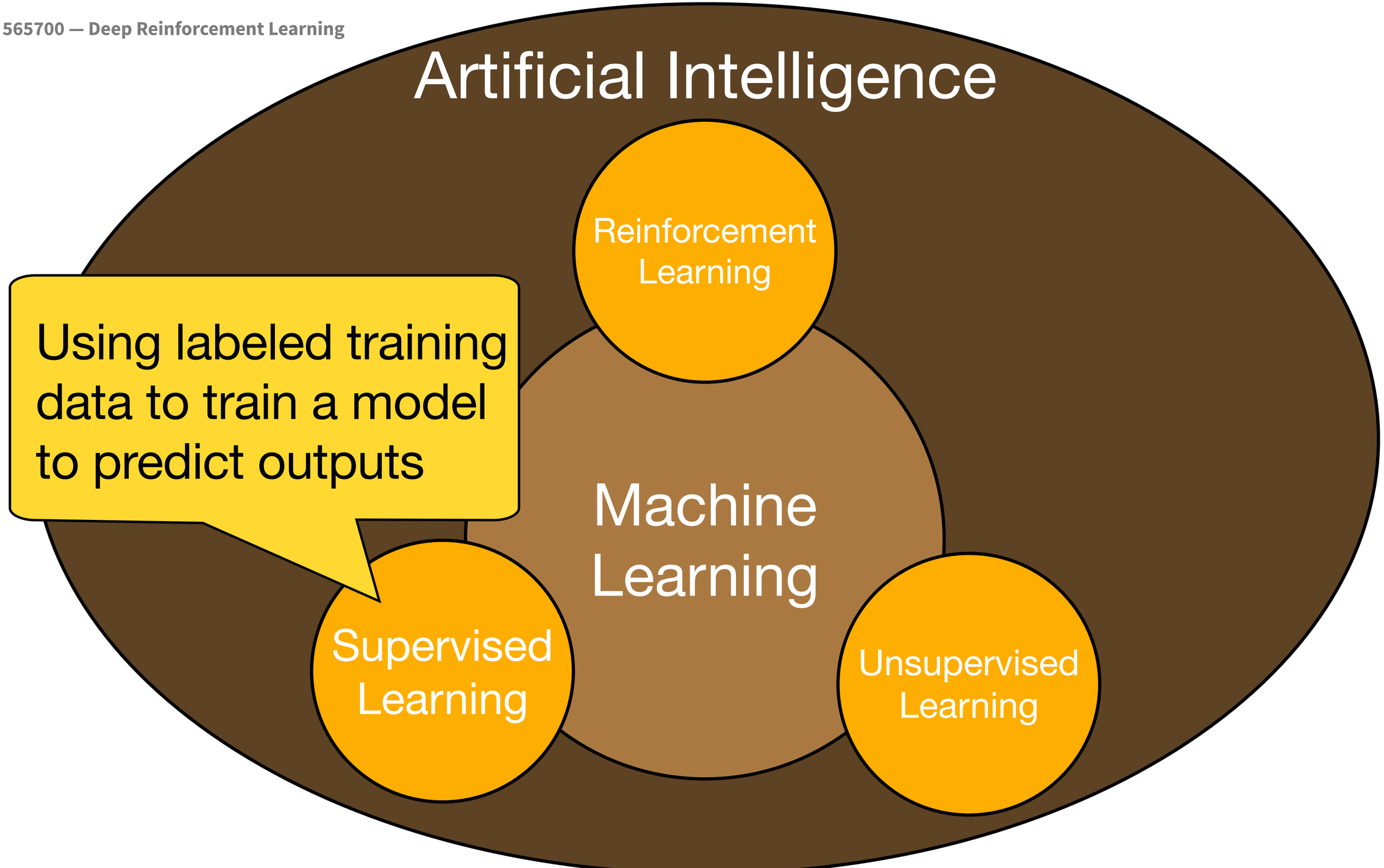
Machine Learning?

What is Artificial Intelligence

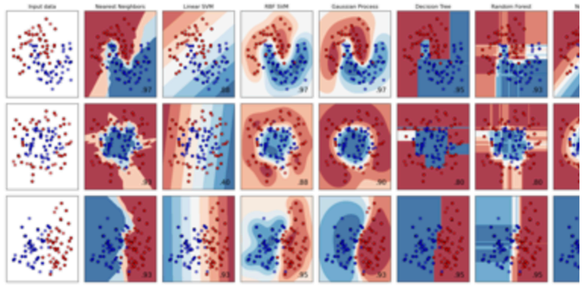


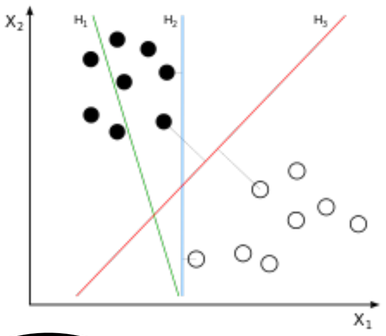



Artificial Intelligence
Reinforcement Learning
Machine Learning
Supervised Learning
Unsupervised Learning


Artificial Intelligence
Reinforcement Learning
Using labeled training data to train a model to predict outputs
Machine Learning
Supervised Learning
Unsupervised Learning

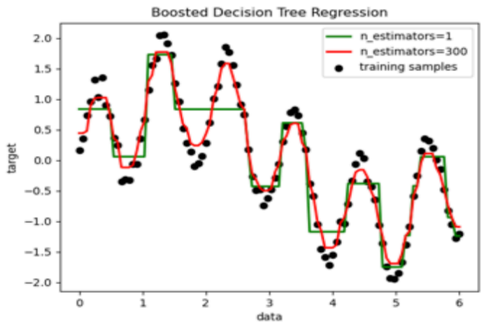
Using labeled training data to train a model to predict outputs

