

# 1 General

## 1.1 Interviewer Considerations

### Notes:

- How did the candidate **analyze** the problem?
- Did the candidate miss any special or **edge** cases?
- Did the candidate approach the problem **methodically** and logically?
- Does the candidate have a strong foundation in basic computer science **concepts**?
- Did the candidate produce **working code**? Did the candidate **test** the code?
- Is the candidate's code clean and easy to read and **maintain**?
- Can the candidate **explain** their ideas clearly?

## 1.2 Steps for Success During the Technical Interview

### Summary:

1. **Clarify the question**
  - (a) Understand what the question is asking and gather example inputs and outputs.
  - (b) Clarify constraints such as:
    - i. Can numbers be negative or repeated?
    - ii. Are values sorted or do we need to sort them?
    - iii. Can we assume input validity?
  - (c) Asking clarifying questions shows communication skills and prevents missteps.
2. **Design a solution**
  - (a) Avoid immediate coding; propose an initial approach and refine it.
  - (b) Analyze the algorithm's time and space complexity.
  - (c) Consider and address edge cases.
  - (d) Think aloud to demonstrate logical reasoning and collaboration.
  - (e) Discuss non-optimal ideas to show your thought process.
3. **Write your code**
  - (a) Structure the solution using helper functions.
  - (b) Confirm API details when uncertain.
  - (c) Use your strongest programming language and full syntax.
  - (d) Write complete, working code—not pseudocode.
4. **Test your code**
  - (a) Validate your solution with 1–2 example test cases.
  - (b) Walk through each line using inputs.
  - (c) Do not assume correctness—prove it through testing.
  - (d) Discuss any further optimizations and their trade-offs.

## 1.3 Common Mistakes to Avoid

### Warning:

1. Starting to code without clarifying the problem.
2. Failing to write or discuss sample inputs and outputs.
3. Using pseudocode instead of fully functional code.
4. Misunderstanding the problem or optimizing prematurely.

## 1.4 Syntax

### Summary:

1. `dict.items()`
  - Returns a view object that displays a list of a dictionary's key-value tuple pairs.
2. `sorted(iterable, key=..., reverse=...)`
  - `iterable`: The sequence or collection (e.g., list, dictionary view) to be sorted.
  - `key=...`: A function that extracts a comparison key from each element. Sorting is performed based on the result of this function.
    - `key=lambda x: x[0]`: Sort by the first element of each tuple.
    - `key=lambda x: x[1]`: Sort by the second element of each tuple.
  - `reverse=...`: A boolean value. If `True`, sorted in descending order; otherwise, sorted in ascending order (default is `False`).

## 2 Arrays and Hashing

### 2.1 When to Use?

**Summary:**

- To count frequencies in  $O(n)$  time.
- To check membership in constant time.
- To map keys to values (e.g., index, count, group).
- To group elements by shared features (e.g., anagrams).
- To detect duplicates efficiently.

### 2.2 Hashing

**Algorithm:**

```
1 def solve_problem(nums):
2     # Step 1: Initialize the hashmap (e.g., for frequency, index, or existence check)
3     hashmap = {}
4
5     # Step 2: Iterate over the array
6     for i, num in enumerate(nums):
7         # Step 3: Define your condition (e.g., check complement, existence, frequency)
8         if some_condition_based_on_hashmap(num, hashmap):
9             # Step 4: Return or process result as needed
10            return result_based_on_condition
11
12        # Step 5: Update the hashmap
13        hashmap_update_logic(num, i, hashmap)
14
15    # Step 6: Handle the case where the condition is never met
16    return final_result_if_needed
17
18 # Helper functions (replace with actual logic based on the problem)
19 def some_condition_based_on_hashmap(num, hashmap):
20     # Example: return (target - num) in hashmap
21     pass
22
23 def hashmap_update_logic(num, i, hashmap):
24     # Example: hashmap[num] = i
25     pass
```

