# 15B17CI371 – Data Structures Lab

## ODD 2024
## Week 3-LAB B
## Practice Lab

## Virtual Lab

### Unsorted Arrays vs Binary Search

Choose difficulty: ☑ Beginner ☑ Intermediate ☑ Advanced

**1. How do you describe an array?**

- a: Data structure having linear access time Explanation
- b: Data structure containing elements of similar types in contiguous storage
- c: A container of unique elements of similar types Explanation
- d: Data structure containing elements located in various locations memory which may or may not be contiguous Explanation

**2. What is the time complexity of traversing through all the elements in an array?**

- a: O(N^2)
- b: O(1)
- c: O(N) Explanation
- d: O(log N)

**3. Let us consider the following code:**

```
int a = 0, b[N];
for (i = 0; i < M; i++) {
    a+=i;
}
for (i = 0; i < N; i++) {
    scanf(\"%d\", &b[i]);
    a+=b[i];
```

```
    a--1;
}
for (i = 0; i < N; i++) {
    scanf(\"%d\", &b[i]);
    a+=b[i];
}
```

What is the space and time complexity of the above code?

- a: Space: O(M+N), Time: O(M+N)
- b: Space: O(N), Time: O(M*N)
- c: Space: O(M), Time: O(M)
- d: Space: O(N), Time: O(M+N) Explanation

4. Let us consider following four arrays:
A = [9, 5, 11, 25, 7, 35]
B = [1, 2, 9, 15, 27]
C = [29, 27, 27, 18, 4, 2]
D = [1, 8, 2, 5, 6, 7, 8, 9]
Which of the arrays are sorted?

- a: A and C
- b: B and D
- c: B and C Explanation
- d: A and D

4. Let us consider following four arrays:
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- c: B and C Explanation
- d: A and D

5. If for large inputs, X is a better choice than Y, then:

- a: Y is asymptotically more efficient than X Explanation
- b: X is asymptotically more efficient than Y Explanation
- c: X and Y are equivalently efficient Explanation
- d: None of the above

Submit Quiz

5 out of 5

1.

```
#include &lt;iostream&gt;
using namespace std;
void missingterm( int a[],int n)
{

for(int j=0;j&lt;n;j++)
{
if(a[j]!=j)
{

cout&lt;&lt;j&lt;&lt;&quot; missing&quot;;
break;

}

}

}
void sort(int arr[],int n)

{
for(int i=0;i&lt;n;i++)

{
for(int j=i+1;j&lt;n;j++)
{
int temp;
if (arr[i]&gt;arr[j])
{
temp=arr[i];
arr[i]=arr[j];
arr[j]=temp;
}
}
}
for (int i=0;i&lt;n;i++)
{
cout&lt;&lt;arr[i]&lt;&lt;&quot; &quot;;
}
cout&lt;&lt;endl;
missingterm(arr,n);
```

```
}

int main()
{

int n;

cout&lt;&lt;&quot;enter size: &quot;;
cin&gt;&gt;n;
int arr[n];

cout&lt;&lt;&quot;enter elements: &quot;;
for (int i=0;i&lt;n;i++)
{
int a;
cin&gt;&gt;a;
arr[i]=a;
}
sort(arr,n);

}
```

```
enter size: 4
enter elements: 0
1
2
4
0 1 2 4
3 missing
Process returned 0 (0x0)   execution time : 9.852 s
Press any key to continue.
```

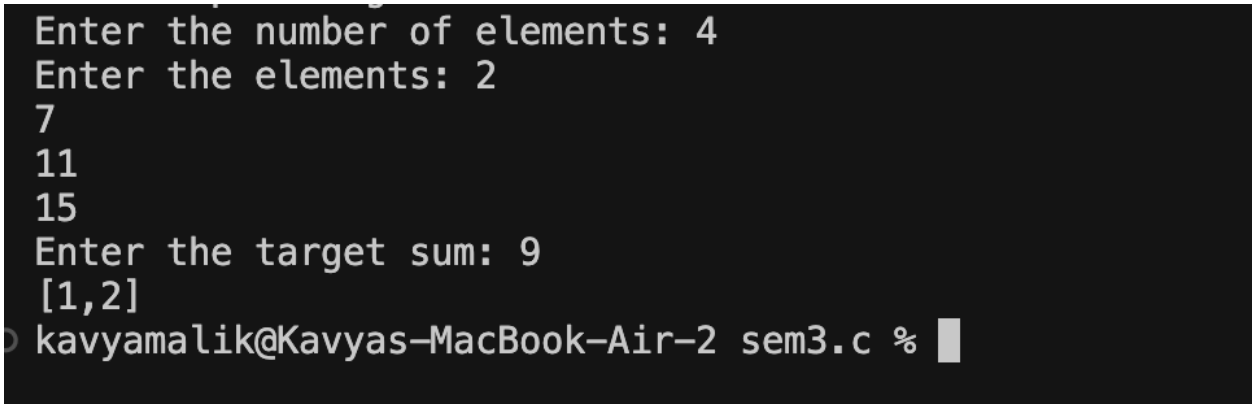
```
enter size: 6
enter elements: 5
6
4
3
2
1
1 2 3 4 5 6
0 missing
Process returned 0 (0x0)   execution time : 8.207 s
Press any key to continue.
```

