COLLEGE OF COMPUTING AND INFORMATION SCIENCES

Mid-Term Assessment Fall 2020 Semester

Class Id	104949/104950	**Course Title**	Data Structure
Program	BSCS	**Campus / Shift**	Main Campus / Morning
Date	19th – October 2020	**Total Marks**	41
Duration	02 hours	**Faculty Name**	Affan Alim/ Naveed Shaikh
Student Id		**Student Name**	

Instructions of online submission:

- Filling out Student-ID and Student-Name on exam header is mandatory.
- Do not remove or change any part of exam header or question paper.
- Write down your answers in given space or at the end of exam paper with proper title "Answer for Question#".
- Answers should be formatted correctly (font size, alignment and etc.)
- Handwritten text or image should be on A4 size page with clear visibility of contents.
- Only PDF format is accepted (Student are advise to install necessary software)
- In case of CHEATING, COPIED material or any unfair means would result in negative marking or ZERO.
- A mandatory recorded viva session will be conducted to ascertain the quality of answer scripts where deemed necessary.

- **Caution:** Duration to perform Mid-Term Assessment is **02 hours only**. Extra 01 hours are given to cater all kinds of odds in submission of Answer-sheet. **Therefore, if you failed to upload answer sheet on LMS (in PDF format) within 03 hours limit, you would be considered as ABSENT/FAILED.**

Instruction of Paper:

- Attempt all parts of the same question in the given order.
- Attempt all questions on the answer sheet.
- You're not allowed to assume anything. Strictly stick to the mentioned requirements.

QUESTION#1 – LINEAR ARRAYS [07 points]

Part (a) [02 points]

If the starting memory address of an array A[-5, 23] is 450 then what will be the memory address of 21st element? Size of each memory location is 4-byte.

Note: In this question array index starts from -5 and end with 23

Part (b) [05 points]

Suppose you have two different email IDS like abc@yahoo.com and abc@gmail.com. You receive some emails only in ***gmail***, or only in ***yahoo*** but some time you receive an email at both emails account. Suppose your emails subjects are maintaining in linear array data structure such that ***gmail*** array has ***m*** emails and ***yahoo*** has ***n*** emails. (In ideal case the subjects are not repeated in any email ID)

gmail email subjects

Hi	Interview call	How are u	Exam week	Best friend	Dangerous for you	Good morning	**…**	***mth***

yahoo email subjects

Feeling bad	Going picnic	Hi	Good morning	Going abroad	Best Friend	Dear friend	**…**	***nth***

Your task is to write an algorithm to collect the emails by **UNION** method of both emails in a single array named ***YGmail*** with size ***m+n***.

Note:

Your algorithm should be neat & clean and free from plagiarism. The above arrays are only for understanding the question, don’t write algorithm only for above arrays. Your algorithm should be generic. The comparison of strings is same as the comparison of numbers.

Part (a) [06 points]

For the multidimensional arrays *A*(2:21, 4:30) and *B*(1:11, 3:13, 1:6). Compute the following:

(i) Length of each dimension for *A* and *B*, in term of *m* x *n* (rows x columns).
(ii) Number of memory blocks/cells being allocated for *A* and *B*.
(iii) Memory address of *A*[9, 11] in ***column major*** order. Assume base address is Base (A) = 405 and size of each memory location is 4.

Part (b) [05 points]

Write an algorithm using a ***single loop*** to swap the values of primary diagonal with the values of secondary diagonal of a square matrix (a square matrix is a matrix that contains equal number of rows & columns). The user input will be an ***array*** and size ***N***.

For example, the program must switch the elements as shown:

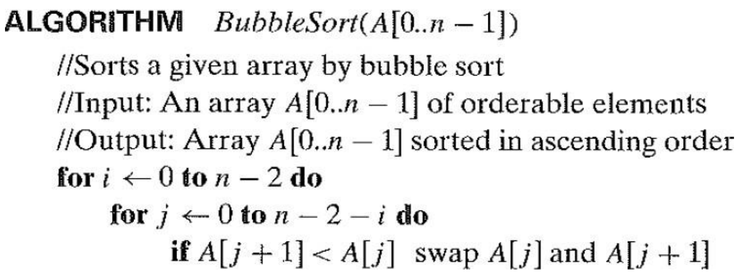
$$\text{Matrix} = \begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{matrix} \qquad \text{After switching} = \begin{matrix} 3 & 2 & 1 \\ 4 & 5 & 6 \\ 9 & 8 & 7 \end{matrix}$$

Your algorithm should be generic.

QUESTION#3 – SORTING [09 points]

Part (b) [2+2+5points]

Consider the ***bubble sort*** algorithm given below:



```
ALGORITHM  BubbleSort(A[0..n − 1])
    //Sorts a given array by bubble sort
    //Input: An array A[0..n − 1] of orderable elements
    //Output: Array A[0..n − 1] sorted in ascending order
    for i ← 0 to n − 2 do
        for j ← 0 to n − 2 − i do
            if A[j + 1] < A[j]  swap A[j] and A[j + 1]
```

Answer the following questions:

(i) Update the algorithm for best case (don’t write any other algorithm of bubble sort)
(ii) The second for loop contains the **(*n*-2-*i*)**, what is the purpose of ***i*** here
(iii) Calculate the running time of this algorithm by using summation notation. (don’t copy from the Internet, answer should in your own way)

QUESTION#4 – Linked List [14 points]

Part (a) [06]

Write an algorithm for sorting with consideration that ***n*** data is stored in linked list. Don’t make any assumption just stick to the following instructions:

- Each node contains an **INFO** field and a **NEXT** pointer.
- **Start** contains the address of the header node.
- Don’t change any values in the **INFO.**

Part (b) – [05+03]

Consider the given algorithm for insertion of a data at after the given location in linked list.

```
INSLOC(INFO, LINK, START, AVAIL, LOC, ITEM)

1. [OVERFLOW?] If AVAIL = NULL, then Write: OVERFLOW, and Exit
// [Remove first node from AVAIL list]
2. Set NEW := AVAIL and
3. AVAIL := LINK[AVAIL]
4. Set INFO[NEW] := ITEM. [Copies new data into node]
5. If LOC = NULL, then: [Insert as first node]
6.        Set LINK[NEW] := START and
7.        START : = NEW
8. else: [Insert after node with location LOC]
9.        Set LINK[NEW] := LINK[LOC] and
10.       LINK[LOC] := NEW
[End of If structure]
11. Exit
```

Answer the following questions:

(i) Draw the diagram for the simulation of the above algorithm such that your diagram reflects the updated link with different colors. Also, show the correspondence in the diagram between updated links and line number of algorithms

(ii) Calculate the running time of given algorithm