TeamOne

MEMBERS

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Vehicle Routing Problem

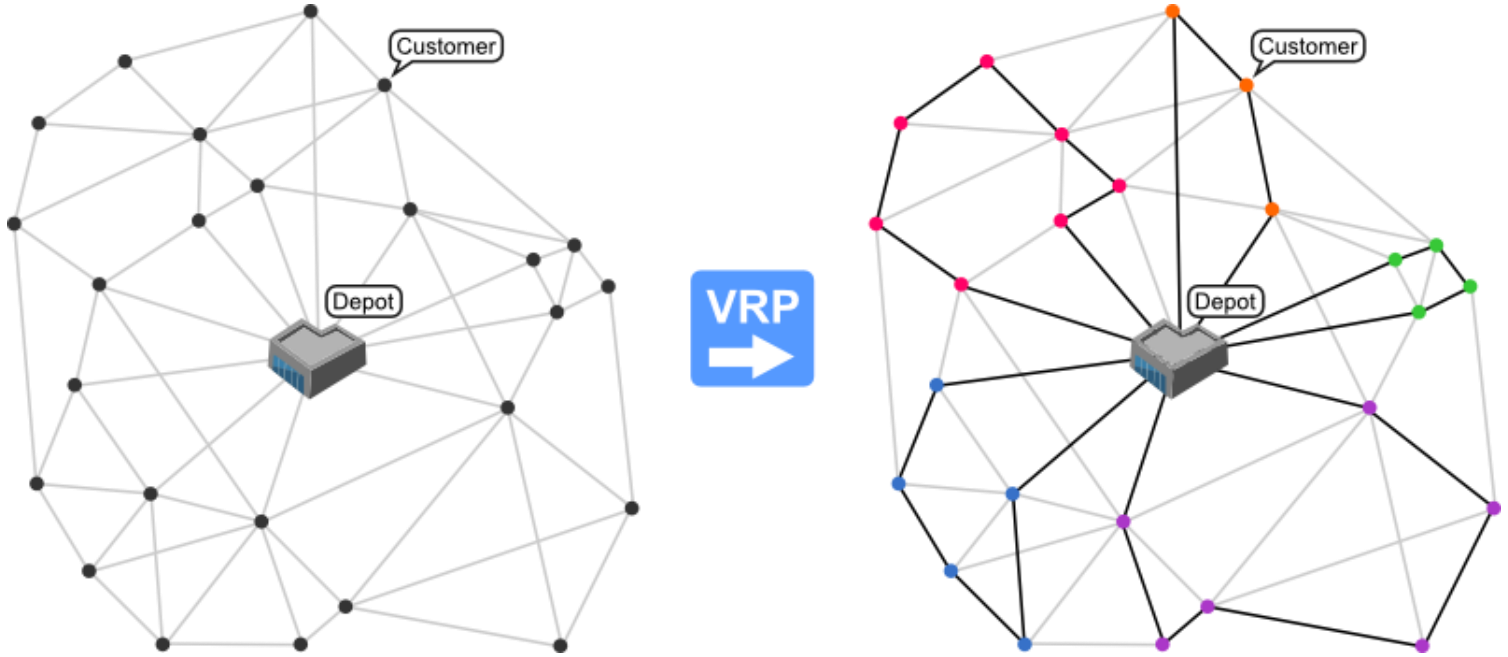


Image Source - http://neo.lcc.uma.es/vrp/vehicle-routing-problem/

(Capacitated) Vehicle Routing Problem

CVRP

The objective - To deliver a set of customers with known demands on minimum-cost vehicle routes originating and terminating at a depot.

CVRP

Practical scenarios kept in mind

Finite set of customers

No restriction on number of trucks

Capacity restricted to avoid the following situation

Solutions

Heuristics

- Improved savings: built on the idea of Clark and Wright

2-Phase (Cluster first, solve later)

- Sweep (Cluster)
- TSP (solution)