Listing 1: General Hashing Pattern

## 2.3 Common Problems

### Summary:

Problem	Description:
217. Contains Duplicate	Given an integer array <code>nums</code> , return true if any value appears at least twice. <ul style="list-style-type: none"> <li>• Use a set to store the elements. If an element is already in the set, return True.</li> <li>• Otherwise, add it to the set.</li> </ul>
242. Valid Anagram	Given two strings <code>s</code> and <code>t</code> , return true if <code>t</code> is an anagram of <code>s</code> and false otherwise. <ul style="list-style-type: none"> <li>• Use a hashMap to count the frequency of each character in <code>s</code> and <code>t</code>.</li> <li>• If the frequency maps are equal, return True. Otherwise, return False.</li> </ul>
1. Two Sum	Given an array of integers, return indices of the two numbers s.t. they add up to a specific target. <ul style="list-style-type: none"> <li>• <b>Tricks:</b> <ul style="list-style-type: none"> <li>– Use a hashMap to store the indices of the elements, <code>prevMap[nums[i]] = i</code></li> <li>– For each element, check if the <code>target - nums[i]</code> is in the map.</li> <li>– If it is, return the index of the <code>target - nums[i]</code> (from <code>prevMap</code>) and <code>i</code>. Otherwise, add <code>target - nums[i]</code>.</li> </ul> </li> </ul>
**49. Group Anagrams	Given an array of strings, group the anagrams together. <ul style="list-style-type: none"> <li>• Use a hashMap to store a tuple of count of each char as the key and the list of words as the value.</li> <li>• For each word, create a tuple of count of each char and add the word to the list in the map.</li> <li>• Finally, return the values of the map.</li> </ul>
**347. Top K Frequent Elements	Given an integer array <code>nums</code> and an integer <code>k</code> , return the <code>k</code> most frequent elements. <ul style="list-style-type: none"> <li>• Use a hashMap to count the frequency of each element.</li> <li>• Sort the map by frequency and return the top <code>k</code> elements.</li> </ul>

## 3 Two Pointers

### 3.1 When to Use?

#### Summary:

- If we need to find a pair of elements that satisfy a condition.
- If we need to find a subarray that satisfies a condition.

### 3.2 Slow and Fast Pointers

#### Algorithm:

1.

#### 3.2.1 Common Problems

#### Summary:

Problem	Description:
15. 3Sum	Given an array of integers, return all the triplets [nums[i], nums[j], nums[k]] s.t. $i \neq j$ , $i \neq k$ , and $j \neq k$ .
<ul style="list-style-type: none"> <li>• <b>Tricks:</b></li> </ul>	
125. Valid Palindrome	Given a string, determine if it is a palindrome, considering only alphanumeric characters and ignoring cases.
<ul style="list-style-type: none"> <li>• <code>s_new = ".join(char.lower() for char in s if char.isalnum())</code> to remove non-alphanumeric and lowercase.</li> <li>• Use front and back pointers. If they not equal, return False. If equal move both pointers.</li> </ul>	
167. Two Sum II - Input array is sorted	Given an array of integers that is already sorted in ascending order, find two numbers such that they add up to a target.
<ul style="list-style-type: none"> <li>• Use front and back pointers. If <math>&gt;</math> target, move back pointer left. If <math>&lt;</math> target, move front pointer right.</li> </ul>	

### 3.3 Left and Right Pointers

#### Algorithm:

1. Initialize two pointers. Some common choices:
  - One at the front and one at the back of the array.
  - Both at the front of the array.
  - Both at the back of the array.

#### 3.3.1 Common Problems

##### Summary:

Problem	Description:
15. 3Sum	Given an array of integers, return all the triplets [nums[i], nums[j], nums[k]] s.t. $i \neq j$ , $i \neq k$ , and $j \neq k$ .
• Tricks:	
125. Valid Palindrome	Given a string, determine if it is a palindrome, considering only alphanumeric characters and ignoring cases.
• <code>s_new = ".join(char.lower() for char in s if char.isalnum())</code> to remove non-alphanumeric and lowercase.	
• Use front and back pointers. If they not equal, return False. If equal move both pointers.	
167. Two Sum II - Input array is sorted	Given an array of integers that is already sorted in ascending order, find two numbers such that they add up to a target.
• Use front and back pointers. If $>$ target, move back pointer left. If $<$ target, move front pointer right.	

