ਸੰਤ ਲੌਂਗੋਵਾਲ ਇੰਸਟੀਚਿਊਟ ਆਫ਼ ਇੰਜੀਨੀਅਰਿੰਗ ਐਂਡ ਟੈਕਨਾਲੋਜੀ
संत लौंगोवाल अभियांत्रिकी एवं प्रौद्योगिकी संस्थान
Sant Longowal Institute of Engineering and Technology
(Deemed-to-be-University, under Ministry of Education, Govt. of India)

Question Bank

Data Structure CS 2015

Course Material for Data Structure

Subject Code: CS215

Class: ICD III Semester

DEPARTMENT
OF
COMPUTER SCIENCE AND ENGINEERING

1. What is a data structure? Explain its various types and discuss its significance in computer science.
2. Define Abstract Data Types (ADTs) and elaborate on their role in structuring data.
3. Given a sorted array of n numbers, describe an O(n) algorithm that determines if two distinct elements exist in the array whose sum equals a given x. Provide a detailed explanation of how the algorithm works.
4. Determine the space complexity of the following code segment. Justify your answer.

```
sum=0;

for(i=1; i<=n; i++)        n
    for(j=1; j<=n; j*=4)   logn at base 4
        sum+=1;
    int *arr;
    arr=new int[sum];      space nlogn at base 4
```

5. Transform each postfix expression to infix (using operand stacks).

   (i) AB+C-

   (ii) ABC+-

   (iii) AB-C+DEF-+$

   (iv) ABCDE-+$*EF*-

   (v) AB+C*DE--FG+$

6. Sachin has a 26-node binary tree, each node labeled by a unique alphabet letter.

   The preorder and postorder sequences of nodes are as follows:

   preorder: M N H C R S K W T G D X I Y A J P O E Z V B U L Q F

   postorder: C W T K S G R H D N A O E P J Y Z I B Q L F U V X M

   Draw Sachin's binary tree.

7. Draw the binary trees and evaluate the postfix and prefix expressions for the following infix expression.

   (i) a*b+(c/d-e)$l-m%n-r+s*t/x

(ii) z+y*x-(c$d/e*f-g)+l*r$g

8. Is every Complete Binary tree a full binary tree? Why or Why not?

9. Find the priority Queue using Max heap for the following elements stored in an array/linked list.

   17, 52, 8, 23, 234, 67, 87, 92, 30, 98, 127, 72, 48, 7, 23, 56, 83

10. Start with an AVL search tree and insert the following keys in the given order: 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Draw figures depicting your tree immediately after each insertion and following the rebalancing rotation (if any). Label all nodes with their balance factors and identify the rotation type (if any) done.

11. Describe an efficient method to merge two balanced binary search trees with n elements each into a balanced BST. Give it running time.

12. What would be the address of A[-3] if the base address of the array **A[-10,-4]** is **1000?** Consider an element that takes **2** bytes to be stored**.**

13. Write the output of the following program.

```c
#include <stdio.h>

int main() {

    int a[]={5,1,15,20,25};
    int i,j,m;
    i=++a[1];
    j=a[1]++;
    m=a[i++];
    printf("%d, %d, %d", i, j, m);

    return 0;
}
```

14. If an array **SLIET[3][5][4]** is a 3-D array having a base address **1000**, then what would be the address of **SLIET[1][2][3]** in **row-major** memory allocation of the array in the 32-bit system**?**

15. CSE[20][50], if the location of CSE[10][25] is stored at the address **10000.**An array **CSE[50][100]** is stored along the row's memory, with each element occupying 2 bytes. Find out the base address of the location.

16. Show the m**erge-sort** process on the following data. **5,7,6,1,0,9,2,10,55,11,25,6.** Also, discuss its **time complexity.**

17.

a. Explain and write the output of the following program.

```
#include <stdio.h>
int main() {
   int arr[5] = {10, 20, 30, 40, 50};
   int (*ptr)[5] = &arr;
   printf("%d\n", *pts[4]);
   printf("%d\n", *(*ptr + 1));
   printf("%d\n", *(*ptr + 3));
   printf("%d\n", *(*ptr + 4));
   printf("%d\n", *ptr[2]);
   return 0;}
```

b.

```
#include <stdio.h>
void increment(int *x) {

   (*x)++;
}
int main() {
   int a = 10;
   increment(&a);
   printf("%d\n", a);
   return 0;}
```

18. int **arr[-2:1][0:2] =** {{2, 3, 1}, {19, 12, 7}, {10, 9, 8}, {3, 11, 5}};

What would be the value of **arr[0][0].**

19. Find the expression **4*(10 + 10) / 2** ↑2 output**.**

20. Given that the front and rear pointers of a **queue Q** initially start at positions 2 and 3, respectively, what will be their values after **enqueuing** 3 and 5 into the queue and then dequeuing **twice**?

