Sort and Searching algorithms

LO:

compare the trade-offs between different algorithms for solving the same problem

A searching algorithm looks for a given item in a given data structure.

One of the most common and time-consuming operations in computer science is searching, the process used to find the location of a target among a list of objects.

Searching process in data processing context is a process to find the location of data in a list or table given. It’s being done by comparing each data item with the search key.

Several types of searching methods

- **Linear Search**

The linear Search is used whenever the list is not ordered. Generally, linear search are used only for small lists or lists that are not searched often. In other cases, we have to sort the list and then search it using the binary search.

- **Binary Search**

The linear search algorithm is very slow. If we have an array of 1000 elements, we must do comparisons in the worst case. If the array is not sorted, the linear search is the only solution. However, if the array is sorted, we can use a more efficient algorithm called the binary search.

Sort algorithms

A sorting algorithm is an algorithm that puts elements of a list in a certain order. The most-used orders are numerical order and lexicographical order.

Sorting is any process of arranging items in some sequence and/or in different sets, and accordingly, it has two common, yet distinct meanings:

1. Ordering: arranging items of the same kind, class, nature, etc. in some ordered sequence
2. Categorizing: grouping and labelling items with similar properties together (by sorts)

Several types of sorting methods

Selection Sort

Selection sort is a sorting algorithm, specifically an in-place comparison sort. Selection sort is noted for its simplicity, and also has performance advantages over more complicated algorithms in certain situations.

Insertion Sort

Insertion sort is a simple sorting algorithm, a comparison sort in which the sorted array (or list) is built one entry at a time. It is much less efficient on large lists than more advanced algorithms.

Bubble Sort

Bubble sort is a simple sorting algorithm. It works by repeatedly stepping through the list to be sorted, comparing two items at a time and swapping them if they are in the wrong order. The pass through the list is repeated until no swaps are needed, which indicates that the list is sorted. The algorithm gets its name from the way smaller elements "bubble" to the top of the list. Because it only uses comparisons to operate on elements, it is a comparison sort.

Merge Sort

Merge sort is a comparison-based sorting algorithm. In most implementations it is stable, meaning that it preserves the input order of equal elements in the sorted output. It is an example of the divide and conquer algorithmic paradigm. It was invented by John von Neumann in 1945.

Quick Sort

As one of the more advanced sorting algorithms, you might think that the Quick sort Algorithm is steeped in complicated theoretical background, but this is not so. Like Insertion Sort, this algorithm has a fairly simple concept at the core, but is made complicated by the constraints of the array structure.

- Q1. What is Sorting and Searching algorithms?
- Q2. List down 3 methods of sorting
- Q3. List down 3 types of searching method

Summary

- One of the most common applications in computer science is sorting.
- Data may be sorted in either ascending or descending order.
- There are several types of sorting such as selection, insertion, bubble, merge and quick sort.
- Searching is the process of finding the location of a target among list of objects.
- There are several types of searching methods such as linear, binary.

