

## Exercise 4

I have evolved both robots “hopper” and “halfcheetah” using original as well as modified reward function. I used the following command to evolve the robot

```
sudo python3 ../bin/es.py -f hopper.ini -s 2
sudo python3 ../bin/es.py -f halfcheetah.ini -s 2
```

However in both cases, evolved agent does not perform good. There was just a very little bit improved result in case of reward function from pybullet folder but still evolved agent is not able to take any steps. You can find evolved trained files in “**xhopper\_original**” and “**xhopper\_edited**” directories. I have also placed the two files namely ‘robot\_locomotors.py’ and ‘gym\_locomotion\_envs.py’ original and modified files in respective directories.

## Exercise 5

```
user@d98aaf14445b:/opt/balance-bot$ sudo pip install -e .
WARNING: The directory '/home/user/.cache/pip' or its parent directory is not owned or is not writable by the current user. The cache has been disabled
permissions and owner of that directory. If executing pip with sudo, you may want sudo's -H flag.
Obtaining file:///opt/balance-bot
Requirement already satisfied: gym in /usr/local/lib/python3.5/dist-packages (from balance-bot==0.0.1) (0.16.0)
Requirement already satisfied: pybullet in /usr/local/lib/python3.5/dist-packages (from balance-bot==0.0.1) (2.5.0)
Requirement already satisfied: six in /usr/lib/python3/dist-packages (from gym->balance-bot==0.0.1) (1.10.0)
Requirement already satisfied: scipy in /usr/local/lib/python3.5/dist-packages (from gym->balance-bot==0.0.1) (1.4.1)
Requirement already satisfied: numpy>=1.10.4 in /usr/local/lib/python3.5/dist-packages (from gym->balance-bot==0.0.1) (1.17.4)
Collecting enum34<=1.1.6
  Downloading enum34-1.1.10-py3-none-any.whl (11 kB)
Requirement already satisfied: cloudpickle<=1.2.0 in /usr/local/lib/python3.5/dist-packages (from gym->balance-bot==0.0.1) (1.2.2)
Requirement already satisfied: pygame<=1.5.0,>=1.4.0 in /usr/local/lib/python3.5/dist-packages (from gym->balance-bot==0.0.1) (1.5.0)
Requirement already satisfied: future in /usr/local/lib/python3.5/dist-packages (from pygame<=1.5.0,>=1.4.0->gym->balance-bot==0.0.1) (0.18.2)
Installing collected packages: balance-bot, enum34
  Running setup.py develop for balance-bot
Successfully installed balance-bot enum34-1.1.10
user@d98aaf14445b:/opt/balance-bot$ python3
Python 3.5.2 (default, Oct 8 2019, 13:06:37)
[GCC 5.4.0 20160609] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import balance_bot
>>>
```

I have made the file directory “**balance-bot**” as described and created files in them as described in the pdf training manual. The result is the creation of a successful GYM environment which I have checked by installing it. The screenshot is as follows:

As we can see that the environment is successfully imported without any error.

## Exercise 6

I have run 11 experiments for the seeds of 1, 2, 3, 4, 5, 8, 9, 10, 11, 12 and 13 whose results are present in directory “**xdiscrim**”. I observed that robots evolved with higher seeds are unstable and tend to rotate around the cylinder and their own axis whereas the robots evolved with lower seeds are relatively stable and tend to stay at one point very near to the cylinder. I see the robots evolved with seeds 11, 12 and 13 are constantly rotating on their own axis while moving forward and when they reach near the

cylinder robot starts to rotate around the cylinder. So I would group 11, 12 and 13 seeds as one group with unstable behaviour.

Till seed 10, robot rarely rotates around its own axis and when reaches near the cylinder, its just stays in front of cylinder trying to be stationary or does small forward and backward movements continuously. So I would group them as stable behaviour.