Microservices: it is a controller for distributed systems, where a architect develops a application in order handle the different servers.

***a service-oriented application component that is tightly scoped, strongly encapsulated, loosely coupled, independently deployable and independently scalable***

Microservices architectures, or simply Microservices is an SDLC approach based on which larger applications are built as a collection of small functional modules. These functional modules are independently deployable, scalable, target specific business goals, and communicate with each other over standard protocols like HTTP request/response with resource APIs and lightweight asynchronous messaging.

***The project I have worked is great example for microservice, it is large scale data storage application built on small functional modules (like creating pools, volumes , hosts, and volume groups ) , each module is scalable , independently deployable, functional, target specific goals and communicate with each other with HTTP.***

## ***Time complexity:***

Constant Time Complexity: O(1) – when only one statement executes in program

**Linear Time Complexity: O(n) – when programs iterates through loop n times -** more efficient and faster`x

**Quadratic Time Complexity: O(n²) -** Nested **For Loops** run on quadratic time – less efficient, and their performance can degrade quickly as the input size grows

**Exponential Time Complexity: O(2^n) - Brute-Force algorithms – loop iterate growth rate increases.**

**Logarithmic Time Complexity: O(log n) -** inversely proportional to the input “n” or “Divide and Conquer” – **Two pointer algorithms**

The optimal time complexity of Two pointer approach typically lies in O(n) as linear search, In most of the cases like searching and sorting (merge sort or binary search) the time complexity falls in between O(log n) or O(n log n).

For two pointer approach the time complexity depends on underlying developed logic too.

## Data Structure – Java Script

Array, Objects, Linked Lists, Queues, Hash Table, Trees, Graphs

typeOf(variable\_ref); > returns the data type of variable

parseInt(variable\_ref); > returns the NUMBER data type ;

Floor>Math.floor(1.2) > 1

Floor means closet integer lesser than the given number.

Ceil> Math.ceil(3.5) > 4

Ceil means closet integer greater than the given number.

### Maps:

Based on the concept of key and value pair.

Properties:

* Keyes can’t be duplicated, has to be unique.
* INSERT is not possible if the key already presents.
* UPDATE value for a key
* DELETE based on key
* Position doesn’t matter

Obj[“key”] =17;

Object.keys(obj);

Let map = new Map();

map.set(‘a’,1);

### Objects:

class Car {

constructor(name, year) {

this.name = name;

this.year = year;

}

}

const myCar1 = new Car("Ford", 2014);

const myCar2 = new Car("Audi", 2019);

<script>

**const person = {**

**firstName : "John",**

**lastName : "Doe",**

**age : 50,**

**eyeColor : "blue"**

**};**

document.getElementById("demo").innerHTML = person.firstName + " " + person.lastName;

</script>

### Arrays:

Homogeneous Data

Constant size, go for it when the known quantity of items.

Accessed and stored data using index.

Int array[] = new int[]; || var array[] = new Array();

Length is property of Array class.

Push – unshift -adding an element pop-shift -to delete an element.

### Comparator interface

Multiple sorting based on object properties

Comparator provides **compare() method** to sort elements.

**Collections.sort(List, Comparator) or Arrys.sort(array,comparator)**

**More like object comparision**

new Comparator<Integer> (){

                public int compare(Integer a, Integer b){

                    return a-b;

                    }}

### Comparable Interface

Comparable provides **compareTo() method** to sort elements.

We can sort the list elements of Comparable type by **Collections.sort(List)** method.

More like object specific comparesion

## **Data Structure**

**STRINGS, ARRAYS ,LIST, MAP, SET**

Maps – doesn’t allows the duplicate keys, to get sorted map use Treemap – no null treemap

Set - doesn’t allows the duplicate values, , to get sorted set use Treeset- no null in treemap

### **Set** -JAVA

Interface Set interface extends Collection interface. In a set, no duplicates are allowed. Every element in a set must be unique.

