**Report**

This project DDPG model, agent implement project.

**Learning algorithm**

DDPG (Deep Deterministic Policy Gradient)

I modified ddpg_agent, model in ddpg-pendulum project. DDPG is an actor-critic algorithm; it has two networks: actor and critic. Technically, the actor produces the action to explore. During the update process of the actor, TD error from a critic is used. The critic network gets updated based on the TD error similar to Q-learning update rule.

**Hyper Parameters**

BUFFER_SIZE=int(1e5): replay buffer size

BATCH_SIZE=128: minibatch size

GAMMA=0.99: discount factor

TAU=1e-3: for soft update of target parameters

LR_ACTOR=1e-3: learning rate of the actor

LR_CRITIC=1e-3: learning rate of the critic

WEIGHT_DECAY=0: L2 weight decay


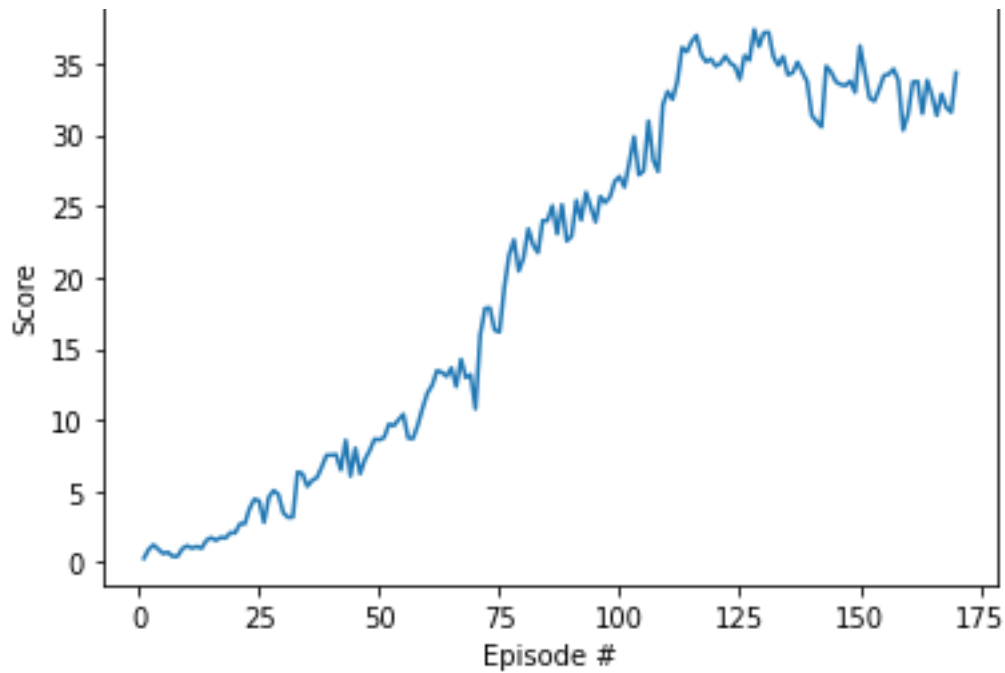**Model architecture**

Actor

   Two hidden layer fc1 size 400, fc2 size 300, and use relu for each hidden layer

   Finally connect to tanh activation function.

