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CS 420 - Lab 2

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Introduction

This project involves using the LEAP library to test how changing different parameters impacts a population across generations. The different parameters tested were population size, probability of mutation, probability of uniform crossover, and tournament size. Each of these was isolated and tested. 256 different combinations of these parameters were tested along with an additional 20 iterations with random populations. Therefore, 276 rows can be found in my CSV file.

Which parameters have the biggest impact on performance/fitness achieved?

Out of the four parameters, two of them seemed to have a significant impact on performance: mutation and population. As seen in the figure below, when the population size was 25, fitness suffered. Likewise, if the mutation probability was too high or too low (0.00 or 0.05), the performance decreased. The other two parameters had less impact on performance. Tournament size seemed to impact how quickly the population was able to achieve a higher average fitness. However, the last generation shows how each population regardless of tournament size eventually achieved a similar fitness. When tournament size = 2, the fitness was still achieved; albeit slower than the other 3 iterations. The probability of uniform crossover was less clear. When the probability = 0.0, 0.3, or 0.5 they performed comparably well. However, when p_c = 0.1, the fitness suffered. By generation 30, they were close in terms of fitness; but it took much longer to achieve this level of fitness. I suppose this is why a default value of 0.3 was chosen for the probability of uniform crossover. However, when all combinations of parameters were

included in the analysis (the heat map). It seemed that 0.5 performed the worst while 0.3 was the second worst. This means that when default parameters are used 0.3 performed better; however this was not the case for the rest of the iterations. This indicates the probability of crossover is dependent on the other four parameters. This subject will be looked at later in this report.

How does selection pressure impact performance?

Higher selection pressure caused the fitness to improve more from generation to generation as indicated in the figure below. As you can see in the heat map below, regardless of population size, higher selection pressure correlates directly with fitness. As you can see in the line graph displaying performance for different tournament sizes, the same correlation is indicated.

Are both crossover and mutation necessary?

Mutation is extremely necessary. Some populations had fitnesses that plateaued across generations. This makes sense because, without mutation, everything is up to the starting genomes. As seen in the line graph below, when mutation probability = 0.00 the fitness flatlines around generation 15. This shows why mutation is necessary for the overall fitness of a population over time. Uniform crossover is not necessary. The line graph below displaying performance across generations for each of the crossover probabilities conveys this notion. A crossover probability of 0.0 performed very similarly to a probability of 0.5. This shows that uniform crossover probability is not necessary. Below is a heat map that shows how fitness changes depending on crossover and mutation probability.

Which parameters interact with each other the most?

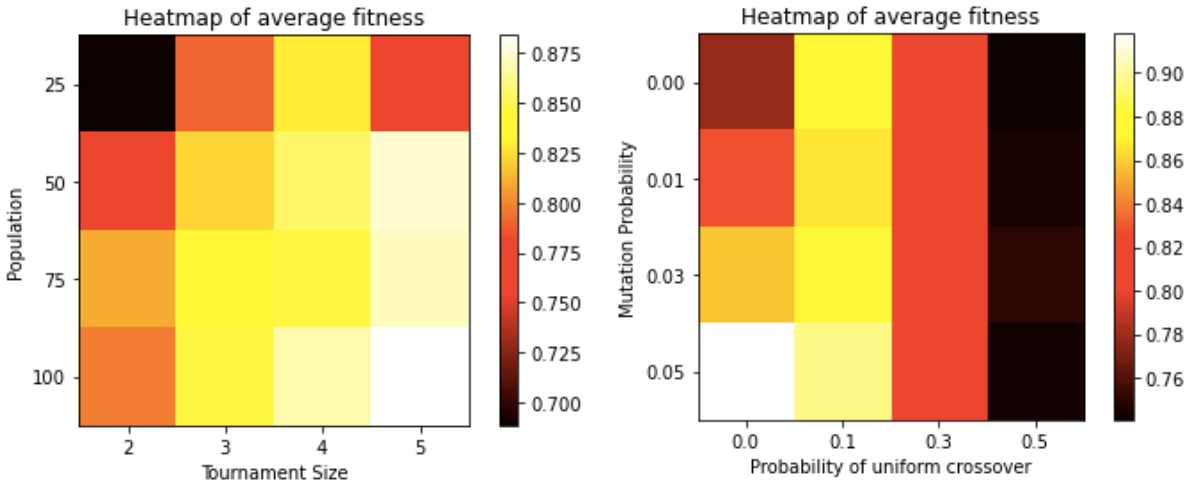
According to the data, tournament size and population interact the most. As the tournament size and population size decrease, so does fitness. And likewise, as these values increase so does fitness. Higher population values interact very well with higher tournament sizes. The heat map

displaying the fitness across different tournament sizes and population sizes reflects this positive relationship.

How does population size affect performance?

When the population size is 25, a large decrease in performance is evident in the data. As stated in the answer to the previous question, a heat map below displays this as well as the line graph below. Increasing population size increases performance regardless of the other parameters. The increased population size comes with increased diversity. This makes sense because the selection availability should positively correlate with the size of the population. And increased selection choices should result in higher overall fitness for a population over time.

Heat-maps



Line Graphs for Each Parameter