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23CSE211

Design and Analysis of Algorithms

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IN

COMPUTER SCIENCE AND ENGINEERING

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CHENNAI

1. Merge Sorting

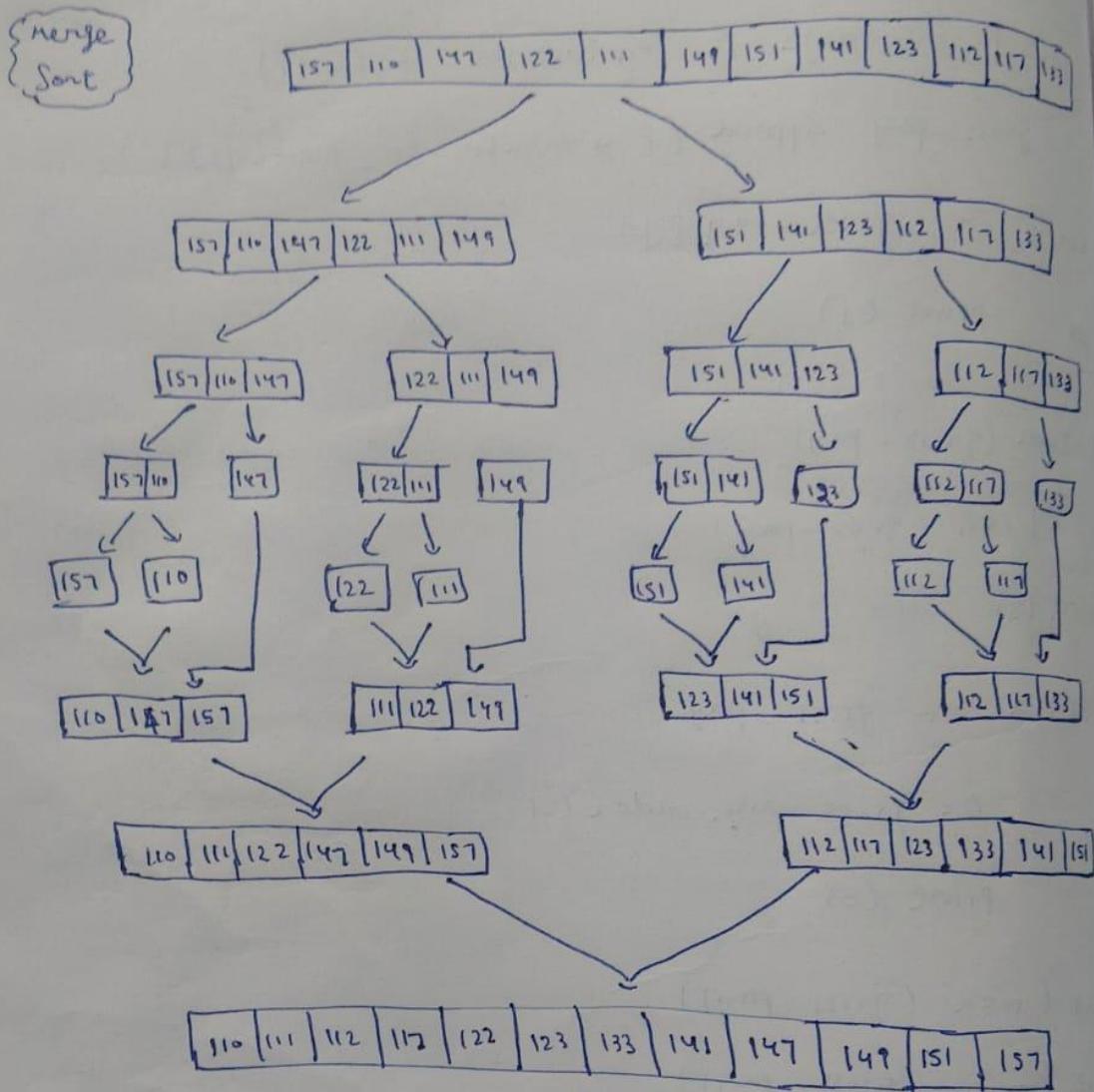
Merge Sort is a Divide and Conquer sorting algorithm.

