530 - Principles of AI
Snake Game using Reinforcement Learning

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Motivation

There is no fun and engagement when the agents in our games outsmart human players.

(Uncertainty makes the game interesting)

A perfect AI will either win a game or the match would end in a draw.

Alpha Go, The First Reinforcement Learning computer program to defeat a professional human Go player.

Goal and Expected behavior

Goal: Build a snake game (to grab as many apples as possible while not walking into a wall or the snake’s body) such that the goal of the agent is to maximize the sum of the rewards during an episode/iteration.

Expected Behavior:
Initially, the agent explores a lot
Gathers Information
When the learning continues, exploration decreases and Agent chooses the action to perform.

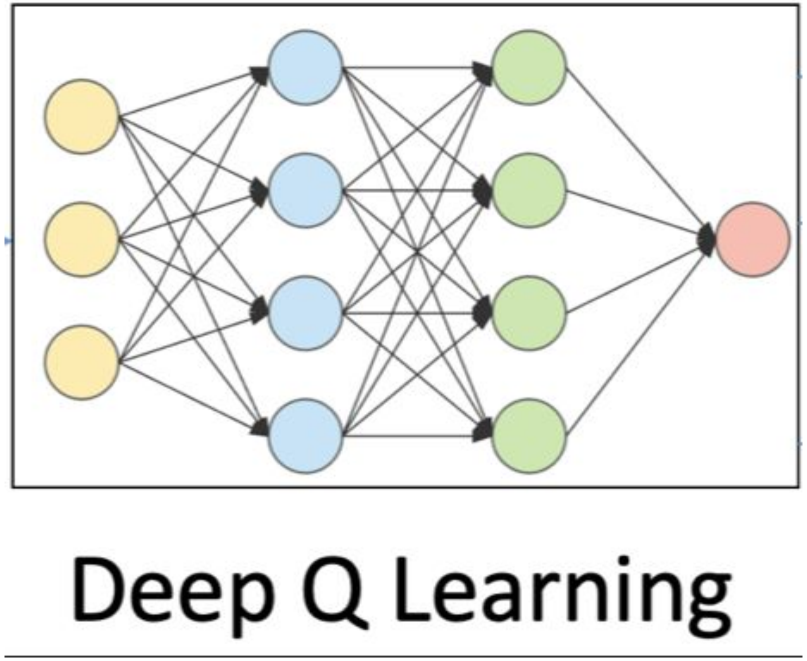
Model used: Deep Reinforcement Learning

Deep Reinforcement Learning also known as Deep Q Learning, a Combination of Deep Learning and Reinforcement Learning.

Input: State of the snake

Output: Action to perform

Reward: Reward for performing certain action (example Eating the apple will have a positive reward while dying will have a negative reward)



Algorithm:

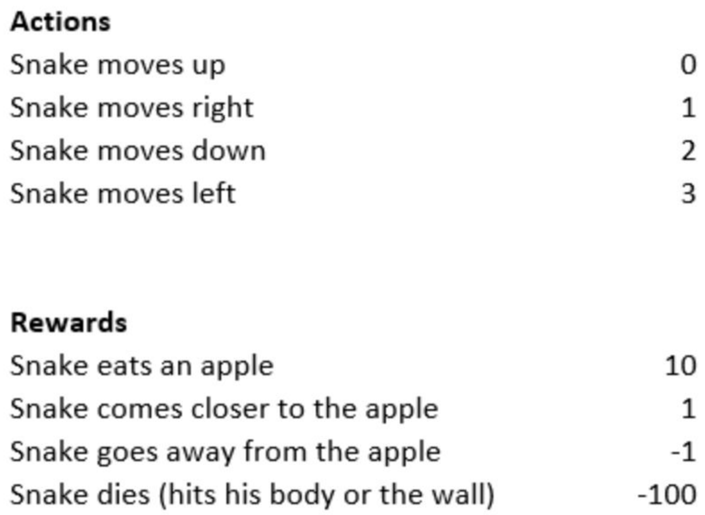
Step 1: Game starts with a random state value

Step 2: Initially system chooses random action, later exploration rate decays and relies more on Neural Network

Step 3: System is updated depending upon the actions performed (states are stored in replay previous experiences also known as memory)

