International University - VNUHCM

School of Computer **Science** and **Engineering**

**Midterm Examination**

Date: 03/04/2023; Duration: 90 minutes

**Handwritten notes** are **allowed,** laptops/PCs/PDAs are **not allowed**.

**SUBJECT: Algorithms & Data Structures (IT013IU)**

Approval

Signature

Lecturer:

Signature

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Mhas the Phedry

Full name: Trần Thanh Tùng

Full name:

Proctor 1

Signature

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Proctor 2

Signature

Full name:

**STUDENT INFO**

**Student** name**:**

**Student ID:**

Full name:

INSTRUCTIONS: the total of point is 100 (equivalent to 30% **of** the course)

1. *Purpose:*

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Test your knowledge of data structures and algorithms in the following topics: Array,

Searching algorithms, Queue, Stacks (CLO1)

Examine your skill in analysis and design algorithms (CLO2)

2. *Requirement*:

Write the answers and draw models CLEAN and TIDY directly in the exam paper Submit your exam including this paper inside

Note: For all calculations in this subject, the **rounding** up **convention** is used. For example, **7/2 is** round **up** to **4**

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**1. Sort (20 marks)**

Given array A

Index 0

1

2

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3

4

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LO

6

*7* 8

9

10 11 12

7 87 35

Data 72 4 12 53 15 2 8 16 40 21

Sort the array B with selection sort by filling the table below

Action 0 1 2 3 4 5 6 7 8

9 10 11 12

2. **Queue and Stack (20 marks)**

a. (10 marks) What values are returned after each dequeue() during the following

sequence of queue operations, if executed on an initially empty queue? enqueue(0), enqueue(3), dequeue(), enqueue(0), enqueue(4), dequeue(), dequeue(), enqueue(2), enqueue(0), dequeue(), enqueue(2), enqueue(3), dequeue(), dequeue(), enqueue(1330), dequeue(), dequeue()

b. (10 marks) What values are returned after each pop() during the following series of

stack operations, if executed upon an initially empty stack?

push(0), push(3), pop(), push(0), push(4), pop(), pop(), push (2), push(0), pop(),

push(2), push(3), pop(), pop(), push(1330), pop(), pop()

3. **Linked** list **(30** marks**)**

Given 2 classes Node and DoublyLinkList

public class DoublyLinkList (

public class Node {

}

public Node first;

public Node last;

public int key;

public Node next;

public Node previous;

-

(5 marks) Implement function delete\_first for the doubly linked list

(5 marks) Implement function insert\_last for the doubly linked list

(20 marks) Implement an algorithm to merge two sorted doubly linked lists to make **a** new

sorted linked list.

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**4.** Complexity **(20** marks**)**

Propose the worst-case complexity of the following operations in linked-lists

Data structure

Unsorted, simple

Sorted simple

Unsorted, double Sorted double

linked list

linked list

linked list

linked list

Search

O(n)

O(n)

O(n)

O(n)

Insert a new

0(1)

0(1)

0(1)

0(1*)*

value

Delete a given

O(1)

0(1)

0(1)

((^)

value

Get minimum

O(n)

0(1)

O(n)

0(1*)*

Get maximum

O(n)

0(1)

((n)

ou)

5. **Queue (10 marks)**

Whereas a stack allows insertion and deletion of elements at only one end, and a queue allows insertion at one end and deletion at the other end, a deque (double ended queue, pronounced like "deck") allows insertion and deletion at both ends.

Write 04 **(four)** O(1)-time procedures to insert elements into and delete elements from both ends of a deque implemented by an array.

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