Data Structures & Algorithms

Q.1 Let A be a two dimensional array declared as follows: **[GATE 1998]**

A: array [1...10] [1...15] of integer;

Assuming that each integer takes one memory location, the array is stored in row-major order and the first element of the array is stored at location 100, what is the address of the element A[i][j]?

(A) 15i+j+84 (B) 15j+i+84 (C) 10i+j+89 (D) 10j+i+89

Q.2 Consider the following declaration of a two-dimensional array in C:

char a[100][100];

Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a[40][50] is: **[GATE 2002]**

(A) 4040 (B) 4050 (C) 5040 (D) 5050

Q.3 In a compact one dimensional array representation for lower triangular matrix (all elements above diagonal are zero) of size n x n, non zero elements of each row are stored one after another, starting from first row, the index of $(i,j)^{th}$ element in this new representation is

(A) i+j (B) (j-1)+(i(i-1)/2) (C) i+j-1 (D) i+(j(j-1)/2)

[GATE 1994]

Q.4 An n x n array v is defined as follows:

v[i, j] = i-j for all i, j, 1 <= i <= n, 1 <= j <= n

The sum of the elements of the array v is

(A) 0 (B) n-1 (C) $n^2 - 3n + 2$ (D) $n^2 (n+1)/2$

[GATE 2000]

Q.5 What does the following function do for a given Linked List with first node as head?

```
void fun1(struct node* head)
{
  if(head == NULL)
  return;
  fun1(head->next);
  printf("%d  ", head->data);
```

}

(A) Prints all nodes of linked lists

(B) Prints all nodes of linked list in reverse order

(C) Prints alternate nodes of Linked List

(D) Prints alternate nodes in reverse order

Q.6 Which of the following points is/are true about Linked List data structure when it is compared with array

(A) Arrays have better cache locality that can make them better in terms of performance.

(B) It is easy to insert and delete elements in Linked List

(C) Random access is not allowed in a typical implementation of Linked Lists

(D) The size of array has to be pre-decided, linked lists can change their size any time.

Q.7 What is the output of following function for start pointing to first node of following linked list? 1->2->3->4->5->6

```
void fun(struct node* start)
{
 if(start == NULL)
  return;
 printf("%d  ", start->data);

 if(start->next != NULL )
  fun(start->next->next);
 printf("%d  ", start->data);
}
```

(A) 1 4 6 6 4 1

(B) 1 3 5 1 3 5

(C) 1 2 3 5

(D) 1 3 5 5 3 1

Q.8 What is the worst case time complexity of inserting n elements into an empty linked list, if the linked list needs to be maintained in sorted order ?

(A) $\Theta(n)$

(B) $\Theta(n \log n)$

(C) $\Theta(n^2)$

(D) $\Theta(1)$

(n-1) element

Total Sum = $1+2+\cdots+(n-1) = \frac{n((n-1)+1)}{2} \cong \frac{n^2}{2}$

[GATE 2020]

Q.9 The following C function takes a single-linked list of integers as a parameter and rearranges the elements of the list. The function is called with the list containing the integers 1, 2, 3, 4, 5, 6, 7 in the given order. What will be the contents of the list after the function completes execution?

```
struct node
```

```
{
 int value;
 struct node *next;
};
void rearrange(struct node *list)
{
 struct node *p, * q;
 int temp;
 if ((!list) || !list->next)
    return;
 p = list;
 q = list->next;
 while(q)
 {
   temp = p->value;
   p->value = q->value;
   q->value = temp;
   p = q->next;
   q = p?p->next:0;
 }
}
```

(A) 1,2,3,4,5,6,7
(B) 2,1,4,3,6,5,7
(C) 1,3,2,5,4,7,6
(D) 2,3,4,5,6,7,1

[GATE 2008]

Q.10 In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is:

(A) $\log_2 n$ (B) n/2 (C) $\log_2 n - 1$ (D) n

[GATE 2002]

Q.11 Consider the function f defined below.

```
struct item
{
 int data;
 struct item * next;
};

int f(struct item *p)
```

```
{
return (
        (p == NULL) ||
        (p->next == NULL) ||
        (( P->data <= p->next->data) && f(p->next))
       );
}
```

For a given linked list p, the function f returns 1 if and only if

(A) not all elements in the list have the same data value.

(B) the elements in the list are sorted in non-decreasing order of data value

(C) the elements in the list are sorted in non-increasing order of data value

(D) None of them **[GATE 2003]**

Q.12 What are the time complexities of finding 10th element from beginning and 10th element from end in a singly linked list? Let n be the number of nodes in linked list, you may assume that n > 10.