21. Using **stack,** find the postfix form of the following prefix expression (+ / *** 2 * 5 +3, 6, 5,2)**

22. Write a **C program/Pseudo code** to insert an element at a specified position in a **linked list**.

23. What are the benefits/needs of a **Circular Queue?**

24.

A **warehouse automation system** uses a **stack** (for last-in-first-out tasks) and a **queue** (for first-in-first-out tasks). The system processes these operations in sequence:

1. Enqueue tasks A and B into the task queue.
2. Perform task A from the queue and push it onto the undo stack.
3. Enqueue tasks C and D into the task queue.
4. Undo task A (pop it from the stack and Enqueue it back into the queue).
5. Perform task B in the queue.

Answer the following questions.

a. **What are the final contents of the stack (undo operations)?**
b. **What are the final contents of the queue (pending tasks)?**

25. Compare the time complexities of Quick Sort and Merge Sort in the best, worst, and average cases. Explain how the choice of pivot in Quick Sort affects its performance.

Multiple Choice Questions (60)

1. Which of the following data structures allows insertion and deletion from both ends?
    a. a) Queue
    b. b) Deque
    c. c) Stack
    d. d) Array
2. What is the time complexity of searching in a balanced binary search tree?
    a. a) O(n)
    b. b) O(log n)
    c. c) O(1)
    d. d) O(n log n)
3. Which data structure is used in implementing recursion?
    a. a) Queue
    b. b) Stack
    c. c) Linked List
    d. d) Tree
4. In which traversal method is each node processed before any of its children?
    a. a) In-order
    b. b) Pre-order
    c. c) Post-order
    d. d) Level-order
5. A queue follows which of the following principles?
    a. a) LIFO
    b. b) FIFO
    c. c) FILO
    d. d) LILO
6. Which sorting algorithm is the fastest in the average case?
    a. a) Bubble Sort
    b. b) Quick Sort
    c. c) Insertion Sort
    d. d) Selection Sort
7. Which of the following is not a type of linked list?
    a. a) Singly Linked List
    b. b) Doubly Linked List
    c. c) Circular Linked List
    d. d) Triple Linked List
8. The time complexity of inserting an element in an AVL tree is:
    a. a) O(n)
    b. b) O(log n)

    c. c) O(1)
    d. d) O(n log n)
9. Which of the following data structures is used for Breadth-First Search in a graph?
    a. a) Stack
    b. b) Queue
    c. c) Array
    d. d) Linked List
10. A hash function is used to:
    a. a) Find the largest element
    b. b) Convert a string into a numeric key
    c. c) Sort data
    d. d) Traverse a tree
11. Which data structure uses nodes with a "left" and "right" pointer?
    a. a) Stack
    b. b) Queue
    c. c) Binary Tree
    d. d) Array
12. What is the space complexity of a queue using an array of size n?
    a. a) O(1)
    b. b) O(n)
    c. c) O(log n)
    d. d) O(n^2)
13. The time complexity of bubble sort in the worst case is:
    a. a) O(n)
    b. b) O(n^2)
    c. c) O(log n)
    d. d) O(n log n)
14. In a stack, which operation is used to remove an element?
    a. a) Pop
    b. b) Push
    c. c) Peek
    d. d) Enqueue
15. What is a graph with no cycles called?
    a. a) Cyclic Graph
    b. b) Acyclic Graph
    c. c) Weighted Graph
    d. d) Complete Graph
16. The time complexity of the binary search is:
    a. a) O(n)
    b. b) O(log n)
    c. c) O(1)
    d. d) O(n^2)
17. Which of the following is an application of a stack?
    a. a) CPU Scheduling

b. b) Function Call Management
c. c) Spooling
d. d) Disk Scheduling

18. How many children can a binary tree node have?
    a. a) 1
    b. b) 2
    c. c) 3
    d. d) Unlimited

19. Which data structure is used in depth-first search?

a) Queue

b) Stack

c) Tree

d) Graph

19. A circular queue is better than a linear queue because:

a) It saves space

b) It is easier to implement

c) It uses less memory

d) It is faster

20. Which traversal method processes all nodes at the same level before moving to the next level?

a) Pre-order

b) In-order

c) Post-order

d) Level-order

21. Which of the following is the best time complexity of the merge sort algorithm?

a) O(n^2)

b) O(n log n)

c) O(log n)

d) O(n)

