CS5401 FS2018 Assignment 1c with bonus

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Introduction

Assignment 1c involved implementing an EA leveraging constraint satisfaction to more effectively solve Light Up puzzles. This report compares the performance of penalty function and repair function constraint satisfaction techniques as well as plain-vanilla EA performance. It also outlines a comparison between Validity Forced plus Uniform Random versus plain Uniform Random initialization for a plain-vanilla EA, a constraint satisfaction EA employing a penalty function, and a constraint satisfaction EA employing a repair function. The extent to which EA performance is affected by the penalty coefficient used in a penalty function constraint satisfaction EA will also be examined.

Constraint Satisfaction EA Performance Comparisons

For the baseline assignment, an EA leveraging a penalty function was implemented. The penalty function subtracted from a given genotype's fitness the number of constraints violated multiplied by the penalty coefficient. Violated constraints involved bulbs shining on other bulbs and black cell constraints not being met.

This EA was compared to an EA implemented for the bonus assignment that used the repair function constraint satisfaction technique. Figure 1 and Figure 2 show evaluations versus fitness for the penalty function EA and the repair function EA respectively tested against the Light Up puzzle provided on the course website.

Figure 3 and Figure 4 show evaluations versus fitness for the aforementioned EAs tested against randomly generated puzzles.

Through visually examining each configuration, it can be deduced that the penalty function EA outperformed the repair function EA. Statistical analysis supporting this claim can be found ??.
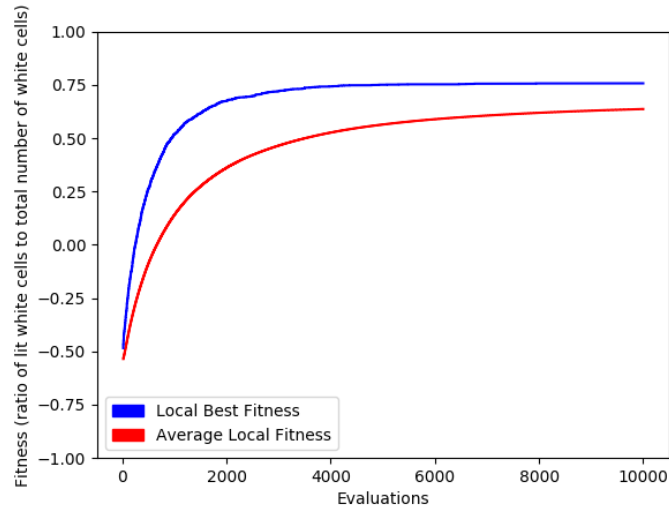
Figure 1: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Penalty Function EA with the Validity Enforced, Provided Puzzle**, Averaged Over All Runs
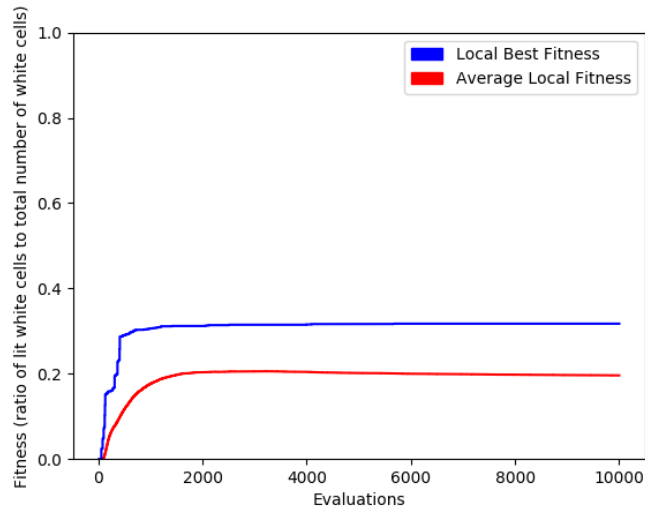

