Evolutionary Computation Final Exam

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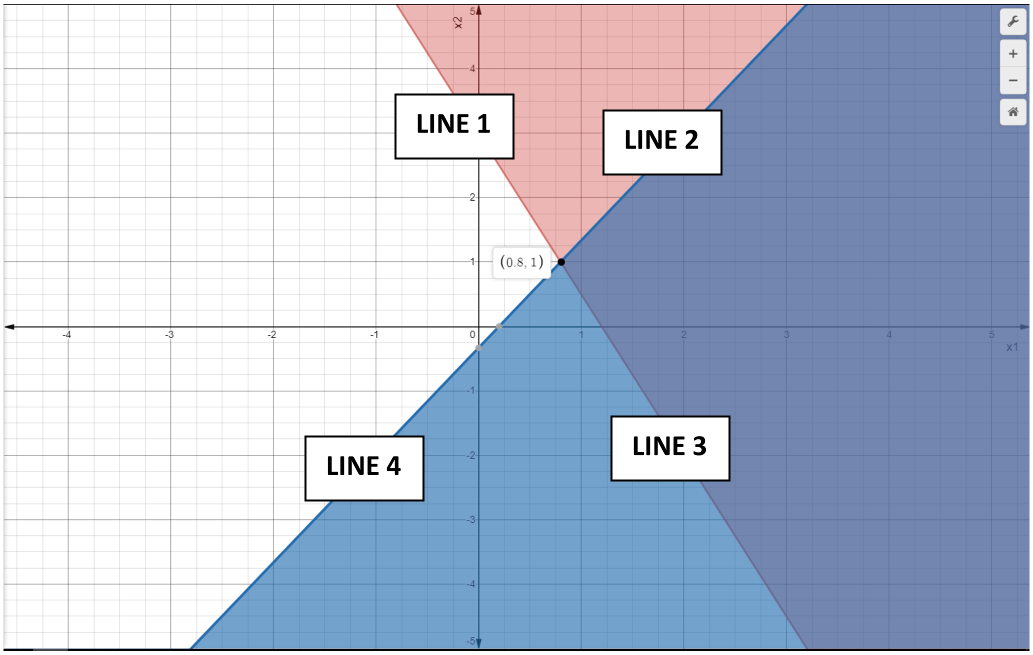
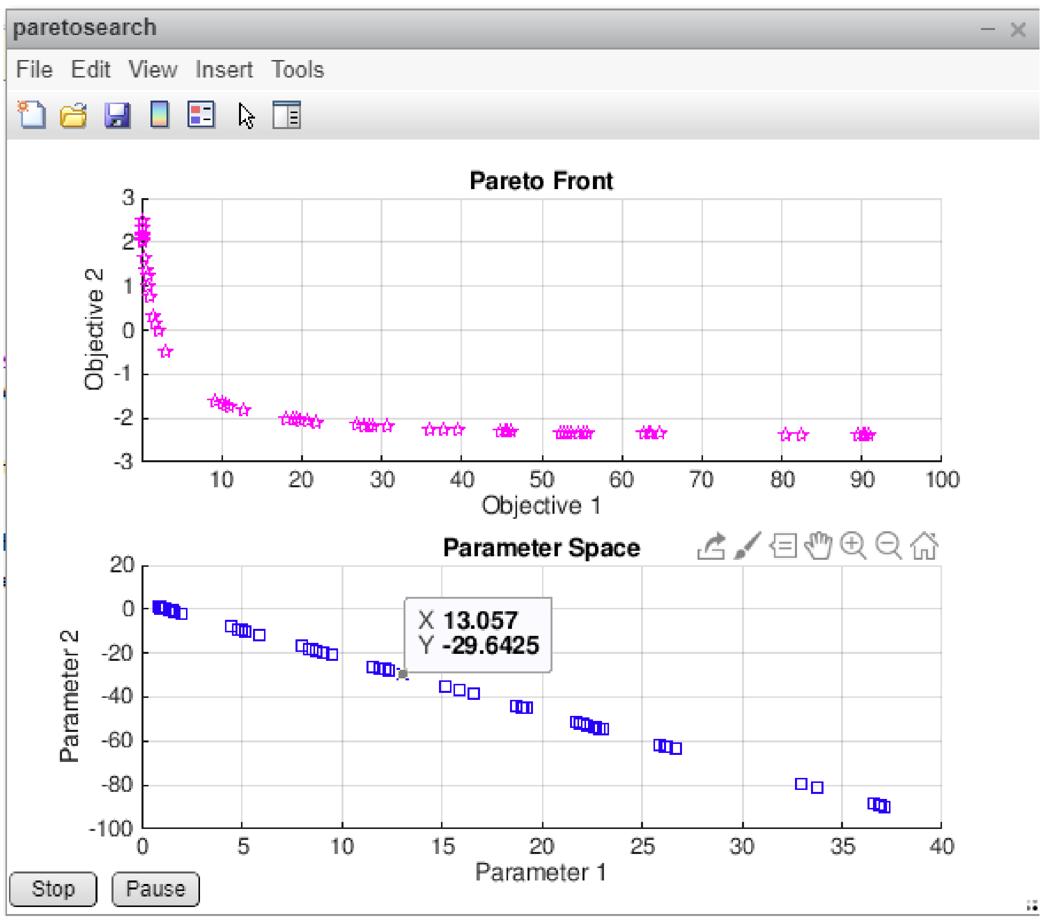
1. (a) $o(S_1) = 3$ $\delta(S_1) = 9 - 3 = 6$
   $o(S_1) = 3$ $\delta(S_1) = 5 - 1 = 4$
   (b) probability = $p_c \frac{\delta(S_1)}{lS_1 - 1} = p_c \times \frac{6}{11}$
   (c) probability = $o(S_1)p_m = 3 \times p_m$
   (d) probability = $1 - p_c \frac{\delta(S_1)}{l_{S_1} - 1} - o(S_1)p_m \cong \sim 1 - \frac{6p_c}{11} - 3p_m$
   (e) probability for (b) = $p_c \frac{\delta(S_2)}{l_{S_2} - 1} = p_c \times \frac{4}{11}$
   probability for (c) = $o(S_2)p_m = 3 \times p_m$
   probability for (d) = $1 - p_c \frac{\delta(S_2)}{l_{S_2} - 1} - o(S_2)p_m \cong \sim 1 - \frac{4p_c}{11} - 3p_m$
   (f) building block is defined as low order, low defining-length schemata with above average fitness. We can see that S_1 and S_2 has quite small order and defining length from (a) . However, we could not deduce how small it would be required for this problem to be considered building block. The other reason is that we also could not deduce the fitness of schema for these two schemata.
2. **Fitness sharing** -> 100, 200, 300, and 400 respectively
   Deterministic crowding -> 250, 250, 250, and 250 respectively
   Fitness sharing represents the capacity f the environment. For each local optimum, the more individual that resides around the area, the fitness will be lower overall. Therefore, selection is used to prune the individual with similar fitness at local optimum, which results in the same ratio between fitness and the resulting fitness sharing. In this case, the ratio would be 1:2:3:4.
