University of Chittagong
Department of Computer Science and Engineering
2nd Semester B.Sc. (Engg.) Examination-2019
Course Code: CSE-211 Course Title: Data Structures
Total marks: 54 Marks Time: 4.00 hours

[Answer any ***three*** questions from each of the ***Group-A*** and ***Group-B.*** Separate answer script must be used for Group-A and Group-B. Figures in the right-hand margin indicate full marks.]

Group-A

1. (a) Define data structure. Illustrate the steps of data structure. 1.5+2

   (b) Classify data structure with figure. 3

   (c) What do you mean by field, record, and file? 2.5

2. (a) Define the following terms: graphs, multigraphs, strongly connected graphs, and unilaterally connected graphs. 2

   (b) Consider the directed graph G in Fig. 2.1. (i) Find all the simple paths from X to Z. (ii) Find all the simple paths from Y to Z. (iii) Find in-deg(Y) and out-deg(Y). (iv) Are there any sources or sinks? 2

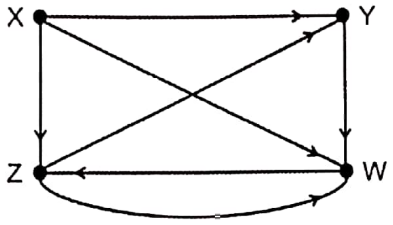


Fig. 2.1

   (c) Write down breadth-first search and depth-first search algorithms. 2.5

   (d) Consider the following graph G in Fig. 2.2. Suppose G represents the daily flights between cities of some airline, and suppose we want to fly from city A to city J with the minimum number of stops. Find out the minimum path P from A to J where each edge has length 1. 2.5

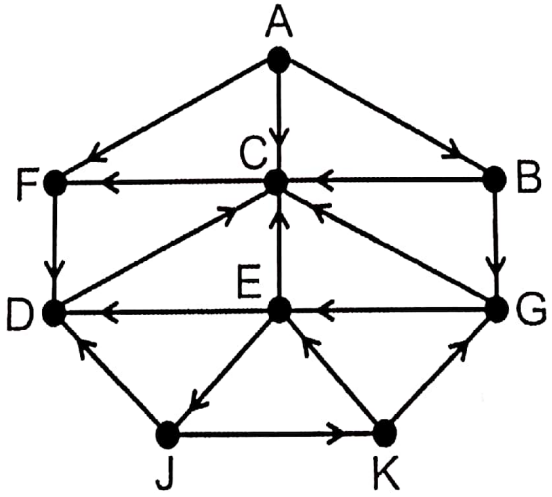


Fig. 2.2 Graph, G

3. (a) Briefly describe the notations of (i) the complexity of an algorithm and (ii) the space-time tradeoff of algorithms.

(b) Suppose a data set S contains n elements. Compare the running time T_1 of the linear search algorithm with the running time T_2 of the binary search algorithm when (i) n = 1000 and (ii) n = 10000.

(c) Write short notes on merge-sort and radix sort. Suppose 9 cards are punched as follows: 2.5

348, 143, 361, 423, 538, 128, 321, 543, 366

Arrange the 9 numbers in ascending order using the radix sort algorithm.

(d) What is hashing? Consider the following 4-digit employee number: 2.5

9614, 5882, 6713, 4409, 1825

Find the 2-digit hash address of each number using (i) Division method, with m = 97; (ii) Midsquare method; and (iii) Folding method.

4. (a) Write down the procedures to implement PUSH and POP operations in stack. Suppose a given space S of N contiguous memory cells is allocated to K = 6 stacks. Describe ways that the stacks may be maintained in S. Explain which technique is more effective to minimize overflow in stacks. 2

(b) Write short notes on Towers of Hanoi. Illustrate the solution to the Towers of Hanoi problem for n = 3. 2

(c) Write short notes on (i) Queues, (ii) Deques and (iii) Priority queues. 2.25

(d) Suppose S is the following list of 14 alphabetic characters: 1.5

D A T A S T R U C T U R E S

Suppose the characters in S are to be sorted alphabetically. Use the quicksort algorithm to find the final position of the first character D.

