Algorithms for Search

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Objectives

- At the end of this lecture, student will be able to
  - apply the general strategies of searching in a list of elements
  - use various approaches of searching in a list of elements

Contents

- Linear Search
- Binary Search

Searching

- Searching
  - The process of finding a particular element (Key value) of an array

- Two types
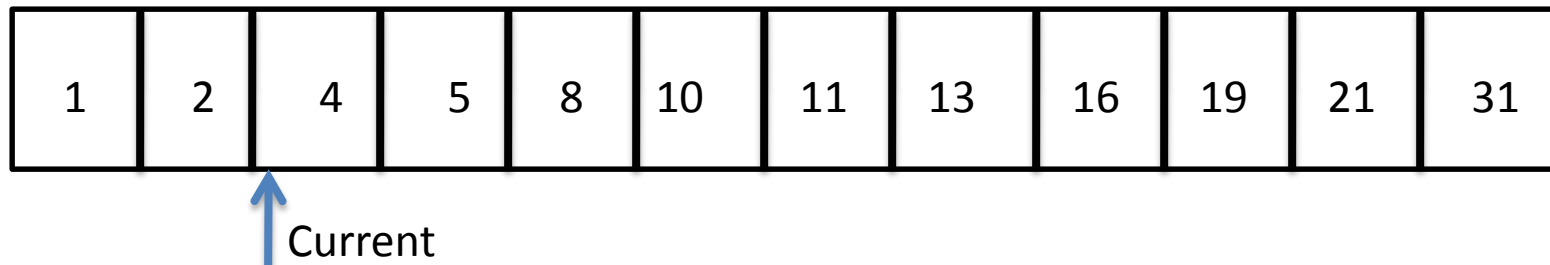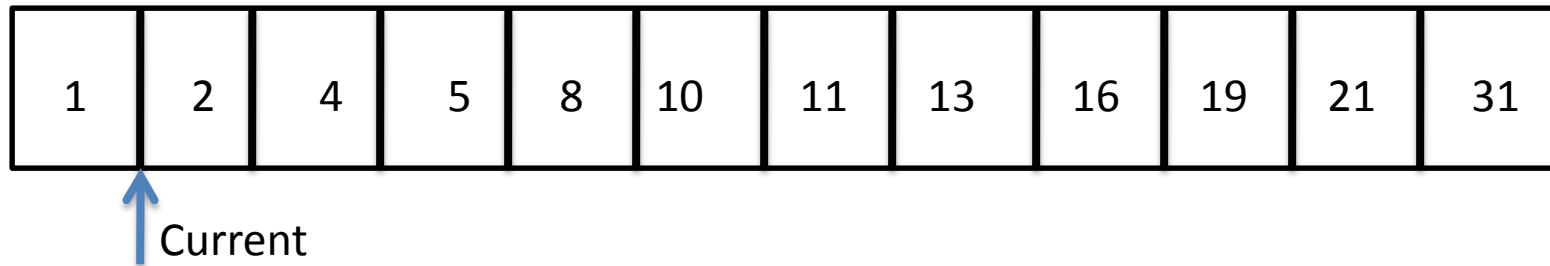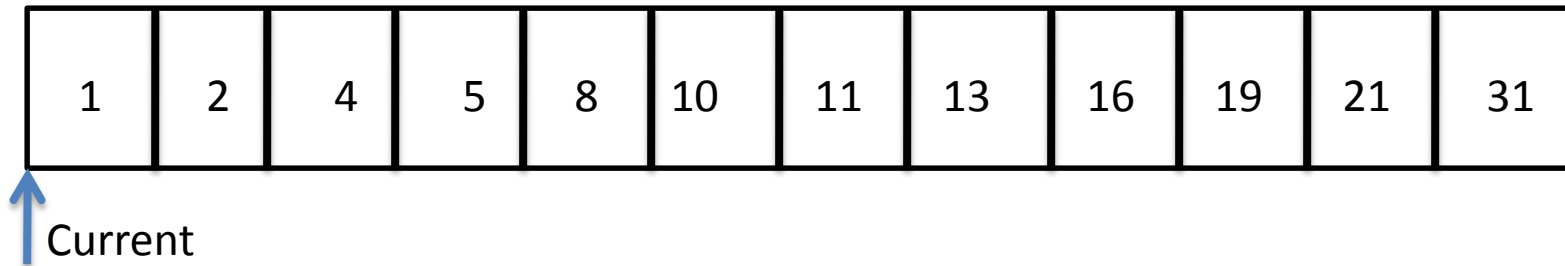 1. Linear search
  2. Binary search

Linear Search

- Also known as sequential search
- Suitable for searching a set of data for a particular value

- It operates by checking every element of a list one at a time in sequence until
  - a match is found or
  - end of array is reached

Trace of Linear Search

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

↑ Current

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

↑ Current

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

↑ Current

Linear Search

- Linear search runs in O(N)

- If the data is distributed randomly, on average N/2 comparisons will be needed

- The best case
  - value is equal to the first element tested, in which case only 1 comparison is needed

- The worst case
  - value is not in the list (or is the last item in the list), in which case N comparisons are needed

Merits and Demerits of Linear Search

- Merits
  - Works well for small or unsorted arrays
  - Easy to implement

- Demerits
  - Inefficient for large arrays

Binary Search

- Assumes that the data in the array is *Sorted*

- A technique for finding a particular value in a linear array, by ruling out half of the data at each step

Binary Search Algorithm

- Locate the middle element of the array and compares it to the search key

- If they are equal
  - search key is found
- If they are not equal
  - problem is reduced to searching one-half of the array

