

# Patuakhali Science and Technology University

B.Sc. Engineering in CSE (1st Year) Semester-I

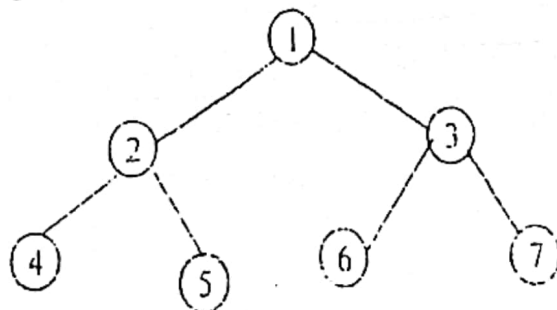
Final Examination-2013 (January - June) Session: 2011-12

Course Code: CEE 211 Course Title: Data Structure and Algorithm

Credit Hour: 3.0 Full Marks: 3.50 x 4 = 70 Duration: 3.0 Hours

[Split answering of any question is not considered. Answer any five of the following questions. Please insert examples and/or figures for each question's answer if required]

1.
  - (i) Why linked list is better than array to store unlimited number of data?
  - (ii) How linked list helps for data insertion and deletion with respect to array?
  - (iii) Define Graph and Tree. What is the basic difference between them?
  - (iv) How two sorted array can be merged into one sorted array?
2.
  - i) Why Stack and Queue are more preferable than array?
  - ii) How the DFS algorithm works for a sample graph?
  - iii) What is the Shortest Path problem? How it is calculated using any algorithm?
  - iv) Write algorithms for a) pre-order b) in-order and c) post-order tree traversal.
3.
  - i) How tree is used to represent a mathematical expression?
  - ii) Traverse a tree using BFS algorithm.
  - iii) Define the level, depth, children, predecessor, and ancestor of a sample tree.
  - iv) Make the PSTU organizational hierarchy using tree.
4.
  - i) How we can make a connectivity matrix from adjacency list?
  - ii) Write sample code for push and pop function of a Stack.
  - iii) How en-queue and de-queue methods for Queue are implemented using array?
  - iv) Make the postfix expression of the equation:  $((A+B) (C+D)) - ((P/Q) + (R-S))$ ;
5.
  - i) Define linked list, two-way linked list, and circular linked list.
  - ii) How a node of a linked list is created using programming code?
  - iii) How a node is added at last position of the linked list using programming code?
  - iv) How the pivot element create its position after the first iteration for Quick sort algorithm?
6.
  - i) What are the basic differences between Selection sort and Bubble sort?
  - ii) Write the name of the visited node using IN-ORDER and POST-ORDER algorithm from the following tree?



iii) Build a binary tree from the pre-order and post order traversal value that is given below.  
PRE-ORDER: XBYDCE IN-ORDER : YBFDCAE

iv) How Divide and Conquer approach is applied to Merge sort, Quick sort algorithm?

Answer any 7 of the following questions. Split answering is not recommended.

1. a. Demonstrate insertion and deletion of an item into an array. 6  
 b. If you have an array with length  $n$  and you want to insert a value at position  $p$ , how many times you have to move the data of the current array? Similarly, how many times you have to move the data of the array with length  $n$  if you want to delete the element at position  $p$ ? 4

2. a. What are the fundamental characteristics of arrays and linked lists? 5  
 b. Discuss with example how you can insert an item in sorted order into a linked list. 5

3. a. Provide two examples of each of the applications of queues and stacks. 4  
 b. What are the operations on Queues? Discuss with example in short. 6

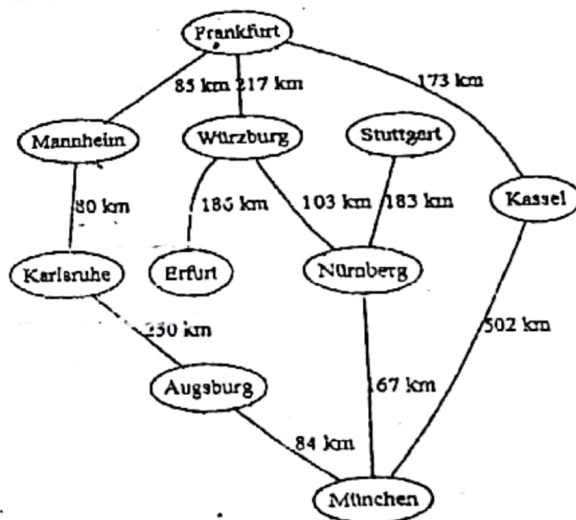
4. a. When is binary search better than linear search and when is linear search better than binary search? Explain with example. 5  
 b. Apply binary search on the following list to search 13. 5  
 1 2 5 8 9 10 13 15 17