Meta Heuristics

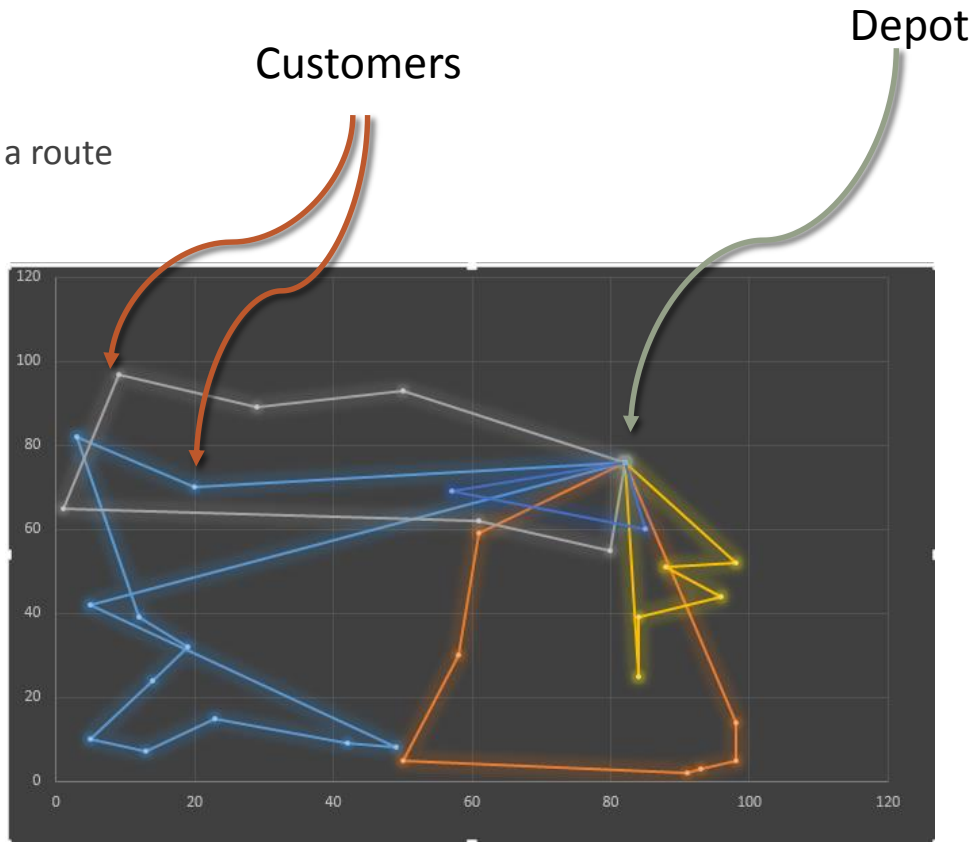
- Genetic Algorithm 1
- Genetic Algorithm 2

Improved Savings

1. Generate savings pairs
   - Measure of distance points saved by pairing two arbitrary customers in a route
2. Rank in reverse order
3. Start with the first savings pair
4. Add to new route
5. Find a pair with one node connected
6. Iterate and fit to trucks as per capacity

Source : http://ieeexplore.ieee.org/document/7784340

Wang Xing, Zhao Shu-Zhi ; Wang Xing, Chu Hao ; Li Yan



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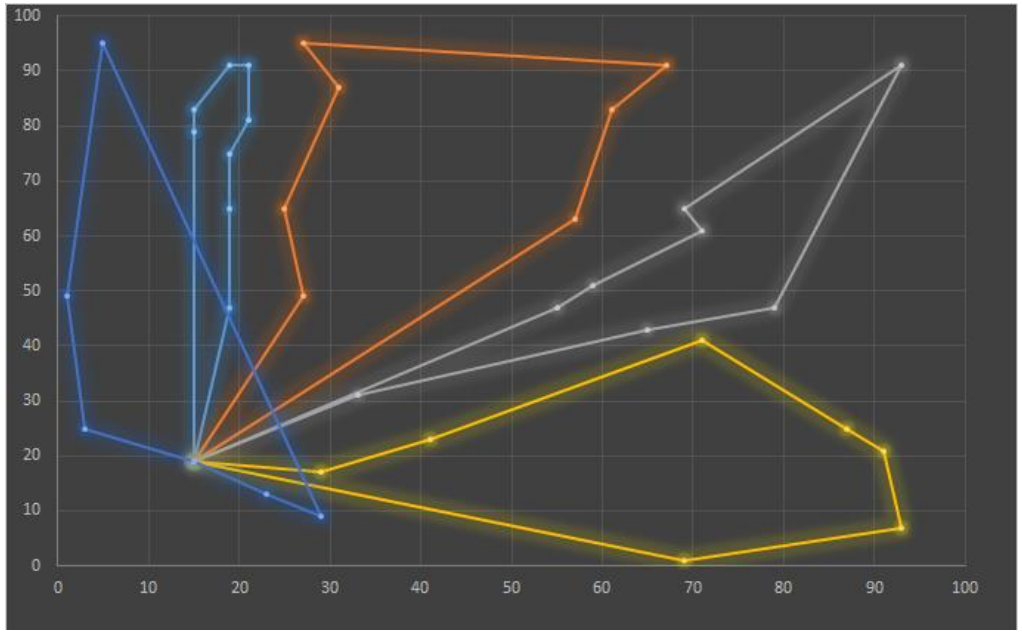
2-phase : Cluster-first , Route-Second

Sweep Algorithm to cluster

- Radially group customers and form clusters as per capacity with center as depot
- Multiple approaches possible
- Our implementation. Clockwise + Euclidean distance

Apply these customers' clusters to TSP (Google OR tools)

Generate routes



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Genetic Algorithms Approach 1

- Generate Population (Random)
- Selection (Based on Fitness Function)
- Crossover
- Mutation

Chromosome Structure

{ DEPOT – NODE1 – NODE2 – DEPOT – NODE3 – NODE4 – NODE5 - DEPOT}

{ DEPOT – NODE4 – NODE2 –NODE3 – DEPOT – NODE1 – NODE5 - DEPOT}

.

