COMP 6660 Fall 2022 Assignment 1b

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Results

Green Bridge Generation

The experiment was ran for a total of 30 runs, with each run generating a maximum of 5000 generations each. In this experiment, Fitness Proportionate Selection was used for parent selection, while k Tournament Without Replacement was used for survival selection. The recombine method used was 1-point crossover. The experiment started with 500 parents/mu and generated 10 children at a mutation rate of 60%. Best fitness values per run are given in table 2 on page 5. The best solution found was given a fitness score of **60876900**. This fitness was first hit in the **22nd run**. The bridge created for this solution is shown in figure 1 on page 2. A plot of the max fitness progress vs the average fitness for the 30 runs is shown in figure 2 on page 2.

Yellow Bridge Generation

The experiment was ran for a total of 30 runs, with each run generating a maximum of 5000 generations each. In this experiment, Fitness Proportionate Selection was used for parent selection, while Stochastic Universal Sampling was used for survival selection. The recombine method used was 1-point crossover. The experiment started with 500 parents/mu and generated 10 children at a mutation rate of 30%. Best fitness values per run are given in table 2 on page 5. The best solution found was given a fitness score of **36133100**. This fitness was first hit in the **28th run** of the search. The
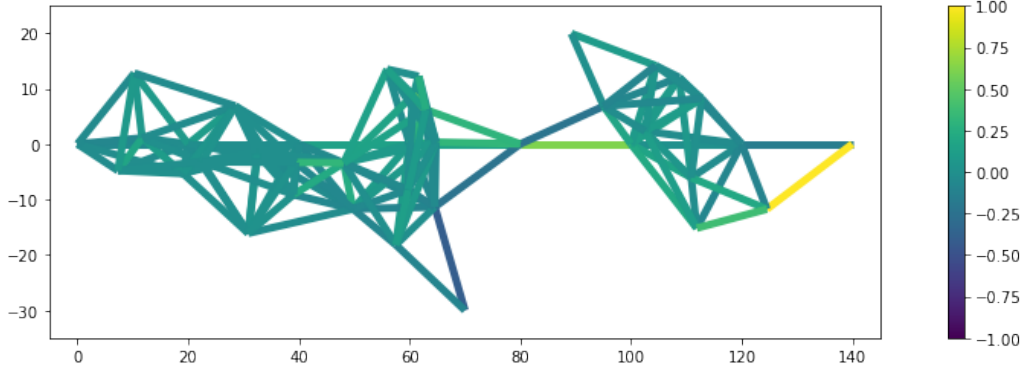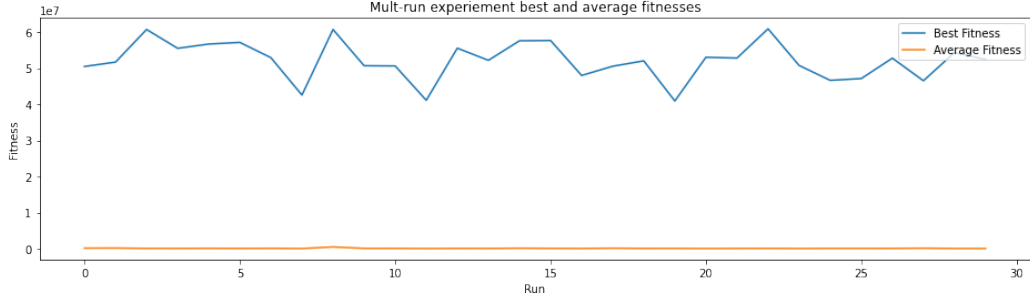
Figure 1: Green Best Solution Bridge

Figure 2: Green Best Fitness and Average Fitness Progress

bridge created for this solution is shown in figure 3 on page 4. A plot of the max fitness progress vs the average fitness for the 30 runs is shown in figure 4 on page 4.

