GENETIC ALGORITHM: TRAVELLING SALES MAN PROBLEM

INFO6205_213

Akash Anand: 001873134
Karan Saini: 001828012

PROBLEM

- Given a set of cities and distance between every pair of cities, the problem is to find the shortest possible route that visits every city exactly once and returns to the starting point.

Genotype and phenotype

- Genotype is the digital information that is passed down generation to generation
- Phenotype is an expression of data.
- For this TSP problem we have considered the order of array index as genotype, which intern are stored in an array.

Fitness Function

- A gene's fitness is calculated by inverting the sum of distance between all the vertices(cities) within a gene, which also includes distance between last and the first city (Hamiltonian cycle)
- The smaller the distance the higher fitness value and vice versa

- Fitness of a gene = $\frac{1}{\text{distance between cities}}$

Normalized fitness

- Each gene contains a normalized fitness value (between 0-1), which determines its probability of getting chosen for crossover over other genes within a population.
- It is calculated by dividing a gene's fitness value with the sum of all genes fitness value.
- Let's say A, B and C are genes then,

$$\text{Normalized fitness value of A} = \frac{\text{fitness of A}}{fitness\ of\ A + fitness\ of\ B + fitness\ of\ C}$$

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Crossover

- For crossover, it is not always best to choose the fittest among the population, every gene should be considered for better variation in the population
- But the genes with high fitness value should have high chances of being selected and the gene with low fitness value should have less chances. Therefore, normalized fitness values are assigned to each gene.