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Solutions

Heuristics

- Improved savings: Clark and Wright

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Meta Heuristics

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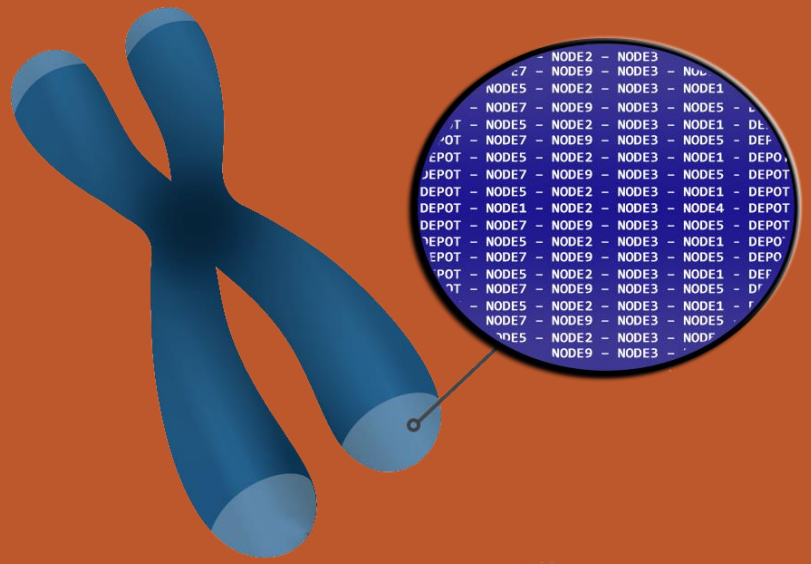
Genetic Algorithms Approach 2

- The initial population generated for genetic algorithm should not be highly random.
- Generate A More Robust Population Before Applying Genetic Algorithm.



