2540. Minimum Common Value

Easy | Array | Hash Table | Two Pointers | Binary Search

Leetcode Link

Problem Description

The problem involves finding the smallest integer that is common to two sorted arrays of integers `nums1` and `nums2`. Both arrays are sorted in non-decreasing order. To solve this problem, we are tasked with comparing the integers from both arrays to identify a common integer. If such an integer is found, it should be returned as the result. If there is no integer common to both arrays, the function should return `-1`.

Intuition

The solution strategy is based on the fact that both arrays are already sorted in non-decreasing order. This allows us to use a two-pointer approach to efficiently compare elements of the two arrays without the need to look at every possible pair of elements.

Here's how the two-pointer approach works:

1. Start with two pointers, `i` and `j`, both initialized to 0, which will traverse through `nums1` and `nums2` respectively.
2. While both pointers have not reached the end of their respective arrays, compare the elements pointed to by `i` and `j`.
3. If the elements are equal, that means we've found a common integer, and we return that integer immediately since we are looking for the minimum and the array is sorted.
4. If they are not equal, we need to move the pointer that points to the smaller element to the right to find a potential match, as the larger element will never match with any previous elements in the other array due to sorting.
5. If we reach the end of either array without finding a match, we conclude there is no common integer, and thus return `-1`.

Using this method, we efficiently move through both arrays, comparing only the necessary elements, and we are guaranteed to find the smallest common integer if one exists.

Solution Approach

The implementation of the solution is a direct application of the two-pointer approach described in the intuition section. The approach utilizes the given sorting of `nums1` and `nums2` to compare elements and find the least common integer.

Here is how the algorithm is applied through the given Python code:

1. Initialize two pointers `i` and `j` to `0`. These pointers are indices for iterating through `nums1` and `nums2` respectively.
2. Determine the lengths of the two arrays `nums1` and `nums2` and store them in variables `m` and `n`. This is done to avoid repeated calculation of lengths within the loop.
3. Use a while loop that continues as long as `i < m` and `j < n`. This condition ensures that we do not go out of bounds in either array.
4. Inside the loop, compare the elements at the current indices of the two arrays, `nums1[i]` and `nums2[j]`. If they are equal, `nums1[i]` (or `nums2[j]`, since they are the same) is immediately returned as the solution since it's the first common integer found when traversing the arrays from left to right.
5. If the elements are not equal, increment the pointer `i` if `nums1[i]` is less than `nums2[j]`, because we are looking for the possibility of `nums1[i]` being in the subsequent elements of `nums2`.
6. Otherwise, increment the pointer `j` since `nums2[j]` is less, and we want to find if `nums2[j]` matches any subsequent elements in `nums1`.
7. If the while loop ends without returning, this implies that there was no common element between the two arrays. Therefore, we return `-1` at the end of the function to indicate that no common integer was found.

In summary, the algorithm leverages the sorted nature of the inputs to use a methodical, step-by-step comparison that conserves unnecessary checks. This is a common technique in problems involving sorted arrays, known for its efficiency and simplicity.

Example Walkthrough

Let's consider two sorted arrays `nums1` and `nums2` for the walkthrough:

- `nums1 = [1, 3, 5, 7]`
- `nums2 = [2, 3, 6, 8]`

We need to find the smallest integer common to both `nums1` and `nums2`. According to the solution approach, we will use the two-pointer technique.

1. Initialize two pointers, `i` and `j`, at `0`. So `i` points to `nums1[i]` which is `1`, and `j` points to `nums2[j]` which is `2`.
2. Compare the elements at `nums1[i]` and `nums2[j]`. Since `1 < 2`, it doesn't match, and we increment `i` since `nums1[i]` is smaller.
3. Now `i = 1` and `j = 0`. The new values at the pointers are `nums1[1]` which is `3`, and `nums2[0]` which is `2`.
4. Again, compare `nums1[i]` with `nums2[j]`. Since `3 > 2`, we increment `j` this time as `nums2[j]` is smaller.
5. `i` is still at `1` and `j` is incremented to `1`. We now have `nums1[1]` as `3`, and `nums2[1]` also as `3`.
6. Since `nums1[i]` is equal to `nums2[j]`, we have found the smallest common integer, which is `3`.
7. Return `3` as the result.

