K. J. Somaiya College of Engineering, Mumbai-77
(A constituent College of Somaiya Vidyavihar University)

Batch: A3 **Roll. No.: 16010121051**

Experiment:

Grade: AA / AB / BB / BC / CC / CD /DD

Title: Implementation of hashing concept

Objective: To understand various hashing methods

Expected Outcome of Experiment:

CO	Outcome
CO4	Demonstrate sorting and searching methods.

Websites/books referred:

1. stackoverflow

2. geeksforgeeks

3. Rema Thareja

Abstract: -

(Define Hashing ,hash function, list collision handling methods)

Searching is the process of finding a given value position in a list of values. It decides whether a search key is present in the data or not. It is the algorithmic process of finding a particular item in a collection of items. It can be done on internal data structure or on external data structure.

Searching methods(Linear search, binary search, hash search):

Linear Search: A linear search or sequential search is a method for finding an element within a list. It sequentially checks each element of the list until a match is found or the whole list has been searched.

Binary Search: Binary search, also known as half-interval search, logarithmic search, or binary chop, is a search algorithm that finds the position of a target value within a sorted array. Binary search compares the target value to the middle element of the array.

Hash Search: One of the most common approaches is to use a hash function to transform one or more characteristics of the searched-for item into a value that is used to index into an indexed hash table. Hash-based searching has better average-case performance than the other search algorithms described.

Algorithm Binary Search:

Condition : Only applicable to sorted arrays.

□ *Compare x with the middle element.*

□ *If x matches with the middle element, return the mid index.*

□ *Else If x > mid element, search in the right half.*

□ *Else search in the left half.*

Hashing: (Define hashing, collision and list collision handling methods)

Hashing: Hashing is the process of converting a given key into another value. A hash function is used to generate the new value according to a mathematical algorithm.

Collision: A collision occurs when more than one value to be hashed by a particular hash function hash to the same slot in the table or data structure (hash table) being generated by the hash function.

Collision handling methods:

□ *Open Hashing (Separate chaining)*

□ *Closed Hashing (Open Addressing)*

□ *Liner Probing*

□ *Quadratic probing*

□ *Double hashing*

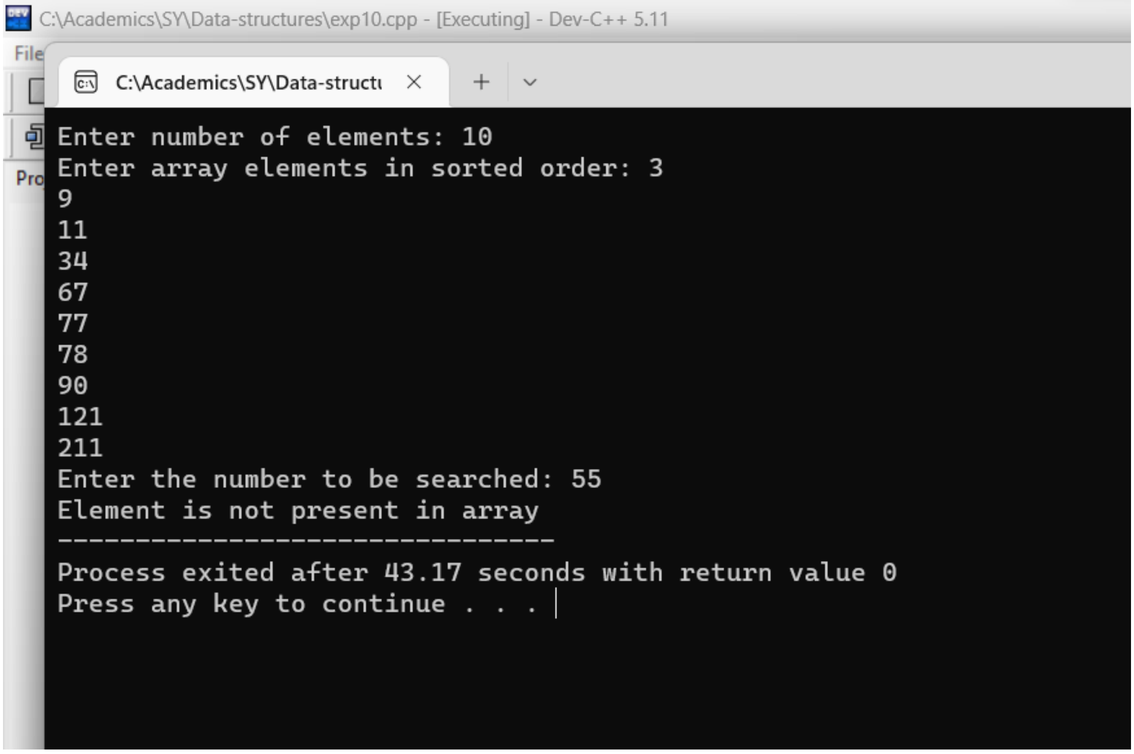
Code and output screenshots:

```
#include <bits/stdc++.h>
using namespace std;

int binarySearch(int arr[], int l, int r, int x){
while (l <= r) {
int m = l + (r - l) / 2;

if (arr[m] == x)
return m; //middle element

if (arr[m] < x)
l = m + 1; //left half

else
r = m - 1; //right half
}
```

