COMP 5660 Fall 2023 Assignment 2a

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1 Green: Pac-Man Random Search

1.1 Parameters

See Table 1 for Green random search Parameters.

Parameter Name	Value
Depth Limit	7
Constant Terminal Range	[-2,2]

Table 1: Green Random Search Parameter Values

1.2 Results

See Figure 1 for an Evaluations vs best Pac-Man game score. This value increases as the run progresses, as random search discovers more fit Genotypes. For this section, the fitness of the agent is equal to the score of the game.

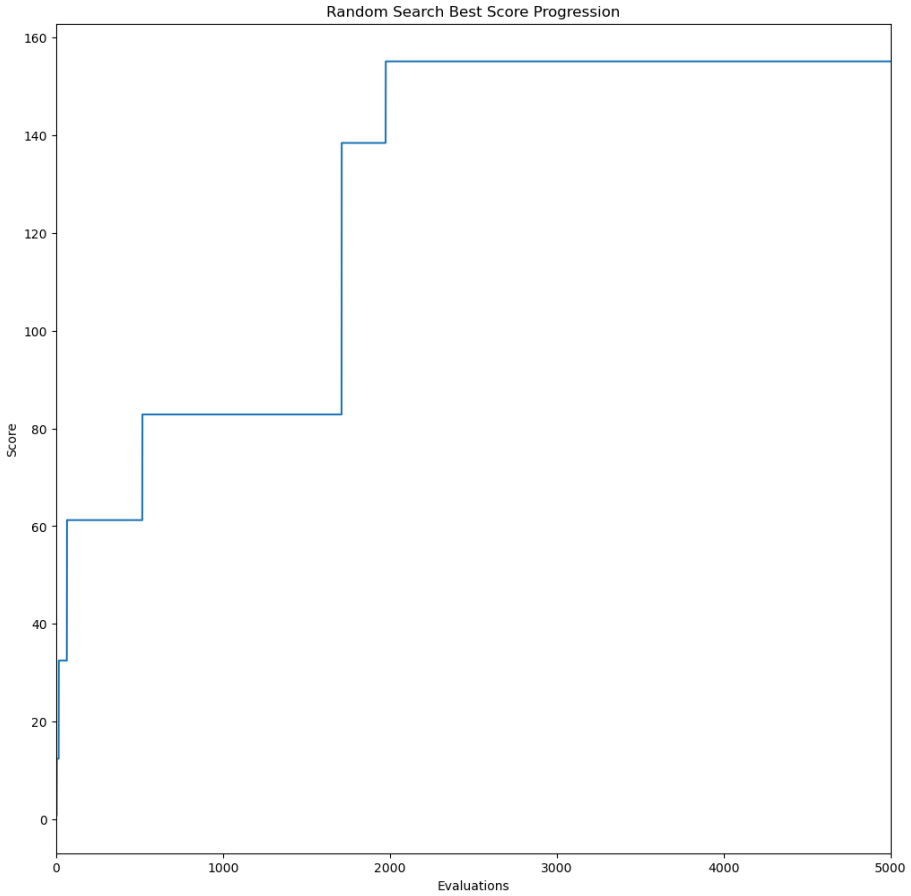

Figure 1: Green Evals vs Best Score Plot

1.3 Solutions

The best run from Green Random Search yielded a best score of 155.14 during run 10. The parse tree (Genotype) for the solution is shown below in the form of an in-order traversal that shows the underlying formula found.

$$((\mathbf{G}\ \mathbf{RAND}\ 1.274)/(\mathbf{P} \times 0.894))$$

The log of this game is saved in the 'data/green' directory. The visualizer reveals some interesting behaviors of the agent. Due to the RAND in the numerator, the model randomly decides between moving from Ghosts AND toward pills versus only moving toward pills. This can lead to it oscillating between two positions and simply wasting time.
The use of Manhattan distance over shortest path also leads to some confusing behavior, as the model occasionally got stuck in corners across from a pill, as

that spot minimized distance to it, whereas the actual path involved going the other direction. The RAND likely helped the model here, allowing it to escape from these situations.

1.4 Statistical Analysis

10 runs were performed to validate the results of the random search experiment. These runs resulted in a mean score of 111.56 and a standard distribution of 17.07.

