

NOORUL ISLAM COLLEGE OF ENGINEERING, KUMARACOIL
Computer Science and Engineering

Third Semester
CS1151 - DATA STRUCTURES

UNIT-I – PROBLEM SOLVING

PART -A

1. Write down the definition of data structures?

A data structure is a mathematical or logical way of organizing data in the memory that consider not only the items stored but also the relationship to each other and also it is characterized by accessing functions.

2. Give few examples for data structures?

Stacks, Queue, Linked list, Trees, graphs

3. Define Algorithm?

Algorithm is a solution to a problem independent of programming language. It consist of set of finite steps which, when carried out for a given set of inputs, produce the corresponding output and terminate in a finite time.

4. What are the features of an efficient algorithm?

Free of ambiguity
Efficient in execution time
Concise and compact
Completeness
Definiteness
Finiteness

5. List down any four applications of data structures?

Compiler design
Operating System
Database Management system
Network analysis

6. What is divide and conquer?

Given a function to compute on 'n' inputs the divide and conquer strategy suggests splitting the n inputs into k subsets yielding k subproblems. These sub problems are solved independently and then a solution must be found to combine the sub solutions into a solution of the whole:

7. State the importance of dynamic programming

Instead, a mathematical way of thinking about it is to look at what you should do at the end, if you get to that stage. So you think about the best decision with the last potential partner (which you must choose) and then the last but one and so on. This way of tackling the problem backwards is Dynamic programming.

8. Define storage structure?

The representation of a particular data structure in the memory of a computer is called a storage structure.

9. Define file structure?

A storage structure representation in auxiliary memory of the computer is known as file structure.

10. What are the four major parts in an iterative process?

- 1) Initialization
- 2) Decision
- 3) Computation
- 4) Update

11. Write down the algorithm for solving Towers of Hanoi problem?

1. Push parameters and return address on stack.
2. If the stopping value has been reached then pop the stack to return to previous level else move all except the final disc from starting to intermediate needle.
3. Move final discs from start to destination needle.
4. Move remaining discs from intermediate to destination needle.
5. Return to previous level by popping stack.

12. What are the different types of data structures?

- i) Primitive data structure
- ii) Non primitive data structure.

13. What do you mean by primitive data structure?

Primitive data structure is concerned with structuring of data at their most primitive level within a computer, that is the data structures are directly operated upon by machine-level instructions

eg) Integers, real number, characters

14. What are the three stages of problem solving aspect.

- i) Selection of an appropriate mathematical model
- ii) Formulation of algorithms based on the choice made in stage I
- iii) The design of storage structures for the data structure.

15. Define depth of recursion?

Depth of recursion means the number of times, the recursive procedure call itself.

16. What is searching?

Searching is a process of finding a record in the table according to the given key value. Searching is extensively used in data processing.

17. What is Linear search?

Linear search scans each entry in the table in a sequential manner until the desired record is found. Efficiency: $O(n)$

18. Define Space Complexity

The Space complexity of an algorithm is the amount of memory it needs to run to completion

19. Define Time Complexity

Time complexity of an algorithm is the amount of computer time it needs to run to completion

20. What are asymptotic notations?

The notations that enable us to make meaningful statements about the time and space complexity of a program are called asymptotic notations.

21. What is information?

Information is a recorded or communicated material that has some meaning associated with symbolic representation.

22. Define Recursion?

Recursion is a function calling itself again and again.

23. What is a Fibonacci sequence?

Fibonacci sequence is the number of integers

0, 1, 1, 2, 3, 5, 8, 13, 21, 34,

Each element in this sequence is the sum of the two preceding elements.

PART - B

24. Explain the types of analysis that can be performed on an algorithm?

- Correctness analysis
- Rate of growth
- Time analysis
- Order analysis
- Space analysis
- Example

25.i) Design an algorithm to reverse the linked list. Trace it with an example?

ii) Define an efficient representation of two stacks in a given area of memory with n words and explain.

i) algorithm

- Define a stack and queue
- Delete elements from queue and add it to stack
- Pop elements from stack
- Example and trace

ii)

- figure
- push operation pop operation advantages

26. Explain the process of problem solving?
- Problem definition phase
 - Getting started with problem
 - The use of examples
 - Simulation among problems
 - Working backwards from solution
 - Problem solving techniques
27. Explain program verification in detail?
- Input and output assertion
 - Computer model for program execution
 - Implications
 - Verification of program segments
 - Proof of termination
28. Explain top down design?
- Breaking a problem into sub problem
 - Choice of suitable data structure
 - Construction of loops
 - Initial conditions for loops
 - Iterative construct
 - Termination of loops

UNIT-II-ADT

PART – A

1. What is an Abstract Data type(ADT)? Explain?

- Definition of ADT
- Example: Rational ADT
- Pseudo code of Rational ADT

2. What is a Stack ?

A Stack is an ordered collection of items into which new items may be inserted and from which items may be deleted at one end, called the top of the stack. The other name of stack is Last-in -First-out list.

