B.Tech/CSE/3rd Sem/CSEN-2101/2015

2015

DATA STRUCTURES & ALGORITHMS

(CSEN 2101)

Time Alloted : 3 Hours *Full Marks : 70*

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternative for the following : **[10×1=10]**

   i) Suppose there is an AVL, tree of height 4 what is the minimum number of nodes present in the tree?

   (a) 12 (b) 13

   (c) 11 (d) 10

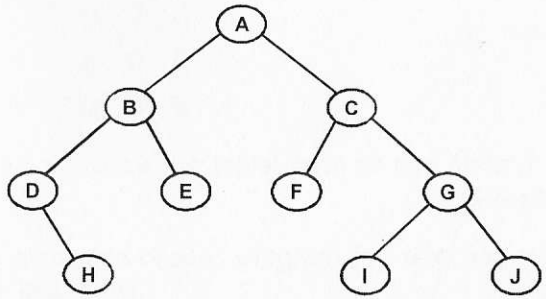
   ii) The recurrence relation for algorithm A is given as S(n) = S(n/4) + c*n;

   Then determine the asymptotic complexity of A.

   (a) O(n) (b) $O(\log_2 n)$

   (c) $O(\log_4 n)$ (d) $O(n^2)$

iii) What will be the post-order traversal of the given graph



(a) A B C D E F G H I J (b) H D E B F I J C G A

(c) D H E B A F I J G C (d) None of the above

iv) A data structure where elements can be added or removed at either end but not in the middle is :

(a) Linked lists (b) a Stack

(c) Queue (d) Deque

v) Which of the following sorting algorithms is of divide-and-conquer type?

(a) Selection sort (b) Quick sort

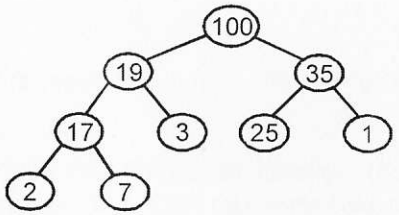
(c) Merge sort (d) Both B & C

vi) The maximum number of nodes in an binary tree of height H is

(a) $2^{H+1} - 1$ (b) 2^H

(c) $2^H - 1$ (d) None of the above

vii)



The above mentioned tree is an example of

(a) heap (b) fully binary tree

(c) None of the above (d) all of the above

viii) Column-major ordering in arrays can be seen in the following high-level programming language,

(a) C (b) Matlab

(c) C++ (d) Java

ix) Inserting a node at the beginning of a circular linked list would take

(a) O(1) (b) O(n)

(c) O(logn) (d) $O(n^2)$

x) A graph has 8 nodes and 10 edges. What could be the maximum number of connected components in such a graph?

(a) 2 (b) 5

(c) 4 (d) 3

GROUP - B

2. (a) Explain how you can implement a queue using a circular singly linked list. Show how you can perform enqueue and dequeue operations in O(1) time.

(b) Write a C function to reverse a single-linked list (provide comments)

(c) Say we have a 2 D matrix given below:

0 2 0

5 0 0

0 6 9

Now what will be the triplet form of this matrix?

(5+4+3) = 12

3. (a) Write a pseudo-code/C program for detecting loop in a singly linked list.

(b) Write a pseudo-code/C program to insert an element in a doubly linked list. Provide with all assumptions you made

(c) Write a function to create a singly linked list. Give the declarations and variable definitions assumed in your function. **3+5+4 = 12**

GROUP - C

4. (a) Consider an editor supporting undo operations of last many actions (one at a time). Which data structure would you use to store the Individual operations and why?

(b) Convert the following prefix expression to its postfix form:

– * – + a b c / e f – g / h i

(c) Write down an efficient algorithm to implement queue using stack. Analyze the time complexity for enqueue and dequeue operations. **3+4+5 = 12**

5. (a)
```
int Fibonacci (int n)
{
if (n = 0)
return 0;
else if (n = 1)
```

return 1;

else

return (Fibonacci (n – 1) + Fibonacci (n – 2);

}

Say, a recursive Fibonacci function (as shown above) has been provided. Can this recursive call be optimized by tail recursion? Explain.

(b) Explain the Tower of Hanoi problem. Write a C program/ pseudo-code that uses recursion to solve the problem. Solve the recurrence relation to find out the time complexity of the method. **6+6 = 12**

Group - D

6. (a) Insert the following numbers into a binary search tree in the order that they are given and draw the resulting tree. 87, 36, 22, 15, 56, 85, 48, 90, 72, 6

Delete 48 and draw the resulting tree.

Delete 15 and draw the resulting tree.

(b) Repeat the above exercise for AVL trees.

(c) Write proper C function of finding the height of a Binary Tree. **(2+1+1)+(2+1+1)+4 = 12**

7. (a) Explain two different ways to store a graph data structure in a program. Explain with an example.

(b) What is the worst-case complexity of inserting n elements into an initially empty heap? (assume the elements are inserted one at a time) Compare this with the complexity of buildHeap().

(c) Draw the binary tree from given Pre Order traversal – GBQACKFPDERH and in order traversal – QBKCFAGPEDHR. **4+5+3 = 12**

GROUP - E

8. (a) Arrange the following list of elements in ascending order using quick sort considering the first element as pivot.

77, 66, 55, 44, 33, 11, –2, –10

Show all the steps and explain.

(b) When should we use counting sort over other sorting methods? Explain the algorithm for counting sort and explain its time complexity from the pseudo–code.

6+6 = 12

9. (a) All of the data entered into a table are required to have final digit between 0 and 6. Suppose keys 1121, 1432, 1321, 1323, 1841, 1223 are hashed into a table of size 7 using the hash function h(x) = x mod 10, and linear probe function f(i) = ai + b, for nonnegative integer constants a and b. Solve for a and b from resultant hash table given below :

cell 0	cell 1	cell 2	cell 3	cell 4	cell 5	cell 6
empty	1121	1432	1323	1223	1841	1321

(keys were hashed in the order of which they appear above. Assume that h(k) + f(0) is used to probe for the first open address in the event of a collision.)

(b) Describe quadratic probing. Explain it with an example.

(c) How you are going to make bubble sort more efficient? Explain it with an example.

5+4+3 = 12