TSP - Genetic Algorithm

1) Pretoria
2) Maseru
3) Vic Falls
4) Windhoek
5) Lusaka
6) Maputo
7) Gaborone
8) Manzini

What is the shortest route to tour all the cities.

Representation.

- **Representation is an ordered list of city numbers known as an order-based GA.**
- CityList1 (3 5 7 2 1 6 4 8)
- CityList2 (2 5 7 6 8 1 3 4)

Methods of Selection

1) Tournament.
2) Fitness proportionate.
3) Roulette-wheel
4) Elitist selection.

Fitness proportionate.

1. **Calculate Total Fitness:** Sum the fitness scores of all individuals in the population.

2. **Assign Selection Probability:**
   a. Divide the fitness score of each individual by the total fitness.
   b. This represents the **proportion of the roulette wheel** each individual occupies.

Assign Selection Probability:

- Divide the fitness score of each individual by the total fitness.
- This represents the **proportion of the roulette wheel** each individual occupies.

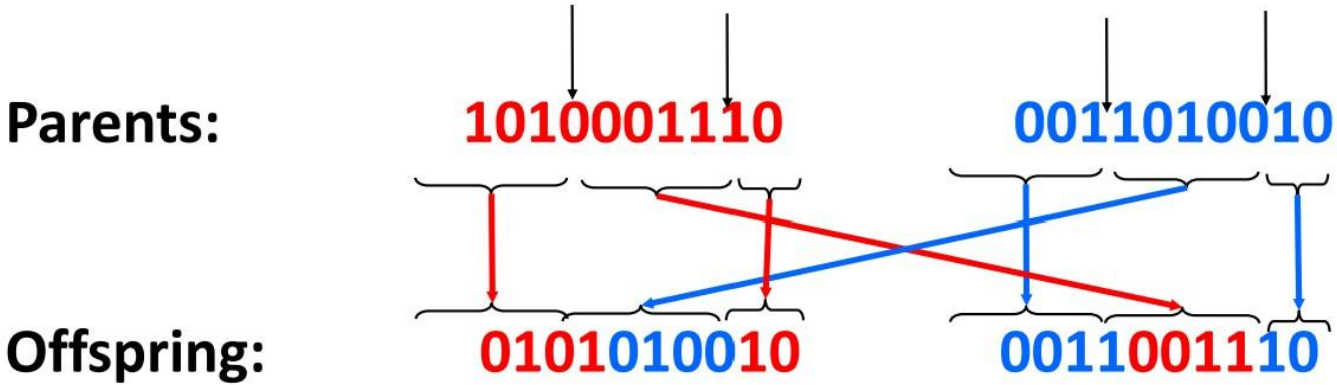
Example

- Consider a population of 4 individuals with fitness scores: [5, 3, 2, 1].
- Total Fitness = 11.
- Selection Probabilities:
  - Individual 1: 5/11 ≈ 0.45
  - Individual 2: 3/11 ≈ 0.27
  - Individual 3: 2/11 ≈ 0.18
  - Individual 4: 1/11 ≈ 0.09

- The roulette wheel would be divided:
  - Individual 1: Takes up nearly half the wheel (higher chance of selection).
  - Individuals 2 and 3: Have smaller slices.
  - Individual 4: Smallest slice (lowest chance).

NB.. Roulette-wheel selection vs Fitness proportionate

2 - point Crossover



Uniform Crossover

A random subset is chosen.

The subset is taken from parent 1 and the other bits from parent 2.

Parents: 1010001110 0011010010

Offspring: 0011001010 1010010110

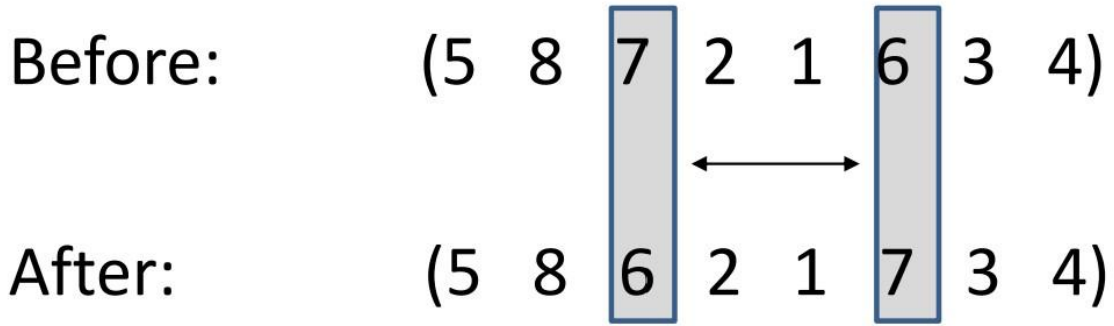
Order 1 Crossover- TSP

Crossover combines inversion and recombination

Parent1	(3	5	7	2	1	6	4	8)
Parent2	(2	5	7	6	8	1	3	4)
Child	(5	8	7	2	1	6	3	4)

Mutation

Mutation involves reordering of the list



Fitness Function

Fitness function is the cost.

Advantages of GA

- Concept is easy to understand
- Modular, separate from application
- Supports multi-objective optimization
- Easy to exploit previous or alternate solutions
- Flexible building blocks for hybrid applications.

QUESTIONS