COMP 5560 Fall 2022 Assignment 2b

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1. Evolutionary Search

In this assignment, an evolutionary search (parameterized in configs/green2b_config.txt) through the space of state evaluation functions is performed in order to create a Pac-Man controller. The experiment is comprised of 30 runs of 2000 evaluations, where for each the best fitness encountered is recorded. The plot comparing evaluations against fitness per generation of all runs in the experiment is depicted (Figure 1). Overall, the highest fitness recorded was 223.

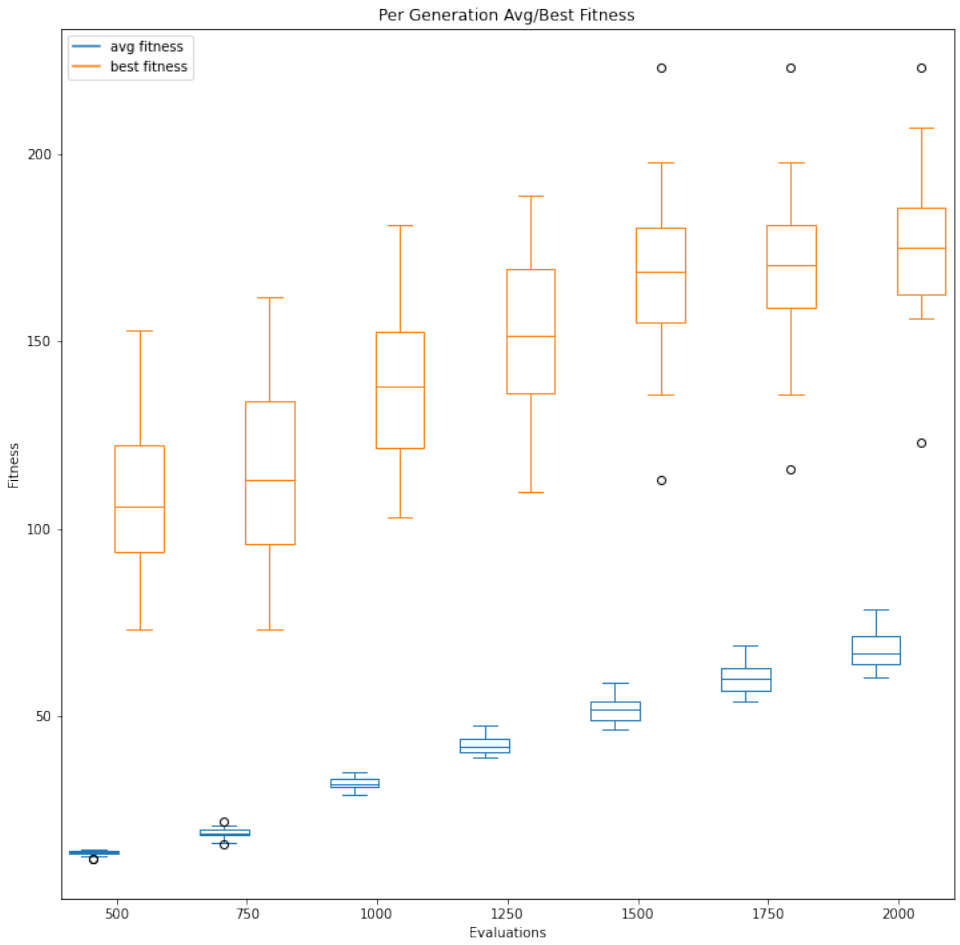

Figure 1: Box plots of the Averaged Per Generation Avg/Best Fitness

2. Analysis

A two-sample F-Test for equality of variances is used to determine if the variances of the random search algorithm (data/green2a/results.txt) and the evolutionary algorithm (data/green2b/results.txt) are equal. Given that $F > 1$ but $F < F\ Critical\ one\text{-}tail$, the null hypothesis of equal variances fails to be rejected and it is determined that the two populations do not have significantly unequal variances. This prompts the use of a two-sample t-Test assuming equal variances.

F-Test Two-Sample for Variances	random	evolutionary
Mean	119	175.03
Variance	428.0689655	365.7574713
Observations	30	30
df	29	29
α	**0.025**	
F	1.170362875	
P(F<=f) one-tail	0.337340973	
F Critical one-tail	2.100995817	

Table 1: F-Test of Random Search and Evolutionary Algorithms

A two-sample t-Test is used to determine if the means of the random search algorithm (data/green2a/results.txt) and the evolutionary algorithm (data/green2b/results.txt) are equal. Given that $t\ Stat < 0$ and $t\ Stat < -t\ Critical\ two\text{-}tail$, the null hypothesis of equal means is rejected and it is determined that the two populations have significantly unequal means. The evolutionary algorithm can be assumed to perform better than the random search algorithm.

t-Test: Two-Sample Assuming Unequal Variances	random	evolutionary
Mean	119	175.03
Variance	428.0689	365.757
Observations	30	30
Pooled Variance	396.9132184	
Hypothesized Mean Difference	0	
df	58	
α	**0.05**	
t Stat	-10.8929	
P(T<=t) one-tail	5.92901E-16	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	1.1858E-15	
t Critical two-tail	2.001717484	

Table 2: t-Test of Random Search and Evolutionary Algorithms

3. Best Solution

The state evaluation function with the best fitness (parse tree in solutions/green2b.txt) was found to have a fitness of 223. As a convenience, below is the function written mathematically.

$$V(s') = \frac{(\frac{RAND(-0.800,\, W)}{F} + RAND(P,\, W)) * RAND(G,\, F) * (F + W)}{\frac{G*P}{F*P} * RAND(RAND(G,\, (W + G)),\, -8.203 * -2.011)} \tag{1}$$

Watching the playback of this solution (game log recorded in worldFiles/green2b.txt) shows a Pac-Man controller that paths to the pills reasonably well. It does this for the first half of the game while occasionally getting stuck in holding or oscillation cycles. However, for the bulk of the middle portion, the controller cycles in the corner without pathing towards anything of value. The controller did manage to survive but frequently occupied a tile adjacent to a ghost. The controller seems very fruit driven, twice abandoning a pill a few tiles away and pathing towards fruit on the other side of the board. It was in this state as time ran out as well, despite having only one pill on the map remaining.