ASSIGNMENT 5

Jingxian Bao

1. [2 POINTS] WHAT IS THE DIMENSIONALITY OF THE ACTION SPACE OF YOUR ENVIRONMENT? WHAT IS THE DIMENSIONALITY OF THE OBSERVATION SPACE OF YOUR ENVIRONMENT?

Dimensionality of the action space is 5.

1. accelerate

2. decelerate

3. change into the left lane

4. change in to the right lane

5. do nothing, i.e. maintain speed in present lane.

Dimensionality of the observation space is defined by *lanesDide*, *patchesAhea*d, and *pathesBehand*.

In the case of:

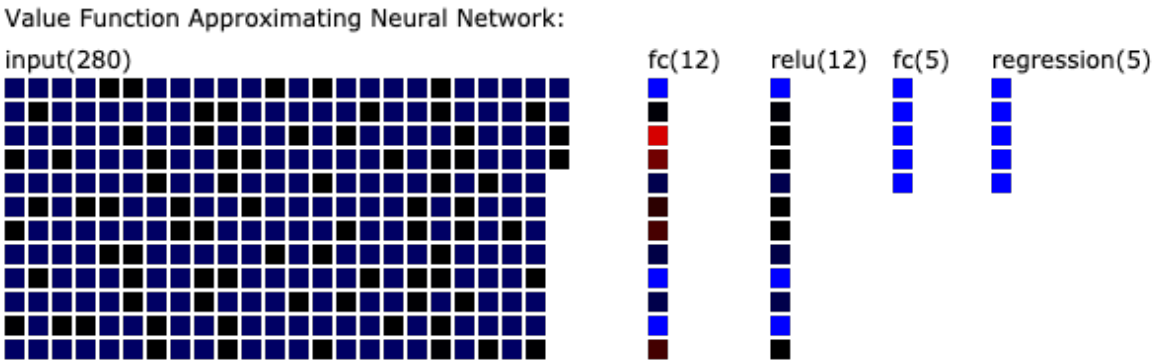
lanesSide = 3;

patchesAhead = 30;

patchesBehind = 10;

The observation space is a 7*40 rectangle.

2. [2 POINTS] INCLUDE A COMPLETE VISUALIZATION OF YOUR NETWORK OBTAINED FROM THE DEEPTRAFFIC SITE, SHOWN AS 'VALUE FUNCTION APPROXIMATING NEURAL NETWORK' WHEN YOU LOAD AND RUN YOUR NETWORK. ALSO INCLUDE IN THE REPORT THE CODE WHICH IS USED TO DEFINE 'LAYER_DEFS' I.E. THE NETWORK ARCHITECTURE.



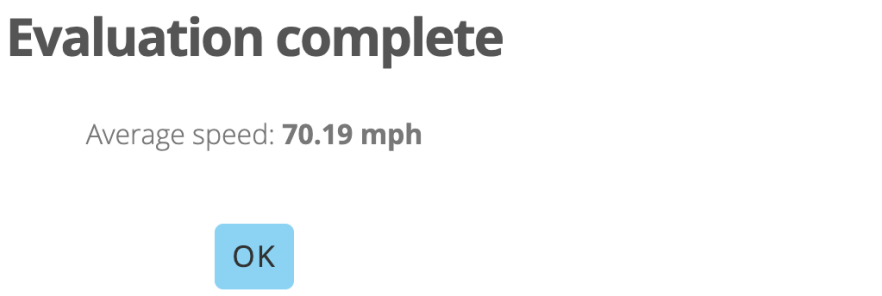

```
var layer_defs = [];
    layer_defs.push({
    type: 'input',
    out_sx: 1,
    out_sy: 1,
    out_depth: network_size
});
layer_defs.push({
    type: 'fc',
    num_neurons: 12,
    activation: 'relu'
});
layer_defs.push({
    type: 'regression',
    num_neurons: num_actions
});

var tdtrainer_options = {
    learning_rate: 0.001,
    momentum: 0.0,
    batch_size: 64,
    l2_decay: 0.01
};
```

