Searching in C

Searching is a fundamental operation in computer science, involving finding a specific element within a dataset. In C programming, we commonly employ two primary searching techniques:

1. Linear Search:

- **Simple and straightforward:** Iterates through the array sequentially, comparing each element with the target value.
- **Time complexity:** O(n) in the worst case, where n is the number of elements.
- **Suitable for unsorted arrays:** Can be used on any array, regardless of order.

2. Binary Search:

- **Efficient for sorted arrays:** Requires the array to be sorted in ascending or descending order. [1]
- **Divide and conquer approach:** Repeatedly divides the search space in half.
- **Time complexity:** O(log n), significantly faster than linear search for large datasets.

Example: Linear Search

```
#include <stdio.h>

int linearSearch(int arr[], int n, int x) {
    for (int i = 0; i < n; i++) {
        if (arr[i] == x) {
            return i;
        }
    }
    return -1;
}

int main() {
    int arr[] = {2, 3, 4, 10, 40};
    int x = 10;
    int n = sizeof(arr) / sizeof(arr[0]);
    int result = linearSearch(arr, n, x);
    (result == -1) ? printf("Element is not present in array")
                   : printf("Element is present at index %d", result);
    return 0;
}
```

Example: Binary Search

```
#include <stdio.h>

int binarySearch(int arr[], int l, int r, int x) {
    if (r >= l) {
        int mid = l + (r - l) / 2;
        if (arr[mid] == x)
            return mid;
        if (arr[mid] > x)
            return binarySearch(arr, l, mid - 1, x);
        return binarySearch(arr, mid + 1, r, x);
    }
    return -1;
}

int main() {
    int arr[] = {2, 3, 4, 10, 40};
    int x = 10;
    int n = sizeof(arr) / sizeof(arr[0]);
    int result = binarySearch(arr, 0, n - 1, x);
    (result == -1) ? printf("Element is not present in array")
                   : printf("Element is present at index %d", result);
    return 0;
}
```

Choosing the Right Search:

- **Unsorted arrays:** Linear search is the only option.
- **Sorted arrays:** Binary search is significantly more efficient.