* HashSet does not guarantee any order
* LinkedHashSet maintain insertion order
* TreeSet maintain sorting order
* HashSet and LinkedHashSet allows only one null
* TreeSet does not allow null
* All three are not thread-safe

**JAVA- put(), remove,clear(),containsKey(),containsValue(), get()**

**for(int i: arra){}**

### Spiral matric implementation

ArrayList<Integer> sum = new ArrayList<Integer>();

         int index =c+r-1;

         int cEnd= 0;

         int rEnd = 0;

         int add =0;

*// diagonal sum -column*

            while (cEnd < c){

              int row=0;

              int col=cEnd;

              int value =c;

              while(iter < value){ *//witin matrix diagonal*

                add + = M.get(row).get(col);

                row++;

                col++;

                iter++;

            }

            cEnd++; *//increasing column*

             }

         while (j < rEnd){

         }

         while(i<index){

            for (int i=0; i<)

              add +=M.get(1).get(1);

             add+=  M.get(2)+M.get(2));

             }

         }

# knowledge of data structures

<https://www.hackerrank.com/domains/data-structures>

### Heap Data Structure

### *A Heap is a special****Tree-based Data Structure****in which the tree is a*[*complete binary tree*](https://www.geeksforgeeks.org/complete-binary-tree/)*.*

* **Heapify:** a process of creating a heap from an array. to balance the tree.
* **Insertion:** process to insert an element in existing heap time complexity O(log N).
* **Deletion:** deleting the top element of the heap or the highest priority element, and then organizing the heap and returning the element with time complexity O(log N).
* **Peek:** to check or find the first (or can say the top) element of the heap.

**Types of Data structure:**

1. **Max-Heap :** In max heap the key present at top node must be maximum/greatest among the keys. The same property must be recursively true for all sub-trees in that Binary Tree.
2. **Min-Heap :** in min heap the key present at top node must be minimum of all keys present in heap. The same property must be recursively true for all sub-trees in that Binary Tree.

### LinkedList

## **Problem solving approach**

1. Define the problem

* Clearly understand the problem and the nature of the data to be sorted. Consider the size of the dataset, the range of values, and whether the data is partially sorted or completely unsorted.

1. Understand Algorithm characteristics

* Different sorting algorithms have different time and space complexities. Understand the characteristics of common sorting algorithms such as Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, Quick Sort, and Heap Sort.

1. Choose the right algorithm

* Select the sorting algorithm that best suits the specific requirements of the problem. Consider factors such as time complexity, space complexity, stability, and adaptability.

1. Implement the chosen algorithm

* Translate the chosen algorithm into code. Pay attention to details like array indexing, loop structures, and termination conditions. Ensure that the implementation handles edge cases and performs correctly on various input scenarios.

1. Optimize if Necessary:

* Analyze the performance of the implemented algorithm. If needed, consider optimization techniques such as tail recursion elimination, loop unrolling, or parallelization to improve efficiency. However, optimization should be based on actual performance measurements.

1. Test Extensively:

* Develop a comprehensive set of test cases to verify the correctness and efficiency of the sorting algorithm. Include cases with varying data sizes, sorted and reverse-sorted data, and data with duplicates.

1. Handle Edge Cases:

* Ensure that the sorting algorithm handles edge cases gracefully. For example, empty arrays, arrays with a single element, or datasets with identical elements.

1. Document and Analyze:

* Document the implemented algorithm, including its time and space complexity. Perform a thorough analysis of the algorithm's behavior under different scenarios. This documentation aids in understanding, maintaining, and sharing the sorting solution.

1. Consider Special Requirements:

* If the problem has specific constraints, such as limited memory or the need for stable sorting, consider these requirements during the selection and implementation of the sorting algorithm.

1. Iterate and Refine:

* Based on the testing and analysis, iterate on the implementation if needed. Refine the algorithm or choose a different one if the initial selection proves suboptimal for the problem at hand.