Figure 2: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Repair Function EA with the Validity Enforced, Provided Puzzle**, Averaged Over All Runs
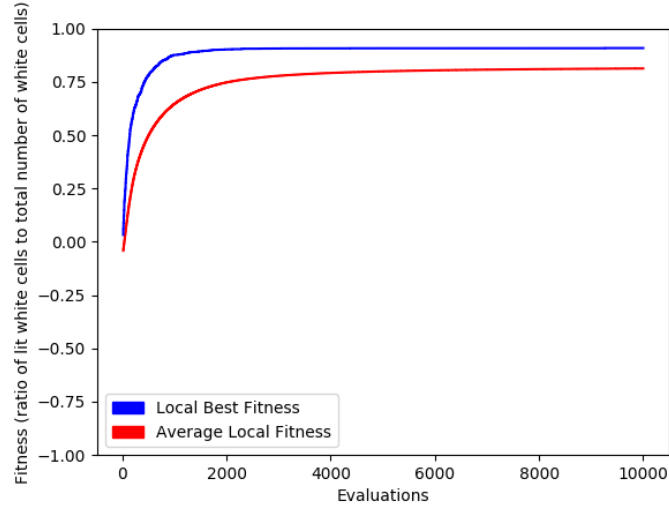
Figure 3: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Penalty Function EA with the Validity Enforced, Randomly Generated Puzzle**, Averaged Over All Runs
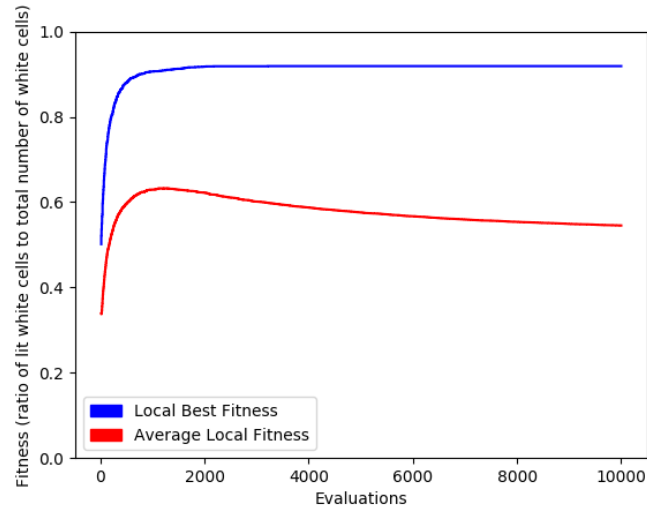

Figure 4: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Repair Function EA with the Validity Enforced, Randomly Generated Puzzle**, Averaged Over All Runs

Table 1: My caption

|	random_gen_validity_enforced	random_gen_validity_enforced_bonus
mean	0.9081384890909392	0.9188060294943169
variance	0.002217915192875166	0.060460786982912955
standard deviation	0.047094746977504466	0.24588775281195474
observations	30	30
df	29	29
F	0.036683531650059054	
F critical	0.5373999648406917	
Unequal variances assumed		
observations	30	
df	31	
t Stat	-0.2294580495633768	
P two-tail	0.8200141447652132	
t Critical two-tail	2.0395	
Nether random_gen_validity_enforced_bonus nor random_gen_validity_enforced is statistically better		
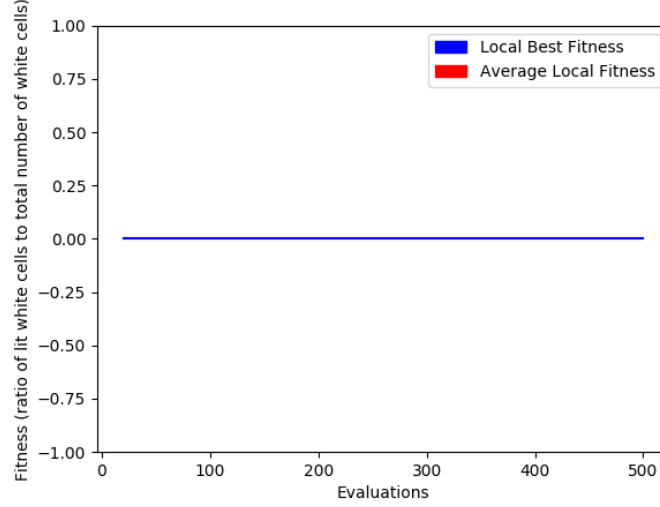
Figure 5: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Plain-Vanilla EA with the Validity Enforced, Provided Puzzle**, Averaged Over All Runs
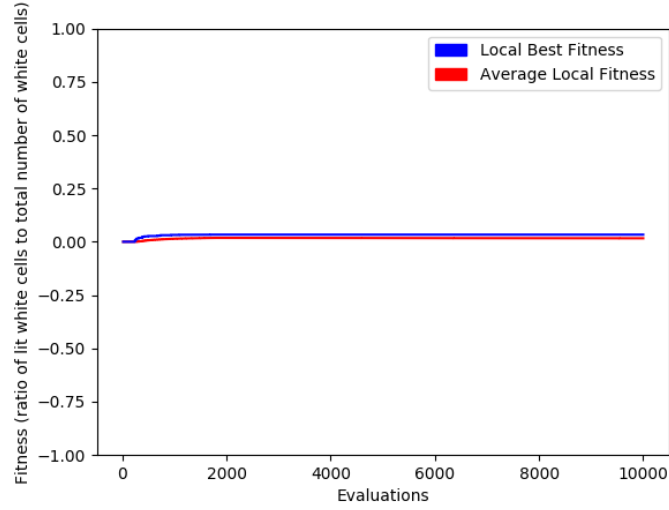
Figure 6: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Plain-Vanilla EA with the Validity Enforced, Randomly Generated Puzzle**, Averaged Over All Runs
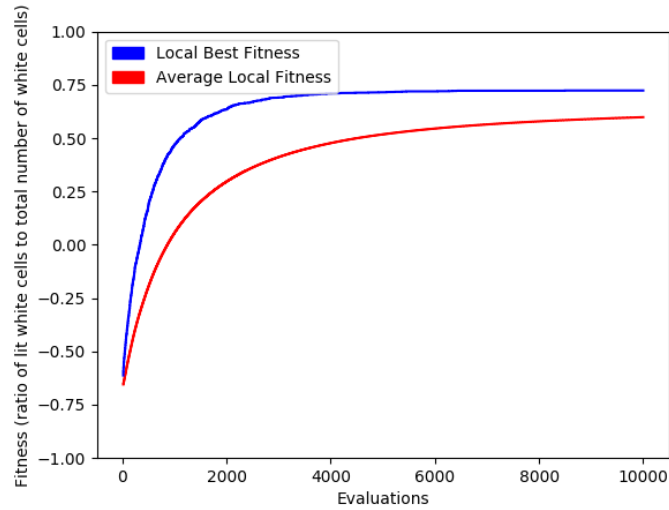

