# Travelling Salesman Problem (TSP) Algorithm

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## What is the TSP?

The **Travelling Salesman Problem (TSP)** is a famous **combinatorial optimization** problem in computer science and mathematics.

## Objective:

Find the **shortest possible route** that visits each city exactly once and returns to the starting city.

## Real-Life Applications

* Route planning (Google Maps, logistics)

* Microchip manufacturing (circuit optimization)

* DNA sequencing

* Drone path optimization

## TSP Problem Statement

Given a list of cities and the distance between each pair of cities, find the shortest possible tour that:

* Starts and ends at the same city.

* Visits each city exactly once.

## TSP Algorithm Steps (Using Brute Force)

Step-by-Step Process:

1. **List all cities (nodes)**

   Identify the cities that need to be visited.

2. **Create a cost/distance matrix**

   Show distances or travel costs between every pair of cities.

3. **Generate all possible tours (paths)**

   Make all permutations of city visits, starting and ending at the same city.

4. **Calculate total distance for each tour**

   Add up the distances between cities in the path.

5. **Compare all paths**

   Find the tour with the **minimum total cost or distance**.

6. **Return the best tour**

   This is the **optimal solution** (shortest path visiting all cities once).

Example (4 cities: A, B, C, D):

* Possible tours from A:

  A → B → C → D → A

  A → C → D → B → A

  A → D → B → C → A

  ... (total of (n-1)! = 6 paths)

* Calculate the cost of each and pick the shortest.

**TSP Greedy (Nearest Neighbor) Steps:**

1. Start at a city.
2. Visit the **nearest unvisited city**.
3. Repeat until all cities are visited.
4. Return to the starting city.
5. Total distance = sum of all traveled edges.