LAB SUBMISSION – 6 <-link

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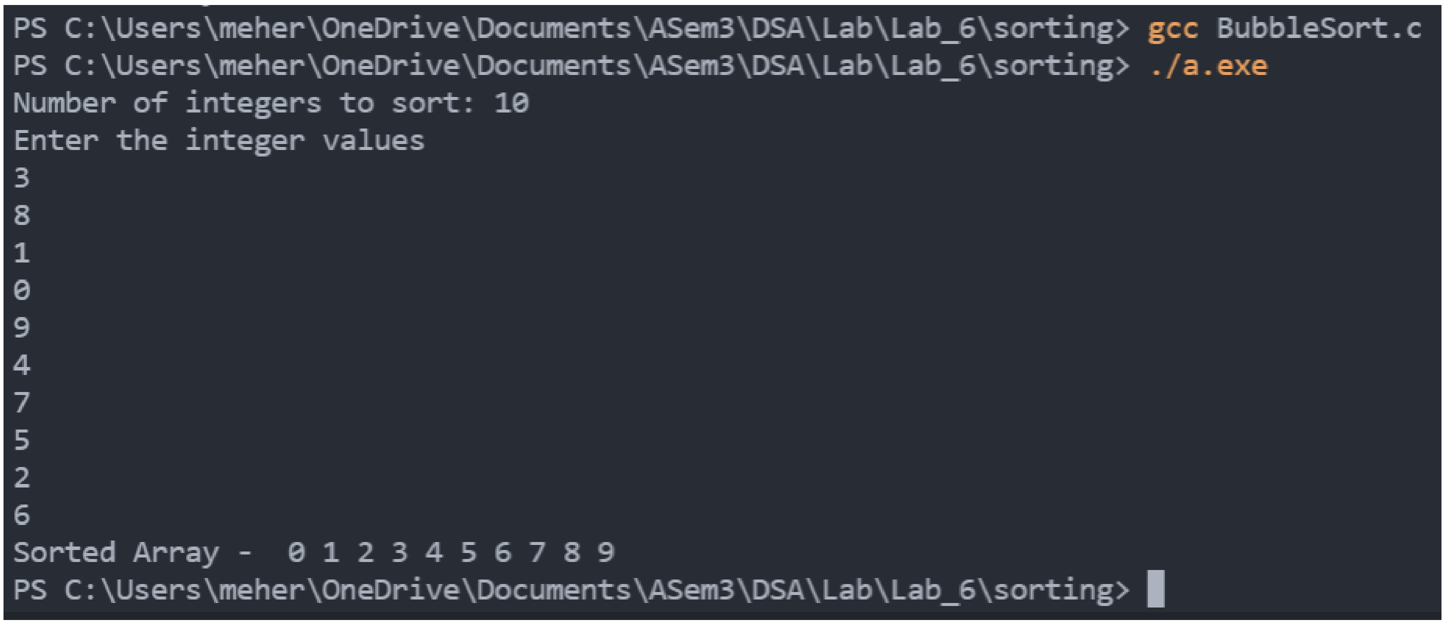
BUBBLE SORT – REGULAR AND MODIFIED BUBBLE SORT

```c
// BubbleSort.c
#include <stdio.h>

void bubblesort_1(int arr[], int n);
void bubblesort_2(int arr[], int n);
void bubblesort_3(int arr[], int n);
// At the first passing, the largest element is moved to the end of the list. Similarly, at the second passing
// the second largest element is moved to the second last index of the list.

// Time complexity:O(n*n)
// Sort stability: Stable sort
// Space complexity: O(1) - inplace
int main()
{
    int x, n, hold;
    int flag = 0;
    printf("Number of integers to sort: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the integer values\n");
    // Takes in the values from the user
    for(int i = 0; i < n; i++)
    {
        scanf("%d", &x);
        arr[i] = x;
    }

    bubblesort_3(arr, n);

    printf("Sorted Array - ");
    for (int a = 0; a < n; ++a)
    {
        printf(" %d", arr[a]);
    }
}
```

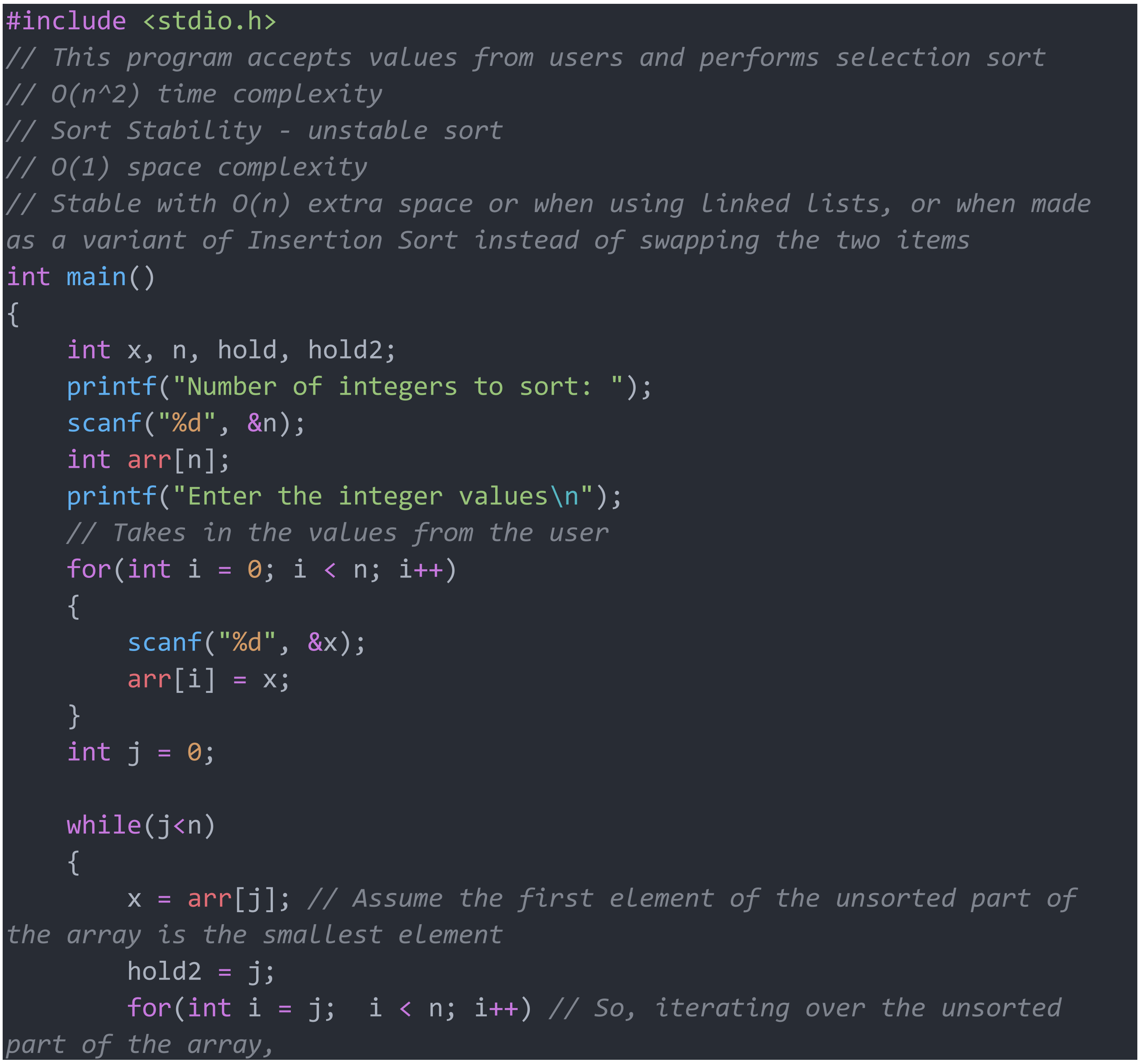
```c
// Worst method, will always go through the n*n iterations
void bubblesort_1(int arr[], int n)
{
    int hold;
    for(int i = 0; i < n-1; i++)
    {
        for(int i = 0; i < n-1; i++)
        {
            if(arr[i]>arr[i+1])
            {
                hold = arr[i];
                arr[i] = arr[i+1];
                arr[i+1] = hold;
            }
        }
    }
}

// Second method, if the total number of swaps during a pass is 0 then it
exits as the list is sorted
void bubblesort_2(int arr[], int n)
{
    int flag, hold;
    do{
        flag = 0;
        for(int i = 0; i < n-1; i++)
        {
            if(arr[i]>arr[i+1])
            {
                hold = arr[i];
                arr[i] = arr[i+1];
                arr[i+1] = hold;
                flag = flag + 1;
            }
        }
    }while(flag != 0);
}

/*OPTIMIZED BUBBLE SORT*/
// Best method, along with exiting once the list is sorted (like second
method), the value of n decreases every
// iteration (by 1). This is because after a pass, the largest element of
the pass is moved to the last and we
// don't need to check for swaps there.