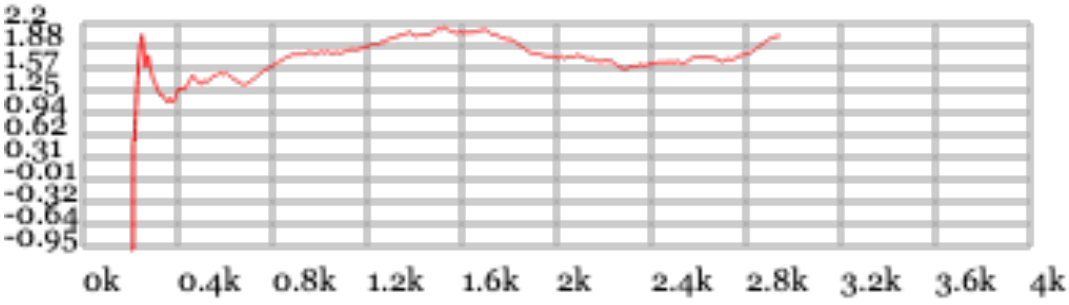
3. [2 POINTS] INCLUDE IN THE REPORT THE PARAMETERS OF THE OPTIMIZER ('OPT') WHICH GAVE YOU THE BEST RESULTS. WHAT IS THE BEST SPEED ATTAINED BY YOUR TRAINED NEURAL NETWORK?

```
var opt = {};
opt.temporal_window = temporal_window;
opt.experience_size = 3000;
opt.start_learn_threshold = 500;
opt.gamma = 0.95;
opt.learning_steps_total = 100000;
opt.learning_steps_burnin = 1000;
opt.epsilon_min = 0.0;
opt.epsilon_test_time = 0.0;
opt.layer_defs = layer_defs;
opt.tdtrainer_options = tdtrainer_options;
```

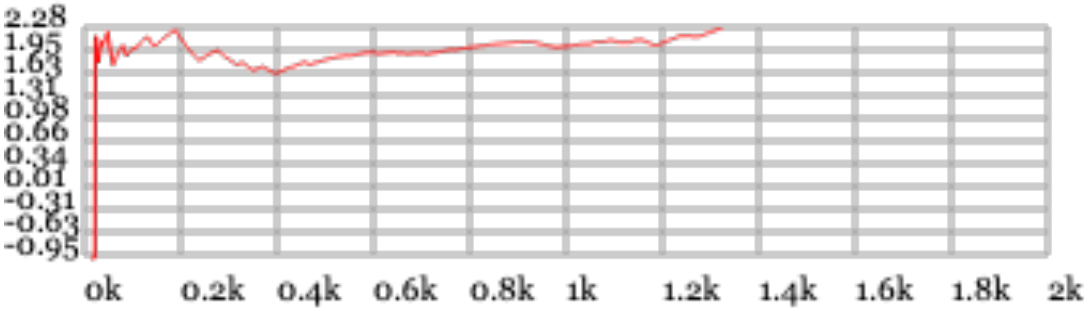
The best speed attained is 70.19.



4. [2 POINTS] INCLUDE A PLOT WHICH SHOWS THE MOVING AVERAGE OF YOUR CAR'S REWARD AFTER IT HAS BEEN TRAINED USING YOUR DESIGNED NETWORK.



5. [2 POINTS] SET THE LEARNING ALGORITHM TO 'ADAM' INSTEAD OF 'SGD'. THIS CAN BE ACCOMPLISHED BY SETTING 'METHOD' ATTRIBUTE IN THE 'TDTRAINER_OPTIONS' DICTIONARY TO 'ADAM'. DOES THIS SPEED UP THE TRAINING PROCESS I.E. DO THE REWARDS DURING THE TRAINING PROCESS INCREASE FASTER WITH 'ADAM' COMPARED TO 'SGD'?



After changing the learning algorithm from "sgd" to "adam" the rewards increase faster. As shown in the graph above, reward of the model using "adam" increases rapidly to around 1.95, yet the initial reward of the "sgd" model is only about 1.88 and drops to 1 after few rounds of training.

6. [0 POINTS] HOW MANY HOURS DID THIS ASSIGNMENT TAKE TO CODE (EXCLUDING THE TIME SPENT IN RUNNING THE CODE)?

About 2 hours.