(A) O(1) and O(n)

(B) O(1) and O(1)

(C) O(n) and O(1)

(D) O(n) and O(n)

Q.13 You are given pointers to first and last nodes of a singly linked list, which of the following operations are dependent on the length of the linked list?

(A) Delete the first element

(B) Insert a new element as a first element

(C) Delete the last element of the list

(D) Add a new element at the end of the list

Q.14 What is the minimum number of stacks of size n required to implement a queue of size n?

(A) One (B) Two (C) Three (D) Four

[GATE 2001]

Q.15 Consider the following operation along with Enqueue and Dequeue operations on queues, where k is a global parameter.

```
MultiDequeue(Q){
m = k
while (Q is not empty and m  > 0) {
Dequeue(Q)
m = m - 1
   }
}
```

What is the worst case time complexity of a sequence of n MultiDequeue() operations on an initially empty queue? **[GATE 2013]**

(A) $\Theta(n)$ (B) $\Theta(n+k)$ (C) $\Theta(nk)$ (D) $\Theta(n^2)$

Q.16 Which of the following permutations can be obtained in the output (in the same order) using a stack assuming that the input is the sequence 1, 2, 3, 4, 5 in that order?

(A) 3, 4, 5, 1, 2 (B) 3, 4, 5, 2, 1 (C) 1, 5, 2, 3, 4 (D) 5, 4, 3, 1, 2

[GATE 1994]

Q.17 Let S be a stack of size $n \geq 1$. Starting with the empty stack, suppose we push the first n natural numbers in sequence, and then perform n pop operations. Assume that Push and pop operation take X seconds each, and Y seconds elapse between the end of one such stack operation and the start of the next operation. For $m \geq 1$, define the stack-life of m as the time elapsed from the end of Push(m) to the start of the pop operation that removes m from S. The average stack-life of an element of this stack is

(A) n (X + Y) (B) 3Y + 2X (C) n (X + Y) – X (D) Y + 2X

[GATE 2003]

Q.18 Assume that the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x , +, -. The postfix expression corresponding to the infix expression a + b × c – d ^ e ^ f is

(A) abc × + def ^ ^ – (B) abc × + de ^ f ^ –

(C) ab + c × d – e ^ f ^ (D) – + a × bc ^ ^ def

[GATE 2004, ISRO - 2009]

Q.19 The result evaluating the postfix expression 10 5 + 60 6 / * 8 – is

(A) 284 (B) 213 (C) 142 (D) 71

[GATE 2015]

Q.20 A binary search tree is used to locate the number 43. Which of the following probe sequences are possible and which are not? Explain

(A) 61 52 14 17 40 43

(B) 2 3 50 40 60 43

(C) 10 65 31 48 37 43

(D) 81 61 52 14 41 43

(E) 17 77 27 66 18 43

[GATE 1996]

Q.21 Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in that order into an initially empty binary search tree. The binary search tree uses the usual ordering on natural numbers. What is the in-order traversal sequence of the resultant tree?

(A) 7 5 1 0 3 2 4 6 8 9 (B) 0 2 4 3 1 6 5 9 8 7

(C) 0 1 2 3 4 5 6 7 8 9 (D) 9 8 6 4 2 3 0 1 5 7

[GATE 2003, ISRO 2009]

Q.22 Let T(n) be the number of different binary search trees on n distinct elements.

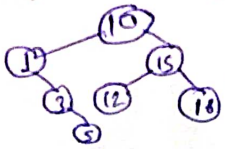
Then $T(n) = \sum_{k=1}^{n} T(k-1)T(x)$, where x is

(A) n-k+1 (B) n-k (C) n-k-1 (D) n-k-2

[GATE 2003]

Q.23 The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?

(A) 2 (B) 3 (C) 4 (D) 6



[GATE 2004]

Q.24 The numbers 1, 2, ... n are inserted in a binary search tree in some order. In the resulting tree, the right subtree of the root contains p nodes. The first number to be inserted in the tree must be

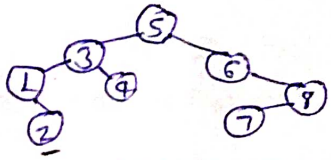
(A) p (B) p + 1 (C) n – p (D) n – p + 1

[GATE 2005]

Q.25 A binary search tree contains the numbers 1, 2, 3, 4, 5, 6, 7, 8. When the tree is traversed in pre-order and the values in each node printed out, the sequence of values obtained is 5, 3, 1, 2, 4, 6, 8, 7. If the tree is traversed in post-order, the sequence obtained would be

(A) 8, 7, 6, 5, 4, 3, 2, 1 (B) 1, 2, 3, 4, 8, 7, 6, 5

(C) 2, 1, 4, 3, 6, 7, 8, 5 (D) 2, 1, 4, 3, 7, 8, 6, 5



[GATE 2005]