```

```c
void bubblesort_3(int arr[], int n)
{
    int flag, hold;
    do{
        flag = 0;
        for(int i = 0; i < n-1; i++)
        {
            if(arr[i]>arr[i+1])
            {
                hold = arr[i];
                arr[i] = arr[i+1];
                arr[i+1] = hold;
                flag = flag + 1;
            }
        }
        n--;  // to remove unneccessary comparisions towards the end
    }while(flag != 0);
}

// Another code for optimized bubble sort
/*
int flag = 0;
for(int j = 0; j < n -1; j++)
{
    flag = 0;
    for(int i = 0; i < n-j-1; i++)
    {
        if(arr[i] > arr[i+1])
        {
            hold = arr[i];
            arr[i] = arr[i+1];
            arr[i+1] = hold;
            flag = 1;
        }
    }
    if(flag == 0)
        break;
}
*/
```

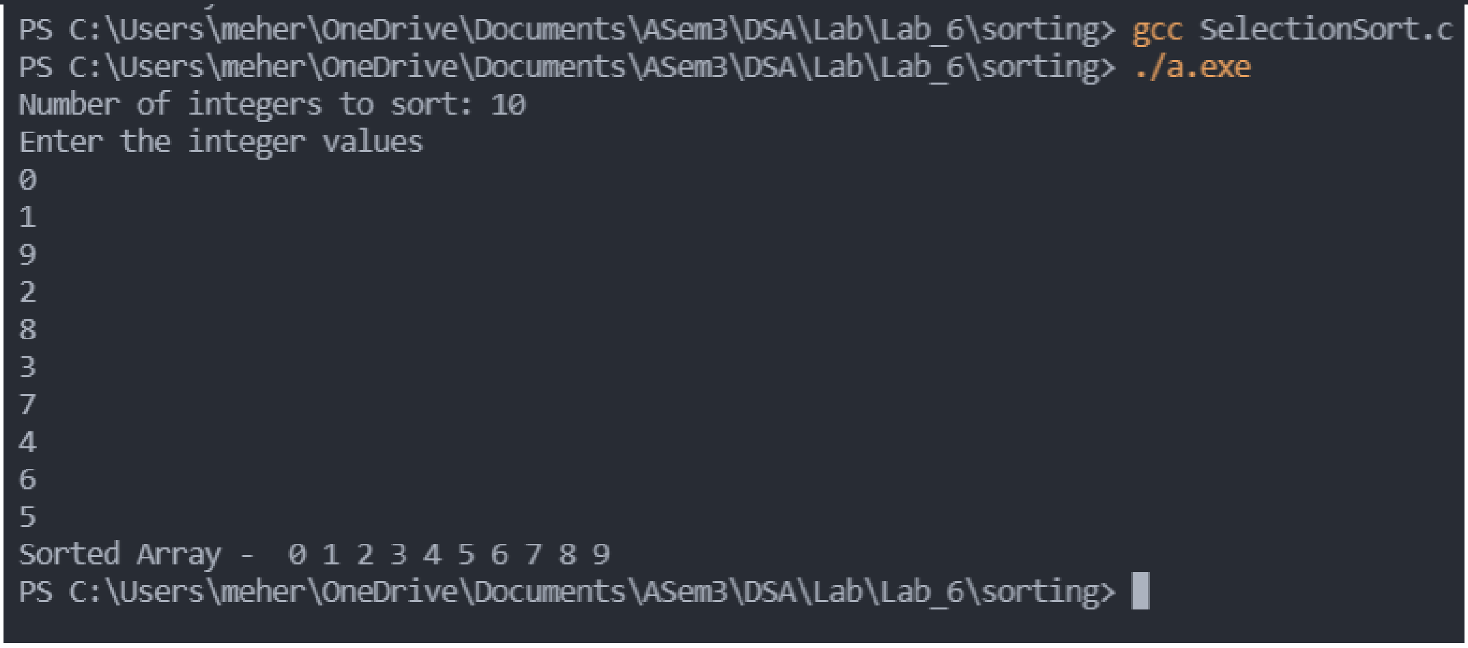


```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> gcc BubbleSort.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> ./a.exe
Number of integers to sort: 10
Enter the integer values
3
8
1
0
9
4
7
5
2
6
Sorted Array -  0 1 2 3 4 5 6 7 8 9
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting>
```

SELECTION SORT



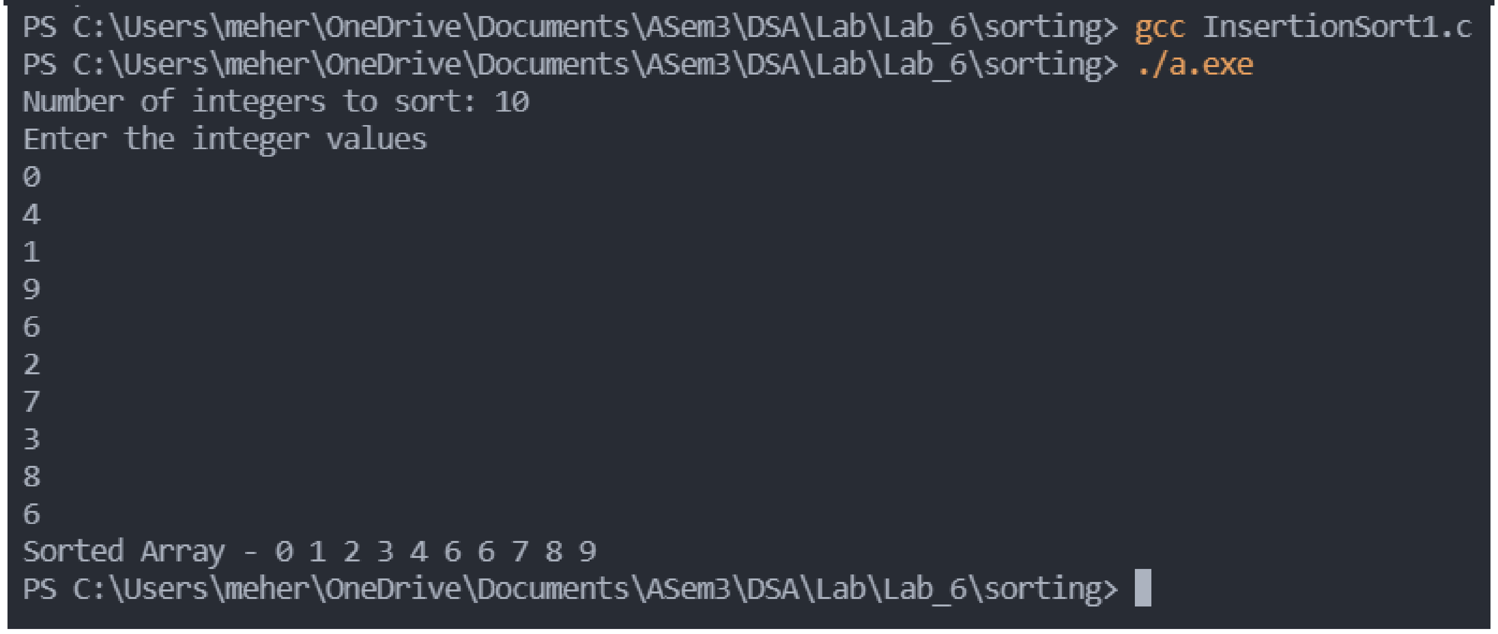
```c
#include <stdio.h>
// This program accepts values from users and performs selection sort
// O(n^2) time complexity
// Sort Stability - unstable sort
// O(1) space complexity
// Stable with O(n) extra space or when using linked lists, or when made
as a variant of Insertion Sort instead of swapping the two items
int main()
{
    int x, n, hold, hold2;
    printf("Number of integers to sort: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the integer values\n");
    // Takes in the values from the user
    for(int i = 0; i < n; i++)
    {
        scanf("%d", &x);
        arr[i] = x;
    }
    int j = 0;

    while(j<n)
    {
        x = arr[j]; // Assume the first element of the unsorted part of
the array is the smallest element
        hold2 = j;
        for(int i = j;  i < n; i++) // So, iterating over the unsorted
part of the array,
        {
            if(x > arr[i]) // If our assumption is greater than an
element,
            {
                x = arr[i]; // Change assumption to that element
                hold2 = i; // Remember the location of that element in
'hold2' var
            }
        } // Repeat till the end, now you have the smallest element in the
unsorted array

        // Now you have to swap the first element of the unsorted array
