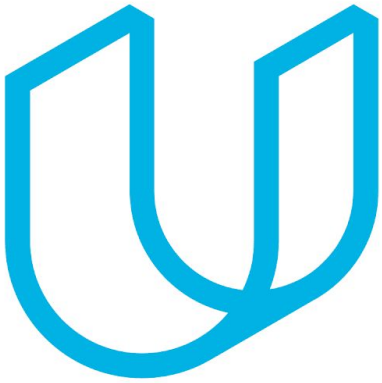
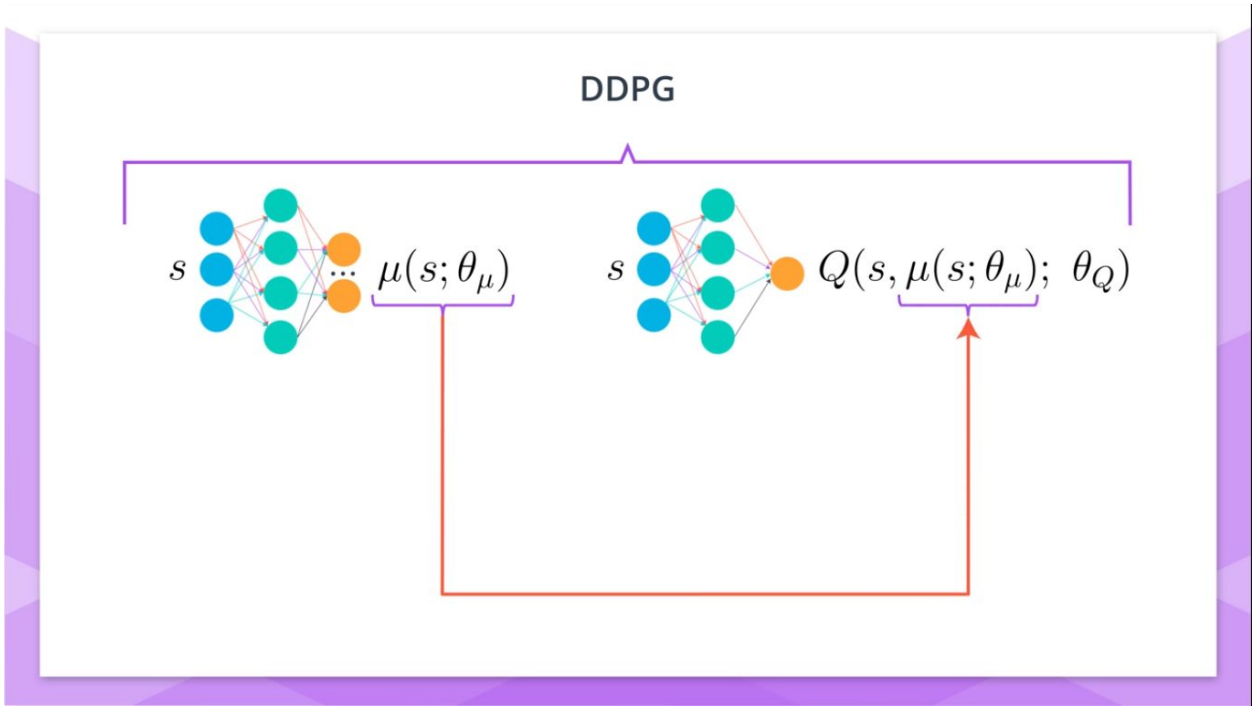


UDACITY

Collaboration and Competition - Report

By Taimur Zahid

Model Architecture and Algorithm: For this project, the Multi-Agent Deep Deterministic Policy Gradients (MADDPG) algorithm was used. The following image is a screenshot taken from one of the lessons of the Deep Reinforcement Learning Nanodegree. The algorithm consists of two deep neural networks, one for the Actor and one for the Critic. The actor is used to approximate the optimal policy deterministically, i.e it outputs the best believed action for any given state. The critic learns to evaluate the optimal action-value function by using the actor's best believed action. Each agent receives its own, local observation and we use it to simultaneously train both agents through self-play. Each agent used the same actor network to select actions, and the experiences were added to a shared replay buffer.