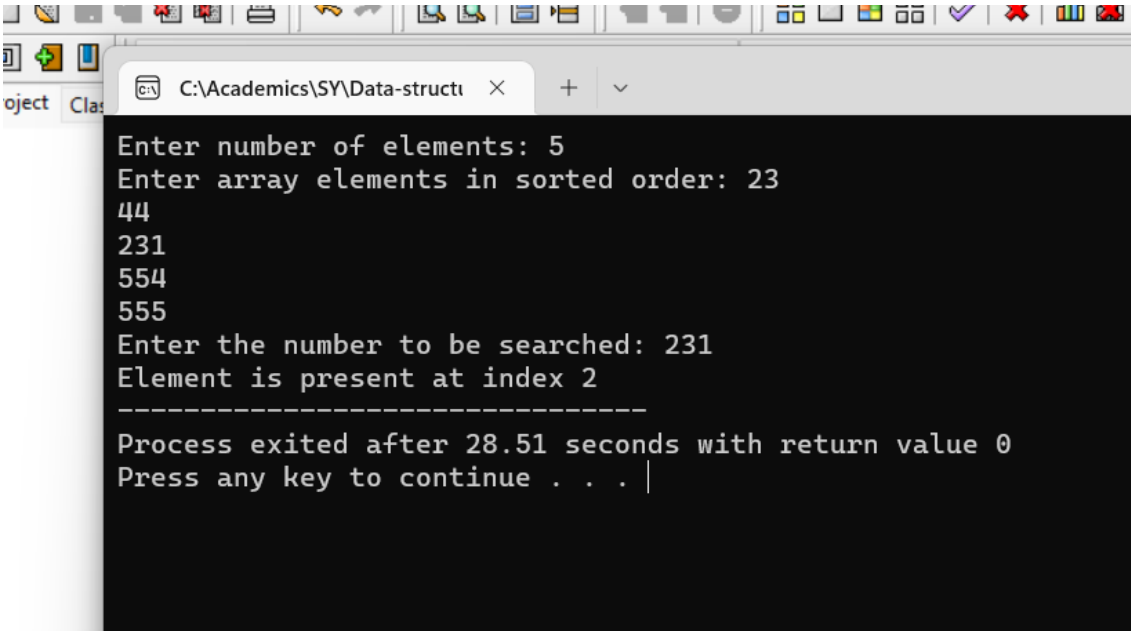
}

```
return -1; //element not prsent

}


int main(){


int n;

cout<<"Enter number of elements: ";

cin>>n;

int arr[n];

cout<<"Enter array elements in sorted order: ";

for(int i=0;i<n;i++){

cin>>arr[i];

}

int x;

cout<<"Enter the number to be searched: ";

cin>>x;

int result = binarySearch(arr, 0, n - 1, x);

if(result == -1)

cout << "Element is not present in array";

else

cout << "Element is present at index " << result;

return 0;

}
```