with the smallest element in the unsorted array

        hold = arr[j]; // Save the value of the first element of unsorted
array in 'hold' var
        arr[j] = x; // Put the smallest element at the beginning of the
unsorted array
        arr[hold2] = hold; // Put the value stored in 'hold' var in the
location of the smallest elemnt (which we saved in 'hold2' var)

        j = j + 1;
    }
    printf("Sorted Array - ");
    for (int a = 0; a < n; ++a)
    {
        printf(" %d", arr[a]);
    }
}
```



```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> gcc SelectionSort.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> ./a.exe
Number of integers to sort: 10
Enter the integer values
0
1
9
2
8
3
7
4
6
5
Sorted Array -  0 1 2 3 4 5 6 7 8 9
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> 
```

INSERTION SORT

```c
#include <stdio.h>
void InsertionSort(int arr[], int n);
int main()
{
    int n, x;
    printf("Number of integers to sort: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the integer values\n");
    // Takes in the values from the user
    for(int i = 0; i < n; i++)
    {
        scanf("%d", &x);
        arr[i] = x;
    }

    InsertionSort(arr, n);

    printf("Sorted Array - ");
    for(int i = 0; i < n; i++)
    {
        printf("%d ", arr[i]);
    }
}
// https://www.youtube.com/watch?v=OAyj2d-GH0c
// TC - BEST CASE - O(n)
// TC - WORST CASE CASE - O(n^2)
// SPACE COMPLEXITY - O(1) - IN PLACE
// Sort Stability - Stable sort
// its most helpful when you have an almost sorted array
// used in online query - when elements are coming in one by one at random

void InsertionSort(int arr[], int n)
{
    for(int i = 1; i < n ; i++)
    {
        int key = arr[i];

        // start of the unsorted region
        int j = i -1;
        // element in the unsorted region is less than the current element
        while(j>=0 && arr[j]>key) // if the back of sorted region is
greater than our key
                                  //"arr[j]>key" - here for equal
elements, the ones on theleft will remain of the left side, making the
algorithm "stable"
                                  //"arr[j]>=key" - here even if the
element is equal to the current it will be moved to the right, and the
cuurent element which was originally on the right side wiil come to the
left, making the sort "unstable"
                                  // Stability of a sort can matter when
elements being sorted are dictionaried/mapped with other data.
