NAME:	Utsav Avaiya
UID:	2021300005
SUBJECT	DAA
EXPERIMENT NO :	2
AIM:	Experiment on finding the running time of an algorithm
THEORY AND ALGORITHM:	Sorting refers to ordering data in an increasing or decreasing fashion according to some linear relationship among the data items. Sorting can be done on names, numbers and records. Sorting reduces the For example, it is relatively easy to look up the phone number of a friend from a telephone dictionary because the names in the phone book have been sorted into alphabetical order. This example clearly illustrates one of the main reasons that sorting large quantities of information is desirable. That is, sorting greatly improves the efficiency of searching. If we were to open a phone book, and find that the names were not presented in any logical order, it would take an incredibly long time to look up someone's phone number. 1. **Merge Sort**: Merge sort is a sorting algorithm that works by dividing an array into smaller subarrays, sorting each subarray, and then merging the sorted subarrays back together to form the final sorted array. In simple terms, we can say that the process of merge sort is to divide the array into two halves, sort each half, and then merge the sorted halves back together. This process is repeated until the entire array is sorted.

2. **Quick sort**: Like Merge Sort, Quick Sort 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 Quick Sort 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.

ALGORITHM:

1.Merge Sort:

step 1: start
step 2: declare array and left, right, mid variable
step 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)

step 4: Stop

2.Quick Sort:

Partition Algorithm:

```
PARTITION (array A, start, end){
    pivot ? A[end]
    i ? start-1
    for j ? start to end -1 {
        do if (A[j] < pivot) {
            then i ? i + 1
            swap A[i] with A[j]
        }
    }
```

swap A[i+1] with A[end]

return i+1
}

Quick Sort Algorithm:

```
QUICKSORT (array A, start, end){
    if (start < end){
        p = partition(A, start, end)
        QUICKSORT (A, start, p - 1)
        QUICKSORT (A, p + 1, end)
    }
}
```

PROGRAM:

```c
#include <stdio.h>
#include <math.h>
#include <conio.h>
#include <stdlib.h>
#include <time.h>

void swap(int *a, int *b) {...

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) {
    if (low < high) {
        int pivot = partition(arr, low, high);
        quickSort(arr, low, pivot - 1);
        quickSort(arr, pivot + 1, high);
    }
}
```

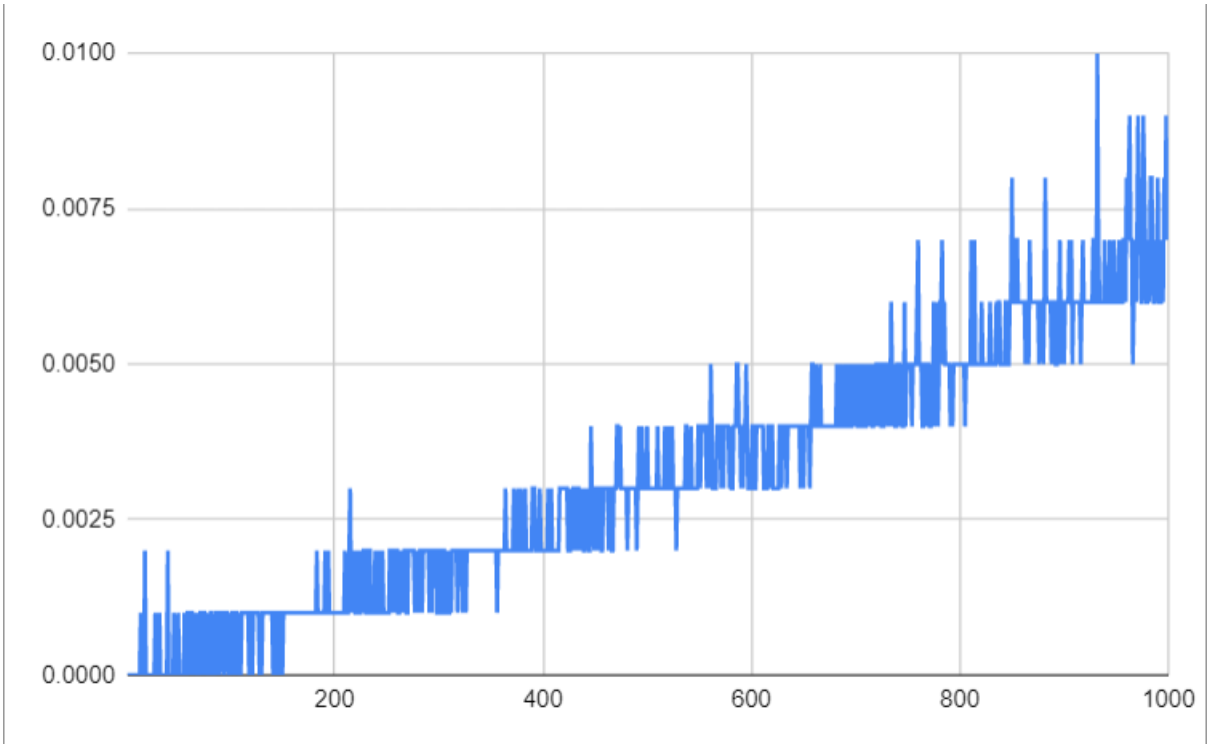
```
void merge(int arr[], int l, int m, int r) {
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;
    int L[n1], R[n2];
    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];
    i = 0;
    j = 0;
    k = l;
    while (i < n1 && 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);
    }
}
```