Green Statistical Analysis

The best fitness per run data was compared against uniform random search algorithm data sample provided. The distribution of the data is not known to be normal and the sample size is greater than 29. Therefore, a two sample F-Test was performed for variances. The table showing the results of this test can be found in figure 5 on page 6. The chosen value for α was 0.025. The sample size for each sample was 30. The variance for sample 1 was 28,097,548,423,781.6 and the variance for sample 2 was 28,506,034,482,758.6. The calculated test statistic F was valued at 0.985670189965424. The nearest

Green Run Number	Best Solution Fitness Score
1	50456200
2	51667500
3	60695200
4	55483900
5	56665700
6	57124400
7	52900900
8	42544400
9	60706400
10	50667400
11	50604000
12	41096700
13	55522200
14	52160700
15	57566100
16	57652400
17	47970000
18	50522600
19	52014200
20	40906200
21	53006100
22	52785300
23	60876900
24	50734600
25	46614400
26	47112100
27	52756500
28	46503700
29	54310600
30	52409600

Table 1: Green Best Fitness Score Per Run

critical value to F(F Critical one-tail) was 0.475964774310031. According to
the test results, the value of F is smaller than one and but is greater than
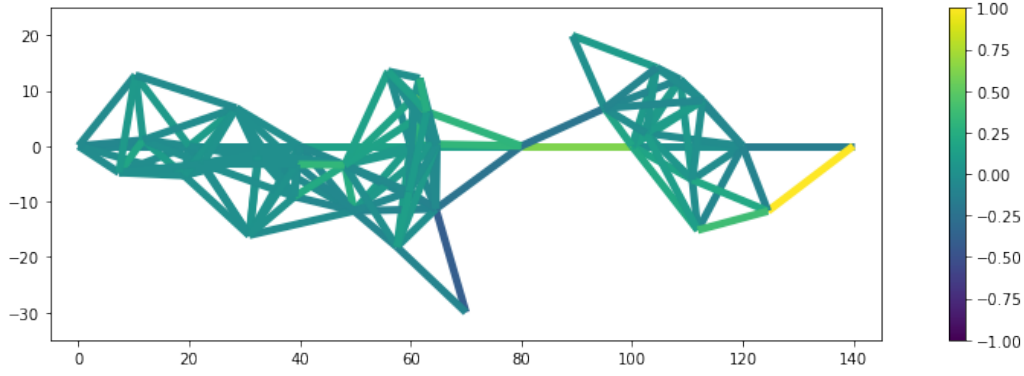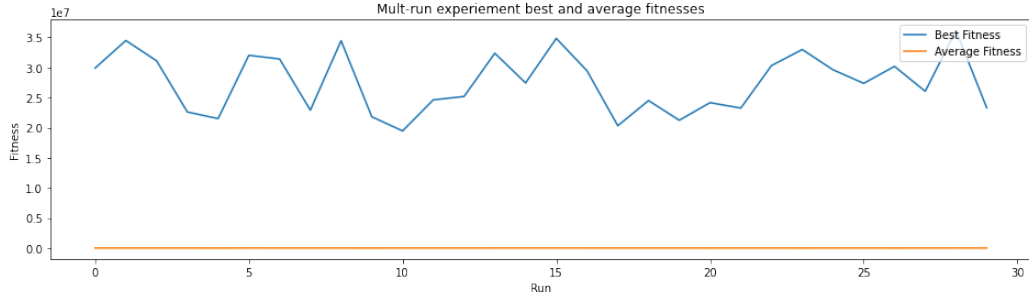
Figure 3: Yellow Best Solution Bridge

Figure 4: Yellow Best Fitness and Average Fitness Progress

F Critical one-tail. This means that there is no significant differences in the variances of the two data sets.

With the variances of the data sets showing no significant differences, a Two-tailed two-sample t-test assuming equal variances was used next for comparison. The table showing the results of this test can be found in figure 6 on page 7. The chosen value for α was 0.05. The sample size for each sample was 30. The sample mean for sample 1 was 52,067,896.66 and the sample mean for sample 2 was 33,950,000. The sample variance for sample 1 was 28,097,548,423,781.6 and the sample variance for sample 2 was 28,506,034,482,758.6. The calculated test statistic t was found to be 13.1900500859535. The upper critical value (t Critical two-tail) was 2.00171748414524. Therefore, the two experiments produced significantly different mean fitness. The experiment with the highest sample mean can