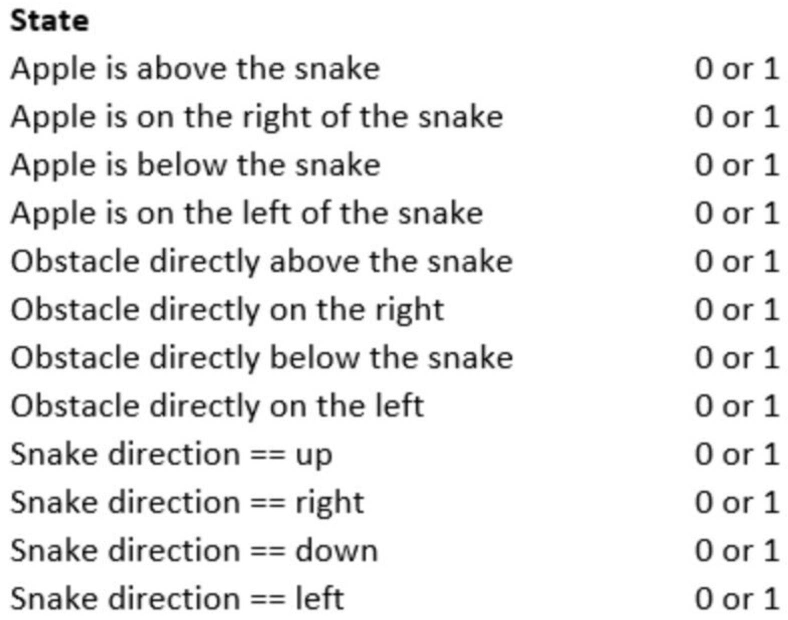
Step 4: Last 2 operations are repeated until the snake dies

Actions, Rewards and states



Actions	
Snake moves up	0
Snake moves right	1
Snake moves down	2
Snake moves left	3

Rewards	
Snake eats an apple	10
Snake comes closer to the apple	1
Snake goes away from the apple	-1
Snake dies (hits his body or the wall)	-100



State	
Apple is above the snake	0 or 1
Apple is on the right of the snake	0 or 1
Apple is below the snake	0 or 1
Apple is on the left of the snake	0 or 1
Obstacle directly above the snake	0 or 1
Obstacle directly on the right	0 or 1
Obstacle directly below the snake	0 or 1
Obstacle directly on the left	0 or 1
Snake direction == up	0 or 1
Snake direction == right	0 or 1
Snake direction == down	0 or 1
Snake direction == left	0 or 1

Epsilon sets the level of exploration and decreases over time :
param['epsilon'] = 1
param['epsilon_min'] = .01
param['epsilon_decay'] = .995

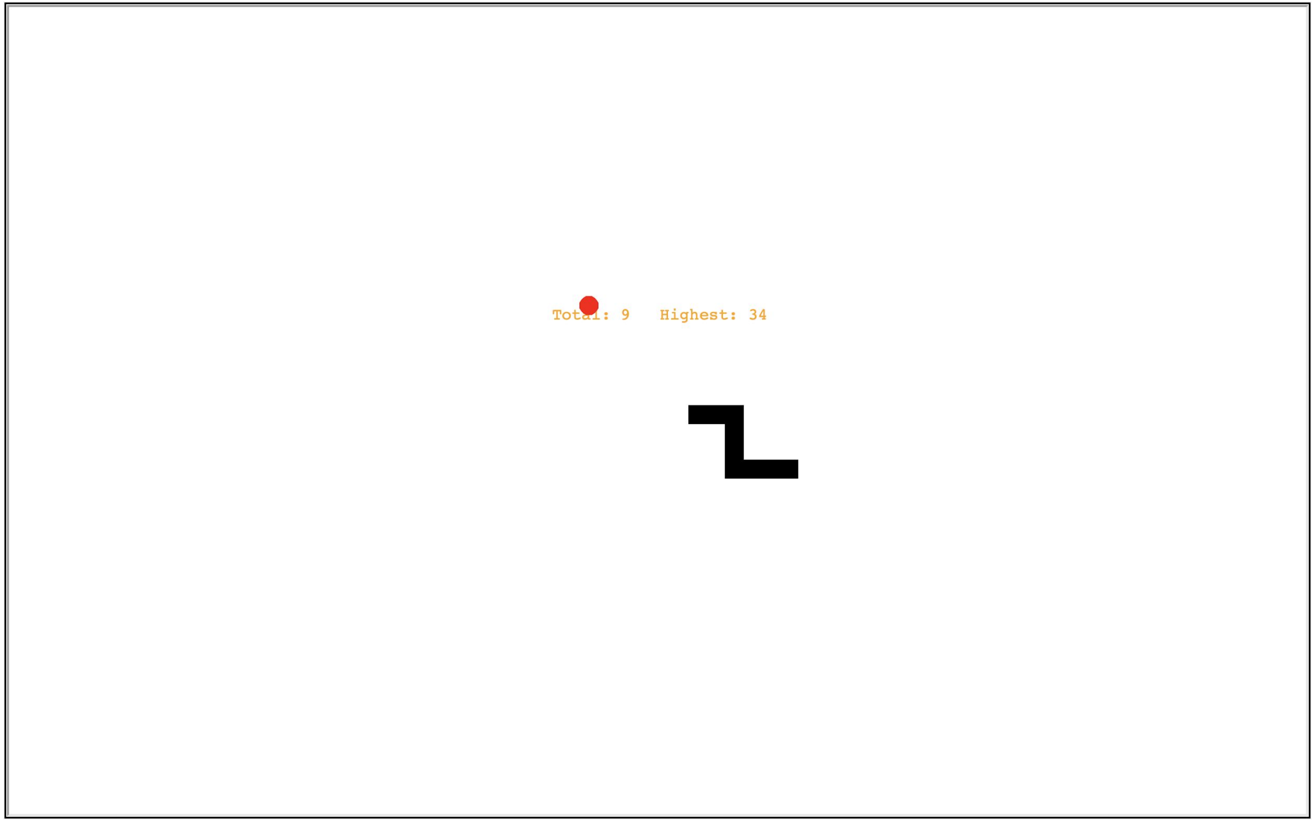
the batch size is needed for replaying previous experiences :
param['batch_size'] = 500
neural network parameters :
param['learning_rate'] = 0.00025

