COMP 5660 Fall 2023 Assignment 1b

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1 Green Deliverables

1.1 EA Parameters

See Table 1 for Green EA Parameters.

Parameter Name	Value
μ	1000
λ	500
Mutation Rate	0.50
Parent Selection Method	Fitness Proportionate
Survival Selection	K-Tournament Without Replacement ($k = 7$)
Recombination Method	One-Point Crossover
Mutation Expected Loci Changed	2
Mutation Creep Normal Distribution σ	3

Table 1: Green EA Parameter Values

1.2 Results

See Figure 1 for an Evals vs Population Mean and Population Max fitness. As the plot shows, the mean and max fitness stay relatively close for the run.

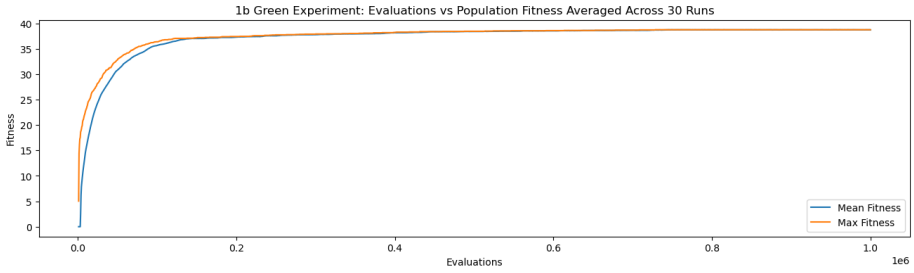

Figure 1: Green Evals vs Mean and Max Fitness

See Figure 2 for the optimal solution generated by the Green parameters. This solution came from run 8 and had fitness 40.

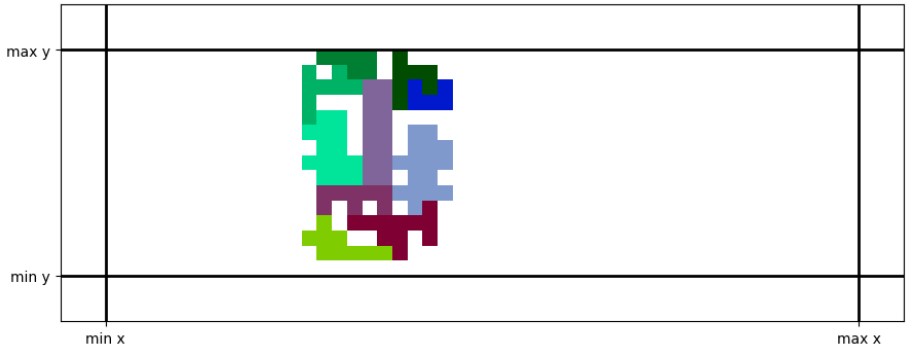

Figure 2: Best Solution from Green

1.3 Statistical Analysis

In this section, the data from the random initialization is compared to the base EA implemented in this report.
The statistics for each dataset are shown in Table 2.

1b data mean:	38.733333333333334
1b data stdv:	0.8276819867946673
1a data mean:	24.966666666666665
1a data stdv:	1.7515182248421006

Table 2: Green Statistical Data

After performing a Welch's T-test, a p value was found of $3.37492803 \cdot 10^{-34}$. With $\alpha = 0.05$, the null hypothesis of the methods yielding the same results can be firmly rejected, as $\alpha >> p$.
Based on the means of the fitnesses from each dataset, the results from the EA are clearly better.

2 Yellow Deliverables

2.1 EA Parameters

See Table 3 for Yellow EA Parameters.

Parameter Name	Value
μ	1000
λ	500
Mutation Rate	0.50
Parent Selection Method	Stochastic Universal Sampling (SUS)
SUS Probability Distribution	Fitness Proportionate
Survival Selection	K-Tournament Without Replacement ($k = 7$)
Recombination Method	One-Point Crossover
Mutation Expected Loci Changed	2
Mutation Creep Normal Distribution σ	3

Table 3: Yellow EA Parameter Values

2.2 Results

See Figure 3 for an Evals vs Population Mean and Population Max fitness. As the plot shows, the mean and max fitness stay relatively close for the run.

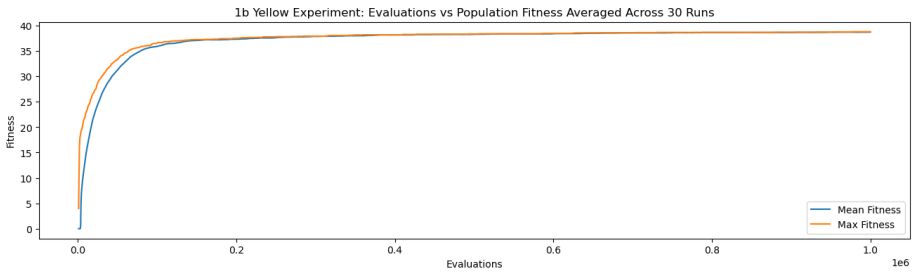

Figure 3: Yellow Evals vs Mean and Max Fitness

See Figure 4 for the optimal solution generated by the Yellow parameters. This solution came from run 0 and had fitness 40.

