Algorithms and Data Structures, Academic Year 2013/2014

International Bologna Master in Bioinformatics

December 16, 2014

Please complete the following exercises by applying the concepts that have been illustrated to you during the classes. The score associated with each exercise and the expected time for completion is reported in the first line. Do NOT copy/exchange results (the parameters of each exercise are different).

Exercise 0 (2 points): write your name and surname in the first row of all the sheets you use.

Name:_____ Surname:_____

Exercise 1 (35 points, 60 minutes): please design the data structures and provide a high level description (e.g. pseudo-code) of the main components of the algorithm that you would implement to efficiently realize a function that takes a random sequence of N integer numbers as an argument and returns the sequence with all the even numbers listed in reverse order and all the odd numbers untouched. E.g. given the input sequence:

56   23   14   57   89   33   22   54   18   9

the output should be

18   23   54   57   89   33   22   9   14   56

For the implementation of the solution, please provide a motivation for your design, and a sketchy discussion of average/worst-case complexity in space and computation.

(use additional sheets for this exercise, including the back of this sheet)
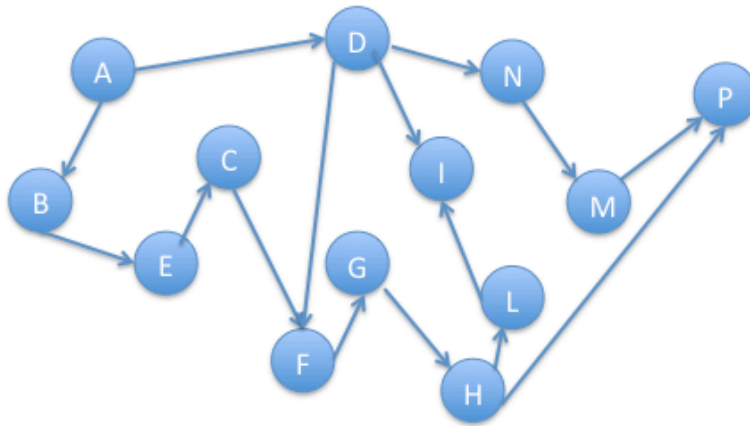
Name:_____ Surname:_____

Exercise 2 (18 points, 20 minutes): given the following sequences of visited nodes of a generic binary search tree, write the tree itself in the space below.

pre-order visit:									
10	4	22	11	18	5	71	16	37	4
in-order visit:									
22	11	4	18	5	10	16	71	4	37
post-order visit:									
11	22	5	18	4	16	4	37	71	10

Name:_____ Surname:_____

Exercise 3 (15 points, 20 minutes): please provide the ordered sequence of visited nodes in a Depth-First-Search (BFS) visit of the directed graph G, starting from node A, by using the Adjacency Set implementation (also show the Adjacency Set data structure, and plot the graph).

Name:_____ Surname:_____

Exercise 4 (15 points, 10 minutes): Please compute the time and space complexity for the computation of this recursive function and determine the mathematical expression implemented, for any x>0.

function f(int x)
begin
      if (x == 0)   then return (3)
                 else
                 if (|x| <= 3)   then return (f(x-1))
                                 else
                                 if (|x| == 4) then return (f(x-2)-1)
end

Name:_____ Surname:_____

Exercise 5 (15 points, 10 minutes): Please demonstrate that $F(x) = x^2+3x$ is $O(g(x))$ when $g(x) = x^2$.