## Spanning-Tree and MST

## Exercise 1: Spanning Tree

Find all possible spanning trees for the two graphs in Figure 1 subject to the constraint that node 1 must be the root. Determine the number of nodes N and $\operatorname{arcs} \mathrm{A}$ in each of these spanning trees. Can you see a relation between N and A ?


Figure 1

Exercise 2 : BFS
I. Write the pseudo-code of the protocole «Dijkstra-like».
2. Write the pseudo-code of the protocole «Bellman-Ford».
3. Execute both protocols on the topology proposed on Figure 2 below (root node is node I).

## Exercise 3: Minimum Spanning Tree

Consider the network in Figure 2. Find all possible minimum spanning trees for the graph subject to the constraint that node 1 is the root.

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Figure 2

## Exercise 4: Minimum/Maximum Spanning Tree

Consider the graph in Figure 2 where the weights on the edges represent the fiability of the corresponding communication link (where 0 is the minimum and 1 is the maximum fiability of the link).
I. Which kind of spanning tree is adapted in order to implement a best effort fiable routing ?
2. How many such spanning trees can be computed on top of the network represented in Figure 2.

## Exercise 5 : Minimum Spanning Tree

Consider a network such that to each edge is associted a weight and assume that all weights are distinct. Consider the following «red rule» algorithm : let M be the set of all the edges of the network ordered from largest to smallest weight. For each edge in $M$ delete it from $M$ if it is part of a cycle in $M$. Does this algorithm correctly implement a MST ? Motivate your answer.

## Exercise 6: Distributed Prim and GHS

Recall the algorithms Distributed Prim and GHS seen in class. Compute their complexity. Execute the Distributed Prim and GHS algorithms for the network presented in Figure 3.

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## Spanning-Tree and MST



Figure 3

## Exercise 7: Kruskal and GHS

Clustering groupes nodes in a network such that nodes in the same cluster verify some metric.
I Kruskal or GHS algorithms can be used in order to obtain a clustering? Motivate your answer !
2. If yes, how many clusters you can obtain ?
3. What can you say about the distances of the crossing edges between these components ?

