

## National University of Computer and Emerging Sciences, Lahore Campus



Course:	Design & Analysis of Algorithms	Course Code:	CS-2009
Program:	BS (Computer Science)	Semester:	Spring 2022
Duration:	60 Minutes	Total Marks:	19
Paper Date:	21-Mar-22	Section:	ALL
Exam:	Midterm 1	Page(s):	8
Name		Roll Number	

**Instruction/Notes:** Weightage of the exam is Section Specific (i.e., for each section the weightage would be as per the announcement done in that regard).

Do NOT un-staple your exam, otherwise it might be cancelled.

Ample space is provided for rough work; NO EXTRA sheets will be provided.

Question	1	2	3	4	Total
Marks	/3	/4	/5	/7	/19

### Question 1:

**[3] Marks**

Arrange the function  $(1.5)^n$ ,  $n^{100}$ ,  $(\log n)^3$ ,  $\sqrt{n} \log n$ ,  $10^n$ ,  $(n!)^2$ , and  $n^{99} + n^{98}$  in a list so that each function is big- $O$  of the next function. [hint: increasing order]

**Question 2:****4 Marks**

Consider the following algorithm

```
NoIdea ( n )  
    if n > 1  
        print 'A'  
        NoIdea ( n /3 )  
        for i = 1 to n  
            print 'B'  
        NoIdea ( n /3 )
```

Write down the time-complexity of the above algorithm in recursive form (*only write the recursive equation, you are not required to solve the recurrence*).

**Question 3:****5 Marks**

What would be the output of  $\text{MyAlgo}(A, 1, 10)$ , where  $A$  is given as below:

$$A = \langle 3, 7, 2, 6, 1, 8, 5, 4, 0, 9 \rangle$$

**Note:** Show complete working to claim for any **partial credit**.

$\text{MyAlgo}(A, p, r)$

**if**  $p < r$

$q = \text{DoSomething}(A, p, r)$

$\text{MyAlgo}(A, p, q - 1)$

$\text{MyAlgo}(A, q, r - 1)$

//-----//

$\text{DoSomething}(A, p, r)$

$x = A[r]$

$i = p - 1$

**for**  $j = p$  **to**  $r - 1$

**if**  $A[j] \leq x$

$i = i + 1$

        exchange  $A[i]$  with  $A[j]$

**return**  $i + 1$

[Contents of  $A$  when the Algorithm terminates]

$A =$

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**Question 4:****[1+6] Marks**

Let  $A[1 \dots n]$  be an array of  $n$  numbers such that

$$A[i] \leq A[i + 2] \quad \forall 1 \leq i \leq n - 2$$

i) Write an instance of  $A$  for  $n = 10$  (your array must not be already sorted).

ii) Give an algorithm that sorts  $A$  in non-decreasing order i.e., the output of your algorithm should be the array  $A$  such that

$$A[i] \leq A[i + 1] \quad \forall 1 \leq i \leq n - 1$$

Your algorithm must run in  $\mathbf{O}(n)$  worst-case time.

**Hint:** Some modification to the Merge procedure could be helpful in this scenario.

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**Extra space for Rough work**

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