Indian Insitute of Engineering Science and Technology, Shibpur

B.Tech(CST) 3rd Semester End Semester Examination, January 2021

Data Structures CS2103

Time: 1.30 hrs Full Marks: 50

Answer question number 1 and any four from the rest. Credit will be given to precise answer.

1. Answer any five questions

(a) What do you mean by abstract data type?

(b) Differentiate linear from a non-linear data structure.

(c) Write down the prefix form of the expression $(A + B) * D + E/(F + A * D) + C$

(d) What are the primary advantages of a linked list?

(e) Calculate the address of a random element present in a 2D array of size $m \times n$, given the base address as α.

(f) Explain the scenarios when you prefer to use linear search over binary search.

(g) What are the problems with component sum hash code maps? $[5 \times 2]$

2. (a) Discuss the advantages and disadvantages of the link list-based and array-based implementations of a queue.

(b) Create a data structure that efficiently supports the stack operations (pop and push) and also return the maximum element. Assume the elements are integers or reals so that you can compare them. [5+5]

3. (a) Suppose you are given a linked list L (containing integer keys) and an integer x, write a function to rearrange the link list L in such a way that all the nodes less that x comes before all the nodes greater than or equal to x.

(b) You are given two lists L_1 and L_2, sorted in increasing order, write a function to create and return a new list L_3 representing the intersection (i.e. nodes with common values) of the two lists. [5+5]

4. (a) Prove that in a $k-$ary tree (i.e. a tree of degree k) with n nodes, the total number of $NULL$ links are $n(k-1)+1$.

(b) Prove that if the closest leaf in an AVL tree is at level k (assuming the root is at level 1) then all the levels from 1 to $k-1$ contain the maximum possible number of nodes.

(c) Show the result of inserting $2, 1, 4, 5, 9, 3, 6, 7$ into an initially empty AVL tree (show the tree at the end of each insertion) [2+4+4]

5. (a) Justify which sorting method would you prefer in the following situations

(i) sorting a keys that are already almost in order

(ii) Sorting a huge randomly-ordered file of small records

(b) Prove that the running time of Quicksort when alternately good and bad splits occur is $O(n \lg n)$, where n is the number of elements. Note that good splits creates equal partition and bad splits creates partition of size 1 and $n-1$. [5+5]

6. (a) What is collision in hashing and how can it be resolved?

(b) What do you mean by universal hashing?

(c) Suppose a hash table T has 11 slots, $T[1], T[2], \ldots T[11]$, and suppose 8 keys A, B, C, D, E, X, Y, and Z with the following hash addresses

Keys:	A	B	C	D	E	X	Y	Z
h(k):	4	8	2	11	4	11	5	1

are inserted into the hash table T in that order as shown below.

X	C	Z	A	E	Y	-	B	-	-	D
1	2	3	4	5	6	7	8	9	10	11

Now find the average number S of probes(comparison) for a successful search and the average number U of probes(comparison) for a unsuccessful search. [2+3+5]