Merge Sort

```cpp
//  Author: Anish Tilloo
//  Roll No. : 34
//  Program: Merge Sort

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

void merge(int arr[], int left, int mid, int right){
    // size of array one and array two
    int arrayOne = mid - left + 1;
    int arrayTwo = right - mid;

    // dynamicall allocating two sub array
    auto *subArrayOne = new int[arrayOne];
    auto *subArrayTwo = new int[arrayTwo];

    // putting the elements of array one and two from main array
    for (int i = 0; i < arrayOne; i++)
    {
        subArrayOne[i] = arr[left + i];
    }
    for (int j = 0; j < arrayTwo; j++)
```

```cpp
    }
    for (int j = 0; j < arrayTwo; j++)
    {
        subArrayTwo[j] = arr[mid + 1 + j];
    }

    int indexOfOne = 0;
    int indexOfTwo = 0;
    int indexOfMerged = left;

    // merging the arrays
    while (indexOfOne < arrayOne && indexOfTwo < arrayTwo)
    {
        if (subArrayOne[indexOfOne] <= subArrayTwo[indexOfTwo])
        {
            arr[indexOfMerged] = subArrayOne[indexOfOne];
            indexOfOne++;
        }
        else
        {
            arr[indexOfMerged] = subArrayTwo[indexOfTwo];
            indexOfTwo++;
```

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MergeSort.cpp

Practical-3 > MergeSort.cpp > inputArray(int [], int)

```cpp
        else
        {
            arr[indexOfMerged] = subArrayTwo[indexOfTwo];
            indexOfTwo++;
        }
        indexOfMerged++;
    }

    // if one array end the copy all the remaining elements from the remaining array
    while (indexOfOne < arrayOne)
    {
        arr[indexOfMerged] = subArrayOne[indexOfOne];
        indexOfOne++;
        indexOfMerged++;
    }

    while (indexOfTwo < arrayTwo)
    {
        arr[indexOfMerged] = subArrayTwo[indexOfTwo];
        indexOfTwo++;
        indexOfMerged++;
    }
}
```

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MergeSort.cpp

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```cpp
        indexOfMerged++;
    }
}

void mergeSort(int arr[], int left, int right){
    if (left < right)
    {
        int mid = (left + right) / 2;
        mergeSort(arr, left, mid);
        mergeSort(arr, mid + 1, right);

        merge(arr, left, mid, right);
    }

}

void inputArray( int arr[], int arraySize){
    cout << "Enter the elements of the array one by one " << endl;
    for (int i = 0; i < arraySize; i++)
    {
        cin >> arr[i];
    }
```

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MergeSort.cpp

Practical-3 > MergeSort.cpp > inputArray(int [], int)

```cpp
void printArray(int arr[], int arraySize){
    for (int i = 0; i < arraySize; i++)
    {
        cout << arr[i] << " ";
    }
}

int main(){
    int arraySize;
    cout << "Enter the size of the array " << endl;
    cin >> arraySize;

    int arr[arraySize];
    inputArray(arr, arraySize);

    mergeSort(arr, 0, arraySize - 1);

    cout << "Sorted Array" << endl;
    printArray(arr, arraySize);
}
```

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MergeSort.cpp

Practical-3 > MergeSort.cpp > inputArray(int [], int)

PROBLEMS 4 OUTPUT DEBUG CONSOLE TERMINAL Code

```
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3> cd "e:\College-Work\Sixth-Semester\DAA-practical\
Practical-3\" ; if ($?) { g++ MergeSort.cpp -o MergeSort } ; if ($?) { .\MergeSort }
Enter the size of the array
6
Enter the elements of the array one by one
90 5 12 7 34 2
Sorted Array
2 5 7 12 34 90
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3> cd "e:\College-Work\Sixth-Semester\DAA-practical\
Practical-3\" ; if ($?) { g++ MergeSort.cpp -o MergeSort } ; if ($?) { .\MergeSort }
Enter the size of the array
5
Enter the elements of the array one by one
8 5 1 9 10
Sorted Array
1 5 8 9 10
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3>
```

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Heap Sort

HeapSort.cpp - DAA-practical - Visual Studio Code

Practical-3 > HeapSort.cpp > heapify(int [], int, int)

```cpp
//  Author: Anish Tilloo
//  Roll No. : 34
//  Program: Heap Sort

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

// Heap Sort
void heapify(int arr[], int n, int i)
{
    int largest = i; // Initialize largest as root
    int l = 2 * i + 1; // left = 2*i + 1
    int r = 2 * i + 2; // right = 2*i + 2

    // here we are checking if the left child index is greater than n or not
    // and the left child is greater than the current element
    if (l < n && arr[l] > arr[largest])
        largest = l;

    // here we are checking if the right child index is greater than n or not
    // and the right child is greater than the current element
    if (r < n && arr[r] > arr[largest])
```

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Practical-3 > HeapSort.cpp > heapify(int [], int, int)

```cpp
    // and the left child is greater than the current element
    if (l < n && arr[l] > arr[largest])
        largest = l;

    // here we are checking if the right child index is greater than n or not
    // and the right child is greater than the current element
    if (r < n && arr[r] > arr[largest])
        largest = r;

    // If largest is not root
    if (largest != i) {
        swap(arr[i], arr[largest]);

        heapify(arr, n, largest);
    }
}

void heapSort(int arr[], int n)
{
    for (int i = n / 2 - 1; i >= 0; i--){
        heapify(arr, n, i);
    }
```

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HeapSort.cpp

Practical-3 > HeapSort.cpp > heapify(int [], int, int)

```cpp
void heapSort(int arr[], int n)
{
    for (int i = n / 2 - 1; i >= 0; i--){
        heapify(arr, n, i);
    }


    for (int i = n - 1; i >= 0; i--) {
        // Move current root to end
        swap(arr[0], arr[i]);

        // call heapify on the reduced heap
        heapify(arr, i, 0);
    }
}

void inputArray( int arr[], int arraySize){
    cout << "Enter the elements of the array one by one " << endl;
    for (int i = 0; i < arraySize; i++)
    {
        cin >> arr[i];
    }
```

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HeapSort.cpp

Practical-3 > HeapSort.cpp > heapify(int [], int, int)

```cpp
void printArray(int arr[], int n)
{
    for (int i = 0; i < n; ++i)
        cout << arr[i] << " ";
    cout << "\n";
}

int main()
{
    int n;
    cout << "Enter the no of elements in the array" << endl;
    cin >> n;
    int arr[n];
    inputArray(arr, n);

    heapSort(arr, n);

    cout << "Sorted array is \n";
    printArray(arr, n);
}

```

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HeapSort.cpp

Practical-3 > HeapSort.cpp > heapify(int [], int, int)

PROBLEMS 4 OUTPUT DEBUG CONSOLE TERMINAL

```
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3> cd "e:\College-Work\Sixth-Semester\DAA-practical\
Practical-3\" ; if ($?) { g++ HeapSort.cpp -o HeapSort } ; if ($?) { .\HeapSort }
Enter the no of elements in the array
6
Enter the elements of the array one by one
12 90 69 14 65 23
Sorted array is
12 14 23 65 69 90
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3> cd "e:\College-Work\Sixth-Semester\DAA-practical\
Practical-3\" ; if ($?) { g++ HeapSort.cpp -o HeapSort } ; if ($?) { .\HeapSort }
Enter the no of elements in the array
5
Enter the elements of the array one by one
8 4 12 65 1
Sorted array is
1 4 8 12 65
PS E:\College-Work\Sixth-Semester\DAA-practical\Practical-3>
```

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