CSE 7004 - Combinatorial Optimization
Term Project

Due: May 28, 2018

In the Capacitated Warehouse Location Problem (CWLP), a company considers opening n warehouses at some locations for satisfying the demands of m customers for a good. Let

f_i = Fixed cost of operating warehouse i if it is opened,

a_i = Maximum capacity (in units) of the warehouse i,

c_{ij} = Cost of transporting one unit of good from warehouse i to customer j,

d_j = Demand (in units) of customer j,

The decisions to be made are which warehouses to open and how much to ship from any warehouse to any customer such that the total cost is minimized.

Using the following decision variables:

$$y_i = \begin{cases} 1 & \text{if warehouse i is opened} \\ 0 & \text{if warehouse i is not opened} \end{cases}$$

x_{ij} = Number of units of goods to be shipped from warehouse i to customer j

CWLP can be formulated as:

$$
\begin{aligned}
\min \ & \sum_{i=1}^{n} f_i \, y_i + \sum_{i=1}^{n} \sum_{j=1}^{m} c_{ij} \, x_{ij} \\
\text{s.t.} & \sum_{i=1}^{n} x_{ij} = d_j \ (j = 1, \ldots, m) \\
& \sum_{j=1}^{m} x_{ij} \leq a_i \, y_i \ (i = 1, \ldots, n) \\
& x_{ij} \in \mathbb{N} \ (\forall i, j) \\
& y_j \in 0, 1 \ (\forall j).
\end{aligned}
$$

In this project you should implement:

- A test case generator for CWLP: The test case generator should be parametric and should be capable of generating test cases of varying difficulty. The values of the parameters are:
  - n, m: Fixed values, small instances m=1000, n=10; medium instances m=2000, n=20; large instances m=5000, n=50.
  - a_i: An integer value drawn from uniform(3000,21000).
  - d_j: An integer value drawn from uniform(10,110). Note that $\sum_{i=1}^{n} a_i \geq \sum_{j=1}^{m} d_j$ must always hold. Although statistically unlikely, you should check this constraint and draw new numbers for a_i if necessary.
  - c_{ij}: A double value drawn from uniform(0.2,1).
  - f_i: A double value drawn from uniform(3600,7200).
- A front-end for Gurobi MIP Solver: Your program should prepare the integer program associated with the generated test cases and run Gurobi solver.
- A heuristic solver: You should propose and implement at least one heuristic method for CWLP.

You should prepare a test suite consisting of at least 30 problem instances for each small, medium and large instance type and solve these instances with Gurobi and using your heuristic method(s). Set maximum time for solving an instance to 10 minutes. You should prepare a detailed report

discussing the details of the heuristic method(s), presenting and discussing the experiment results. Details of the project will be explained in class.

You need to install academic version of the Gurobi solver from http://www.gurobi.com. Academic version requires one time activation which could be done in our university's network.