Third Semester B. Tech. / B. E. (Computer Science and Engineering / Artificial Intelligence and Machine Learning / Cyber Security) Examination

DATA STRUCTURES / DATA STRUCTURE AND ALGORITHMS

Time : 3 Hours]   [Max. Marks : 60

Instructions to Candidates :—

All questions carry marks as indicated.

1. (a) Given an Array ADT, write an algorithm for adding a new element at the specified position. If the specified position is not existing then add the new element at the end.   6(CO1)

    (b) Consider row major implementation of 2D array A.

    B - Base address

    W - Size of each element (8 bytes)

    L1 - Lower bound of rows : 0

    U1 - Upper bound of rows : 4

    L2 - Lower bound of columns : 0

    U2 - Upper bound of columns : 4

    Base Address of A is 2026.

    What is he address of element A[2][3] ? What is the address of element A[3][3] ? Write stepwise solution for your answers.   4(CO1)

2. (a) Convert the arithmetic expression, $A \wedge (B + C) * (D - (E / B))$ to its equivalent postfix form. Evaluate the obtained postfix expression for $A = 2$, $B = 5$, $C = 2$, $D = 9$ and $E = 10$. Show the contents (stack frame) at each stage of transformation and evaluation.   5(CO2)

(b) Consider you have a Stack Data Structure and the application you have to create uses Queue Data Structure. Can you implement Queue Data Structure using Stack ?

Write proper enqueue and dequeue methods and demonstrate the working in main( ). 5(CO2)

3. (a) Consider a circular doubly linked list that is already created. Write a function to :

(i) Remove the third last element and return the data contained in the deleted node.

(ii) Swap the first and last nodes by managing links between the nodes. Do not swap data. 4(CO2)

(b) There are two product assembly lines AL1 and AL2 implemented as linked lists where code information is stored as data (X# for AL1 and Y# for AL2). AL1 is of main parts with code X# in which the subpart from AL2 with code Y# is to be fitted. Write an algorithm to compare AL1 and AL2 so that X# and Y# are matching. Function should output appropriate message as shown in below examples.

Example1 :–

AL1 : $1 \rightarrow 2 \rightarrow 3$
AL2 : $1 \rightarrow 2 \rightarrow 3$
Output : Start Assembling!

Example2 :–

AL1 : $1 \rightarrow 2 \rightarrow 4$
AL2 : $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$
Output : Stop Assembling! 6(CO2)

4. (a) Sort the following numbers using heap sort. Show the stepwise output (as tree) of all iterations :

40, 20, 10, 80, 60, 50, 7, 30, 100

Also mention the best, average and worst case complexities of heap sort algorithm. 5(CO3)

(b) Consider a list of Employee data (ID, Name, Address, Salary) is implemented as doubly linked list and is sorted in the ascending order of ID.

    (i) Can we apply a binary search algorithm to locate the information of an Employee ? Support your answer with brief explanation.
2(CO3)

    (ii) Write the algorithm to insert new employee information in list so that it remains sorted after new insertion.
3(CO3)

5. (a) Create a B-Tree of order 5 from the given keys :

3, 14, 7, 1, 8, 5, 11, 17, 13, 6, 23, 12, 20, 26, 4, 16, 18, 24, 25
5(CO4)

(b) The diameter of a tree is the number of nodes on the longest path between two leaves in the tree. The diagram below shows a tree with a diameter 9. The leaves that form the ends of the longest path are nodes X and Y. Write a function to display the diameter value of a binary tree.
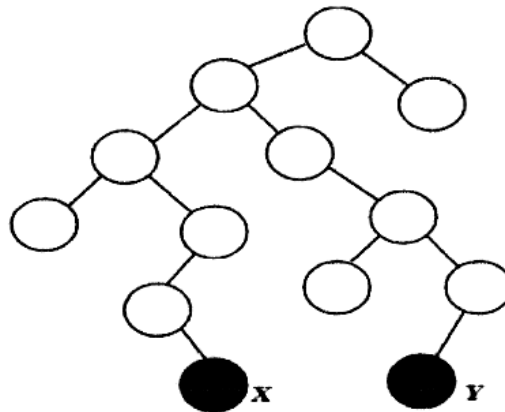
Note : There may be more than one path in the tree of the same diameter.
5(CO4)

6. (a) Consider the graph given below and apply Dijkstra's algorithm starting at vertex A. Note that the nodes will be processed in alphabetical order. Show contents of all data structures used during execution.

(Fig. on Next Page...)
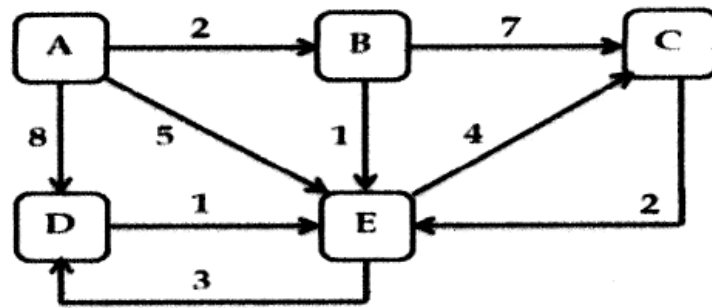
5(CO4)

(b) Consider a closed addressing scheme that randomizes the keys using $h(x) = x \% 7$.

Construct the hash table when following list of keys in mentioned sequence are processed —

92, 66, 55, 33, 86, 82, 11, 73, 14, 44, 38

Assume that an individual bucket can hold a single key.   5(CO3)

❖