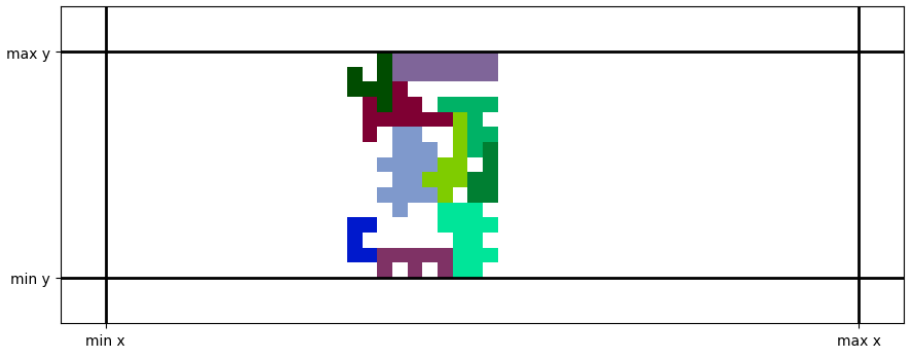

Figure 4: Best Solution from Yellow

2.3 Statistical Analysis

In this second, the data from the Green section of the report is compared to the Yellow version with Stochastic Universal Sampling.
The statistics for each dataset are shown in Table 4.

yellow data mean:	38.733333333333334
yellow data stdv:	0.7466399831028446
green data mean:	38.733333333333334
green data stdv:	0.8276819867946673

Table 4: Yellow Statistical Data

After performing a Welch's T-test, a p value was found of 0.6250396054974117. With $\alpha = 0.05$, the null hypothesis of the methods yielding the same results cannot be rejected, indicating that the methods are not statistically significantly different.

3 Red Deliverables

3.1 New Recombination Method: N-Point Crossover

In order to include a new recombination method in the EA, n-point crossover was implemented. This method selects n points to 'split' the genes of each parent, then creates a child by taking alternate stretches from each parent.
The implementation used in this paper will randomly choose which points to use, guaranteeing that they are unique. It will also randomly select which parent to start with when selecting alternative stretches.

3.2 EA Parameters

See Table 5 for Red EA Parameters.

Parameter Name	Value
μ	1000
λ	500
Mutation Rate	0.50
Parent Selection Method	Fitness Proportionate Selection
Survival Selection	K-Tournament Without Replacement ($k = 7$)
Recombination Method	N-Point Crossover (n=2)
Mutation Expected Loci Changed	2
Mutation Creep Normal Distribution σ	3

Table 5: Red EA Parameter Values

3.3 Results

See Figure 5 for an Evals vs Population Mean and Population Max fitness. As the plot shows, the mean and max fitness stay relatively close for the run.

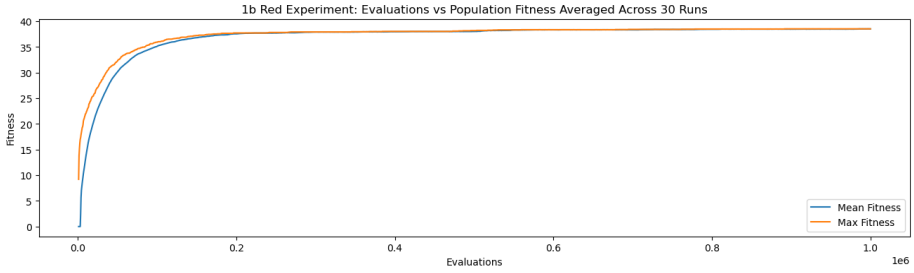

Figure 5: Red Evals vs Mean and Max Fitness

See Figure 6 for the optimal solution generated by the Red parameters. This solution came from run 2 and had fitness 40.

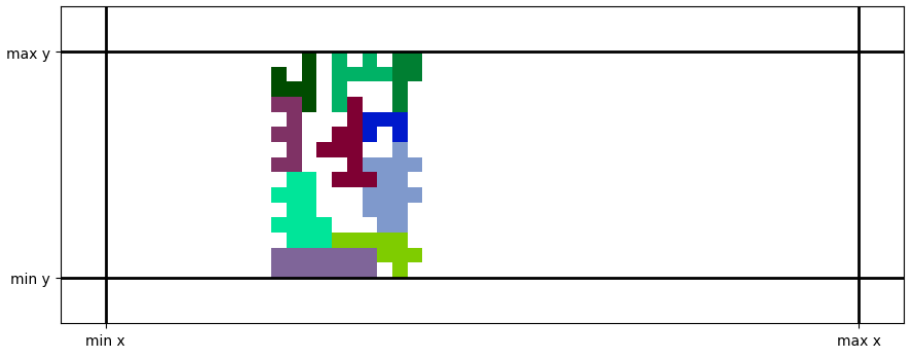

Figure 6: Best Solution from Red

3.4 Statistical Analysis

In this second, the data from the Green section of the report is compared to the Red version with 2-point crossover.
The statistics for each dataset are shown in Table 6.

yellow data mean:	38.53333333333333
yellow data stdv:	0.9371024061116425
green data mean:	38.733333333333334
green data stdv:	0.8276819867946673

Table 6: Red Statistical Data

After performing a Welch's T-test, a p value was found of 0.3846152091409889. With $\alpha = 0.05$, the null hypothesis of the methods yielding the same results cannot be rejected, indicating that the methods are not statistically significantly different.