
Algorithms-1 - CS21003
(Class Test I)
Date: 11 – September – 2021

Maximum marks: 30

Duration: 1 hour

File naming convention: e.g., 18CS3004_G3_CT1.pdf (or any other extension).

In case of multiple files, use _1, _2 etc at the end.

Submission is via Moodle only. Email submissions will NOT be accepted. Please manage your time well keeping in mind that Internet and power disruptions are a new normal!

No clarifications from the TAs today. You can make any assumption as long as it is rational and you clearly state the same while solving the problem.

Plagiarism, in any form (including Internet source) will be severely penalized.

Whenever pseudocodes are asked, you can write C/C++ style code/pseudocode

Question 1

(a) Argue that the solution to the recurrence $T(n) = T(n/3) + T(2n/3) + n$ is $\Omega(n \log n)$.

[5 marks]

(b) Draw the recursion tree for $T(n) = 4T(n/2) + n$ and provide the tight asymptotic bound on the solution.

[4 marks]

Question 2

Design an algorithm that computes 3^n using only $c \log n$ instructions for some positive constant c . Provide a pseudocode.

[6 marks]

Question 3

Let A be a sorted array of n distinct even integers. Suggest an $O(\log n)$ -time algorithm to find out whether there is an index i for which $A[i] = 2i$. Provide a brief idea of the algorithm / pseudocode.

[5 marks]

Question 4

Give a divide and conquer algorithm for the following problem. Explain briefly your algorithm, followed by a pseudocode. What is the complexity?

You are given an array A of n floating-point numbers a_0, a_1, \dots, a_{n-1} . Let $P = a_0 a_1 \dots a_{n-1}$ (multiplication of all the numbers), and $b_i = P/a_i$ for $i = 0, 1, 2, \dots, n-1$. Your task is to compute in an array B the numbers b_0, b_1, \dots, b_{n-1} . You are forbidden to use division by a floating point number. [That prohibits the naive solution for this problem. So, you need to think how to arrive at b_i 's without division operation.] **[3+5+2 = 10 marks]**