2.

```
#include <iostream>

using namespace std;

#define MAX_SIZE 100

void bubbleSort(int arr[], int size) {
    for (int i = 0; i < size - 1; ++i) {
        for (int j = 0; j < size - i - 1; ++j) {
            if (arr[j] > arr[j + 1]) {
                int temp = arr[j];
                arr[j] = arr[j + 1];
                arr[j + 1] = temp;
            }
        }
    }
}

void findPairWithSum(int arr[], int size, int target) {
    if (size < 2) {
        cout << "No pairs found" << endl;
        return;
    }
```

```
    bubbleSort(arr, size);

    int left = 0;
    int right = size - 1;

    while (left < right) {
        int currentSum = arr[left] + arr[right];

        if (currentSum == target) {
            cout << "[" << left + 1 << "," << right + 1 << "]" << endl;
            return;
        } else if (currentSum < target) {
            ++left;
        } else {
            --right;
        }
    }

    cout << "No pairs found" << endl;
}

int main() {
    int size;
    cout << "Enter the number of elements: ";
```

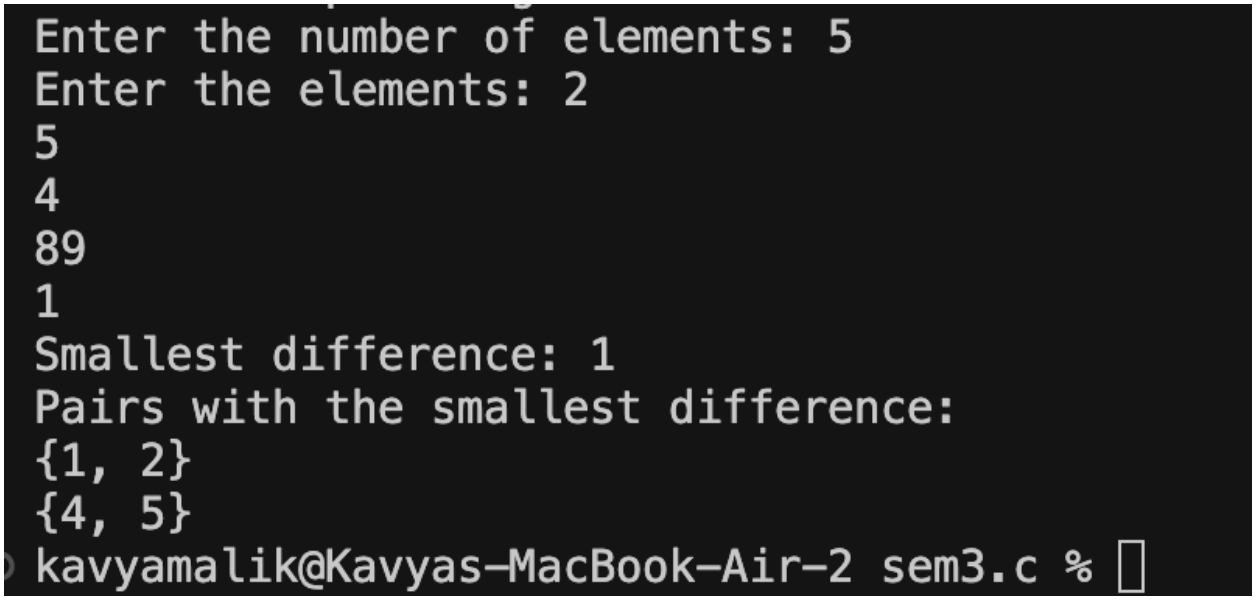
```
    cin >> size;

    if (size < 2 || size > MAX_SIZE) {
        cout << "Invalid size. Size must be between 2 and " << MAX_SIZE << "." << endl;
        return 1;
    }

    int array[MAX_SIZE];
    cout << "Enter the elements: ";
    for (int i = 0; i < size; ++i) {
        cin >> array[i];
    }

    int target;
    cout << "Enter the target sum: ";
    cin >> target;

    findPairWithSum(array, size, target);

    return 0;
}
```




