Jarrett Hill

Jwh0100@auburn.edu

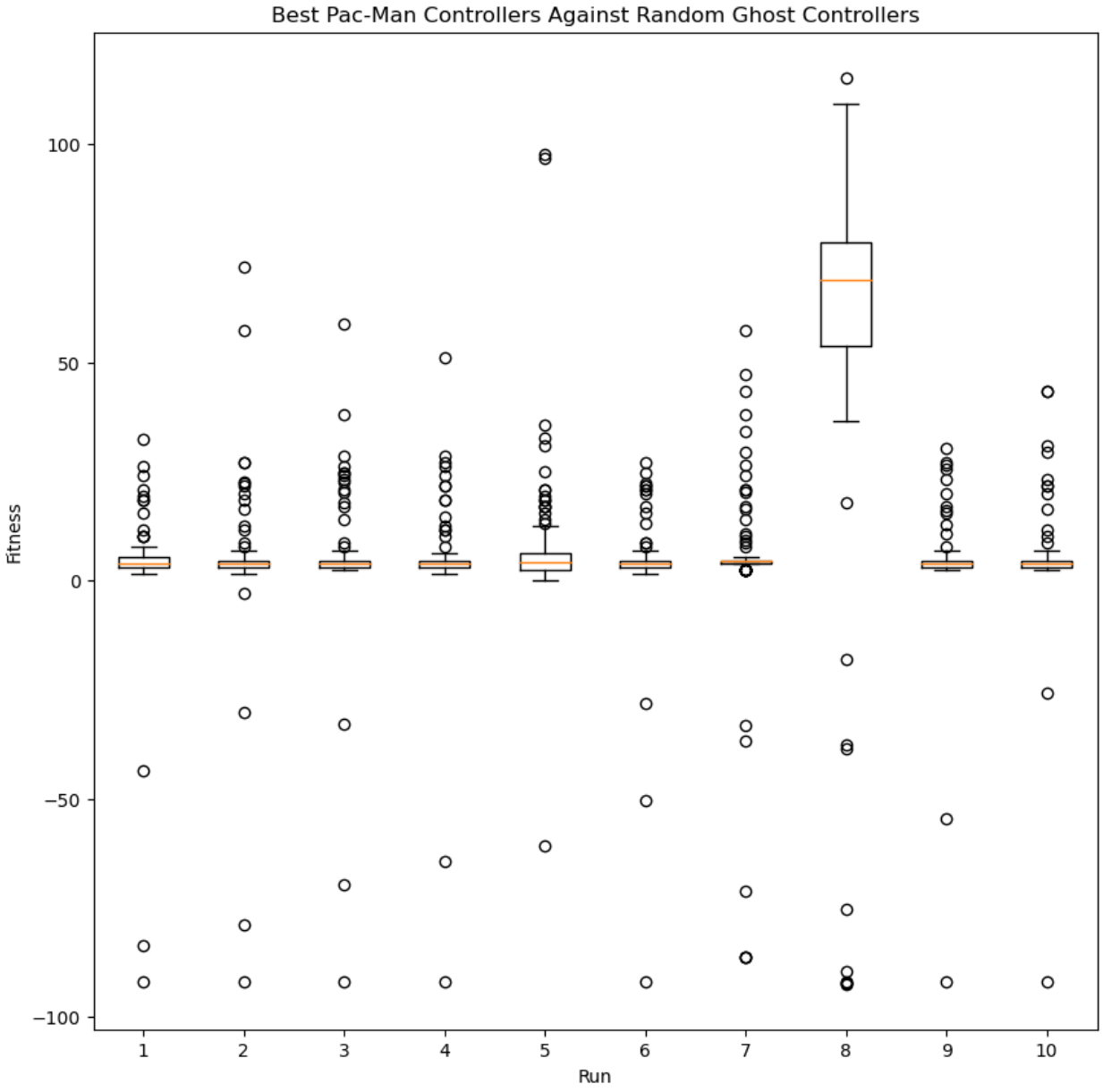
COMP 5660 Fall 2023 Assignment 2c

Parse Trees of best Pac-Men and Ghosts from each of the 10 runs:

