CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

DEVANG PATEL INSTITUTE OF ADVANCE TECHNOLOGY & RESEARCH

Computer Science & Engineering

NAME: PARTH NITESHKUMAR PATEL

ID: 19DCS098

SUBJECT: DESIGN AND ANALYSIS OF ALGORITHM

CODE: CS 351

PRACTICAL-3.1

AIM:

ANALYSE THE DIVIDE AND CONQUER TECHNIQUE

Implement and perform analysis of worst case of Merge Sort and Quicksort. Compare both algorithms.

PROGRAM CODE:

MERGE SORT:

```
#include<iostream>
using namespace std;
int counter=0;
void merge(int arr[], int left, int middle, int right){
    int sizeLeft = middle - left +  1;
    int sizeRight = right - middle;
    int leftArray[sizeLeft], rightArray[sizeRight];
    for(int i=0;i<sizeLeft;i++){
        leftArray[i] = arr[left + i];
    }

    for(int i=0;i<sizeRight;i++){
        rightArray[i] = arr[middle+1+i];
    }
    int i=0;
```

```
    int j=0;
    int k=left;
    while(i<sizeLeft && j< sizeRight){
        if(leftArray[i] <= rightArray[j]){
            arr[k] = leftArray[i];
            i++;
        } else {
            arr[k] = rightArray[j];
            j++;
        }
        k++;
    }
    while(i<sizeLeft){
        arr[k] = leftArray[i];
        i++;
        k++;
    }
    while(i<sizeRight){
        arr[k] = rightArray[j];
        j++;
        k++;
    }
}

void mergeSort(int arr[], int left,int right){
    counter++;
    if (right > left){
        int middle = (left + right) / 2;
        mergeSort(arr, left, middle);
        mergeSort(arr, middle+1, right);
        merge(arr, left, middle, right);
    }
}
```

```
int main(){
    int size;
    cout << "Enter the input size: ";
    cin >> size;

    int arr[size];
    cout << "Enter the values of array: "<< endl;
    for(int i=0;i<size;i++){
        cin >> arr[i];
    }

    mergeSort(arr,0,size);

    cout << "The sorted array : "<< endl;
    for(int i=0;i<size;i++){
        cout << arr[i] << " ";
    }
    cout<<"\nCOUNTER: "<<counter<<endl;
    cout<<"PARTH PATEL 19DCS098"<<endl;
}
```

OUTPUT:

```
Enter the input size: 10
Enter the values of array:
10 9 8 7 6 5 1 2 3 4
The sorted array :
1 2 3 4 5 6 7 8 9 10
COUNTER: 21
PARTH PATEL 19DCS098
```

QUICK SORT:

```
#include <iostream>
using namespace std;
int counter=0;
int partition(int arr[], int low, int high){

    int pivot = arr[high];
    int i = low-1;

    for(int j=low;j<=high-1;j++){
        if(arr[j] <= pivot){
            i++;
            swap(arr[i],arr[j]);
        }
    }
    swap(arr[i+1],arr[high]);
    return i+1;
}

void quickSort(int arr[], int low, int high){
   counter++;
    if(low < high){
        int pivotIndex = partition(arr,low,high);

        quickSort(arr,low,pivotIndex-1);
        quickSort(arr,pivotIndex+1,high);
    }
}

int main(){
```

```
    int size;
    cout << "Enter the input size : ";
    cin >> size;

    int arr[size];
    cout << "Enter the values : "<< endl;
    for(int i=0;i<size;i++){
        cin >> arr[i];
    }

    quickSort(arr,0,size-1);

    cout << "The sorted array : "<< endl;
    for(int i=0;i<size;i++){
        cout << arr[i] << " ";
    }
    cout<<"COUNTER :"<<counter<<endl;
    cout<<"PARTH PATEL 19DCS098"<<endl;
}
```

