
# Design & Analysis Algorithm
# Assignment - 2

**Name : Hemal Chudasama**
**Roll No. : 21BCP152**
**Div - 3 , G - 5**

# -: Merge sort :-

The Merge Sort algorithm is a sorting algorithm that is based on the Divide and Conquer paradigm. In this algorithm, the array is initially divided into two equal halves and then they are combined in a sorted manner.

- **Merge Sort Algorithm :-**

1. start
   2. declare array and left, right, mid variable
   3. perform merge function.
      if left > right
         return
      mid= (left+right)/2
      mergesort(array, left, mid)
      mergesort(array, mid+1, right)
      merge(array, left, mid, right)
   4. Stop

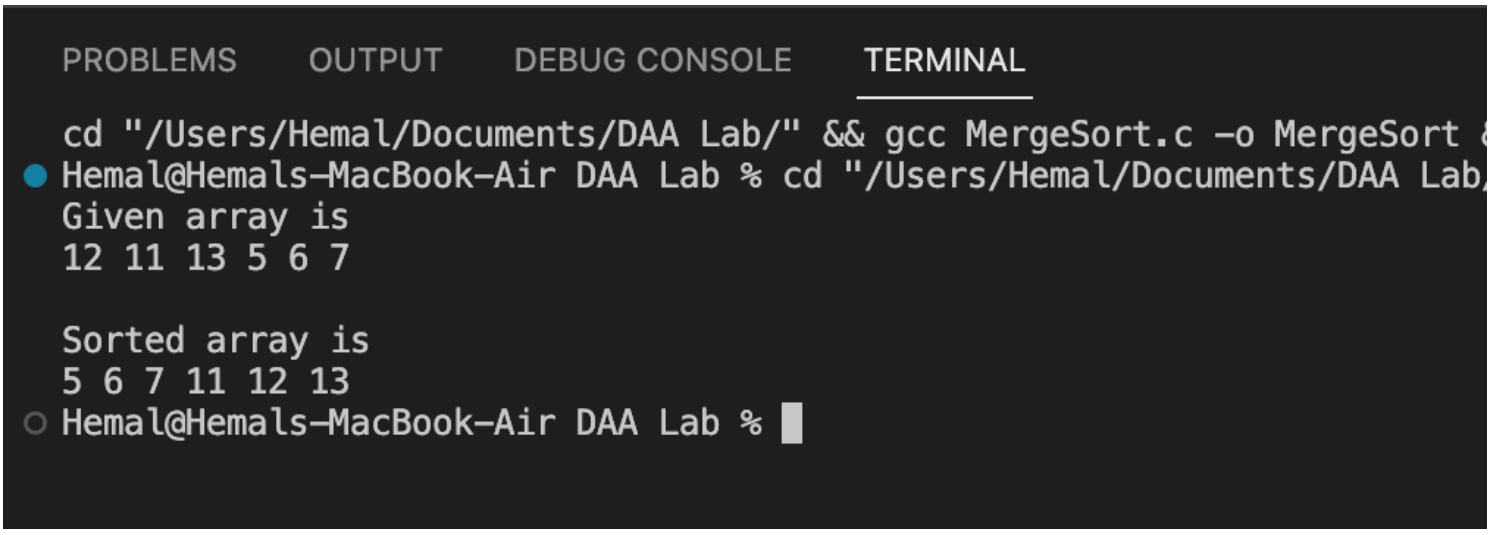
- **Program :-**

```c
#include <stdio.h>
#include <stdlib.h>

void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;

    int L[n1], R[n2];

    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
```

```
        R[j] = arr[m + 1 + j];

    i = 0;
    j = 0;
    k = l;
    while (i < n1 && j < n2) {
        if (L[i] <= R[j]) {
            arr[k] = L[i];
            i++;
        }
        else {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    while (i < n1) {
        arr[k] = L[i];
        i++;
        k++;
    }

    while (j < n2) {
        arr[k] = R[j];
        j++;
        k++;
    }
}

void mergeSort(int arr[], int l, int r)
{
    if (l < r) {
        int m = l + (r - l) / 2;

        mergeSort(arr, l, m);
        mergeSort(arr, m + 1, r);

        merge(arr, l, m, r);
    }
```

```
}

void printArray(int A[], int size)
{
    int i;
    for (i = 0; i < size; i++)
        printf("%d ", A[i]);
    printf("\n");
}

int main()
{
    int arr[] = { 12, 11, 13, 5, 6, 7 };
    int arr_size = sizeof(arr) / sizeof(arr[0]);

    printf("Given array is \n");
    printArray(arr, arr_size);

    mergeSort(arr, 0, arr_size - 1);

    printf("\nSorted array is \n");
    printArray(arr, arr_size);
    return 0;
}
```

- **Output :-**



# -: Quick sort :-

Like Merge Sort, QuickSort is a Divide and Conquer algorithm. It picks an element as a pivot and partitions the given array around the picked pivot. There are many different versions of quickSort that pick pivot in different ways.

- Always pick the first element as a pivot.
- Always pick the last element as a pivot (implemented below)
- Pick a random element as a pivot.
- Pick median as the pivot.

The key process in quickSort is a partition(). The target of partitions is, given an array and an element x of an array as the pivot, put x at its correct position in a sorted array and put all smaller elements (smaller than x) before x, and put all greater elements (greater than x) after x. All this should be done in linear time.

- **Quick Sort Algorithm :-**

```
QUICKSORT (array A, start, end)
1. {
2.  if (start < end)
3.  {
4.  p = partition(A, start, end)
5.  QUICKSORT (A, start, p - 1)
6.  QUICKSORT (A, p + 1, end)
7.  }
8. }

PARTITION (array A, start, end)
9. {
10.  pivot ? A[end]
11.  i ? start-1
12.  for j ? start to end -1 {
13.  do if (A[j] < pivot) {
14.  then i ? i + 1
15.  swap A[i] with A[j]
```

16. }}
17. swap A[i+1] with A[end]
18. **return** i+1
19.}

- **Program :-**

```
#include <stdio.h>

void swap(int *a, int *b) {
  int t = *a;
  *a = *b;
  *b = t;
}

int partition(int array[], int low, int high) {

  int pivot = array[high];

  int i = (low - 1);

  for (int j = low; j < high; j++) {
    if (array[j] <= pivot) {

      i++;

      swap(&array[i], &array[j]);
    }
  }

  swap(&array[i + 1], &array[high]);

  return (i + 1);
}

void quickSort(int array[], int low, int high) {
  if (low < high) {
```

```c
    int pi = partition(array, low, high);

    quickSort(array, low, pi - 1);

    quickSort(array, pi + 1, high);
  }
}

void printArray(int array[], int size) {
  for (int i = 0; i < size; ++i) {
    printf("%d  ", array[i]);
  }
  printf("\n");
}

int main() {
  int data[] = {8, 7, 2, 1, 0, 9, 6};

  int n = sizeof(data) / sizeof(data[0]);

  printf("Unsorted Array\n");
  printArray(data, n);

  quickSort(data, 0, n - 1);

  printf("Sorted array in ascending order: \n");
  printArray(data, n);
}
```

- **Output :-**