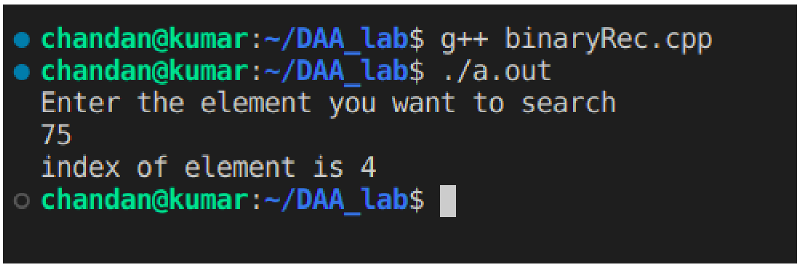
Practical No. :- 01

Implement binary search algorithm and compute its time complexity.

Code->

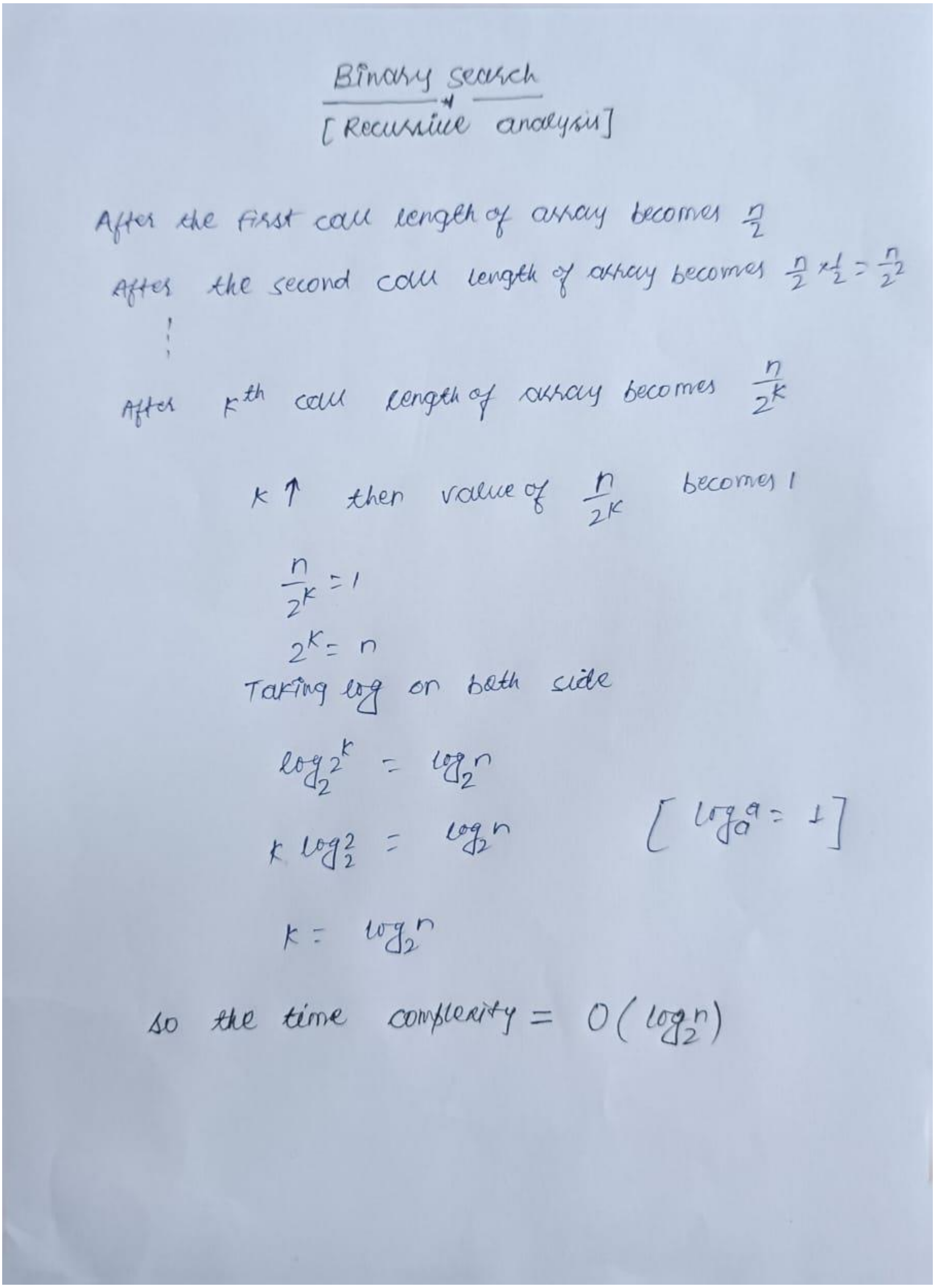
```
#include <bits/stdc++.h>
using namespace std;
int binarySearch(int arr[], int x, int low, int high)
{
if (low <= high)
{
int mid = (low + high) / 2;
if (arr[mid] == x)
return mid;
else if (x > arr[mid])
{
return binarySearch(arr, x, mid + 1, high);
}
else
{
return binarySearch(arr, x, low, mid - 1);
}
}
return -1;
}


int main()
{
int arr[] = {12, 32, 45, 67, 75, 79, 90};
int size = sizeof(arr) / sizeof(arr[0]);
cout<<"Enter the element you want to search"<<endl;
int x;
cin>>x;
cout << "index of element is " << binarySearch(arr, x, 0, size - 1) << endl;

return 0;
}
```

output:-



```
● chandan@kumar:~/DAA_lab$ g++ binaryRec.cpp
● chandan@kumar:~/DAA_lab$ ./a.out
  Enter the element you want to search
  75
  index of element is 4
○ chandan@kumar:~/DAA_lab$ 
```

Analysis of algorithm:-



Binary search

[Recursive analysis]

After the first call length of array becomes $\frac{n}{2}$

After the second call length of array becomes $\frac{n}{2} \times \frac{1}{2} = \frac{n}{2^2}$

$\vdots$

After k^{th} call length of array becomes $\frac{n}{2^k}$

$k \uparrow$ then value of $\frac{n}{2^k}$ becomes 1

$$\frac{n}{2^k} = 1$$

$$2^k = n$$

Taking log on both side

$$\log_2 2^k = \log_2 n$$

$$k \log_2 2 = \log_2 n \qquad [\log_a a = 1]$$

$$k = \log_2 n$$

so the time complexity $= O(\log_2 n)$