DATA STRUCTURE AND ITS IMPORTANCE

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Abstract

This article is about algorithm, complexity of algorithm, what is data structure? , different types of data structures, real life applications of some data structures and the very most important thing that why data structure plays an important role in computers. Many times the programmer may think why to study about data structures when we are interested in programming. But programming is just a language or we can say that programs are set of instructions given to the computer to find out the solution of a problem. There you need some techniques to store and organize your data that will be the input to your programs, as well as you need to store the output after processing on data, here comes the answer of why to study about data structure. Once the data is properly organized you can easily access it whenever needed.

Keywords

Data Structure, Algorithm, Complexity

Introduction

In computers what is precious is our data. We have so much of data with us but we don't know how to keep it and how to use it effectively. If the data is not stored properly then it will be scattered in the memory and you will not get the required data. For avoiding all this things Data Structure is there. Data Structure is a way of collecting and organizing data in such a way that we can perform operations on these data in an effective way. Data Structures is about storing data elements in terms of some relationship, for better organization and storage. For example, we have data Name of a student "Sanjay" and age 16. Here "Sanjay" is of **String** data type and 16 are of **integer** data type. For using data structures one should know about algorithm.

Algorithm

Algorithm is a step wise representation of a problem's solution. In other words you can say algorithms are way to process the data. But the algorithm should have the finite steps. **Algorithms are everywhere.** Whatever the problem is, it can be solved using the solution into small steps and that is the Algorithm. **Suppose you want to find meaning of a word from a Dictionary. Algorithm for this involved following steps:**

- Find the Dictionary where it is
- Search for the word in that dictionary
- Once you found the word look for the meaning

Like this when you learn algorithms, you learn the ways to solve common problems. But the main thing in the case of algorithm is its complexity. The time needs to execute your algorithm should be less. One problem can have multiple ways of solution. From that you have to select any one according to its complexity.

Complexity of an algorithm

Complexity of an algorithm is concerned about how fast or slow a particular algorithm performs. Complexity is defined as T (n) – time T versus input size n. According the situations in which your algorithm is run, on the basis of its performance following are the types of analysis of algorithms:

The process of analyzing the problem-solving capability of the algorithm in terms of the time and size required is called as Analysis of Algorithm. The main concern of analysis of algorithms is the time required or performance of that algorithm. According to this concern the complexity of an algorithm can be classified into following types −

- **Worst-case** − The maximum number of steps taken to reach at the solution of a problem on size **n**

  For Example: The worst-case time-complexity of insertion sort is of O (n^2)

- **Best-case** − The minimum number of steps taken to reach at the solution of a problem on size **n**

  For Example: The best-case time-complexity of insertion sort is of O (n)

- **Average case** − An average number of steps taken to reach at the solution of a problem on size **n**

  For Example: The average-case time-complexity of insertion sort is of O (n^2)

- **Amortized** − A sequence of operations applied to the input of size **n** averaged over time.

Data Structure

Data structure is a particular way of storing and organizing information in a computer so that it can be retrieved and used most productively.

Data Structures helps to store data efficiently. A dictionary stores words. But think if the words in the dictionary are randomly stored then it is impossible to find out any specific word in that dictionary.

In dictionary the words are stored in Alphabetical Order. This is what the data structure a dictionary follows. Binary search algorithm is used to search a word in the dictionary.

Data structure is core subject for any programmer as it will give many different ways to manage your data and use it effectively.

The job of a computer programmer is to perform operations on data, basically we perform the following three steps:-

1) Take some input

2) Process it

3) Give back the output.

4) Stores that

Where the input can be in any form, for e.g. on Google Maps you give the starting point and the destination as input while searching for directions. While logging in to Facebook or gmail, you give your email / mobile No. and password as input and so on.

In the second step processing of our data is done for the required output using some step wise solution and by storing data into memory using some data structure. In the third step, the computer application gives us output in some form or the other.

To execute all these steps efficiently, optimization is required .The most we can optimize is the second step, where we have used Data structures and algorithms.

