

Grokking the Coding Interview: Patterns for Coding Questions

42% completed

- Problem Challenge 1
- Solution Review: Problem Challenge 1
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- Solution Review: Problem Challenge 2

Pattern: Tree Depth First Search

- Introduction
- Binary Tree Path Sum (easy)
- All Paths for a Sum (medium)
- Sum of Path Numbers (medium)
- Path With Given Sequence (medium)
- Count Paths for a Sum (medium)
- Problem Challenge 1
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Pattern: Two Heaps

- Introduction
- Find the Median of a Number Stream (medium)
- Sliding Window Median (hard)
- Maximize Capital (hard)
- Problem Challenge 1
- Solution Review: Problem Challenge 1

Pattern: Subsets

- Introduction
- Subsets (easy)
- Subsets With Duplicates (easy)
- Permutations (medium)
- String Permutations by changing case (medium)
- Balanced Parentheses (hard)
- Unique Generalized Abbreviations (hard)
- Problem Challenge 1
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- Problem Challenge 3
- Solution Review: Problem Challenge 3

Pattern: Modified Binary Search

- Introduction
- Order-agnostic Binary Search (easy)
- Ceiling of a Number (medium)
- Next Letter (medium)

Order-agnostic Binary Search (easy)

We'll cover the following

- Problem Statement
- Try it yourself
- Solution
- Code
 - Time complexity
 - Space complexity

Problem Statement

Given a sorted array of numbers, find if a given number 'key' is present in the array. Though we know that the array is sorted, we don't know if it's sorted in ascending or descending order. You should assume that the array can have duplicates.

Write a function to return the index of the 'key' if it is present in the array, otherwise return -1.

Example 1:

```
Input: [4, 6, 10], key = 10
Output: 2
```

Example 2:

```
Input: [1, 2, 3, 4, 5, 6, 7], key = 5
Output: 4
```

Example 3:

```
Input: [10, 6, 4], key = 10
Output: 0
```

Example 4:

```
Input: [10, 6, 4], key = 4
Output: 2
```

Try it yourself

Try solving this question here:

JavaPython3JSJSC++

```
1 const binary_search = function(arr, key) {
2   // TODO: Write your code here
3   return -1;
4 };
5
6 console.log(binary_search([4, 6, 10], 10))
7 console.log(binary_search([1, 2, 3, 4, 5, 6, 7], 5))
8 console.log(binary_search([10, 6, 4], 10))
9 console.log(binary_search([10, 6, 4], 4))
10
```

RUNSAVERESET

Solution

To make things simple, let's first solve this problem assuming that the input array is sorted in ascending order. Here are the steps for **Binary Search**:

- Let's assume **start** is pointing to the first index and **end** is pointing to the last index of the input array (let's call it **arr**). This means:

```
int start = 0;
int end = arr.length - 1;
```

- First, we will find the **middle** of **start** and **end**. An easy way to find the middle would be: $middle = (start + end) / 2$. For **Java** and **C++**, this equation will work for most cases, but when **start** or **end** is large, this equation will give us the wrong result due to integer overflow. Imagine that **start** is equal to the maximum range of an integer (e.g. for Java: `int start = Integer.MAX_VALUE`). Now adding anything to **start** will result in an integer overflow. Since we need to add both the numbers first to evaluate our equation, an overflow might occur. The safest way to find the middle of two numbers without getting an overflow is as follows:

- Number Range (medium)
- Search in a Sorted Infinite Array (medium)
- Minimum Difference Element (medium)
- Bitonic Array Maximum (easy)
- Problem Challenge 1
- Solution Review: Problem Challenge 1
- Problem Challenge 2
- Solution Review: Problem Challenge 2
- Problem Challenge 3
- Solution Review: Problem Challenge 3

Pattern: Bitwise XOR

- Introduction
- Single Number (easy)
- Two Single Numbers (medium)
- Complement of Base 10 Number (medium)
- Problem Challenge 1
- Solution Review: Problem Challenge 1

Pattern: Top 'K' Elements

- Introduction
- Top 'K' Numbers (easy)
- Kth Smallest Number (easy)
- 'K' Closest Points to the Origin (easy)
- Connect Ropes (easy)
- Top 'K' Frequent Numbers (medium)
- Frequency Sort (medium)
- Kth Largest Number in a Stream (medium)
- 'K' Closest Numbers (medium)
- Maximum Distinct Elements (medium)
- Sum of Elements (medium)
- Rearrange String (hard)
- Problem Challenge 1
- Solution Review: Problem Challenge 1
- Problem Challenge 2
- Solution Review: Problem Challenge 2
- Problem Challenge 3
- Solution Review: Problem Challenge 3

Pattern: K-way merge

- Introduction
- Merge K Sorted Lists (medium)
- Kth Smallest Number in M Sorted Lists (Medium)
- Kth Smallest Number in a Sorted Matrix (Hard)
- Smallest Number Range (Hard)
- Problem Challenge 1
- Solution Review: Problem Challenge 1

Pattern : 0/1 Knapsack (Dynamic Programming)

