Reinforcement learning for Flight Ticket Pricing (CSE 402 at 22/02/2021)

Md. Abu Shahan (170103020017 – shahanahmed668@gmail.com); Nabil Islam (170103020060 – nabilislam0047@gmail.com); (Supervisor: SC)

Objective

- This project aims to predict optimal airline ticket price window on which a customer should buy his ticket.
- The uncertainty and variability in ticket prices, also the sophisticated algorithm chosen by airlines makes the task very complex.
- To solve this difficult task, we employed two reinforcement learning techniques: the Q learning and the deep Q network.

Our Previous Work

In the previous semester we trained two datasets with Q-Learning model to predict optimal time to buy air ticket. The result of the optimization was ok, but not satisfactory enough.

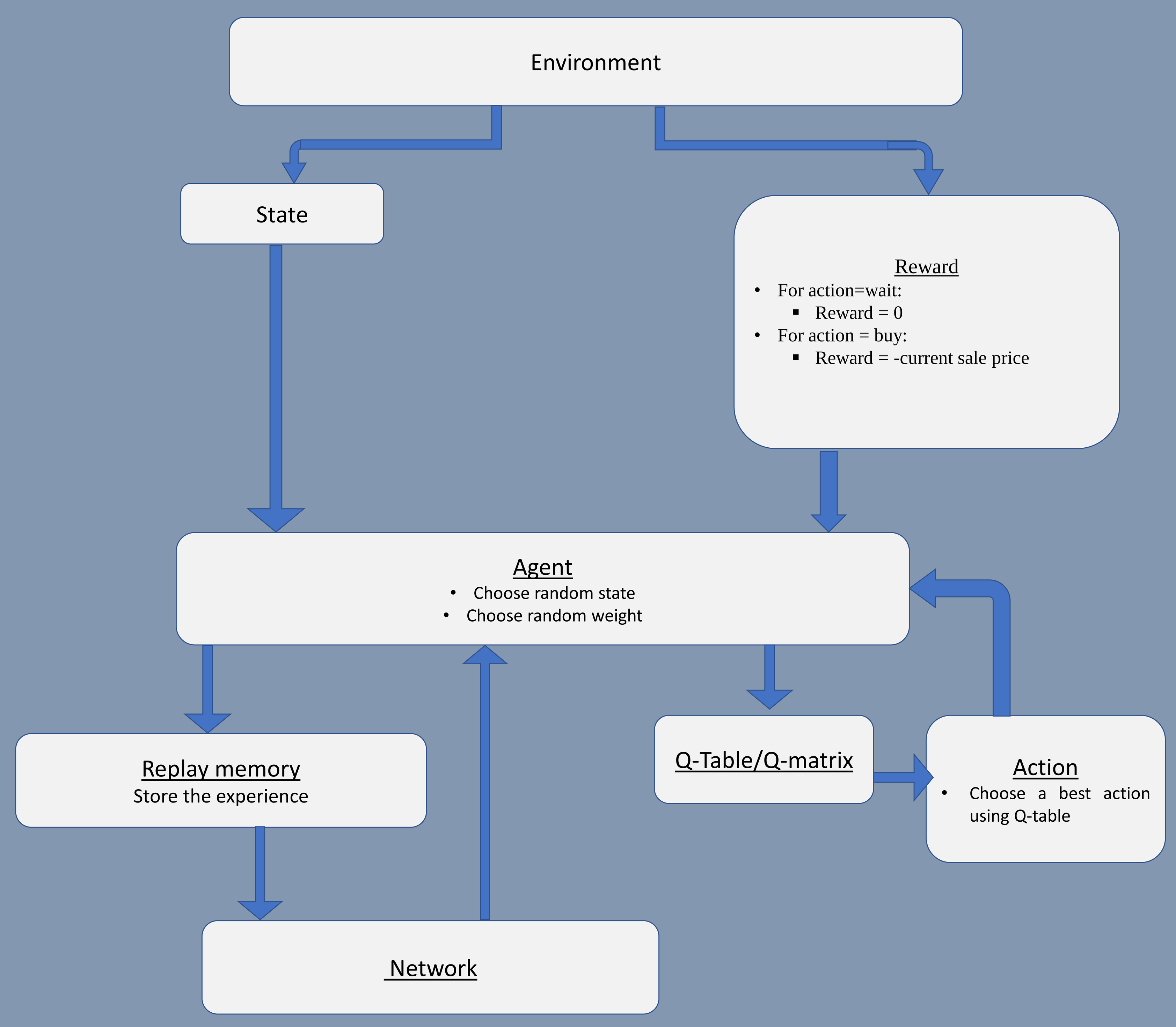
Q-Learning

We implemented a Q-learning model to predict air ticket price optimally. This model can predict the optimal time to buy tickets but the result was not satisfying.