        {
            arr[j+1]=arr[j]; // shift that to the right
            j=j-1; // decrement the index by 1
        }

        arr[j+1]=key; // put in the key at the appropriate place
    }
}
```



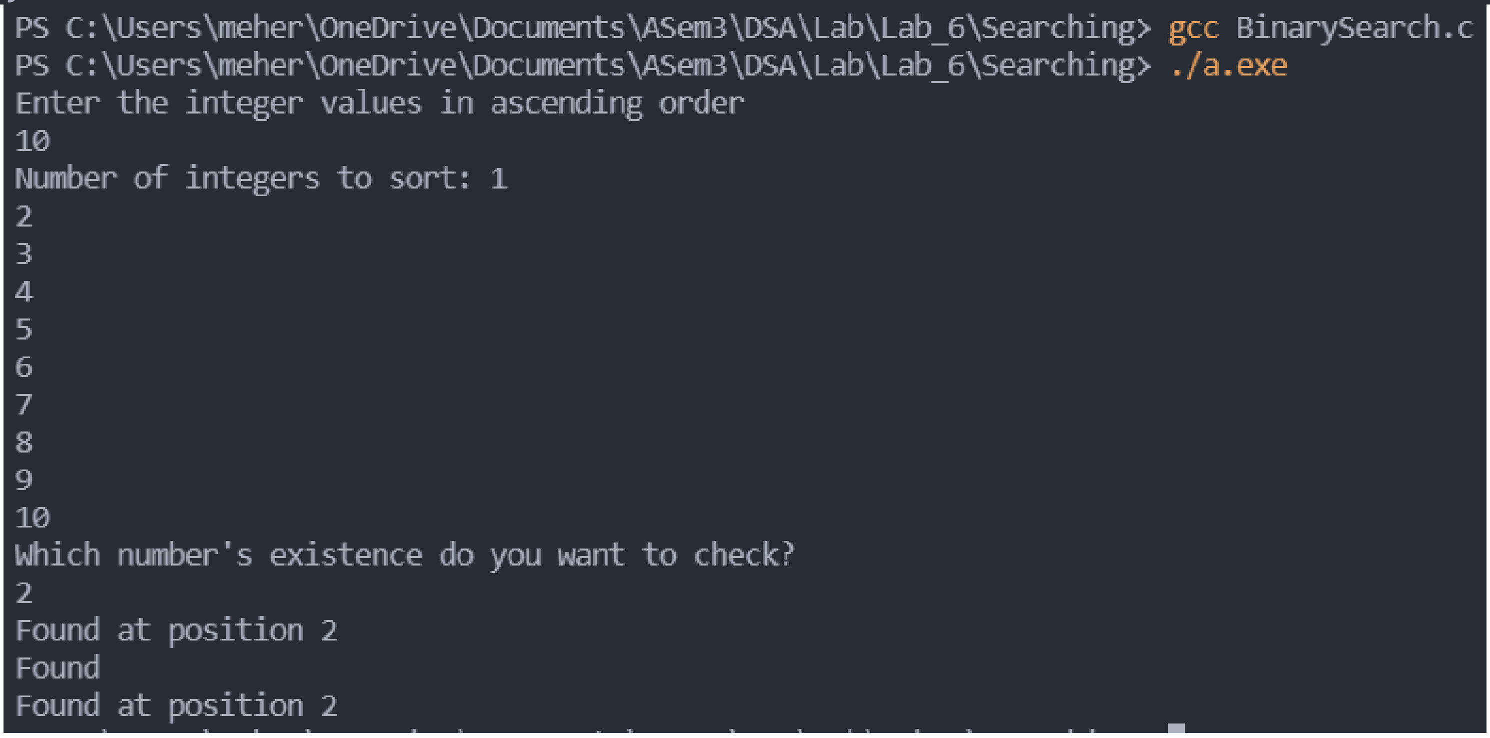
```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> gcc InsertionSort1.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> ./a.exe
Number of integers to sort: 10
Enter the integer values
0
4
1
9
6
2
7
3
8
6
Sorted Array - 0 1 2 3 4 6 6 7 8 9
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\sorting> 
```

BINARY SEARCH

```
#include <stdio.h>
void InsertionSort(int arr[], int n);
int main()
{
    int n, x;
    printf("Enter the integer values\n");
    scanf("%d", &n);
    int arr[n];
```

```c
    printf("Number of integers to sort: ");
    // Takes in the values from the user
    for(int i = 0; i < n; i++)
    {
        scanf("%d", &x);
        arr[i] = x;
    }

    InsertionSort(arr, n);

    printf("Sorted Array - ");
    for(int i = 0; i < n; i++)
    {
        printf("%d ", arr[i]);
    }
}
// https://www.youtube.com/watch?v=OAyj2d-GH0c
// TC - BEST CASE - O(n)
// TC - WORST CASE CASE - O(n^2)
// SPACE COMPLEXITY - O(1) - IN PLACE
// Sort Stability - Stable sort
// its most helpful when you have an almost sorted array
// used in online query - when elements are coming in one by one at random

void InsertionSort(int arr[], int n)
{
    for(int i = 1; i < n ; i++)
    {
        int key = arr[i];

        // start of the unsorted region
        int j = i -1;
        // element in the unsorted region is less than the current element
        while(j>=0 && arr[j]>key) // if the back of sorted region is
greater than our key
                                  //"arr[j]>key" - here for equal
elements, the ones on theleft will remain of the left side, making the
algorithm "stable"
                                  //"arr[j]>=key" - here even if the
element is equal to the current it will be moved to the right, and the
cuurent element which was originally on the right side wiil come to the
left, making the sort "unstable"
                                  // Stability of a sort can matter when
elements being sorted are dictionaried/mapped with other data.
