

Binary Search

Performing Binary Search

- ◆ Binary search algorithm:
 - ◆ Is used for searching large lists
 - ◆ Searches the element in very few comparisons
 - ◆ Can be used only if the list to be searched is sorted

Implementing Binary Search (Contd.)

- ◆ Consider a list of 9 elements in a sorted array.

	0	1	2	3	4	5	6	7	8
arr	9	13	17	19	25	29	39	40	47

Implementing Binary Search (Contd.)

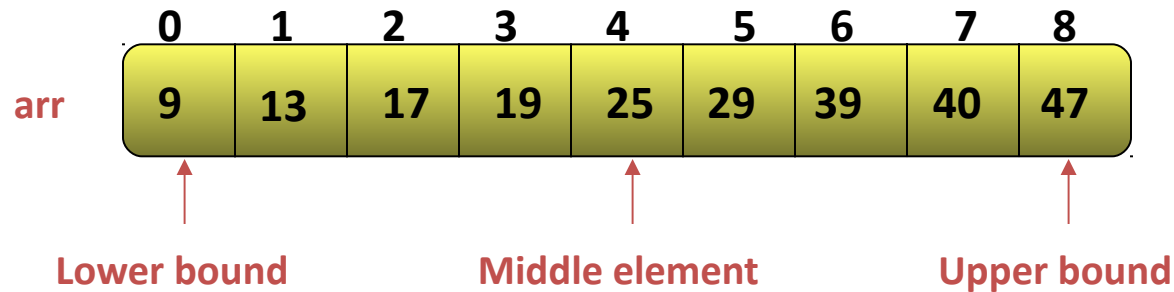
- ◆ You have to search an element 13 in the given list.

	0	1	2	3	4	5	6	7	8
arr	9	13	17	19	25	29	39	40	47

Implementing Binary Search (Contd.)

- ◆ Determine the index of the middlemost element in the list:

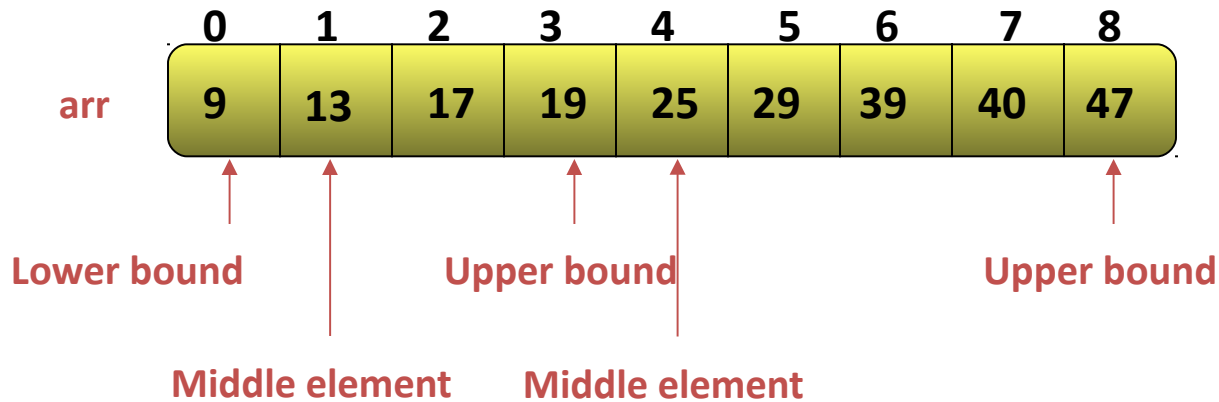
$$\begin{aligned}\text{Mid} &= (\text{Lower bound} + \text{Upper bound})/2 \\ &= (0 + 8)/2 \\ &= 4\end{aligned}$$



Implementing Binary Search (Contd.)

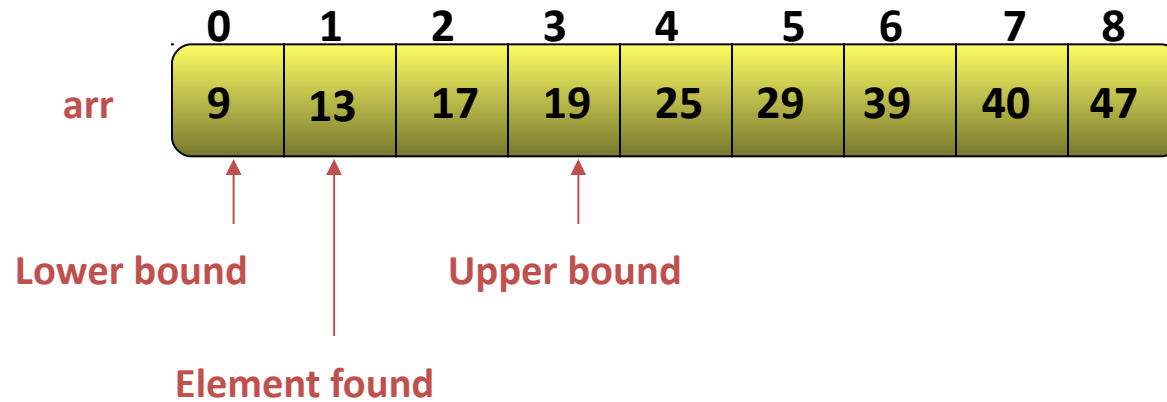
- ◆ 13 is not equal to the middle element, therefore, again divide the list into two halves:

$$\begin{aligned}\text{Mid} &= (\text{Lower bound} + \text{Upper bound})/2 \\ &= (0 + 3)/2 \\ &= 1\end{aligned}$$



Implementing Binary Search (Contd.)

- ◆ 13 is equal to middle element.
- ◆ Element found at index 1.



Algorithm to search target in an array of N numbers using binary search algorithm

ALGORITHM BinarySearch(target, A[], N)

1. low = 0
2. high = N – 1
3. while(low<=high)
 - 3.1 mid = (low + high)/2
 - 3.2 if A [mid] = target
 - 3.2.1 Print “Found at mid position”
 - 3.2.2 return
 - 3.3. If target < A [mid]
 - 3.3.1 high = mid – 1
 - 3.4. If target > A [mid]
 - 3.4.1 low = mid + 1
4. print “Not found”

Determining the Efficiency of Binary Search

- ◆ In binary search, with every step, the search area is reduced to half.
- ◆ In the best case scenario, the element to be search is found at the middlemost position of the list:
 - ◆ The number of comparisons in this case is 1.
- ◆ In the worst case scenario, the element is not found in the list:
 - ◆ After the first bisection, the search space is reduced to $n/2$ elements, where n is the number of elements in the original list.
 - ◆ After the second bisection, the search space is reduced to $n/4$ elements, that is, $n/2^2$ elements.
 - ◆ After i^{th} bisections, the number of comparisons would be $n/2^i$ elements.

Just a minute

◆ In _____ search algorithm, you begin at one end of the list and scan the list until the desired item is found or the end of the list is reached.

◆ Answer:
◆ linear

Just a minute

◆ To implement _____ search algorithm, the list should be sorted.

◆ Answer:
◆ binary