



Optimization of vehicle routing problem using artificial bee colony algorithm

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Problem Statement

A decorative network diagram in the top right corner, featuring a complex web of interconnected nodes and lines, with some nodes highlighted in blue.

Capacitated vehicle routing problem(CVRP) is a combinatorial optimization problem which states as follows:

“ Find the optimal delivery routes for a set of vehicles to supply the set of customers with given demands minimizing the total cost of all the routes.”

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Constraints

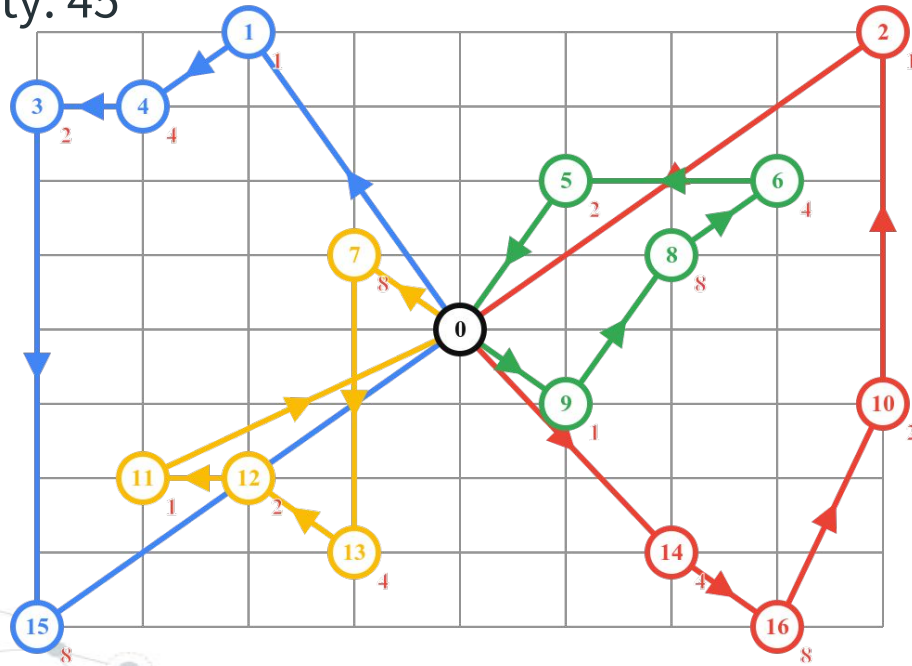
We have to find the optimal routes such that the following criterias are satisfied.

- N customers with demand of d_i
- There is a cost C_{ij} associated for going from i to j .
- K trucks with capacity of Q .
- Each customer should be visited exactly once.
- Each truck should start and end at a depot.

Example

Number of vehicles: 4

Vehicle Capacity: 45



Computational Complexity

- CVRP is an NP-hard problem
- The brute force algorithm has a factorial growth rate for possible solutions. Assuming the processor used for enumeration does around ~1 bi/sec following is the time taken

<i>Problem Size (Number of Nodes)</i>	<i>Approximate Solution Time</i>
10	3 milli-seconds
20	77 years
25	490 million years
30	8.4×10^{15} years
50	9.6×10^{47} years

Why solve CVRP?

- In US transportation related goods and services contributes to around \$1156 billion i.e. 11% of the GDP
- Even a small percent of saving will yield a substantial saving
- VRP not only contributes to saving the transportation cost but also helps in environment protection by reducing the fuel utilization

Ways to solve CVRP.

1. **Exact algorithm**

Finds the most optimal solution

1. **Approximate algorithm**

These technique doesn't guarantee the optimal solution

Example: Hill climbing, simulated annealing, genetic algorithm, artificial bee colony algorithm ... etc.

Artificial bee colony algorithm

- Approximation algorithm
- Foraging behaviour
- The position of the food source represents a possible solution to the problem
- The nectar amount represents the fitness of the solution.
- The number of employed bees represents the number of solutions

Milestones

1. Milestone 1 ✓
 - a. Finding dataset
 - b. Implementation of an exact algorithm
2. Milestone 2
 - a. Implement an approximate algorithm(Artificial bee colony algorithm)
 - b. Improve the performance of artificial bee colony algorithm
3. Milestone 3
 - a. Parallelize the artificial bee colony algorithm
 - b. Compare and contrast the run-time of all the implementations

A decorative network diagram in the top-left corner of the slide. It features a complex web of interconnected nodes and edges. The nodes are represented by small circles, some of which are solid blue, some are solid grey, and some are hollow with a blue outline. The edges are thin grey lines connecting the nodes. The overall shape of the network is roughly triangular, pointing towards the top-left corner.

Questions?

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Thank you.

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