22. The data structure used to implement a LRU cache is:

a) Stack

b) Queue

c) Hash Map with Doubly Linked List

d) Priority Queue

23. Which of the following is true for a max heap?

a) The largest element is at the root

b) The smallest element is at the root

c) The tree is balanced

d) It is a type of binary search tree

24. Which data structures allow insertion, deletion, and search in O(1) time?

a) Stack

b) Hash Table

c) Array

d) Linked List

25. In a linked list, the last node points to:

a) The first node

b) NULL

c) The head node

d) Itself

26. What is the best way to store a large number of sorted elements?

a) Stack

b) Heap

c) Binary Search Tree

d) Hash Table

27. Which of the following is a self-balancing binary search tree?

a) AVL Tree

b) Binary Tree

c) Red-Black Tree

d) Both a and c

28. The operation of deleting an element from a queue is called:

a) Pop

b) Dequeue

c) Push

d) Insert

29. A graph with all nodes having equal indegree and outdegree is called:

a) Complete graph

b) Bipartite graph

c) Eulerian graph

d) Directed graph

30. Which of the following can be used to represent a sparse matrix?

a) 2D Array

b) Linked List

c) Adjacency List

d) Adjacency Matrix

31. Which sorting algorithm is best for small arrays?

a) Quick Sort

b) Bubble Sort

c) Insertion Sort

d) Merge Sort

31. Which data structure is used to convert an infix expression to a postfix expression?

a) Queue

b) Stack

c) Array

d) Tree

32. In an adjacency matrix representation of a graph, if there are n nodes, the matrix size will be:

a) n x n

b) n^2

c) n x 2

d) 2 x n

33. Which of the following data structures is suitable for implementing Dijkstra's algorithm?

a) Stack

b) Priority Queue

c) Binary Search Tree

d) Hash Table

34. Which of the following is not a balanced tree?

a) AVL Tree

b) Red-Black Tree

c) B-Tree

d) Binary Search Tree

35. The height of a complete binary tree is:

a) O(log n)

b) O(n)

c) O(1)

d) O(n log n)

36. What is the complexity of searching in a hash table with proper collision handling?

a) O(n)

b) O(log n)

c) O(1)

d) O(n log n)

37. Which of the following is a linear data structure?

a) Stack

b) Tree

c) Graph

d) Hash Table

38. Which of the following data structures can be used to perform level order traversal of a binary tree?

a) Stack

b) Queue

c) Array

d) Linked List

39. In a doubly linked list, each node contains:

a) Only data

b) Data and one pointer

c) Data and two pointers

d) Data and three pointers

40. Which of the following is true for a binary search tree?

    a) The left child is always smaller than its parent

    b) The right child is always larger than its parent

    c) Both a and b

    d) None of the above

41. Which data structure is used for implementing a function call in a computer program?

    a) Stack

    b) Queue

    c) Linked List

    d) Hash Table

42. Which of the following is used to represent the adjacency list in a graph?

    a) Array

    b) Linked List

    c) Hash Table

    d) Tree

43. Which data structure is used in the implementation of depth-first search?

    a) Queue

    b) Stack

    c) Array

    d) Binary Tree

44. A binary tree with n nodes has a minimum height of:

    a) log2(n)

    b) n

    c) n/2

d) n^2

45. Which of the following is an example of a non-linear data structure?

a) Array

b) Stack

c) Linked List

d) Graph

46. Which of the following data structures supports efficient range queries?

a) Segment Tree

b) Binary Tree

c) Linked List

d) Stack

47. A min-heap can be used to implement:

a) Queue

b) Stack

c) Priority Queue

d) Deque

48. Which data structure is best for implementing an undo feature in text editors?

a) Queue

b) Stack

c) Tree

d) Linked List

49. What is the degree of a node in a tree?

a) The number of edges connected to it

b) The number of children it has

c) The depth of the node

d) The height of the node

50. Which of the following is a non-comparison-based sorting algorithm?

a) Quick Sort

b) Merge Sort

c) Bubble Sort

d) Radix Sort

51. What is the maximum number of children a node can have in a binary tree?

a) 1

b) 2

c) 3

d) Unlimited

52. Which data structure is used to store a list of items with frequent deletions from the front?

a) Queue

b) Stack

c) Doubly Linked List

d) Array

53. What is the height of a tree with only one node?

a) 0

b) 1

c) 2

d) Depends on the type of tree

54. Which data structure is used in the implementation of breadth-first search?

a) Stack

b) Queue

c) Tree

d) Graph

55. Which of the following data structures does not store elements in a sorted manner?

a) AVL Tree

b) Red-Black Tree

c) Hash Table

d) Binary Search Tree

56. Which of the following operations is not possible in O(1) time in a dynamic array?

a) Access

b) Insert at end

c) Delete at end

d) Insert at a given index

57. What is the time complexity of deleting a node in a doubly linked list?

a) O(n)

b) O(log n)

c) O(1)

d) O(n^2)

58. What is a data structure?
a) A programming language
b) A collection of algorithms
c) A way to store and organize data
d) A type of computer hardware

59. Which of the following is not the application of stack?
a) Data Transfer between two asynchronous process
b) Compiler Syntax Analyzer
c) Tracking of local variables at run time
d) A parentheses balancing program

60. Which of the following statement(s) about stack data structure is/are NOT correct?

a) Top of the Stack always contain the new node

b) Stack is the FIFO data structure

c) Null link is present in the last node at the bottom of the stack

d) Linked List are used for implementing Stacks