

COMP 5313- ARTIFICIAL INTELLIGENCE

EXERCISE 1

OpenAI Gym RL: Robo- Taxi Driving

Methodology:

I created one .py file in order to train one agent using random walk and train the other agent using Q- learning.

Random Walk: A random walk is a stochastic process where a walker takes unpredictable steps at each time point, lacking a systematic trend or memory of past movements. In reinforcement learning, a random walk is used for basic exploration, providing a benchmark for more advanced strategies, and serving as a simple initialization method for agents navigating an environment.

Q-learning Technique: Q-learning is a model-free reinforcement learning technique used for training agents to make decisions in an environment. It involves learning a Q-value function that estimates the expected cumulative future rewards for taking a particular action in a given state. The agent iteratively updates its Q-values based on the observed rewards, allowing it to make informed decisions to maximize long-term rewards over time.

Training an Agent using Random Walk:

In this Robo- taxi driving problem there are 500 possible states and 6 possible actions. We set the agent at a random start state and he takes a random action. In iterations, the agent selects a random action from the possible actions and the loop ends when the driver drops the passenger at the destination.

Training an Agent using Q- Learning Technique:

The Q-Learning is first trained for 10000 episodes and the values are updates in each iteration. During the training a comparison graph is plotted for time steps to complete a ride and penalties per ride. Then the trained agent will perform the task for 1 episode only so that we could compare with random walk agent.

Comparison:

- **Agent trained using Random Walk**

```
print("Timesteps taken (Agent ): {}".format(epochs))
print("Penalties incurred (Agent): {}".format(penalties))
print("Rewards collected (Agent): {}".format(reward))
```

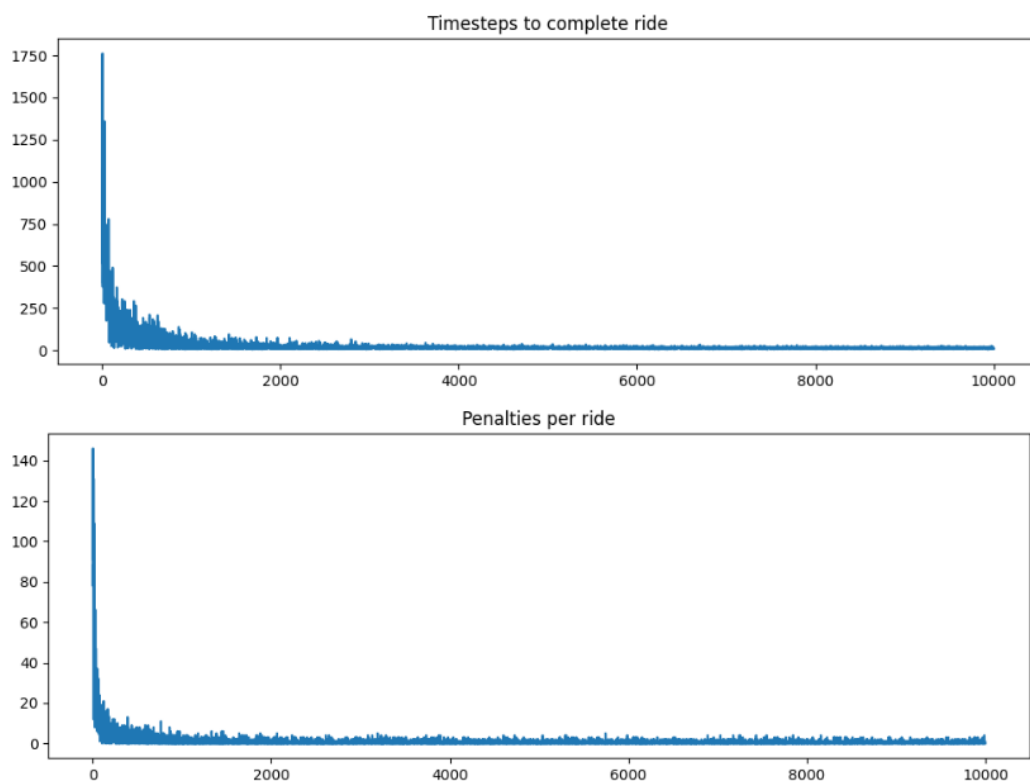
```
Timesteps taken (Agent ): 1672
Penalties incurred (Agent): 558
Rewards collected (Agent): 20
```

- **Agent trained using Q- Learning**

```
print(f'Avg steps to complete ride: {np.array(timesteps_per_episode).mean()}')
print(f'Avg penalties to complete ride: {np.array(penalties_per_episode).mean()}')
```

```
Avg steps to complete ride: 23.0
Avg penalties to complete ride: 1.0
```

Graph plotted while training



Conclusion:

As you can see from the above results the number of steps taken for one episode in random walk is more than one episode in Q-learning. From this we can decide Q- learning is better than Random walk.

References:

- [1] Lecture Notes 2 of AI by Dr. Sabah
- [2] <https://fakabbir.github.io/reinforcement-learning/docs/opentaxi-v2/>
- [3] https://www.youtube.com/watch?v=4D-dQmIx_r0
- [4] <https://www.gocoder.one/blog/rl-tutorial-with-openai-gym/>
- [5] <https://www.learndatasci.com/tutorials/reinforcement-q-learning-scratch-python-openaigym/>
- [6] <https://www.youtube.com/watch?v=1i0MnGILhec>
- [7] <https://hackernoon.com/reinforcement-learning-part-2-the-q-learning-algorithm>