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Yellow Run Number	Best Solution Fitness Score
1	29899800
2	34468100
3	31093400
4	22601300
5	21499200
6	32009400
7	31400600
8	22903600
9	34434700
10	21808100
11	19456300
12	24615600
13	25173500
14	32354300
15	27429500
16	34817300
17	29434600
18	20318500
19	24496000
20	21229800
21	24150600
22	23247400
23	30309900
24	32971700
25	29608000
26	27356700
27	30173900
28	26037300
29	36133100
30	23296800

Table 2: Yellow Best Fitness Score Per Run

then be assumed to produce a significantly higher mean fitness than the other. Since experiment 1 produced a higher sample mean, we can conclude that

experiment 1 is statistically significantly better than experiment 2 (random uniform search).

F-Test Two-Sample for Variances		
	Variable 1	Variable 2
Mean	52067896.67	33950000
Variance	2.80975E+13	2.8506E+13
Observations	30	30
df	29	29
F	0.98567019	
P(F<=f) one-tail	0.484632705	
F Critical one-tail	0.475964774	

Figure 5: Green F-Test Two-Sample for Variance Excel Data

Yellow Statistical Analysis

The best fitness per run data was compared against uniform random search algorithm data sample provided. The distribution of the data is not known to be normal and the sample size is greater than 29. Therefore, a two sample F-Test was performed for variances. The table showing the results of this test can be found in figure 7 on page 8. The chosen value for α was 0.025. The sample size for each sample was 30. The variance for sample 1 was 24,023,617,480,229.9 and the variance for sample 2 was 28,506,034,482,758.6. The calculated test statistic F was valued at 0.842755504795316. The nearest critical value to F(F Critical one-tail) was 0.475964774310031. According to the test results, the value of F is smaller than one and but is greater than F Critical one-tail. This means that there is no significant differences in the variances of the two data sets.

With the variances of the data sets showing no significant differences, a Two-tailed two-sample t-test assuming equal variances was used next for comparison. The table showing the results of this test can be found in

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	52067896.67	33950000
Variance	2.80975E+13	2.8506E+13
Observations	30	30
Pooled Variance	2.83018E+13	
Hypothesized Mean Difference	0	
df	58	
t Stat	13.19005009	
P(T<=t) one-tail	2.08404E-19	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	4.16807E-19	
t Critical two-tail	2.001717484	

Figure 6: Green t-Test Two-Sample Assuming Equal Variances Excel Data

figure 8 on page 8. The chosen value for α was 0.05. The sample size for each sample was 30. The sample mean for sample 1 was 27,490,966.66 and the sample mean for sample 2 was 33,950,000. The sample variance for sample 1 was 24,023,617,480,229.9 and the sample variance for sample 2 was 28,506,034,482,758.6. The calculated test statistic t was found to be -4.88119200764386. The upper critical value (t Critical two-tail) was 2.00171748414524. Therefore, the two experiments produced significantly different mean fitness. The experiment with the highest sample mean can then be assumed to produce a significantly higher mean fitness than the other. Since experiment 1 produced a lower sample mean, we can conclude that experiment 1 is not statistically significantly better than experiment 2 (random uniform search).

F-Test Two-Sample for Variances		
	Variable 1	*Variable 2*
Mean	27490966.7	33950000
Variance	2.4024E+13	2.8506E+13
Observations	30	30
df	29	29
F	0.8427555	
P(F<=f) one-tail	0.32404619	
F Critical one-tail	0.47596477	

Figure 7: Yellow F-Test Two-Sample for Variance Excel Data

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	27490966.7	33950000
Variance	2.4024E+13	2.8506E+13
Observations	30	30
Pooled Variance	2.6265E+13	
Hypothesized Mean Difference	0	
df	58	
t Stat	-4.881192	
P(T<=t) one-tail	4.3117E-06	
t Critical one-tail	1.67155276	
P(T<=t) two-tail	8.6233E-06	
t Critical two-tail	2.00171748	

Figure 8: Yellow t-Test Two-Sample Assuming Equal Variances Excel Data