IE 479: HW1

Question 1: Company AA produces a medical vaccine, which requires special care during transportation. At the plant, the vaccine is packaged so that it will remain safe for 7 days. However, the company is serving over a wide geographical area and not all the customers can be reached in 7 days. Thus the company has rented special centers throughout their service area at which the vaccine can be froze again. There are two different types of centers; at small centers, the vaxine can be frozen almost instantly and will remain safe for 3 more days, at large centers the freezing process takes 1 day but the vaccine becomes good as new and remains safe for an additional 7 days. However, the vaccine can be frozen at most once before it reaches its final destination.

There are 5 main hospitals that the vaccine should be sent to and the demand at hospital j is d_j. The vaccine should be ready before certain deadlines, denoted by dl_j, at each hospital.

Let G=(N, A) denote the transportation network. $N=\{0, 1, 2, ...,9\}$. For convenience, let node 0 denote the production plant, nodes 1, 2, ..5 denote the 5 hospitals. Assume node 6 is the large center and nodes 7, 8, and 9 are small centers that the company has rented. Let t_{ij} denote the travel time along link (i, j) and c_{ij} denote the per unit cost of traversing link (i, j). Also, let freezing at large centers cost l_j \$/unit and at small centers cost s_j \$/unit. Assume that both T $=[t_{ij}]$ and C=$[c_{ij}]$ satisfy triangle inequality.

a) Provide a model for the problem which minimizes the total cost. Explain your variables and write clearly for full credit.

b) Suppose now that the company AA has not rented the freezing centers yet. There are m alternative locations for large centers, denoted by set M, and n alternative locations for large centers denoted by S. For convenience let $M=\{6, ...,6+m\}$ and $S=\{7+m, ..., 7+m+n\}$. Let f_{lj} (f_{sj}) denote the fixed cost of locating a large center (small center) at j. Construct a cost minimizing model which will additionally provide the locations of the centers, if needed.

Question 2: Solve the following MCNFP with network simplex. Find a bfs and then iterate to reach optimal solution. Numbers in the parenthesis represent the cost and capacity of the arc, respectively. Numbers in the boxes represent the supply/demand at the nodes.