Outputs:


C:\Academics\SY\Data-structures\exp10.cpp - [Executing] - Dev-C++ 5.11
C:\Academics\SY\Data-structu

```
Enter number of elements: 10
Enter array elements in sorted order: 3
9
11
34
67
77
78
90
121
211
Enter the number to be searched: 55
Element is not present in array
--------------------------------
Process exited after 43.17 seconds with return value 0
Press any key to continue . . .
```



```
Enter number of elements: 5
Enter array elements in sorted order: 23
44
231
554
555
Enter the number to be searched: 231
Element is present at index 2
--------------------------------
Process exited after 28.51 seconds with return value 0
Press any key to continue . . .
```

Conclusion: -Searching algorithms were implemented successfully.

Post lab questions-

a. **Compare and contrast various collision handling methods.**

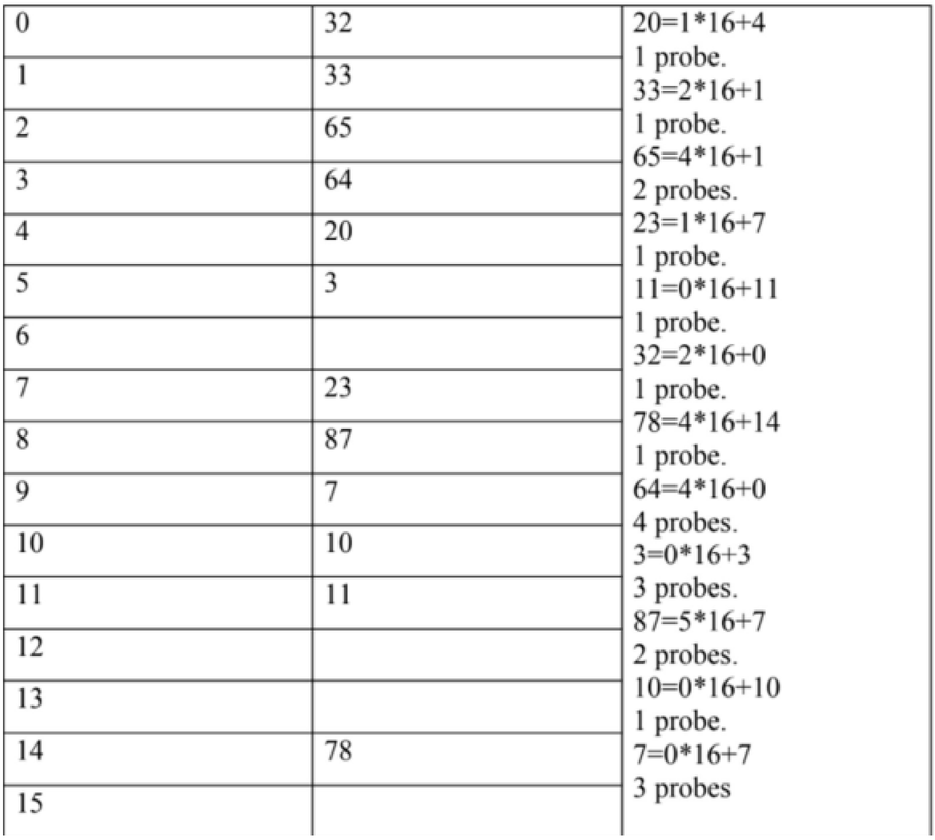
- In Open Hashing each cell in the array points to a list containg the collisions. The hashing has produced the same index for all items in the linked list.
- In Closed Hashing you use only one array for everything. You store the collisions in the same array. The trick is to use some smart way to jump from collision to collision until you find what you want. And do this in a reproducible / deterministic way.

