








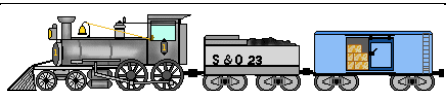
NATIONAL SCHOOL OF BUSINESS MANAGEMENT
BSc in Management Information Systems (Special) (NSBM)– 20.3
BSc (Hons) in Software Engineering (NSBM)– 20.3
BSc (Hons) in Computer Science (NSBM)– 20.3
1st Year 2nd Semester Examination
08 November 2021
CS106.3 – Data Structures and Algorithms

Instructions to Candidates

- 1) **Answer four (04) questions INCLUDING Question 01.**
- 2) Time allocated for the examination is five (05) hours (Including downloading and uploading time)
(Note: No email submissions are accepted under any condition)
- 3) Weightage of Examination: 60% out of final grade
- 4) Provide answers to the selected questions in the given format under the question
- 5) Please upload the document with answers (Answer Script) to the submission link before the submission link expires
- 6) Answer script should be uploaded in PDF Format
- 7) Under any circumstances E-mail submissions would not be taken into consideration for marking. Incomplete attempt would be counted as a MISSED ATTEMPT
- 8) The Naming convention of the answer script – Module Code_Subject name_Index No
- 9) You must adhere to the online examination guidelines when submitting the answer script to N-Learn
- 10) Your answers will be subjected to Turnitin similarity check, hence, direct copying and pasting from internet sources, friend's answers etc. will be penalized
- 11) All answers **must be typed** except for those marked as [*] in which hand-drawn or hand-written answers are accepted. You may use the templates given at the last page to do some calculations.

1. An algorithm is a method for solving a class of problems on a computer, but one can relate to solve day-to-day life problems with them. **(Total-40 Marks)**

I. Identify the following situations and explain applications/usages of data structures and algorithms. **(1 x 10 = 10 Marks)**

| Algorithm /Data Structure | Sample | Day-to-day life Application |
|---------------------------|---|---|
| Tree Data structure |  | 1. |
| 2. |  | When finding a lost key by checking all places. |
| 3. |  | 4. |
| 5. |  | 6. |
| 7. |  | 8. |
| 9. |  | 10. |

II. TSP Insurance Inc. is planning to boost their businesses by hiring new sales representatives. These sales reps will be assigned to different regions in Colombo district. Their task is to visit each and every household/company and promote the new insurance plan within a week. They get 10% commission for each and every new household visit and 20% commission for new companies visit. Andre, who recently joined TSP, is assigned to Pitipana area that has 1,000 houses and 50 companies. As a close friend you have to analyze Andre's situation and provide him advices for maximizing the commission. Your answer should contain an analysis of the situation, suggested algorithms, illustrations, analysis with numbers, and data structures. (30 Marks)

2. Suppose you are a librarian. You got a shipment of 1,000 different books on a Sunday when you were alone at work. The books had been dropped off in one long straight line. But they are all out of order. To make things worst you must sort them by 9:00 AM on Monday. Analyze the situation and discuss sorting options you have. Your discussion should include at-least two sorting algorithms, the way they work in this situation (you may refer the illustration below), predict roughly how many comparisons required, and assuming a comparison takes a second how long it takes to sort all the books.

(15 Marks)



3. In computer science, a sorting algorithm is an algorithm that puts elements of a list in a certain order. The most frequently used orders are numerical order and lexicographical order. (Total-15 Marks)

- I. Sort the [19, 7, 43, 3, 9, 82, 10] array using merge sort algorithm. Note that the illustrations and labels are mandatory. (7 Marks)
- II. Write pseudo/source codes to merge [2, 4, 8, 9] and [3, 5, 6, 10] arrays into a single sorted array. (6 Marks)

- III. Estimate the time complexity of merge sort algorithm showing the steps you followed including reduction. (2 Marks)

4. Stacks and queues are linear data structures that allow one to access single data item at a time. (Total-15 Marks)

- I. Compare (look for similarities) and contrast (look for differences) stacks and queues in terms of adding, removing, size, and emptiness. Note the wording is important; e.g.: add → push (5 Marks)
- II. Discuss variations of queue data structure. (2 Marks)
- III. Based on the stack implementation given below implement add (push), removing, emptiness, and check whether a stack is full. The answer has to be source codes with proper coding conventions and comments explaining your strategy. (2 x 4 = 8 Marks)

```
#define size 5
/* stack structure */
struct stack {
    int s[size];
    int top;
} st;
```

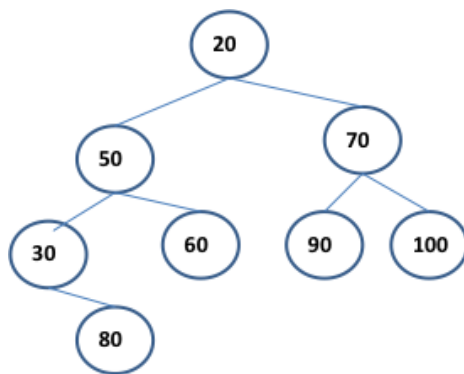
5. Searching algorithms aim to find position of a target value within an array/list. They can be classified based on their mechanism of searching. (Total-15 Marks)

- I. Write pseudo/source codes for searching an integer variable called *item* using linear search in an array called *unorderedArray*. (7 Marks)
- II. Compare (look for similarities) and contrast (look for differences) linear search with binary search. (5 Marks)
- III. How do you derive the complexity of binary search as **$O(\log n)$** ? Show **all** the steps including the mathematics. (3 Marks)

6. Asymptotic Analysis refers to defining the mathematical bound/framing of an algorithm's runtime performance. (Total-15 Marks)

- I. Discuss the time complexity of an algorithm with some examples and notations commonly used. (5 Marks)
- II. Simplify the following expressions with reasoning. (10 Marks)
- a. $7n - 3$
 - b. $50n + \log n$
 - c. $n \log n + 8n^2 + 600n$
 - d. $n! + 2n$
 - e. $9n! + 5n^n + 2^n$

7. A tree in computer science is a widely used abstract data structure that is also non-linear



format storing data in a hierarchical structure. (Total-15 Marks)

- I. Identify the root, siblings, a leaf, descendants, and ancestors of the above tree data structure. (4 Marks)
- II. Discuss three different variations of trees; such as binary search tree (BST). Your answer should have a simple illustration as well. (3 Marks)
- III. Draw a BST by inserting these numbers from left to right. [11, 7, 8, 19, 4, 10, 5, 17, 43, 49, 31] (4 Marks)
- IV. Explain pre-order (VLR) traversing strategy and apply it to read the above tree. Show the order of reading data items. (4 Marks)

END OF THE PAPER