

## HOME WORK 3 - CS 687

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### PART 1

#### Instructions.

Install Dependencies : numpy, matplotlib, joblib, pylab

```
pip install --user joblib
```

To Run Q Learning :

Go to main.py

In main function set trials to required number of trials and set the hyper parameters like alpha, epsilon, gamma and Fourier Order

So if you want fourier of order "x", please set order = "x+1"

Also if you want to plot graph for the question make sure the directory q3\_final\_QL is empty and then run python main.py will run for required trials but will not plot any graphs. It saves all the trials to the directory q3\_final\_QL.

Graph - uses all files saved to q3\_final\_QL

To plot a graph, go to main.py and comment main() and uncomment plotforQLearning()

and run 'python main.py'

It saves it as file named q3\_ql\_10k.png

If you want to update the number of episodes QLearning runs for, in each trial. Go to Qlearning.py and update episode\_stop\_count from 60 to the desired number

If you want to set the number of process that is spawned inside training , go to main.py and set n\_jobs=required\_number\_of\_jobs

To Run SARSA :

Go to mainsarsa.py

In main function set trials to required number of trials and set the hyper parameters like alpha, epsilon, gamma and Fourier Order

So if you want fourier of order "x", please set order = "x+1"

Also if you want to plot graph for the question make sure the directory q3\_final\_SARSA is empty and then run python mainsarsa.py will run for required trials but will not plot any graphs. It saves all the trials to the directory q3\_final\_SARSA.

Graph - uses all files saved to q3\_final\_SARSA

To plot a graph, go to main.py and comment main() and uncomment plotforSARSA() and run 'python mainsarsa.py'

It saves it as file named q3\_sarsa\_10k.png

If you want to update the number of episodes that SARSA runs for, in each trial. Go to sarsa.py and update episode\_stop\_count from 200 to the desired number

If you want to set the number of process that is spawned inside training , go to mainsarsa.py and set n\_jobs=required\_number\_of\_jobs