(e) Suppose S consists of the following n = 5 letters: 1.25

A B C D E

Find the number C of comparisons to sort S using quicksort. What general conclusion can one make, if any?

Group-B

5. (a) Define and explain the bubble sort. 3

(b) Write down the bubble sort algorithm. 3

(b) Suppose the following numbers are sorted in an array A: 3

32, 51, 27, 85, 66, 23, 13, 57

Apply the bubble sort algorithm to sort the array.

(a) Write short notes on the following terms and draw the relevant figures: 2.5
(i) Garbage collection, (ii) Header linked lists, (iii) Two-way circular header lists.

(b) Let $p(x)$ denote the following polynomial in one variable (containing four nonzero terms): 1.5

$$p(x) = 2x^8 - 5x^7 - 3x^2 + 4$$

Represent $p(x)$ using the header link list.

(c) Describe traversing a link list with necessary algorithm and example. 1.5

(d) Let LIST be a linked list in memory. Write a procedure which 1.5
(i) Finds the number NUM of times a given ITEM occurs in LIST
(ii) Finds the number NUM of nonzero elements in LIST
(iii) Adds a given value K to each element in LIST

(e) Describe deletion from a linked list with necessary example. 2

7. (a) Write down the binary search algorithm. Modify the binary search algorithm, so that it becomes a search and insertion algorithm. 3

(b) Define data items, entity, primary key, and data structure. Give a brief description of traversing, sorting, searching, deleting and inserting. 2

(c) Find 371(mod 8), -371(mod 8). What are the similarities and dissimilarities between function subalgorithms and procedure subalgorithms? Explain with necessary examples. 2

(d) The daily flights of an airline company appear in Fig 7.1. CITY lists the cities, and ORIG[K] and DEST[K] denote the cities of the origin and destination, respectively, of the flight NUMBER[K]. Draw the corresponding directed graph of the data. 2

CITY

1	Chattogram
2	Barishal
3	Dhaka
4	Khulna
5	Rajshahi

(a)

	NUMBER	ORIG	DEST
1	701	2	3
2	702	3	2
3	705	5	3
4	708	3	4
5	711	2	5
6	712	5	2
7	713	5	1
8	715	1	4
9	717	5	4
10	718	4	5

(b)

Fig. 7.1

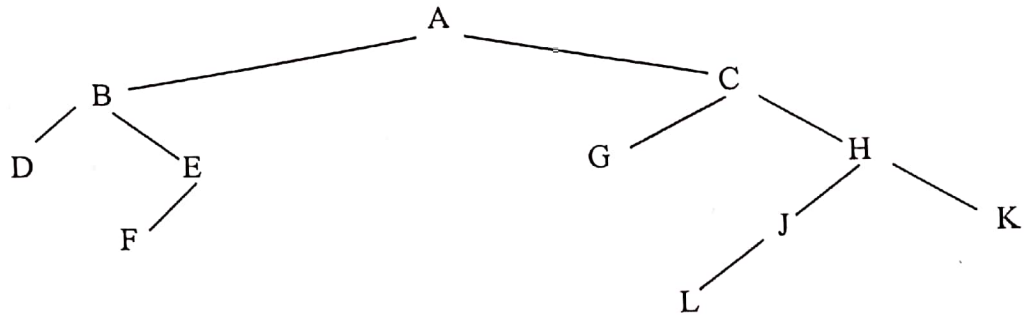
8. (a) Suppose the following eight numbers are inserted in order into an empty binary search tree T:

50, 33, 44, 22, 77, 35, 60 40

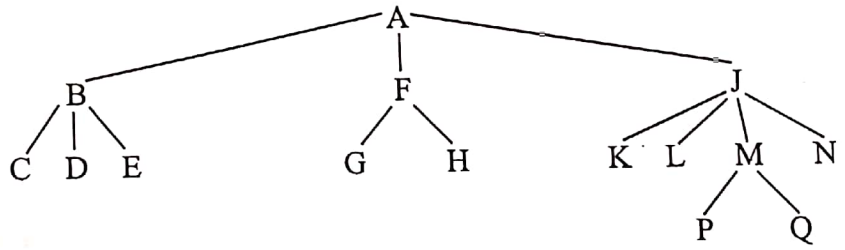
Draw the tree T.