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | 0 | 5 | 3 | 0 | 0 | 0 | 6 |
| 2 | 5 | 0 | 0 | 6 | 0 | 7 | 0 |
| 3 | 3 | 0 | 0 | 0 | 8 | 6 | 0 |
| 4 | 0 | 6 | 0 | 0 | 0 | 0 | 7 |
| 5 | 0 | 8 | 0 | 0 | 0 | 3 | 0 |
| 6 | 0 | 7 | 6 | 0 | 3 | 0 | 0 |
| 7 | 6 | 0 | 7 | 0 | 0 | 0 | 0 |

5. a. Draw the graph for the given adjacency matrix. 4  
 b. Apply BFS and DFS on the graph you get in the answer to the question no. 5.a. Start from node A and stop when you find node E. Show step-by-step demonstration of BFS and DFS. 6

6. a. What are the characteristics of a Binary Search Tree (BST)? 2  
 b. Construct a BST with the following data. Show each step 5  
 10 13 8 5 3 18 20 16 16 25  
 c. How can you achieve sorted output from a Binary Search Tree? Explain with example. 3

7. a. Construct the adjacency matrix for the graph given. 2  
 b. Apply Dijkstra's algorithm on the same graph of question 7.a. with Frankfurt being the start node. Show step-by-step demonstration of the algorithm. 8



8. Demonstrate how bubble sort works on the following data set. Show each iteration with sub-iterations. 10

5 1 4 2 8

Show the generation of the Huffman tree using Huffman encoding algorithm on the following text and then encode the text. 10

WAS IT A CAR OR A CAT I SAW?



[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]

Answer any 5 of the following questions.

- 1) a) Define graph. Differentiate between dijkstra's and Floyd/warshall algorithm. 3  
 b) Consider the following graph G in Fig b.1. Suppose the nodes X,Y,Z,W are stored in memory in an array DATA as follow: 6

DATA: X,Y,Z,W

- i) Find the adjacency matrix A of the graph G.
- ii) Find the path matrix P of G using powers of the adjacency matrix A.
- iii) Is G strongly connected?



Fig b.1

- c) Apply BFS on graph 1 and DFS on graph 2 to traverse it and write the vertex sequence with details calculation. 5

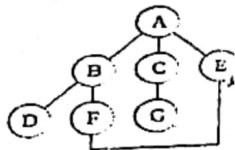


Fig c.1 : graph 1

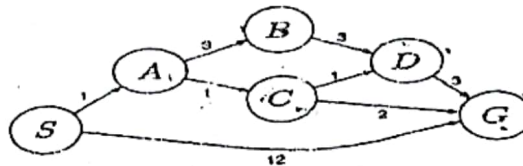


Fig c.2 : graph 2

$$\begin{aligned}
 &10 \times [73 - ] - 48 / [15 + ] + 4 \\
 &10 \times [73 - *] - 48 / [15 + ] + 4 \\
 &10 \times [73 - *] - 48 / [15 + ] + 4
 \end{aligned}$$

- 2) a) Build a Huffman tree for the following text.

**GREEN GLASS GLOBES GLOW GREENLY**

- b) Define heap. Construct a min heap using following data set(DATA). Using heap data structure write an algorithm to sort a set of numerical data in ascending or descending order. 7

DATA: 2,7,3,17,19,100,1,25,36

- c) Create an algorithm to find and delete all duplicates from a data set using BST data structure. 3

- a) Translate each infix expression into its equivalent postfix expression

i)  $(A-B)*(D-E)$  ii)  $A*(B+D)/E-F*(G+H/K)$  iii)  $10*(7-3)-48/(1+5)+4$

10, 7, 3, - \*

Consider postfix expression of question 3.iii) and evaluate it according to a algorithm using stack data structure.

- b) Define priority queue. Propose at least four methods to build priority queue using array or linked list and analyze the complexity of each methods to find the best one.

- c) What is the difference between data structure and abstract data types? How do you find inorder successor of a node? Show with figure.

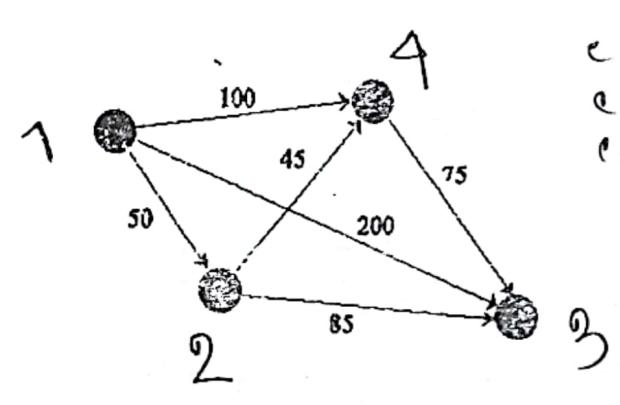
$$10 \times [73 - ] - 48 / [15 + ] + 4$$

Linked list + array

P-6.99

Why do you learn sorting algorithm?

