

Deep RL Robot Arm

Abstract: in this project training is done on a robot arm with 3 degrees of freedom using Deep RL in order to achieve the task of touching an object in the environment.

1-Introduction

There are 2 objectives that were set for this project,

1- train the arm to touch the object with any part

Here a goal is set to reach 90% accuracy

2- train the arm to touch the object with the grip

Here a goal is set to reach 80% accuracy

2-Background

The DQN agent (robot arm) is trained using Deep RL technique
RL:

An agent (the robot arm in this case) is trained to achieve a certain task and is rewarded if he does actions that achieve it and penalized if the actions don't achieve the task

DRL:

We add an artificial neural network to the agent which replaces the traditional sensor measurement step with end to end approach. Where the network receives the sensor measurements as input and the output is the action the agent will take.

3- Project :

Hyper parameters:

Several runs were made to find the best values, starting with the learning rate from 0.1 it was found that 0.001 was a good choice.

2 optimizers were tested adam and RMSprop and the later proved to be more suitable for this task

Lstm was enabled for the project with a size of 256

Relay memory of 10000 and 20000 were tested and 20000 proved to yield better results

Rewards:

Task1:

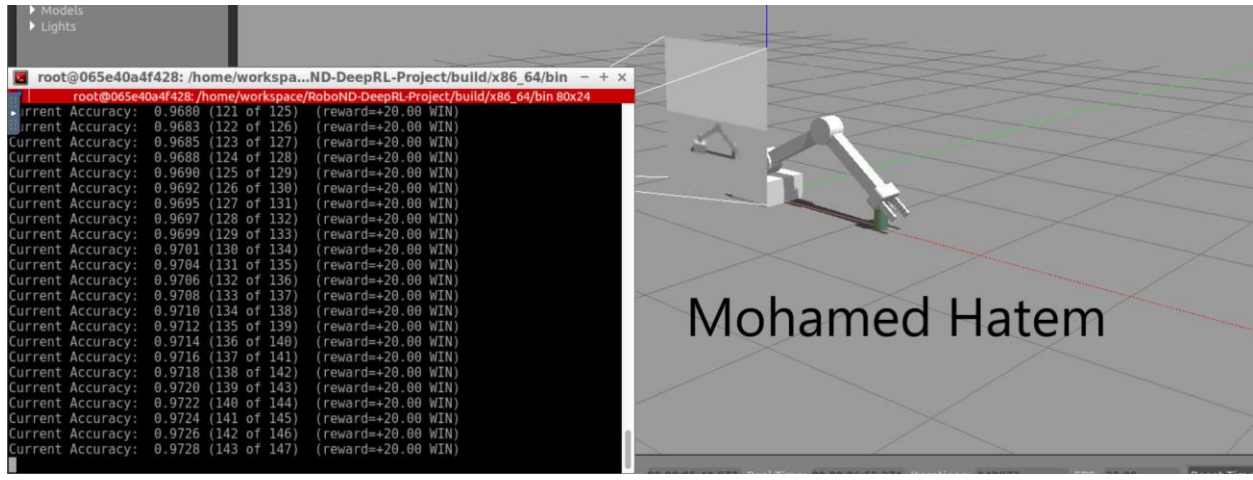
The agent receives a reward if any part of the robot touches the object, and receives a loss if it takes more than 100 frames or touches the ground which will result in the end of the episode

Task2:

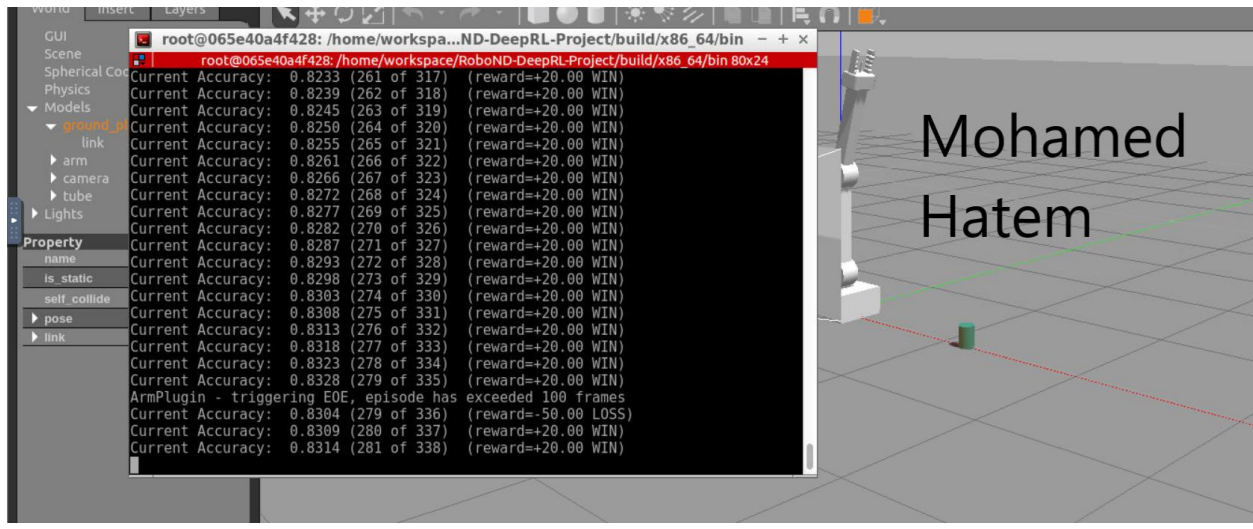
The agent receives a reward if the grip of the robot arm touches the object, and receives a loss if it takes more than 100 frames or touches the ground which will result in the end of the episode

4- Results

Task1:



Task2:



5- Discussion:

Both target accuracy were achieved with the first task having 97% and the second 83%, accuracy can be increased if we modified the reward function and tweaked the hyper parameters

6-Conclusion/future work:

The robot arm can be trained to grasp objects located in random parts of the environment not just a fixed location also we can extend this to pick and place objects while also placing them in a sorting order passed on a predefined criteria.