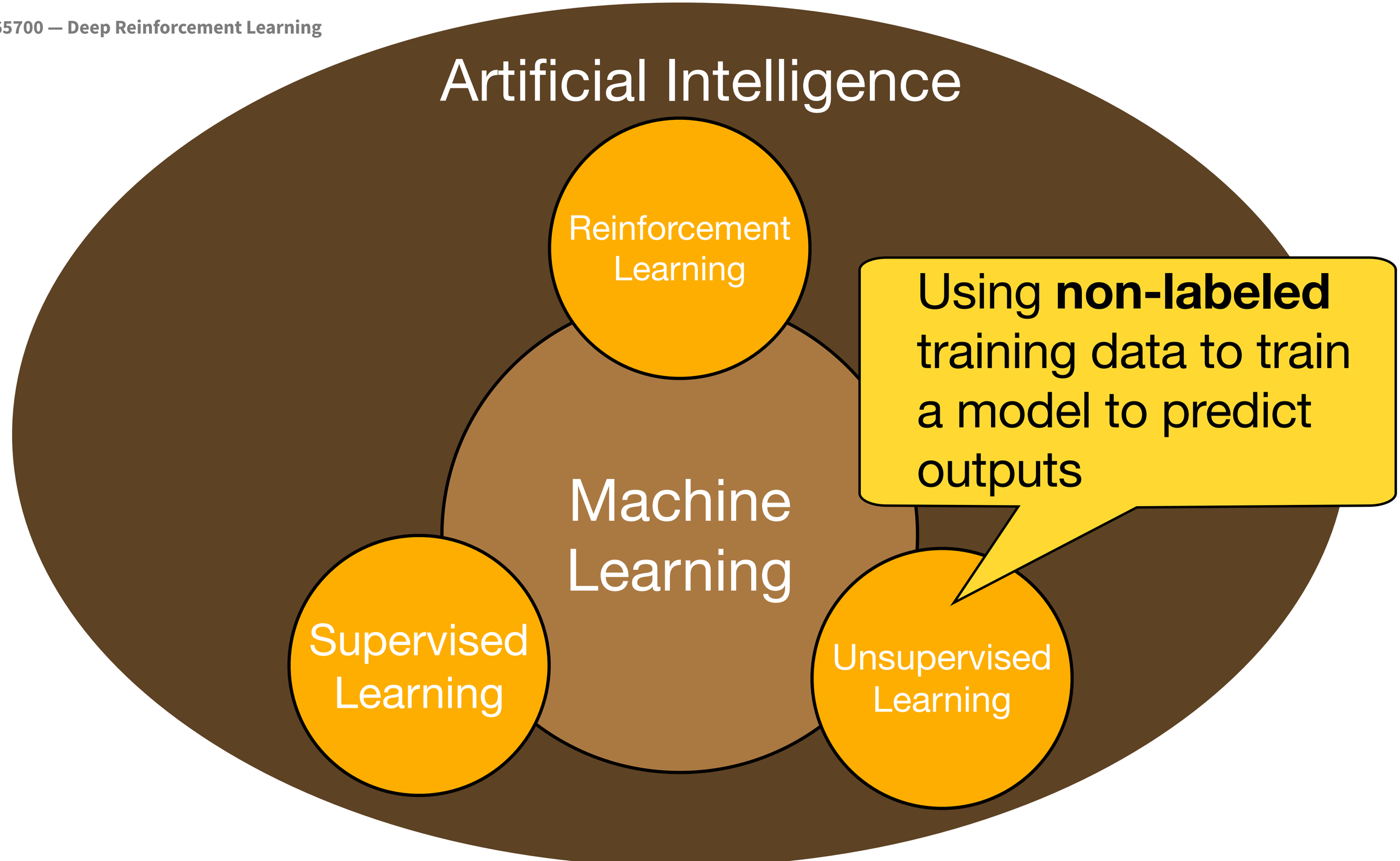




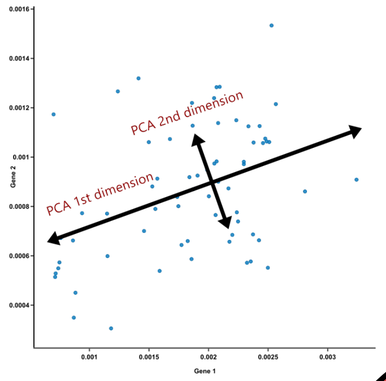
Supervised Learning

- Classification
- SVM
- Regression
- Decision Tree



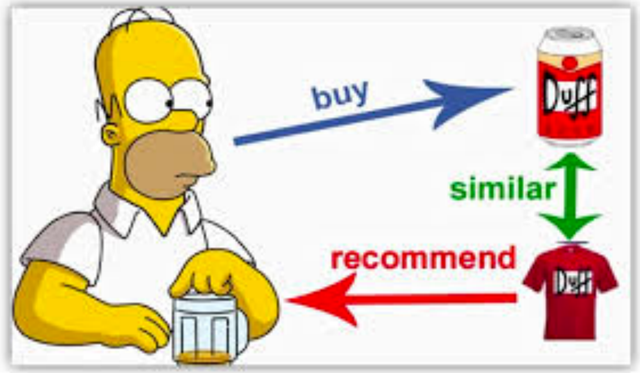

Artificial Intelligence
Reinforcement Learning
Machine Learning
Supervised Learning
Unsupervised Learning
Using **non-labeled** training data to train a model to predict outputs

