Project Report

This report highlights the Q-Network, the learning agent along with the hyperparameters and provides some references for future work.

Q-Network

The network is a feed-forward network with 3 fully connected layers as follows

1. Input 37 (see state size) => Output 64
2. Input 64 => Output 64
3. Input 64 => Output 4 (action size)

with ReLU activation function that maps state -> action values.

Learning Agent

The learning agent is created as a class that interacts and learns from the environment with qnetwork_local and qnetwork_target as initialized QNetwork variants plus Adam variant as optimizer.

Hyperparameters

- Replay buffer size	=> 1e-5
- Minibatch size	=> 64
- Discount factor Gamma	=> 0.99
- TAU for soft update of target parameters	=> 1e-3
- Learning rate	=> 5e-4
- How often to update the network	=> 4
- Number of episodes	=> 2,000
- Max number of iterations per episode	=> 1,000
- Epsilon starting value	=> 1.0
- Epsilon min value	=> 0.01
- Epsilon decay rate	=> 0.995

Training

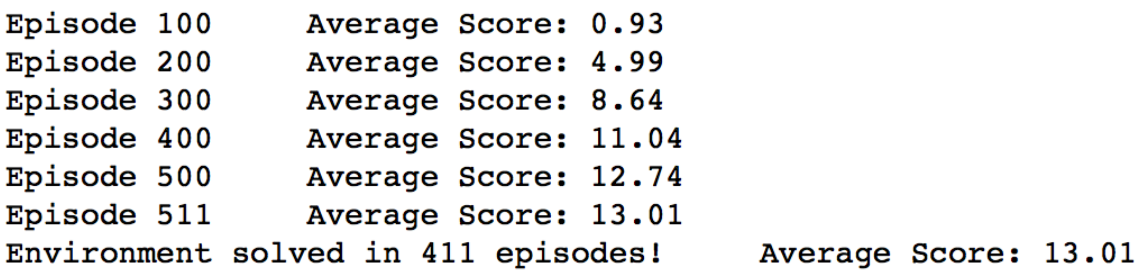
The training of the agent via dqn function (see Navigation_Solution.ipynb) is running the following steps in every episode:

- Return actions for given state state as per current policy from qnetwork_local using epsilon-greedy action selection
- Save experience in replay memory
- Learn every defined update time steps if enough samples are available in memory with random subset to update value parameters using given batch of experience tuples
    1. Get max predicted Q values (for next states) from qnetwork_target
    2. Compute Q targets for current states

3. Get expected Q values from qnetwork_local
4. Compute and minimize MSE loss
5. Soft update target network via

In total it is designed to run over 2,000 episodes (with 1,000 iterations per episode) - but it is considered as solved and hence ends if the agent gets an average score of +13 over 100 consecutive episodes.

Plot of Rewards



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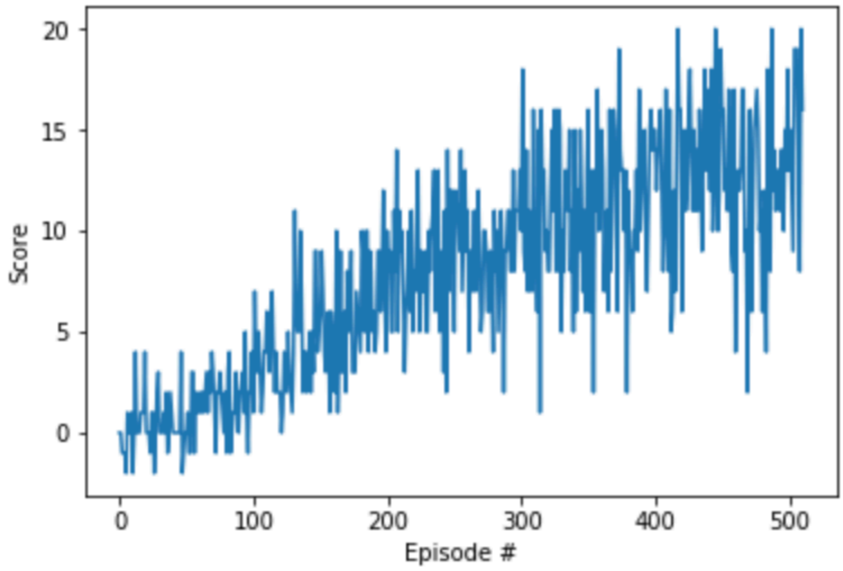
Episode 100     Average Score: 0.93
Episode 200     Average Score: 4.99
Episode 300     Average Score: 8.64
Episode 400     Average Score: 11.04
Episode 500     Average Score: 12.74
Episode 511     Average Score: 13.01
Environment solved in 411 episodes!     Average Score: 13.01
```



Future Work

Fine-tuning can be achieved by further hyperparameter optimization.

Additional enhancements can be achieved via implementing

- Double Q-Learning (see https://arxiv.org/abs/1509.06461)
- Dueling Q-Networks (see https://arxiv.org/abs/1511.06581)
- Prioritized Experience Replay (see https://arxiv.org/abs/1511.05952)
- Rainbow Approach (see https://arxiv.org/pdf/1710.02298.pdf)