(b) What is the divide-and-conquer algorithm? Write a recursive procedure to calculate N!. 2

(c) What is the threaded tree? Discuss inorder threading using the following binary tree T 2



(d) Compare binary tree and general tree. Consider the general tree T 3



(i) Find the corresponding binary T´.

(ii) Find the preorder, inorder and postorder traversals of T´.

University of Chittagong
Department of Computer Science and Engineering
2nd Semester B. Sc. Engineering Examination – 2018
Course Code: CSE 211 Course Title: Data Structure
Total Marks: 52.5 Time: 4:00 Hours

[Answer any *three* questions from **Group-A** and any *three* questions from **Group-B**; Separate answer script must be used for Group-A and Group-B. Figures in the right-hand margin indicate full marks.]

Group-A

1. (a) Define the following terms: multigraphs, directed graphs, and adjacency matrix. **1.5**
   (b) Consider the directed graph G in Figure 1. (i) Find all the simple paths from X to Z. (ii) Find all the simple paths from Y to Z. (iii) Find indeg(Y) and outdeg(Y). (iv) Are there any sources or sinks? **2**

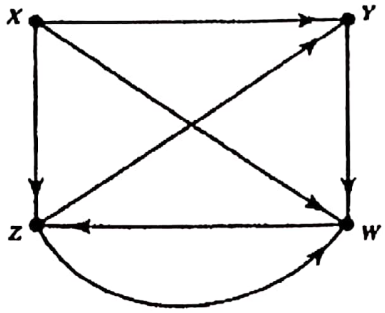


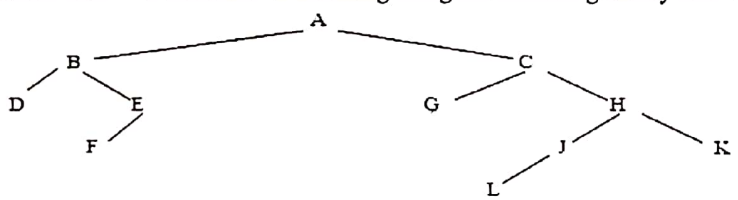
Figure 1

   (c) Consider the directed graph G in Figure 1. Suppose the nodes are stored in memory in an array DATA as follows: **2.75**
   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?
   (d) Write down the purposes of Warshall's Algorithm and Hashing. **2.5**

2. (a) Consider the linear arrays AAA(-5:45),BBB(-5:10) and CCC(18). **2**
   (i) Find the number of elements in each array.
   (ii)Suppose Base(AAA)=300 and w= 4 words per memory cell for AAA. Find the Address of AAA[15], AAA[35], and AAA[55].
   (b) Using Bubble sort algorithm, find the number of comparisons (C) and the number of interchanges (D) which alphabetize the n=6 letters in **PEOPLE**. **2**
   (c) Write down binary search algorithm. Modify the binary search algorithm, so that it becomes a search and insertion algorithm. **3**
   (d) What are the major drawbacks of Binary Search Algorithm? Suppose DATA is a Linear array, which contains 1000 elements. Using binary search algorithm, what are the maximum required comparisons to find the location of an item in DATA array? **1.75**

