Asymmetric Vehicle Routing Problem

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2012 IN3-HAROSA Workshop
for Junior Researchers

Outline

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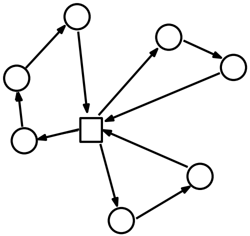
Asymmetric Capacitated Vehicle Routing Problem



- A set of customer demands have to be served
- A fleet of homogeneous fleet
- Each customer is supplied by a single vehicle
- The travel cost represents asymmetric distances or travelling times
- Minimizing travel cost

Example

Solution using minimum distances and real itineraries

References

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- Fischetti, M., Toth, P., and Vigo, D. (1994).
  A branch-and-bound algorithm for the capacitated vehicle-routing problem on directed-graphs. *Operations Research, 42(5):846–859.*
- Clarke, G. and Wright, J. (1964).
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- Fisher, M. and Jaikumar, R. (1981).
  A generalized assignment heuristic for vehicle-routing. *Networks, 11(2):109–124.*

References

- Pisinger, D. and Røpke, S. (2007).
  A general heuristic for vehicle routing problems. *Computers & Operations Research, 34(8):2403–2435.*
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  Edge assembly crossover for the capacitated vehicle routing problem. In Cotta, C. and van Hemert, J. I., editors, *Evolutionary Computation in Combinatorial Optimization, 7th European Conference, EvoCOP*, Lecture Notes in Computer Science, pages 142–153, Valencia. Springer.

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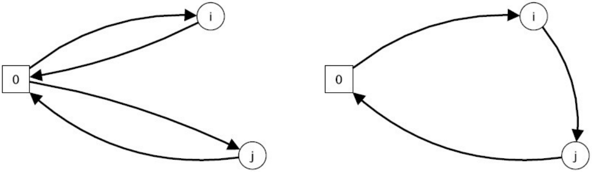
Clarke and Wright Savings



- Best-known heuristics for solving the VRP
- Great simplicity and fast implementation
- Baseline scenario in which each customer is supplied by a separate vehicle
- The saving supplying to customers i and j for the same vehicle are: $S_{ij} = d_{0i} + d_{0j} - d_{ij}$
- It always chooses the edge with the highest savings value if the constraints are not violated

Simulation in Routing via the Generalized Clarke and Wright Savings heuristic

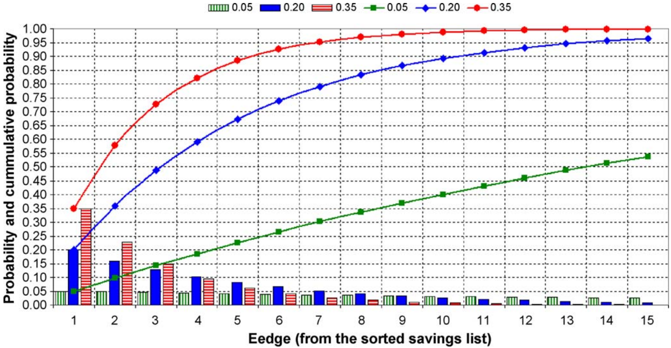
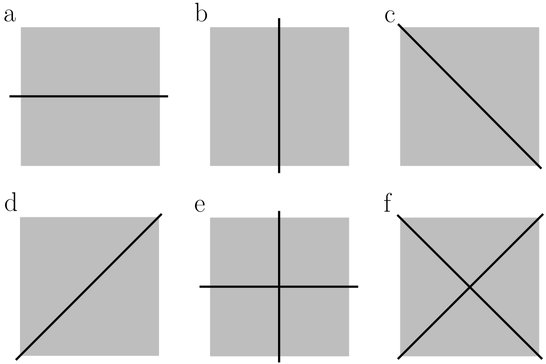


Fig. 1. Effects of the chosen parameter on the geometric distribution.

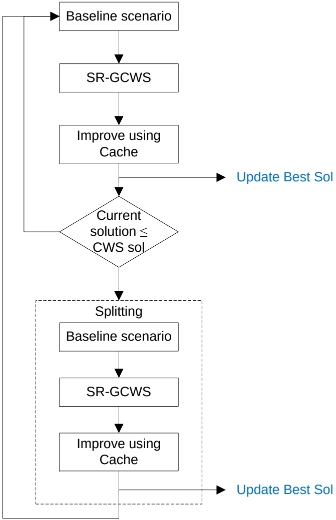
Each time a new edge must be selected, a quasi-geometric distribution assigns a random value at each edge assigning exponentially diminishing probabilities to each eligible edge according to its position inside the sorted saving list.

Splitting policies



Divide the original set of nodes into disjoint subsets and then to solve each of these subsets by applying the same methodology described before.