As we have seen that Data structure is a particular way of storing and organizing information in a computer. Organizing information in computer can have a lot of impact on the performance.

Take for example, a library. Suppose, you want to have a book on Java Programming from a public library, to do that you have to first go to the computer section, then to programming section. If the books are not organized properly then it is very difficult to find the required book from that collection.

This is the way a librarian organizes his/her books (data) into a particular form (data structure) to efficiently   perform   a   task   (find   a   book   on   Java   Programming).

For all these reasons computer programmer process and look for the best way we can organize the data we have, so it can be better processed based on input provided.

Data Structures and Algorithms play a great role in programming but only if you know actually how to write a program. There are so many types of data structures form that sometimes arrays

work, sometimes linked lists, sometimes searching techniques and sometimes trees and hash tables work but to become a good programmer you should learn data structures.

What are the different types of data structures?

The types of data structures are:

Arrays: A set of similar types of values.

Lists: A group of similar items having connectivity to the previous or/and next data items.
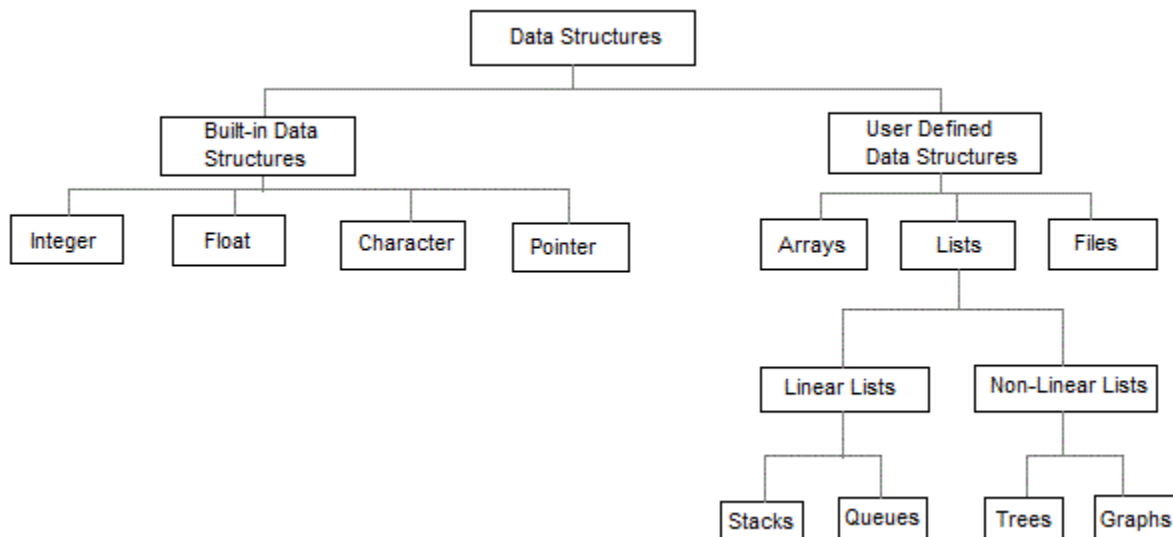
Files: A file is a collection of records. Where, each record contains number of fields.

Stacks: A stack has a LIFO (Last in First Out) data structure.

Queues: A queue has a FIFO (First in First Out) data structure.

Trees: A data structure where the data is organized in a hierarchical structure.

Graphs: An abstract data type representing relationships or connections.

Applications of some data structures in real life:

1. Arrays: On chess board arrays are used. It is very useful to store collection of similar type of data elements. Stacks are easy to implement using arrays for CPU scheduling.
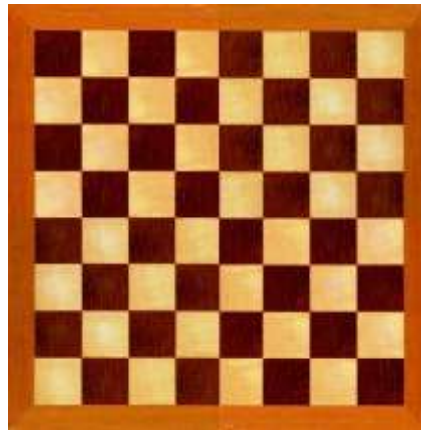

Fig. Chess Board

2. Graph Theory: Connecting with friends on social media, where each user is a vertex, and when users connect they create an edge. Routing , networks of communication, data organization, Google maps to showing locations and to fining out shortest path etc.

