3rd Semester B.Tech. (CST) Mid-Semester Examination 2016
Data Structure and Algorithms
CS – 302

F. M. = 50   Time – 2 hrs.

Answer all questions

1. Write answer for the following questions. Justify your answer wherever applicable.

i) Let P be a singly linked list. Let Q be the pointer to an intermediate node x in the list. What is the worst-case time complexity of the best known algorithm to delete the node x from the list?

(A) O(N)   (B) O(N^2)   (C) O(log$_2$N)   (D) O(log(log$_2$N))

ii) The initial configuration of a queue is a,b,c,d ('a' is in the front end). How many minimum number of deletions and insertions are required to get the configuration d,c,b,a ?

iii) What are the time complexities of finding 8th element from beginning and 8th element from end in a singly linked list? Let n (> 8) be the number of nodes in linked list.
(A) O(1) and O(n)   (B) O(1) and O(1)   (C) O(n) and O(1)   (D) O(n) and O(n)

iv) What is the postfix equivalent of the prefix expression * + a b – c d ?

v) Which of the following points is/are true about Linked List data structure when it is compared with array?

(A) It is easy to insert and delete elements in Linked List
(B) Random access is not allowed in a typical implementation of Linked Lists
(C) The size of array has to be pre-decided, linked lists can change their size any time
(D) All of the above

vi) The running time of an algorithm is given by
            T(n) = T(n-1) + T(n-2) - T(n-3)   if n > 3
            = n otherwise
The order of this algorithm is

A) n   B) log$_2$ (n)   C) n^n D) n^2

vii) To evaluate an expression without any embedded function calls:

(A) One stack is needed
(B) Two stacks are needed
(C) Three stacks are needed
(D) None of the above

viii) Arrange the following complexity in ascending order

A) nlog$_2$(n)   B) n+n^2 +n^3 C) 2^4 D) n$^{1/2}$

ix) The following postfix expression with single digit operands is evaluated using a stack:
    8 2 3 ^ / 2 3 * + 5 1 * - (^ is the exponentiation operator)

The top two elements of the stack after the first * is evaluated are:
(A) 6,1   (B) 5,7   (C) 3,2 (D) 1,5

1

x) Do you consider queue as a priority queue? Justify your answer.

xi) What is the worst case complexity of linear search and interpolation search?

xii) Which of the following is true about linked list implementation of stack?

(A) In push operation, if new nodes are inserted at the beginning of linked list, then in pop operation, nodes must be removed from end.

(B) In push operation, if new nodes are inserted at the end, then in pop operation, nodes must be removed from the beginning.

(C) Both of the above

(D) None of the above

xiii) Name one possible additional information that can be stored in head node of a stack.

xiv) What is the worst case time complexity of bubble sort? $\rightarrow n^2$

xv) Suppose a queue is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = -1. What are the conditions to detect queue full and queue empty ?

2. i) Convert the following infix expression into postfix expression   [15x2]

A $ B * C- D +E / F where A $ B $\rightarrow A^B$

ii) Write pseudocode for converting infix to postfix expression using stack. Assume that there is no parenthesis in infix expression.

iii) Show all the intermediate values in stack for the evaluation in tabular form.

$+$ uul   [5+10+5]

$F = \partial_\infty + 1$

$f = 0 \, 8 \, 8 \, \partial = n - 1$

$f = \partial - 1$ (empty)

Data Structure and Algorithms (CS – 302)

F. M. = 70

Time – 3 hrs.

Answer Question 1 and any two from the rest.

1. Write answer for the following questions. Justify your answer.

a) Which of the following is not true about comparison based sorting algorithms?

   i) The minimum possible time complexity of a comparison based sorting algorithm is O(nLogn) for a random input array

   ii) Any comparison based sorting algorithm can be made stable by using position as a criteria when two elements are compared

   iii) Radix Sort is not a comparison based sorting algorithm

   iv) Heap Sort is not a comparison based sorting algorithm

b) Suppose we are sorting an array of eight integers using quicksort, and we have just finished the first partitioning with the array looking like this: 2 5 1 7 9 12 11 10; which statement is correct?

   i) The pivot could be either the 7 or the 9

   ii) The pivot could be the 7, but it is not the 9

   iii) The pivot is not the 7, but it could be the 9

   iv) Neither the 7 nor the 9 is the pivot

c) What is the best time complexity of bubble sort?

   i) $O(N^2)$ ii) O(NlogN)   iii) O(N)   iv) $O(N(logN)^2)$

d) You have to sort 1 GB of data with only 100 MB of available main memory. Which sorting technique will be most appropriate?

   i) Heap sort   ii) Merge sort   iii) Quick sort   iv) Insertion sort

e) What is the maximum number of edges an undirected graph with n vertices may have?

   i) n   ii) 2n   iii) n^2 iv) n(n-1)/2

f) Given an undirected graph G with V vertices and E edges, the sum of the degrees of all vertices is

   i) E   ii) 2E   iii) V   iv) 2V

g) What is the worst case time complexity for search, insert and delete operations in a general Binary Search Tree?

   i) O(n) for all   ii) O(Logn) for all   iii) O(Logn) for search and insert, and O(n) for delete

   iv) O(Logn) for search, and O(n) for insert and delete

h) Which of the following traversal outputs the data in sorted order in a BST?

   i) Post order   ii) Preorder   iii) Inorder

i) Consider a binary max-heap implemented using an array. Which one of the following array represents a binary max-heap?

   i) 25,12,16,13,10,8,14   ii) 25,14,16,13,10,8,12   iii) 25,14,12,13,10,8,16

j) Which of the following is a true about Binary Trees?
   i) Every binary tree is either complete or full
   ii) Every complete binary tree is also a full binary tree
   iii) Every full binary tree is also a complete binary tree
   iv) None of the above

k) Considering level of root is 1, what is the maximum number of nodes on level i of a binary tree ?

   i) 2^{i-1} ii) 2^i iii) 2^{i+1} iv) $2^{((i+1)/2)}$

l) In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is
   i) $\log_2 n$ ii) n/2   iii) $\log_2 n$ -1   iv) n

m) The following postfix expression with single digit operands is evaluated using a stack:

   8 2 3 ^ / 2 3 * + 5 1 * -

   Note that ^ is the exponentiation operator. The top two elements of the stack after the first * is evaluated are:
   i) 6,1   ii) 5,7   iii) 3,2   iv) 1,5

n) The initial configuration of a queue is w,x,y,z ('w' is in the front end). How many minimum number of deletions and insertions are required to get the configuration z,y,x,w ?
   i) 3,3   ii) 4,2   iii) 2,4   iv) 1,5

o) Which of the following sorting algorithms has the lowest worst-case complexity?
   i. Merge Sort   ii. Bubble Sort   iii. Quick Sort   iv. Insertion Sort

   $n \log n$ n^2 $O(n^2)$ n [15x2]

2. a) At what stage of problem solving is the ADT used? What are the other stages of problem solving?
   b) In which way recursive function call is different from iterative function call? Explain the differences citing one example.
   [5+15]

3. a) Do a comparative study on linear linked list, circular linked list and doubly linked list.
   b) Write the following functions (pseudocode) for doubly linked list:
      i)   insert right (for inserting a node at right)
      ii) delete left (for deleting a node from left)

   [10+(5+5)]

4. a) Define connected graph and disjoint graph. Give example of each of them.

   b) Write pseudocode for Dijkestra single source shortest path problem. Explain its usage and how it works.
   [10+10]

5. Write short notes on the following:
   a) AVL Tree
   b) Heap Sort
   [10+10]