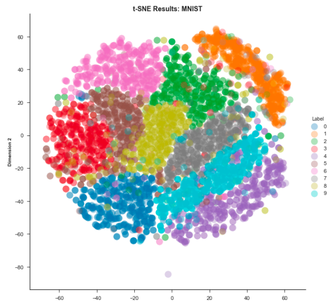
Using **non-labeled** training data to train a model to predict outputs

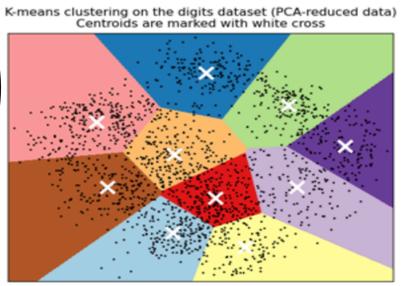


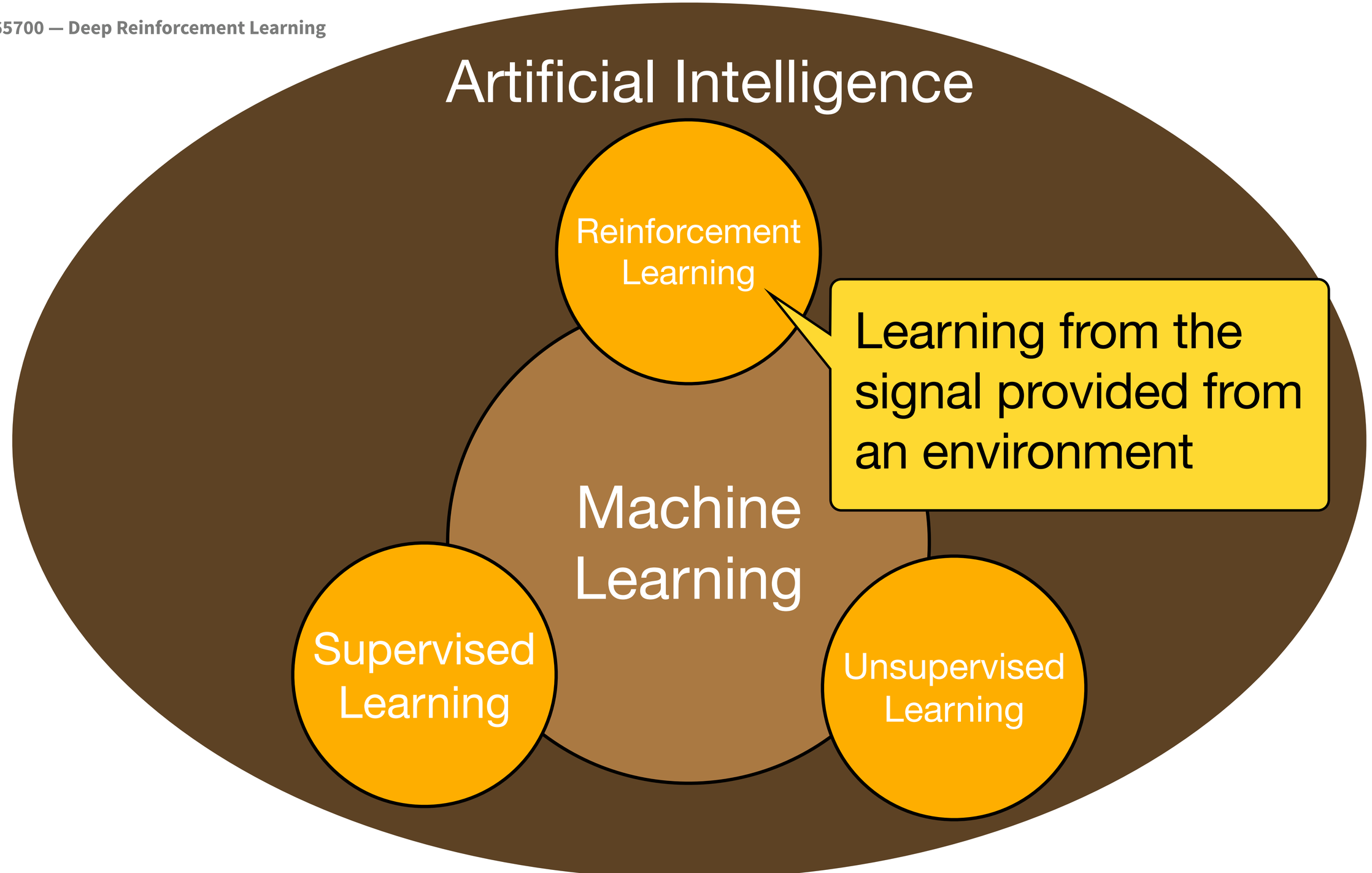
Unsupervised Learning

- Dimensionally Reduction
- Recommended Systems
- t-SNE
- Clustering

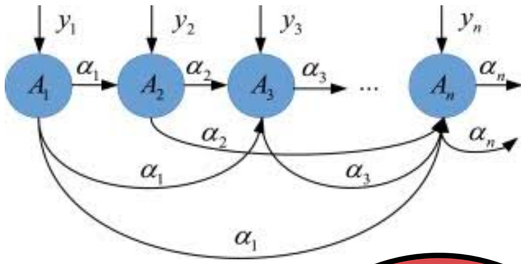







Artificial Intelligence
Reinforcement Learning
Learning from the signal provided from an environment
Machine Learning
Supervised Learning
Unsupervised Learning