Figure 7: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Penalty Function EA with the Uniform Random Initialized, Provided Puzzle**, Averaged Over All Runs
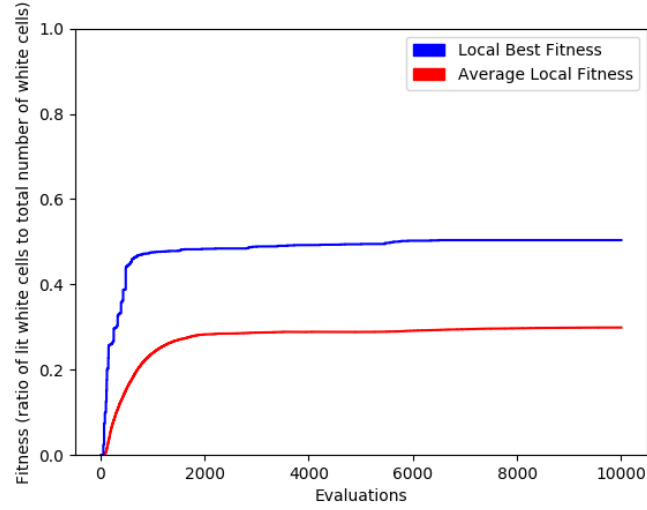
Figure 8: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Repair Function EA with the Uniform Random Initialized, Provided Puzzle**, Averaged Over All Runs
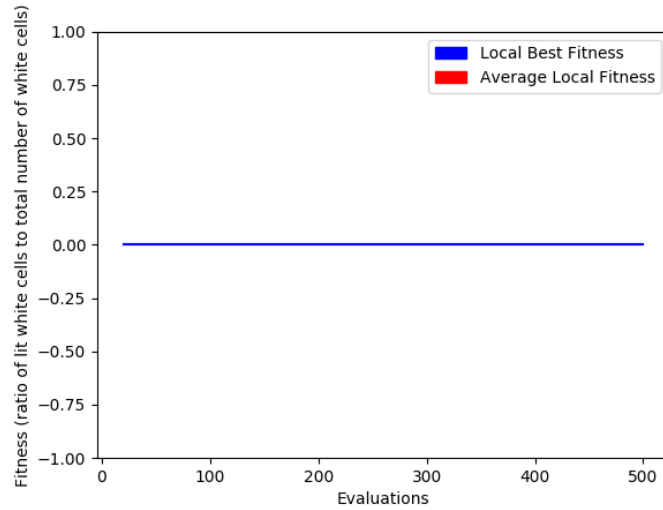

