Data Structures and Algorithms

LECTURE 06: SEARCHING ALGORITHMS

UNIVERSITY of GREENWICH

Alliance with FPT Education

Pearson

BTEC

Contents

- Searching Algorithms
  - – Linear Search
  - – Binary Search

Search Algorithm

- **Search algorithm** == an algorithm for finding an item with specified properties among a collection of items
- Different types of searching algorithms:
  - For virtual search spaces
    - Satisfy specific mathematical equations
    - Try to exploit partial knowledge about a structure
  - For sub-structures of a given structure
    - A graph, a string, a finite group
  - Search for the min / max of a function, etc.

Linear Search

- **Linear search** finds a particular value in a list
  - Checking every one of the elements
  - One at a time, in sequence
  - Until the desired one is found
- Worst & average performance: O(n)
- See the **visualization**

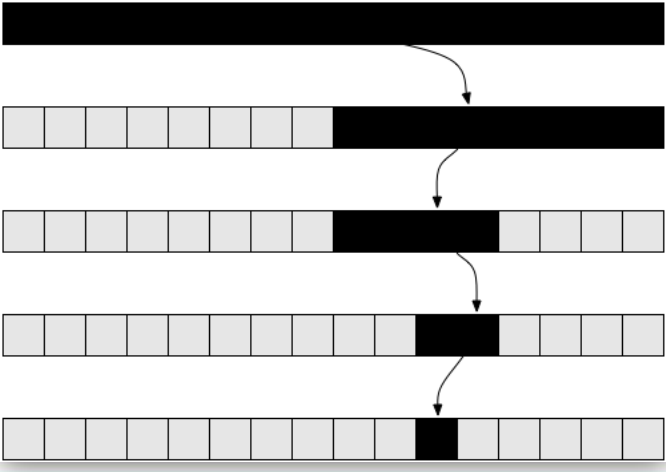
```
for each item in the list:
  if that item has the desired value,
    return the item's location
return nothing
```

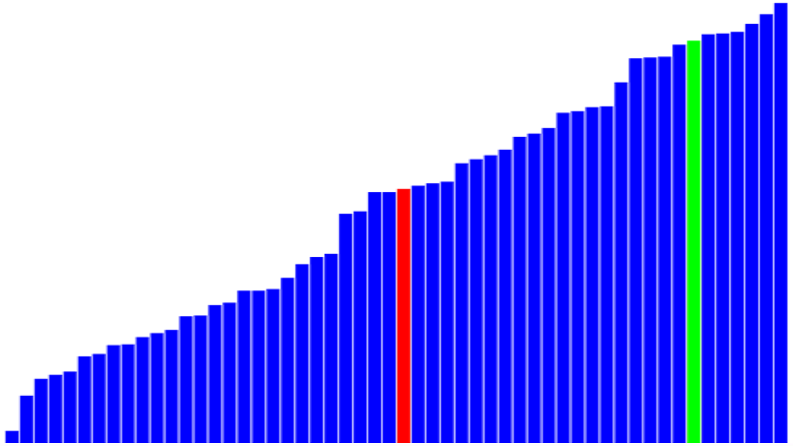
Linear Search

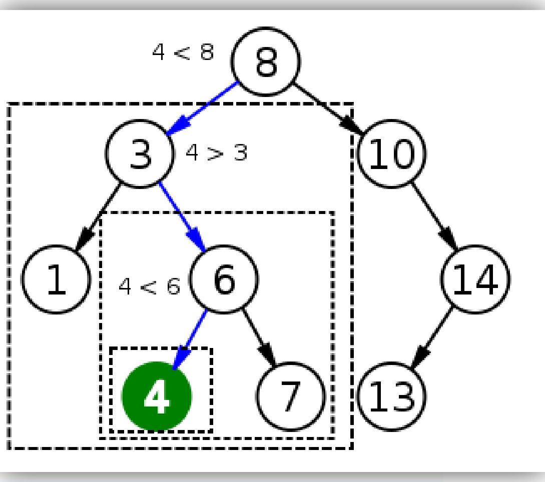
```
int LinearSearch(int arr[], int x)
 {
     int n = arr.length;
     for (int i = 0; i < n; i++)
     {
         if (arr[i] == x)
             return i;
     }
     return -1;
 }
```

Binary Search

- Binary search finds an item within a ordered data structure
- At each step, compare the input with the middle element
  - – The algorithm repeats its action to the left or right sub-structure
- Average performance: **O(log(n))**
- See the visualization







Binary Search (Iterative)

```
int binarySearch(int arr[], int key, int start, int end) {
  while (end >= start) {
    int mid = (start + end) / 2;
    if (arr[mid] < key)
      start = mid + 1;
    else if (arr[mid] > key)
      end = mid - 1;
    else
      return mid;
  }
  return KEY_NOT_FOUND;
}
```

Summary

- **Searching** algorithms
  - Binary Search, Linear Search