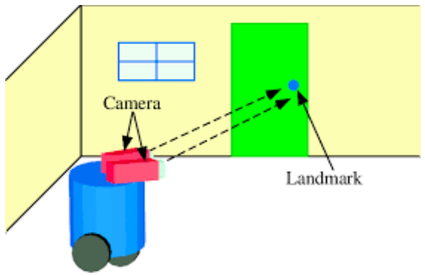
Learning from the signal provided from an environment



Reinforcement Learning

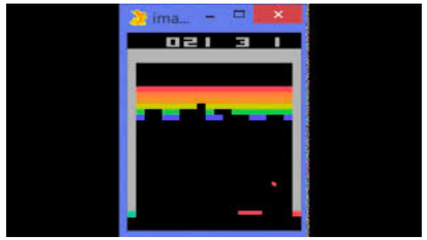
Sequential Decision

Self-driving Car



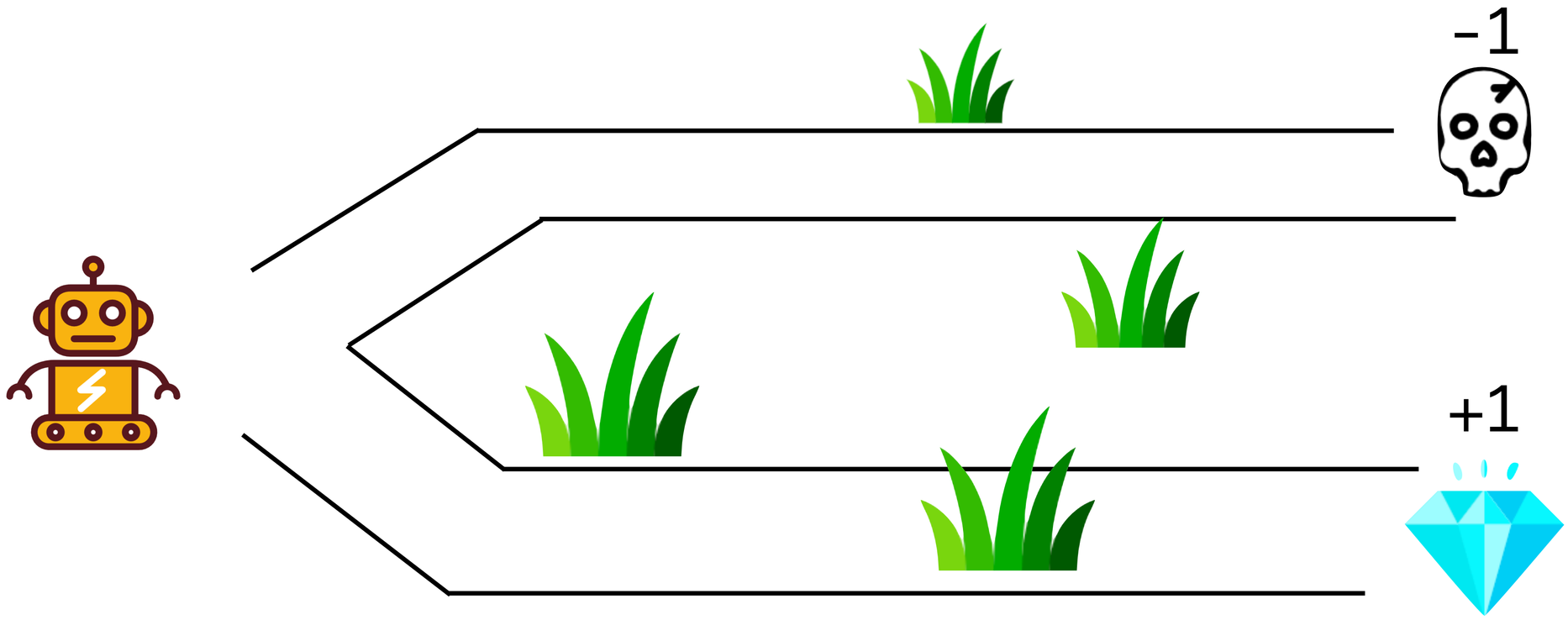
Robot Navigation

Game Playing



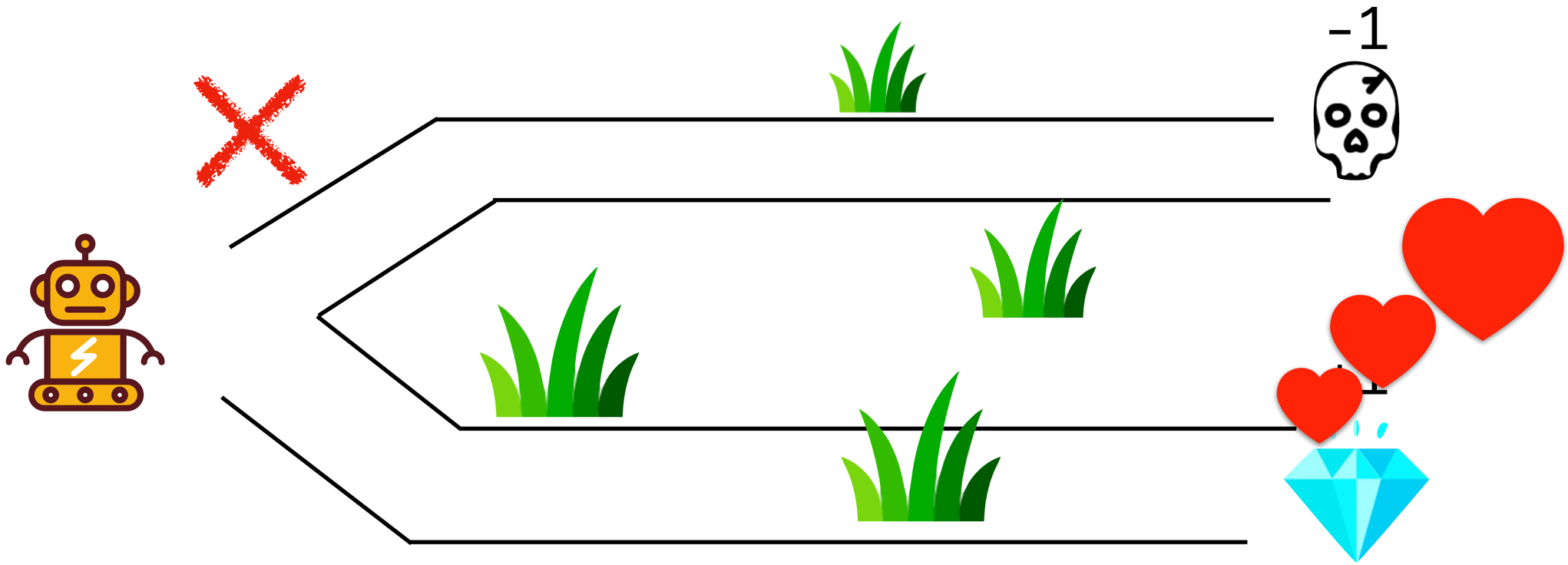
What is Reinforcement Learning

Example



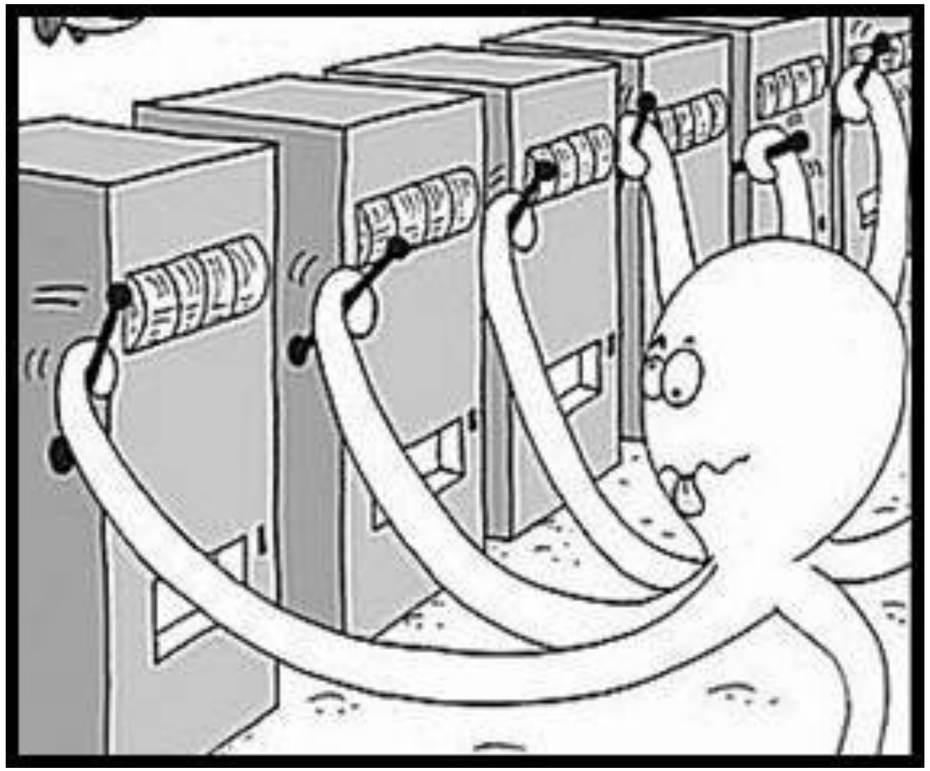
What is Reinforcement Learning

Example



Multi-Armed Bandit

Example



- N Different Machines
- Different machines have different winning probabilities
- Find the best Machine by **Trial-and-Error**
- **Exploration / Exploitation**

What RL Differs from the Other Subjects

- Only **reward signals** are available
- Feedback is delayed
- Data collected by the agents themselves (most cases)
- Data samples are **non-i.i.d (independent and identically distributed)**

