"Investing in Africa's future"

COLLEGE OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE (CBPLG)

DATA STRUCTURES AND ALGORITHMS –CSC 411

END OF SECOND SEMESTER EXAMINATIONS

MAY/JUNE 2020

LECTURER: Mr. Timothy Makambwa

DURATION: 48 HOURS

INSTRUCTIONS

Answer **One** question from this Examination

Start **each** question on a new page on your answer sheet.

The marks allocated to **each** question are shown at the end of the section.

Question One

A)

Assume that each of the expressions below gives the processing time T(n) spent by an algorithm for solving a problem of size n. Select the dominant term(s) having the steepest increase in n and specify the lowest Big-Oh complexity of each algorithm.

[20 Marks]

Expressions	Dominant Terms	O(…)
$5 + 0.001n^3 + 0.025n$		
$500n + 100n^{1.5} + 50n \log10 n$		
$0.3n + 5n^{1.5} + 2.5 \bullet n^{1.75}$		
$n^2 \log2\ n + n(\log2\ n)^2$		
$n \log3\ n + n \log2\ n$		
$3 \log8\ n + \log2 \log2 \log2\ n$		
$2n + n^{0.5} + 0.5n^{1.25}$		
$0.01n \log2\ n + n(\log2\ n)^2$		
$100n \log3\ n + n^3 + 100n$		
$0.003 \log4\ n + \log2 \log2\ n$		

B)

Given the following binary search tree:

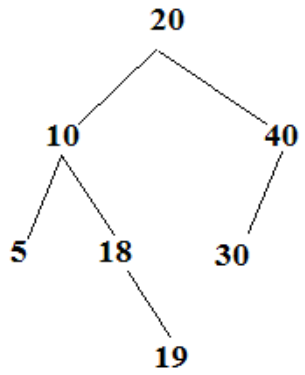

Figure 1

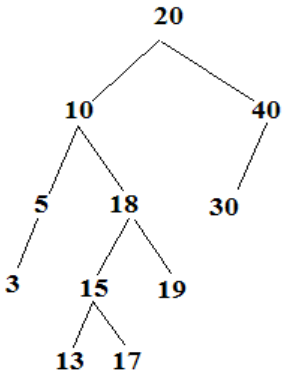

Figure 2

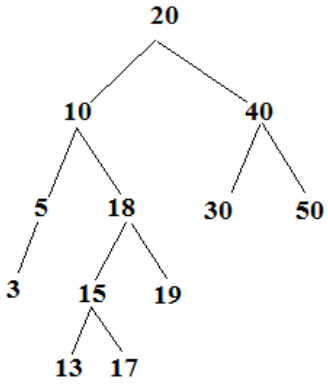

Figure 3

B.1 Draw the AVL tree in **Figure 1** after <u>insert</u> the element 25 [10 Marks]

B.2 Convert **Figure 2** into AVL tree [10 Marks]

B.3 Convert **Figure 3** into AVL tree and then draw the AVL tree after <u>Delete</u> the element 20

[10 Marks]

Question Two

Suppose Fibonacci_3 defines as the following:

$$\text{Fib}(n) = \begin{cases} 0 & \text{if } n = 0 \\ 1 & \text{if } n = 1 \\ 1 & \text{if } n = 2 \\ \text{Fib}(n-1) + \text{Fib}(n-2) + \text{Fib}(n-3) & \text{otherwise} \end{cases}$$

2.1 Show the first 10 numbers of Fibonacci_3 [5 Marks]

2.2 Write a **recursive** function for Fibonacci_3 [10 Marks]

2.3 Write a **Non-recursive** function for Fibonacci_3 [10 Marks]

2.4 Constuct the Binary Search tree given the number 50,30,70,25,80,40,60,75,35,90,100 in order [5 Marks]

2.5 Draw the Binary Search tree in (3.1) after delete the element 90 [5 Marks]

2.6 Draw the Binary Search tree in (3.2) after insert the element 73 [5 Marks]

2.7 Draw the Binary Search tree in (3.3) after delete the element 100 and 80 (use the right child if you need to choose left side or right) [5 Marks]

2.8 Draw the Binary Search tree in (3.4) after delete the element 25 [5 Marks]

Question Three

3.1. Based on the given sequence, construct a Binary Heap step by step through "**insert one element at a time**." [10 Marks]

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	1	3	5	7	9	20	18	16	14	12	10	8	6	4	2

3.2. Based on the given sequence, use "**BuildHeap operation**" to construct a Binary Heap step by step: **[**10 Marks]

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	1	3	5	7	9	20	18	16	14	12	10	8	6	4	2

3.3. Draw the Binary Heap in (4.2) after **one** deleteMin operation [5 Marks]

3.4. Draw the Binary Heap in (3.3) after **one** deleteMin operation [5 Marks]

3.5 Explain the following terms as they are used in data structures and algorithms

(i) Sorting
(ii) Traversal
(iii) Push
(iv) Search space
(v) Insert [10 Marks]

3.6 Explain the factors you would consider when selecting an algorithm to use from among several alternative algorithms to use [5 Marks]

3.7 Compute the running time for the following functions under asymptotic growth
(i) Linear algorithm [2 Marks]
(ii) $N \log N$ algorithm [3 Marks]

END OF PAPER