Neural Network - Actor

```
self.fc1 = nn.Linear((state_size * 2), fcs1_units)
self.fc2 = nn.Linear(fcs1_units, fc2_units)
self.fc3 = nn.Linear(fc2_units, action_size)
```

Neural Network - Critic

```
self.fc1 = nn.Linear((state_size * 2), fcs1_units)
self.fc2 = nn.Linear(fcs1_units + (action_size * 2), fc2_units)
self.fc3 = nn.Linear(fc2_units, 1)
```

Hyperparameters: The Values for the Hyperparameters are as follows:

```
BUFFER_SIZE = int(1e6)
BATCH_SIZE = 128
GAMMA = 0.99
TAU = 8e-3
LR_ACTOR = 1e-3
LR_CRITIC = 1e-3
WEIGHT_DECAY = 0
LEARN_EVERY = 1
LEARN_NUM = 1
GRAD_CLIPPING = 1.0
OU_SIGMA = 0.2
OU_THETA = 0.15
EPSILON = 5.0
EPSILON_DECAY = 6e-6
```

Training Outputs and Plots: The Training output along with the graph are as follows:

- Episode 1 (0s) Moving Avg: 0.1000 Best Score: 0.1000
- Episode 100 (0s) Moving Avg: 0.0070 Best Score: 0.1000
- Episode 200 (1s) Moving Avg: 0.0250 Best Score: 0.2000
- Episode 300 (0s) Moving Avg: 0.0290 Best Score: 0.2000
- Episode 400 (0s) Moving Avg: 0.0539 Best Score: 0.5000
- Episode 500 (1s) Moving Avg: 0.0700 Best Score: 0.5000
- Episode 600 (0s) Moving Avg: 0.1139 Best Score: 0.6000
- Episode 700 (2s) Moving Avg: 0.1160 Best Score: 0.6000
- Episode 800 (1s) Moving Avg: 0.1420 Best Score: 0.6000
- Episode 900 (1s) Moving Avg: 0.1799 Best Score: 0.8000
- Episode 1000 (4s) Moving Avg: 0.1999 Best Score: 1.1900
- Episode 1100 (1s) Moving Avg: 0.2240 Best Score: 1.1900
- Episode 1200 (3s) Moving Avg: 0.2079 Best Score: 1.1900
- Episode 1300 (2s) Moving Avg: 0.2250 Best Score: 1.6000
- Episode 1400 (1s) Moving Avg: 0.2178 Best Score: 1.6000
- Episode 1500 (2s) Moving Avg: 0.2629 Best Score: 1.6000
- Episode 1600 (0s) Moving Avg: 0.3219 Best Score: 1.6000
- Episode 1700 (1s) Moving Avg: 0.2928 Best Score: 1.6000
- Episode 1800 (4s) Moving Avg: 0.2939 Best Score: 1.6000
- Episode 1900 (6s) Moving Avg: 0.3508 Best Score: 1.6000
- Episode 2000 (0s) Moving Avg: 0.3819 Best Score: 3.0000
- Episode 2100 (1s) Moving Avg: 0.4420 Best Score: 3.2000
- Episode 2200 (5s) Moving Avg: 0.3276 Best Score: 3.2000
- Episode 2300 (2s) Moving Avg: 0.3786 Best Score: 3.2000
- Episode 2400 (1s) Moving Avg: 0.4227 Best Score: 3.2000

- Episode 2500 (1s) Moving Avg: 0.3370 Best Score: 3.5000
- Episode 2600 (1s) Moving Avg: 0.4390 Best Score: 3.5000
- Episode 2700 (1s) Moving Avg: 0.2620 Best Score: 3.5000
- Episode 2800 (4s) Moving Avg: 0.3340 Best Score: 3.5000
- Episode 2900 (1s) Moving Avg: 0.3409 Best Score: 3.5000
- Episode 3000 (0s) Moving Avg: 0.3399 Best Score: 3.5000
- Episode 3100 (2s) Moving Avg: 0.3927 Best Score: 3.5000
- Episode 3200 (5s) Moving Avg: 0.3188 Best Score: 3.5000
- Episode 3253 (7s) Moving Avg: 0.5038 Best Score: 3.5000

```
Environment solved in 3153 episodes! Average Score: 0.50
```