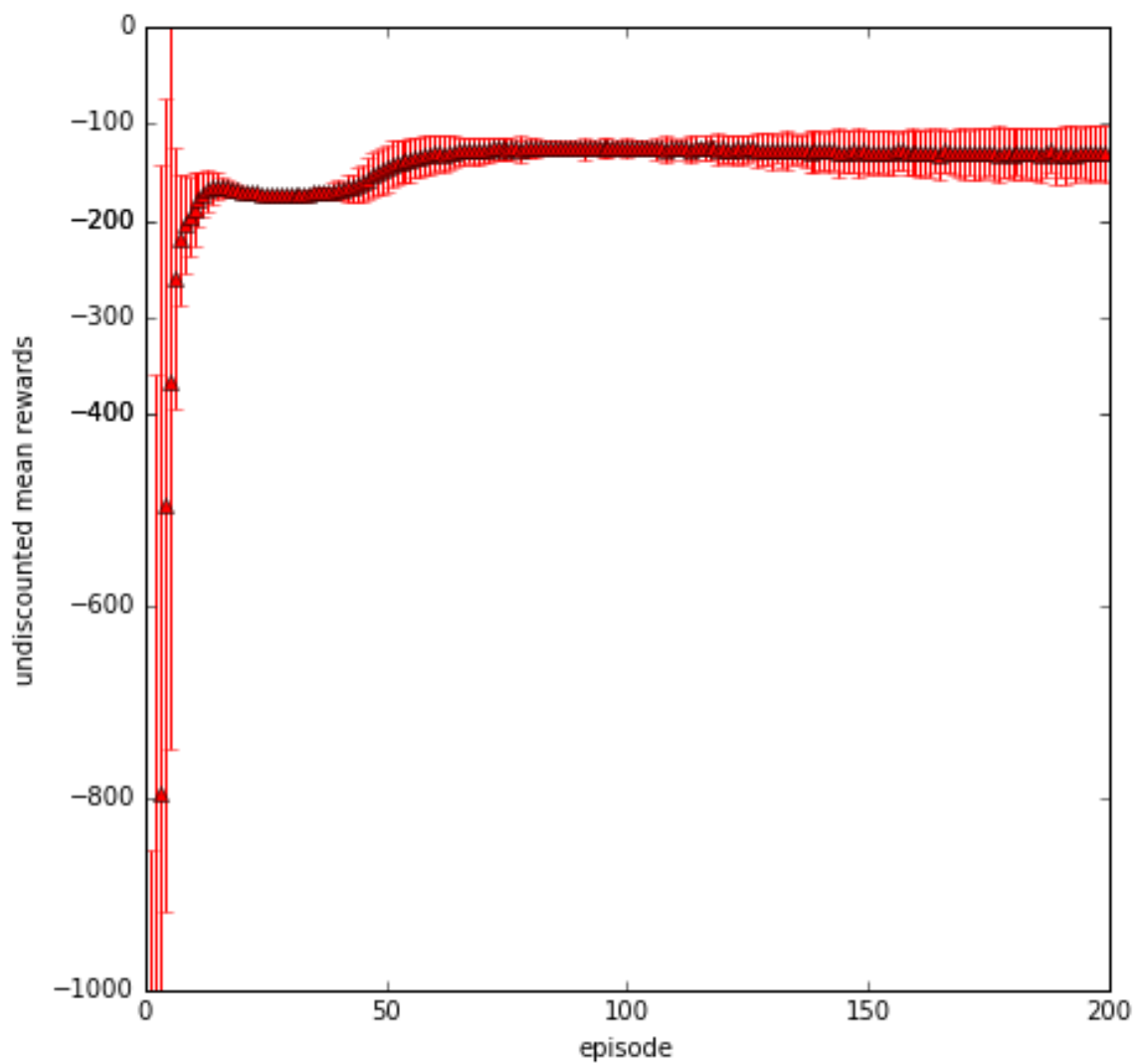
## PART 2

**SARSA Graphs.** The following was done with the hyperparameters :

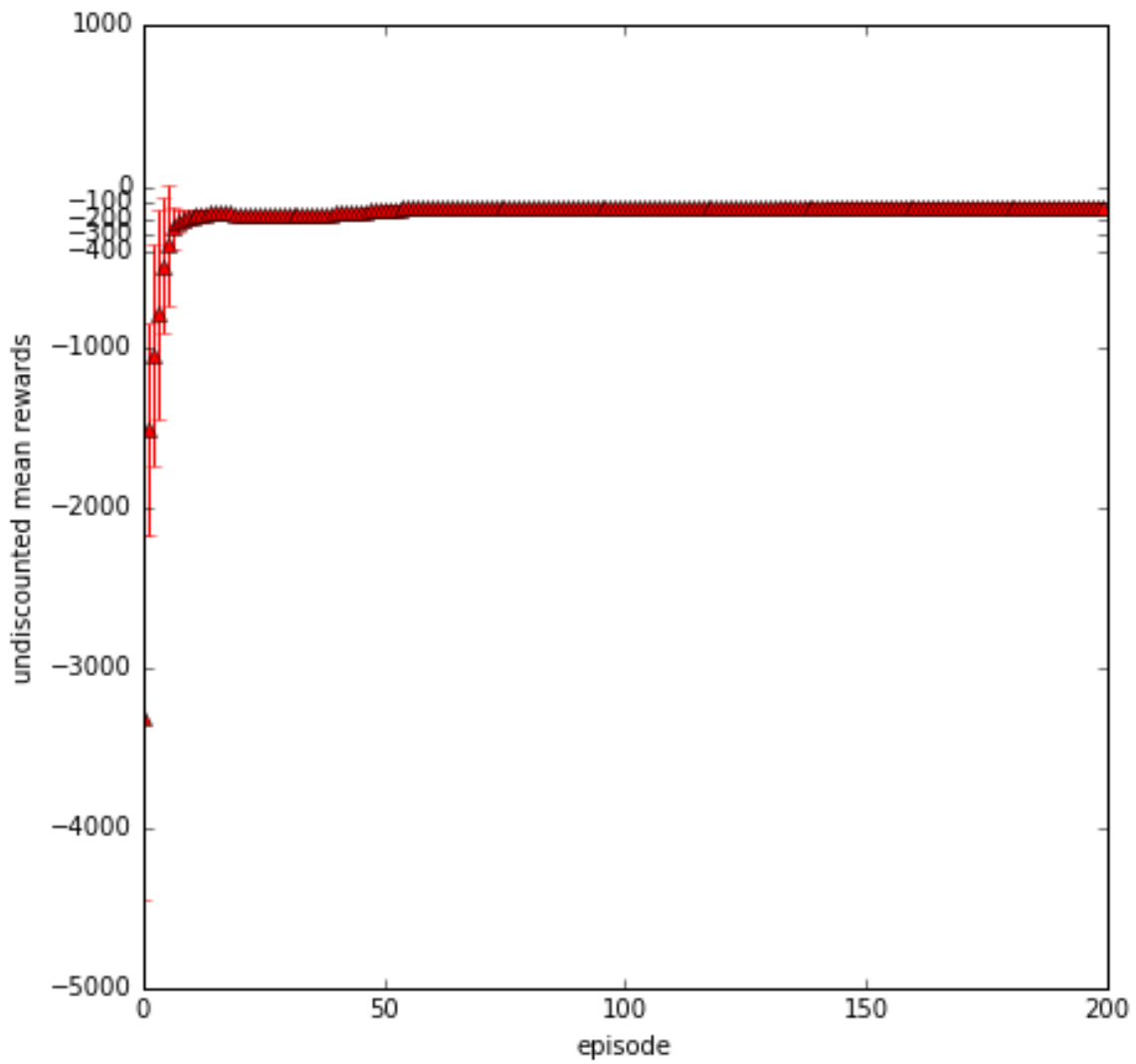
$\alpha = 0.01, \gamma = 1, \epsilon = 0.01$ , Fourier Order = 1

