Data Structure summary / functional programming

Module 1: Introduction, Big O notation

Big O notation is a mathematical notation that describes the limiting behavior of a function when the argument tends towards a particular value or infinity. Big O is a member of a family of notations invented by German mathematicians Paul Bachmann,[1] Edmund Landau,[2] and others,
collectively called Bachmann–Landau notation or asymptotic notation. The letter O was chosen by Bachmann to stand for Ordnung, meaning the order of approximation.

https://en.wikipedia.org/wiki/Big_O_notation

Module 2: Basic data structures, Lists, dictionaries, tuples, stacks, queues

Data Structure/Collection - collection or sequence of data in memory stored in one variable

- ***Array, List, Set, Dictionary/Map, Queue, Stack, LinkList, Other***
- *Some data structures store duplicate value*
- *Some data structures store unique values*
- *Some data structures store key/value*
- *Some data structures can be readonly or non modifiable*
- *Access collection item via index*
- *Loop through collections, for, foreach, do, while*
- *Search items in a collection*
- *CRUD, create update, delete items in a collection*

Array - are used to store multiple items in a single variable of the same data type.

https://www.w3schools.com/js/js_arrays.asp

Arr1 = [1,2,3,1]
Arr2 = [“a”,”b”,”c”,”a”]

Can contain duplicates, modifiable - crud

Lists are used to store multiple items in a single variable.
https://www.w3schools.com/js/js_arrays.asp

List = [“a”,1,”b”,2, “a”,1,”3”]

Can contain duplicates, modifiable - crud

Set - are used to store multiple unique , do duplicates, items in a single variable.
https://www.w3schools.com/js/js_sets.asp

Set = [“a”,1,”b”,2]
No duplicates, unique values, modifiable - remove and add only

dictionaries/map, Dictionaries are used to store data values in key:value pairs
https://www.w3schools.com/js/js_maps.asp

In JavaScript, a tuple is effectively an immutable array of primitives with known length.
You can use a plain JavaScript array as a tuple to handle cases like returning multiple values as follows

https://masteringjs.io/tutorials/fundamentals/tuple

Set = [“a”:”value1”,”b”:value2,1:value3]
Key/Value, Unique key, No duplicates, modifiable , crud

stacks,

The stack is a data structure that follows Last In First Out (LIFO) principle.
The element that is added at last is accessed at first. This is like stacking your books on top of each other. The book that you put at last comes first.

example: queue add , last in first out, ie stack of plates, a, b, a, c, d

d
c
a
b
a

Items are added to the top of the stack
first output: d

Can contain duplicates, modifiable - add, remove

https://www.programiz.com/javascript/examples/stack

queues

A queue is a data structure that follows the First In First Out (FIFO) principle.

example: queue add , last in first out, ie: line of queue, a, b, c, b

Items are added to the end of the queue
first output: a

Can contain duplicates, modifiable - add, remove

https://www.programiz.com/javascript/examples/queue

Module 3: Recursion

Recursion is a programming technique where a function calls itself repeatedly to solve a problem

https://www.programiz.com/javascript/recursion

Module 4: Linked Lists and Binary Trees

Linked Lists -

A linked list is a data structure that consists of a sequence of elements,
each of which contains a reference (or "link") to the next element in the sequence.
The first element is called the head and the last element is called the tail.

https://www.tutorialspoint.com/implementation-of-linkedlist-in-javascript

linklistt =begin: “a”:value->1:value ->”b”:value -> ,2:value->”a”:value->end
Can contain duplicates, modifiable - crud

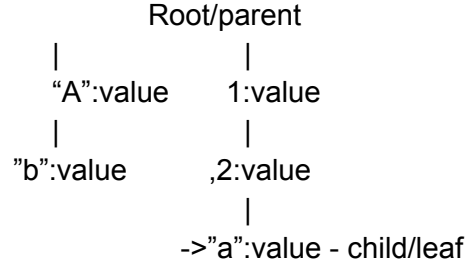
Binary Trees

A Binary Tree is a type of tree data structure where each node can have a maximum of two child nodes, a left child node and a right child node.

https://www.w3schools.com/dsa/dsa_data_binarytrees.php

root/parent - parent/child, leaf

Binary tree =



Can contain duplicates, modifiable - crud

Module 5: Heaps and Sorting

Heaps

A Heap is a special Tree-based Data Structure that has the following properties.

It is a complete Complete Binary Tree.
It either follows max heap or min heap property.

https://www.geeksforgeeks.org/min-heap-in-javascript/

Sorting

Sorting is an algorithm that sorts an array from the lowest value to the highest value

https://www.w3schools.com/dsa/dsa_algo_bubblesort.php

Module 6: Dynamic Programming

see javascript class document/example on Dynamic Javascript and Document Object Model ie: DOM, Events, Other

functional programming - ie: excel, python, javascript, react, other

- grouping function by feature
- used in mathematical functions and formulas ie: math calculations, ai/ml, other
- does not modify input parameters
- high order functions
- semantic - function name defines feature - sum, add, ave etc
- can be nested, function chaining. avg(sum))
- can take a function as input and return a function - ie: high order function
- other

A higher-order function is a function that either takes one or more
functions as arguments or returns a function as its result.
This allows for more abstract and flexible programming, enabling functions to operate on other functions

can combine oop and functional programming

Functional programming is a computer science paradigm that uses functions to solve problems instead of changing state or mutable data. It's a declarative programming style that emphasizes the use of functions over changing state.

Key characteristics

- **Pure functions**: Functions that always return the same result when given the same arguments
- **Immutability**: Uses immutable data instead of mutable data
- **Modularity**: Breaks down large projects into smaller modules
- **Declarative style**: Uses expressions instead of statements

Benefits

- Makes programs easier to validate
- Ensures consistent outputs for given inputs
- Creates maintainable software
- Writes cleaner, more predictable code

Languages

- Haskell, Scala, Clojure, Elm, and Erlang are specifically designed for functional programming
- JavaScript, Python, and C# also support functional programming concepts

Techniques

- Map, filter, and reduce for list operations
- Recursion for looping
- Currying and partial application for function flexibility

https://en.wikipedia.org/wiki/Functional_programming#:~:text=In computer science%2C functional programming,taking input from a user).