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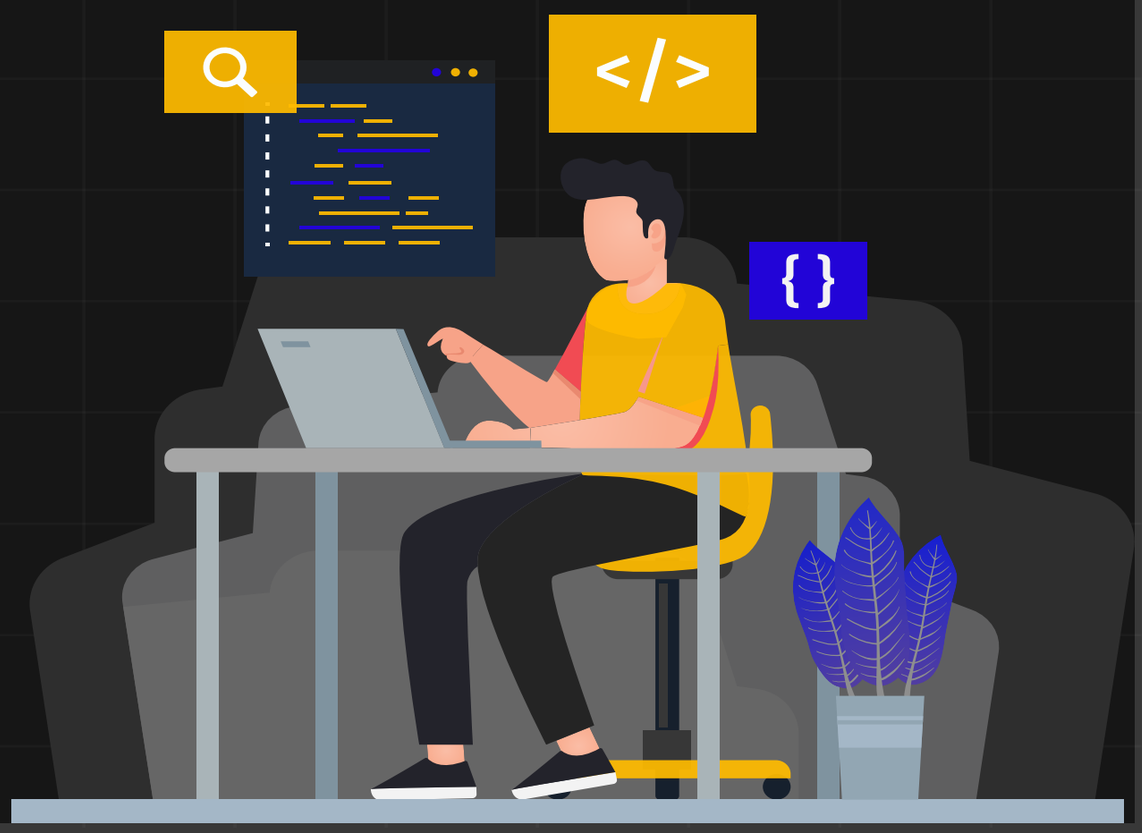
DSA Cheat Sheet



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Arrays & Strings →

Stores data elements based on an sequential, most commonly 0 based, index.

Time Complexity

- Indexing: Linear array: O①, Dynamic array: O①
- Search: Linear array: O(n), Dynamic array: O(n)
- Insertion: Linear array: n/a, Dynamic array: O(n)
- Optimized Search: Linear array: O(log n), Dynamic array: O(log n)

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Bonus:

- type[] name = {val1, val2, ...}
- Arrays.sort(arr) → O(n log(n))
- Collections.sort(list) → O(n log(n))
- int digit = '4' - '0' → 4
- String s = String.valueOf('e') → "e"
- (int) 'a' → 97 (ASCII)
- new String(char[] arr) ['a','e'] → "ae"
- (char) ('a' + 1) → 'b'
- Character.isLetterOrDigit(char) → true/false
- new ArrayList<>(anotherList); → list w/ items
- StringBuilder.append(char||String)

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Stack/Queue/Deque →

Stack (Last In First Out, push(val), pop(), peek())
Queue (First In Last Out, offer(val), poll(), peek())
Deque (Provides first/last, offer(val), poll(), peek())
Heap (Ascending Order, offer(val), poll(), peek())

Implementation:

```
Stack <E> stack = new Stack();
Queue <E> queue = new Linked List();
Deque <E> deque = new Linked List();
PriorityQueue <E>  pq = new PriorityQueue();
```

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DFS & BFS Big O Notation →

DFS (Time = O(E+V) Space = O(Height))
BFS (Time = O(E+V) Space = O(Length))
V & E ⟶ where V is the number of vertices and E is the number of edges.
Height ⟶ where h is the maximum height of the tree.
Length ⟶ where l is the maximum number of nodes in a single level.