LINEAR SEARCH
BINARY SEARCH

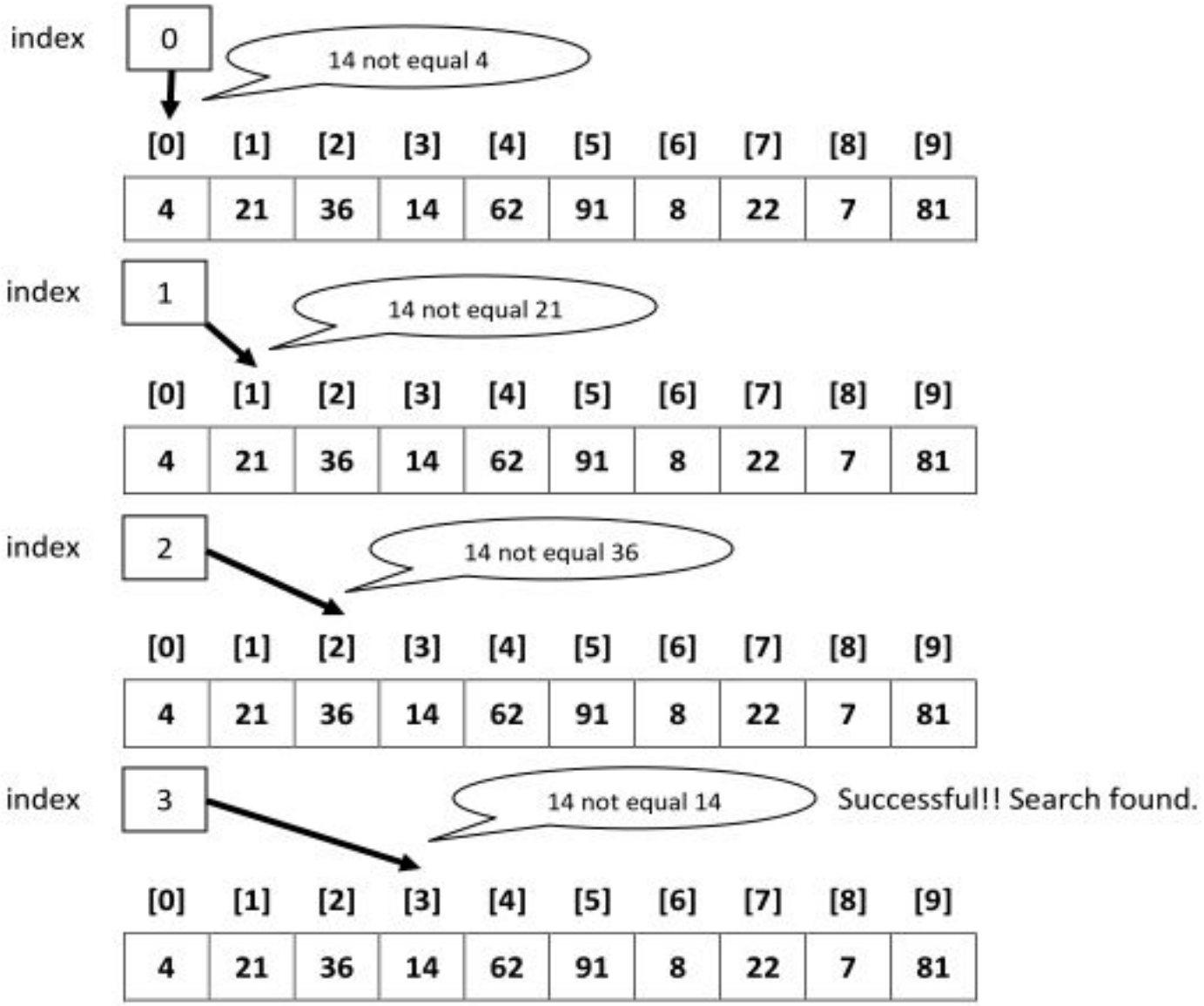
Learning objectives

- write a binary search algorithm to solve a particular problem
- show understanding of the conditions necessary for the use of a binary search

Linear Search

Linear search is a very simple search algorithm. In this type of search, a sequential search is made over all items one by one. Every item is checked and if a match is found then that particular item is returned, otherwise the search continues till the end of the data collection.

Let say, we want to search whether 14 is in the list.

