Empirical Research on Time Complexity and VRP

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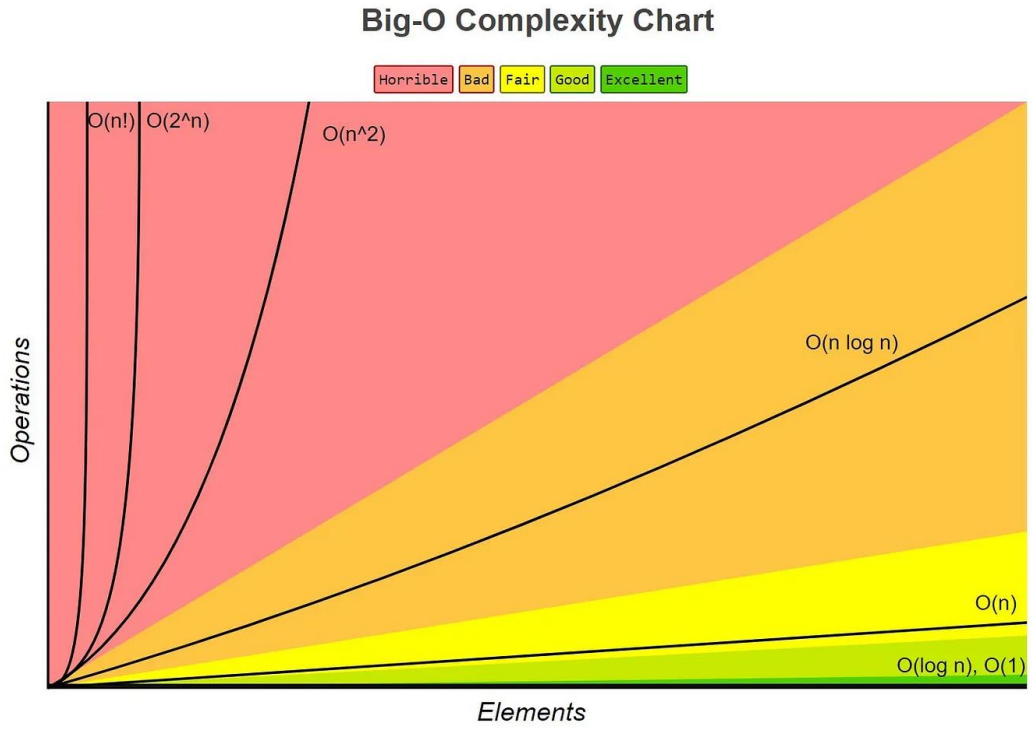
Introduction

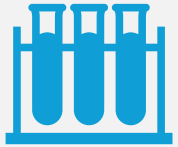
- Complexity and Time Complexity in a nutshell