# knowledge of algorithms

## Brute Force:

Two loops, quadratic TC > O(n\*2)

 int result=1;

        int count=0;

        for(int i=1;i<n;i++){*//7 4 10 9 6 1 8 2 5 3*

            for(int j=i-1;j>=0;j--){

                if(nums[i]!=nums[j]){

                    count++;

                }

            }

            if(count == i){

                result ++;

            }

            count =0;

        }

        return result;

## Two pointer approach

Two pointers, one loop , logarithmic TC > O(log N)

## Optimized approach

Sort the data structure + loop ,O(nlogn)

## Newton Raphson Method  - to find sqrt(n)

public class SqrtCalculator {

public static double sqrt(int x) {

if (x == 0) {

return 0;

}

double x0 = x; // Initial estimate

while (true) {

double x1 = 0.5 \* (x0 + (x / x0)); // Calculate the next estimate

if (Math.abs(x1 - x0) < 1e-6) {

return x1; // Converged to a sufficiently accurate result

}

x0 = x1; // Update the current estimate

}

}

public class SqrtCalculator {

public static double sqrt(int x) {

if (x == 0) {

return 0;

}

double prev, curr = 1;

do {

prev = curr;

curr = (prev + x / prev) / 2;

} while (Math.abs(curr - prev) >= 1e-6); // Adjust the tolerance as needed

return curr;

}

}

## **Binary Search:**

In binary search:

* There is one primary pointer (usually called "mid" or "pivot") that divides the search space into two halves.
* It repeatedly adjusts this primary pointer based on a comparison between the target value and the value at the midpoint.
* The search space is divided into two halves, and one of them is eliminated at each iteration.

You can efficiently find the target value in a sorted array of distinct integers with a binary search algorithm, which has a time complexity of O(log N) logarithmic time complexity for sorted arrays. Here's a Java example of how to do this:

int left = 0;

        int right = nums.length - 1;

        while (left <= right) {

            int mid = left + (right - left) / 2;

            if (nums[mid] == target) {

                return mid; *// Target found, return its index.*

            }

            if (nums[mid] < target) {

                left = mid + 1; *// Target is on the right side.*

            } else {

                right = mid - 1; *// Target is on the left side.*

            }

        }

        return -1; *// Target not found in the array.*

    }

## **Bubble sort**

Bubble sort is used to sort the array of elements. The time complexity is O(n2) require one nested for loop, where each element is compared with its next element. In Ascending order below algorithm is used

* If the next element is less than the previous element, the next element will get swapped to prev index .
* Else the no swap.

Every element is with each n elements of an array

**int** n = array.length;

**for**(**int** i=0;i<n-1;i++) {

**for**(**int** j=0;j<n-i-1;j++) {

**if**(array[j+1] < array[j]) {

**int** tmp = array[j];

array[j] = array[j+1];

array[j+1] = tmp;

}

}

}

## **Insertion sort**

Best for partial sorted arrays, the time complexity O(n) and unsorted array worst O(n2)

* Start with second index of an array to loop though
* Store the current index element
* Declare and initialize the prev position variable i-1;
* Repeat the loop until j>=0 && arr[j]>key

If true assign the j to j+1

Decrease the j j-1

* Once repetition ends assign key to j+1;

The insertion sort is achieved by comparing previous elements with current element , if the current element (namely key) is less than previous element, the positions of all greater elements get shifted to right side, once loop ends the correct position of key gets find, then assigning key to that position , array get sorted.

Initial Array: {12, 11, 13, 5, 6}

Iteration 1:

key = 11

Compare 11 with 12 (element before it). Since 12 is greater than 11, move 12 to the right.

Array becomes {12, 12, 13, 5, 6}.

Now, assign the key to the correct position (j).

Array becomes {11, 12, 13, 5, 6}.

Iteration 2:

key = 13

Compare 13 with 12 (element before it). Since 12 is less than 13, stop the comparison.

Array remains {11, 12, 13, 5, 6}.

Iteration 3:

key = 5, j =2

Compare 5 with 13 (element before it). Since 13 is greater than 5, move 13 to the right.