According to the example, `3` is the smallest integer that is found in both arrays `nums1` and `nums2`. Thus demonstrating the efficiency of the two-pointer approach in solving such problems. If there were no common elements, the pointers would reach the end of their respective arrays, and the function would return `-1`.

Python Solution

```python
class Solution:
    def getCommon(self, nums1: List[int], nums2: List[int]) -> int:
        # Initialize pointers for both lists
        index1 = index2 = 0

        # Get the lengths of both lists
        length1, length2 = len(nums1), len(nums2)

        # Iterate over both lists as long as there are elements in each
        while index1 < length1 and index2 < length2:
            # If the current elements are the same, return the common element
            if nums1[index1] == nums2[index2]:
                return nums1[index1]

            # If the current element in nums1 is smaller, move to the next element in nums1
            if nums1[index1] < nums2[index2]:
                index1 += 1
            else:
                # If the current element in nums2 is smaller, move to the next element in nums2
                index2 += 1

        # If no common elements are found, return -1
        return -1

```

Java Solution

```java
class Solution {

    /**
     * Finds the first common element in two sorted arrays.
     *
     * If a common element is found, this method returns that element.
     * If there are no common elements, the method returns -1.
     *
     * @param nums1 The first sorted array.
     * @param nums2 The second sorted array.
     * @return The first common element or -1 if none found.
     */
    public int getCommon(int[] nums1, int[] nums2) {
        int nums1Length = nums1.length;
        int nums2Length = nums2.length;

        // Initialize indices for iterating through the arrays
        int index1 = 0;
        int index2 = 0;

        // Loop through both arrays until one array is fully traversed
        while (index1 < nums1Length && index2 < nums2Length) {
            // Check the current elements in each array for a match
            if (nums1[index1] == nums2[index2]) {
                // If a match is found, return the common element
                return nums1[index1];
            }

            // Increment the index of the smaller element
            if (nums1[index1] < nums2[index2]) {
                ++index1;
            } else {
                ++index2;
            }
        }

        // Return -1 if no common element is found
        return -1;
    }
}

```

C++ Solution

```cpp
class Solution {
public:
    // Function to find the first common element in two sorted arrays
    int getCommon(vector<int>& nums1, vector<int>& nums2) {
        int sizeNums1 = nums1.size(); // Size of the first array
        int sizeNums2 = nums2.size(); // Size of the second array

        // Initialize pointers for both arrays
        int indexNums1 = 0;
        int indexNums2 = 0;

        // Loop through both arrays until one array is fully traversed
        while (indexNums1 < sizeNums1 && indexNums2 < sizeNums2) {
            // If a common element is found, return it
            if (nums1[indexNums1] == nums2[indexNums2]) {
                return nums1[indexNums1];
            }

            // Move the pointer in the smaller-value array to find a match
            if (nums1[indexNums1] < nums2[indexNums2]) {
                ++indexNums1;
            } else {
                ++indexNums2;
            }
        }

        // If no common element is found, return -1
        return -1;
    }
};

```

Typescript Solution

```typescript
// Function to find the first common element between two sorted arrays.
// If no common element is found, returns -1.
function getCommon(nums1: number[], nums2: number[]): number {
    // Length of the first array.
    const length1 = nums1.length;
    // Length of the second array.
    const length2 = nums2.length;
    // Initialize pointers for both arrays.
    let index1 = 0;
    let index2 = 0;

    // Continue looping until the end of one array is reached.
    while (index1 < length1 && index2 < length2) {
        // Check if the current elements are the same.
        if (nums1[index1] === nums2[index2]) {
            // If they are the same, return the common element.
            return nums1[index1];
        }
        // If the current element of nums1 is smaller, move to the next element in nums1.
        if (nums1[index1] < nums2[index2]) {
            index1++;
        } else {
            // Otherwise, move to the next element in nums2.
            index2++;
        }
    }
    // If no common element is found, return -1.
    return -1;
}

```

Time and Space Complexity

The time complexity of this code is `O(m + n)`, where `m` is the length of `nums1` and `n` is the length of `nums2`. This is because each while loop iteration increments either `i` or `j`, but never both at the same time, thus at most `m + n` iterations occur before the loop terminates.

The space complexity of the code is `O(1)` because there are no additional data structures that grow with the input size. Only a fixed number of integer variables `i`, `j`, `m`, and `n` are used regardless of the input size.