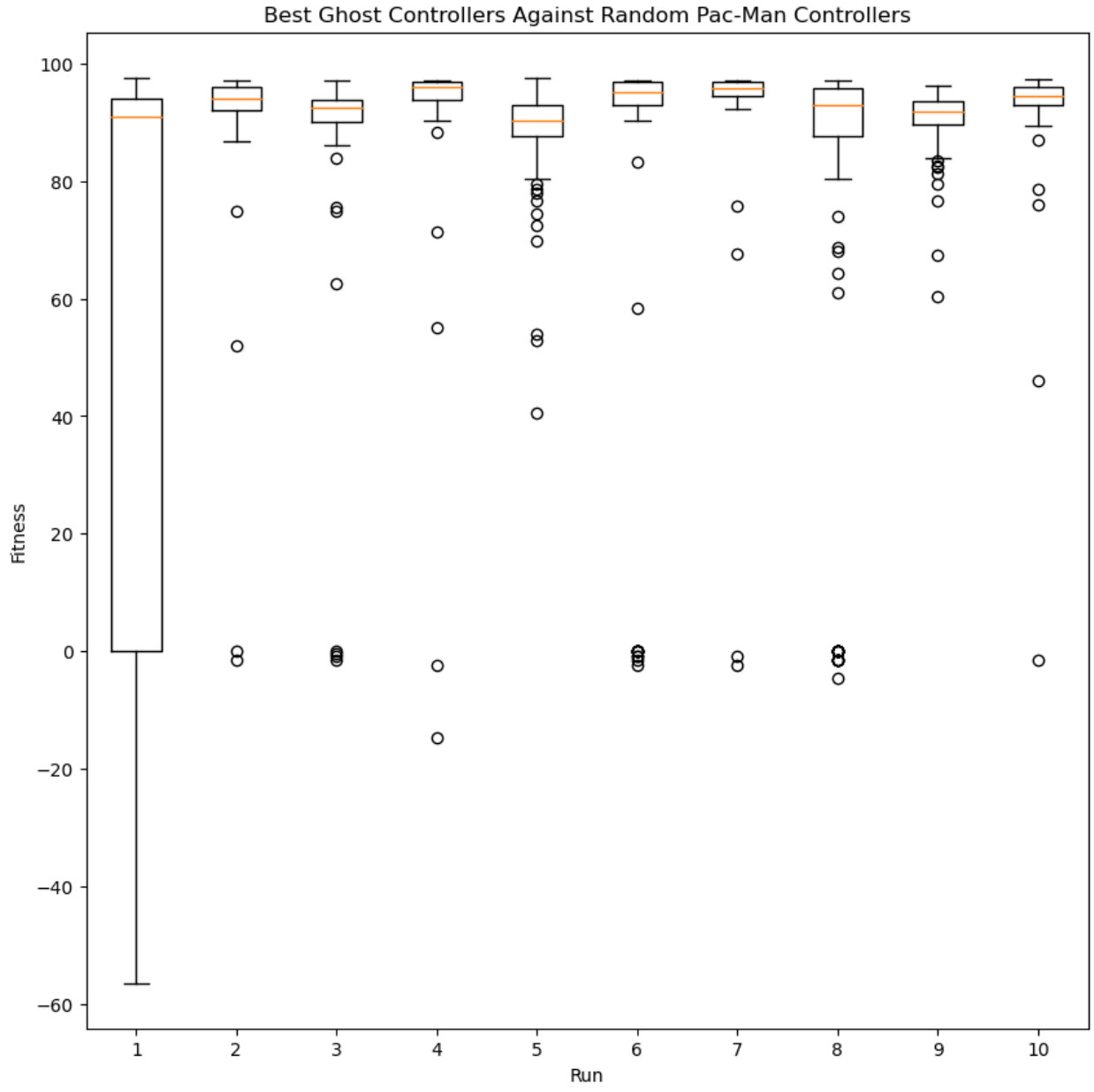
See page 6.

