

Data structures and algorithms test one
Bachelors in Software Engineering, year two
Date: Monday December 5, 2022 15:00 – 16:00

1. Given a stream of n integers.
 - a. You are tasked to identify an appropriate data structure to randomly store these integers. Justify your choice of data structure. **4mks**
 - b. Rearrange the integers such that all the odd integers appear first, followed by the even ones. Design an algorithm to routinely execute this task. **8mks**
 - c. With appropriate example demonstrate the best-case and the worst-case scenarios. **4mks**
2. Consider the following function, generate the time equation of the function. **8mks**

```

public void f(int[] a, int m) {
    int[] b = new int[m];
    for (int i = 0; i < a.length; i++) {
        int j = a[i];
        b[j]++;
    }
    int i = 0;
    for (int j = 0; j < m; j++) {
        for (int k = 0; k < b[j]; k++) {
            a[i] = j;
            i++;
        }
    }
}

```

3. Under what circumstances do you prefer either an array or a linked list? **10mks**
4. Write short note on the following
 - a. Greedy algorithms **4mks**
 - b. Divide and conquer algorithms **4mks**
 - c. Depth first traversal **4mks**
 - d. Breadth first traversal **4mks**

Attempt all questions

$n^2 + 3n$
 $n^4 + 3$
 $f(n) = O(g(n))$
 $n^3 + 2n = n^2 + 3n$
 $n = 1$
 $1^3 + 2(1) = 1^2 + 3(1)$
 $1 + 2 = 1 + 3$
 $3 = 4$
 $n = 2$
 $2^3 + 2(2) = 2^2 + 3(2)$
 $8 + 4 = 4 + 6$
 $12 = 10$
 $n = 3$
 $3^3 + 2(3) = 3^2 + 3(3)$
 $27 + 6 = 9 + 9$
 $33 = 18$
 $n = 4$
 $4^3 + 2(4) = 4^2 + 3(4)$
 $64 + 8 = 16 + 12$
 $72 = 28$
 $n = 5$
 $5^3 + 2(5) = 5^2 + 3(5)$
 $125 + 10 = 25 + 15$
 $135 = 40$

MAKERERE UNIVERSITY

**COLLEGE OF COMPUTING AND INFORMATION SCIENCE
SCHOOL OF COMPUTING AND INFORMATICS TECHNOLOGY**

END OF SEMESTER I EXAMINATION 2022/2023

PROGRAMME: BSc. CS, BSc. Flat, BSSE.

YEAR OF STUDY: II

COURSE NAME: DATA STRUCTURES AND ALGORITHMS

COURSE CODE: CSC2100

DATE: 1ST FEB 2023

TIME: 08:00AM - 11:00AM

INSTRUCTIONS

1. ATTEMPT ALL QUESTIONS IN SECTION A (40 MARKS)
2. ATTEMPT THREE (3) QUESTIONS IN SECTION B. (60 MARKS)
3. DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO SO
4. ALL ROUGH WORK SHOULD BE IN YOUR ANSWER BOOKLET.

SECTION A [40 MARKS]

(2)

- Which stack operation results into stack underflow?
- Consider the following pseudocode:
declare a stack of characters
while (there are more characters in the word to read)
 {
 read a character
 push the character on the stack
 }

What will be the contents of the stack after executing the above code for the input "Tik Tok"? (4)
 Demonstrate with suitable diagram. (2)

- What is the distinguishing feature between a stack and a queue? (2)
- In a circular array of n elements, where rear is the n^{th} index in the array, determine the index after rear? (3)
- Identify any three applications of priority queues in computing (2)
- How do you test for an empty stack? (5)
- Explain array-based implementation of queues (4)
- Write short note on the following (4)
 - Enqueueing and pushing (4)
 - Double linked list and circular linked list (4)
 - Abstract data structure and linear data structure (2)
- Distinguish between algorithm analysis and algorithm design (2)
- How is branch and bound strategy different from back tracking strategy? (4)
- Define hashing and give at least two characteristics of a good hash function? (4)

SECTION B [60 MARKS]

Question One

- Design a selection sort algorithm that arranges all multiples of 2 on one end of the array and the rest of the integers on the other side of the array (10)
- Hand simulate the above algorithm with the array below (10)

3	10	1	8	22	7	9	6	4	16
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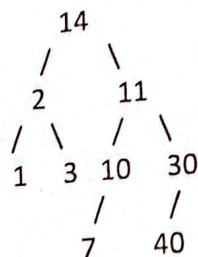
Question Two

- Suppose that p is a reference to node N in a linked list, and it is not the tail node. What are the steps to removing the node after N ? (5)
- Using the infix to postfix algorithm and stack data structure, demonstrate how the expression $a+b*(c*b-d)$ is converted to postfix. (10)
- What is the value of the postfix expression $1\ 2\ 3\ 4\ +\ -\ *$ (5)

Question Three

- a) With the aid of a suitable example, demonstrate the defining characteristics of recursive algorithms (12)
- b) With suitable examples, distinguish between direct recursion and indirect recursion. (8)

Question Four



- a) Identify the following nodes in the graph above (2)
- i. Leaf nodes (2)
 - ii. Ancestor nodes (2)
 - iii. Descendant nodes (2)
 - iv. sibling nodes
- b) Traverse the tree in (4)
- i. An in-order traversal (4)
 - ii. A pre-order traversal (4)
 - iii. A post-order traversal

Question Five.

- a) Write short notes on the following as used in hashing (4)
- i. Separate chaining (4)
 - ii. Open addressing
- b) Design an algorithm to execute linear search on data stored in two-dimension array. (8)
- c) Determine the computing time of the algorithm in (b) (4)

End