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Data Structures - Reference Book

93A GKD Nagar P.N.Palayam Coimbatore – 641037
Prabhu - 99946 75750
Email - sixphrase@gmail.com
Website - www.sixphrase.in

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1) **What is data structure?**

A data structure is a way of organizing data that considers not only the items stored, but also their relationship to each other. Advance knowledge about the relationship between data items allows designing of efficient algorithms for the manipulation of data.

2) **List out the areas in which data structures are applied extensively?**

1. Compiler Design,
2. Operating System,
3. Database Management System,
4. Statistical analysis package,
5. Numerical Analysis,
6. Graphics,
7. Artificial Intelligence,
8. Simulation

3) **What are the major data structures used in the following areas : RDBMS, Network data model and Hierarchical data model.**

1) RDBMS = Array (i.e. Array of structures)

2) Network data model = Graph

3) Hierarchical data model = Trees

4) **If you are using C language to implement the heterogeneous linked list, what pointer type will you use?**

The heterogeneous linked list contains different data types in its nodes and we need a link, pointer to connect them. It is not possible to use ordinary pointers for this. So we go for void pointer. Void pointer is capable of storing pointer to any type as it is a generic pointer type.

5) **Minimum number of queues needed to implement the priority queue?**

Two. One queue is used for actual storing of data and another for storing priorities.

6) **What is the data structures used to perform recursion?**

Stack. Because of its LIFO (Last In First Out) property it remembers its 'caller' so knows whom to return when the function has to return. Recursion makes use of system stack for storing the return addresses of the function calls.

Every recursive function has its equivalent iterative (non-recursive) function. Even when such equivalent iterative procedures are written, explicit stack is to be used.

7) **What are the notations used in Evaluation of Arithmetic Expressions using prefix and postfix forms?**

Polish and Reverse Polish notations.

8) **Convert the expression ((A + B) * C - (D - E) ^ (F + G)) to equivalent Prefix and Postfix notations.**

Prefix Notation: - * +ABC ^ - DE + FG

Postfix Notation: AB + C * DE - FG + ^ -

9) **Sorting is not possible by using which of the following methods? (Insertion, Selection, Exchange, Deletion)**

Sorting is not possible in Deletion. Using insertion we can perform insertion sort, using selection we can perform selection sort, using exchange we can perform the bubble sort (and other similar sorting methods). But no sorting method can be done just using deletion.

10) **What are the methods available in storing sequential files ?**

1) Straight merging,
2) Natural merging,
3) Polyphase sort,
4) Distribution of Initial runs.

11) **List out few of the Application of tree data-structure?**

1) The manipulation of Arithmetic expression,
2) Symbol Table construction,
3) Syntax analysis.

12) **List out few of the applications that make use of Multilinked Structures?**

1. Sparse matrix,
2. Index generation.

13) **In tree construction which is the suitable efficient data structure? (Array, Linked list, Stack, Queue)**

Linked list is the suitable efficient data structure.

14) What is the type of the algorithm used in solving the 8 Queens problem?

Backtracking.

15) In an AVL tree, at what condition the balancing is to be done?

If the 'pivotal value' (or the 'Height factor') is greater than 1 or less than -1.

16) What is the bucket size, when the overlapping and collision occur at same time?

One. If there is only one entry possible in the bucket, when the collision occurs, there is no way to accommodate the colliding value. This results in the overlapping of values.

17) Classify the Hashing Functions based on the various methods by which the key value is found.

1. Direct method,
2. Subtraction method,
3. Modulo-Division method,
4. Digit-Extraction method,
5. Mid-Square method,
6. Folding method,
7. Pseudo-random method

18) What are the types of Collision Resolution Techniques and the methods used in each of the type?

1. **Open addressing (closed hashing),** The methods used include: Overflow block.
2. **Closed addressing (open hashing),** The methods used include: Linked list, Binary tree.

19) In RDBMS, what is the efficient data structure used in the internal storage representation?

B+ tree. Because in B+ tree, all the data is stored only in leaf nodes, that makes searching easier. This corresponds to the records that shall be stored in leaf nodes.

20) What is a spanning Tree?

A spanning tree is a tree associated with a network. All the nodes of the graph appear on the tree once. A minimum spanning tree is a spanning tree organized so that the total edge weight between nodes is minimized.

21) Does the minimum spanning tree of a graph give the shortest distance between any 2 specified nodes?

No. The Minimal spanning tree assures that the total weight of the tree is kept at its minimum. But it doesn't mean that the distance between any two nodes involved in the minimum-spanning tree is minimum.

22) Which is the simplest file structure? (Sequential, Indexed, Random)

Sequential is the simplest file structure.

23) Whether Linked List is linear or Non-linear data structure?

According to Access strategies Linked list is a linear one.
According to Storage Linked List is a Non-linear one.

24) Which file contains the definition of member functions?

Definitions of member functions for the Linked List class are contained in the LinkedList.cpp file.

25) How is any Data Structure application is classified among files?

A linked list application can be organized into a header file, source file and main application file. The first file is the header file that contains the definition of the NODE structure and the LinkedList class definition. The second file is a source code file containing the implementation of member functions of the LinkedList class. The last file is the application file that contains code that creates and uses the LinkedList class.

26) What member function places a new node at the end of the linked list?

The appendNode() member function places a new node at the end of the linked list. The appendNode() requires an integer representing the current data of the node.

27) Why is the isEmpty() member method called?

The isEmpty() member method is called within the dequeue process to determine if there is an item in the queue to be removed i.e. isEmpty() is called to decide whether the queue has at least one element. This method is called by the dequeue() method before returning the front element.

28) How is the front of the queue calculated ?

The front of the queue is calculated by front = (front+1) % size.

29) What does each entry in the Link List called?

