CS5401 FS2018 Assignment 1b

William Lorey
wwlytc@mst.edu

Experiment Plots

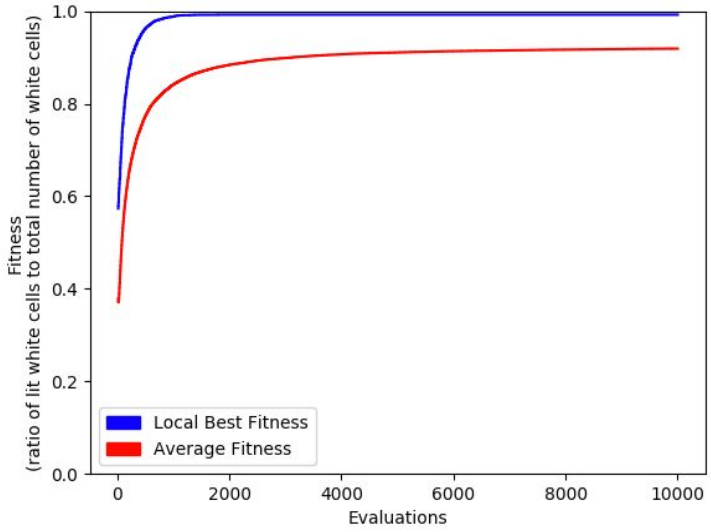

Figure 1: Evaluations versus Average Fitness and Evaluations versus Local Best Fitness for Provided Puzzle, Averaged Over All Runs

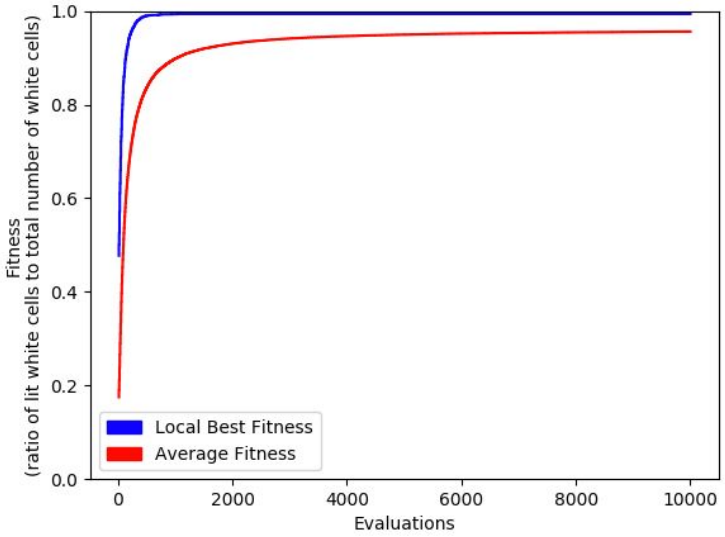

Figure 2: Evaluations versus Average Fitness and Evaluations versus Local Best Fitness for Randomly Generated Puzzle, Averaged Over All Runs

Statistical Analysis Discussion

For both puzzle varieties (the provided puzzle and the generated puzzle) the evolutionary algorithm was compared to the random search algorithm to determine statistical superiority between the methods, in the context of this problem instance. The numerical analysis for each of these experiment classes can be found in the Statistical Analysis for Provided Puzzle and Statistical Analysis for Randomly Generated Puzzle sections.

In each case, since the distribution was not known to be normal and since the sample size was greater than 29, the variances were compared using the f-test. The f-test for both experiment comparisons yielded the conclusion that variances could be assumed equal. This was because the conditions

$$|mean(Random\ Search) < mean(EA)| \quad \text{and} \quad F > F\ Critical$$

both held true. Finally, the two-tailed two-sample t-test assuming equal variances was performed for both experiment comparisons. The following condition held true for both tests:

$$|t\ Stat| > |t\ Critical\ Two - Tail|$$

This condition's validity meant that the null hypothesis was rejected, meaning that the variable with the larger mean indicated a better algorithm (statistically) on this particular problem instance. In both cases, the evolutionary algorithm had a larger mean when compared to that of the random search. Because of this, the evolutionary algorithm is proven to be superior to the random search for this problem instance, in both the case of the provided puzzle and the randomly generated puzzle.

Statistical Analysis for Provided Puzzle

Table 1: F-Test Two-Sample for Variances for Provided Puzzle Analysis

	Random Search	EA
Mean	0.6966216216	0.9923423423
Variance	0.0009928906073	0.00004638842011
Observations	30	30
df	29	29
F	21.40384615	
P(F<=f) one-tail	0	
F Critical one-tail	1.860811435	

Table 2: t-Test: Two-Sample Assuming Equal Variances for Provided Puzzle Analysis

	Random Search	EA

Mean	0.6966216216	0.9923423423
Variance	0.0009928906073	0.00004638842011
Observations	30	30
Pooled Variance	0.0005196395137	
Hypothesized Mean Difference	0	
df	58	
t Stat	-50.24308544	
P(T<=t) one-tail	0	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0	
t Critical two-tail	2.001717484	

Table 3: Standard Deviation for Provided Puzzle Analysis

Standard Deviation	sqrt(0.0009928906073)	0.03151016672

Statistical Analysis for Randomly Generated Puzzle

Table 4: F-Test Two-Sample for Variances for Randomly Generated Puzzle Analysis

	Random Search	EA
Mean	0.9038096235	0.9936490682
Variance	0.001202739143	0.00008180893878
Observations	30	30
df	29	29
F	14.70180595	
P(F<=f) one-tail	0	
F Critical one-tail	1.860811435	

Table 5: t-Test: Two-Sample Assuming Equal Variances for Randomly Generated Puzzle Analysis

	Random Search	EA
Mean	0.9038096235	0.9936490682
Variance	0.001202739143	0.00008180893878
Observations	30	30
Pooled Variance	0.000642274041	
Hypothesized Mean Difference	0	
df	58	
t Stat	-13.7294299	

P(T<=t) one-tail	0	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0	
t Critical two-tail	2.001717484	

Table 6: Standard Deviation for Randomly Generated Puzzle Analysis

Standard Deviation	sqrt(0.001202739143)	0.03468052973