3. (a) Write short notes on the following terms and draw the relevant figures: **2**
   (i) Garbage Collection, (ii) Header Linked Lists, (iii) Two-Way Circular Header Lists, (iv) Overflow and Underflow.
   (b) Describe insertion into a Linked List: (i) Inserting at the beginning of a List, and (ii) Inserting after a given node. **2.5**
   (c) The following list of names is assigned (in order) to a linear array INFO: **2.25**
   Mary, June, Barbara, Paula, Diana, Audrey, Karen, Nancy, Ruth, Eileen, Sandra, Helen.
   That is, INFO[1]=Mary, INFO[2]=June,…,INFO[12]=Helen. Assign values to an array LINK and a variable START so that INFO, LINK and START form an alphabetical listing of the names.
   (d) Mention major advantages and disadvantages of array and linked list. **2**

4. (a) What is threaded tree? Discuss inorder threading using the following binary tree T **2.25**



   (b) Define: Stacks, Queues, Deques and Priority Queues. **2**
   (c) Write an algorithm to evaluate a postfix expression. **2**

(d) Suppose A is the following list of 12 numbers: 2.5

44, 33, 11, 55, 77, 90, 40, 60, 99, 22, 88, 66

Suppose the numbers in A are to be sorted in ascending order. Use the quicksort algorithm to find position of the first number 44.

Group - B

5. (a) Define big O notation. Briefly describe the notations of (i) the complexity of an algorithm and (ii) the space-time tradeoff of algorithms. 1.75

(b) Write down the Bubble Sort Algorithm. Briefly describe the complexity of Bubble Sort, Quicksort and Heapsort algorithms. 3

(c) Suppose an array A contains 8 elements as follows: 2

77, 33, 44, 11, 88, 22, 66, 55

Arrange the 8 elements of array A in ascending order using (i) Insertion Sort and (ii) Selection Sort algorithms. 2

(d) Compare bubble sort and Merge sort. 2

6. (a) Differentiate between the following operations: PUSH and POP. 2.25

(b) Translate, by inspection and hand, the following infix expression into its equivalent postfix and prefix expression:

A * (B + D) / E – F * (G + H / K) 2.5

(c) Consider the following arithmetic expression P, written in postfix notation:

P: **12, 7, 3, -, /, 2, 1, 5, +, *, +**

(i)Translate P, by inspection and hand, into its equivalent infix expression.

(ii)Evaluate the infix expression. 2

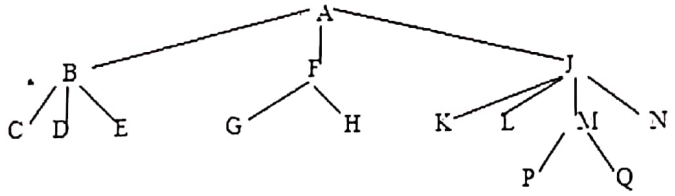
(d) Let N be an integer and suppose H(N) is recursively defined by

$$H(N)=\begin{cases} 3*N & \text{if } N<5 \\ 2*H(N-5)+7 & \text{otherwise} \end{cases}$$

(a) Find the base criteria of H, and (b) Find H(2), and H(8).

7. (a) Define: Binary trees, Complete Binary trees, and Extended Binary trees. 1.5

(b) What are the differences among the structures of Binary Search Tree, Sorted Linear Array and Linked List? Consider the general tree T. 2.25



(i) Find the corresponding binary T′.

(ii) Find the preorder, inorder and postorder traversals of T′.

(c) Write down Huffman's Algorithm. Suppose the following six weights are given 2

4, 15, 25, 5, 8, 16

Find a 2-tree T with the given weights and a minimum weighted path length P. [Hints: Use the Huffman algorithm.]