2 Red: Ghost Random Search

2.1 Parameters

See Table 2 for Red Ghost random search parameters. The Ghost genotypes were allowed to contain the M terminal, where the value of that node is the distance to the nearest Pac-Man.

Parameter Name	Value
Depth Limit	7
Constant Terminal Range	[-2,2]

Table 2: Red Ghost Random Search Parameter Values

2.2 Results

See Figure 2 for an Evaluations vs worst Pac-Man game score. This value decreases as the run progresses, as random search discovers more fit ghost Genotypes. For this section, the fitness of the agent is equal to $-1\times$ the score of the game. The value quickly approaches -100, as the agents discover near perfect strategies to end the game as quickly as possible.

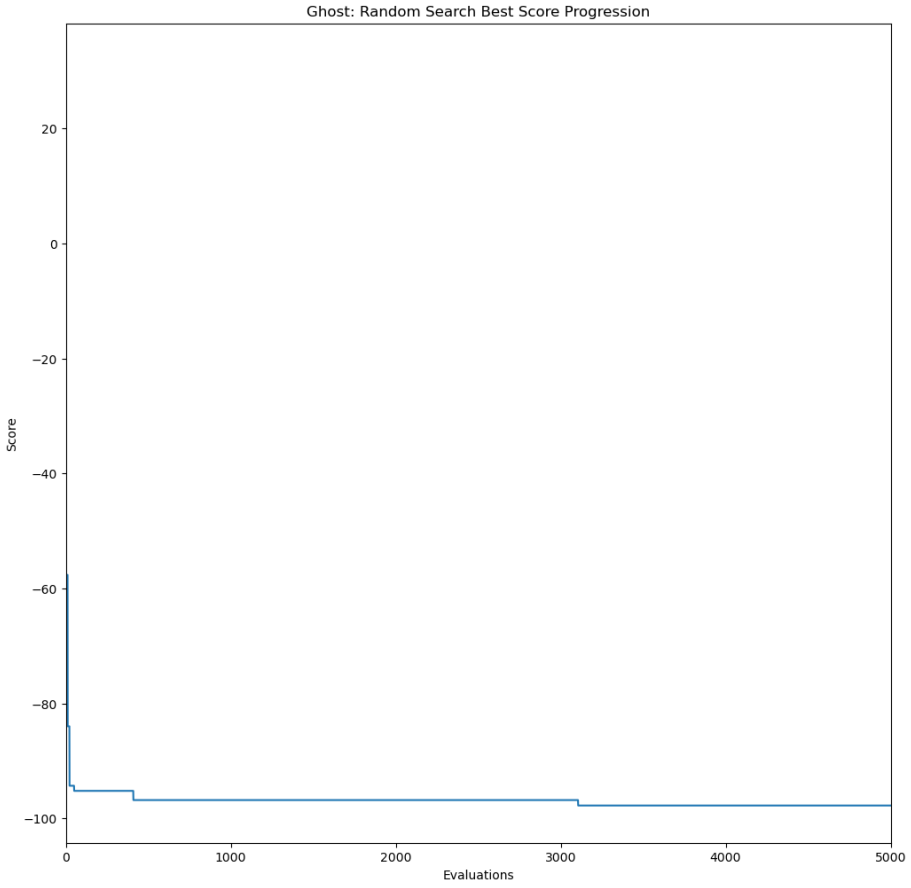

Figure 2: Red Evals vs Best Score Plot

2.3 Solutions

The best run from Red Random Search yielded a best score of −97.74 during run 8. The parse tree (Genotype) for the ghost solution is shown below in the form of an in-order traversal that shows the underlying formula found.

$$(\mathbf{G}/\mathbf{M})$$

The log of this game is saved in the 'data/red' directory. The visualizer shows each ghost immediately moving directly toward Pac-Man, who is executing random moves. The **G** in the numerator also ensures that ghosts try to approach Pac-Man from multiple corridors, as they stay away from each other while approaching Pac-Man.

2.4 Statistical Analysis

10 runs were performed to validate the results of the random search experiment. These runs resulted in a mean score of -97.05 and a standard distribution of 0.30. It seems that most, if not all, random search experiments found the optimal strategy against a random-direction-selecting Pac-Man agent.