Transportation Logistics

Part VI: VRP - improvement heuristics

Intra-route (single-route)

Improvement heuristics working on a single route (all TSP operators!)

Inter-route (multiroute)

Improvement heuristics considering several routes at once.

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Intra-route (single-route)

Intra-route algorithms

λ-opt (Lin, Kernighan, 1973)

λ edges are removed from the tour and the λ remaining segments are reconnected in all possible ways (2-opt, 3-opt...)

Or-Opt (Or, 1976)

Moving strings of 3, 2, and 1 consecutive vertices to another location in the tour (corresponds to a restricted form of 3-opt; orientation is not changed).

4-opt* (Renaud et al., 1996)

a restricted version of 4-opt: promising reconnections between a sequence of at most w edges and another sequence of 2 edges.

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    Inter-route (multiroute)

Inter-route operators

(Following Van Breedam's classification)

String cross

Two strings of vertices are exchanged by crossing two edges in two different routes. (2-opt*: two edges from different routes are replaced by two new edges)
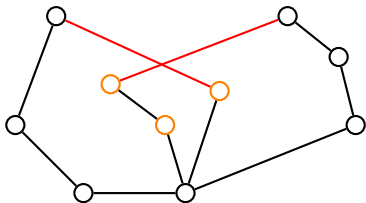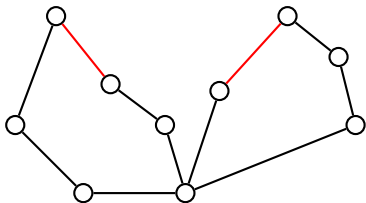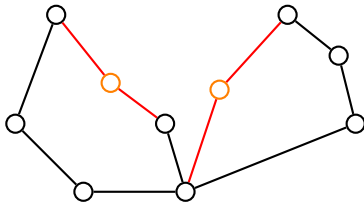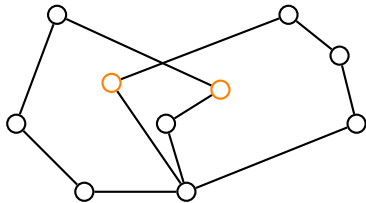

Source: Laporte and Semet (2002) Classical Heuristics for the CVRP. Chapter 5 of Paolo Toth, and Daniele Vigo (eds) The Vehicle Routing Problem, SIAM.

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Inter-route (multiroute)

Inter-route operators

(Following Van Breedam's classification)

String exchange (swap)

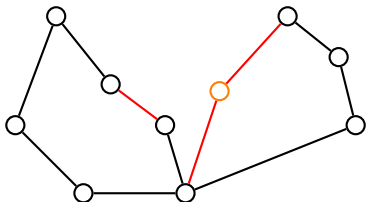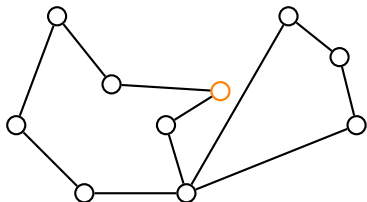Two strings of at most k vertices are exchanged between two routes.

Source: Laporte and Semet (2002) Classical Heuristics for the CVRP. Chapter 5 of Paolo Toth, and Daniele Vigo (eds) The Vehicle Routing Problem, SIAM.

Transportation Logistics
  VRP - improvement heuristics
    Inter-route (multiroute)

Inter-route operators

(Following Van Breedam's classification)

String relocation (move)

A string of at most k vertices is moved from one route to another (usually $k = 1$ or 2).


Source: Laporte and Semet (2002) Classical Heuristics for the CVRP. Chapter 5 of Paolo Toth, and Daniele Vigo (eds) The Vehicle Routing Problem, SIAM.

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  Inter-route (multiroute)

Inter-route operators

Cyclic transfer

b routes are considered and k customers from each route are shifted to the next route of the cyclic permutation.

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      Inter-route (multiroute)
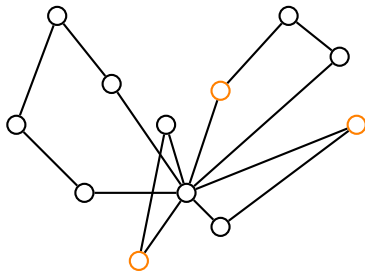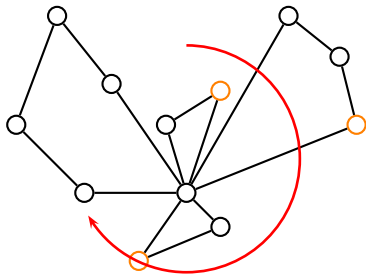
Van Breedam's comparison

Impact of parameter/operator choice on the final solution quality:

good vs. bad starting solution

★ good starting solution

string cross vs. string exchange

★ string exchange

$k = 1$ **vs.** $k = 2$

★ $k = 2$

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VRP - improvement heuristics
Inter-route (multiroute)

References

Paolo Toth, and Daniele Vigo (2002) The Vehicle Routing Problem, SIAM. (Chapter 5)

W. Domschke (1997) 'Logistik: Rundreisen und Touren' Oldenbourg.