```

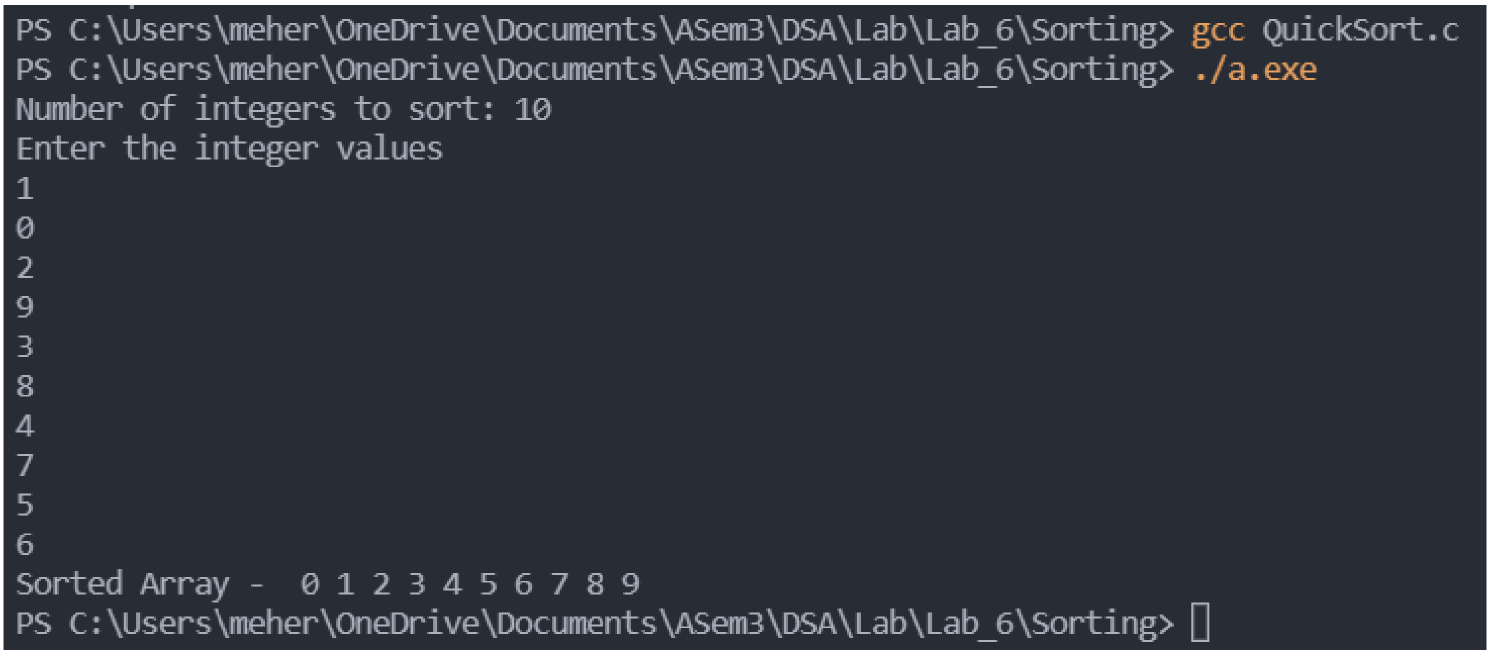
```
        {
            arr[j+1]=arr[j]; // shift that to the right
            j=j-1; // decrement the index by 1
        }

        arr[j+1]=key; // put in the key at the appropriate place
    }
}
```



```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Searching> gcc BinarySearch.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Searching> ./a.exe
Enter the integer values in ascending order
10
Number of integers to sort: 1
2
3
4
5
6
7
8
9
10
Which number's existence do you want to check?