Array becomes {11, 12, 13, 13, 6}.

Now, assign the key to the correct position (j).

Array becomes {11, 12, 5, 13, 6}.

Continue this process until 5 is in its correct position: {11, 5, 12, 13, 6}.

Iteration 4:

key = 6

Compare 6 with 13 (element before it). Since 13 is greater than 6, move 13 to the right.

Array becomes {11, 5, 12, 13, 13}.

Now, assign the key to the correct position (j).

Array becomes {11, 5, 12, 6, 13}.

Continue this process until 6 is in its correct position: {11, 5, 6, 12, 13}.

After these iterations, the array becomes sorted: {5, 6, 11, 12, 13}.

**for**(**int** i=1;i<arr.length;i++) {

**int** key = arr[i];

**int** j= i-1;

**while**(j>=0 && arr[j]>key) {

arr[j+1] = arr[j];

j = j-1;

}

arr[j+1]= key;

}

**for**(**int** i:arr) {

System.***out***.println(i);

}

## **Selection sort**

The time complexity is o(n2) due to n\*n iterations, in selection sort the smallest element get selected and swapped to first index

* a third variable used to find the smallest number in exiting part of an array
* the nested loop is loops through the array to find the smallest, once loop ends the the third variable holds the index of smallest num
* swap the third variable index and i index.

int array [] = new int[]{10,3,1,6,2,4};

int mid =0;

for(int i=0;i<array.length;i++){

mid =i;

for(int j=i+1;j<array.length;j++){// smallest number

if(array[j]<array[mid]){

mid =j;

}

}

int tmp = array[i];

array[i] = array[mid];//smallest number is moved to initial index

array[mid]= tmp;

}

## **Merge sort**

Merge Sort is a divide-and-conquer algorithm that works by dividing the array into two halves, recursively sorting each half, and then merging the sorted halves. It is a stable and efficient sorting algorithm with a time complexity of O(n log n) in the worst, average, and best cases.

Merge sort achieved by dividing the array for all possible way by half, it is implemented in a mergeSort method while sorting the elements using merge method. Where is each half is sorted recursively.

Algorithm:  
need to implement two function one is for recursive call of merge and mergesort methods.

* Merge sort method > it have arguments array, left(0), and right(length-1).

Find the middle of the array by left+right/2 is equal to middle

Call mergesort method for left to middle and for middle+1 to right with arr

Call the Merge method for each divided array to sort and combine.

* Merge Method > where the divided parts of array sorted and merged

Create two arrays with size of left and right + middle for each half and copy the divide arrays elements to respective temporary array

And perform the sort logic for both temporary array assign to k index

If any elements left at any side of temporary array move them to k index

## **Heap sort**

Heap Sort is a comparison-based sorting algorithm that uses a binary heap data structure to build a max-heap or a min-heap. In the context of Heap Sort, we typically use a max-heap to sort elements in ascending order. Here's an overview of the Heap

# knowledge of the application of data structures and algorithms

https://open.kattis.com/

### Example: HashMap and ArrayList program

TO find intersection elements of two arrays

 static List<Integer> intersectionOfTwoArraysBasic(int n, List<Integer>a, int m, List<Integer>b){

    List<Integer> result = new ArrayList<>();

*// Time complexity - O(n+m)*

*//use a for each loop and Hashmap(duplicate keys not allowed)*

*//check the value of a[i] not a key in map*

*//if yes put new key in map, else update the exiting key with old+1;*

    Map<Integer,Integer> freq = new HashMap<Integer,Integer>();

    int count =0;

    for(int i: a){

        if(!freq.containsKey(i)){

            freq.put(i,1);

        }

        else{

        freq.put(i,freq.get(i)+1);

        }

    }

*//iterating through the b[] using for each loop*

*// check the element of b being as key in map or not*

*// if yes check the accurance count >0*

*//if yes decrement the its value and add to the result list*

    for(int i: b){

        if(freq.containsKey(i)){

            if(freq.get(i)>0){

            result.add(i);

            freq.put(i,freq.get(i)-1);

            }

        }

    }

*//sort the sort list and return*

        Collections.sort(result);

        return result;

    }

### Priority Queue:

*PriorityQueue<E> pq = new PriorityQueue<E>();*

*Add()- to add, peek() – to retrive, poll() – to remove and retrieve , contains() - tocchek*

### Recursion

Implementing the function call inside same function.