Figure 9: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Plain-Vanilla EA with the Uniform Random Initialized, Provided Puzzle**, Averaged Over All Runs
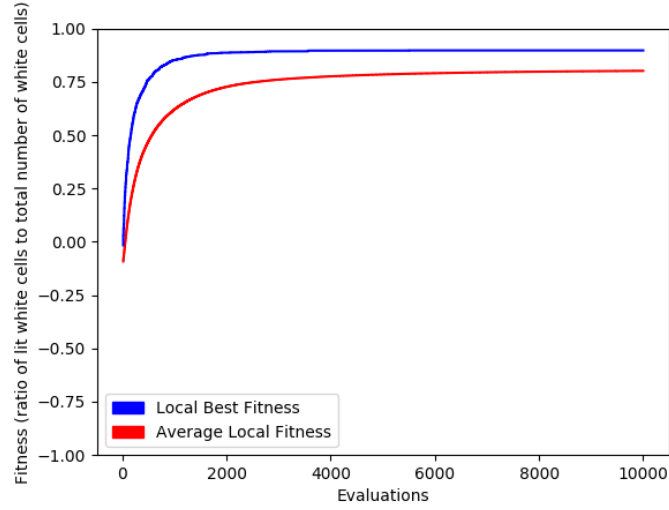
Figure 10: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Penalty Function EA with the Uniform Random Initialized, Randomly Generated Puzzle**, Averaged Over All Runs
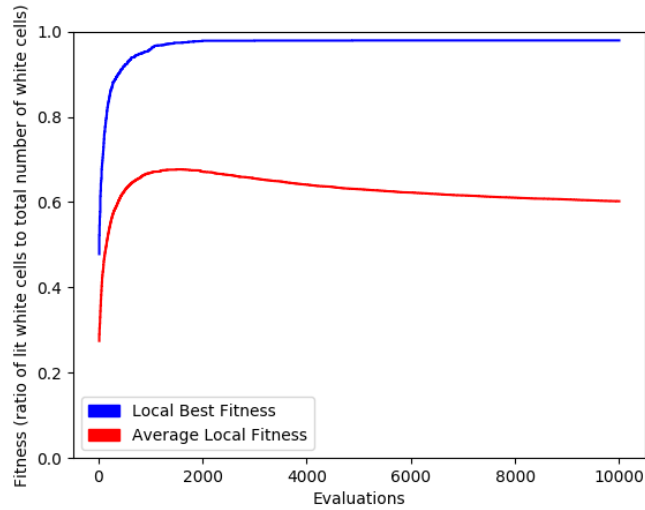

Figure 11: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Repair Function EA with the Uniform Random Initialized, Randomly Generated Puzzle**, Averaged Over All Runs
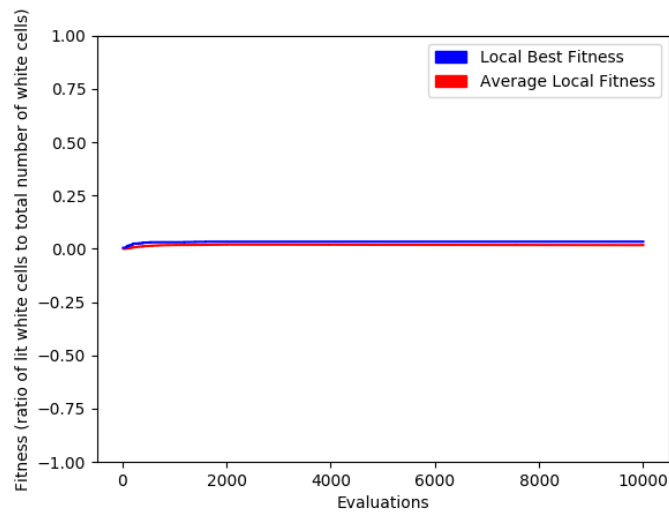
Figure 12: Evaluations versus Average Local Fitness and Evaluations versus Local Best Fitness for the **Plain-Vanilla EA with the Uniform Random Initialized, Randomly Generated Puzzle**, Averaged Over All Runs