Question, Research, Hypothesis, Experiment, Data Analysis, Conclusion

Question: How does changing the population size affect the amount of generations it takes to complete each course

Hypothesis: Increased population will lead to an improvement in the fitness of each generation.

Experiment.

Population numbers: 20, 30, 40
Generation amount: 10
Maps: 1, 2, 3

	Map 1	Map 2	Map 3
Generation 0	346847.2	386.9	497.8
Generation 1	576480.0	426.4	7092.6
Generation 2	691296.3	445.4	9929.6
Generation 3	691296.3	445.4	9929.6
Generation 4	691296.3	445.4	10409.6
Generation 5	691296.3	466.2	48272.0
Generation 6	691296.3	509.6	48272.0
Generation 7	691296.3	509.6	48272.0
Generation 8	857217.8	838.6	48272.0
Generation 9	857217.8	838.6	76775.8

Population: 30

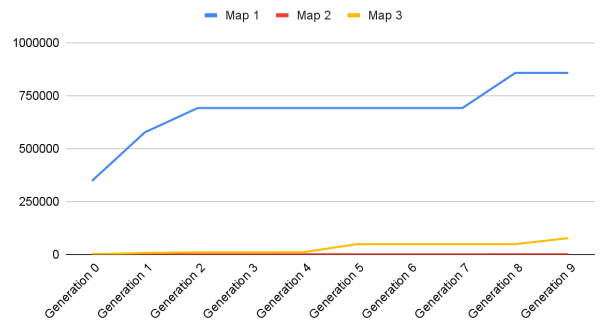
	Map 1	Map 2	Map 3
Generation 0	346847.2	392.5	223.0
Generation 1	576480.0	404.8	492.6
Generation 2	576480.0	361368.6	493.6
Generation 3	576480.0	361368.6	548.6
Generation 4	576480.0	576480.0	5533.9
Generation 5	576480.0	576480.0	5540.9
Generation 6	576480.0	576480.0	10163.0
Generation 7	576480.0	576480.0	10163.0
Generation 8	576480.0	576480.0	69406.0
Generation 9	576480.0	576480.0	69406.0

Population: 40

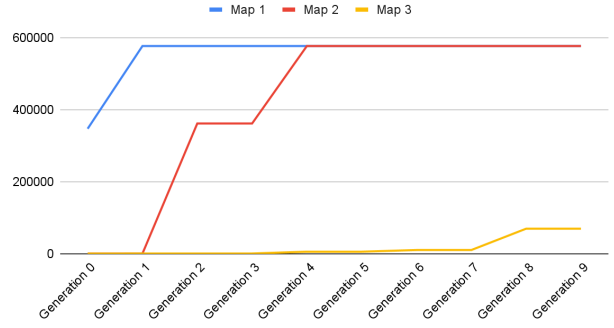
	Map 1	Map 2	Map 3
Generation 0	766173.2	866.9	1509.9
Generation 1	766173.2	347421.5	4263.9
Generation 2	766173.2	347421.5	4263.9
Generation 3	766173.2	347421.5	9273.6
Generation 4	766173.2	349141.6	41227.5
Generation 5	766173.2	349141.6	69827.4
Generation 6	766173.2	352360.4	69827.4
Generation 7	970171.8	352360.4	69827.4
Generation 8	970171.8	576480.0	69827.4
Generation 9	970171.8	576480.0	71944.9

Graphs

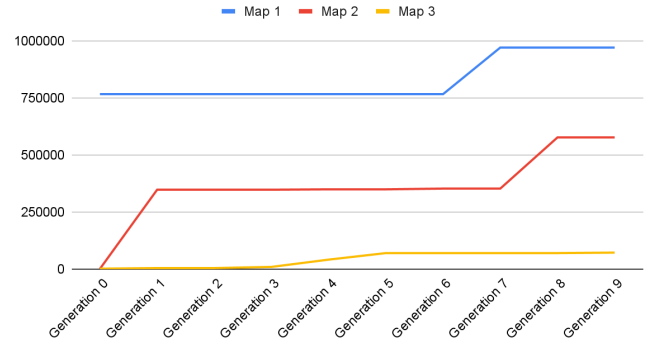
Population: 20



Population: 30



Population: 40



Analysis of Experimental Results

The following analysis focuses on the highest fitness scores achieved in a series of experiments conducted across three populations (20, 30, and 40) on three different maps (Map 1, Map 2, and Map 3) over multiple generations (0 to 9). The highest fitness score represents the peak performance achieved within each generation.

Population 20:

Map 1:
In Population 20 on Map 1, the highest fitness score started at 346,847.2 in Generation 0 and remained relatively stable throughout subsequent generations.

Map 2:
For Map 2, the highest fitness score in Population 20 began at 386.9 in Generation 0. Although it experienced fluctuations, it generally stayed at lower values.

Map 3:
On Map 3, Population 20 started with a highest fitness score of 497.8 in Generation 0. Similar to Map 2, it displayed fluctuations but consistently remained lower compared to Map 1.

Population 30:

Map 1:
Population 30, when placed on Map 1, exhibited a pattern of stability in the highest fitness score. It started at 346,847.2 in Generation 0 and maintained this level in the early generations. A significant increase was observed in Generation 7.

Map 2:
On Map 2, Population 30 started with a highest fitness score of 392.5 in Generation 0. Similar to the previous populations, it showed fluctuations but generally remained at lower values.

Map 3:
Population 30 on Map 3 began with a highest fitness score of 223 in Generation 0. Similar to Map 2, it experienced fluctuations, with notable increases in Generations 3 and 4.

Population 40:

Map 1:
For Population 40 on Map 1, the highest fitness score started at 766,173.2 in Generation 0 and underwent a significant increase in Generation 8.

Map 2:
Map 2 showed a similar pattern for Population 40, with an initial highest fitness score of 866.9 in Generation 0 and a substantial increase in Generation 8.

Map 3:
In the case of Map 3, Population 40 began with a highest fitness score of 1,509.9 in Generation 0, again experiencing a significant increase in Generation 8.

General Observations:

- Across all populations and maps, there is a clear trend of performance improvement as generations progress, especially in later generations.
- Map 3 consistently demonstrated the highest highest fitness scores compared to Maps 1 and 2.
- Generation 8 stood out as a critical point across all populations and maps, where a significant increase in the highest fitness score was observed.
- In most of the maps the higher the population count the higher the fitness of each generation

<u>Conclusion</u>

This experiment was to see if changing the population count of the neural network will affect the fitness level of each generation.

The experiment showed that when you increase the starting population of the neural network it will result in a higher fitness level throughout each generation. This occurred in every test except for maps one and three in which the population of 20 had higher fitness scores then the population of 30. This proves the hypothesis as an increase in population improved the fitness of each generation.

The main limitations of this experiment involve:

- Only using the highest fitness score as it only shows one aspect of the population and the experiment could benefit from seeing what the average fitness of the population is to get a better picture of what is happening within each generation.
- Recording more then one test per population per map. The nature of genetic algorithms is based on the randomness that comes with mutations and

performing the tests multiple times will provide more accurate results and match the hypothesis far closer then it currently does
- Running the tests for more generations. By recording data for more then 10 generations we will be able to see what the algorithm does over a longer span of time and see how high the fitness score gets and how fast it goes up compared to the other population sizes.

This experiment has expanded my understanding of how population size affects the fitness score of a genetic algorithm proving that the higher it is the faster and better the algorithm will perform. This can be applied to future problems in this area through increasing the initial populations set for certain neural nets in order to reach a solution faster.