b. Store the given numbers in bucket of size 16, resolve the collisions if any with

  a. Linear probing
  b. Quadratic hashing
  c. Chaining

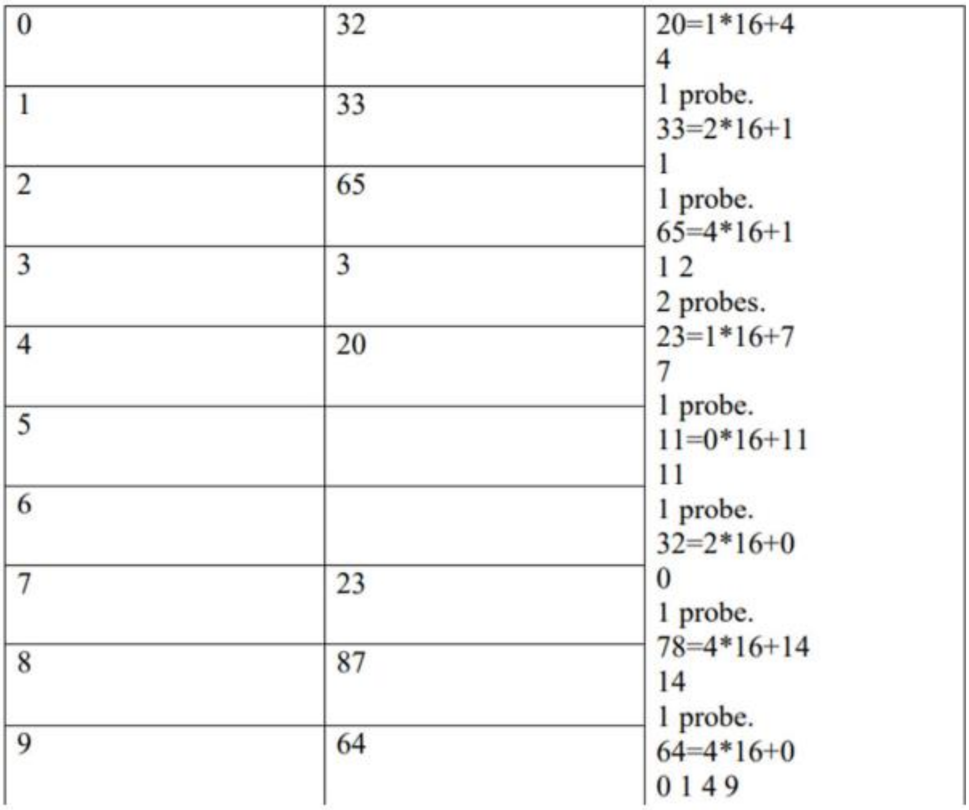
20, 33, 65, 23, 11, 32, 78, 64, 3, 87, 10, 7

