ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

**Distributed
Computing**

HS 2010   Prof. Dr. Roger Wattenhofer, Philipp Sommer, Johannes Schneider

Ad Hoc And Sensor Networks
Exercise 5

Assigned: October 25, 2010
Due: November 1, 2010

1 Data Gathering Topologies

As seen in the lecture, multiple tree structures exist that are suitable to collect information from all nodes in a sensor network. Among others, the Shallow Light Tree (SLT) was presented. Consider a graph as depicted below. Each edge in this graph has a given weight corresponding to the energy necessary to transmit one message between the two adjacent nodes. Build the SLT of this graph if we assume node 1 as the root node. The path between any node and the root on the SLT has to be at most two times the weight of the shortest path between these two nodes in the initial graph (i.e. $\alpha = 2$). In order to facilitate the construction process you are to build the SLT step-by-step.
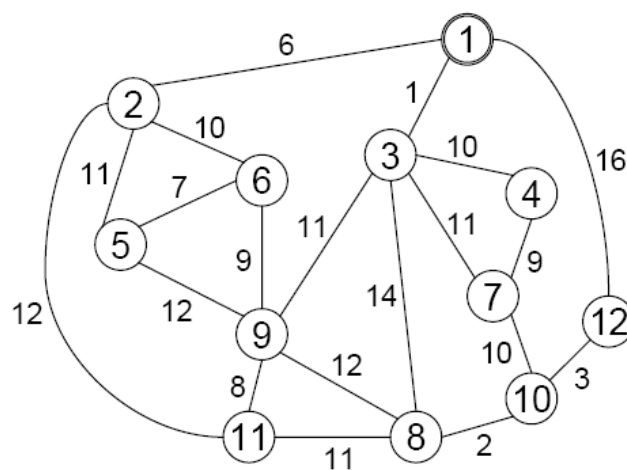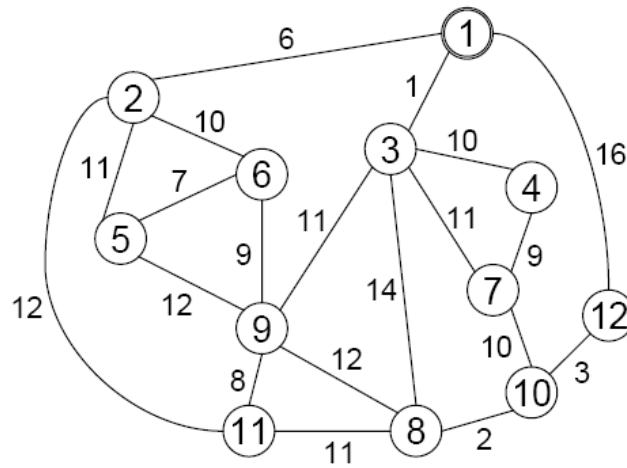
a) First, draw the Minimum Spanning Tree (MST) of the graph
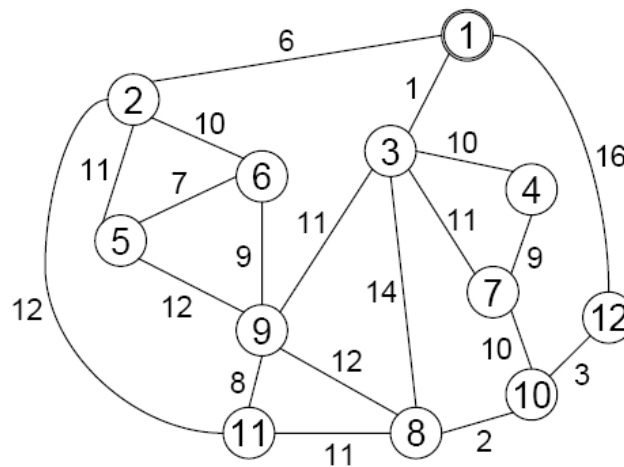
b) Next, construct the Shortest Path Tree (SPT) with node 1 as root.
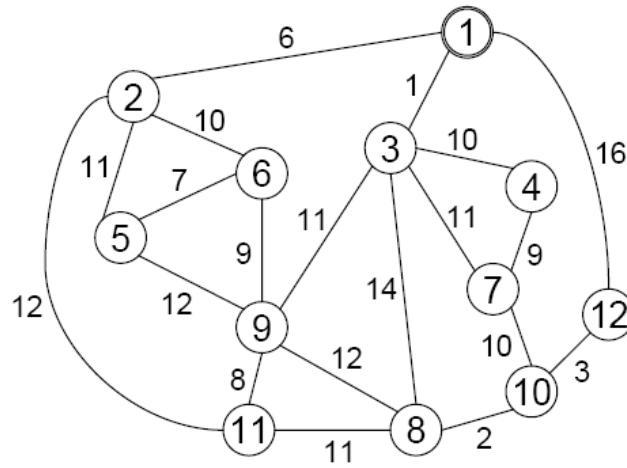
c) And finally build the SLT with $\alpha = 2$

2 Universal Spanning Tree

We again consider the graph given in Exercise 1. A universal spanning tree should provide a good data gathering topology no matter what subset of nodes is supposed to deliver data back to the sink. The cost of the induced subgraph divided by the cost of the ideal data gathering topology is defined to be the stretch of the universal spanning tree. What is the stretch of the MST, SPT, and SLT, respectively, if we consider them to be universal spanning trees? Find example node sets for which the three topologies perform bad.