Banana Collection Navigation

####1. DQN Model and Learning Algorithm

In the Unity Banana Collection project, I use these DQN algorithm enhancement, including `Double DQN`, `Priortized Experience Replay (PER)` and `Dueling DQN` methods.

The model structure are as follows:

```
DQNNetwork(
  (hidden): Sequential(
    (0): Linear(in_features=37, out_features=64, bias=True)
    (1): LeakyReLU(negative_slope=0.01)
    (2): Linear(in_features=64, out_features=64, bias=True)
    (3): LeakyReLU(negative_slope=0.01)
  )
  (V): Linear(in_features=64, out_features=1, bias=True)
  (A): Linear(in_features=64, out_features=4, bias=True)
)
```

The model parameters are as follows:

1.1 Table: training parameters

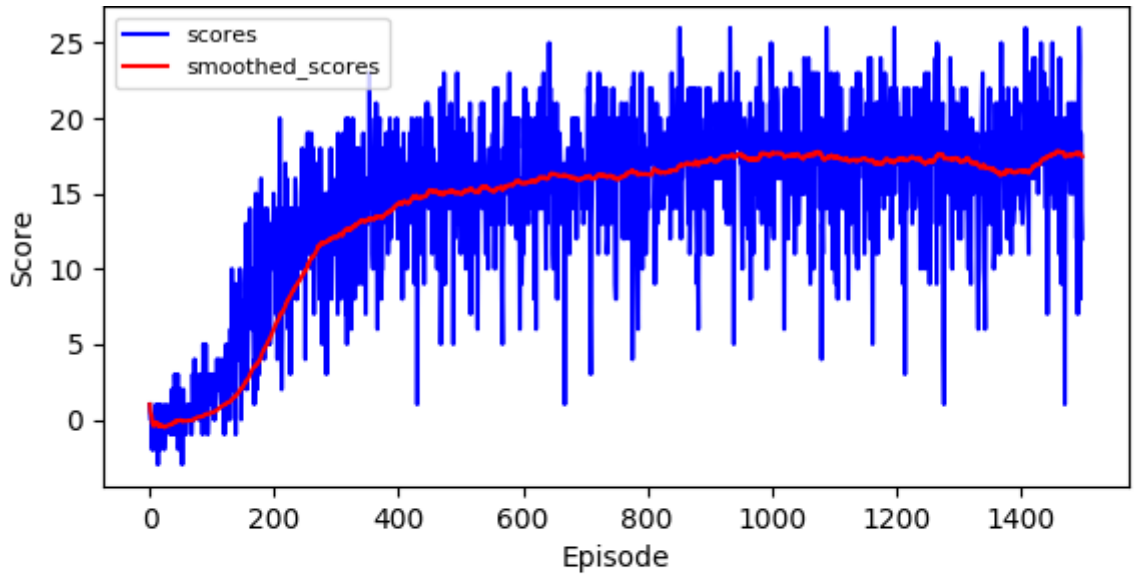
Parameter Name	Parameter Value	Remarks
n_epochs	1500	number of epochs
epsilon	1.	initial epsilon-greedy value
epsilon_decay	0.99	epsilon decay multiplier after each epoch
epsilon_min	0.005	the lower limit of epsilon
batch_size	32	batch size
learning_rate	1e-4	learning rate
gamma	0.95	parameter for setting the discounted experiences of future rewards
replay_buffer_size	10000	size of replay buffer
local_tau	1e-4	interpolation parameter for updating target model parameters
training_steps	3	how many steps to train the model
smoothed_window	100	how many epochs to calculate smoothed scores

1.2 Table: Prioritized Replay Buffer parameters

Parameter Name	Parameter Value	Remarks
replay_buffer_size	10000	size of replay buffer
alpha	0.6	the importance of TD error to priority
beta	0.4	importance-sampling, from initial experiences increasing to 1
beta_increment_per_sampling	0.001	the increment of beta after each sample step
epsilon	0.01	the increment of every TD error to avoid 0
abs_err_upper	1.	the upper limit of every TD error
min_prob_lower	1.e-6	the lower limit of minimum priority

####2. Performance Analysis

Figure 1: Performance on the Unity Banana Collection using the hyper-parameters as above



From the figure above, we can see the scores are increased slowly after about epoch 400.

####3. Future Work

3.1 Try to adjust the hyper-parameters to make it more fast after epoch 400.

3.2 Try to train pixel banana collection environment on GPU machine.

```
PixelDQNNetwork(
  (hidden): Sequential(
    (0): Conv2d(3, 16, kernel_size=(5, 5), stride=(2, 2))
    (1): BatchNorm2d(16, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
    (2): ReLU()
    (3): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1,
ceil_mode=False)

    (4): Conv2d(16, 32, kernel_size=(3, 3), stride=(1, 1))
    (5): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
    (6): ReLU()
    (7): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1,
ceil_mode=False)

    (8): Conv2d(32, 64, kernel_size=(3, 3), stride=(1, 1))
    (9): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
    (10): ReLU()
    (11): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1,
ceil_mode=False)
  )
  (fc1): Sequential(
    (0): Linear(in_features=576, out_features=32, bias=True)
    (1): LeakyReLU(negative_slope=0.01)
  )
  (V): Linear(in_features=32, out_features=1, bias=True)
  (A): Linear(in_features=32, out_features=4, bias=True)
)
```