Operations Research
TD n°3

Master Computer Science 1st year
Université Nice-Sophia Antipolis

1 Minimum cost Flow modeling

These exercises come from "Network Flows: Theory, Algorithms, and Applications", Ahuja, Ravindra K. and Magnanti, Thomas L. and Orlin, James B. 1993, Prentice-Hall, Inc.

1.1 Supply demand problem

A car manufacturer has several manufacturing plants and produces several car models at each plant that it then ships to geographically dispersed retail centers throughout the country. Each retail center requests a specific number of cars of each model. The firm must determine the production plan of each model at each plant and a shipping pattern that satisfies the demands of each retail center and minimizes the overall cost of production and transportation.

1.2 The entrepreneur's problem

An entrepreneur faces the following problem. In each of T periods, he can buy, sell, or hold for later sale some commodity, subject to the following constraints. In each period i he can buy at most α_i units of the commodity, can holdover at most β_i units of the commodity for the next period, and must sell at least γ_i units (perhaps due to prior agreements). The enterpreneur cannot sell the commodity in the same period in which he buys it. Assuming that p_i, w_i and s_i denote the purchase cost, inventory carrying cost, and selling price per unit in period i, what buy-sell policy should the entreprenuer adopt to maximize total profit in the T periods? Formulate this problem as a minimum cost flow problem for $T = 4$.

1.3 Terminal assignment problem

Centralized teleprocessing networks often contain many (as many as tens of thousands) relatively unsophisticated geographically dispersed terminals. These terminals need to be connected to a central processor unit (CPU) either by direct lines or though concentrators. Each concentrator is connected to the CPU through a high-speed, cost-effective line that is capable of merging data flow streams from different terminals and sending them to the CPU. Suppose that the concentrators are in place and that each concentrator can handle at most K terminals. For each terminal j, let c_{oj} denote the cost of laying down a direct line from the CPU to the terminal and let c_{ij} denote the line construction cost for connecting concentrator i to terminal j.The decision problem is to construct the minimum cost network for connecting the terminals to the CPU. Formulate this problem as a minimum cost flow problem.