dennybritz / **reinforcement-learning**

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Implementation of Reinforcement Learning Algorithms. Python, OpenAI Gym, Tensorflow. Exercises and Solutions to accompany Sutton's Book and David Silver's course. http://www.wildml.com/2016/10/learnin…

176 commits **3** branches **0** releases **24** contributors MIT

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dennybritz committed on **GitHub** Merge pull request #102 from sstarzycki/patch-1 ··· Latest commit 762f34c Jul 21, 2017

DP	Update description of env.P[s][a]	Jul 21, 2017
DQN	DQN copy_model_parameters memory leak fixed, tensorboard summaries up…	Jul 8, 2017
FA	correct more typos	Jul 6, 2017
Introduction	Merge branch 'master' of github.com:dennybritz/reinforcement-learning	Jun 12, 2017
MC	Merge branch 'master' of github.com:dennybritz/reinforcement-learning	Jun 12, 2017
MDP	Merge branch 'master' of github.com:dennybritz/reinforcement-learning	Jun 12, 2017
PolicyGradient	Remove unused line	Jun 17, 2017
TD	Update book link	Jun 12, 2017
lib	fix typo	Mar 14, 2017
.gitignore	Deep Q Updates	Sep 18, 2016
LICENSE	Add MIT License	Oct 3, 2016
README.md	Merge branch 'master' of github.com:dennybritz/reinforcement-learning	Jun 12, 2017
__init__.py	Add MC Control with Epsilon-Greedy Policies	Sep 1, 2016

README.md

Overview

This repository provides code, exercises and solutions for popular Reinforcement Learning algorithms. These are meant to serve as a learning tool to complement the theoretical materials from

- Reinforcement Learning: An Introduction (2nd Edition)
- David Silver's Reinforcement Learning Course

Each folder in corresponds to one or more chapters of the above textbook and/or course. In addition to exercises and solution, each folder also contains a list of learning goals, a brief concept summary, and links to the relevant readings.

All code is written in Python 3 and uses RL environments from OpenAI Gym. Advanced techniques use Tensorflow for neural network implementations.

Table of Contents

- Introduction to RL problems & OpenAI Gym
- MDPs and Bellman Equations
- Dynamic Programming: Model-Based RL, Policy Iteration and Value Iteration
- Monte Carlo Model-Free Prediction & Control
- Temporal Difference Model-Free Prediction & Control

- Function Approximation
- Deep Q Learning (WIP)
- Policy Gradient Methods (WIP)
- Learning and Planning (WIP)
- Exploration and Exploitation (WIP)

List of Implemented Algorithms

- [Dynamic Programming Policy Evaluation](DP/Policy Evaluation Solution.ipynb)
- [Dynamic Programming Policy Iteration](DP/Policy Iteration Solution.ipynb)
- [Dynamic Programming Value Iteration](DP/Value Iteration Solution.ipynb)
- [Monte Carlo Prediction](MC/MC Prediction Solution.ipynb)
- [Monte Carlo Control with Epsilon-Greedy Policies](MC/MC Control with Epsilon-Greedy Policies Solution.ipynb)
- [Monte Carlo Off-Policy Control with Importance Sampling](MC/Off-Policy MC Control with Weighted Importance Sampling Solution.ipynb)
- [SARSA (On Policy TD Learning)](TD/SARSA Solution.ipynb)
- [Q-Learning (Off Policy TD Learning)](TD/Q-Learning Solution.ipynb)
- [Q-Learning with Linear Function Approximation](FA/Q-Learning with Value Function Approximation Solution.ipynb)
- [Deep Q-Learning for Atari Games](DQN/Deep Q Learning Solution.ipynb)
- [Double Deep-Q Learning for Atari Games](DQN/Double DQN Solution.ipynb)
- Deep Q-Learning with Prioritized Experience Replay (WIP)
- [Policy Gradient: REINFORCE with Baseline](PolicyGradient/CliffWalk REINFORCE with Baseline Solution.ipynb)
- [Policy Gradient: Actor Critic with Baseline](PolicyGradient/CliffWalk Actor Critic Solution.ipynb)
- [Policy Gradient: Actor Critic with Baseline for Continuous Action Spaces](PolicyGradient/Continuous MountainCar Actor Critic Solution.ipynb)
- Deterministic Policy Gradients for Continuous Action Spaces (WIP)
- Deep Deterministic Policy Gradients (DDPG) (WIP)
- Asynchronous Advantage Actor Critic (A3C)

Resources

Textbooks:

- Reinforcement Learning: An Introduction (2nd Edition)

Classes:

- David Silver's Reinforcement Learning Course (UCL, 2015)
- CS294 - Deep Reinforcement Learning (Berkeley, Fall 2015)
- CS 8803 - Reinforcement Learning (Georgia Tech)

Talks/Tutorials:

- Introduction to Reinforcement Learning (Joelle Pineau @ Deep Learning Summer School 2016)
- Deep Reinforcement Learning (Pieter Abbeel @ Deep Learning Summer School 2016)
- Deep Reinforcement Learning ICML 2016 Tutorial (David Silver)
- Tutorial: Introduction to Reinforcement Learning with Function Approximation
- John Schulman - Deep Reinforcement Learning (4 Lectures)
- Deep Reinforcement Learning Slides @ NIPS 2016

Other Projects:

- carpedm20/deep-rl-tensorflow
- matthiasplappert/keras-rl

Selected Papers:

- Human-Level Control through Deep Reinforcement Learning (2015-02)
- Deep Reinforcement Learning with Double Q-learning (2015-09)
- Continuous control with deep reinforcement learning (2015-09)
- Prioritized Experience Replay (2015-11)

- Dueling Network Architectures for Deep Reinforcement Learning (2015-11)
- Asynchronous Methods for Deep Reinforcement Learning (2016-02)
- Deep Reinforcement Learning from Self-Play in Imperfect-Information Games (2016-03)
- Mastering the game of Go with deep neural networks and tree search