

MATH 3411 (Ng/Fall 2011)
Handout 6
for class on November 15, 2011.
A few applications of Minimum Cost Spanning Tree problem

- The Department of Transportation (DOT) wishes to build enough roads so that people from each town could drive to any one of the other six towns either directly or via another town. The costs of construction are:

<i>Towns</i> <i>From:</i>	<i>To:</i>	1	2	3	4	5	6	7
1		–	10	12	4	–	–	–
2		10	–	12	–	–	–	–5
3		12	12	–	1	2	18	15
4		4	–	1	–	3	–	–
5		–	–	2	3	–	20	–
6		–	–	18	–	20	–	19
7		–	–5	15	–	–	19	–

The costs with – means it costs too much to even consider constructing a road between the two towns, while a negative cost just means that the residents of the two towns are so desperate that they are willing to pay the DOT to construct the road.

How should DOT design the system of roads for this rural region at minimum total cost?

- (Cluster Analysis).

This problem involves partitioning a set of data into certain *natural groups*, meaning the data points within a particular group of cluster (data) should be more *closely-related* to each other than the data points not in that cluster.

Cluster analysis is useful in disciplines that rely on empirical investigations. For instance, in **medicine**, we have data on a set of 400 patients, measured with respect to 20 symptoms. Suppose the doctor has diagnosed all these patients as having the same disease, which is not well-understood yet. The doctor would like to know if she can develop a better understanding of this disease by categorizing the symptoms into smaller groupings that can be detected through *cluster analysis*. Doing so might permit the doctor to find more natural disease categories to replace or to subdivide the original disease.

A class of problems that arise within the context of cluster analysis is the problem of finding a partition of a set of n points in the *Euclidean space* into k clusters.

A type of combinatorial optimization problem that can be used to **help** solve the aforementioned problem is called **minimum cost spanning tree** .