SVKM's NMIMS
School of Technology Management & Engineering, Indore
Computer Engineering Department
Program: B.Tech/MBA.Tech Sem II

Course: Data Structure

PART A

(PART A: TO BE REFFERED BY STUDENTS)

Experiment No.09

A.1 Aim:

Implement and compare Linear and Binary search techniques to solve the given problem

A.2 Prerequisite:

1. Knowledge of searching Techniques.
2. Fundamental concepts of C\C++.

A.3 Outcome:

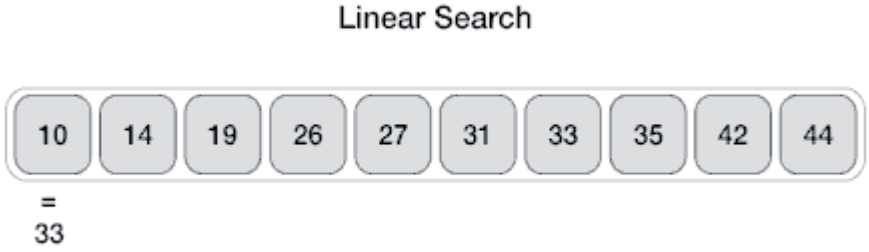
After successful completion of this experiment, students will be able to

1. Identify the need of searching techniques
2. Implement the searching techniques to solve the given problem
3. Enlist the applications of searching

A.4 Theory:

A.4.1. Introduction to searching:

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.



Algorithm

```
Linear Search ( Array A, Value x)

Step 1: Set i to 1
Step 2: if i > n then go to step 7
Step 3: if A[i] = x then go to step 6
Step 4: Set i to i + 1
Step 5: Go to Step 2
Step 6: Print Element x Found at index i and go to step 8
Step 7: Print element not found
Step 8: Exit
```

Pseudocode

```
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 is a fast search algorithm with run-time complexity of O(log n). 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.

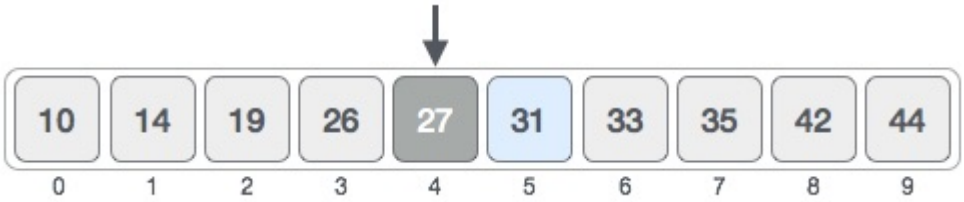
How Binary Search Works?

For a binary search to work, it is mandatory for the target array to be sorted. We shall learn the process of binary search with a pictorial example. The following is our sorted array and let us assume that we need to search the location of value 31 using binary search.

First, we shall determine half of the array by using this formula −

```
mid = low + (high - low) / 2
```

Here it is, 0 + (9 - 0) / 2 = 4 (integer value of 4.5). So, 4 is the mid of the array.



Now we compare the value stored at location 4, with the value being searched, i.e. 31. We find that the value at location 4 is 27, which is not a match. As the value is greater than 27 and we have a sorted array, so we also know that the target value must be in the upper portion of the array.

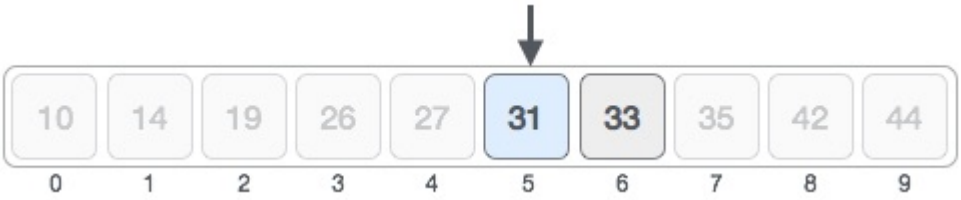
We change our low to mid + 1 and find the new mid value again.

```
low = mid + 1
mid = low + (high - low) / 2
```

Our new mid is 7 now. We compare the value stored at location 7 with our target value 31.

The value stored at location 7 is not a match, rather it is more than what we are looking for. So, the value must be in the lower part from this location.

Hence, we calculate the mid again. This time it is 5.



We compare the value stored at location 5 with our target value. We find that it is a match.

We conclude that the target value 31 is stored at location 5.

Binary search halves the searchable items and thus reduces the count of comparisons to be made to very less numbers.

Pseudocode

The pseudocode of binary search algorithms should look like this −

```
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

end procedure
```

A.5 Procedure/Algorithm:

A.5.1:

TASK 1:

Q1. Enter the scores of subject Data Structure along with Students' roll number in the database. Search the marks obtained by a certain student using the student's roll number. If student's roll number does not exist then print the message accordingly.

NOTE: Apply both **Linear** and **Binary** search techniques and compare the time taken to search the required elements in both search approaches.

--Take marks and roll number as user input.

PART B

(PART B : TO BE COMPLETED BY STUDENTS)

(Students must submit the soft copy as per following segments within two hours of the practical. The soft copy must be uploaded on the Blackboard or emailed to the concerned lab in charge faculties at the end of the practical in case the there is no Black board access available)

Roll No.	Name:
Class :	Grade :
Date of Experiment:	Date of Submission

B.1 Software Code written by student: (Task 1)

(Paste your C/C++/code completed during the 2 hours of practical in the lab here)

B.2 Input and Output: (Task 1)

(Paste your program input and output in following format, If there is error then paste the specific error in the output part. In case of error with due permission of the faculty extension can be given to submit the error free code with output in due course of time. Students will be graded accordingly.)

B.3 Observations and learning [w.r.t. all tasks]:

(Students are expected to comment on the output obtained with clear observations and learning for each task/ sub part assigned)

B.4 Conclusion:

(Students must write the conclusion as per the attainment of individual outcome listed above and learning/observation noted in section B.3)

B.5 Question of Curiosity

(To be answered by student based on the practical performed and learning/observations)

Q1. Enlist a real life problem that can be solved using linear search.

Q2. Enlist a real life problem that can be solved using binary search.