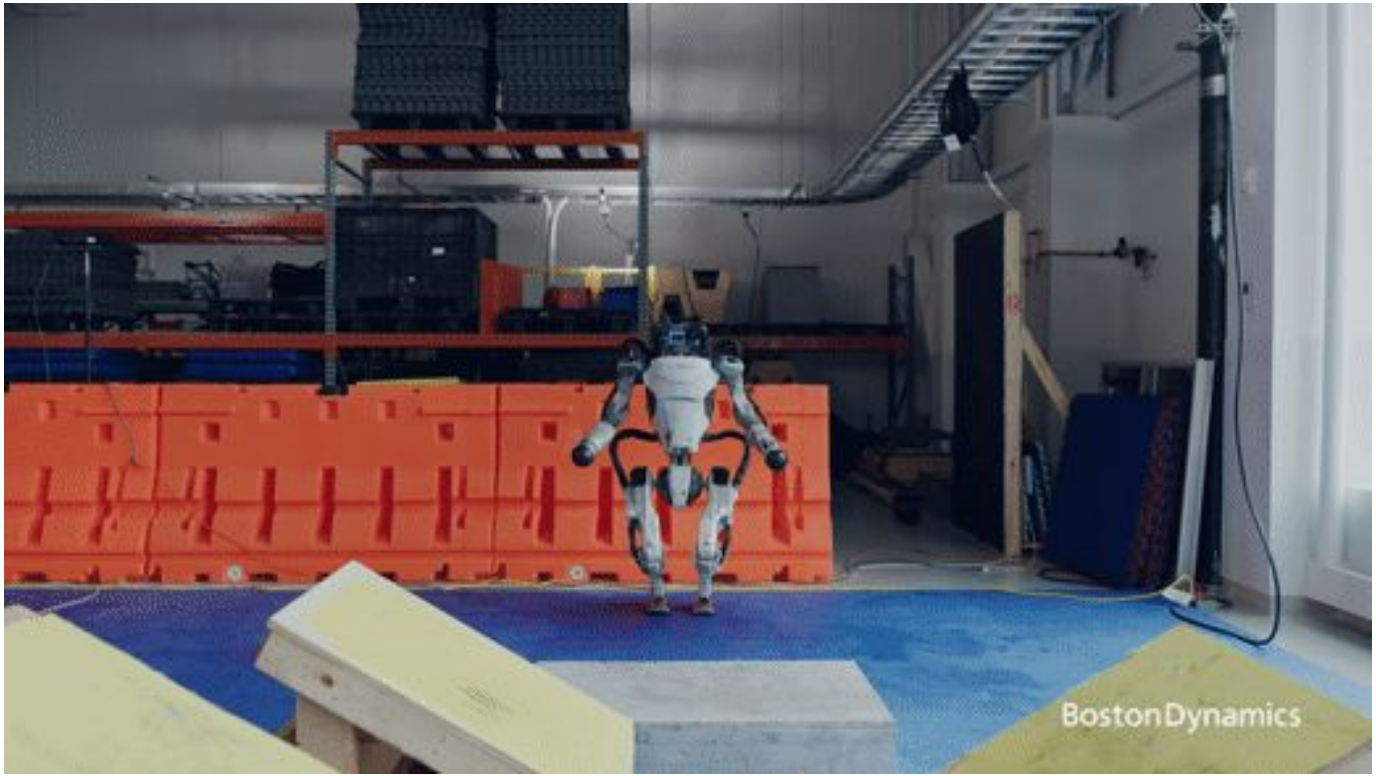
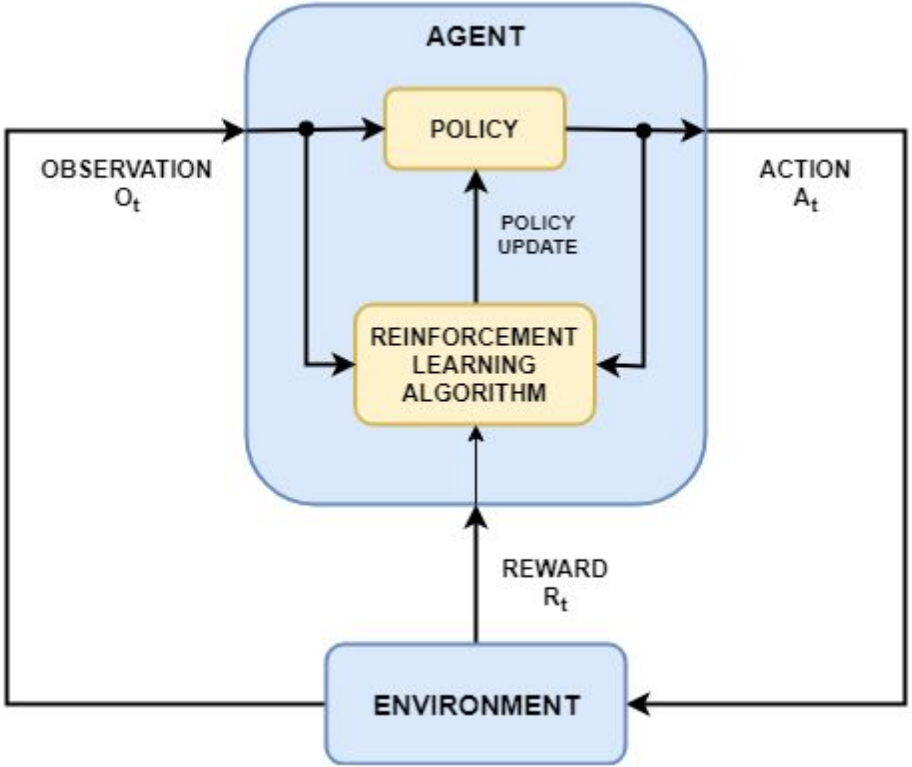
Teaching a Robot How to Walk

