Traveling Salesman Problem

Exact Solution presentation

Description

- The Traveling Salesman problem is a shortest path algorithm that finds the most optimal path that visits every city exactly only one time with the shortest distance traveled.
- The decision version of the problem focuses on checking if there exists a path that visits every city
- The optimization version focuses on finding the path that visits every city in the most optimal way.

Real Life Applications

Traveling salesman is used by postal and delivery services to get a optimized route that leads to the least time traveled to reach a particular destination

(Big O) runtime analysis

- The exact solution uses brute force to visit all permutations to find the most optimal path leading to be O(n!).

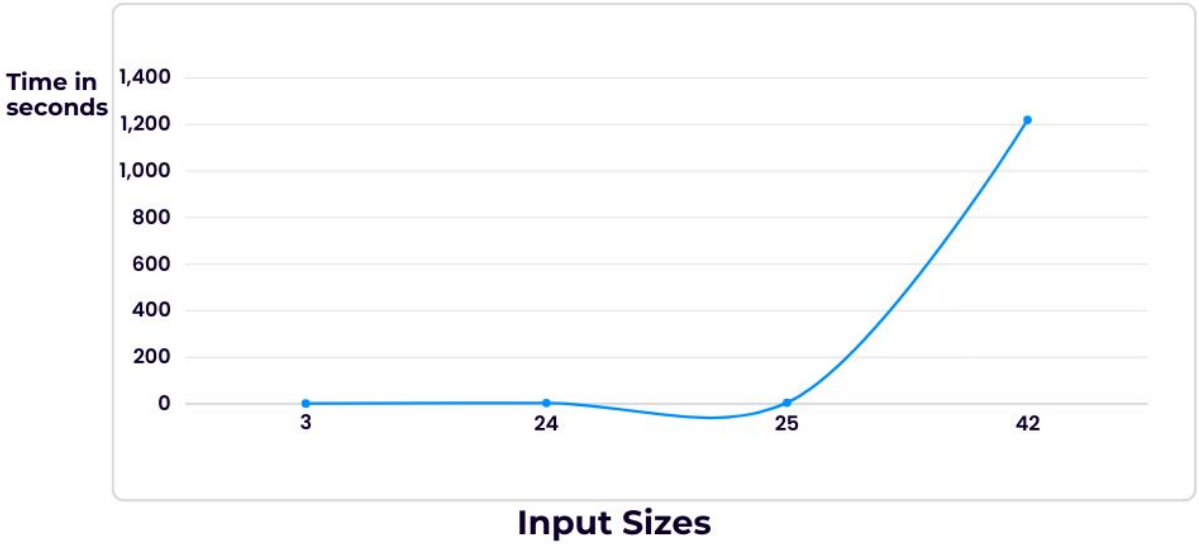
Explanation of Implementation

```
function tsp(graph, n):
    all_permutations = permutations(range(1, n))
    min_length = infinity
    min_path = None

    for path in all_permutations:
        path = (0,) + path + (0,)
        length = 0
        for i in range(n):
            length += graph[path[i]][path[i + 1]]
        if length < min_length:
            min_length = length
            min_path = path

    return min_length, min_path
```

Exact Solution Runtime Analysis



Reduction

- The Traveling Salesman problem is known to be a reduction from the Hamiltonian Cycle problem

Input/Output Examples

3 3 0 1 2 1 2 4 0 2 1	7.0 1 0 2 1

Certifier Process

- Checks that each city is visited exactly once.
- Checks that there is connected path between very city.
- Checks that it makes a cycle where it starts and ends in the same city.