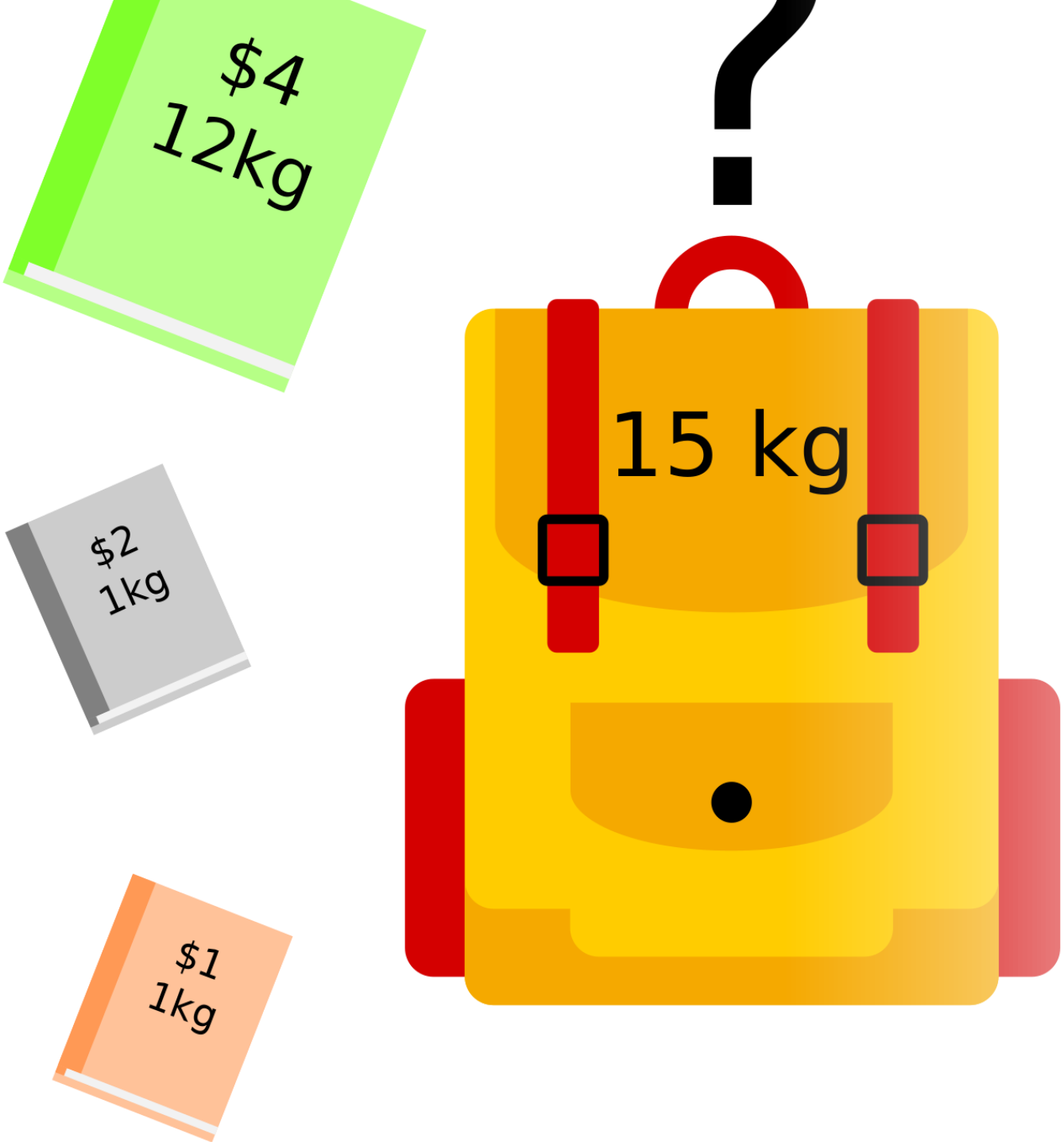
Knapsack Problem Experiments

what is knapsack problem

the idea and the design of experiments



the results of experiments



Knapsack Problem Experiments

what is knapsack problem

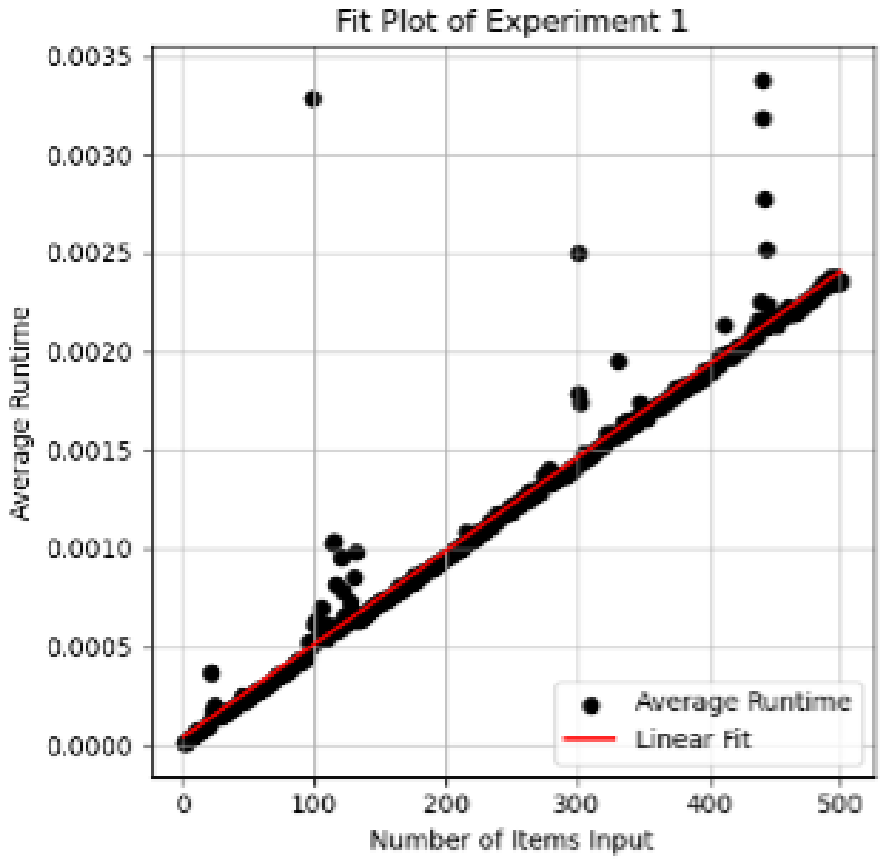
“Given a set of items, each with a weight and a value, determine which items to include in the collection so that the total weight is less than or equal to a given limit and the total value is as large as possible.”