(d) The elements 32, 15, 20, 30, 12, 25, 16 are inserted one by one in the given order into a maxheap. Construct the resultant maxheap step by step. 3

8. (a) What is Data Structure? What do you understand by data structures operations? Describe Linear and Non-linear data structures. 3

(b) Find 26(mod 7), -26(mod 7). Consider the algebraic expression $(7x+y)(5a-b)^3$. Draw the corresponding tree diagram. 1.5

(c) What is subalgorithm? What are the similarities and dissimilarities between function subalgorithms and procedure subalgorithms? Explain with necessary examples. 2

(d) Suppose a linear array ID-DATA contains ID of N students. One 2nd Semester student requests to check whether his ID is in the array ID-DATA or not. Write down an algorithm to search the location of the given student's ID for informing his status. Suppose the linear array ID-DATA contains 93 elements. Find the worst-case and average-case complexity of the linear search algorithm. 2.25

University of Chittagong
Department of Computer Science & Engineering
2nd Semester B.Sc (Engg.) Examination 2017
Course No: CSE 211
Course Title: Data Structures

Full Marks: 52.5 **Time: 4 Hours**

Answer any three questions from each seaction. Figures at right margin illustrate marks.

Section-A

1. (a) Illustrate the Big-O, Big-Omega and Big-Theta notation with appropriate figures. 3

   (b) Examine the pseudo-code below. (Recall that integer division rounds down any fractional values to the nearest whole number and that % is the modulus operator which returns the remainder after doing integer division.) 2

```
Algorithm RecursiveFunction(n) // n is an integer
  if (n > 0)
   RecursiveFunction(n/2)
   PrintOut(n%2)
 Endif
```

   What is the Big-O running time of the algorithm described by that pseudo-code? Explain your answer.

   (c) Given a list of data stored in a sorted array, describe an algorithm to search the data as efficiently as possible. You may describe your algorithm in pseudo-code or C/C++ as long as your description is clear. 2

   (d) What is the average and worst case analysis of an algorithm/data structure? 1.75

2. (a) Define a Node to implement a linked list and illustrate its every member using a figure. 1

   (b) Illustrate the only pointer assignment operations with appropriate figures (assume a linked list with at least 3 nodes): 3
   Insert a data at head, insert a data after end, delete a data at 'loc'
   (N.B. 'loc' is an address of arbitrary location in a linked list)

(c) Write an algorithm for traversing a linked list.

(d) Illustrate the following two linked lists with figures: Circularly linked list, Doubly linked list

3. (a) How do you implement 2 stacks using only one array? Your stack routines should not indicate an overflow unless every slot in the array is used.

(b) What is 'overflow' and 'underflow' in case of stack?

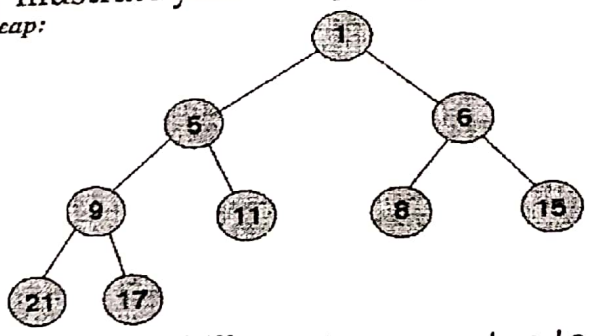
(c) Define pop() and push() function of a stack.

(d) Write an algorithm to solve the 'Tower of Hanoi' problem. Illustrate the sequence of calling the function to produce results when there are 4 discs.

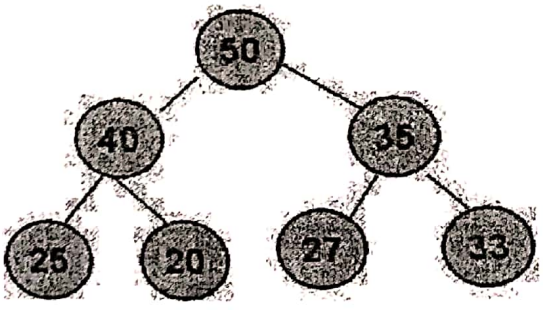
4. (a) What primary data structure do you prefer to represent a heap, array or linked list? Show a few logics in favor of your answer.

(b) Suppose, the figure below is heap. How do you insert 3 and heapify the data in the following heap? Illustrate your every step.

Heap:



(c) Consider the following heap and illustrate every step to delete the root from the heap.