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DFS vs BFS

DFS:

- Better when target is closer to Source.
- Stack ⟶ LIFO
- Preorder, Inorder, Postorder
- Search
- Goes deep
- Recursive
- Fast

BFS:

- Better when target is far from
- Source.
- Queue ⟶ FIFO
- Level Order Search
- Goes wide
- Iterative
- Slow

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Bonus	{1, -1, 0, 2, -2} into map
HashMap	{-1, 0, 2, 1, -2} ⟶ any order
Linked HashMap	{1, -1, 0, 2, -2} ⟶ insertion order
TreeMap	{-2, -1, 0, 1, 2} ⟶ sorted

Set doesn't allow duplicates.
map. get or Default Value (key, default value)

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BFS Implementation For Graph:

```
public boolean connected(int[][] graph, int
start, int end) {
    Set <Integer> visited = new HashSet<>();
    Queue<Integer> toVisit = new Linked
List<>();
    toVisit.enqueue(start);
    while(!toVisit.isEmpty()) {
        int curr = toVisit.dequeue();
        if (visited.contains(curr)) continue;
        if (curr == end) return true;
        for (int i : graph[start]) {
            toVisit.enqueue(i);
        }
        visited.add(curr);
    }
    return false;
}
```

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BFS Implementation For Level- Order Tree Traversal:

```
private void printLevelOrder(TreeNode root) {
    Queue<TreeNode> queue = new Linked
List<>();
    queue.offer(root);
    while(!queue.isEmpty()) {
        TreeNode tempNode = queue.poll();
        print( tempNode.data + " ");
        // add left child
        if (tempNode.left != null) {
            queue.offer(tempNode.left);
        }
        // add right right child
        if (tempNode.right != null) {
            queue.offer(tempNode.right);
        }
    }
}
```

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DFS Implementation For Graph:

```
public boolean connected(int[][] graph, int
start, int end) {
    Set<Integer> visited = new HashSet<>();
        return connec ted (graph, start, end,
visited);
}
private boolean connected (int[][] graph, int
start, int end, Set<Integer> visited) {
    if (start == end) return true;
    if (visited.contains(start)) return false;
    visited.add(start);
    for(int i : graph[start]) {
        if (connected(graph, i, end, visited))
{
            return true;
        }
    }
    return false;
}
```

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DFS Implementation For In-Order Tree Traversal:

```
private void inorder(TreeNode TreeNode) {
    if(TreeNode == null)
        return;
    // Traverse left
    inorder(TreeNode.left);
    // Traverse root
    print(TreeNode.data + " ");
    // Traverse right
    inorder(TreeNode.right);
}
```

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Dynamic Programming →

Dynamic programming is the technique of storing repeated computations in memory, rather than recomputing them every time you need them.

The ultimate goal of this process is to improve runtime. Dynamic programming allows you to use more space to take less time.

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Dynamic Programming Patterns:

Minimum (Maximum) Path To Reach A Target
Approach:
Choose Minimum (Maximum) Path Among All Possible Paths Before
The Current State, Then Add Value For The Current State.
Formula:

Routes[I] = Min(Ro Ute S[I-1], Routes [I-2], … , Routes [I-K]) + Cost[I]

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Binary Search Recursive

```
public int binarySearch(int search, int[]
array, int start, int end) {
int middle = start + ((end - start) / 2);
    if(end < start) {
        return -1;
    }
    if (search == array[middle]) {
        return middle;
    } else if (search < array[ mid dle]) {
        return binary Search (search, array,
start, middle - 1);
    } else {
        return binary Search (search, array,
middle+1, end);
    }
}
```

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Binary Search Iterative

```
public int binarySearch(int target, int[]
array) {
    int start = 0;
    int end = array.length - 1;
    while (start <= end) {
        int middle = start + ((end - start) /
2);
        if (target == array[middle]) {
            return target;
        } else if (search < array[middle]) {
            end = middle - 1;
        } else {
            start = middle + 1;
        }
    }
    return -1;
}
```

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Distinct Ways Approach:

Choose minimum (maximum) path among all possible paths before the current state, then add value for the current state.
Formula:

routes[i] = routes [i-1] + routes [i-2], ... , + routes [i-k]

Merging Intervals Approach

Find all optimal solutions for every interval and return the best possible answer
Formula:

dp[i][j] = dp[i][k] + result[k] + dp[k+1][j]

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DP On Strings

Approach:
Compare 2 Chars Of String Or 2 Strings. Do Whatever You Do. Return.

Formula:

If S1[I-1] == S2[J-1] Then Dp[I][J] = //Code.