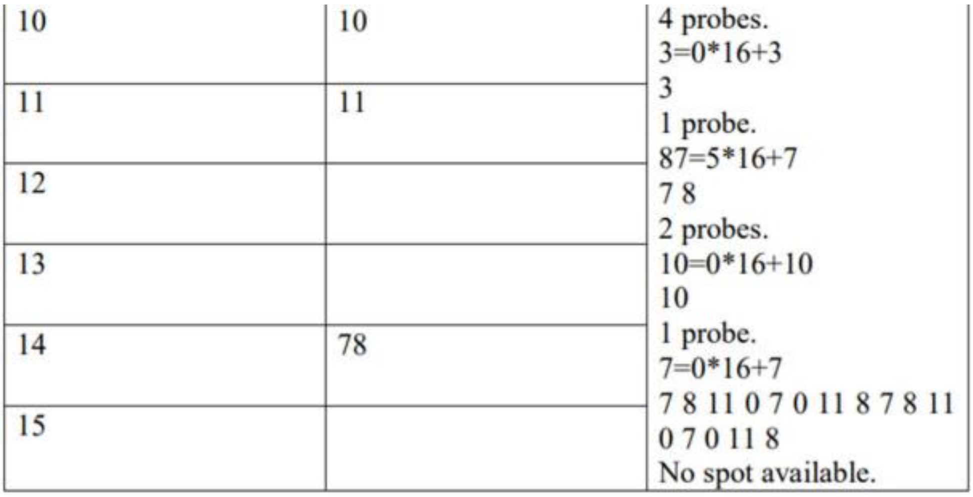
A]Linear probong



0	32	20=1*16+4 1 probe. 33=2*16+1 1 probe. 65=4*16+1 2 probes. 23=1*16+7 1 probe. 11=0*16+11 1 probe. 32=2*16+0 1 probe. 78=4*16+14 1 probe. 64=4*16+0 4 probes. 3=0*16+3 3 probes. 87=5*16+7 2 probes. 10=0*16+10 1 probe. 7=0*16+7 3 probes
1	33	
2	65	
3	64	
4	20	
5	3	
6		
7	23	
8	87	
9	7	
10	10	
11	11	
12		
13		
14	78	
15		

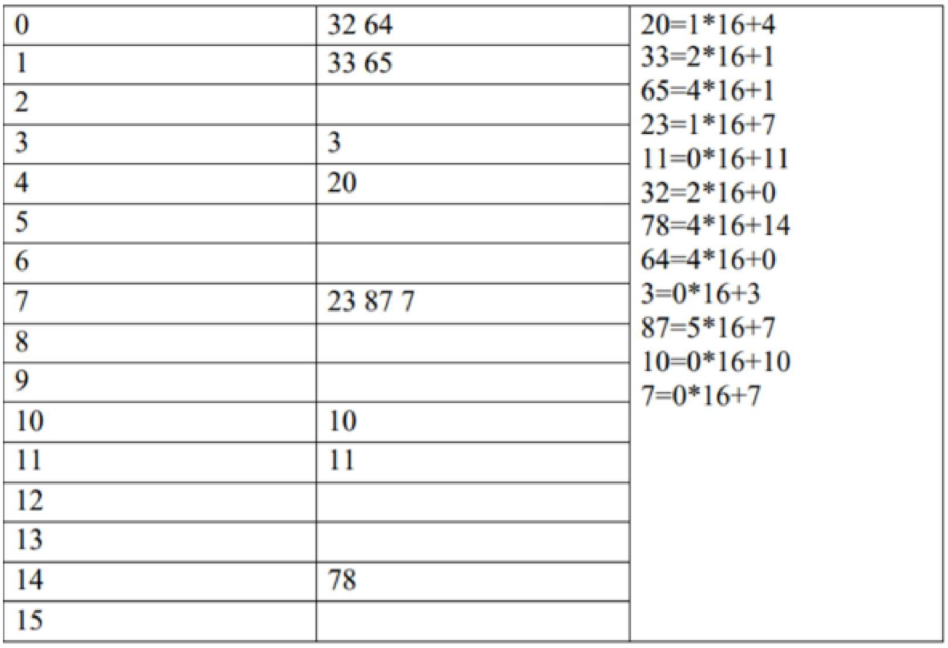
B]Quardic hashing





0	32	20=1*16+4 4 1 probe. 33=2*16+1 1 1 probe. 65=4*16+1 1 2 2 probes. 23=1*16+7 7 1 probe. 11=0*16+11 11 1 probe. 32=2*16+0 0 1 probe. 78=4*16+14 14 1 probe. 64=4*16+0 0 1 4 9
1	33	
2	65	
3	3	
4	20	
5		
6		
7	23	
8	87	
9	64	
10	10	4 probes. 3=0*16+3 3 1 probe. 87=5*16+7 7 8 2 probes. 10=0*16+10 10 1 probe. 7=0*16+7 7 8 11 0 7 0 11 8 7 8 11 0 7 0 11 8 No spot available.
11	11	
12		
13		
14	78	
15		

C]chaining



0	32 64	20=1*16+4 33=2*16+1 65=4*16+1 23=1*16+7 11=0*16+11 32=2*16+0 78=4*16+14 64=4*16+0 3=0*16+3 87=5*16+7 10=0*16+10 7=0*16+7
1	33 65	
2		
3	3	
4	20	
5		
6		
7	23 87 7	
8		
9		
10	10	
11	11	
12		
13		
14	78	
15		