3. What are the two operations of Stack?

- PUSH
- POP

4. Write postfix form of the expression $-A+B-C+D$?

$A-B+C-D+$

5. What is a Queue ?

A Queue is an ordered collection of items from which items may be deleted at one end called the front of the queue and into which items may be inserted at the other end called rear of the queue. Queue is called as First –in-First-Out(FIFO).

6. What is a Priority Queue?

Priority queue is a data structure in which the intrinsic ordering of the elements does determine the results of its basic operations. Ascending and Descending priority queue are the two types of Priority queue.

7. What are the different ways to implement list?

Simple array implementation of list

Linked list implementation of list

cursor implementation of list

8. What are the advantages in the array implementation of list?

a) Print list operation can be carried out at the linear time

b) Find K^{th} operation takes a constant time

9. What is a linked list?

Linked list is a kind of series of data structures, which are not necessarily adjacent in memory. Each structure contains the element and a pointer to a record containing its successor.

10. Name the two fields of Linked list?

➤ Info field

➤ Next field

11. What is a doubly linked list?

In a simple linked list, there will be one pointer named as 'NEXT POINTER' to point the next element, whereas in a doubly linked list, there will be two pointers one to point the next element and the other to point the previous element location.

12. Name the three fields of Doubly Linked list?

➤ Info field

➤ Left field

➤ Right field

13. Define double circularly linked list?

In a doubly linked list, if the last node or pointer of the list, points to the first element of the list, then it is a circularly linked list.

14. What is the need for the header?

Header of the linked list is the first element in the list and it stores the number of elements in the list. It points to the first data element of the list.

15. List three examples that uses linked list?

Polynomial ADT

Radix sort

Multi lists

16. Give some examples for linear data structures?

Stack

Queue

17. Write postfix from of the expression $-A+B-C+D$?

$A-B+C-D$

18. How do you test for an empty queue?

In the case of array implementation of queue, the condition to be checked for an empty queue is $READ < FRONT$.

19. What are the postfix and prefix forms of the expression?

$A+B*(C-D)/(P-R)$

Postfix form: $ABCD-*PR-/+$

Prefix form: $+A/*B-CD-PR$

20. Explain the usage of stack in recursive algorithm implementation?

In recursive algorithms, stack data structures is used to store the return address when a recursive call is encountered and also to store the values of all the parameters essential to the current state of the procedure.

21. Write down the operations that can be done with queue data structure?

Queue is a first - in -first out list. The operations that can be done with queue are insert and remove.

22. What is a circular queue?

The queue, which wraps around upon reaching the end of the array is called as circular queue.

PART – B

23. What is a Stack? Explain with example?

- Definition of Stack
- Operations of Stack: PUSH and POP
- Example

24. Write the algorithm for converting infix expression to postfix expression?

- Definition of Expression
- Types of expression
- Algorithm for infix to postfix expression
- Example

25. What is a Queue? Explain its operation with example?

- Definition of Queue
- Operations of Queue: insert and remove
- Example

26. Explain the applications of stack?

- Evaluating arithmetic expression
- Balancing the symbols
- Function calls

27. Write an algorithm for inserting and deleting an element from Doubly linked list? Explain linear linked implementation of Stack and Queue?

- Introduction to Doubly linked list
- Operations: insertion and deletion with algorithm
- Linked list implementation of Stack
- Linked list implementation of Queue

UNIT-III - TREES

PART- A

1. Define non-linear data structure?

Data structure which is capable of expressing more complex relationship than that of physical adjacency is called non-linear data structure.

2. Define tree?

A tree is a data structure, which represents hierarchical relationship between individual data items.

3. Define leaf?

In a directed tree any node which has out degree 0 is called a terminal node or a leaf.

4. What is meant by directed tree?

Directed tree is an acyclic digraph which has one node called its root with indegree 0 while all other nodes have indegree 1.

5. What is an ordered tree?

In a directed tree if the ordering of the nodes at each level is prescribed then such a tree is called ordered tree.

6. What is a Binary tree?

A Binary tree is a finite set of elements that is either empty or is partitioned into three disjoint subsets. The first subset contains a single element called the root of the tree. The other two subsets are themselves binary trees called the left and right subtrees.

