

Traveling Salesman Problem: The problem says that a salesman is given a set of cities, he has to find the shortest route to visit each city exactly once and return to the starting city.

The Travelling Salesman Problem is one of the best-known NP-hard problems, which means that there is no exact algorithm to solve it in polynomial time. The minimal expected time to obtain optimal solution is exponential. So, for that reason, we usually use heuristics to help us to obtain a “good” solution.

Heuristic methods vary from exact methods in that they give no guarantee to find the optimal solution to the given problem (so that solution is called suboptimal), but in many cases this is the solution of good quality and we can obtain it in acceptable time.

Genetic Algorithm

Genetic algorithms are inspired by Darwin’s theory about development and evolution. Genetic algorithm is started with a set of solutions (denoted by chromosomes) called population. Solutions from one population are booked and used to form a new population. This is motivated by a hope, that the new generation will be better than the old one in its characteristics.

Solutions which are selected to form new solutions (offspring) are selected according to their fitness attributes; the more suitable they are the high probability they have to replicate.(Survival of the fittest)

Path Representation: 1->4->7->6->5->3->2

Gene: a city, represented as (x, y) coordinates

Individual: a single route satisfying the conditions of TSP (chromosome)

Population: a collection of possible routes(individuals)

Parents: two routes that are combined to create a new route

Mating Pool: a collection of parents that are used to create the next population

Fitness: a function that tells us how good each route is, how short the distance is, in this case.

Mutation: a way to introduce variation in the population by randomly swapping two cities in a route

City

Cities are represented as coordinates and distance calculation is done between cities using simple distance formula

Fitness

Fitness is being taken as the inverse of the route distance. The idea is to minimize route distance, so a larger fitness score is better.

Selection

Besides the elite individuals, select few individuals randomly.

Cross-over (Partially Mapped Crossover Operator (PMX))

Parents

1	2	3	4	5	6	7	8	9
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9	8	7	6	5	4	3	2	1
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Offspring

					6	7	8	
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9	5	4	3	2	6	7	8	1
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In the TSP, we need to include all locations exactly once. In PMX, we randomly select a subset of the first parent string and then fill the remainder of the route with the genes from the second parent in the order in which they appear, without duplicating any genes in the selected subset from the first parent.

Mutate

1	2	3	4	5	6	7	8	9
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1	2	8	4	5	6	7	3	9
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With specified low probability, two cities will swap places in a route

Genetic Algorithm Function

Create the initial population and loop through generations