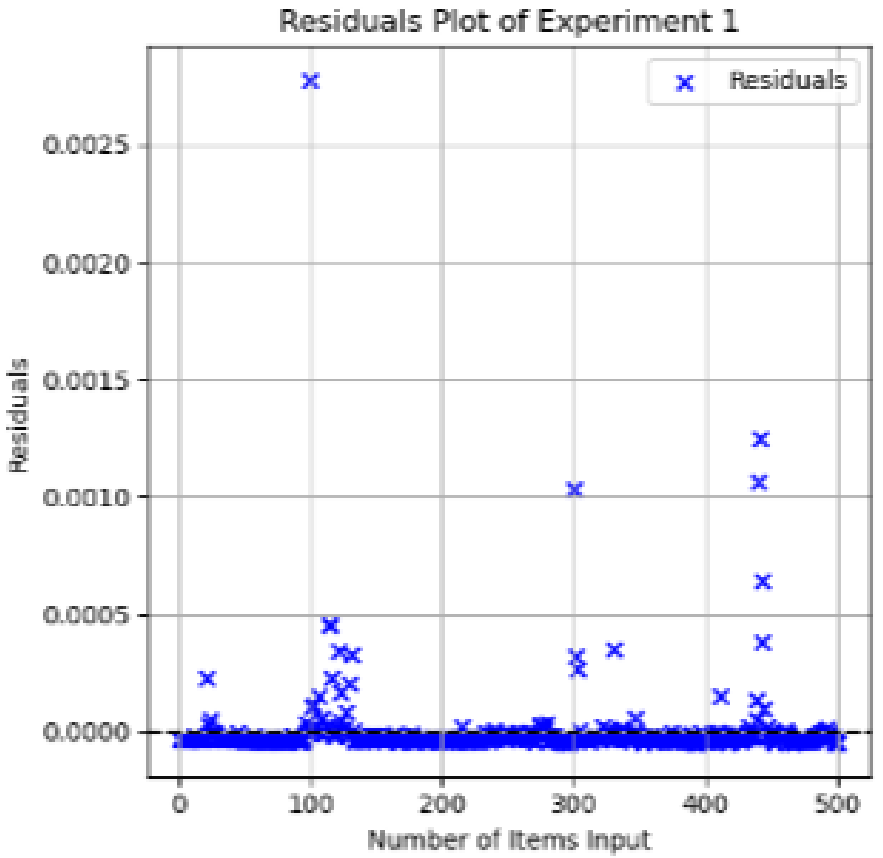
Knapsack Problem Experiments

the idea and the design of experiments

Knapsack Problem Experiments

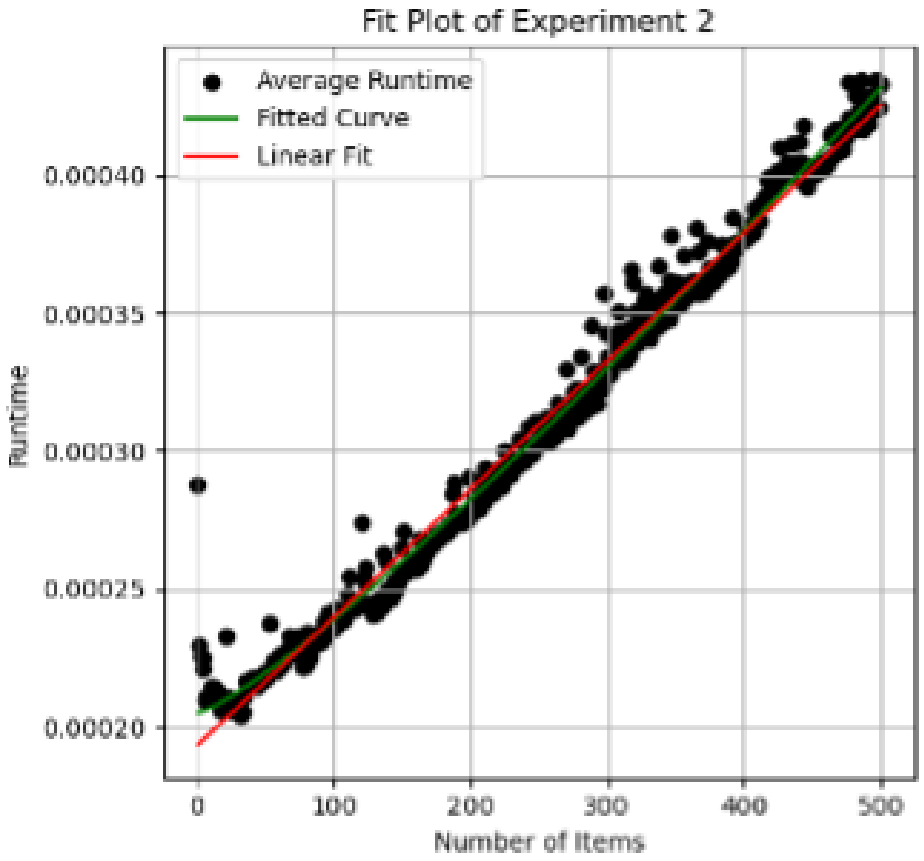
the results of experiments

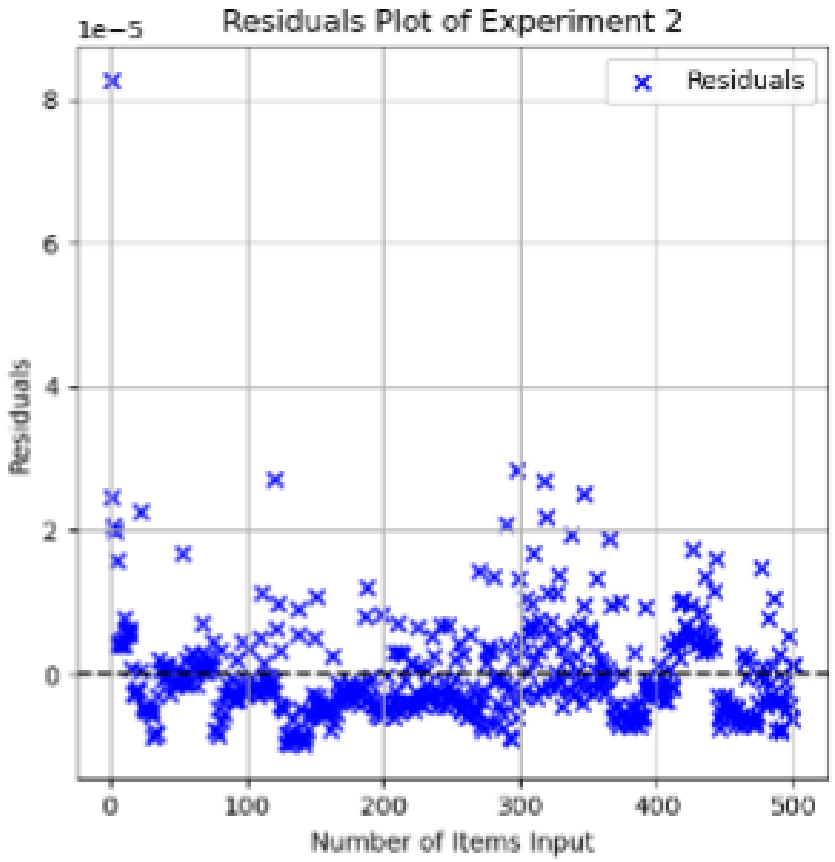




Knapsack Problem Experiments

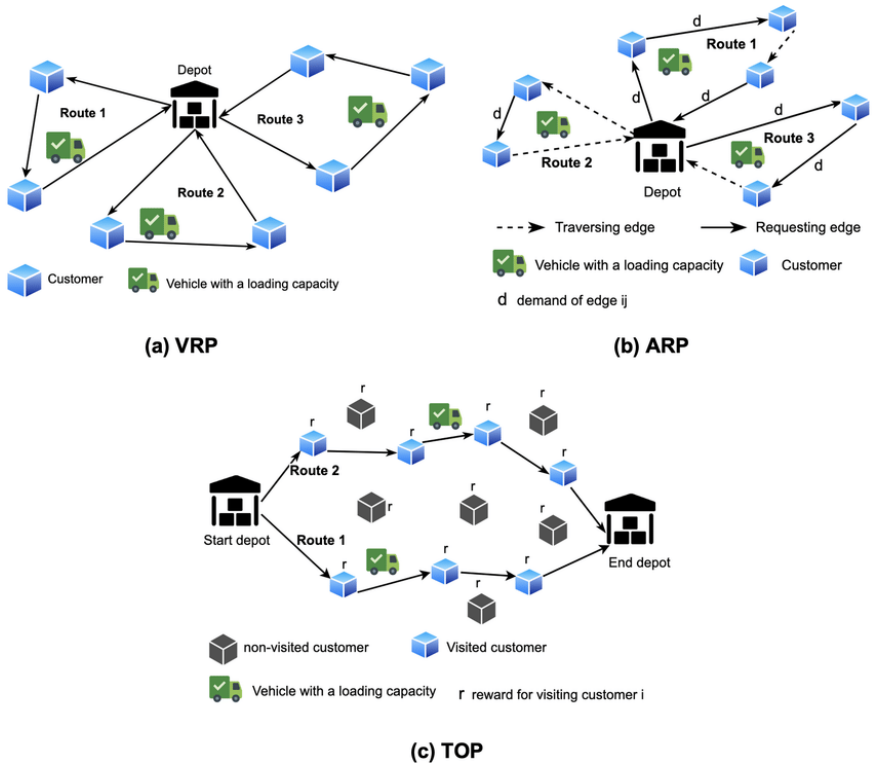
the results of experiments





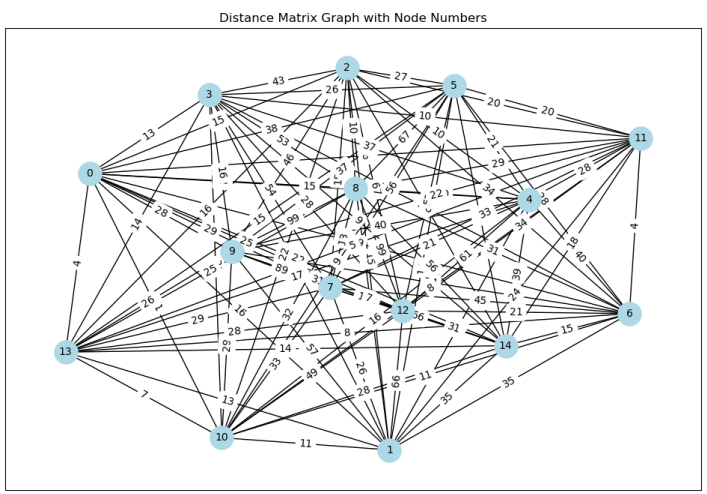
Introduction on VRP

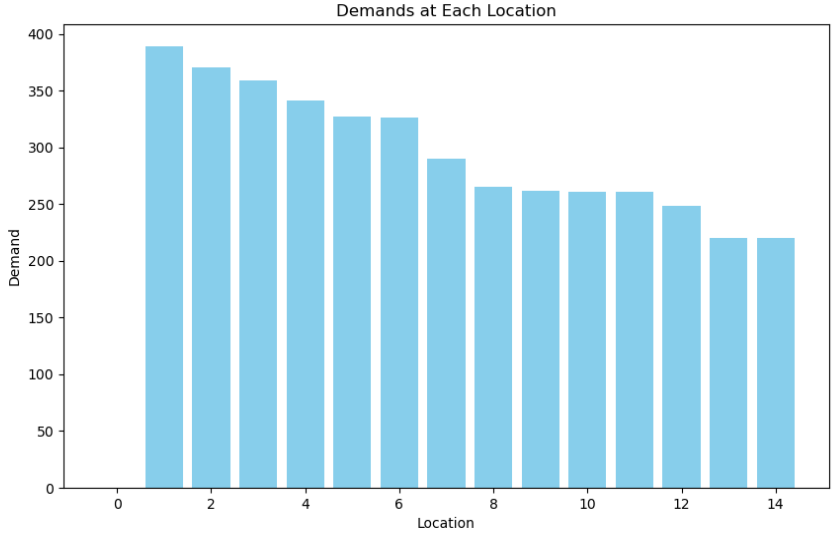
- VRP aims to determine the optimal routes for a fleet of vehicles that start from one