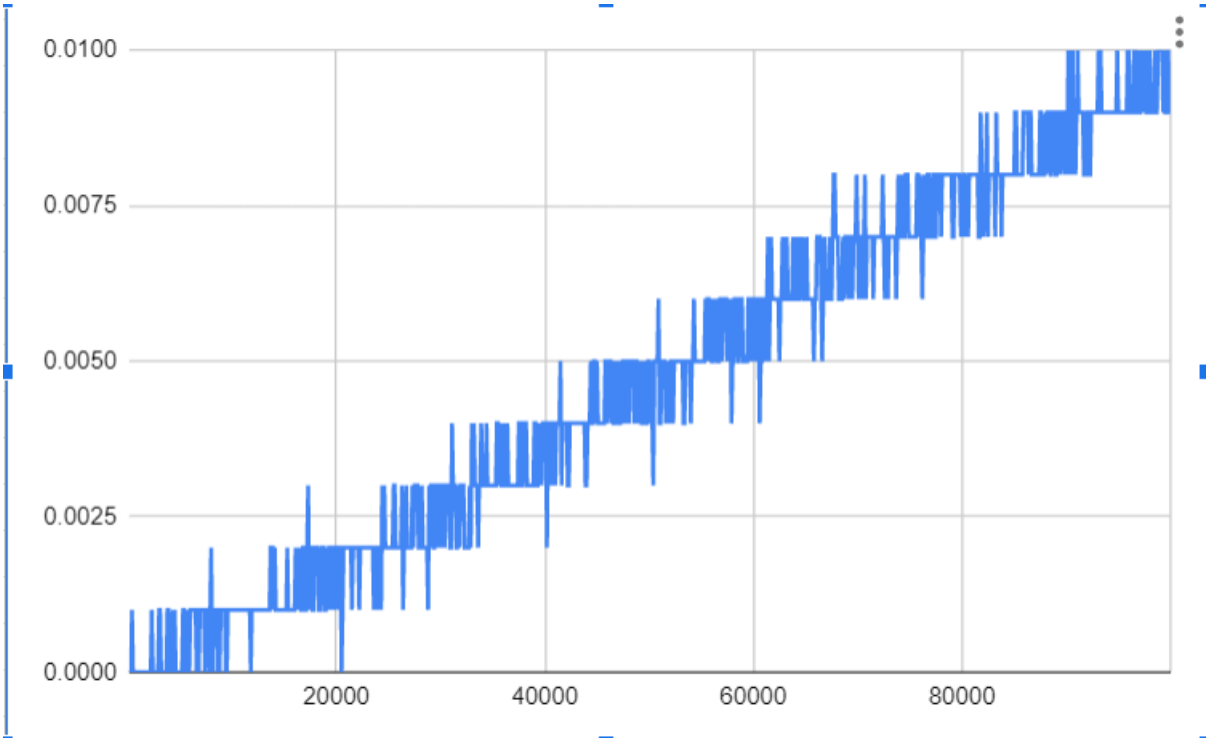
RESULT (SNAPSHOT):

Graph for taken by MERGE sort and QUICK sort:

MERGE SORT:



QUICK SORT:



CONCLUSION AND OBSERVATION:	Quick sort has an average time complexity of O(n log n) and a worst case time complexity of O(n^2). On the other hand, merge sort has a time complexity of O(n log n) for both average and worst cases. Both quick sort and merge sort are efficient sorting algorithms, but quick sort is faster in average cases while merge sort is more consistent in its performance.