

Algorithms and Programming
14 June 2016 – Theory Part (12 points)

1. (1 point)

Given the following sequence of pairs, where the relation $i-j$ means that node i is adjacent to node j :
 1-9, 2-3, 0-5, 4-2, 0-8, 3-6, 0-10, 1-5, 6-9, 9-4

apply an on-line connectivity algorithm with quick union, showing at each step the contents of the array and the forest of trees at the final step. Node names are integers in the range from 0 to 10.

2. (0.5 + 0.5 points)

Sort in ascending order the following array of integers with merge-sort (0.5 points) and bottom-up merge-sort (0.5 points). Show the data structures used in the intermediate steps.

10 23 6 78 54 6 90 20

3. (2 points)

Consider a 13-node binary tree. Its visits return the following sequences:

preorder	10	5	16	7	20	17	4	2	1	7	8	13	11
inorder	16	7	17	20	4	5	10	1	2	8	13	7	11
postorder	17	4	20	7	16	5	1	13	8	11	7	2	10

Draw the original binary tree.

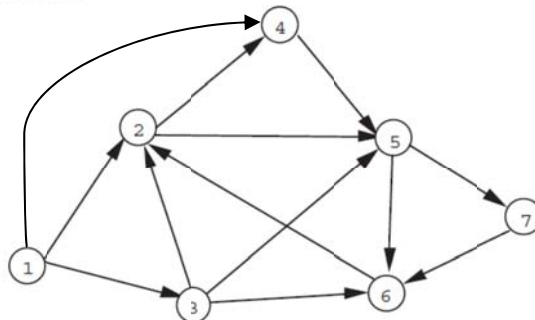
4. (1 point)

A correct BST contains integer keys in the range 1-300. The user searches for key 231. Among these sequences, which are the ones that cannot occur? Why?

250	200	240	260	255	220	230	231
150	300	200	250	220	240	235	231
270	100	200	300	260	190	220	231

5. (2.0 + 1.5 + 1.5 points)

Given the following directed graph:



- Visit it in depth-first starting from node 1 (2 points)
- Redraw it labelling edges as T (tree), B (back), F (forward), C (cross), starting from node 1 (1.5 points)
- Visit it in breadth-first starting from node 1 (1.5 points)

Qualora necessario, si trattino i vertici secondo l'ordine alfabetico.

6. (1.5 + 0.5 punti)

Starting from A, find using the Bellman-Ford algorithm the shortest paths from A to every other node (1.5 points). Show relevant steps. Would Dijkstra's algorithm find the same result? Justify your answer (0.5 points).