Box plots showing controller performance against 100 random controllers:

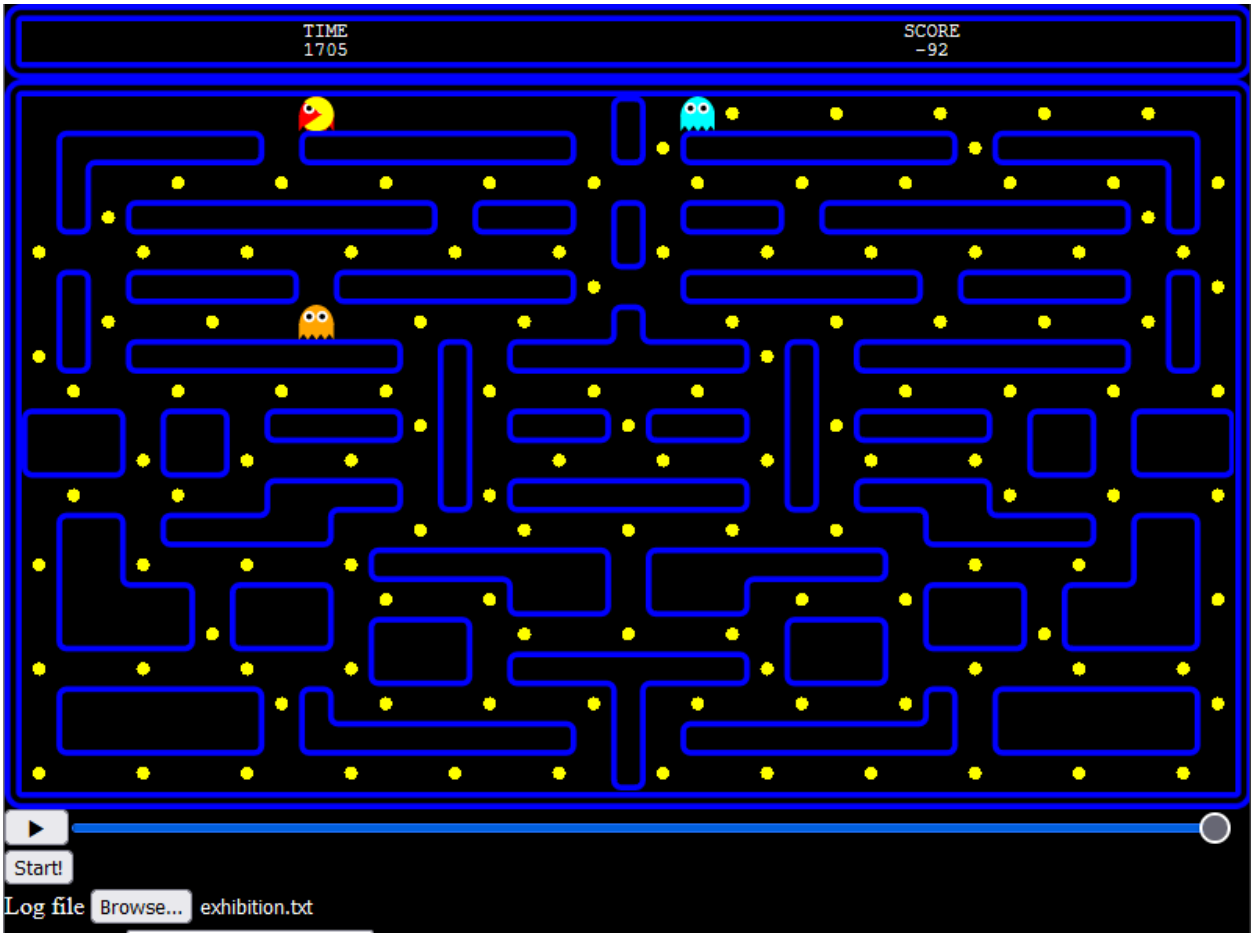
Pacman:


Best Pac-Man Controllers Against Random Ghost Controllers
Fitness
100
50
0
−50
−100
1
2
3
4
5
6
7
8
9
10
Run

Ghost:


Best Ghost Controllers Against Random Pac-Man Controllers
Fitness
Run
100
80
60
40
20
0
−20
−40
−60
1
2
3
4
5
6
7
8
9
10

