CNG 462 Artificial Intelligence Term Project Progress Presentation

Doom Bot using Deep Convolutional Q-Learning with Eligibility Trace

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Outline

- Why I choose this
- Q-Learning
- Deep Q-Learning
- Convolutional Neural Network
- Eligibility Trace
- Videos from game
- Training demonstration
- Future work

Why and How?

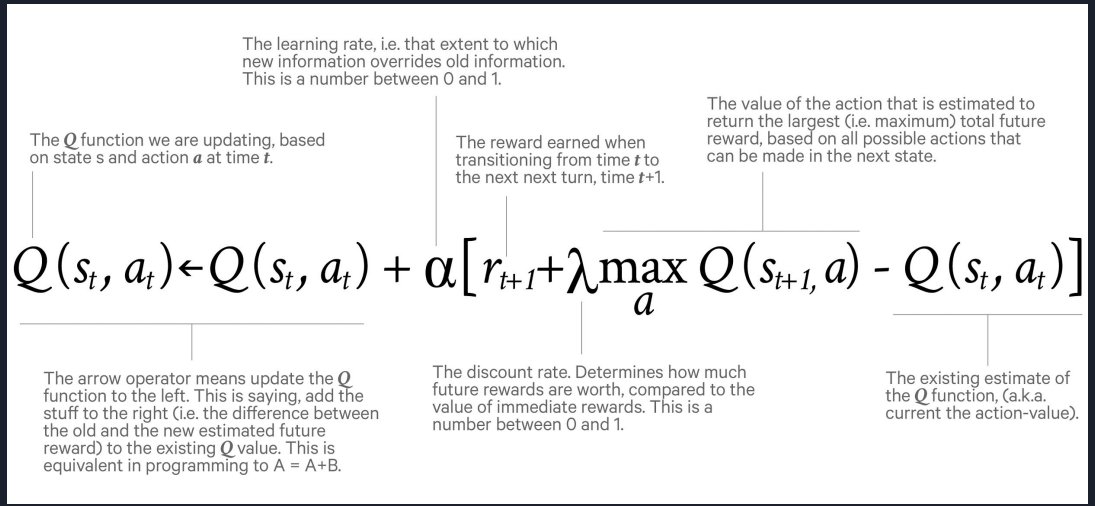
- An exciting and more hands-on side of Artificial Intelligence
- Wondered how game bots are coded
- Wanted to learn about Neural Networks
- Wanted to learn how an image from the game can be used to train AI

How:

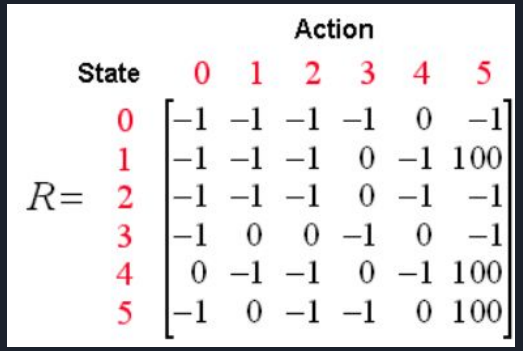
- PyTorch: For Convolutional Neural Network
- Numpy: For two dimensional arrays
- Ppaquette and Open AI: Doom environment

Q-Learning

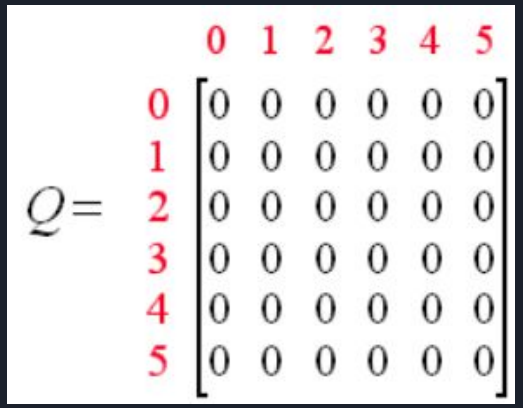
- A type of reinforcement learning
- Consists of actions and states
- Matrix named “R” and “Q”



Pseudocode for Q-Learning



$$R = \begin{array}{c} \\ \text{State} \\ 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \text{Action} \\ \begin{array}{cccccc} 0 & 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} -1 & -1 & -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 & -1 & 100 \\ -1 & -1 & -1 & 0 & -1 & -1 \\ -1 & 0 & 0 & -1 & 0 & -1 \\ 0 & -1 & -1 & 0 & -1 & 100 \\ -1 & 0 & -1 & -1 & 0 & 100 \end{bmatrix} \end{array}$$



$$Q = \begin{array}{c} \\ 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{cccccc} 0 & 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Set the gamma parameter, environment rewards in R

Initialize matrix Q to zero

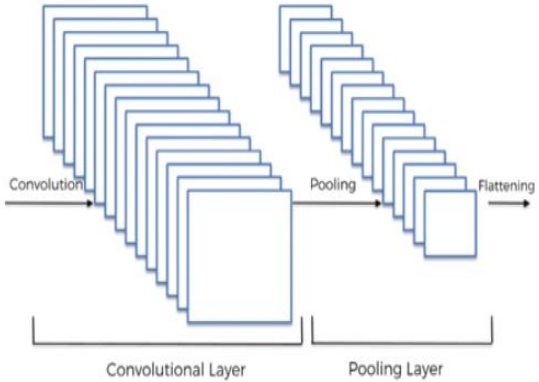
For each episode:

