Relationship Between Iteration Count and Cost in Genetic Algorithms

The algorithm in **optimization.py** works by selecting the best individuals (lists of genes with the lowest cost) from a population and creating a new population consisting of only those individuals. These individuals then have children to restore the population to its original size. Children are created by combining two lists. The best individuals are now chosen from this group to create a new population and the process is repeated many times. Mutations are also added to the population to add random variation.

There are several variables that affect the change in cost of the output over time. I choose to study the effects of changing the total number of iterations on the final output.

With each iteration, the average cost of individuals in the population decreases as the lowest-cost individuals are selected to create the next generation. Since the output of the algorithm is the individual with the lowest cost from the gene pool, the lower the average cost of the gene pool, the lower the cost of the best individual. Therefore, the best individual will have a lower cost as the number of iterations increases.

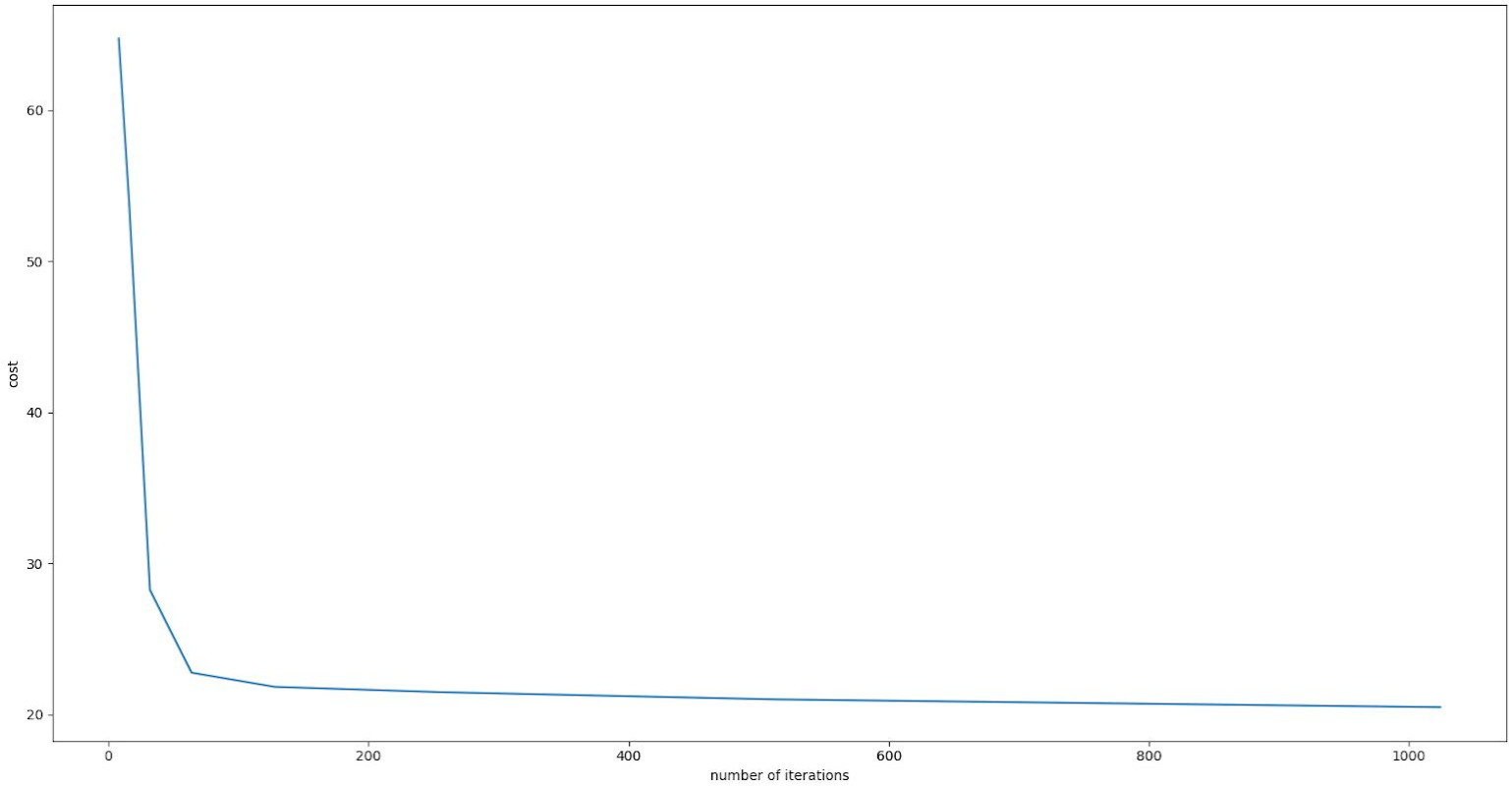
The gene pool initially starts off in a random state making the average cost high. Because the best individual is selected from this gene pool, it will have a high cost when the number of iterations is low.

As the number of iterations increases, low cost genes become more frequent in the gene pool causing the average cost and best cost of the gene pool to decrease.

I created a graph using matplotlib to show the relationship between iterations and the cost of the best individual after a certain number of iterations. The cost starts high but as the number of iterations increases, it rapidly falls before leveling out at a low level.

In the first few iterations, most of the bad genes are removed from the gene pool causing a rapid decrease in the average and best cost of the population. As this process continues, there are fewer and fewer bad genes to remove which slows down progress. Also, random mutations are less likely to cause improvement as the standard of the gene pool increases. These factors cause improvement to slow down and plateau as the number of iterations increases. Improvement still occurs but much more slowly.

The graph below shows how the cost decreases with additional iterations.



In this graph, the x-axis is the number of iterations and the y-axis is the cost.

The graph and code are in the same directory as this document.