- If the search key is less than the middle element of the array
  - the first half of the array is searched
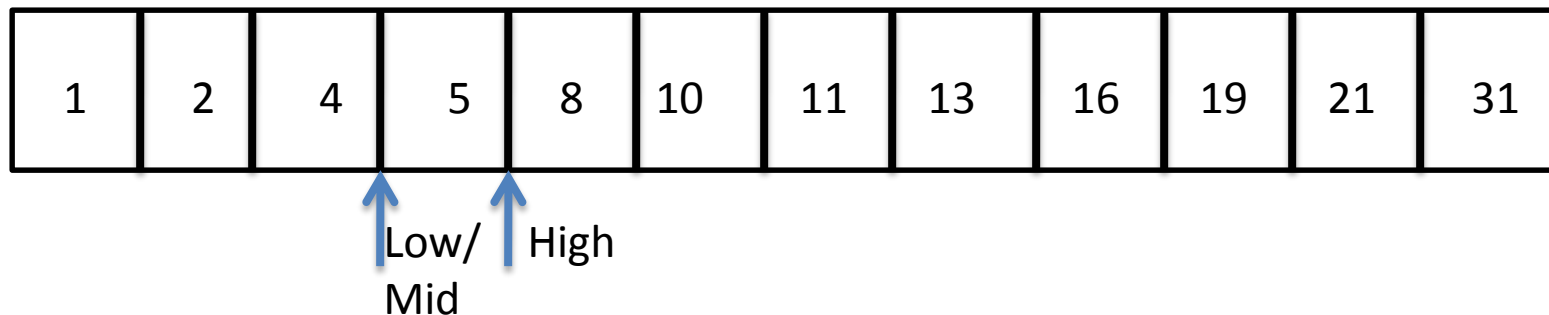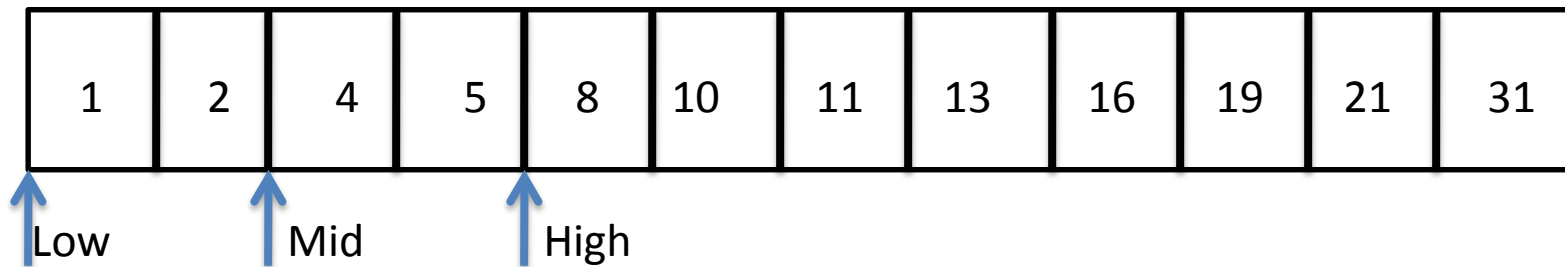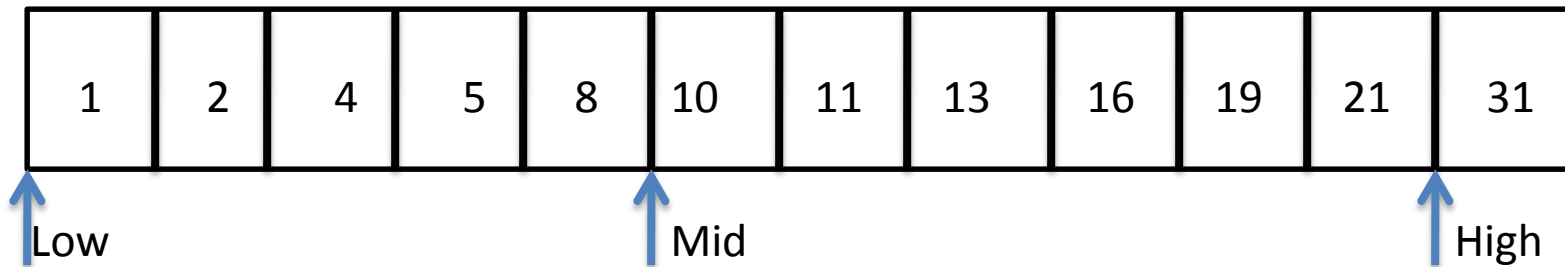 - otherwise the second half of the array is searched

Binary Search Algorithm contd.

- The search continues until
  - search key is equal to the middle element of a subarray or
  - subarray consists of one element that is not equal to the search key (i.e., the search key is not found)

Trace of Binary Search

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

Low   Mid   High

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

Low   Mid   High

| 1 | 2 | 4 | 5 | 8 | 10 | 11 | 13 | 16 | 19 | 21 | 31 |

Low/   High
Mid

Binary Search - Algorithm

```
low=0;  high=MAX-1;
while(low<=high){
    middle=(low+high)/2;
    if(key==array[middle]){
            printf("\nElement found at %d position",middle);
            break;
    }
    else if(key<array[middle])
      high=middle-1;
    else
      low=middle+1;
}
```

Linear Search and Binary Search

Linear Search

- Works on sorted as well as unsorted items
- Very efficient if the items are less and present in the beginning of the list
- Works with arrays and linked lists
- More number of comparisons are required if the items are present in the later part of the array or its elements are more

Binary Search

- Works only on sorted items
- Very efficient if the items are sorted
- Works well with arrays and not on linked lists
- Number of comparisons are less

Summary

- Linear search is a search algorithm, also known as sequential search, that is suitable for searching a set of data for a particular value

- A binary search algorithm is a technique for finding a particular value in a linear array, by ruling out half of the data at each step