CS 5804 Mini-Project: Snake Game Automation and Optimization

Team Name: Triple Filtered with Diamonds

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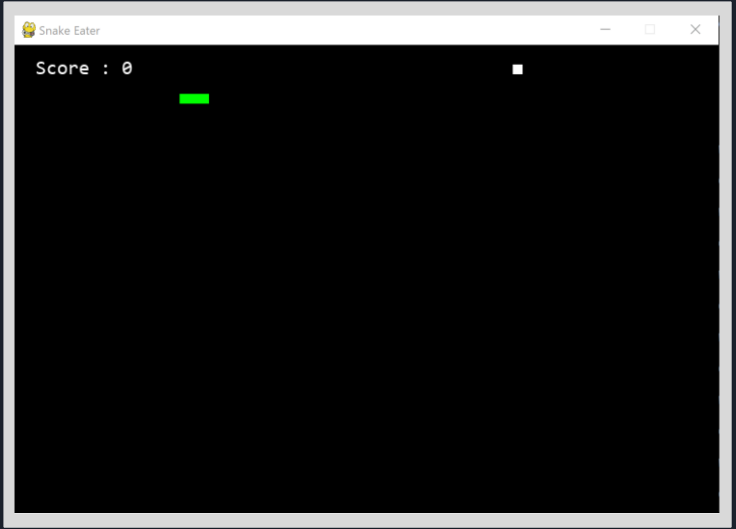
Problem Description

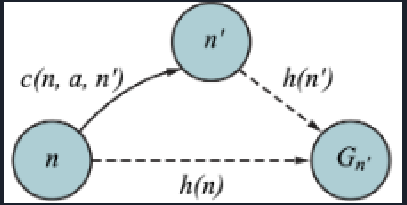
- The problem is based around the classic ‘Snake Game’.
- The game takes place on an XY square grid, and the snake moves in any of 4 cardinal directions that don’t involve going backwards.
- The goal is for the snake to acquire fruit that is randomly put on the game board one at a time while avoiding hitting the walls or its own body.
- When a piece of food is eaten, the score increments by one, the snake’s body becomes incrementally longer, and it becomes more challenging to avoid the body.



Problem Description Continued

- Goal of the game: get the highest score by eating a single piece of fruit at a time.
- To win: must eat every single piece of fruit until the snake body takes up every space on the game board.
    - Almost unattainable, therefore the goal is to get the highest score.
- Our project goal: create an optimal solution for the snake to eat all of the food, hence occupying the whole board without hitting itself.
- The world record for a human is 256 points
- Even though there’s no way of finding an average score for humans, we can easily state that 256 is an extremely large number that is not attainable by most humans.
    - This depends on the snake game’s version, speed, and responsiveness.

Approaches



$$w_i \leftarrow w_i + \alpha \cdot \text{difference} \cdot f_i(s, a)$$
$$\text{difference} = \left(r + \gamma \max_{a'} Q\left(s', a'\right)\right) - Q(s, a)$$

A* search approach

Using a searching algorithm, it’s possible to find the most efficient path to the food that doesn’t involve hitting itself.

The heuristics come from the pure manhattan distance to the fruit, which is known, though could be longer due to the snake body being in the way. Therefore, it’s consistent and admissible.

Q Learning approach

Using training runs, it’s possible over a while to have the snake learn the most effective ways to get the most food.

This approach has more work behind the initial training, as it won’t know too much of what to do, however it can eventually run better than just the A* search.

Results - A* Approach

- When running our game, the snake would quickly determine where the food was and would effectively head towards it.
- However, the snake had a tendency to make detours. In some cases it would go to the edge of the screen, circle back and then go right to it.
- It was however, very responsive.
- The score average over 10 runs was 80.7 points.
- However, it has the ability to go higher depending on the computer.

A* Demonstration

Results - Q Learning Approach

- Fundamental Q learning agent code does not have enough training methods to build on itself.
- Snake using this approach tends to turn on itself and end the game early
- Needs more training methods to help the snake adapt to its environment
- Ideally, the Q learning approach would work more efficiently/effectively than the A* approach
  - Learning each time the game is run
  - Makes less unnecessary actions
  - Can avoid problematic situations.

Lessons Learned

- Applying a generic Agent to both the A* and Q Learning approaches would require different agents associated with each one.
    - A* Agent and QLearning's agent.
    - In theory, these could have been in the same agent class.
- More time to train the QLearning Agent.

Future Work

- Improve the model and the agent.
- A* eventually stops working without a way to check and ensure it doesn’t run into any problems.
- Q-learning needs to have a lot more training data.
- Likely combining both agents to create the most optimal Snake Game AI.

References

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