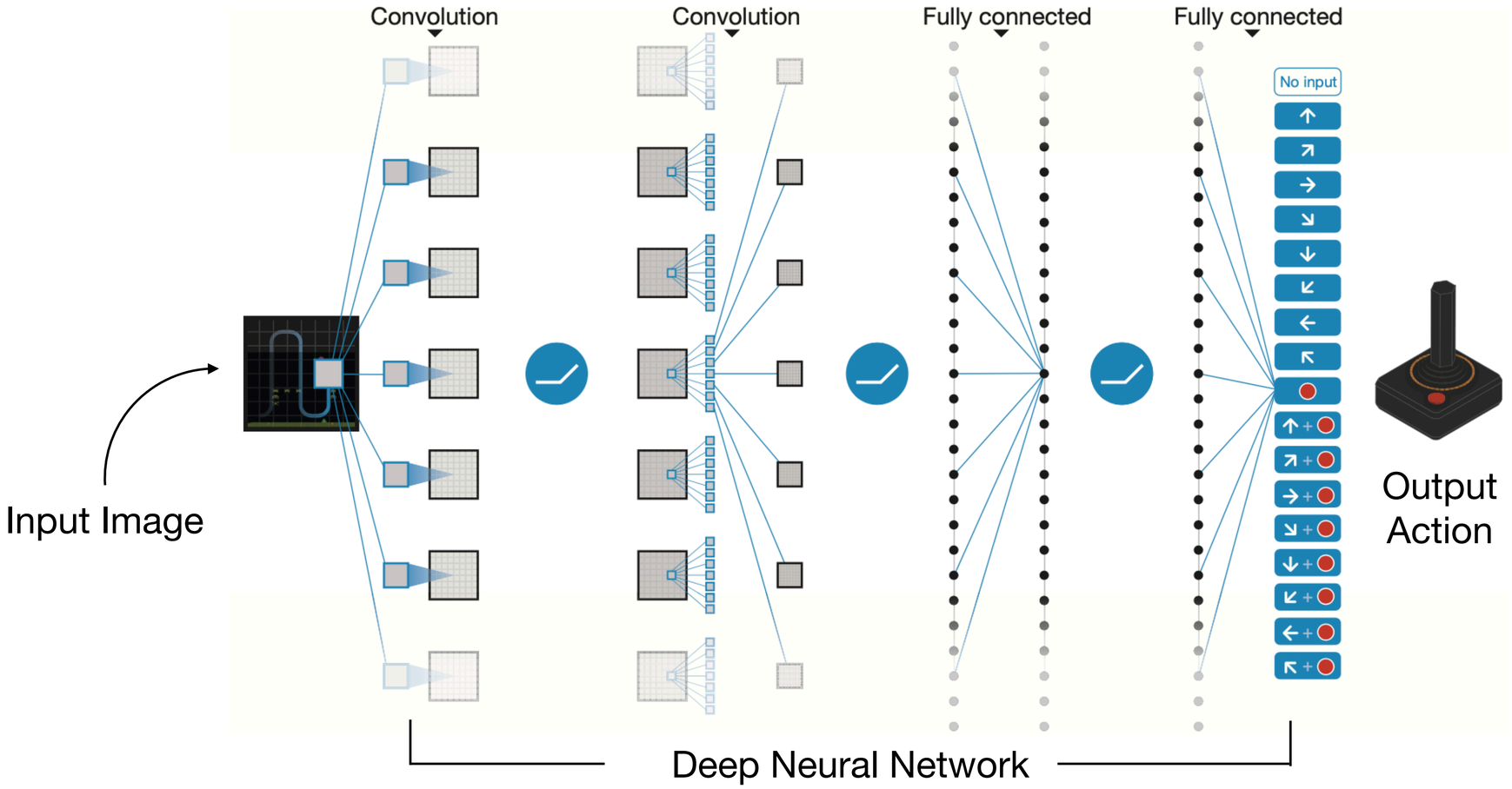
What Reinforcement Learning Can Do

DRL example

- Playing Atari Games
- Hide and Seek
- Alpha Star / Alpha Go
- Rubik’s Cube
- Robotic Arm