Best Pac-Man vs. Best Ghost Exhibition Match:



Analysis:

It was a quick game. Pac-Man fought hard but was pretty much immediately boxed in by red and orange. The Pac-Man tried to kite for as long as he could (about 3 seconds) then red moved in for the elimination. The parse trees for these individuals are:

Pac-Man:

```
/
|-
||RAND
|||*
||||G
||||G
|||W
||7.2570766001733205
|P
```

Or: ((RAND(G*G, W) - 7.2570766001733205) / P)
RAND(G*G, W) represents a random value between G*G (the square of the distance to the nearest ghost) and W (number of nearby walls). This value is then subtracted by 7.2570766001733205 and is divided by P (distance to nearest pill)

Ghost:

```
-
|-
||P
||*
|||F
|||*
||||F
||||M
|F
```

Or: ((P - (F * (F * M))) - F)
F * M is the product of the distance to fruit and the distance to Pac-Man. This is then multiplied by F, and the result is subtracted from P (distance to nearest pill). Finally, F (distance to fruit) is subtracted from this entire result.

Note:
The last run I attempted for my controllers failed because I attempted to save the TreeGenotype objects improperly. I was already running late so I decided that replicating the controllers from their respective parse trees was something I could do. I realize this is probably going to affect my results in some unknown way but I am already pushing the due date so here is my best effort solution.

Some further experiment analysis:
I noticed that over half of my most successful pac-man controllers had a single-node parse tree of 'G' I think this is indicative of my ghosts dominating the pac-men so much that the most successful controllers were the ones that only took into account ghost positions. From looking at my ghost parse trees it is clear that they were not experiencing a similar issue. I think this is representative of disengagement(?) as my pac-man population had essentially moved it's goal from collecting pills to just survive. I would like to think this is a consequence config parameters (probably) encouraging a small population of super-ghosts due to the parent selection being fitness_proportionate_selection and survival selection being truncation. Even though this was true for my pacman controllers as well I think the much smaller population for the ghosts probably exacerbated their dominance over the pac-men.