Presentation by Tyler Ingebrand

The problem we are trying to solve



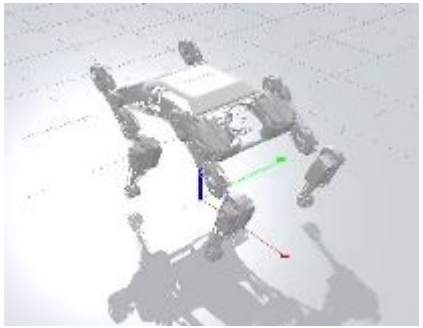
An automated solution: Reinforcement Learning



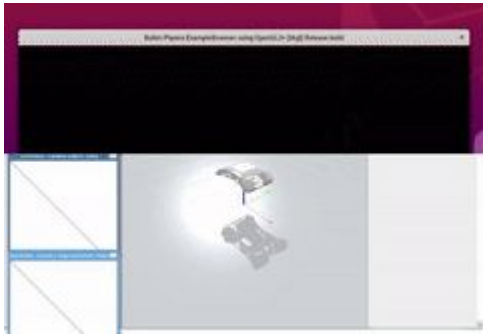
Our chosen embedded system: The Petoi Bittle + Pi

The RL pipeline

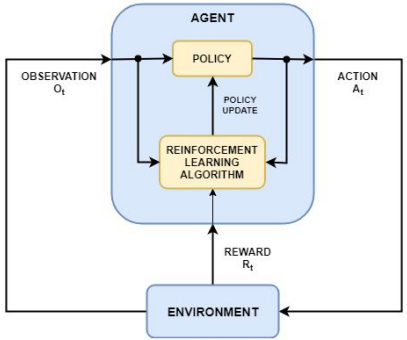
URDF model



Physics Simulator

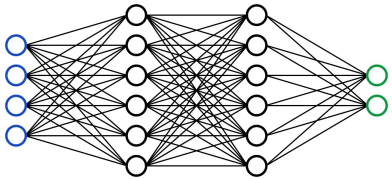


Training process



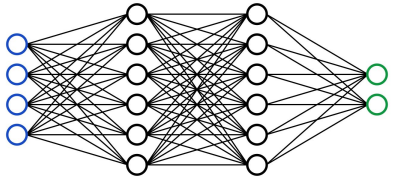
The RL pipeline

Convert NN to C++ format



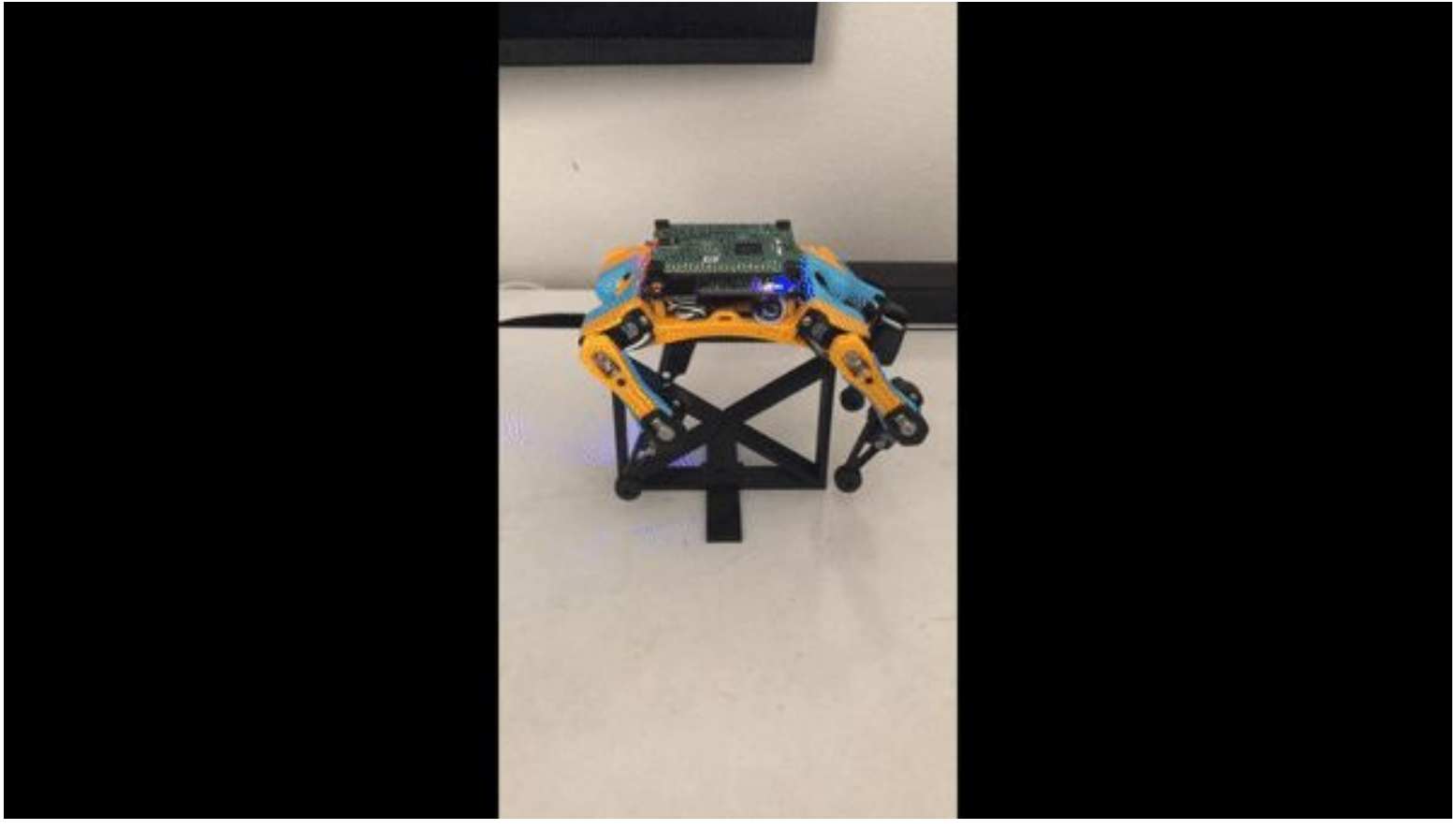
Use embedded programming to fetch the state

Use NN to compute an action from the state



Apply action to robot

Results



Challenges

- Simulation accuracy
  - This will be improved as the software improves, and as compute power improves
- Training time
  - Needed a GPU
- Robot Design - Ground up approach to RL
  - Design the robot to be easily simulated, release the exact specs sent to manufacturers as URDF files
  - We had to make a lot of assumptions due to the robot design

Resources

- Information on creating MDPs - https://gym.openai.com/docs/#environments
- Information on different RL algorithms - https://ychai.uk/notes/2019/04/02/RL/SpinningUp/RL-taxonomy/
- How to use PyBullet (simulator) - https://usermanual.wiki/Document/pybullet20quickstart20guide.479068914/html#pf15
- How to create a custom MDP - https://gerardmaggiolino.medium.com/creating-openai-gym-environments-with-pybullet-part-2-a1441b9a4d8e
- Info on DDPG - https://spinningup.openai.com/en/latest/algorithms/ddpg.html
- General info on how NNs work - https://www.youtube.com/watch?v=aircAruvnKk&ab_channel=3Blue1Brown
- Past work on trying to train RL algorithms on robots in simulation - https://www.youtube.com/watch?v=Wypc1a-1ZYA&start=381&ab_channel=MATLAB
- You would be surprised how much support you can find on Google