Data Structures Notes

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Hello Stranger! *These are notes made during the my #100daysofCode Challenge. Start date: 7th November 2022 (in-progress)*
The notes were written using Notion app and exported into a pdf.

*If you can't **explain it simply**, you don't **understand it well** enough.*

~ Albert Einstein

Introduction

A `data structure (DS)` is a way of organizing data so that it can be used efficiently.

Data structures are helpful in:

1. Creating fast and powerful algorithms.
2. Managing and organizing data.
3. Making code cleaner and easier to understand.

Abstract Data Type vs Data Structure

Abstract data types are `analogous to modes of transportation` e.g. walking, train, biking, plane. `They are just ways of getting from one point to another.` When you choose a ***`specific mode of transportation like biking then that is considered a data structure.`***

An `abstract data type (ADT)` is referred to as an abstraction of a data structure which provides only the interface to which a data structure must adhere to. The interface does not give specific details about how something should be implemented or in what programming language.

Abstraction (ADT)	Implementation (DS)
List	Dynamic Array, Linked List
Queue	Linked list based queue, Array based queue, Stack based queue,
Map	Tree Map, Hash Map / Hash Table
Vehicle	Golf cart, Smart car, Bicycle

Computational Complexity Analysis

This helps us understand the performance that the data structures are providing. i.e knowing the time and space an algorithm will need.

An algorithm that takes so much time to run even if it uses very little space is not effective. The same is when an algorithm uses all the bytes but runs fast is still not efficient.

This is how Big-O Notation was created.

Big-O Notation (Come back to this)

Big-O Notation gives an upper bound of the complexity in the worst case, helping to quantify performance as input size becomes arbitrary large. **`In other words we are always looking for the worst case scenario of an algorithm when using Big-O in terms of time and space.`**

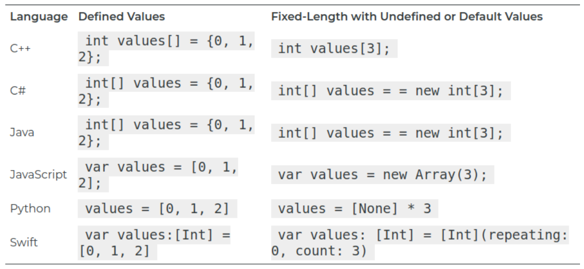
Lets say you are looking for a number 8 in an unordered list of unique numbers, in terms of time, Big-O Notation tells us the time it will take to find 8, in the worst case; when 8 is the last in the list.

Static and Dynamic Arrays

Introduction to Arrays

Static Arrays

Static Arrays are arrays where the `size/length is specified when the array is` `created/allocated.` Because the length is fixed, this type of array is also know as fixed-length arrays / fixed arrays.



Language	Defined Values	Fixed-Length with Undefined or Default Values
C++	`int values[] = {0, 1, 2};`	`int values[3];`
C#	`int[] values = {0, 1, 2};`	`int[] values = = new int[3];`
Java	`int[] values = {0, 1, 2};`	`int[] values = = new int[3];`
JavaScript	`var values = [0, 1, 2];`	`var values = new Array(3);`
Python	`values = [0, 1, 2]`	`values = [None] * 3`
Swift	`var values:[Int] = [0, 1, 2]`	`var values: [Int] = [Int](repeating: 0, count: 3)`

Application of Static arrays

1. Temporary store objects
2. Lookup tables and inverse lookup tables due to its indexing.
3. Can be used to return multiple values from a table
4. Storing and accessing sequential data
5. Used by Input/Output routines as buffers
6. Used in dynamic programming to cache answers to sub-problems

Dynamic Arrays