Parse Trees of best Pac-Men and Ghosts from each of the 10 runs:

```
Pacman 0 :
 G
 ================================================
Pacman 1 :
 G
 ================================================
Pacman 2 :
 G
 ================================================
Pacman 3 :
 G
 ================================================
Pacman 4 :
 -
|G
|/
||+
|||W
|||RAND
||||P
||||G
||F
 ================================================
Pacman 5 :
 G
 ================================================
Pacman 6 :
 *
|G
|/
||G
||+
|||P
|||P
 ================================================
Pacman 7 :
 /
|-
||RAND
|||*
||||G
||||G
|||W
||7.2570766001733205
|P
```

```
 ==================================================
Pacman 8 :
 G
 ==================================================
Pacman 9 :
 G
 ==================================================
Ghost 0 :
 /
|/
||*
|||/
||||-
|||||G
|||||M
||||-
|||||G
|||||-3.5906000417587833
|||/
||||-
|||||F
|||||G
||||+
|||||-23.27783963450041
|||||-
|||||||*
|||||||29.941983581277377
|||||||6.557611534053649
|||||||RAND
|||||||W
|||||||G
||M
|G
 ==================================================
Ghost 1 :
 /
|M
|-
||-
|||*
||||-11.057315991870958
||||-0.5024206166793732
|||F
||RAND
|||P
|||M
 ==================================================
Ghost 2 :
 +
|-
||/
|||+
||||F
||||W
```

```
|||M
||RAND
|||-
||||G
||||W
|||+
||||M
||||W
|/
||RAND
|||+
||||RAND
|||||-
||||||RAND
|||||||6.648399043703222
|||||||P
||||||RAND
|||||||P
|||||||M
|||||P
||||P
|||/
||||G
||||W
||RAND
|||-
||||M
||||/
|||||+
||||||F
||||||W
|||||*
||||||M
||||||W
|||+
||||31.18468131047611
||||W
 ==================================================
Ghost 3 :
 *
|-
||-
|||F
|||F
||-
|||M
|||P
|+
||RAND
|||G
|||P
||+
|||F
|||-6.442766120986789
```

```
 ==================================================
Ghost 4 :
 +
|RAND
||/
|||-
||||+
|||||G
|||||P
||||/
|||||P
|||||P
|||/
||||+
|||||G
|||||G
||||RAND
|||||G
|||||23.42587822162615
||*
|||+
||||*
|||||F
|||||M
||||-
|||||G
|||||G
|||-
||||-
|||||F
|||||M
||||*
|||||F
|||||M
|+
||RAND
|||/
||||-
|||||+
||||||G
||||||P
|||||/
||||||+
|||||||-21.31736872205439
|||||||F
||||||P
||||/
|||||+
||||||G
||||||G
|||||RAND
||||||G
||||||23.42587822162615
|||*
```

```
||||+
|||||*
|||||||F
|||||||M
|||||-
|||||||G
|||||||G
||||-
|||||-
|||||||F
|||||||M
|||||*
|||||||F
|||||||M
||+
|||+
||||G
||||F
|||RAND
||||W
||||-30.257555215659643
 ==================================================
Ghost 5 :
 -
|/
||P
||RAND
|||*
||||RAND
|||||+
|||||||F
|||||||G
|||||/
|||||||M
|||||||F
||||M
|||RAND
||||W
||||W
|M
 ==================================================
Ghost 6 :
 -
|-
||P
||*
|||F
|||*
||||F
||||M
|F
 ==================================================
Ghost 7 :
 +
```

```
|-
||RAND
|||M
|||+
||||P
||||G
||-
|||-
||||W
||||F
|||-
||||W
||||M
|/
||-
|||*
||||F
||||M
|||RAND
||||7.629178930809481
||||F
||-16.551717113018675
 ==================================================
Ghost 8 :
 /
|-
||11.280187802524438
||M
|RAND
||+
|||7.338342895877119
|||11.280187802524438
||RAND
|||P
|||M
 ==================================================
Ghost 9 :
 +
|+
||-
|||F
|||M
||*
|||-2.5408226816303596
|||F
|-
||/
|||+
||||-
|||||-
||||||G
||||||M
|||||-
||||||RAND
```

```
|||||||+
||||||||-9.745094728420796
||||||||G
|||||||/
||||||||G
||||||||M
|||||||/
|||||||/
||||||||W
||||||||P
|||||||-
||||||||F
||||||||W
||||+
|||||RAND
|||||||G
|||||||-14.32646135985847
|||||/
|||||||F
|||||||31.754498469177065
|||+
||||-
|||||-
|||||||M
|||||||RAND
|||||||F
|||||||W
|||||22.752443360169885
||||+
|||||*
|||||||W
|||||||RAND
|||||||+
||||||||P
||||||||G
|||||||M
|||||M
||-22.52856492187484
```

```
Experiment configs:
[shared_configs]
depth_limit = 7
nonterminals = ('+', '-', '*', '/', 'RAND')

[fitness_kwargs]
pac_parsimony_coefficient = 0.2
ghost_parsimony_coefficient = 0.2
experiment = green

[pac_ea]
mu = 400
num_children = 150
mutation_rate = 0.12
parent_selection = fitness_proportionate_selection
survival_selection = truncation
individual_class = TreeGenotype

[pac_parent_selection_kwargs]
k = 5

[pac_survival_selection_kwargs]
k = 1

[pac_problem]
terminals = ('G', 'P', 'F', 'W', 'C')
depth_limit = ${shared_configs:depth_limit}
nonterminals = ${shared_configs:nonterminals}

[ghost_ea]
mu = 100
num_children = 25
mutation_rate = 0.10
parent_selection = fitness_proportionate_selection
survival_selection = truncation
individual_class = TreeGenotype

[ghost_parent_selection_kwargs]
k = 3

[ghost_survival_selection_kwargs]
k = 1

[ghost_problem]
terminals = ('G', 'P', 'F', 'W', 'C', 'M')
depth_limit = ${shared_configs:depth_limit}
nonterminals = ${shared_configs:nonterminals}
```