7. What are the applications of binary tree?

Binary tree is used in data processing.

- a. File index schemes
- b. Hierarchical database management system

8. What is meant by traversing?

Traversing a tree means processing it in such a way, that each node is visited only once.

9. What are the different types of traversing?

The different types of traversing are

- a. Pre-order traversal-yields prefix form of expression.
- b. In-order traversal-yields infix form of expression.
- c. Post-order traversal-yields postfix form of expression.

10. What are the two methods of binary tree implementation?

Two methods to implement a binary tree are,

- a. Linear representation.
- b. Linked representation

11. Define pre-order traversal?

Pre-order traversal entails the following steps;

- a. Visit the root node
- b. Traverse the left subtree
- c. Traverse the right subtree

12. Define post-order traversal?

Post order traversal entails the following steps;

- a. Traverse the left subtree
- b. Traverse the right subtree
- c. Visit the root node

13. Define in -order traversal?

In-order traversal entails the following steps;

- a. Traverse the left subtree
- b. Visit the root node
- c. Traverse the right subtree

14. What is the length of the path in a tree?

The length of the path is the number of edges on the path. In a tree there is exactly one path from the root to each node.

15. Define expression trees?

The leaves of an expression tree are operands such as constants or variable names and the other nodes contain operators.

16. Define Strictly binary tree?

If every nonleaf node in a binary tree has nonempty left and right subtrees, the tree is termed as a strictly binary tree.

17. Define complete binary tree?

A complete binary tree of depth d is the strictly binary tree all of whose nodes are at level d .

18. What is an almost complete binary tree?

A binary tree of depth d is an almost complete binary tree if :

- Each leaf in the tree is either at level d or at level $d-1$
- For any node n_d in the tree with a right descendant at level d , all the left descendants of n_d that are leaves are at level d .

19. Define AVL Tree

An AVL tree is a binary search tree except that for every node in the tree, the height of the left and right subtrees can differ by at most 1.

20. Define collision resolution

The process of finding another position for the colliding record. Various techniques are

Separate chaining

Open addressing

Multiple hashing

PART- B

21. What is a Binary tree? Explain Binary tree traversals in C?

- Definition of Binary tree
- Traversals
- Inorder traversal
- Preorder traversal
- Postorder traversal

22. Explain Representing lists as Binary tree? Write algorithm for finding K^{th} element and deleting an element?

- Representing list as Binary tree
- Finding K^{th} element
- Deleting an element

23. Explain Binary search tree representation?

- Node representation of Binary search tree
- Implicit array representation of Binary tree
- Implementation of various operations

24. What is a Priority Queue? What are its types? Explain?

- Definition of Priority queue
- Types: Ascending and Descending priority queue
- Implementation of priority queue

25. Explain AVL tree in detail

- ❖ Definition
- ❖ Creation
- ❖ Types of rotation
- ❖ Deletion

UNIT-IV - SORTING

PART - A

1. What is meant by sorting?

Ordering the data in an increasing or decreasing fashion according to some relationship among the data item is called sorting.

2. What are the two main classifications of sorting based on the source of data?

- a. Internal sorting
- b. External sorting

3. What is meant by external sorting?

External sorting is a process of sorting in which large blocks of data stored in storage devices are moved to the main memory and then sorted.

4. What is meant by internal sorting?

Internal sorting is a process of sorting the data in the main memory.

5. What are the various factors to be considered in deciding a sorting algorithm?

- a. Programming time
- b. Execution time of the program
- c. Memory needed for program environment

7. What is the main idea behind insertion sort?

The main idea of insertion sort is to insert in the i th pass the i th element in $A(1) A(2) \dots A(i)$ in its rightful place.

8. What is the main idea behind selection sort?

The main idea behind the selection sort is to find the smallest element among in $A(I) A(J+1) \dots A(n)$ and then interchange it with a (J) . This process is then repeated for each value of J .

9. What is the basic idea of shell sort?

Instead of sorting the entire array at once, it is first divide the array into smaller segments, which are then separately sorted using the insertion sort.

10. What is the other name for shell sort?

Diminishing increment sort.

11. What is the purpose of quick sort?

The purpose of the quick sort is to move a data item in the correct direction, just enough for to reach its final place in the array.

12. What is the advantage of quick sort?

Quick sort reduces unnecessary swaps and moves an item to a greater distance, in one move.

13. What is the average efficiency of heap sort?

The average efficiency of heap sort is $O(n \log_2 n)$ where, n is the number of elements sorted.

