Deep Reinforcement Learning Nanodegree Project 2 Report

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Learning Algorithm

I used DDPG algorithm to solve this problem.

Actor-Critic is a mix of policy-based and value-based methods. Policy based agent (actor) determines what action to take, and value-based agent (critical) determines the value of the current state and action. The representative algorithm of Actor-critical learning, DDPG (Deep Deterministic Policy Gradients), is learned in the following ways:

1. Actor makes an action based on state.
2. Critical is taught to predict the reward based on state, action and to create a value like the actual reward.
3. The actor receives an expected reward by delivering the action he created from state to critical and learns to maximize the expected reward.

Hyperparameters

- BUFFER_SIZE = int(1e6) # replay buffer size
- BATCH_SIZE = 1024 # minibatch size
- GAMMA = 0.99 # discount factor
- TAU = 1e-3 # for soft update of target parameters
- Actor LR = 1e-4 # actor learning rate
- Critic LR = 3e-4 # critic learning rate
- n_episodes = 500 # maximum number of training episodes
- max_t = 1000 # maximum number of time steps per episode
- leak = 0.01 # leakyReLU

Model architecture

Actor

```
state = self.bn(state)
x = F.leaky_relu(self.fc1(state), negative_slope=self.leak)
x = F.leaky_relu(self.fc2(x), negative_slope=self.leak)
x =  torch.tanh(self.fc3(x))
```

Critic

```
state = self.bn(state)
x = F.leaky_relu(self.fcs1(state), negative_slope=self.leak)
x = torch.cat((x, action), dim=1)
x = F.leaky_relu(self.fc2(x), negative_slope=self.leak)
x = F.leaky_relu(self.fc3(x), negative_slope=self.leak)
x =  self.fc4(x)
```

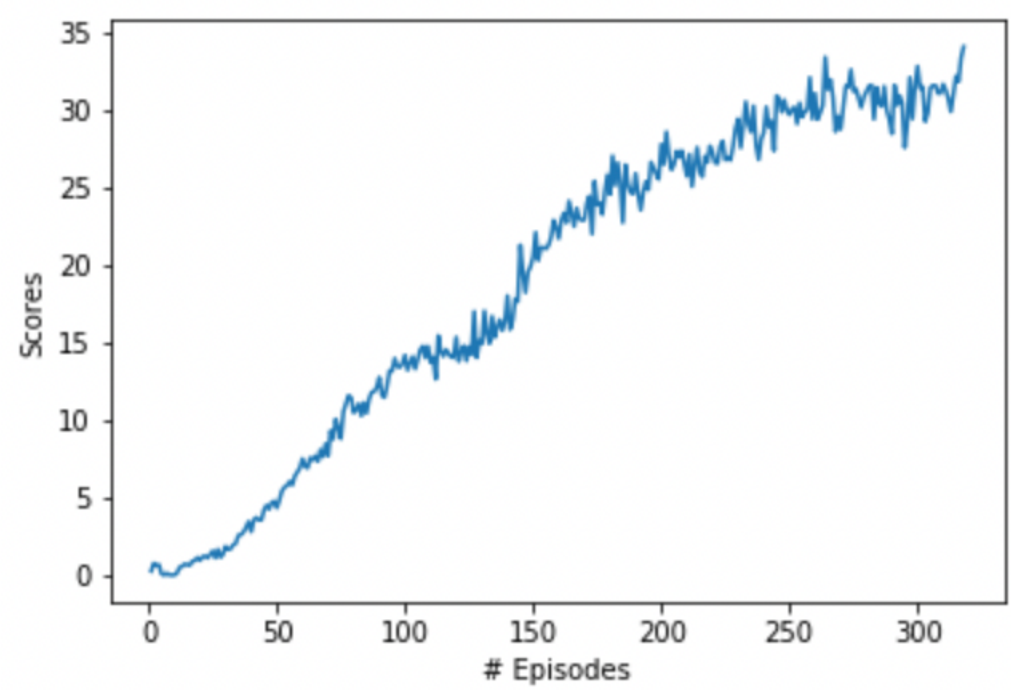
Batch normalization and leaky_ReLU function are applied.

# of episodes needed to solve the environment

```
Episode: 10     Average Score: 0.29     Current Score: 0.04
Episode: 20     Average Score: 0.52     Current Score: 0.98
Episode: 30     Average Score: 0.81     Current Score: 1.89
Episode: 40     Average Score: 1.23     Current Score: 2.84
Episode: 50     Average Score: 1.81     Current Score: 4.37
Episode: 60     Average Score: 2.53     Current Score: 7.54
Episode: 70     Average Score: 3.26     Current Score: 7.73
Episode: 80     Average Score: 4.13     Current Score: 10.50
Episode: 90     Average Score: 4.93     Current Score: 12.78
Episode: 100    Average Score: 5.74     Current Score: 14.21
Episode: 110    Average Score: 7.12     Current Score: 13.75
Episode: 120    Average Score: 8.47     Current Score: 15.36
Episode: 130    Average Score: 9.81     Current Score: 14.94
Episode: 140    Average Score: 11.18    Current Score: 18.04
Episode: 150    Average Score: 12.64    Current Score: 20.53
Episode: 160    Average Score: 14.18    Current Score: 21.73
Episode: 170    Average Score: 15.74    Current Score: 22.94
Episode: 180    Average Score: 17.14    Current Score: 24.58
Episode: 190    Average Score: 18.54    Current Score: 25.91
Episode: 200    Average Score: 19.79    Current Score: 27.81
Episode: 210    Average Score: 21.07    Current Score: 25.75
Episode: 220    Average Score: 22.31    Current Score: 27.28
Episode: 230    Average Score: 23.59    Current Score: 29.44
Episode: 240    Average Score: 24.83    Current Score: 28.54
Episode: 250    Average Score: 25.94    Current Score: 29.71
Episode: 260    Average Score: 26.80    Current Score: 31.08
Episode: 270    Average Score: 27.53    Current Score: 28.77
Episode: 280    Average Score: 28.22    Current Score: 31.18
Episode: 290    Average Score: 28.72    Current Score: 28.48
Episode: 300    Average Score: 29.23    Current Score: 32.83
Episode: 310    Average Score: 29.64    Current Score: 31.67
Episode: 318    Average Score: 30.07    Current Score: 34.09
Environment solved in 218 episodes!     Average Score: 30.07
```

After a total of 218 episodes, average score is over +30.

Plot of rewards



Ideas for Future Work

I used the DDPG model to solve this problem. This model could have solved the problem enough, but other algorithms could be used for better performance. Using algorithms (ex. A3C, A2C, PPO) could achieve better results. And more optimization of hyperparameters is needed.