Assignment 6
Genetic Algorithm: Travelling Salesman Problem

Objective:
To apply a Genetic Algorithm (GA) to solve the Travelling Salesman Problem by finding the shortest route that visits each city exactly once and returns to the starting point.

Problem Statement:
The Travelling Salesman Problem (TSP) is a classic optimization problem. Given a set of cities and the distances between every pair of cities, the objective is to determine the shortest possible route that visits every city exactly once and returns to the origin city.

Steps to implement the Genetic Algorithm:

Step 1. Create Initial Population
Define an initial population, considering n number of cities, with a permutation of city indices representing potential routes, like, $\{1, 2, ..., n\}$. Start by considering a small set of cities (5 cities) and gradually increase the number of cities up to 10.

Step 2. Define Fitness Function
The fitness f of a solution is determined by the total cost (or distance) of the tour. Use the **inverse of the total route cost** as the fitness measure, as a lower cost corresponds to a higher fitness.

Step 3. Selection Process
Select the best routes (individuals) based on their fitness to create the next generation. Use an appropriate selection method (e.g., tournament selection or roulette wheel selection) to choose the parents for crossover.

Step 4. Crossover (Recombination)
Perform crossover on the selected routes to produce new offspring. Use a crossover probability of 0.6 to determine if crossover occurs for a pair of parents. Apply a crossover method suitable for permutations.

Step 5. Mutation
Introduce mutations in the population to maintain genetic diversity. Apply a mutation probability of 0.1, swapping two randomly selected cities in a route to create a small variation.