**In recursion the result depends on base return. And initialized value**

function factorial(n) {

    var result = n;

   if(n==0){

       return 1;

   }

   return result = factorial(n-1)\*result;

//two find nth Fibonacci number

function fib(n){ //O(n) – if stack space consider or O(1) - if stack space not considered   
if(n==0||n==1)

return n;

return fib(n-1)+fib(n-2);

}

//Tribonacci series

function fib(n){ //O(n) – if stack space consider or O(1) - if stack space not considered   
if(n==0)

return n;

else if(n== 1|| n==2){  
return 1;

return fib(n-1)+fib(n-2)+fib(n-3);

}

With out recursive function fib series: O(n)  
var tmp=0

var i=1;

while(i<5){

console.log(tmp);

tmp = i+tmp;

i= tmp-i;

}

Prime which having only two perfect divisible 1 and it self.

HCF & GCD >

Euclid rule > the GCD or HCF of a two number is value of smallest number subtracted from greatest number.

GCD(34, 8) > (26, 8) > (18, 8) > (10, 8)> (2, 8)>(2, 6)>(2, 4)>(2,2) > 2 : TC=O(min(a,b))

Using recursion function

function gcd(a,b){

if(a==0)

return b;

if(b==0)

return a;

return gcd(b, a%b);  
}//TC = O(logmin(a,b)))

CoPrime > the sum two numbers which divisor is only 1.

### Prime

Math.sqrt(n) is best way to loop upto this point. To reduce the number repeating iterations. 1 is not prime so can exempt this. So which having exactly one divisor from 2 to Math.sqrt(n).

 public static boolean isPrime(int n){

       int count = 1;

         for(int i=2;i<=(int)Math.sqrt(n);i++){

            if(n%i ==0){

              count++;

            }

         }

         if(count == 1){

             return true;

         }

         return false;

   }

### Modules pros

Modules helps code lie between the given constraints or between size of an array.

static int[] leftRotation(int[] a, int d) {

        int n = a.length;

        int[] ans = new int[n];

        int j=0;

        for (int i = d; i <n; i++) {

*//int new\_pos = i - d; (i - d + N) % N*

            ans[j] = a[i];

            j++;

        }

        for(int i=0; i<d;i++){

            ans[j] = a[i];

            j++;

        }

        return ans;

    }

Rather than using two for loops using mod can easily get index

 static int[] leftRotation(int[] a, int d) {

        int n = a.length;

        int[] ans = new int[n];

        for (int i = 0; i < n; i++) {

            int new\_pos = (i - d + n) % n;

            ans[new\_pos] = a[i];

        }

        return ans;

    }

### Incrementing array element by 1:

static int[] incrementNumber(int n, int digits[]){

*//int n = digits.length;*

    int carry = 1;

    for (int i = n - 1; i >= 0; i--) {*//9 1 1*

        int sum = digits[i] + carry;*//9  1 2*

        digits[i] = sum % 10;*//9 1 2*

        carry = sum / 10;*//0  0 0*

    }

    if (carry == 1) {

        int[] result = new int[n + 1];

        result[0] = 1;

        return result;

    } else {

        return digits;

    }

    }

Here the approach is space and time optimized because rather than doing 10th position

multiplication and adding, we just using carry to forward to all elements if any.

### Palindrome - String

*to check a string is permutation of palindrome , the string must contains even number of times charcters or only one time, if any charcters is odd number(>1) times then the string is not permutaion of palindrome*

Anagrams – the string which is having same chars but order can be different.

If an array sorted go for binary search which uses two pointer approach.

If an array is not sorted go for linear search;