SR-GCWS-CS


Baseline scenario
SR-GCWS
Improve using Cache
Update Best Sol
Current solution ≤ CWS sol
Splitting
Baseline scenario
SR-GCWS
Improve using Cache
Update Best Sol

Outline

Savings

- The saving supplying to customers i and j for the same vehicle are: $S_{ij} = \hat{d}_{0i} + \hat{d}_{0j} - \hat{d}_{ij}$
- $\hat{d}_{0i} = \frac{d_{0i} + d_{i0}}{2}$

Savings

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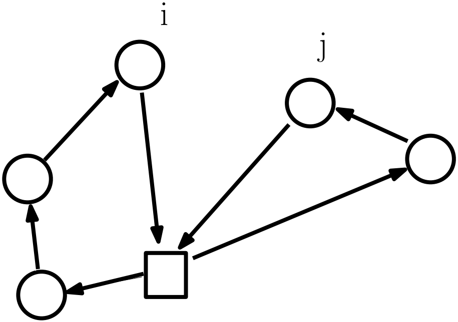

Savings

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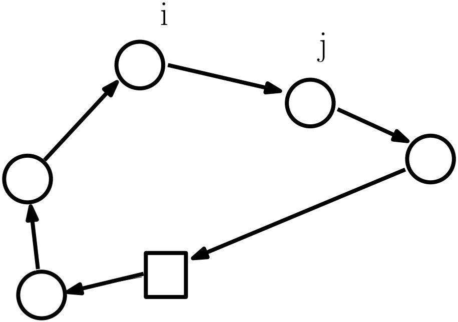


Improve using Cache

- Improve nodes order trying to sort its nodes in a more efficient way by eliminating possible knots in the current route.
- Compare with its reverse route.
- Check if it exists already a cached route covering the same set of nodes.

Outline

Results

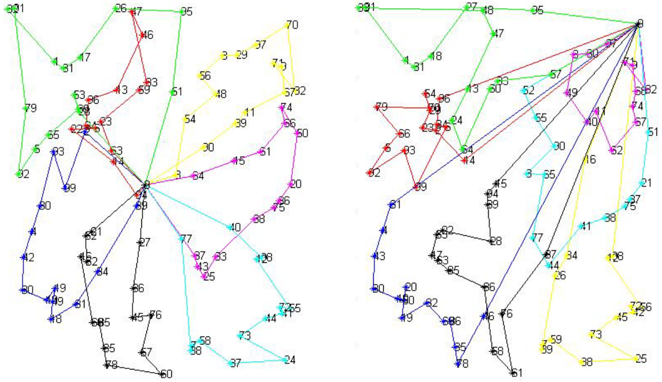
- 20 asymmetric CVRP instances have been used
- With 50 or 100 customers
- A fleet from 2 to 7 vehicles
- 10 random seeds
- 1 minute of Elapsed Time
- Processor: Intel Pentium Dual CPU 2.40 GHz with 3.25 GB Ram

Results

Problem	nCustomers	nVehicles	Gap CWS	Gap Avg10	Gap Best10
G-C-CAA0501NA	50	2	5.77 %	1.56 %	1.45 %
G-A-CAA0501NA	50	2	19.36 %	0.56 %	0.08 %
G-C-CAA0502NA	50	3	7.93 %	0.00 %	0.00 %
G-A-CAA0502NA	50	3	7.47 %	0.00 %	0.00 %
G-C-CAA0503NA	50	4	4.66 %	0.00 %	0.00 %
G-A-CAA0503NA	50	4	9.34 %	0.00 %	0.00 %
G-C-CAA0504NA	50	2	4.14 %	0.00 %	0.00 %
G-A-CAA0504NA	50	2	10.40 %	0.95 %	0.95 %
G-C-CAA0505NA	50	3	8.52 %	0.00 %	0.00 %
G-A-CAA0505NA	50	3	14.71 %	1.99 %	0.68 %
G-C-CAA1001NA	100	5	16.10 %	1.43 %	1.27 %
G-A-CAA1001NA	100	5	11.86 %	**3.14 %**	**2.37 %**
G-C-CAA1002NA	100	5	10.61 %	2.03 %	1.67 %
G-A-CAA1002NA	100	5	11.59 %	1.24 %	1.03 %
G-C-CAA1003NA	100	5	8.66 %	1.44 %	1.36 %
G-A-CAA1003NA	100	5	13.80 %	2.19 %	1.59 %
G-C-CAA1004NA	100	6	9.54 %	0.57 %	0.40 %
G-A-CAA1004NA	100	6	12.31 %	0.75 %	0.74 %
G-C-CAA1005NA	100	7	11.33 %	0.06 %	0.05 %
G-A-CAA1005NA	100	7	9.26 %	1.81 %	1.17 %
		AVG	10.37 %	0.99 %	0.74 %
		MAX	19.36 %	3.14 %	2.37 %

Gap respect to best-known solution [*Nagata, Y. (2007).*]

G-C-CAA1005NA v.s. G-A-CAA1005NA



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