or more depots and visit multiple customer locations for deliveries or pickups. The objective is typically to minimize the total travel distance, time, or cost while satisfying constraints such as vehicle capacity and time windows.
- **Applications**: VRP is widely used in logistics and transportation industries, including parcel delivery, waste collection, and goods distribution. Optimizing vehicle routes can significantly improve transportation efficiency, reduce operational costs, and enhance service quality.
- **Solution Methods**: Approaches to solving VRP include exact algorithms (such as branch and bound, integer programming) and heuristic algorithms (such as genetic algorithms, simulated annealing, ant colony optimization). Given that VRP is an NP-hard problem, heuristic or metaheuristic algorithms are often used in practice to find near-optimal solutions.



Ammouriova, M.(2022). A Heuristic-Based Simulation for an Education Process to Learn about Optimization Applications in Logistics and Transportation.

VRP Application and Solve





Distance Matrix and Nodes Demands

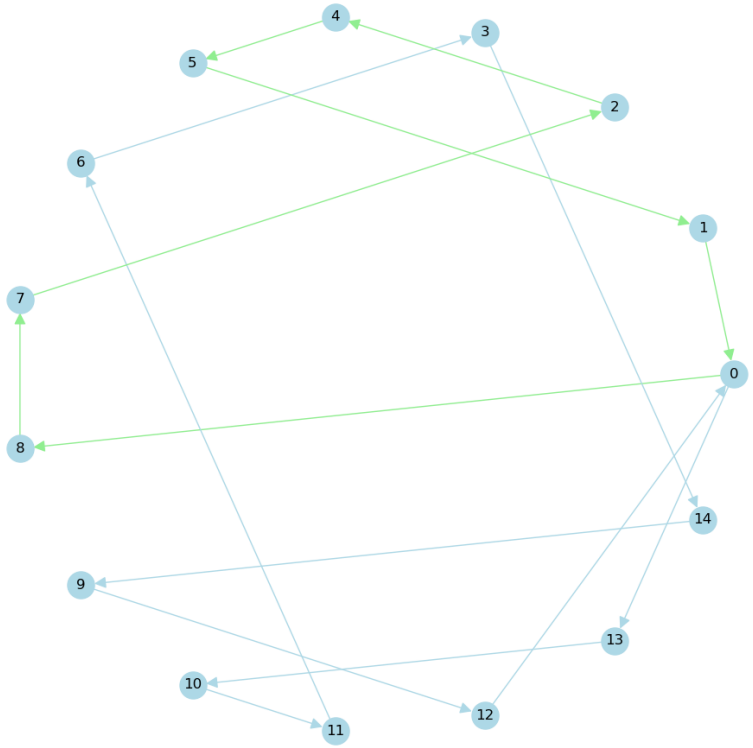
Vehicle Capacities = [2198, 2198]
Number of Vehicles = 2

VRP Solution (Python and Google OR tools)

Vehicle 0 route : 0 -> 13 -> 10 -> 11 -> 6 -> 3 -> 14 -> 9 -> 12 -> 0
Distance of the route : 102.00 m Cost of the route : 153.00

Vehicle 1 route : 0 -> 8 -> 7 -> 2 -> 4 -> 5 -> 1 -> 0
Distance of the route : 109.00 m Cost of the route : 163.50

Total distance of routes : 211.00 m
Total cost of routes : 316.50



The solution routes of VRP use OR tools

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