Fig. Google Maps

Fig. Facebook

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3. Indexes, Tables and search: Google, MySQL, Oracle, etc.

Fig. Oracle   Fig. Google search engine

4. Stack: used in expression evaluation, game playing, memory management, undo\redo operation in word processors, syntax parsing; many virtual machines like JVM are stack oriented, tower of Hanoi, etc.
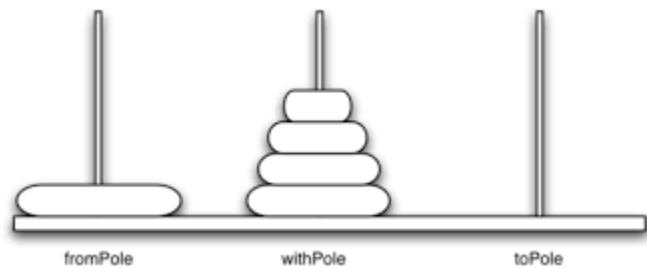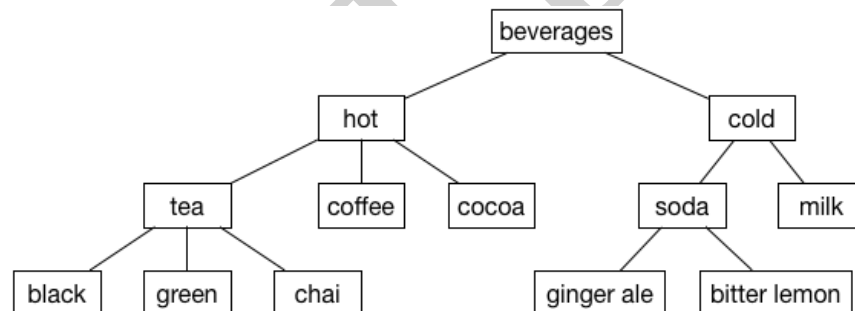

Fig. Stack of plates   Fig. Tower of Hanoi

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5. Queue: Jobs in printer, Operating systems often maintain a queue of processes that are ready to execute or that are waiting for a particular event to occur, etc.

Fig. Queue of people at ATM

6. Trees: Manipulate hierarchical data, for storing router-tables, by compilers to parse expressions; an operating system maintains a disk's file system as a tree, where file folders act as tree nodes, etc.

7. Others

Different kinds of data structures are meant for different kinds of applications, and some are highly specialized to specific tasks.

Importance of Data Structure

Data structures are important for the following reasons

1. Algorithms are used to find out the solution of a problem. In which we have to choose the effective one according to their performance and complexity, while data structure is used to store and organize your data effectively.

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2. Data structures are used in almost every program or software system.

3. Some data structures are essential ingredients of many efficient algorithms, and by using that data structures the management of huge amount of data is possible, such as the large integrated collection of databases.

4. If data structure was not there then some of the applications would not exist today. Like the most popular social networking sites such as Facebook, the search engines like Google, routers for networking, hierarchical structure of folders & files in an operating system, expression evaluation, working of JVM using stack, processing of jobs using CPU scheduling algorithms, and many more.

Conclusion

The most important thing in our computers is our data. There are different types of data available in computers. If that data is not organized properly then it is very difficult or just impossible to find out the required data in the allotted time. There are different techniques of how to organize it using different kinds of algorithms. But to store it in a proper way and not just store but to access and to process fast and easily you need to use some specific data structure according to the type of data and the requirement of that data.

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