Critic

   Two hidden layer fc1 size 400, fc2 size 300, and use relu for each hidden layer


**Plot of Reward**

```
Episode 1       Average Score: 0.29
Episode 2       Average Score: 0.60
Episode 3       Average Score: 0.81
Episode 4       Average Score: 0.84
Episode 5       Average Score: 0.80
Episode 6       Average Score: 0.78
Episode 7       Average Score: 0.73
Episode 8       Average Score: 0.70
Episode 9       Average Score: 0.73
Episode 10      Average Score: 0.77
Episode 11      Average Score: 0.79
Episode 12      Average Score: 0.82
Episode 13      Average Score: 0.83
Episode 14      Average Score: 0.88
Episode 15      Average Score: 0.94
Episode 16      Average Score: 0.98
Episode 17      Average Score: 1.02
Episode 18      Average Score: 1.06
Episode 19      Average Score: 1.12
Episode 20      Average Score: 1.16
Episode 21      Average Score: 1.24
Episode 22      Average Score: 1.31
Episode 23      Average Score: 1.41
Episode 24      Average Score: 1.54
Episode 25      Average Score: 1.65
Episode 26      Average Score: 1.70
Episode 27      Average Score: 1.80
Episode 28      Average Score: 1.92
Episode 29      Average Score: 2.02
Episode 30      Average Score: 2.07
Episode 31      Average Score: 2.10
Episode 32      Average Score: 2.14
Episode 33      Average Score: 2.26
Episode 34      Average Score: 2.38
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Episode 35      Average Score: 2.46
Episode 36      Average Score: 2.56
Episode 37      Average Score: 2.65
Episode 38      Average Score: 2.75
Episode 39      Average Score: 2.87
Episode 40      Average Score: 2.99
Episode 41      Average Score: 3.10
Episode 42      Average Score: 3.18
Episode 43      Average Score: 3.31
Episode 44      Average Score: 3.37
Episode 45      Average Score: 3.47
Episode 46      Average Score: 3.53
Episode 47      Average Score: 3.61
Episode 48      Average Score: 3.70
Episode 49      Average Score: 3.80
Episode 50      Average Score: 3.90
Episode 51      Average Score: 3.99
Episode 52      Average Score: 4.10
Episode 53      Average Score: 4.21
Episode 54      Average Score: 4.31
Episode 55      Average Score: 4.42
Episode 56      Average Score: 4.50
Episode 57      Average Score: 4.57
Episode 58      Average Score: 4.66
Episode 59      Average Score: 4.77
Episode 60      Average Score: 4.89
Episode 61      Average Score: 5.01
Episode 62      Average Score: 5.14
Episode 63      Average Score: 5.27
Episode 64      Average Score: 5.40
Episode 65      Average Score: 5.52
Episode 66      Average Score: 5.63
Episode 67      Average Score: 5.75
Episode 68      Average Score: 5.86
Episode 69      Average Score: 5.97
Episode 70      Average Score: 6.04
Episode 71      Average Score: 6.18
Episode 72      Average Score: 6.34
Episode 73      Average Score: 6.49
Episode 74      Average Score: 6.63
Episode 75      Average Score: 6.75
Episode 76      Average Score: 6.92
Episode 77      Average Score: 7.11
Episode 78      Average Score: 7.31
Episode 79      Average Score: 7.47
Episode 80      Average Score: 7.65
Episode 81      Average Score: 7.84
Episode 82      Average Score: 8.02
Episode 83      Average Score: 8.18
Episode 84      Average Score: 8.37
Episode 85      Average Score: 8.55
Episode 86      Average Score: 8.75
Episode 87      Average Score: 8.91
Episode 88      Average Score: 9.09
Episode 89      Average Score: 9.24
Episode 90      Average Score: 9.40
Episode 91      Average Score: 9.57
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Episode 92      Average Score: 9.73
Episode 93      Average Score: 9.90
Episode 94      Average Score: 10.06
Episode 95      Average Score: 10.21
Episode 96      Average Score: 10.37
Episode 97      Average Score: 10.52
Episode 98      Average Score: 10.68
Episode 99      Average Score: 10.84
Episode 100     Average Score: 11.00
Episode 100     Average Score: 11.00
Episode 101     Average Score: 11.26
Episode 102     Average Score: 11.53
Episode 103     Average Score: 11.82
Episode 104     Average Score: 12.08
Episode 105     Average Score: 12.35
Episode 106     Average Score: 12.65
Episode 107     Average Score: 12.93
Episode 108     Average Score: 13.20
Episode 109     Average Score: 13.51
Episode 110     Average Score: 13.83
Episode 111     Average Score: 14.14
Episode 112     Average Score: 14.47
Episode 113     Average Score: 14.82
Episode 114     Average Score: 15.16
Episode 115     Average Score: 15.51
Episode 116     Average Score: 15.87
Episode 117     Average Score: 16.20
Episode 118     Average Score: 16.54
Episode 119     Average Score: 16.87
Episode 120     Average Score: 17.20
Episode 121     Average Score: 17.52
Episode 122     Average Score: 17.85
Episode 123     Average Score: 18.16
Episode 124     Average Score: 18.46
Episode 125     Average Score: 18.76
Episode 126     Average Score: 19.09
Episode 127     Average Score: 19.39
Episode 128     Average Score: 19.72
Episode 129     Average Score: 20.03
Episode 130     Average Score: 20.37
Episode 131     Average Score: 20.71
Episode 132     Average Score: 21.03
Episode 133     Average Score: 21.31
Episode 134     Average Score: 21.61
Episode 135     Average Score: 21.89
Episode 136     Average Score: 22.18
Episode 137     Average Score: 22.47
Episode 138     Average Score: 22.75
Episode 139     Average Score: 23.01
Episode 140     Average Score: 23.25
Episode 141     Average Score: 23.48
Episode 142     Average Score: 23.72
Episode 143     Average Score: 23.99
Episode 144     Average Score: 24.27
Episode 145     Average Score: 24.53
Episode 146     Average Score: 24.80
Episode 147     Average Score: 25.06
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Episode 148    Average Score: 25.32
Episode 149    Average Score: 25.56
Episode 150    Average Score: 25.84
Episode 151    Average Score: 26.10
Episode 152    Average Score: 26.32
Episode 153    Average Score: 26.55
Episode 154    Average Score: 26.78
Episode 155    Average Score: 27.02
Episode 156    Average Score: 27.28
Episode 157    Average Score: 27.53
Episode 158    Average Score: 27.78
Episode 159    Average Score: 27.97
Episode 160    Average Score: 28.17
Episode 161    Average Score: 28.38
Episode 162    Average Score: 28.58
Episode 163    Average Score: 28.76
Episode 164    Average Score: 28.97
Episode 165    Average Score: 29.16
Episode 166    Average Score: 29.35
Episode 167    Average Score: 29.54
Episode 168    Average Score: 29.73
Episode 169    Average Score: 29.91
Episode 170    Average Score: 30.15
```

**Future Improving Idea**

We can change and test some hyper parameter and activation function. And I think we can modified BATCH_SIZE and learn function. And GAMMA parameter. And optimize OUNoise sample function