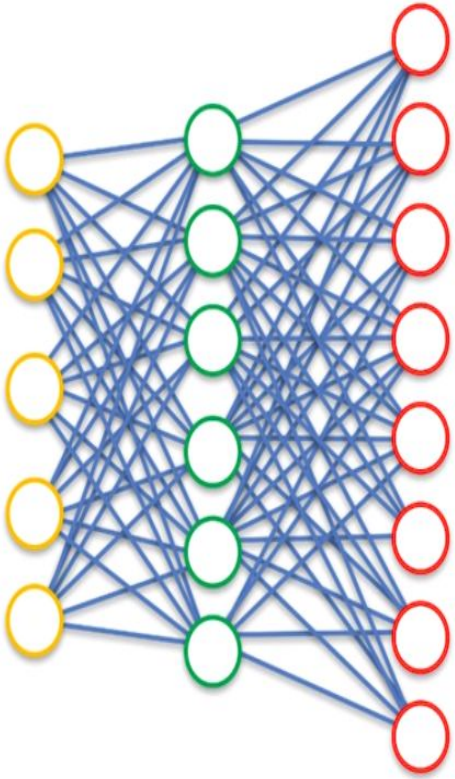
- Select a random initial state
- do while the goal state hasn't been reached
- Select one among possible actions for the current state
- Using this action, consider going to next state
- Get maximum Q value for this next state based on all possible actions
- Compute Q(state,action) using the formula
- Set the next state as the current state

Deep Q-Learning

- It is used for problems which have big (state,action) spaces
- Tries to predict the outcome of going to a state rather than manually trying it
- Deals with such big spaces using hidden layers

Convolutional Neural Network





Eligibility Trace

- Without Eligibility trace AI calculates the reward of states after each action
- With eligibility trace the agent takes the steps and then looks back to see which step was eligible to take the agent to its goal or which ones were bad.
- Faster because it doesn’t calculate the outcome at each step.

Map Specifications

- Goal
  - Reach the vest
- Rewards
  - Plus distance for getting closer to the vest
  - Minus distance for getting further from the vest
  - Minus 100 pts for getting killed
- Ends when
  - Agent touches vest
  - Player is dead
  - Timeout (1 minute)
- Allowed Actions:
  - Attack, Move Right, Move Left, Move Forward, Turn Right, Turn Left

Videos From Gameplay

Videos From Gameplay

Videos From Gameplay

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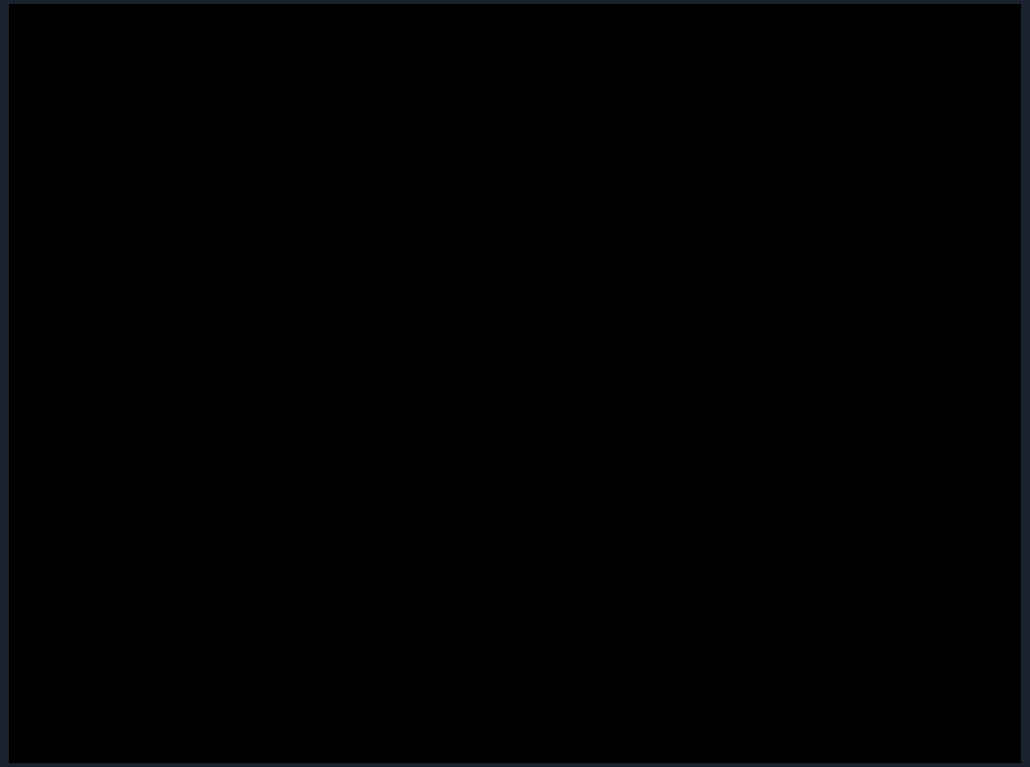
Videos From Gameplay

Training the AI



Future Work

- Training AI for 9 different maps of Doom game
- Trying to enhance the algorithm to learn faster
- Uploading the final version to Github

Thank You

For Listening!