Chromosome Structure

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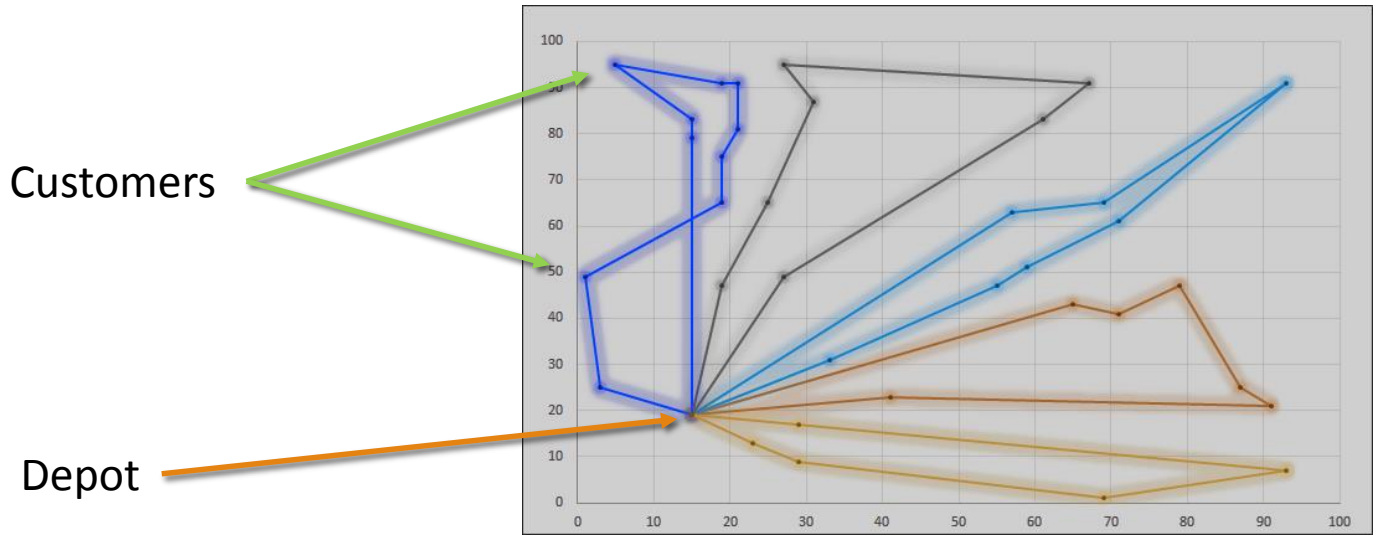
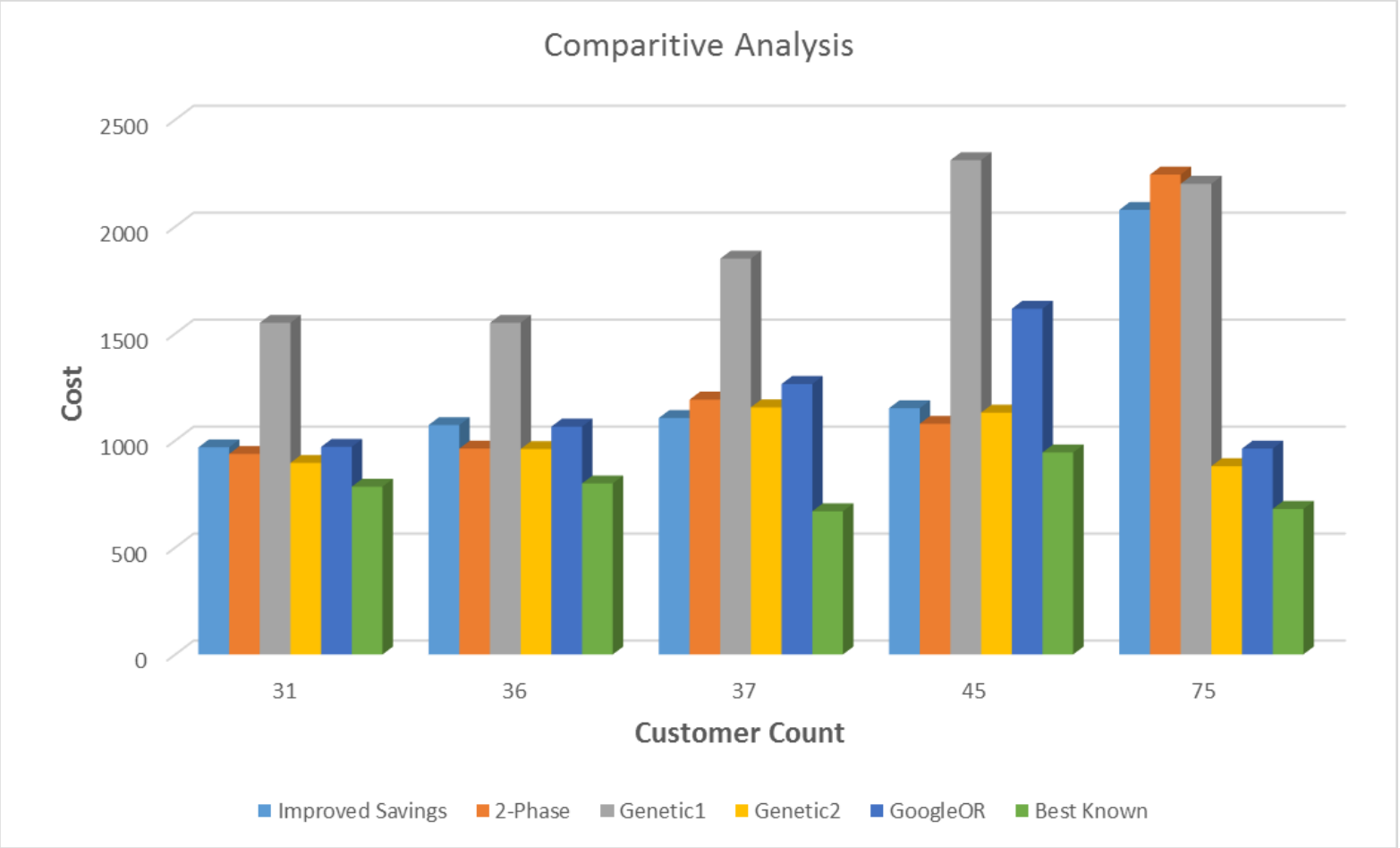
- Apply Sweep to order nodes radially.
- Each Vehicle traverses greedily to radially closest node and generates a route.
- Generate Population By Generating mutated versions of the found route.
- Select parents to cross based on fitness i.e. minimum route cost.
- Generate Children By Crossover and Mutation.
- Repeat Until all Nodes are covered.



Evaluation and Results



Conclusion

- No single solution fits all types of customer distribution.
- Performance varies as per customer distribution.
- Time taken to solve changes drastically .
  - might matter when we want to dynamically update routes.
- Search is needed almost everywhere at some stage.
- High exploration rate doesn't necessarily generate the best solution.

Division of implementations

Jay – Implementation of Improved savings, Partial implementation of sweep

Shlok – Genetic Algorithm 1, Partial implementation of sweep

Chirayu – Genetic Algorithm 2, with sweep and local greedy search

Common Tasks :

- Research various approaches.
- Data accumulation.
- Evaluate implementations
- Compare results.

References

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