

# 01OGD Algorithms and Programming

22/02/2017 – Part I: Theory (12 points)

**1. (2.5 points)**

Given the generic recurrence equation

$$T(n) = aT(n/b) + cn \quad n > 1$$

$$T(1) = 1 \quad n = 1$$

where a, b and c are integer coefficients, applying unfolding, find the 3 solutions for the 3 cases a=b, a<b and a>b.

**2. (2 points)**

Given the following sequence of integers stored in an array:

10 1 27 14 17 0 8 55 19 41 23 91 31 37 7 3 13

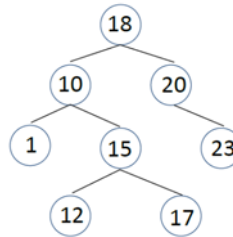
perform the first 2 steps of quicksort to obtain an ascending order. At each step indicate the pivot element you selected. NB: steps must be improperly considered in breadth on the recursion tree, rather than in depth. Return as a result the 2 partitions of the original array and the two partitions of the two partitions found at the previous step.

**3. (1 point)**

Convert the following expression from infix to postfix notation:  $A * ((B * C) + (D * (E + F)))$

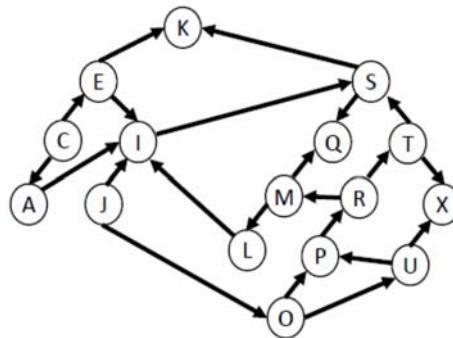
**4. (2 points)**

Insert in sequence in the **root** of the following BST keys 16, 19 and 22 and then delete key 19. Redraw the tree at each relevant step.



**5. (2.5 points)**

Given the following directed graph:



find its strongly connected components using Kosaraju's algorithm. Start from node M. If necessary, consider nodes in alphabetical order. Show relevant steps.

**6. (2 points)**

Using Kruskal's algorithm, find a minimum-spanning tree for the following undirected, weighted and connected graph. Show relevant intermediate steps.