The given list is divided repeatedly into two halves until each sublist has one element.
Single elements are merged back in sorted order.

During merging, elements from two sorted sublists are compared and placed in order.
This process continues until the entire list becomes sorted.

3.1.26

List = [157, 110, 147, 122, 111, 149, 151, 141, 123, 112, 117, 133]



Code:

```
#include <stdio.h>

void merge (int arr[], int low, int mid, int high)
{
    int i=low, j=mid+1, k=0;
    int temp[50];
    int i=0, j=0, k=0;
}
```

```

while (i <= mid && j <= high)
{
    if (arr[i] < arr[j])
    {
        temp[k] = arr[i];
        i++;
    }
    else
    {
        temp[k] = arr[j];
        j++;
    }
    k++;
}
while (i <= mid)
{
    temp[k] = arr[i];
    i++;
    k++;
}
while (j <= high)
{
    temp[k] = arr[j];
    j++;
    k++;
}
for (i = low, k = 0; i <= high; i++, k++)
{
    arr[i] = temp[k];
}
}

void mergesort (int arr[], int low, int high)
{
    int mid;
    if (low < high)
    {
        mid = (low+high)/2;
    }
}

```

```

mergeSort(arr, low, mid);
    mergeSort(arr, mid+1, high);
    mergeSort(arr, low, mid, high);
}

int main()
{
    int arr[] = {157, 110, 147, 122, 111, 148, 151, 141, 123, 112, 117, 133};
    int i;
    mergeSort(arr, 0, 11);
    printf("Sorted Array");
    for(i=0; i<12; i++)
    {
        printf("%d", arr[i]);
    }
    return 0;
}

```

Time complexity = $O(n \log n)$

Space complexity = $O(n)$

2. Quick Sorting

Quick Sort is a Divide and Conquer sorting algorithm.

A pivot element is selected (can be any element).

The array is partitioned such that elements less than the pivot are placed on the left and greater than the pivot on the right.

The pivot is placed in its correct position.

The same process is recursively applied to the left and right subarrays.

Sorting continues until all subarrays have one or no elements.

$$L[0] = [157, 110, 147, 122, 111, 149, 151, 141, 123, 112, 117, 133]$$

Quick Sort

157	110	147	122	111	149	151	141	123	112	117	133
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	122	111	149	151	141	123	112	117	122	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	122	111	149	151	141	123	112	117	133	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	122	111	149	151	141	123	112	117	133	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	122	141	123	133	149	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	122	141	123	133	149	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	122	123	123	141	149	157	151
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	122	123	123	141	157	149	151
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	117	122	123	133	141	157	151
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	147	111	112	117	122	123	133	141	157	149	151
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

110	111	112	117	122	123	123	141	147	147	151	157
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Code:

```
#include <stdio.h>
int quick(int arr[], int low, int high)
{
    int pivot = arr[low];
    int i = low + 1;
    int j = high;
    int temp;

    while (i <= j)
    {
        while (arr[i] <= pivot && i < high)
            i++;
        while (arr[j] > pivot)
            j--;
        if (i < j)
        {
            temp = arr[i];
            arr[i] = arr[j];
            arr[j] = temp;
        }
    }
    temp = arr[low];
    arr[low] = arr[j];
    arr[j] = temp;
    return j;
}
```

```
void quicksort (int arr[], int low, int high)
```

```
{
    int p;
    if (low < high)
    {
        p = quick(arr, low, high);
        quicksort(arr, low, p - 1);
        quicksort(arr, p + 1, high);
    }
}
```

```

    quicksort (arr, low, p-1);
    quicksort (arr, p+1, high);
}

int main()
{
    int arr[] = {157, 110, 147, 122, 111, 149, 151, 141, 123, 112, 117, 139};

    quicksort (arr, 0, 11);

    printf ("Sorted Array");

    for (int i=0; i<12; i++)
    {
        printf (" %d ", arr[i]);
    }

    return 0;
}

```

Time complexity = $O(n \log n)$ for Best & Average case
 $O(n^2)$ for Worst case

Space complexity = $O(n)$