

BACHELOR OF COMPUTER SC. & ENGINEERING EXAMINATION, 2019
(2nd Year, 1st Semester)

DATA STRUCTURES AND ALGORITHMS

Time : Three hours

Full Marks : 100

Answer question no. 1 and any *four* from the rest.

1. (a) What do you mean by Bloom Filter. Explain its basic use. 4+1
 - (b) What is non-linear recursion? Give an example problem which can be solved by using non-linear recursion. 3+2
 - (c) Clearly state what you mean by Time Complexity and Space Complexity of algorithms. 3
 - (d) Show how a Heap will be formed by inserting the following sequence of letters in the order they are given:

Z L F T D Y M E A K

3
 - (e) Show how the following array will be sorted in *decreasing order* using Merge Sort algorithm:

80 90 70 100 10 20 40 60 50.

4
2. Explain what you mean by the notation $f(n) = O(f(n))$.
 Prove that if $T1(n) = O(f(n))$ and $T2(n) = O(g(n))$, then
 $T1(n) + T2(n) = O(\max((f(n)), (g(n))))$,
 with the usual meaning of the symbols.
 Where can you find use of the above result in the analysis of algorithms? Explain.
- Compare in detail, Insertion Sort and Selection Sort algorithms with respect to their time complexities in the best case, average case and worst case.
 Discuss an application where you can efficiently use the best case of Insertion sort.
3+4+3+7+3 = 20
3. To write modern poems, an AI program generates random strings of lengths 2, 3, 4 and 5 letters using the English alphabet. Write an algorithm to generate such strings.
 After generating the strings, the program needs to check whether the generated string is within the set of words of a repertoire of the English language. Explain in detail what data structure you will use to check whether the word is in the English language in near constant time. Assume the repertoire contains 10,000 words.
10+10=20

4. Declare the data type for a doubly linked list.
Your friend has written two functions for traversing a doubly linked list, viz., forward() and backward(), respectively. Give possible templates in C language for the functions.
Write a wrapper function traverse(), which will take as argument, either of the above two functions and execute the forward or backward traversals of a doubly linked list as required.
Write an algorithm using stack for matching parentheses in a given string.
Explain how recursive functions are implemented using stack.
What is mutual recursion? What is its use?

$$1+2+5+3+6+3 = 20$$

5. The files in your computer are arranged in terms of directories, sub-directories and files. What kind of logical data structure can be used for such an arrangement? Explain with an example.
Show how the same arrangement can be stored into a binary structure without losing the relationship among the entities.
Define the ADT B-Tree of order k.
Usually, B-Tree is used to store huge number of records on the hard disk. What are the problems faced during the actual usage in such storage?
Explain in detail, how the concept of B-Tree is extended in B+ tree.
What are the additional advantages of B+ tree over B-Tree?

$$2+2+4+3+6+3 = 20$$

6. What do you mean by Hashing? In what kind of applications would you prefer hashing over other data structures? Explain how a record can be deleted from an Open Addressing Hash Table without disturbing the overall table. What are the Collision Resolution Strategies in open Addressing hashing? Explain their details with advantages and disadvantages of each.

$$2+3+4+11=20$$

7. What is a Greedy Algorithm? What are the benefits and pitfalls of Greedy algorithms? Explain with an example.
Show how a Greedy Algorithm can find out the Minimum Cost Spanning Tree of the Graph in Fig. - 1.

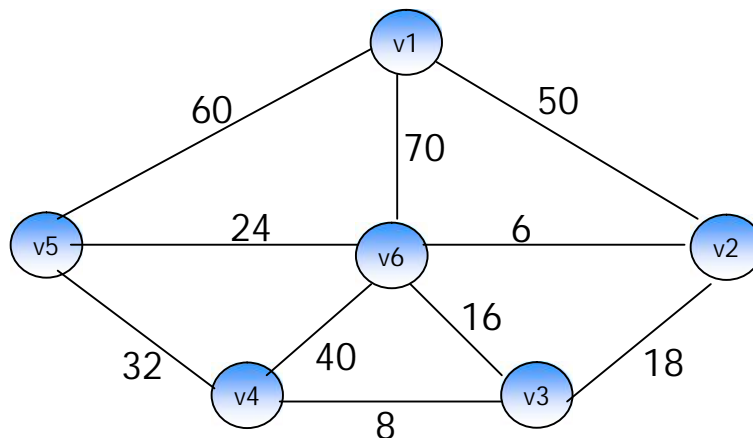


Fig. - 1

$$3+7+10=20$$

8. Write the following functions in C with proper comments. Define the data types you have used:
- Your friend has implemented a data structure singly linked list SLL. She has provided the functions `SLL_init()`, `SLL_insert_front(head, nodep)` and `SLL_delete_front(head)`. Write down the probable C language templates for the functions and use them to implement the `Stack_init`, and `Stack_push` operations for the Stack data structure in C. Show the declaration of the Stack data type used in your function.
 - To check whether a given Binary Search Tree is Height Balanced.
 - To merge two sorted arrays in a third array.
 - To compute the GCD of two integers recursively.

8+4+4+4=20

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Moderated by

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Signature of the Paper Setter