

An Experimentation Toolkit for Robotics Control
and Manipulation Tasks using Reinforcement
Learning Algorithms
A Robot Learning Gym

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Introduction



Figure: A robot arm

- ▶ Suppose we have the robot pictured above
- ▶ How to manipulate objects in the real world autonomously?
- ▶ Maybe use AI? However, not many tools for AI-based robotics
- ▶ To develop smart robots, a good toolkit is required

Purpose

- ▶ Build a toolkit for prototyping AI-based robotics control algorithms
- ▶ Requirements
 - ▶ Should be able to test code quickly and often
 - ▶ Use a fast simulator
 - ▶ Easy to get started (minimal setup barriers)
 - ▶ Visualization tools
- ▶ Try to use popular tools

Current Tools

- ▶ OpenAI Gym: mini-games for testing algorithms

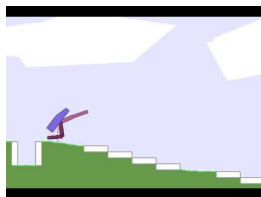


Figure: Bipedal walking in Gym

- ▶ TensorFlow: library for machine learning (AI)
- ▶ MuJoCo: 3D physics simulator
- ▶ These are 3 main projects used in the toolkit

Designing the Framework: Plan

- ▶ Investigate current tools (pros/cons)
- ▶ Build a core framework to plug above tools into
- ▶ Extend OpenAI Gym package
- ▶ Collect robot "models" for MuJoCo
- ▶ Implement some algorithms

Designing the Framework: Process

- ▶ Attempted mixed robots and environments
- ▶ Learn and incorporate TensorFlow
- ▶ Open source code and publish online (GitHub)

Results

- ▶ One possible use case might be benchmarking different algorithms

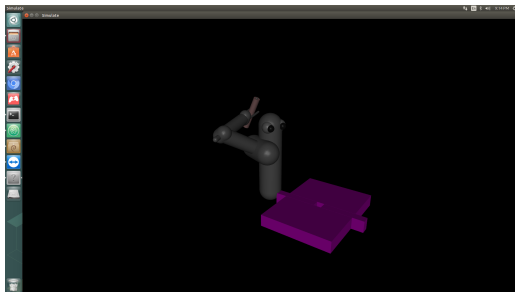


Figure: Peg Insertion Task in MuJoCo

Visualizations



Figure: TensorFlow's histograms

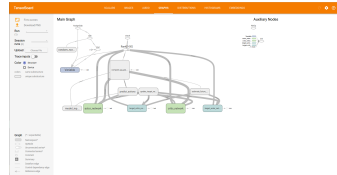


Figure: TensorFlow's visual network architecture

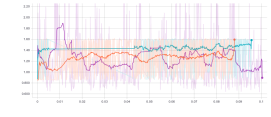


Figure: Reward vs. time graph for a few algorithms

Conclusion

- ▶ Made it easier for myself and others to try new ideas quickly
- ▶ Future Work
 - ▶ Maintain the framework and create more extensive documentation
 - ▶ Experiment with other network architectures
 - ▶ Benchmark more deep learning based algorithms
 - ▶ Include more environments/tasks/robots

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