Set Covering Problem

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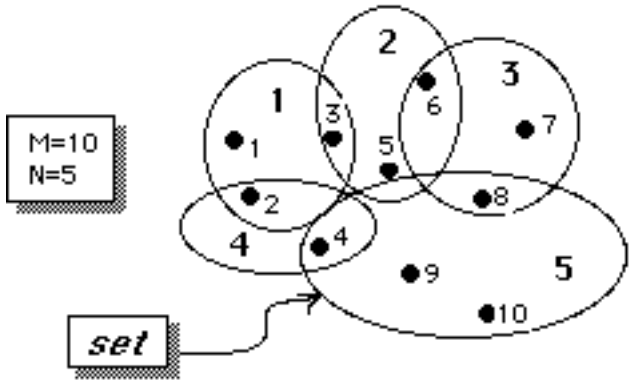
Given M points, and N sets each containing one or more points:

Let C_j = cost of set #j

$$a_{ij} = \begin{cases} 1 & \text{if point i is an element of set j} \\ 0 & \text{otherwise} \end{cases}$$



$$A = \begin{bmatrix} 1&0&0&0&0 \\ 1&0&0&1&0 \\ 1&1&0&0&0 \\ 0&0&0&1&1 \\ 0&1&0&0&0 \\ 0&1&1&0&0 \\ 0&0&1&0&0 \\ 0&0&1&0&1 \\ 0&0&0&0&1 \\ 0&0&0&0&1 \end{bmatrix}$$

Define variables $X_j = \begin{cases} 1 & \text{if set \#j is selected} \\ 0 & \text{otherwise} \end{cases}$

Set Covering Problem

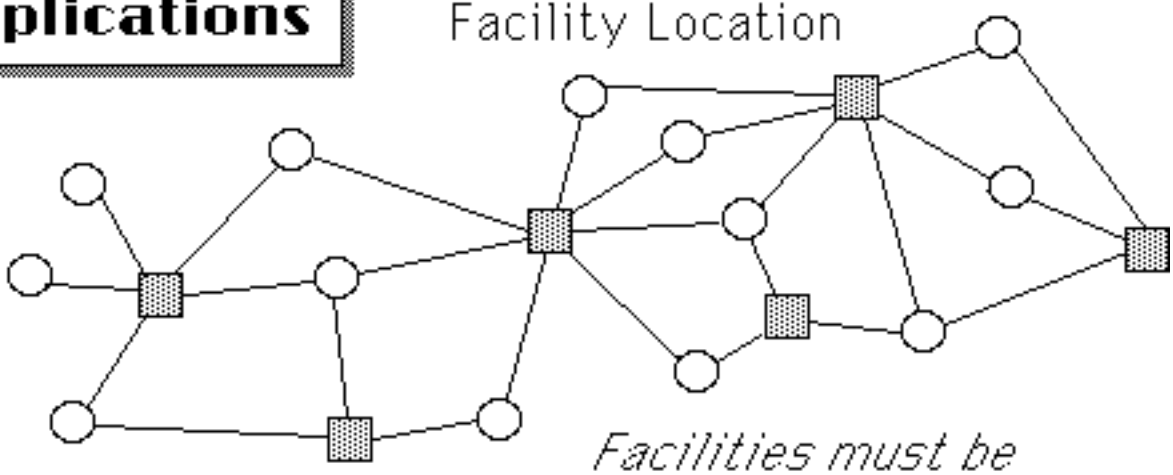
$$\text{Minimize} \quad \sum_{j=1}^{N} C_j X_j$$

$$\text{subject to} \quad \sum_{j=1}^{N} a_{ij} X_j \geq 1 \quad \text{for each i=1, 2, ...M}$$

$$X_j \in \{0,1\} \quad \text{for each j=1, 2, ...N}$$

Applications

Facility Location



■ = potential facility site

○ = customer location

C_j = cost of building facility j

Facilities must be selected to serve every customer. Possible links are indicated.

(customers are "points", facilities are "sets")

Applications

Information Retrieval

Retrieve a given set of ***m*** requests for information from a set of ***n*** files so that the length of the search is minimized.

C_j = length of file j

a_{ij} = 1 if the i^{th} information requested is in file j,
0 otherwise

(information requests are "points", and the files are the "sets")