CS490
Assignment 5
Suggested Due Date: Nov 2

Facility Location

In this assignment you will design an algorithm to solve a problem faced by distribution companies, The Facility Location Problem. A distribution company uses bulk storage facilities to provide goods to many different customers. The goal of this problem is to determine which facilities will be the most cost effective for serving the customers. The complexity of the problem comes from the fact that each facility has different costs and storage capabilities.

The problem is mathematically formulated in the following way: there are N facilities to choose from (numbered 0 through n-1) and M customers that need to be served (numbered from n through n+m-1).

Each facility, f ∈ N has a setup cost s_f and a capacity cap_f. Each customer c ∈ M has a demand d_c. If the facility is used to service <u>any</u> customer, the setup cost is paid. No facility can service customers whose total demand exceeds the capacity of the facility.

Both the facilities and customers are located in a Euclidian space, (x_i, y_i i ∈ N ∪ M. The cost to deliver goods to a particular customer c from a facility f is the Euclidean distance between two locations: $\sqrt{(x_f - x_c)^2 + \left(y_f - y_c\right)^2}$. All customers must be served by exactly 1 facility.

The input consists of |N||M|+1 lines. The first line contains two numbers, |N| followed by |M|. This line is followed by |N| lines, where each line encodes the facility's setup cost s_f, capacity cap_f, and the location x_f and y_f. The remaining |M| lines capture the customer information, where each line encodes the customer's demand, d_c, and location x_c and y_c.

The output has two lines. The first line contains the cost of the customer to facility assignment (i.e. the objective value) as a real number. The next line is a list of |M| values, one per customer, showing which facility is servicing that customer.

(Sample input/output on back)

Input Example
3 4
100 100 1065.0 1065.0
100 100 1062.0 1062.0
100 500 0.0 0.0
50 1397.0 1397.0
50 1398.0 1398.0
75 1399.0 1399.0
75 586.0 586.0

Output Example
2550.013
1 1 0 2

This output represents the assignment of customers to facilities, $a_0 = \{2\}$; $a_1 = \{0,1\}$; $a_2 = \{3\}$. That is, customers 0 and 1 are assigned to facility 1, customer 2 is assigned to facility 0, and customer 3 is assigned to facility 2.