

# Deep Reinforcement Nano Degree Project

## 1: Navigation

Peng Zhao

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### Abstract

This report briefly summarizes the deep reinforcement nano degree project 1, which is training the agent to collect yellow banana using deep reinforcement learning method. The problem is solved after 191 episodes in this experiment.

## 1 Deep Q-Network Reinforcement Learning Algorithm

In deep Q-learning, a neural network is used to approximate the Q-value function. The state is given as the input and the Q-value of all possible actions is generated as output. The steps of deep Q-Network reinforcement learning algorithm are:

Step 1: Store experience in replay memory

Step 2: Obtain minibatch of tuples  $(s_j, a_j, r_j, s_{j+1})$  from memory

Step 3: Set target  $y_j = r_j + \gamma \max_a \hat{q}(s_{j+1}, a, w^-)$

Step 4: Update:  $\Delta w = \alpha(y_j - \hat{q}(s_j, a_j, w)) \nabla_w \hat{q}(s_j, a_j, w)$

Step 5: Go back to Step 2 until beyond the replay times

Step 6: Go back to Step 1 until reach the required score

where  $s_j, a_j, r_j$  are the state, action, and reward respectively in episode  $j$ ,  $\hat{q}$  is the action-value function,  $w$  represents the weights,  $w^-$  represents the target action-value weights,  $\alpha$  is the learning rate. The Step 4 is using the gradient descending algorithm.

## 2 DQN Architecture

The Deep Q-Network consists of 3 layers with Relu activation. The input data size of the first layer is the state size, which is 37. The output size of the first layer is 64. The output size of the second layer is also set to 64 and the output of the third layer is the action size 4.

## 3 Parameter

The choice of  $\varepsilon$ -greedy parameter  $\varepsilon$  can significant effect the speed of learning. In this experiment, I use the following equation to determine this parameter:

$$\varepsilon = \max(\varepsilon_0 \times d, \varepsilon_{min}) \quad (1)$$

where  $\varepsilon_0$  is the initial value of  $\varepsilon$ ,  $d$  is decay rate for each step in episode,  $\varepsilon_{min}$  is the minimum value that  $\varepsilon$  can use. In this experiment, we use  $\varepsilon_0 = 0.5$ ,  $d = 0.98$ ,  $\varepsilon_{min} = 0.01$ .

## 4 Result

The environment has been solved in this experiment, which is shown in the following figure. As shown, after an initial training, the agent began to obtain higher scores after about 25 episodes. The required score (13.0) is finally reached after 191 episodes.

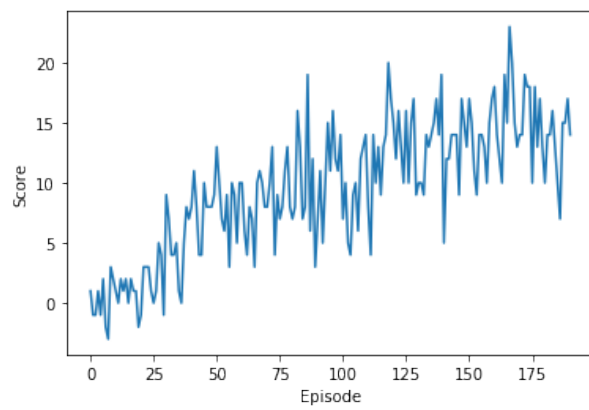


Figure 1: Result