The goal of the project is to create a DQN agent and define reward functions to teach a robotic arm to carry out two primary objectives:

1. Have any part of the robot arm touch the object of interest, with at least a 90% accuracy.
2. Have only the gripper base of the robot arm touch the object, with at least a 80% accuracy.

Type of joint control

For both tasks I chose position control, I didn't try velocity control.

The loss and win reward are defined

```
#define REWARD_WIN 1.0f
#define REWARD_LOSS -1.0f
```

Task #1

Reward function and associated reward values

1. When any part of the arm touch the tube, it wins and set the last reward to REWARD_WIN and end the episode

```
rewardHistory = REWARD_WIN;
newReward = true;
endEpisode = true;
```

2. When any part of the arm touch the ground, it loses and set the last reward to REWARD_LOSS and end the episode

```
rewardHistory = REWARD_LOSS;
newReward = true;
endEpisode = true;
```

3. When the number of frames in the episode exceed the maxEpisodeLength it end the episode and set the reward to REWARD_LOSS (which is the default)

```
rewardHistory = REWARD_LOSS;
newReward = true;
endEpisode = true;
```

4. interim reward based on the distance to the object after smoothing it, with ALPHA = 0.25

```
avgGoalDelta = avgGoalDelta * ALPHA + distDelta * (1 - ALPHA);
rewardHistory = avgGoalDelta * 10.0;
newReward = true;
```

Choice of hyperparameters

INPUT_WIDTH & INPUT_WIDTH	64
OPTIMIZER	RMSprop

LEARNING_RATE	0.01

Results

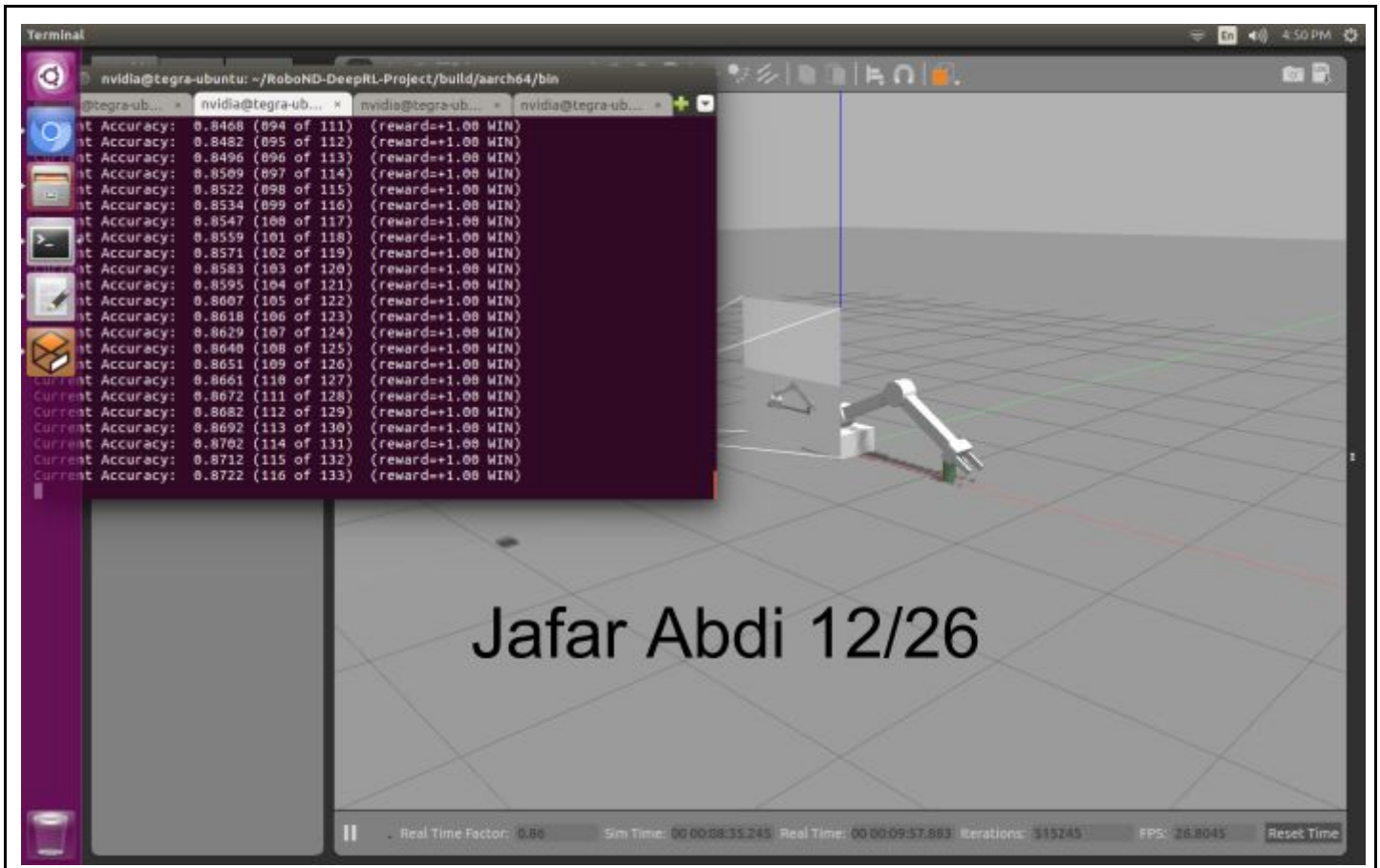## Task #2

Reward function and associated reward values

the same as task #1

Choice of hyperparameters

same as task #1 just changed the following two after two days trying to finish it with RMSprop optimizer

OPTIMIZER	Adam
LEARNING_RATE	0.001

Results

Video of task #2

Discussion

The images and videos of the results are shown in the last table of each task.

For task #1 the required accuracy was achieved easier than the second one.

For task #2 I spend a lot of time tuning the hyperparameters lastly I decided to change the optimizer, unfortunately we have just two options for the optimizer Adam and RMSprop otherwise it gives an error.

Future work

Try to increase the number of frames in an episode, number of episodes.
Try velocity control and compare it to the position one.
Add LSTM and tune its hyperparameters.
Explore a non-fixed base and compare it with the fixed base.
Make the object location change randomly.