Problems Faced:

Reward system : At first I did not set reward for getting close to the apple. Therefore, it took time for the snake to eat the apple.

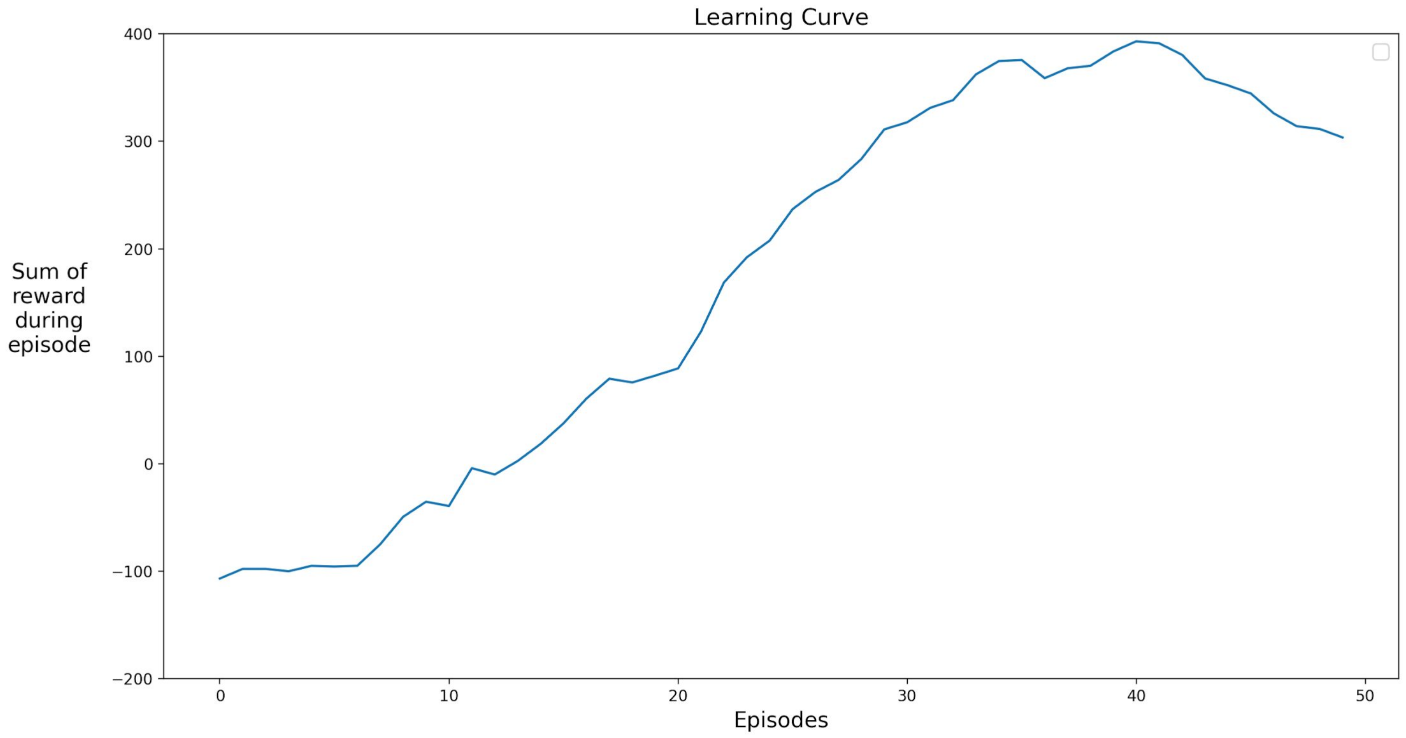
Solution to the problem: Changed the reward system.

Used Turtle feature in python for Graphics



A small video of the game

Graph of Sum of reward vs Episodes/number of games played



More validations can be performed by considering different state (trying to normalize the distance, state space only walls)

Conclusion :

Results and Conclusion : Max Number of apples eaten : 34+ apples eaten in 50 iterations with a score of 300-500 points.

THANK YOU