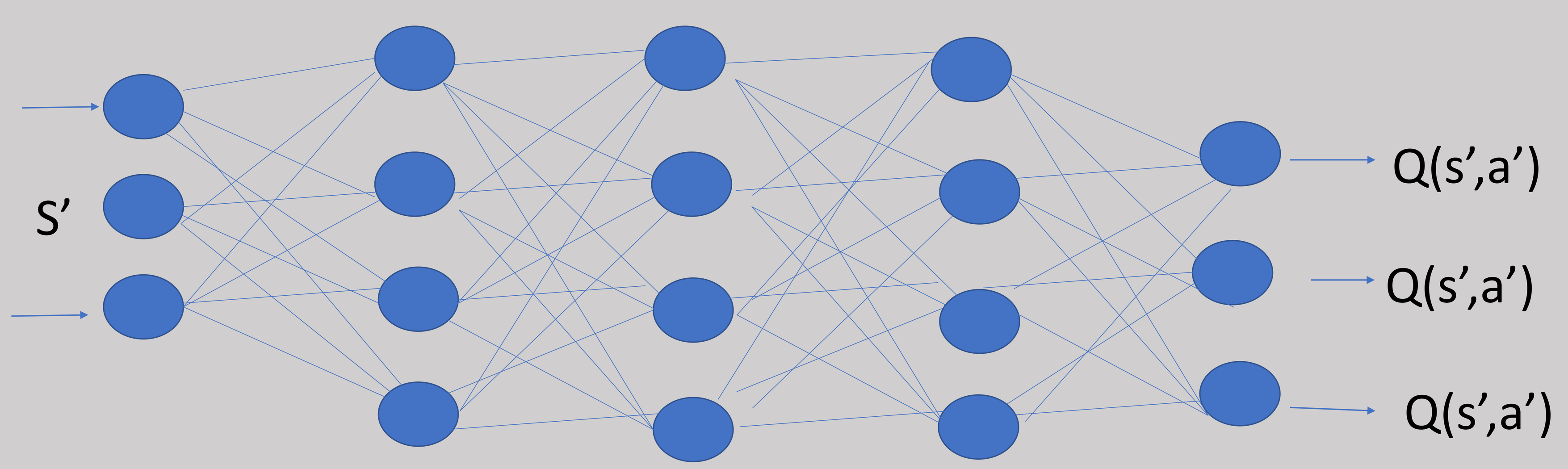
Network Layers

We have implemented a neural network that has 3 hidden layers. We used root-mean-square-error as our loss function. Our activation function is ReLu. The layers take some raw input and transform this input data by calculating weights. Then calculate an intermediate state and pass it to the next step. By repeating those steps the neural network learns multiple layers of non-linear data. Then combine those data in the final layer for output.

High level Architecture



Network architecture



- Calculate loss between output Q-values and target Q-values
- Updates weights in the target network

Our model(Deep Q-Network)

- First of all our agent choose a random state from the environment.
- The agent select an action by exploration or exploitation.
- Execute selected action.
- The agent observe reward and next states.
- Store reward as experience in replay memory.
- Choose random batch of states from replay memory.
- Preprocess states from batch.
- Pass batch of preprocessed states to policy network.
- Calculate loss between output Q-values and target Q-values.
- Pass Calculated loss to the target network for the next state.
- We use updates weights in the policy network to minimize loss.

Result

The DQN model produced a much better result than our previous model Q-Learning. The interesting thing is the number of buys rises in the DQN model. And the avg. price of the ticket (buy) decries significantly. As per our calculation, the DQN model saves at an average of 107 $. (10.39 %) per ticket than the Q-Learning model.

Model	Number of buys (%)	Avg. price of buys
Q-Learning	0.75%	1029
DQN	2.75%	922

What we have done?

- We implemented Q-learning and Deep Q-Network.
- Our models can predict the optimal time to buy the flight tickets at a relatively low price or wait for a better price in the future.
- We improved the result by using DQN.

Future Work

The next time we will try to improve our result. We will try to implement some other reinforcement learning algorithms. We think those algorithms will yield better output for airline price prediction.

.

Conclusion

- DQN improved our result that we are expected.
- This model makes the prediction much better than our previous model Q-learning.

Contribution

- Most of the theoretical part done by Nabil Islam.
- Most of the implementation part done by Md. Abu Shahan.
- In the last half, we merge our contributions and worked accordingly.
- We both understand every single line of both the implementation part and the theoretical part.