2
Found at position 2
Found
Found at position 2
```

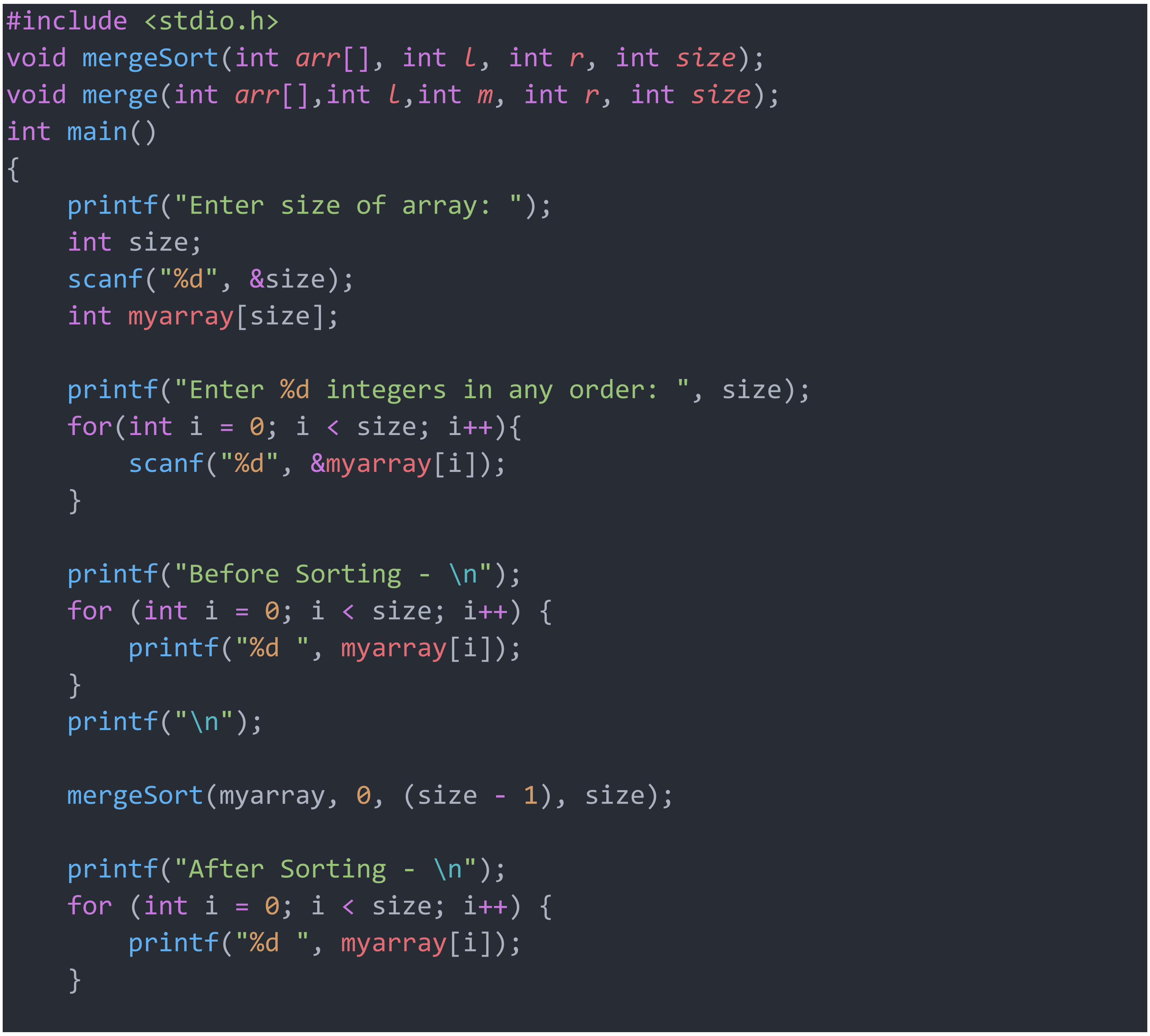
<u>QUICK SORT</u>

```c
#include <stdio.h>

/*
*   Comparision based sort
*   Divide and Conquer
*/
int Partition(int arr[], int beg, int end)
{
    int pivot = arr[end];
    int i = beg-1;
    int hold;
    for(int j = beg; j <= end-1; j++)
    {
        if(arr[j] < pivot)
        {
            i++;
            hold = arr[j];
            arr[j] = arr[i];
            arr[i] = hold;
        }
    }
    hold = arr[end];
    arr[end] = arr[i+1];
    arr[i+1] = hold;
    return i + 1;
}
void QuickSort(int arr[], int beg, int end)
{
    if(beg < end)
    {
        int mid = Partition(arr, beg, end);
        QuickSort(arr, beg, mid - 1);
        QuickSort(arr, mid + 1, end);
    }
}

int main()
{
    int x, n, hold;
    int flag = 0;
    printf("Number of integers to sort: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the integer values\n");
    // Takes in the values from the user
    for(int i = 0; i < n; i++)
    {
        scanf("%d", &x);
        arr[i] = x;
    }

    QuickSort(arr, 0, n);

    printf("Sorted Array - ");
    for (int a = 0; a < n; ++a)
    {
        printf(" %d", arr[a]);
    }
}
```

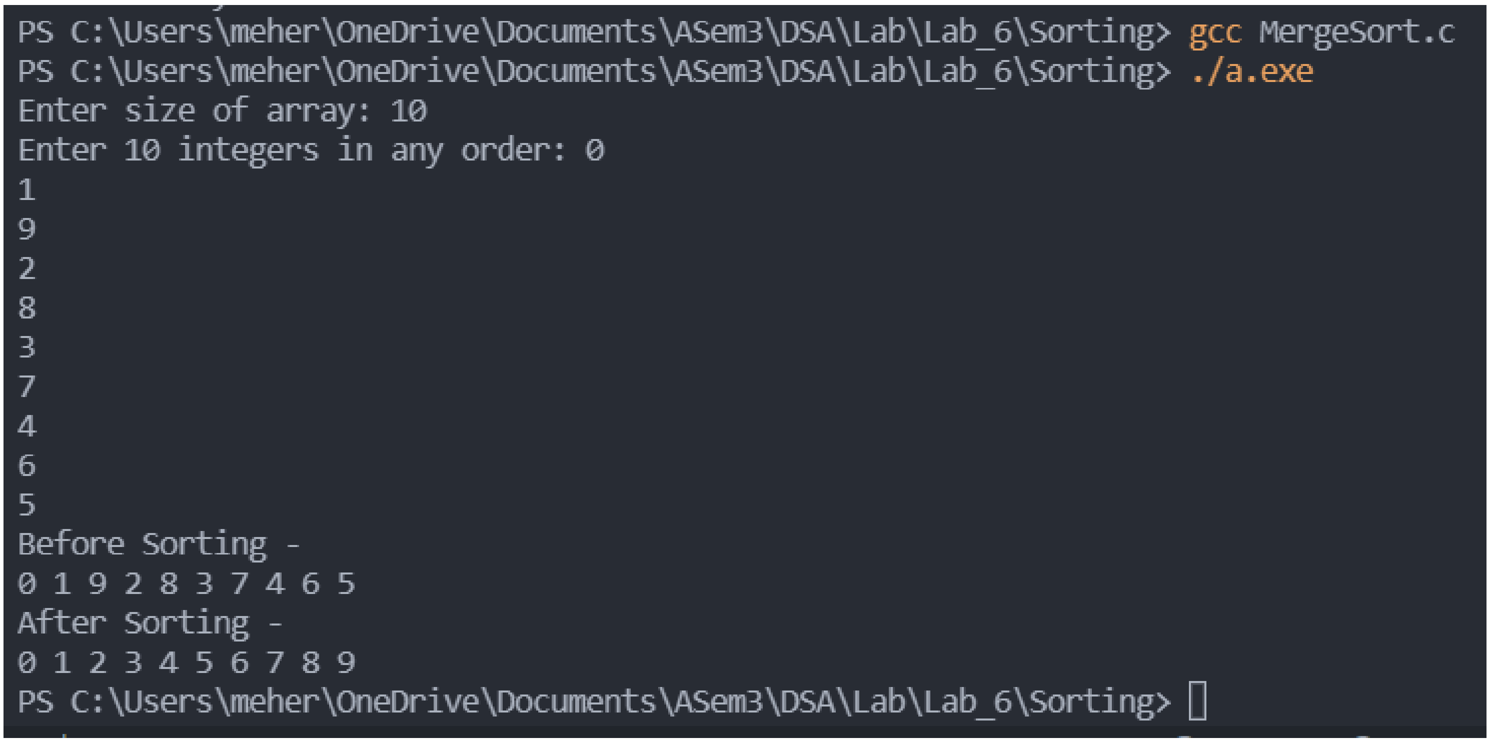


```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> gcc QuickSort.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> ./a.exe
Number of integers to sort: 10
Enter the integer values
1
0
2
9
3
8
4
7
5
6
Sorted Array -  0 1 2 3 4 5 6 7 8 9
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> 
```

MERGE SORT



```c
#include <stdio.h>