Else Dp[I][J] = //Code

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Bit Manipulation →

Sign Bit: 0 ⟶ Positive, 1 ⟶ Negative
AND 0 & 0 ⟶ 0
0 & 1 ⟶ 0
1 & 1 ⟶ 1

OR 0 | 0 ⟶ 0
0 | 1 ⟶ 1
1 | 1 ⟶ 1

XOR 0 ^ 0 ⟶ 0
0 ^ 1 ⟶ 1
1 ^ 1 ⟶ 0

INVERT ~ 0 ⟶ 1
~ 1 ⟶ 0
Bonus:
Shifting
- Left Shift
0001 << 0010 (Multiply By 2)

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Sorting Big O Notation →

	BEST	AVERAGE	SPACE
Merge Sort	O(n log(n))	O(n log(n))	O(n)
Heap Sort	O(n log(n))	O(n log(n))	O①
Quick Sort	O(n log(n))	O(n log(n))	O(log(n))
Insertion Sort	O(n)	O(n^2)	O①
Selection Sort	O(n^2)	O(n^2)	O①
Bubble Sort	O(n)	O(n^2)	O①

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Quick Sort

```java
private void mergesort(int low, int high) {
    if (low < high) {
        int middle = low + (high - low) / 2;
        mergesort(low, middle);
        mergesort(middle + 1, high);
        merge(low, middle, high);
    }
}
private void merge(int low, int middle, int
high)
{
    for (int i = low; i <= high; i++) {
        helper[i] = numbers[i];
    }
    int i = low;
    int j = middle + 1;
    int k = low;
    while (i <= middle && j <= high) {
        if (helper[i] <= helper[j]) {
            numbers[k] = helper[i];
            i++;
        } else {
            numbers[k] = helper[j];
            j++;
        }
        k++;
    }
    while (i <= middle) {
        numbers[k] = helper[i];
```

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Insertion Sort

```
void insertionSort(int arr[]) {
    int n = arr.le ngth;
    for (int i = 1; i < n; ++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;
    }
}
```

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Binary Search Iterative

```
- Combination
public List<List <Integer>>
combinationSum(int[] nums, int target) {
    List<List <Integer>> list = new ArrayList
<>();
    Arrays.sort( nums);
    backtrack(list, new ArrayList <>(), nums,
target, 0);
    return list;
}
```

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Binary Search Iterative

```
private void backtrack(List <List<Integer>>
list, List<Integer> tempList, int [] nums, int
remain, int start){
    if( remain < 0) return;
    else if(remain == 0) list.add(new ArrayList
<>(tempList));
    else{
        for(int i = start; i < nums.l ength;
i++){
            tempList.add(nums[i]);
            // not i + 1 because we can reuse
same elements
            backtrack(list, tempList, nums,
remain - nums[i], i);
            // not i + 1 because we can reuse
same elements
            tempList.remove(tempList.size() -
1);
        }
    }
```

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Subset Backtrack Pattern

```
- Subsets
public List<List<Integer>> subsets( int[] nums) {
    List<List<Integer>> list = new ArrayList <>();
    Arrays.sort( nums);
    backtrack(list, new ArrayList <>(), nums, 0);
    return list;
}
private void backtrack(List<List<Integer>> list, List<Integer>
tempList, int [] nums, int start){
    list.add(new ArrayList<>(tempList));
    for(int i = start; i < nums.length; i++){
    // skip duplicates
        if(i > start && nums[i] == nums[i-1])
        continue;
        // skip duplicates
        tempList.add(nums[i]);
        backtrack(list, tempList, nums, i + 1);
        tempList.remove(tempList.size() - 1);
    }
}
```

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Subset Backtrack Pattern

```
}
private void backtrack (List<List<Integer>> list,
tempList, int [] nums, int start){
    list.add(new ArrayList<>(tempList));
    for(int i = start; i < nums.l ength; i++){
        if(i > start && nums[i] == nums[i-1])
        continue;
        // skip duplicates
        tempList.add(nums[i]);
        backtrack(list, tempList, nums, i + 1);
        tempList.remove(tempList.size() - 1);
    }
}
```

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Palindrome Backtrack Pattern

```
- Palindrome Partitioning
public List<List<String>> partition(String s) {
    List<List<String>> list = new ArrayList<>();
    backtrack (list, new ArrayList <>(), s, 0);
    return list;
}
public void backtrack (List<List<String>> list, List<String>
tempList, String s, int start){
    if(start == s.length())
        list.add(new ArrayList <>(tempList));
    else{
        for(int i = start; i < s.length(); i++){
            if(isPalindrome(s, start, i)){
                tempList.add(s.substring(start, i + 1));
                backtrack(list, tempList, s, i + 1);
                tempList.remove(tempList.size() - 1);
            }
        }
```

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Permutation Backtrack Pattern

```
- Permutations
public List<List<Integer>> permute(int[] nums) {
    List<List<Integer>> list = new ArrayList <>();
        // Arrays.sort(nums); // not necess ary
        backtrack(list, new ArrayList <>(), nums);
        return list;
}
private void backtrack(List<List<Integer>>list, List<Integer>
tempList, int [] nums){
    if(tempList.size() == nums.length){
        list.add(new ArrayList<>(tempList));
    } else{
    for(int i = 0; i < nums.length; i++){
    // element already exists, skip
```

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```
            if(tempList.contains(nums[i])) continue;
            // element already exists, skip
                tempList.add(nums[i]);
                backtrack(list, tempList, nums);
                tempList.remove(tempList.size() - 1);
            }
        }
```