## 4 Sliding Window

### 4.1 Fixed Sliding Window

#### Summary:

- Find a subarray/substring of a fixed size that satisfies a condition.
- Find the maximum or minimum of a subarray of a fixed size.

#### Algorithm:

```
1 initialize window_sum = 0
2 initialize max_result (or other required value)
3
4 # Set up initial window
5 for i in range(0, k):
6     window_sum += arr[i]
7
8 max_result = window_sum # Initialize result
9
10 # Slide the window
11 for i in range(k, n):
12     window_sum += arr[i] - arr[i - k] # Add new element and remove 1st element of prev window
13     max_result = max(max_result, window_sum) (or other computation)
14
15 return max_result (or other required value)
16
```

### 4.1.1 Common Problems

#### Summary:

Problem	Description:
643. Maximum Average Subarray I	Given an integer array <code>nums</code> and an integer <code>k</code> , return the maximum average value of a subarray of length <code>k</code> . <ul style="list-style-type: none"><li>• Follow template.</li></ul>
567. Permutation in String	Given two strings <code>s1</code> and <code>s2</code> , return <code>true</code> if <code>s2</code> contains a permutation of <code>s1</code> , or <code>false</code> otherwise. <ul style="list-style-type: none"><li>• <b>Init:</b> Follow template with <code>window_valid</code>, <code>freqMap_window</code>, <code>freqMap_s1</code>, and fixed size <math>k</math> of <code>len(s1)</code>. Rather than <code>sum</code>, get <code>freq</code> of chars.</li><li>• <b>Special Case:</b> If <code>len(s1) &gt; len(s2)</code>, return <code>False</code>.</li><li>• <b>For:</b> Since contiguous, slide through <code>s2</code> and update <code>freqMap_window</code> by adding new char and removing old char (make sure to <code>del</code> key if <code>freq = 0</code>).</li><li>• <b>Condition:</b> If <code>freqMap_window == freqMap_s1</code>, return <code>True</code>.</li></ul>



## 4.2 Dynamic Sliding Window

### Summary:

- Find longest or shortest subarray/substring that satisfies a condition.

### Algorithm:

```
1 initialize left = 0
2 initialize window_state (sum, count, frequency map, etc.)
3 initialize min_or_max_result
4
5 for right in range(n):
6     update window_state to include arr[right] # Expand the window
7
8     while window_state violates the condition:
9         update min_or_max_result (if needed)
10        update window_state to exclude arr[left] # Shrink the window
11        move left pointer forward
12
13 return min_or_max_result
```