   Deterministic crowding, on the other hand, hoped-for equal distribution of individual on the local optima of the fitness. In this case, the ratio would be 1:1:1:1
3. **Lamarkian local search** is done using local search for an individual **x** to find the local optimum of **x*** to replace it while updating its fitness function. Using this method, diversity and search space of the population will decrease rapidly, especially in the case where only a few local optima exists in the function. After many generations, population will only have individual at around the local optima. Because of this effect, we will see spikely reduce to discrete grid.
   Baldwinian local search will only update its fitness function and will leave the individual unscratched, which results in no change in its search space. After many generations, individual which is near global optima will slowly dominate the population.

4. **Feasible solution area**



Red represents $5x_1 + 2x_2 \geq 6$ **and blue represents** $5x_1 - 3x_2 \geq 1$

The feasible solution is the area that is simultaneously shaded by both color.



Optimal solution for f_1

$$\{(x\_1, x\_2) \mid (5x\_1 + 2x\_2 = 6 \ \vee 5x\_1 - 3x\_2 = 1) \ \wedge x\_1 \geq 0.8\}$$

Optimal solution for f_2

$$\{(x\_1, x\_2) \mid 5x\_1 + 2x\_2 = 6 \ \wedge x\_1 \ \geq 0.8\}$$

To optimize $f_{1,}$ we choose the line that bound the area where the two colors shade it together (LINE 2 and LINE 3 in the figure above).

To optimize f_2, we choose smaller x_2. Therefore, the line to be choose is the one that is lower right part of the area where the two colors shade it together (LINE 3).