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Multi-Container Loading for Optimal Shipping Cost

Jacob Thompson <thompso1@umbc.edu>
Dept. of Computer Science and Electrical Engineering
University of Maryland Baltimore County

Definition and Goal, What?

Given an order of items of known dimensions and weight, a list of valid box sizes, and a shipping rate function, output a selection of boxes in which the entire order fits but the shipping cost is the minimum possible.

Motivation, Why?

- To automatically predict shipping cost to provide accurate quotations
- Shipping cost is not just about weight or value of order
  - Declared Value
  - Dimensional Weight
  - Additional Handling
  - Oversize Packages

Toolbox, How?

- Dynamic programming
- Linear programming
- Artificial intelligence
  - Machine learning
  - Constraint satisfaction
- Approximation algorithms

Related Work

- Bin packing for minimum container count in 1-D, 2-D, 3-D (Martello 97)
  - optimizes wrong quantity-use a container ship for every order
- Bin packing with variable-sized bins (Haouari 09)
  - but, shipper has only a few sizes
- Bin packing with zero unload cost (Lin 06)
  - example of optimizing a quantity other than the number of bins

Future Work

- Determine optimal structure of the problem and effect on complexity
  - Consider box selections in increasing order of cost until the order fits, or,
  - Consider selections that hold the order and find the selection with the least cost
- Develop heuristics for generating selections with low shipping cost
- Use past orders as training data for machine learning algorithm
- Develop approximations that greatly simplify the problem
  - Overestimation of shipping cost is OK
  - But the order **must** fit

• Mohamed Haouari and Mehdi Serairi. Heuristics for the variable sized binpacking problem. *Computers and Operations Research*, 36(10):2877–2884, 2009.
• Chun-Cheng Lin and Chang-Sung Yu. A heuristic algorithm for the three dimensional container packing problem with zero unloading cost constraint. In *2006 IEEE International Conference on Systems, Man, and Cybernetics*, 2006.
• Silvano Martello, David Pisinger, and Daniele Vigo. The three-dimensional bin packing problem. *Operations Research*, 48(2):256–257, 2000.