## 4.2.1 Common Problems

## Summary:

Problem	Description:
121. Best Time to Buy and Sell Stock	<p>Given an array where the <math>i</math>th element is the price of a given stock on day <math>i</math>, find the maximum profit you can achieve.</p> <p>You may not engage in multiple transactions.</p> <ul style="list-style-type: none"> <li>• <b>Buy low, sell high principle</b> <ul style="list-style-type: none"> <li>– Use <math>left = buy</math> and <math>right = sell</math>, initialized at 0, 1.</li> <li>– If <math>price[right] \geq price[left]</math>, update max profit. Move right pointer since we can still sell for a profit.</li> <li>– If <math>price[right] &lt; price[left]</math>, move left pointer since we need to find a lower price to buy.</li> <li>– Continue until right pointer reaches the end of the array.</li> </ul> </li> </ul>
3. Longest Substring W/O Repeating Characters	<p>Given a string <math>s</math>, find the length of the longest substring without repeating characters.</p> <ul style="list-style-type: none"> <li>• <b>Init:</b> Follow template and use frequency map of chars for <code>window_state</code>.</li> <li>• <b>While:</b> If a char is repeated, move left pointer to right by 1 and adjust <code>freqMap</code> until current char is unique.</li> <li>• <b>Change:</b> Compare substring length outside of while with <code>max_res = max(max_res, right - left + 1)</code>.</li> </ul>
424. Longest Repeating Character Replacement	<p>Given a string <math>s</math> that consists of only uppercase English letters, you can replace any letter with another letter.</p> <p>Find the length of the longest substr containing the same letter after performing at most <math>k</math> replacements.</p> <ul style="list-style-type: none"> <li>• <b>Init:</b> Follow template and use <code>freqMap</code> of chars for <code>window_state</code>.</li> <li>• <b>While:</b> If the number of replacements needed exceeds <math>k</math>, i.e. <math>(r - l + 1) - \max\_freq &gt; k</math> <ul style="list-style-type: none"> <li>– Move left pointer to right by 1 and adjust <code>freqMap</code> until the condition is satisfied.</li> </ul> </li> <li>• <b>Change:</b> Compare substring length outside of while with <code>max_res = max(max_res, right - left + 1)</code>.</li> </ul>
**76. Minimum Window Substring	<p>Given two strings <math>s</math> and <math>t</math>, return the minimum window substr of <math>s</math> such that every character in <math>t</math> (including duplicates) is included in the window. If there is no such substring, return ""</p> <ul style="list-style-type: none"> <li>• <b>Init:</b> Set <math>left = 0</math>. Initialize <code>count_t</code> as frequency map of <math>t</math>, <code>count_s</code> for current window, and variables <code>have = 0</code>, <code>required = len(count_t)</code>, <code>res = [-1, -1]</code>, and <code>resLen = \infty</code>.</li> <li>• <b>For right in range(n):</b> Expand window by adding <math>s[right]</math> to <code>count_s</code>. If frequency matches <code>count_t</code>, increment <code>have</code>.</li> <li>• <b>While have == required:</b> <ul style="list-style-type: none"> <li>– Update result if current window is smaller.</li> <li>– Shrink window by decrementing <code>count_s[s[left]]</code>; if below <code>count_t</code>, decrement <code>have</code>; increment <code>left</code>.</li> </ul> </li> <li>• <b>Return:</b> <math>s[res[0]:res[1]+1]</math> if valid window found, else empty string.</li> </ul>
239. Sliding Window Maximum	<p>Given an integer array <math>nums</math> and an integer <math>k</math>, return the maximum value in each sliding window of size <math>k</math>.</p> <ul style="list-style-type: none"> <li>• <b>Init:</b> Use deque to store indices of elements in the current window.</li> <li>• <b>For right in range(n):</b> <ul style="list-style-type: none"> <li>– Remove indices that are out of the current window.</li> <li>– Remove indices from the back of the deque while the current element is greater than the element at those indices.</li> <li>– Append the current index to the deque.</li> <li>– If the window size is reached, append the maximum (element at the front of the deque) to the result list.</li> </ul> </li> </ul>

## 5 Binary Search

### 5.1 When to Use?

**Summary:**

- If array is sorted.

## 6 Linked List

**Summary:** Data structure for storing objects in linear order.

- **Object:** Data and a pointer to the next object.

### 6.1 When to Use?

**Summary:**

- Implement other DS: stacks, queues, hash tables.
- Dynamic memory allocation.

### 6.2 Operations

**Summary:**

Operation	Time Complexity
Search	$O(n)$
Insert	$O(1)$
Delete	$O(1)$
Access	$O(n)$

### 6.3 Singly Linked List

**Algorithm:**

### 6.4 Doubly Linked List

**Algorithm:**

### 6.5 Circular Linked List

**Algorithm:**

## 6.6 Common Problems

### Summary:

Problem	Description:
206. Reverse Linked List	Given the head of a singly linked list, reverse the list and return the reversed list.
<ul style="list-style-type: none"> <li>• <b>Iterative:</b> <ul style="list-style-type: none"> <li>– Init: <math>\underbrace{\text{None}}_{\text{prev}} \rightarrow \underbrace{0}_{\text{curr}} \rightarrow 1 \rightarrow 2</math></li> <li>– While loop until curr is None. curr will point to prev, then curr will get updated to a temp that has curr.next and prev will be updated to curr. <ul style="list-style-type: none"> <li>* <math>\underbrace{\text{None}}_{\text{prev}} \leftarrow \underbrace{0}_{\text{curr}} \rightarrow \underbrace{1}_{\text{temp}} \rightarrow 2</math></li> <li>* <math>\text{None} \leftarrow \underbrace{0}_{\text{prev=curr}} \rightarrow \underbrace{1}_{\text{curr=temp}} \rightarrow 2</math></li> </ul> </li> <li>– prev will be the new head.</li> </ul> </li></ul>	