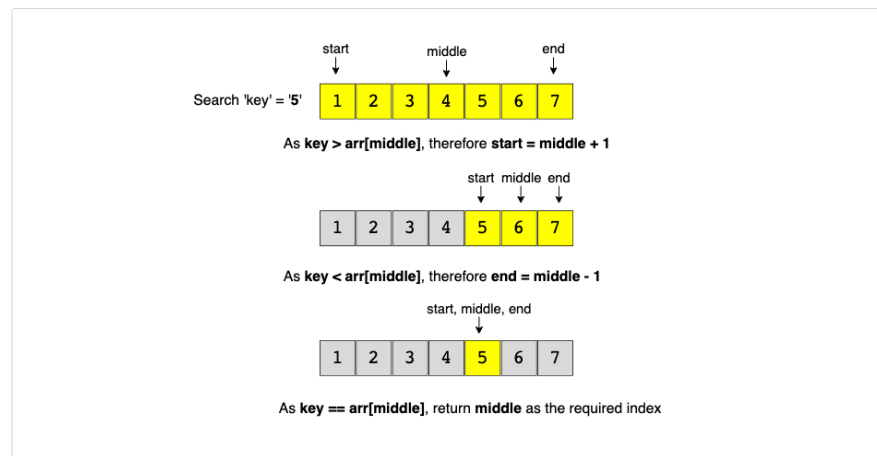
- Introduction
- 0/1 Knapsack (medium)
- Equal Subset Sum Partition

$$\text{middle} = \text{start} + (\text{end} - \text{start}) / 2$$

The above discussion is not relevant for **Python**, as we don't have the integer overflow problem in pure Python.

- Next, we will see if the 'key' is equal to the number at index **middle**. If it is equal we return **middle** as the required index.
- If 'key' is not equal to number at index **middle**, we have to check two things:
 - If **key < arr[middle]**, then we can conclude that the **key** will be smaller than all the numbers after index **middle** as the array is sorted in the ascending order. Hence, we can reduce our search to **end = mid - 1**.
 - If **key > arr[middle]**, then we can conclude that the **key** will be greater than all numbers before index **middle** as the array is sorted in the ascending order. Hence, we can reduce our search to **start = mid + 1**.
- We will repeat steps 2-4 with new ranges of **start** to **end**. If at any time **start** becomes greater than **end**, this means that we can't find the 'key' in the input array and we must return '-1'.

Here is the visual representation of **Binary Search** for the Example-2:



If the array is sorted in the descending order, we have to update the step 4 above as:

- If **key > arr[middle]**, then we can conclude that the **key** will be greater than all numbers after index **middle** as the array is sorted in the descending order. Hence, we can reduce our search to **end = mid - 1**.
- If **key < arr[middle]**, then we can conclude that the **key** will be smaller than all the numbers before index **middle** as the array is sorted in the descending order. Hence, we can reduce our search to **start = mid + 1**.

Finally, how can we figure out the sort order of the input array? We can compare the numbers pointed out by **start** and **end** index to find the sort order. If **arr[start] < arr[end]**, it means that the numbers are sorted in ascending order otherwise they are sorted in the descending order.

Code

Here is what our algorithm will look like:

```

1 function binary_search(arr, key) {
2   let start = 0;
3   end = arr.length - 1;
4   isAscending = arr[start] < arr[end];
5   while (start <= end) {
6     // calculate the middle of the current range
7     mid = Math.floor(start + (end - start) / 2);
8
9     if (key === arr[mid]) {
10      return mid;
11    }
12    if (isAscending) { // ascending order
13      if (key < arr[mid]) {
14        end = mid - 1; // the 'key' can be in the first half
15      } else { // key > arr[mid]
16        start = mid + 1; // the 'key' can be in the second half
17      }
18    } else { // descending order
19      if (key > arr[mid]) {
20        end = mid - 1; // the 'key' can be in the first half
21      } else { // key < arr[mid]
22        start = mid + 1; // the 'key' can be in the second half
23      }
24    }
25  }
26 }

```

MW

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Create

(medium)

Subset Sum (medium)

Minimum Subset Sum Difference (hard)

Problem Challenge 1

Solution Review: Problem Challenge 1

Problem Challenge 2

Solution Review: Problem Challenge 2

Pattern: Topological Sort (Graph)

Introduction

Topological Sort (medium)

Tasks Scheduling (medium)

Tasks Scheduling Order (medium)

All Tasks Scheduling Orders (hard)

Alien Dictionary (hard)

Problem Challenge 1

Solution Review: Problem Challenge 1

Problem Challenge 2

Solution Review: Problem Challenge 2

Miscellaneous

Kth Smallest Number (hard)

Conclusions

Where to Go from Here

Mark Course as Completed

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return -1; // element not found

}

RUN

SAVE

RESET

Close

Output

1.601s

2

4

0

2

Time complexity

Since, we are reducing the search range by half at every step, this means that the time complexity of our algorithm will be $O(\log N)$ where 'N' is the total elements in the given array.

Space complexity

The algorithm runs in constant space $O(1)$.

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Introduction

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Ceiling of a Number (medium)

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