Number of episodes are 200, Number of trials are 500

With the -1000, 0 bound on the yaxis, the graph for SARSA is as follows



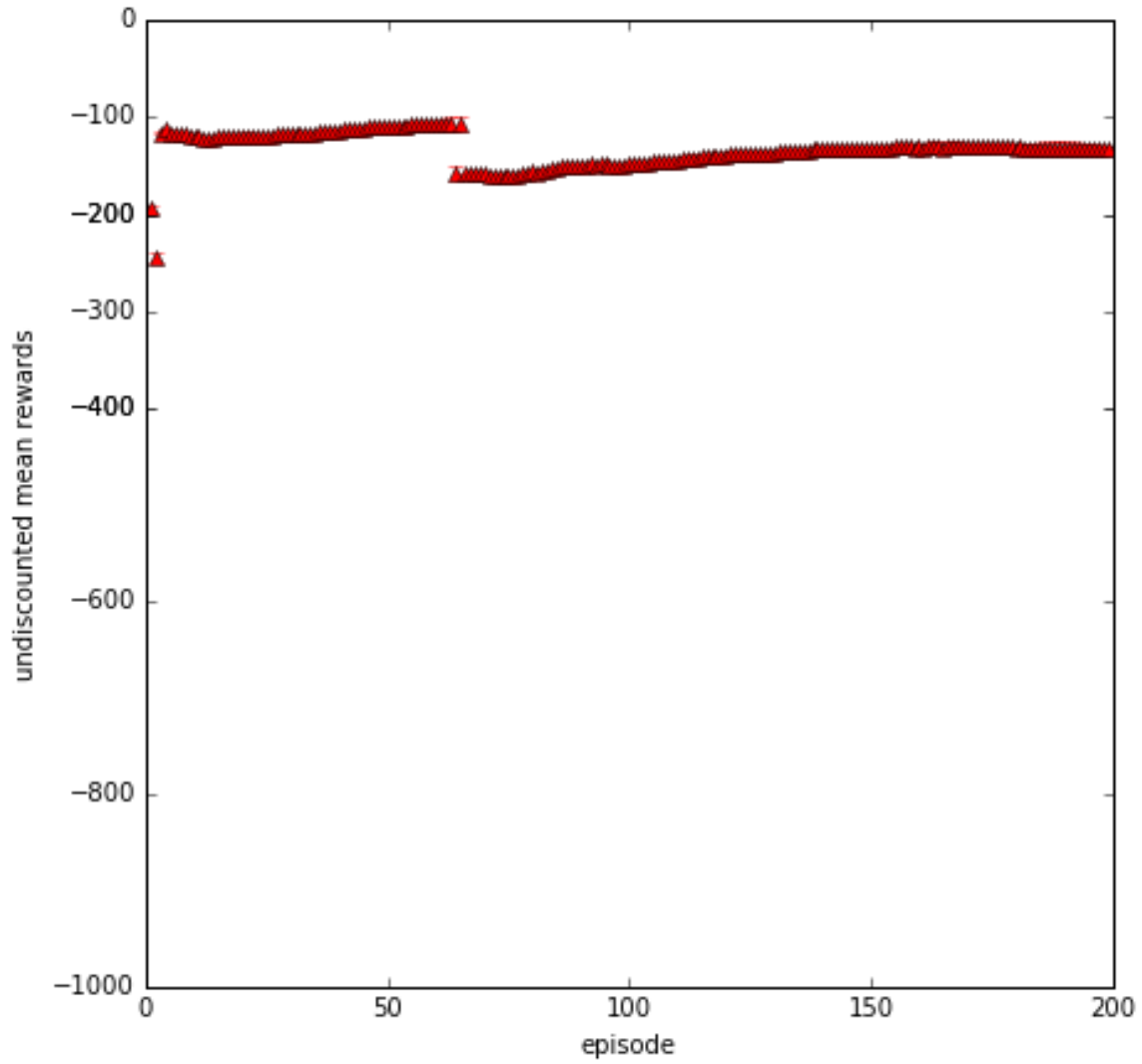
Without the -1000, 0 bound on the yaxis, the graph for SARSA is as follows for the same hyperparameters mentioned above.



