19

RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

BSc in Applied Sciences
Second Year - Semester II Examination – January / February 2023

COM 2307 – DATA STRUCTURES AND ALGORITHMS

Time: Three (03) hours

Instructions

Answer **All** Questions.

This paper consists of **five** (05) questions in **three** (03) pages.

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1. a. "A good understanding of data structures helps programmers to build efficient algorithms". Do you agree with this statement? Justify your answer.

(03 marks)

b. Formally define the notations "big O" and "big Ω".

(04 marks)

c. Discuss the drawbacks of "Step count method" in measuring running time of algorithms.

(03 marks)

d. Find the order of magnitudes of following functions, if the selected $g(n) = n^2$.

i. $f(n) = 4n^2 + 3(n + 2)$

ii. $f(n) = Log\,(2n^3 + 5n) + 4$

iii. $f(n) = 2\,e^{n/2} + 3n + 1$

(06 marks)

e. Devise two algorithms, a recursive and non-recursive (iterative), to compute the n^{th} term of the *Fibonacci* series.

($f(n) = f(n-1) + f(n-2)$ for $n > 2$, $f(1) = f(2) = 1$)

(04 marks)

2. a. What are the advantages and disadvantages of using arrays to construct data structures.
(04 marks)

b. Assume that you require to record marks obtained by a set of students for three (03) subjects along and their index numbers. Write required lines of C codes for the followings.

i. To define a structure to keep marks of a single student.
(02 marks)

ii. To define an array-based list structure to store marks of all students.
(03 marks)

c. Write a C function to read the number of students and to initialize an empty list for that number of students using the structure defined in question 2. part b. ii.
(04 marks)

d. Illustrate how to delete a given record, without leaving vacant cells in the middle, from the list defined in question 2. part b. ii.
(04 marks)

e. Compute the time complexity for the operation in question 2. part d.
(03 marks)

3. a. Compare and contrast singly linked lists and doubly linked lists.
(04 marks)

b. An educational institute conducts ten (10) classes for ten (10) subjects. Any number of students can be registered in a class. The institute requires to record admission number, name, and registered date of registered students.

i. Suggest a suitable structure for this purpose and draw a sketch of your structure.
(04 marks)

ii. Write a C code to define the structure in question 3. part b. i.
(04 marks)

iii. Write an algorithm to combine two classes into one class.
(05 marks)

iv. Find the time complexity of the algorithm you wrote in question 3. part b. iii.
(03 marks)

4. a. "Operations on doubly linked lists are more expensive than singly linked lists". Explain this statement using your own examples.
(04 marks)

b. Write an algorithm or a C function to find and delete a given item of a doubly linked list. Assume that a node consists of an integer item and required links.
(04 marks)

c. Compare and contrast queues and priority queues.
(04 marks)

d. Represent the expression $(A\hat{}2 - B\hat{}2) * (C/2 + D) - (E + 4/F) + G$ in prefix and postfix forms.

(04 marks)

e. Using the postfix expression, you have obtained in question 4. part d., illustrate how a stack is used to evaluate a given postfix expression.

(04 marks)

5. a. Define trees, binary tries and binary search tree (BST)s.

(04 marks)

b. List four (04) applications of trees.

(02 marks)

c. Write a non-recursive (iterative) algorithm to insert an item into a BST.

(04 marks)

d. Explain with an example how to construct a BST using an array.

(03 marks)

e. Construct a BST using the list [100, 20, 50, 10, 30, 60, 35, 40, 25].

(02 marks)

f. Write the In-order, Pre-order and Post-order traversals of the BST constructed in question 5. part e.

(03 marks)

g. Illustrate how to delete the item 30 from the BST constructed in question 5. part e.

(02 marks)

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