- 4 a) What are difference between array and linked list? Write an algorithm which removes the first element a list and adds it to the end of the list without changing any value in INFO.
- b) Given an Integer K, write an algorithm which deletes the Kth element from a linked list and also calculate the complexity of your proposed algorithm.
- c) Consider the following stack of characters, where STACK is allocated N=8 memory cells  
STACK: C, A, F, D, K, \_, \_, \_  
(\_ describe empty memory cell)
- Describe the stack as the following operations take place:  
a) POP(STACK, ITEM) b) POP(STACK, ITEM) c) PUSH(STACK, L) d) PUSH(STACK, P) e) POP(STACK, ITEM) f) PUSH(STACK, R) g) PUSH(STACK, S) h) POP(STACK, ITEM)
- Now Considering Initial state of STACK i) When will underflow and overflow occur? ii) When will C be deleted before A?
- b) Why do you learn sorting algorithm? Sort following data set according to selection sort algorithm and show each steps.  
DATA: 87, 43, 54, 21, 98, 32, 76, 65
- b) How do you modify/create a new algorithm based on the logic of insertion sort such that its performs better than actual one? Compare time complexity of your modified insertion sort algorithm with actual insertion sort algorithm.
- c) Apply dijkstra's algorithm to find the shortest path from node 1 to node 3. Show each steps with detailed calculation.



C A F D K  
C A F D  
C A F D K  
①

- 6 a) A binary tree T has 9 nodes. The inorder and preorder traversal of T yield the following sequence of nodes:  
Inorder: E A C K F H D B G  
Preorder: F A E K C D H G B  
Draw the tree T.
- b) What are the properties of a BST? Draw a BST using following dataset  
DATA: 60, 25, 15, 50, 33, 44, 75, 66  
Now Delete node 44, 75 and 25 considering initial state of BST and draw new shape of tree after each deletion.
- c) Why do you learn data structure? Write the pseudocode of traversing a two-dimensional array.
- d) Write shorts note on i) circular linked list ii) complete graph iii) connected Graph

A linked list whose last node points back to the first node instead of containing the null pointer, called



[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]

Answer any 5 of the following questions.

A Huffman tree is a special type of binary tree used to encode data.

- 1 a) What are the applications of Huffman Algorithm? Encode following input string using Huffman algorithm and compare the result with ASCII encoding. [2+5]

Input String: "Computer Science and Engineering"

- Consider the following graph G in Figure 1. Suppose the nodes X,Y,Z,W are stored in an array DATA as follow: [1+5+1]

DATA: X,Y,Z,W

- i) Find the adjacency matrix A of the graph G. ii) Find the path matrix P of G using warshall algorithm. iii) Is G strongly connected?



Figure 1

- 2 a) Suppose a weighted directed graph G is maintained in memory by a node array DATA and weight matrix W as follow: [1+6]

P-8.36

DATA: V1,V2,V3,V4

|    |      |
|----|------|
| V1 | 0030 |
| V2 | 5017 |
| V3 | 2004 |
| V4 | 0680 |

Draw a picture of G and traverse G using Depth First Search algorithm with pseudocode.



- 3 a) Write the steps of algorithm that will traverse a binary tree in postorder traversal using stack. Discuss the algorithm using example. [3.5+3.5]

P-7.18

- 4 a) Translate each infix expression into its equivalent postfix expression and evaluate postfix expression of question iii using stack. [4+3]

i)  $(A-B)*(D-E)$  ii)  $A*(B+D)/E-F*(G+H/K)$  iii)  $10*(7-3)-48/(1+5)+4$

$$[A-B] * [D-E] = AB - DE$$

- 5 a) What are the properties of binary search tree? Build a max heap considering following list of numbers and write the procedure of sorting these numbers in descending order using heap sort. [1+2+4]

List of numbers: 44,30,50,22,60,55,77,55

- 6 a) Define recursion with example. Write a recursive solution with algorithm steps to the Towers of Hanoi problem for 3 disks. [2+5]

P-5.27 Ex. 9.9.

- 7 a) Given an Integer K, write an algorithm which deletes the Kth element from linked list and also calculate the complexity of your proposed algorithm. [5+2]

- 8 a) What are the differences between stack and queue? Write the pseudocode of insert and delete in linear queue. State the limitation of linear queue. [2+4+1]

- 9 a) Calculate the complexity of bubble sort algorithm. Sort following list of numbers using bubble sort algorithm. [2+5]

List of numbers: 32,51,27,85,66,23,13,57

"Adjacency matrix is better than adjacency list to represent graph in memory"-Justify the statement

- 10 a) Draw a BST using following list of numbers. [3]

List of numbers: 60,25,15,50,33,44,75,66

State the rule of deletion of a node from BST and delete node 44, 75 and 25 from tree built using above list of numbers. [3+4]

- 11 a) Write short note on i) 2-tree ii) path iii) space complexity iv) time complexity

P-7.65