8. Searching Algorithm

What is search algorithm?
A search algorithm is an algorithm for finding an item among a collection of items.
Here, we will concentrate on two search algorithms: Sequential/Linear Search and Binary Search.

Sequential Search:
It examines the first element in the list and then second element and so on until a match is found.

Sequential Search Algorithm (Pseudocode):
```
int sequentialSearch (a[], n, t)
        for i=0 to n-1
                if (a[i]=t) then
                        return i
        next i
        return -1
```

C++ Implementation of Sequential Search Algorithm:
```
int sequentialSearch(int *a, int n, int t)
{
        int i;
        for (i = 0; i < n; i++)
                if (a[i]==t) return i;
        return (-1);
}
```

Binary Search:
This algorithm finds the middle item of a sorted array (in ascending ordered array), compare it against the searched value, then decide which half of the list must contain the searched value, and repeat with that half.

Binary Search Algorithm (Pseudocode):
```
int binarySearch (a[], l, u , t)
        p= (l+u)/2
        while (a[p] ≠ t AND l<=u)
                if (a[p]>t)
                        u=p-1
                else
                        l=p+1
                p=(l+u)/2
        end while
        if (l<=u)
                return p
        else
                return -1
```

Binary Search Algorithm (Recursive Pseudocode):
```
int recBinarySearch(a[],l,u,t) //It returns the location of t in the array a[] from the index l to u.
        if l>u then
                return -1
        else
                mid=(l+u)/2
                if t=a[mid] then
                        return mid
                else if t<a[mid] then
                        return recBinarySearch(a[],l,mid-1,t)
```

```
            else
                    return recBinarySearch(a[],mid+1,u,t)
            end if
    end if
```

Linear Search Vs Binary Search
Linear search follows sequence and Binary search doesn't follow.
Linear search starts searching from the starting to ending point. Binary searching starts from middle point.
For binary search we need sorted elements. Linear search does not need sorted elements.

The time complexity of Linear search is: Best case is O(1), Worst case is O(n), Average case is n(n+1)/2n = O(n)

The time complexity of Binary search is: Best case is O(1), Worst case is O(log n), Average case is log n(logn+1)/2 log n = O(log n)

So we can assume that the time complexity of Binary search is less than Linear search.