

Linear Search

Approach 1: Using Iteration method

This approach uses a for loop to iterate through the array `arr` from the beginning to the end.

Inside the loop, it checks if the current element `arr[i]` is equal to the target value.

If a match is found, it returns the index `i`.

If the loop completes without finding a match, it returns `-1` to indicate that the target value is not present in the array.

Space Complexity: The iterative approach has a constant space complexity of $O(1)$ since it doesn't require any additional data structures proportional to the input size.

Time Complexity: The time complexity of the iterative linear search is $O(n)$ in the worst case, where n is the size of the array. This is because, in the worst case, the target value might be located at the last position or be absent, requiring a complete traversal of the array.

Approach 2: Using Recursive method

This approach uses a recursive function to perform the search.

It checks the base case, which occurs when the index reaches the size of the array. In this case, it returns `-1` to indicate that the target is not found.

If the base case is not met, it checks if the current element `arr[index]` is equal to the target value.

If a match is found, it returns the index.

If a match is not found, it makes a recursive call to the function, passing the array, size, target, and an incremented index.

Space Complexity: The recursive approach has a space complexity of $O(n)$ in the worst case. This is because each recursive call adds a new frame to the call stack, which consumes memory. In the worst case, the recursion depth could be equal to the size of the array.

Time Complexity: The time complexity of the recursive linear search is also $O(n)$ in the worst case. Similar to the iterative approach, it may need to traverse the entire array to find the target value or determine its absence.