3.

```
#include <iostream>
#include <climits>
#include<math.h>
using namespace std;
void bubbleSort(int arr[], int n) {
bool swapped;
for (int i = 0; i < n - 1; ++i) {swapped = false;
for (int j = 0; j < n - i - 1; ++j) {
if (arr[j] > arr[j + 1]) {
int temp = arr[j];
arr[j] = arr[j + 1];
arr[j + 1] = temp;
swapped = true;
}
}
if (!swapped)
break;
}
}
void findPairsWithSmallestDifference(int arr[], int n) {
if (n < 2) {
cout << "Not enough elements to form pairs." << std::endl;
return;
}
bubbleSort(arr, n);
int minDiff=abs(arr[0]-arr[1]);
for (int i = 1; i < n; ++i) {
int diff = arr[i] - arr[i - 1];
if (abs(diff) < minDiff) {
```

```
minDiff = diff;
}
}
cout << "Smallest difference: " << minDiff << endl;
cout << "Pairs with the smallest difference: " << endl;
for (int i = 1; i < n; ++i) {
if (abs(arr[i] - arr[i - 1]) == minDiff) {
cout << "{" << arr[i - 1] << ", " << arr[i] << "}" << endl;
}
}
}
int main() {
int n;
cout << "Enter the number of elements: ";
cin >> n;
if (n <= 0) {
cout << "Number of elements must be positive." << std::endl;
return 1;
}
int* arr = new int[n];
cout << "Enter the elements: ";
for (int i = 0; i < n; ++i) {
cin >> arr[i];
}
findPairsWithSmallestDifference(arr, n);
delete[] arr;
return 0;
}
```




4.

```
#include <iostream>

using namespace std;

int interpolationSearch(int arr[], int size, int key) {
    int low = 0;
    int high = size - 1;

    while (low <= high && key >= arr[low] && key <= arr[high]) {
        if (low == high) {
            if (arr[low] == key) return low;
            return -1;
        }
```

```
        int pos = low + ((key - arr[low]) * (high - low) / (arr[high] - arr[low]));

        if (arr[pos] == key) {
            return pos;
        } else if (arr[pos] < key) {
            low = pos + 1;
        } else {
            high = pos - 1;
        }
    }

    return -1;
}

int main() {
    int size;
    cout << "Enter the number of elements: ";
    cin >> size;

    int arr[size];
    cout << "Enter the elements in sorted order: ";
    for (int i = 0; i < size; ++i) {
        cin >> arr[i];
    }
```

```
    int key;
    cout << "Enter the key to search for: ";
    cin >> key;

    int result = interpolationSearch(arr, size, key);

    if (result != -1) {
        cout << "Element found at index " << result << endl;
    } else {
        cout << "Element not found in the array" << endl;
    }

    return 0;
}
```

```
Enter the number of elements: 5
Enter the elements in sorted order: 1
2
3
4
5
Enter the key to search for: 4
Element found at index 3
kavyamalik@Kavyas-MacBook-Air-2 sem3.c %
```

5.

```
#include <iostream>
using namespace std;
int minSwaps(int *arr,int n) {
int swaps=0;
for (int i=0; i<n; i++)
{
int min=arr[i];
int index=i;
for(int j=i+1;j<n;j++)
if(arr[i]>arr[j])
{
int temp=arr[i];
arr[i]=arr[j];
arr[j]=temp;
swaps++;
}
}
return swaps;
}
int main()
{
int n;
cout<<"Input the number of elements : ";
cin>>n;
cout<<"Input the elements : ";
int *arr=new int[n];
for(int i=0;i<n;i++)
cin>>arr[i];
int a=minSwaps(arr,n);
cout<<"Sorted array : ";
for(int i=0; i<n; i++)
cout<<arr[i]<<" ";
cout<<"\nMinimum Swaps to sort the array : "<<a<<endl;
return 0;
}
```

```
Input the number of elements : 5
Input the elements : 5
4
3
2
1
Sorted array : 1 2 3 4 5
Minimum Swaps to sort the array : 10
kavyamalik@Kavyas-MacBook-Air-2 sem3.c %
```

6.

```
#include <iostream>
#include <vector>
using namespace std;
int mergeAndCount(int *arr,int left,int mid,int right)
{
    int n1=mid-left+1;
    int n2=right-mid;
    vector<int> leftArr(n1);
    vector<int> rightArr(n2);
    for (int i=0; i<n1; i++)
leftArr[i]=arr[left+i];
    for (int i=0; i<n2; i++)
 rightArr[i]=arr[mid+1+i];
    int i=0,j=0,k=left,swaps=0;
    while (i<n1 && j<n2)
    {
```

```
        if (leftArr[i]<=rightArr[j])
            arr[k++]=leftArr[i++];
        else
        {
            arr[k++]=rightArr[j++];
            swaps+=(n1-i);
        }
    }
    while (i<n1) arr[k++]=leftArr[i++];
    while (j<n2) arr[k++]=rightArr[j++];
    return swaps;
}
int mergeSortAndCount(int* arr,int left,int right)
{
    int count=0;
    if (left<right)
    {
        int mid=left+(right-left) / 2;
        count+=mergeSortAndCount(arr,left,mid);
        count+=mergeSortAndCount(arr,mid+1,right);
        count+=mergeAndCount(arr,left,mid,right);
    }
    return count;
}
int main()
{
```

```
    int n;
    cout<<"Input the number of elements : ";
    cin>>n;
    cout<<"Input the elements : ";
    int *arr=new int[n];
    for(int i=0;i<n;i++)
        cin>>arr[i];
    int result=mergeSortAndCount(arr,0,n-1);
    cout<<"Inversion Count: "<<result<<endl;
    return 0;
}
```