Solving Wood Collection Problem using Genetic Algorithms

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1 PROBLEM STATEMENT

- Problem of routing, sequencing and time-tabling of trucks for wood pickup/delivery in Finland. → Huge size of the road network of a substantial portion of Finland;
- Multiple time-windows, at delivery nodes;
- Multiple depots and delivery programs (DPs);
- Heterogeneous wood types, trucks, roads, etc.

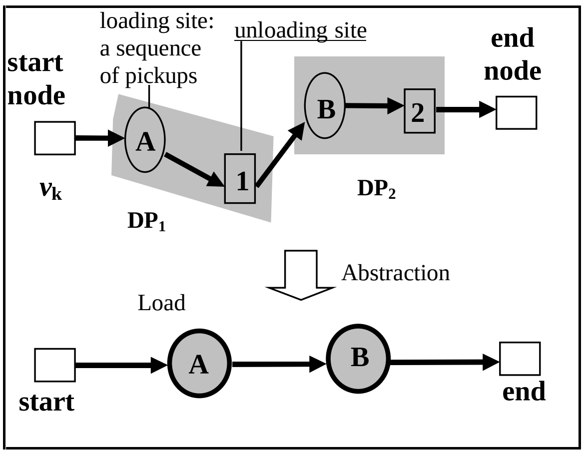
- **Objective**: Assign to each truck a sequence of pickups and deliveries which satisfy the delivery program, time windows and minimize time/distance traveled.

2 APPROACH

Two-stage approach: (1) Local optimization by a KBS which forms sequences of pickups and assigns them to an unloading site; (2) Global optimization by a GA.

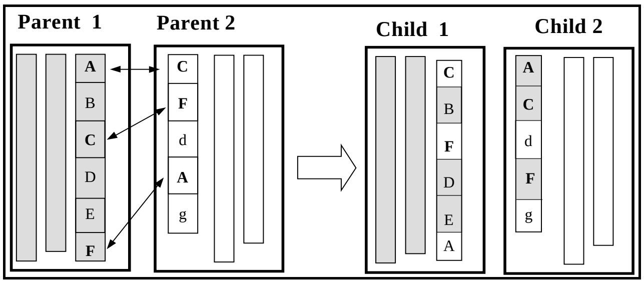
GA: individual = set of all the routes of all the trucks. A truck v_k (≈ chromosome) is a list of pickup and delivery sites.

A sequence of pickups is viewed as one loading node. As a loading site is assigned to an unloading site, they are abstracted into one single node (*load*).



Time windows are handled by penalties in the cost function. Invalid solutions are checked during recombination processes.

2.1 OPERATORS



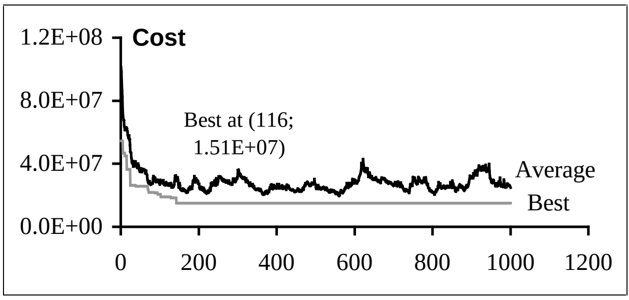
Crossover: exchange order and position of loads.

Mutations: permutation, swaps, remove-reinsert.

Initial population seeded with a heuristically generated solution.

3 RESULTS

With 17 trucks, 87 loads,



Cost evolution with popSize: 30, pMut1: 40%, pMut2: 40%, pMut3: 20%, pCross: 50%. (Time ≈ 10 min.). Prototype written in SmallTalk VisualWorks™.

4 CONCLUSION

The two stage approach is better than the KBS system alone, because GA can be stopped at any time when a quick solution is needed. Compared to the overall running time, GA's running time is not significant (≈10%). Currently GA converges too soon to a local optima.

Further improvements: more specific operators to better handle time windows.