Data Structures

What is the importance of data structures?

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Abhishek Jain, Works at Deutsche Bank | Ex Entrepreneur | .∴

Answered Jul 12, 2015

What do you mean about the importance? Data Structure is most of the programming. If you are working with an object oriented programming language, Object is one of the data structure, along with arrays and lists.
If you're working with some procedural language, they too have structures, list and/or arrays.

They are used to collect data in a particular fashion. It all depends upon the structure. While array stores multiple data of single type in a continuous way, structure stores heterogeneous data. Queues are just array with a LIFO constraint, while Stacks are also array with FIFO principle. Linked Lists are array of structure instances (At least in C/C++) While Objects are like structure with behavior (methods), although you can have behavior for structure in C++, they don't have other OOP concepts with it.

They are used to store, manipulate and arrange data. They are stored there to be processed by algorithms. They are just container for the data. For example if you have a game, you need a data structure to hold the details of a player. We normally use Objects for that. We have a Player object with score as member variable. This score can be a single floating point number or an array of scores for different scenes. It can be an arraylist, if the number of levels are dynamic, to keep the array dynamic.

If you've used any shopping website like Flipkart or Amazon, you would know that they store your last orders and help you to track it. The orders are stored in a database as records (depending on the type of database, in RDBMS they would be records or Tuple, in NoSQL kind of database, they would be called documents or a Key-Value pair). However when the program needs it so that it can pass the data to somewhere (such as warehouse) or display it to you. It loads the data in some form of data structure probably in a Consumer object with orders liked with a relationship to the order table.

TL;DR Data Structures are just ways of storing data. Whenever there's a data which occupies more than a single variable of primary data types (int, float, double etc.), it's a data structure.

Happy Coding!

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Muktabh Mayank, Co-Founder at ParallelDots
Answered Jul 12, 2015

Data Structures are used all the time in general software (probably more than anything else one learns in a CS degree).
Lets take example of Java: We keep using dynamic arrays (ArrayList) , Linked Lists (LinkedList) and hash tables (HashMap) almost in writing any everyday logic. Most modern programming have these data structures implemented and we mostly use them rather than implement them .
Now lets take examples of different types of common software one sees and see whether they use any datastrutures (and I will try to prove that for most software, programming is essentially finding out what datastruture should one use)
1. IDEs (eg: Eclipse) : Rope (data structure) are generally used to store edits, so that one can do ctrl+Z all the time and reach a previous state fast . Trie is used to autocomplete code .
2. OS/Webservers (eg: Linux / Apache) : Priority queue are used to decide order in which threads / web requests are handled.
3. Search Engines (eg: lucene/solr/maybe Google) : are basically implementations of Search engine indexing
4. Databases: (say MySQL) Apart from doing all thread like things an OS does, a DataBase also stores large linked lists on Disks (so essentially the Database Table is a linked list). They also have implementations of Inverted index for fast access
5. Compilers: (say Gcc) Use Hash Tables for symbol tables and trees to store parse trees.
6. Machine Learning: Requires efficient implementations of Matrix (2D Vectors) and Tensors (2+D vectors). Many Linear Algebra libraries are low level Matrix implementations with various Matrix operations built in. For Example, BLAS,NumPy, Eigen,CUDA etc.

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Eugene Yarovoi, Tech Interviews and Competitive Programming Meetup organizer

Updated May 30, 2018

Data structures are key building blocks of important algorithms.

Recently someone asked if they should first learn algorithms or data structures. What I said there pretty much summarizes the need to learn data structures in order to understand algorithms:

Broadly speaking, the purpose of data structures is to allow data that meets certain criteria (what kind of criteria depends on the data structure) to be retrieved from a collection faster than if we had to scan through the whole collection.[1] For example, the steps of several algorithms require getting the smallest value in a collection at any given time. We can't just remember the value in a variable, since elements are being added to and deleted from the collection over time.

We could, of course, store the collection in an unsorted array and simply scan the entire collection every time to find the smallest value, but that would require time proportional to N if there are N elements in the collection. Instead, there are ways of structuring the data (data *structures*) that allow you to find the minimum element much faster.[2]

Many algorithms will need common operations like "find the current minimum of a set of elements efficiently", so data structures represent common techniques that will be shared by all of these algorithms for this purpose.

There are lots of different data structures because there's many ways in which you could want to search data. When learning an algorithm, you should see what data structures it uses, and you should make sure you understand those data structures and what operations they are being used to speed up. You don't have to know all the data structures to start learning algorithms (there's more than you can ever know!) -- you just have to know the ones that are used by the

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[1] Yes, technically, an array is also a data structure. I mean that the purpose of data structures as an area of study is to speed up operations over what you would get using an unsorted array. If you didn't care about speeding up any operations, you could just always put everything into an unsorted array and keep it simple.

[2] Of course, once you start structuring the data in some nontrivial way (that is, not the “put everything in an unsorted array" approach), you also spend time maintaining the structure of the data as elements are inserted into and deleted from your collection. Usually, data structures have to be designed in such a way that they are both efficient to query and efficient to update. For example, a balanced binary tree data structure allows you to find the minimum, insert a value, or remove a value all in time proportional to log(N), which is much smaller than N.

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David Chapman, Assistant Professor of Computer Science at University of Maryland, Baltimore County

Answered Mar 20, 2018

Originally Answered: Why is data structures important while writing programs?

Because you don’t want to write code like this.

```
string Sentence(string words[])

{

int i;

string sentence;

for (i=0; i<words.length; i++)

sentence = sentence + words + " "

return sentence;

}
```

I’ve seen very smart people write this code before, not realizing that the runtime increases with the square of the number of words appended, and appending a long paragraph could take days.

If you want your code to be responsive to the user, you need to use the right algorithms and datastructures.

PERFORMANCE (via asymptotic complexity) is the only reason to favor one datastructure over another. At the end of the day, all datastructures do exactly the same thing (they hold data). They all have the same library operations (append, remove, find, find-min, sort, etc). But these operations take a different

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Having worked with my fair share of customers, customers don't care how you write your code, what language it's written in, or whether it uses tabs or spaces. These questions are irrelevant. Instead, customers usually care about: does it work, how well does it work, and is it too slow. With the wrong datastructures, software becomes slow and unresponsive.

Perhaps 99% of the time, an array is the best choice. But for that 1% of the time Knuth has an entire textbook of datastructures and you need to find the right one for your problem.

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