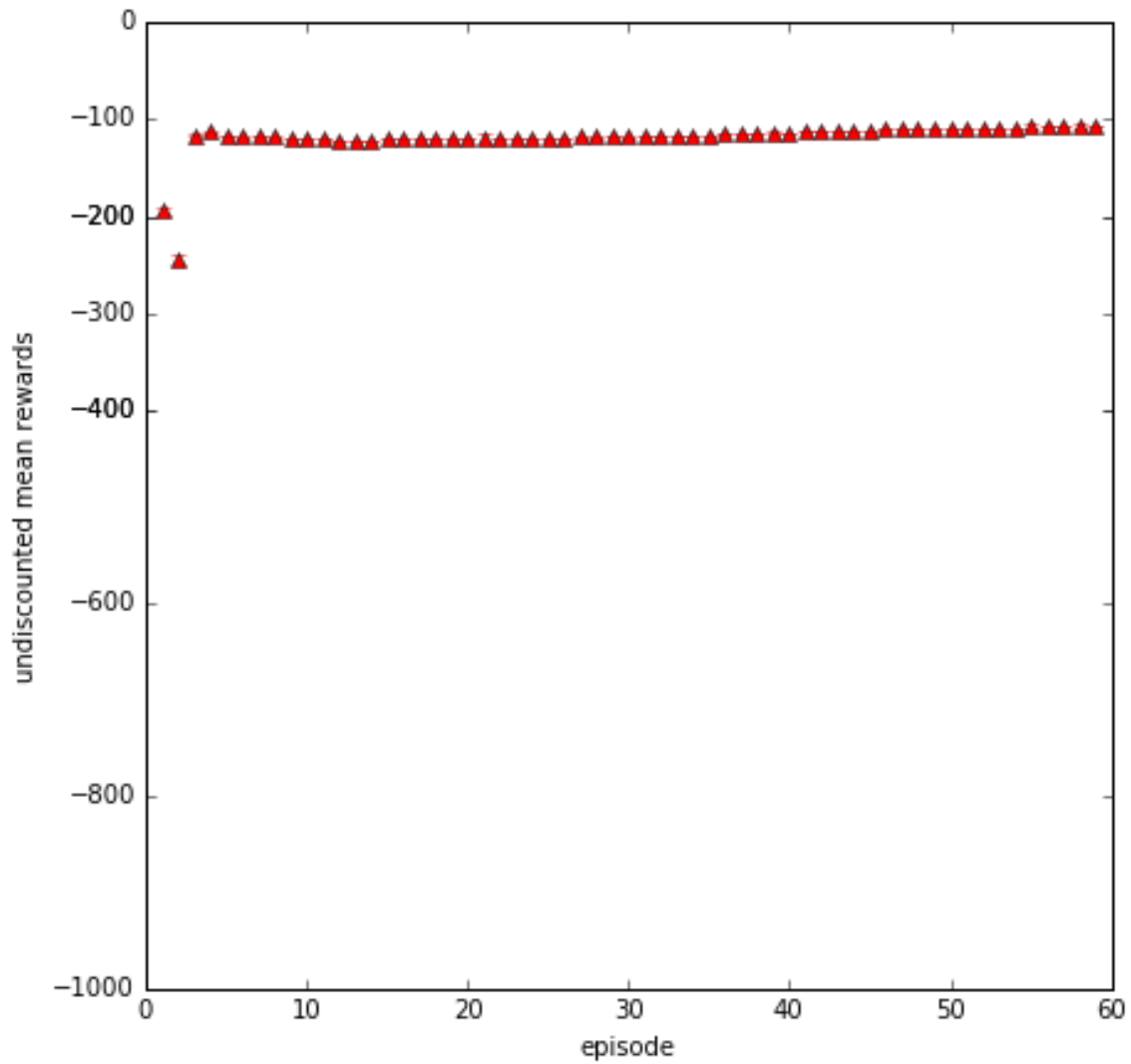
**Qlearning Graphs.** The following was done with the hyperparameters :

$\alpha = 1e - 05, \gamma = 1, \epsilon = 0.07$ , Fourier Order = 1

Number of episodes are 200, Number of trials are 500



Same Hyper parameters as above graph but goes only till 60 episodes instead of 200 episodes.  
 $\alpha = 1e - 05, \gamma = 1, \epsilon = 0.07$ , Fourier Order = 1