14. Define segment?

When large blocks of data are to be sorted, only a portion of the block or file is loaded in the main memory of the computer since, it cannot hold the entire block.

This small portion of file is called a segment.

15. Name some of the external sorting methods?

- a. Polyphase merging
- b. Oscillation sorting
- c. Merge sorting

16. When is a sorting method said to be stable?

A sorting method is said to be stable, if two data items of matching values are guaranteed to be not rearranged with respect to each other as the algorithm progresses.

17. Name some simple algorithms used in external sorting?

- a. Multiway merge
- b. Polyphase merge
- c. Replacement selection

18. When can we use insertion sort?

Insertion sort is useful only for small files or very nearly sorted files.

19. How many passes are required for k -way merging?

The number of passes required using k -way merging is $\lceil \log_k (n/m) \rceil$ because the N H S get k times as large in each pass.

20. Define max heap?

A heap in which the parent has a larger key than the child's is called a max heap.

21. Define min heap?

A heap in which the parent has a smaller key than the child is called a min heap.

PART - B

22. Explain Heap sort?

- Heap sort
- Heap as a priority queue
- Sorting using a heap
- Heap sort procedure

23.Explain Insertion sort with example?

- definition
- algorithm and example
- implementation

24.Explain merge sort with example?

- definition
- algorithm and example
- implementation\
- basic merge algorithm with eg
-

25.Explain shell sort with example?

- definition
- algorithm and example
- implementation

26.Explain quick sort with example?

- definition
- algorithm and example
- implementation

UNIT-V - GRAPHS

PART - A

1. Define Graph?

A graph G consists of a nonempty set V which is a set of nodes of the graph, a set E which is the set of edges of the graph, and a mapping from the set for edge E to a set of pairs of elements of V . It can also be represented as $G=(V, E)$.

2. Define adjacent nodes?

Any two nodes which are connected by an edge in a graph are called adjacent nodes. For example, if an edge $x \in E$ is associated with a pair of nodes (u,v) where $u, v \in V$, then we say that the edge x connects the nodes u and v .

3. What is a directed graph?

A graph in which every edge is directed is called a directed graph.

4. What is an undirected graph?

A graph in which every edge is undirected is called an undirected graph.

5. What is a loop?

An edge of a graph which connects to itself is called a loop or sling.

6. What is a simple graph?

A simple graph is a graph, which has not more than one edge between a pair of nodes than such a graph is called a simple graph.

7. What is a weighted graph?

A graph in which weights are assigned to every edge is called a weighted graph.

8. Define out degree of a graph?

In a directed graph, for any node v , the number of edges which have v as their initial node is called the out degree of the node v .

9. Define indegree of a graph?

In a directed graph, for any node v , the number of edges which have v as their terminal node is called the indegree of the node v .

10. Define path in a graph?

The path in a graph is the route taken to reach terminal node from a starting node.

11. What is a simple path?

A path in a diagram in which the edges are distinct is called a simple path. It is also called as edge simple.

12. What is a cycle or a circuit?

A path which originates and ends in the same node is called a cycle or circuit.

13. What is an acyclic graph?

A simple diagram which does not have any cycles is called an acyclic graph.

14. What is meant by strongly connected in a graph?

An undirected graph is connected, if there is a path from every vertex to every other vertex. A directed graph with this property is called strongly connected.

15. When is a graph said to be weakly connected?

When a directed graph is not strongly connected but the underlying graph is connected, then the graph is said to be weakly connected.

16. Name the different ways of representing a graph?

- a. Adjacency matrix
- b. Adjacency list

17. What is an undirected acyclic graph?

When every edge in an acyclic graph is undirected, it is called an undirected acyclic graph. It is also called as undirected forest.

18. What are the two traversal strategies used in traversing a graph?

- a. Breadth first search
- b. Depth first search

19. What is a minimum spanning tree?

A minimum spanning tree of an undirected graph G is a tree formed from graph edges that connects all the vertices of G at the lowest total cost.

20. Name two algorithms to find minimum spanning tree

- Kruskal's algorithm
- Prim's algorithm

PART - B

21. Explain Shortest path algorithm with example?

- Shortest path algorithm
- Example

22. Explain Depth first and breadth first traversal?

- Depth first traversal
- Efficiency of Depth first traversal
- Breadth first traversal

23. Explain spanning and minimum spanning tree?

- Spanning tree
- Minimum spanning tree

24. Explain Kruskal's and Prim's algorithm?

- Kruskal's algorithm
- Prim's algorithm

25. Explain topological sorting?

- definition
- algorithm and example
- implementation