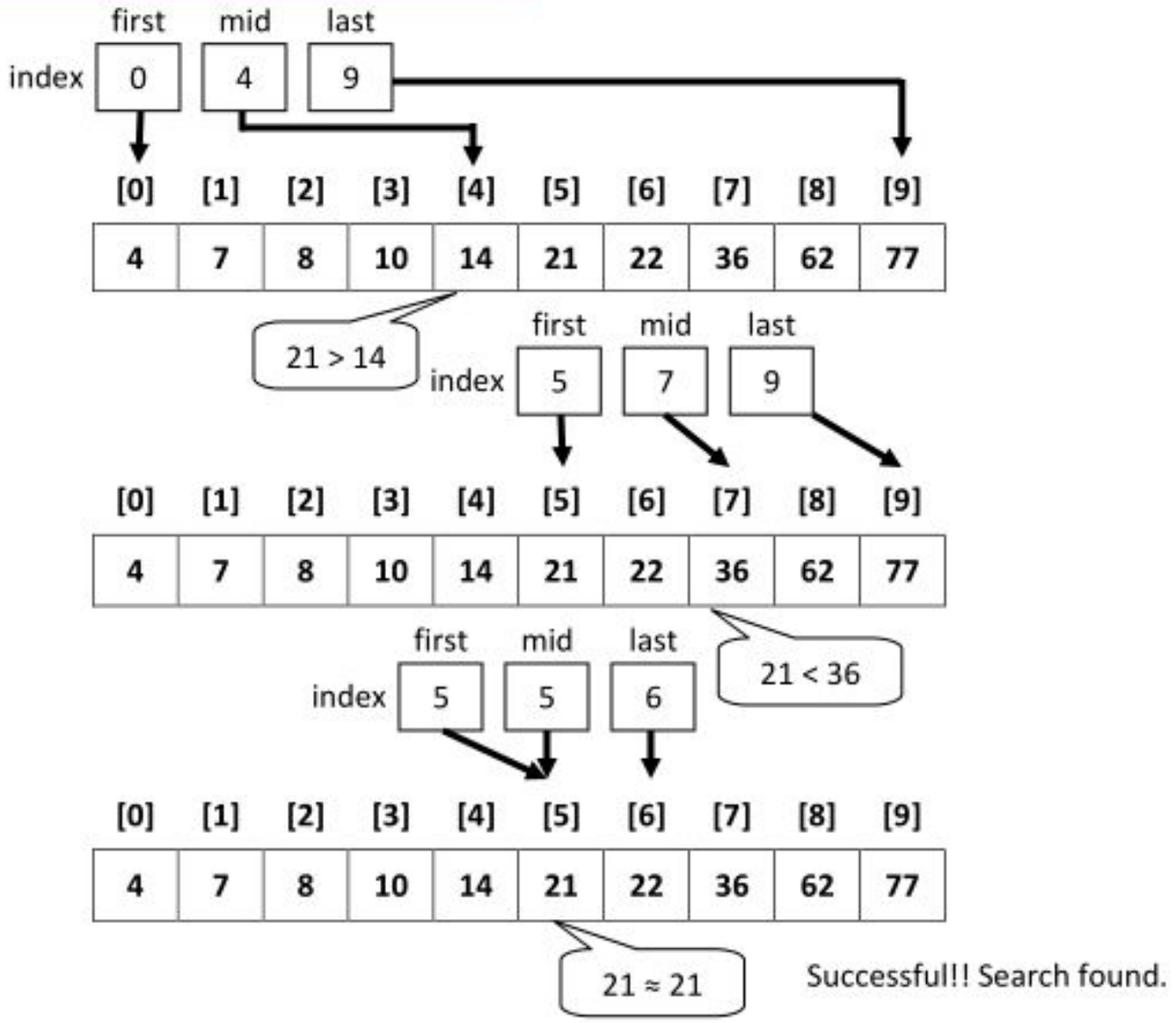


Binary Search

This search algorithm works on the principle of divide and conquer. For this algorithm to work properly, the data collection should be in the sorted form.

Binary search looks for a particular item by comparing the middle most item of the collection. If a match occurs, then the index of item is returned. If the middle item is greater than the item, then the item is searched in the sub-array to the left of the middle item. Otherwise, the item is searched for in the sub-array to the right of the middle item. This process continues on the sub-array as well until the size of the subarray reduces to zero.

Let say, we want to search whether 21 is in the list.



Linear Search

```
procedure linear_search (list, value)

   for each item in the list

      if match item == value

         return the item's location

      end if

   end for

end procedure
```

Binary Search

```
Procedure binary_search
   A ← sorted array
   n ← size of array
   x ← value to be searched

   Set lowerBound = 1
   Set upperBound = n

   while x not found
      if upperBound < lowerBound
         EXIT: x does not exists.

      set midPoint = lowerBound + ( upperBound - lowerBound ) / 2

      if A[midPoint] < x
         set lowerBound = midPoint + 1

      if A[midPoint] > x
         set upperBound = midPoint - 1

      if A[midPoint] = x
         EXIT: x found at location midPoint

   end while
```

```
  int[] A = new int[5] {2, 4, 5, 6, 9 };
  int min = 1;
  int max = 5;
  int mid;
  int x=6;
  int k = 0;
do
{
  mid = (min + max) / 2;
  if (x == A[mid]) { k = mid; break; }
  else
      if (x > A[mid]) min = mid + 1;
      else
          max = mid - 1;
}
while (min > max);
label1.Text = Convert.ToString(k);
```

- https://www.khanacademy.org/computing/computer-science/algorithms/binary-search/a/implementing-binary-search-of-an-array

- https://www.tutorialspoint.com/data_structures_algorithms/binary_search_algorithm.htm