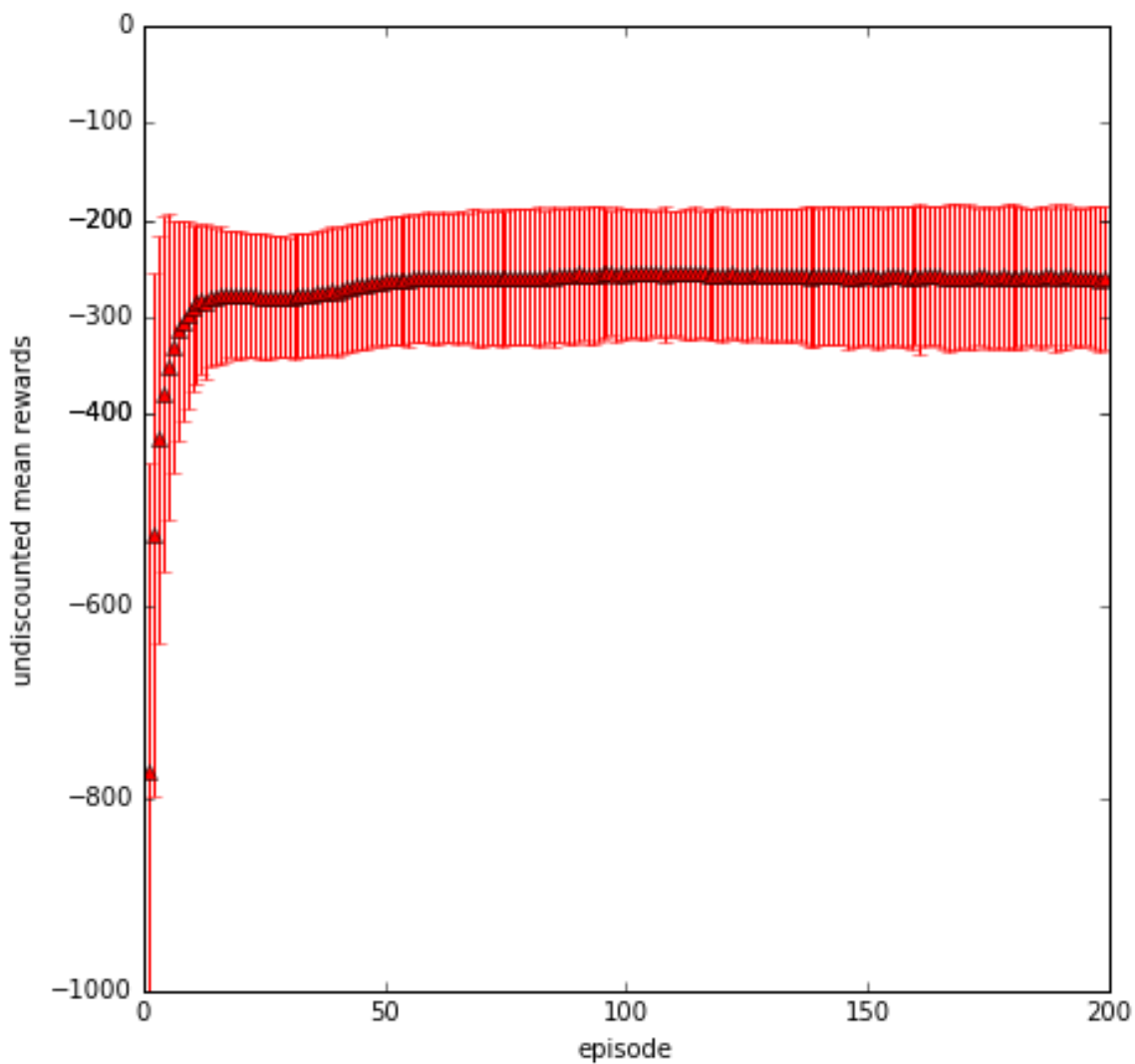


The hyperparameters i tested out are present in the folder hyperparamtuning in the zipped file

### PART 3

**SARSA Graphs.** This is the graph for SARSA run for 200 episodes and 10000 trials with hyperparameters  $\alpha = 0.05, \gamma = 1, \epsilon = 0.5$ , Fourier Order = 1

Time Taken for my code to run is appx 3 hours running 3 parallel tasks each running 3000 trials with 4 process each , and ran another task parallel in another machine for the last 1000 trials on another machine.



**Q Learning Graphs.** This is the graph for Q Learning run for 60 episodes and 10000 trials with hyperparameters  $\alpha = 0.05, \gamma = 1, \epsilon = 0.5$ , Fourier Order = 1

Time Taken for my code to run is appx 2.5 hours on a high spec laptop(i7, 8GB Ram, 8 core CPU) running 2 parallel tasks each running 2000 trials with 4 process each , which was repeated till 10k trials were done.