(d) What is hash function? How can you handle hash-collision?

Section-B

(a) Discuss the advantages and disadvantages of the linked list and array-based implementation of a queue. 1·75

(b) What is the difference between queue and stack? 1

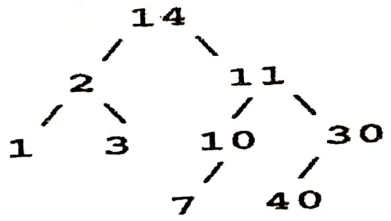
(c) Consider the following queue where QUEUE is allocated six memory cells : 3
FRONT = 2, REAR = 5 . QUEUE : ___, London , Berlin , Rome , Paris , ___
Describe the queue as the following operations take place:

i. Athens is added to the queue.
ii. Two cities are deleted.
iii. Madrid is added.
iv. Moscow is added.
v. Three cities are deleted.
vi. Oslo is added.

(d) Describe the basic functionality of queue, deque and priority queue. 3

1.25+ 1.5

(a) Here is a small binary tree:

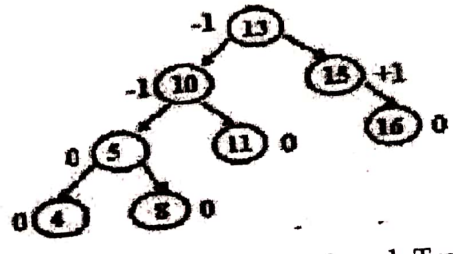


Circle all the leaves. Put a square box around the root. Draw a star around each ancestor of the node that contains 10. Put a big X through every descendant of the node contains 10.

Find the preorder, inorder, and postorder traversal of the algorithm. 2

(b) What are the steps to delete a node from a Binary Search Tree (BST)? Illustrate with an example. 1+2

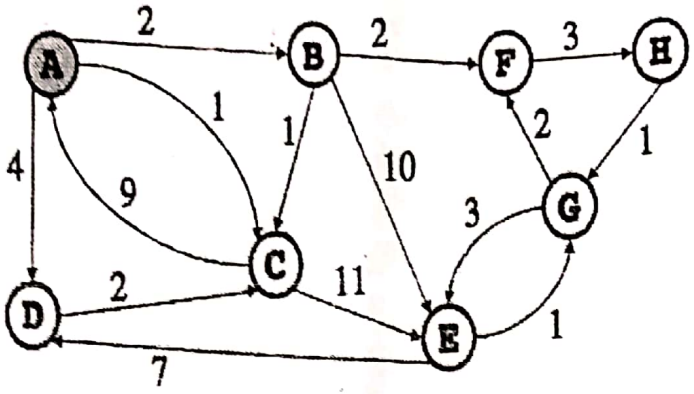
(c) You are given a tree:



What is the difference between a general Binary Search Tree (BST) and AVL tree? Insert 3 as in BST and then convert the resultant tree into AVL tree.

$\tan^{-1} x$, show that, $(1+x^2)y_2 + (2x-1)y_1 = 0$.

7. Consider the graph below and answer the following questions:



(a) Find the adjacency matrix. 1

(b) Find the adjacency list. 1

(c) Illustrate the Dijkstra algorithm to find the shortest path from node A to G of the graph. 3.75

(d) Traverse the above graph using Breadth First Search (BFS). Illustrate the steps you follow. 3

8. (a) Illustrate the procedure of any two of the following sorting algorithms on the array of the numbers {54, 26, 93, 17, 77, 31, 44, 55, 20}: 1.5*2
Insertion sort, Quick sort, Merge Sort

(b) Is there any linear time sorting algorithm? Consider that we do not have any limitation on memory usage. Illustrate with an example. 1.75

(c) See the following letter frequency table and construct a Huffman-tree. 3

Letter	Z	K	M	C	U	D	L	E
Frequency	2	7	24	32	37	42	42	120

(d) Compare complexity of heap sort with bubble sort and quick sort.