Each entry in a linked list is called a node. Think of a node as an entry that has three sub entries. One sub entry contains the data, which may be one attribute or many attributes. Another points to the previous node, and the last points to the next node. When you enter a new item on a linked list, you allocate the new node and then set the pointers to previous and next nodes.

30) What is Linked List ?

Linked List is one of the fundamental data structures. It consists of a sequence of? nodes, each containing arbitrary data fields and one or two (”links”) pointing to the next and/or previous nodes. A linked list is a self-referential datatype because it contains a pointer or link to another data of the same type. Linked lists permit insertion and removal of nodes at any point in the list in constant time, but do not allow random access.

31) How do you assign an address to an element of a pointer array ?

We can assign a memory address to an element of a pointer array by using the address operator, which is the ampersand (&), in an assignment statement such as ptemployee[0] = &projects[2];

32) Run Time Memory Allocation is known as ?

Allocating memory at runtime is called a dynamically allocating memory. In this, you dynamically allocate memory by using the new operator when declaring the array, for example : int grades[] = new int[10];

33) What method is used to place a value onto the top of a stack?

push() method, Push is the direction that data is being added to the stack. push() member method places a value onto the top of a stack.

34) What method removes the value from the top of a stack?

The pop() member method removes the value from the top of a stack, which is then returned by the pop() member method to the statement that calls the pop() member method.

35) What does isEmpty() member method determines?

isEmpty() checks if the stack has at least one element. This method is called by Pop() before retrieving and returning the top element.

36) What is a queue ?

A Queue is a sequential organization of data. A queue is a first in first out type of data structure. An element is inserted at the last position and an element is always taken out from the first position.

37) What is the relationship between a queue and its underlying array?

Data stored in a queue is actually stored in an array. Two indexes, front and end will be used to identify the start and end of the queue.

When an element is removed front will be incremented by 1. In case it reaches past the last index available it will be reset to 0. Then it will be checked with end. If it is greater than end queue is empty.

When an element is added end will be incremented by 1. In case it reaches past the last index available it will be reset to 0. After incrementing it will be checked with front. If they are equal queue is full.

38) Which process places data at the back of the queue?

Enqueue is the process that places data at the back of the queue.

39) What is the easiest sorting method to use?

The answer is the standard library function qsort(). It's the easiest sort by far for several reasons:

It is already written.

It is already debugged.

It has been optimized as much as possible (usually).

Void qsort(void *buf, size_t num, size_t size, int (*comp)(const void *ele1, const void *ele2));

40) What is the bucket size, when the overlapping and collision occur at same time?

One. If there is only one entry possible in the bucket, when the collision occurs, there is no way to accommodate the colliding value. This results in the overlapping of values.

41) In an AVL tree, at what condition the balancing is to be done?

If the pivotal value (or the Height factor) is greater than 1 or less than 1.

42) Minimum number of queues needed to implement the priority queue?

Two. One queue is used for actual storing of data and another for storing priorities.

43) How many different trees are possible with 10 nodes ?

1014 - For example, consider a tree with 3 nodes(n=3), it will have the maximum combination of 5 different (ie, 23 - 3 =? 5) trees.

44) What is a node class?

A node class is a class that, relies on the base class for services and implementation, provides a wider interface to users than its base class, relies primarily on virtual functions in its public interface depends on all its direct and indirect base class can be understood only in the context of the base class can be used as base for further derivation can be used to create objects. A node class is a class that has added new services or functionality beyond the services inherited from its base class.

45) When can you tell that a memory leak will occur?

A memory leak occurs when a program loses the ability to free a block of dynamically allocated memory.

46) What is placement new?

When you want to call a constructor directly, you use the placement new. Sometimes you have some raw memory that's already been allocated, and you need to construct an object in the memory you have. Operator new's special version placement new allows you to do it.

```
class Widget

{

public :

Widget(int widgetsize);

…

Widget* Construct_widget_int_buffer(void *buffer,int widgetsize)

{

return new(buffer) Widget(widgetsize);

}

};
```

This function returns a pointer to a Widget object that's constructed within the buffer passed to the function. Such a function might be useful for applications using shared memory or memory-mapped I/O, because objects in such applications must be placed at specific addresses or in memory allocated by special routines.

47) Tell how to check whether a linked list is circular ?

Create two pointers, each set to the start of the list. Update each as follows:

```
while (pointer1)

{

pointer1 = pointer1->next;

pointer2 = pointer2->next; if (pointer2) pointer2=pointer2->next;
if (pointer1 == pointer2)

{

print (\”circular\n\”);

}

}
```

48) What is the difference between ARRAY and STACK?

STACK follows LIFO. Thus the item that is first entered would be the last removed.

In array the items can be entered or removed in any order. Basically each member access is done using index. No strict order is to be followed here to remove a particular element.

49) What is the difference between NULL AND VOID pointer?

NULL can be value for pointer type variables.

VOID is a type identifier which has not size.

NULL and void are not same. Example: void* ptr = NULL;

50) What is precision?

Precision refers the accuracy of the decimal portion of a value. Precision is the number of digits allowed after the decimal point.

51) What is impact of signed numbers on the memory?

Sign of the number is the first bit of the storage allocated for that number. So you get one bit less for storing the number. For example if you are storing an 8-bit number, without sign, the range is 0-255. If you decide to store sign you get 7 bits for the number plus one bit for the sign. So the range is -128 to +127.

52) What is the heap?

The heap is where malloc(), calloc(), and realloc() get memory.

53) How can I search for data in a linked list?

Unfortunately, the only way to search a linked list is with a linear search, because the only way a linked list's members can be accessed is sequentially. Sometimes it is quicker to take the data from a linked list and store it in a different data structure so that searches can be more efficient.

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