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Assignment 17 (Genetic Algorithms)

Fitness function is of TSP which **minimizes** the total tour length.
Given the population size = 5 and the initial population

We calculate the distances of these permutations from the distance matrix

$$d = \begin{array}{c} \\ c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \end{array} \begin{array}{c} \begin{array}{ccccc} c_1 & c_2 & c_3 & c_4 & c_5 \end{array} \\ \begin{bmatrix} 0 & 110 & 350 & 220 & 70 \\ 110 & 0 & 455 & 260 & 170 \\ 350 & 455 & 0 & 420 & 490 \\ 220 & 260 & 420 & 0 & 170 \\ 70 & 170 & 490 & 170 & 0 \end{bmatrix} \end{array}$$

70<110<170<220<260<350<420<455<490

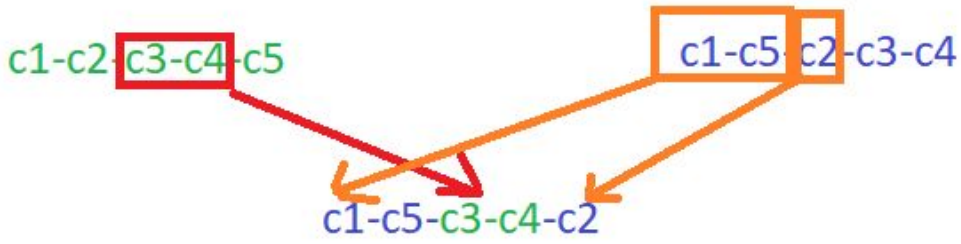
Permutations	Distances
c_1-c_2-c_3-c_4-c_5	1155
c_1-c_3-c_5-c_2-c_4	1270
c_1-c_5-c_2-c_3-c_4	1115
c_5-c_1-c_3-c_2-c_4	1135
c_2-c_5-c_4-c_3-c_1	1110

For tournament selection with q=2, we select c_1-c_2-c_3-c_4-c_5 & c_1-c_3-c_5-c_2-c_4
From which c_1-c_2-c_3-c_4-c_5 wins with minimal distance as 1155
This is our first parent.

Next, we again select c_1-c_3-c_5-c_2-c_4 & c_1-c_5-c_2-c_3-c_4
From which c_1-c_5-c_2-c_3-c_4 wins with minimal distance as 1115 which is our second parent.
c_1-c_3-c_5-c_2-c_4 never wins as it has the highest distance.

Now we compare c_5-c_1-c_3-c_2-c_4 & c_2-c_5-c_4-c_3-c_1 from which c_2-c_5-c_4-c_3-$c_1$wins because it has the minimum distance as 1110 (third parent).

Now we take the first and second parent and perform PMX to produce one offspring with a partial sequence consisting of the **third** and **fourth** city in the sequence.

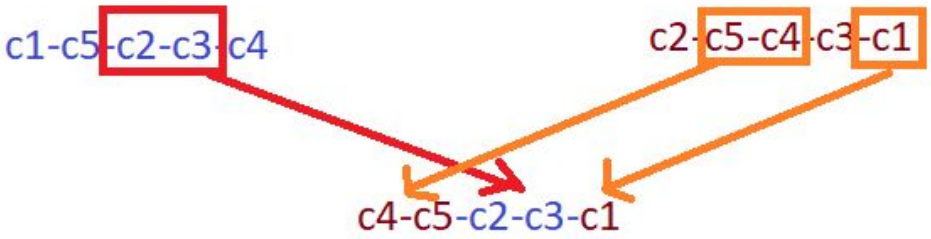


Mappings: c3-c2, c4-c3

The produced offspring has a fitness value of 1240.

Now we use swap mutation with P_m = 0.1 to find the optimal fitness we swap the third and fourth cities and produce c_1-c_5-c_4-c_3-c_2 with distance **1115**.
We retain this solution in our (5+3)-selection scheme.

We perform PMX over second & third parent in a similar manner,

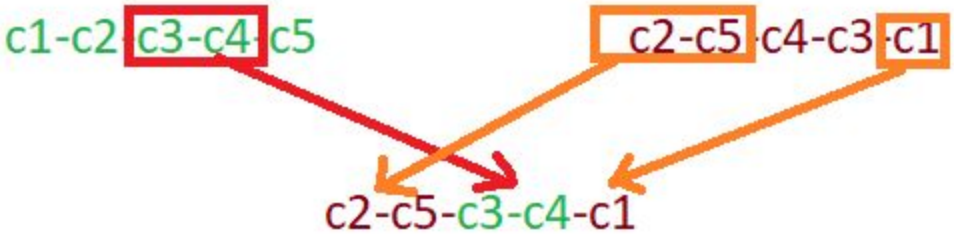


Mappings: c2-c4

The produced offspring has a fitness value of 1145.

We use swap mutation in the **fourth** and **fifth** cities to produce optimal fitness c_4-c_5-c_2-c_1-c_3 with a distance of **800**. We retain this solution in our (5+3)-selection scheme.

We perform PMX over first & third parent in a similar manner,



Mappings: c3-c4, c4-c3

The produced offspring has a fitness value of 1300.

We use swap mutation in the **third** and **fourth** cities to produce optimal fitness
c_2-c_5-c_3-c_4-c_1 with a distance of **1110**. We retain this solution in our (5+3)-selection scheme.

We now stop the procedure and update the population size with (5+3)-selection with the best-fit permutations.

Permutations	Distances
c_1-c_5-c_4-c_3-c_2 (child)	1115
c_4-c_5-c_2-c_1-c_3 (child)	800
c_1-c_5-c_2-c_3-c_4 (parent)	1115
c_2-c_5-c_3-c_4-c_1(child)	1110
c_2-c_5-c_4-c_3-c_1 (parent)	1110