void mergeSort(int arr[], int l, int r, int size);
void merge(int arr[],int l,int m, int r, int size);
int main()
{
    printf("Enter size of array: ");
    int size;
    scanf("%d", &size);
    int myarray[size];

    printf("Enter %d integers in any order: ", size);
    for(int i = 0; i < size; i++){
        scanf("%d", &myarray[i]);
    }

    printf("Before Sorting - \n");
    for (int i = 0; i < size; i++) {
        printf("%d ", myarray[i]);
    }
    printf("\n");

    mergeSort(myarray, 0, (size - 1), size);

    printf("After Sorting - \n");
    for (int i = 0; i < size; i++) {
        printf("%d ", myarray[i]);
    }
    return 0;
}
void mergeSort(int arr[], int l, int r, int size)
{
    if (l < r)
    {
        int m = (l + r)/2;
        mergeSort(arr, l, m, size);
        mergeSort(arr, m + 1, r, size);
        merge(arr, l, m, r, size);
    }
}
void merge(int arr[], int l, int m, int r, int size)
{
    int i = l;
    int j = m +1;
    int k = l;

    int temp[size];

    while(i<=m && j<=r)
    {
        if(arr[i]<=arr[j])
            temp[k++] = arr[i++];
        else
            temp[k++]=arr[j++];
    }

    while(i<=m)
        temp[k++] = arr[i++];

    while(j<=r)
        temp[k++] = arr[j++];

    for (int p = l; p <= r; p++)
        arr[p] = temp[p];
}
```



```
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> gcc MergeSort.c
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> ./a.exe
Enter size of array: 10
Enter 10 integers in any order: 0
1
9
2
8
3
7
4
6
5
Before Sorting -
0 1 9 2 8 3 7 4 6 5
After Sorting -
0 1 2 3 4 5 6 7 8 9
PS C:\Users\meher\OneDrive\Documents\ASem3\DSA\Lab\Lab_6\Sorting> 
```