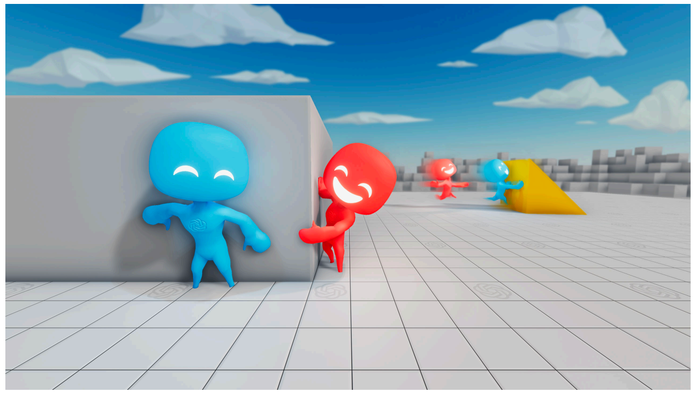
Playing Atari Game

Deep Q-learning

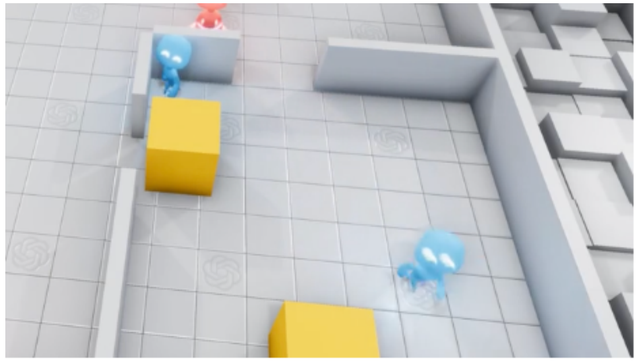


Hide and Seek

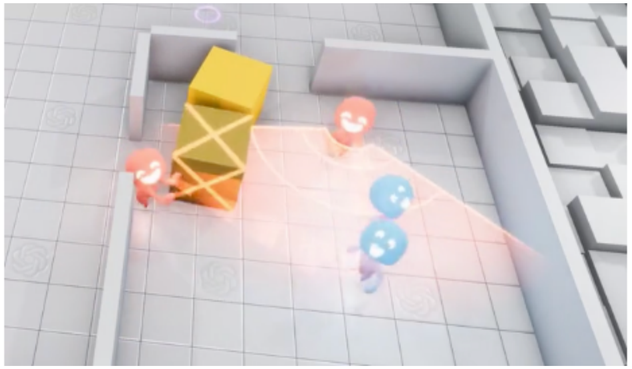
Multi-Agent task



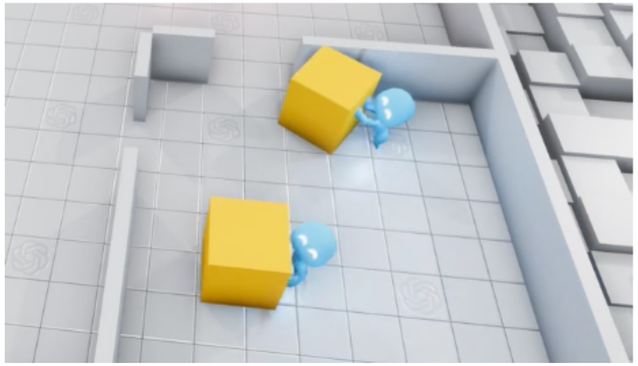
Move



Search



Grab



AlphaGo

Beat Human Expert of GO

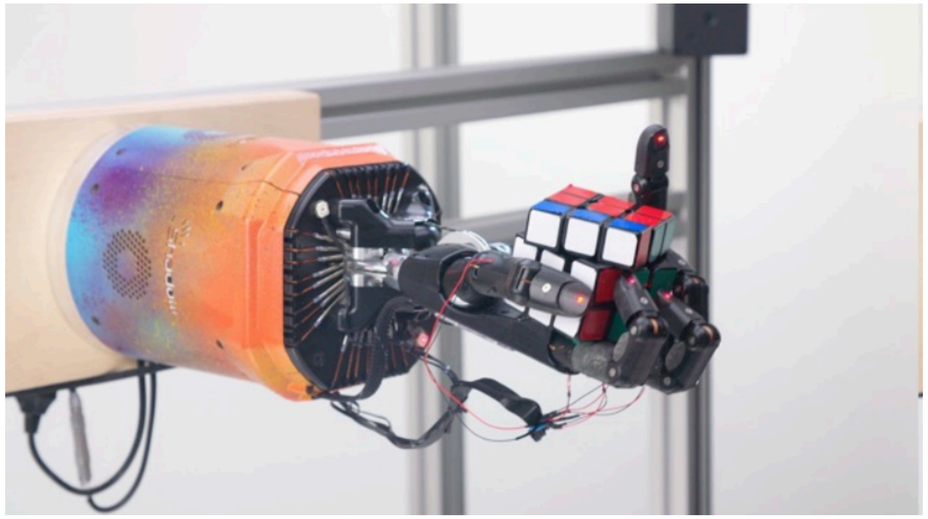
DeepMind

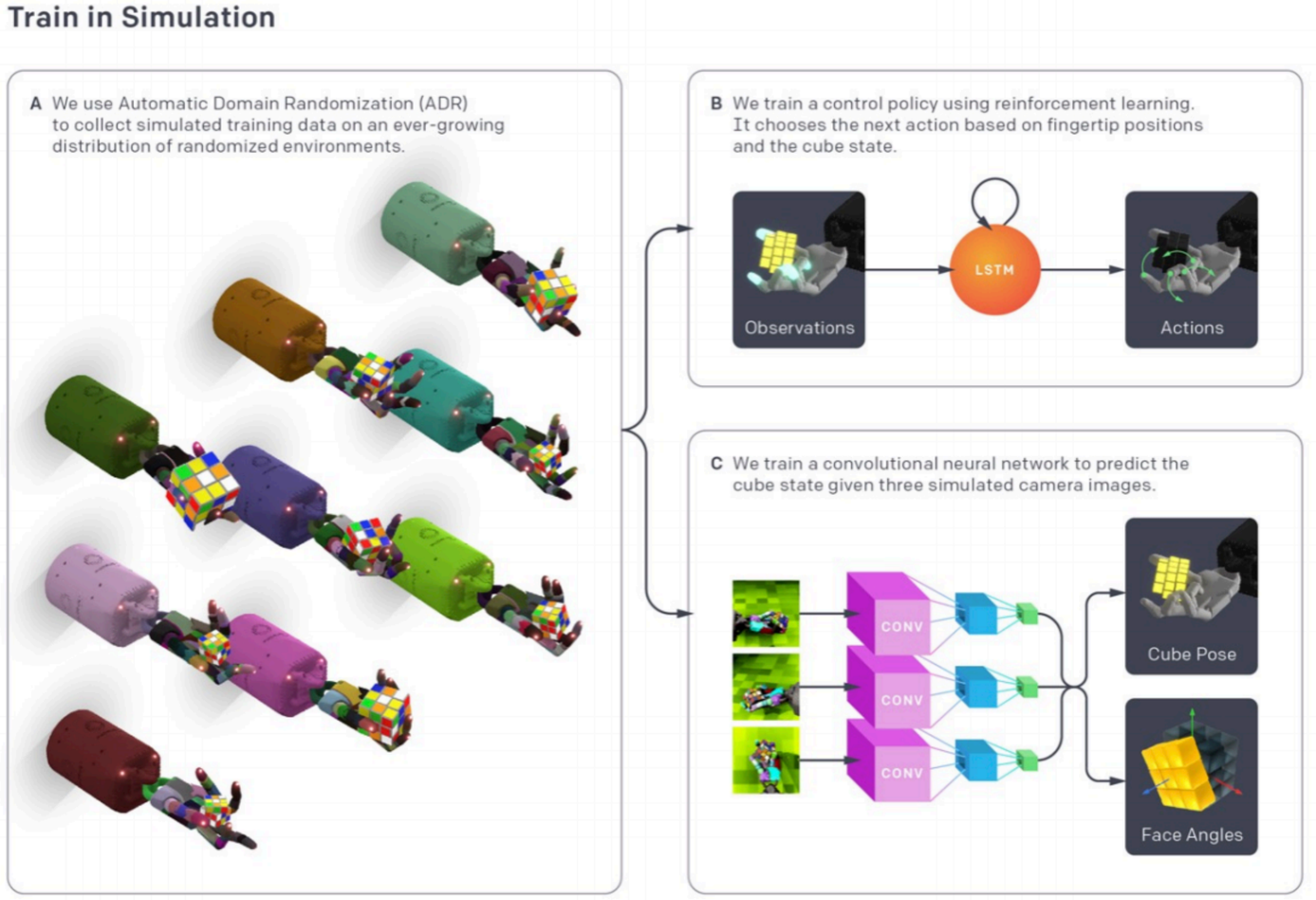
AlphaStar

DOTA game

Rubik's Cube

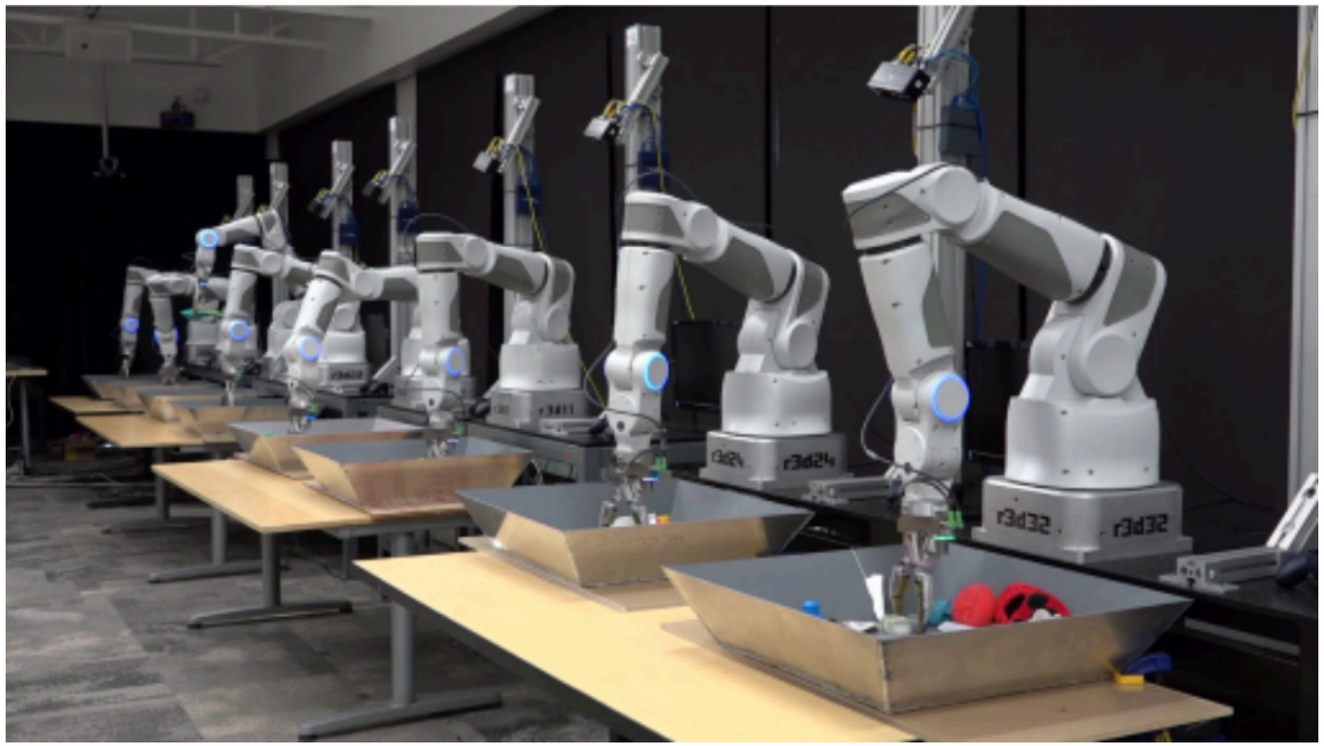