OUTPUT:

```
Enter the input size : 10
Enter the values :
10 9 8 7 6 5 1 2 3 4
The sorted array :
1 2 3 4 5 6 7 8 9 10
COUNTER :15
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```
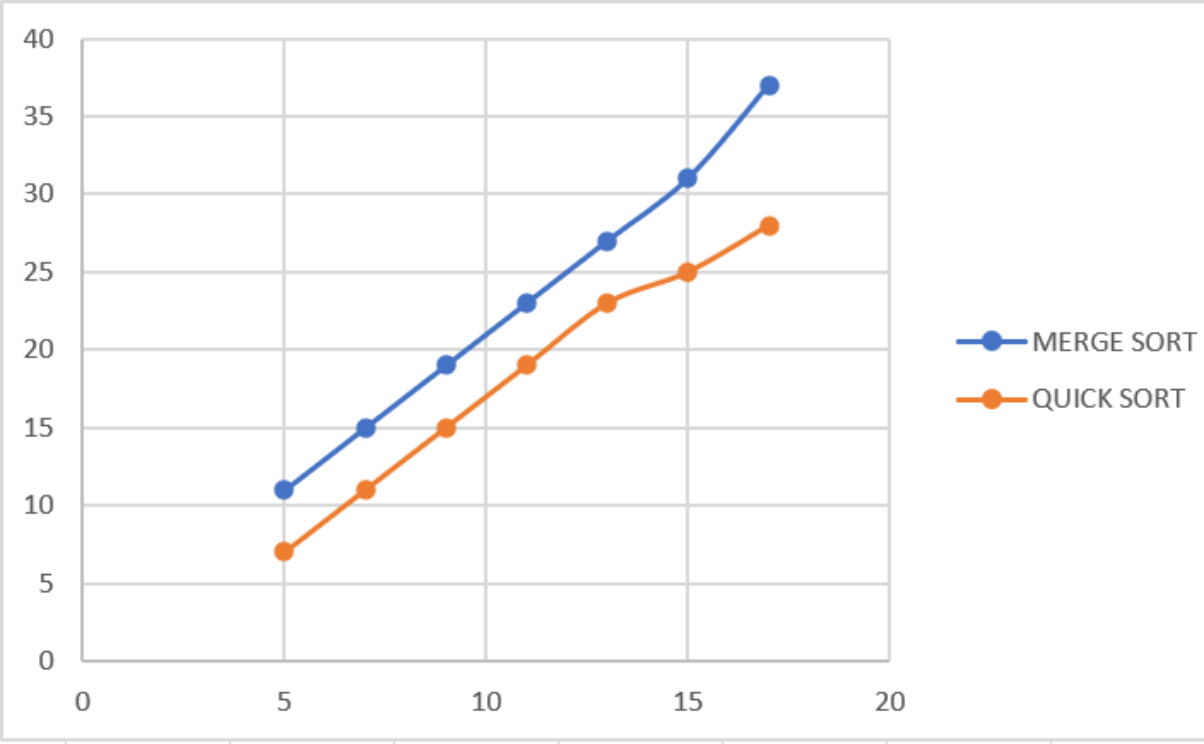

ANALYSIS TABLE:

INPUT	COUNTER	
	MERGE SORT	QUICK SORT
5	11	7
7	15	11
9	19	15
11	23	19
13	27	23
15	31	25
17	37	28

GRAPH:



CONCLUSION:

In this practical, we have learnt about how quick sort and merge sort are behaving in the worst case.

PRACTICAL-3.2

AIM:

Implement the program to find X^Y using divide and conquer strategy and print the number of multiplications required to find X^Y.

PROGRAM CODE:

```
#include<iostream>
using namespace std;
static int counter = 0;
int  power(int x, unsigned int y) {
    if (y == 0)
        return 1;
    else if (y % 2 == 0){
        counter++;
        return power(x, y / 2) * power(x, y / 2);
    }
    else{
        counter++;
        return x * power(x, y / 2) * power(x, y / 2);
    }
}
int main() {
    int x;
    unsigned int y;

    cout<<"Enter the value of X : ";
    cin>>x;
    cout<<"Enter the value of Y : ";
    cin>>y;

    cout<<"X ^ Y : "<<power(x,y)<<endl;
    cout<<"COUNTER : "<<counter<<endl;
```

```
    cout<<"PARTH PATEL\n19DCS098"<<endl;

    return 0;

}
```

OUTPUT:

```
Enter the value of X : 2
Enter the value of Y : 9
X ^ Y : 512
COUNTER : 15
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```

CONCLUSION:

In this practical, we learned to implement the power function using divide and conquer strategy.