

Deep Eligibility Traces

Introduction

This repository consists of implementations of Eligibility Traces and corresponding algorithms in the deep learning setting. Algorithms are implemented in **PyTorch** and **Tensorflow 2.0** on a range of problems. Custom toy problems are provided in the **MDPs** folder.

Baseline Algorithms

Following are the baseline algorithms combined with trace-based updates-

Algorithm	Link	Implementation	Status
Sarsa	Sutton & Barto	sarsa.py	✓
Double Sarsa	Sutton & Barto	doublesarsa.py	✓
Q-Learning	Sutton & Barto	qlearning.py	✓
Double Q-Learning	Sutton & Barto	doubleqlearning.py	✓
Expected Sarsa	Sutton & Barto	expectedsarsa.py	✓
Double Expected Sarsa	Sutton & Barto	doubleexpectedsarsa.py	✓

Trace Algorithms

Following algorithms are available in the current version-

PyTorch

Trace	Baseline Algorithms	Link	Implementation	Status
Q(λ)	Q(1)	Sutton & Barto	watkinsq.py	✓
QET(λ)	Q(1)	Expected Eligibility Traces	qet.py	✓
Replacing Trace	<ul style="list-style-type: none"> ✓ Sarsa ✓ Q-learning ✓ Expected Sarsa ✓ Double Sarsa ✓ Double Q-learning ✓ Double Expected Sarsa 	Sutton & Barto	traces.py	✓

Trace	Baseline Algorithms	Link	Implementation	Status
Accumulating Trace	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Sarsa <input checked="" type="checkbox"/> Q-learning <input checked="" type="checkbox"/> Expected Sarsa <input checked="" type="checkbox"/> Double Sarsa <input checked="" type="checkbox"/> Double Q-learning <input checked="" type="checkbox"/> Double Expected Sarsa 	Sutton & Barto	traces.py	✓
Dutch Trace	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Sarsa <input checked="" type="checkbox"/> Q-learning <input checked="" type="checkbox"/> Expected Sarsa <input checked="" type="checkbox"/> Double Sarsa <input checked="" type="checkbox"/> Double Q-learning <input checked="" type="checkbox"/> Double Expected Sarsa 	Sutton & Barto	traces.py	✓

Tensorflow 2.0

Trace	Baseline Algorithms	Link	Implementation	Status
Q(λ)	Q(1)	Sutton & Barto	watkinsq.py	✓
QET(λ)	Q(1)	Expected Eligibility Traces	qet.py	✓
Replacing Trace	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Sarsa <input checked="" type="checkbox"/> Q-learning <input checked="" type="checkbox"/> Expected Sarsa <input checked="" type="checkbox"/> Double Sarsa <input checked="" type="checkbox"/> Double Q-learning <input checked="" type="checkbox"/> Double Expected Sarsa 	Sutton & Barto	traces.py	✓
Accumulating Trace	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Sarsa <input checked="" type="checkbox"/> Q-learning <input checked="" type="checkbox"/> Expected Sarsa <input checked="" type="checkbox"/> Double Sarsa <input checked="" type="checkbox"/> Double Q-learning <input checked="" type="checkbox"/> Double Expected Sarsa 	Sutton & Barto	traces.py	✓

Trace	Baseline Algorithms	Link	Implementation	Status
Dutch Trace	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Sarsa <input checked="" type="checkbox"/> Q-learning <input checked="" type="checkbox"/> Expected Sarsa <input checked="" type="checkbox"/> Double Sarsa <input checked="" type="checkbox"/> Double Q-learning <input checked="" type="checkbox"/> Double Expected Sarsa 	Sutton & Barto	traces.py	✓

Custom Environments

Following is the list of custom toy environments-

Environment Name	Link	Implementation
CyclicMDP	ESAC	link
OneStateMDP	Sutton & Barto	link
OneStateGaussianMDP	Sutton & Barto	link
GeneralizedCyclicMDP	motivated by ESAC	link
StochasticMDP	hDQN	link
MultiChainMDP	ET(λ)	link

Usage

To run an implementation, use the following command-

```
python main.py --configs configs/configs.yaml --log_dir log/ --env <ENVIRONMENT>
```

For example, to run Q-Learning on the CyclicMDP environment using PyTorch library, use the following-

```
python main.py --configs configs/configs.yaml --log_dir log/ --env CyclicMDP
```

This will train the agent with default arguments listed in [configs.yaml](#) file.

Following is an example to enter custom arguments for Q-Learning on the CartPole-v0 environment using PyTorch library with replacing trace and lambda=0.5-

```
python main.py --configs configs/configs.yaml --log_dir log/ --alg QLearning --env CartPole-v0 --lib torch --trace replacing --lamb 0.5 --num_steps 10000
```

Citation

If you find these implementations helpful then please cite the following-

```
@misc{karush17eligibilitytraces,  
  author = {Karush Suri},  
  title = {Deep Eligibility Traces},  
  year = {2021},  
  howpublished = {\url{https://github.com/karush17/Deep-Eligibility-Traces}},  
  note = {commit xxxxxxxx}  
}
```