Robotic Arm and Hand

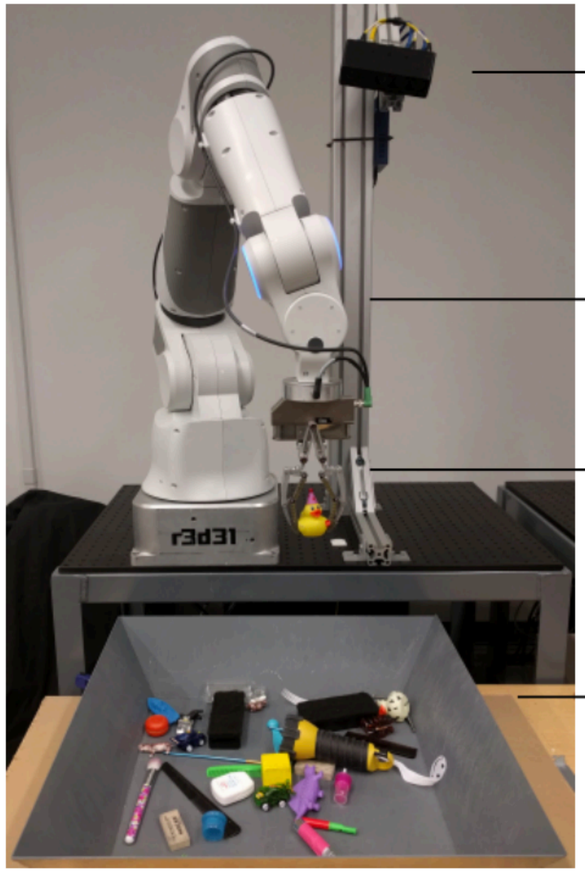




Robotic Arm

Arm Grasp and Push





What Can We Learn from this Course

- Introduction to deep reinforcement learning
- Markov decision process
- Value function approximation / policy gradients
- Deep Q-learning
- Continuous action space learning
- Inverse reinforcement learning
- Reinforcement learning techniques and applications


YOU'RE AWESOME
THANK YOU!
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