The Q-learning agent and the Deep-Q network did not offer drastic differences in overall performance in the games. The Deep-Q network agent performs 500 “steps” per episode while the Q-learning agent plays the game until the agent runs out of lives or completes the game. This made the Deep-Q network agent normally take more episodes to perform as well as the Q-learning agent.

Space Invaders

We chose space invaders because it is a more complex game where the agent must shoot down spaceships before they reach the ground. In this game, the agent will have to shoot down the spaceships and it will also have to know when to react and dodge the spaceships shooting at it. Along with that, the agent will be able to hide behind barriers and will have to know when to do that and when to move. There are a lot of pieces to this game, and we chose it because it would be interesting to see if the agent would know when to do all those things and if it would be successful doing all those things. After a lot of episodes, both agents were able to learn that the ships move slightly, and the agents followed that movement. Both learned to not shoot the barriers as much but do not use them to their advantage. They were also more hesitant to shoot. In the early episodes they would shoot all the time. In the later episodes they would shoot less often but more precisely.

Episodes	Q-Learning Score	Deep-Q Network Score
1	80	60
10	120	100
50	135	120
100	150	180
200	180	170

Skiing

In the Skiing Atari game, the agent must ski downhill, and must go through randomly placed gates without hitting any of the randomly placed trees. We chose this one because it is a good test to see if the agent can respond to random objects in the environment. It was also interesting to see that the agent was able to avoid the negative obstacles (trees) in the environment and not avoid the positive ones (the ski gates). The agent would have to make it through all the gates and make it to the bottom of the hill as fast as it could, unless it could not make it to the bottom. We chose this because we wanted to see if the agent would be able to successfully react and respond to the randomness of the game. Both agents were able to learn a “z” shape movement as the episodes increased. Neither agent was able to reach the bottom with in the time limit.

Episodes	Q-Learning Score	Deep-Q Network Score

1	20	20
10	18	19
50	18	18
100	15	16
200	13	12

Alien

This game is pretty much Pac-man. The agent gets rewarded with 10 points for picking up a dot. The agent also gets 3 lives, losing a life when it runs into one of the 3 aliens. This game is good at seeing how the agent adapts when it finds the power-ups, which rewards the agent with a flat 100 points for getting it and an extra 100 if it runs into an alien while under the effects of a power-up. For this game to converge with either agent we think it would take a lot of episodes. Every time the agents die it gets a negative reward. This can make the agents avoid the position it died in in later episodes. Both learned that the power-up was highly rewarding and went to them quickly. The randomness of the ghosts and unawareness of the agents to the ghosts made this slower to learn.

Episodes	Q-learning Score	Deep-Q Network Score
1	120	100
10	200	160
50	330	280
100	380	400
200	540	640 (About 2/3 of all dots)

Asterix

This game is 8 rows that shoot out either a hook or a pot. The agent moves up and down along the rows. You get 3 lives. The agent loses a life if it gets hit by a hook and gains 50 points if it hits a pot. The game is totally random as to which row gets a hook and which gets a pot. This makes it hard for our agents to learn well. After about 100 episodes, it starts moving up and down the rows fast in hopes of getting the most pots before it dies. This game did not appear to converge on a score. The score did increase with episodes, but it reached a point where the agent would either score around 1000 or end up low around 300 with the amount of randomness involved in this game.

Episodes	Q-Learning Score	Deep-Q Network Score
1	550	100
10	350	250
50	750	300
100	800	650
200	800	500