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AIM Randomized Quick and Merge Sort

1. A set of children were made to stand in a line. Each child has been asked to pick a card which has a unique number (1 to n). The children have to rearrange themselves in ascending order according to the number they are holding. The arrangement has to begin by considering any of the children as a pivot element. Moreover the kids are supposed to use divide and conquer strategy for this arrangement process.

Write a program to help the kids arrange themselves.

Note: The pivot element is the element of a matrix, or an array, which is selected first by an algorithm.

CODE;

```
*****************************************************************************/


#include <iostream>


using namespace std;
void swap(int &x,int &y){
   int temp=y;
   y=x;
   x=temp;
   cout<<x<<" is swapped with "<<y<<endl;


}
int partition (int arr[], int low, int high)
{
   cout<<"students in focus : ";
```

```
for(int i=low;i<=high;i++){
    cout<<arr[i]<<" ";
}
cout<<endl;
int pivot = arr[high]; // pivot
cout<<"The Pivot element is (in this case last element) "<<pivot<<endl;
int i = (low - 1); // Index of smaller element and indicates the right position of pivot found so far


for (int j = low; j <= high - 1; j++)
{
    // If current element is smaller than the pivot
    if (arr[j] < pivot)
    {
        i++; // increment index of smaller element
        swap(arr[i], arr[j]);
        cout<<"Arrangement after swapping : ";
        for(int i=low;i<=high;i++){
            cout<<arr[i]<<" ";
        }
        cout<<endl;


    }
}
swap(arr[i + 1], arr[high]);
cout<<"Arrangement after swapping : ";
```

```
   for(int i=low;i<=high;i++){
      cout<<arr[i]<<" ";
   }
   cout<<endl;
   return (i + 1);
}

/* The main function that implements QuickSort
arr[] --> Array to be sorted,
low --> Starting index,
high --> Ending index */
void quickSort(int arr[], int low, int high)
{
   if (low < high)
   {
      /* pi is partitioning index, arr[p] is now
      at right place */
      int pi = partition(arr, low, high);

      // Separately sort elements before
      // partition and after partition
      cout<<"Arrangement after left division"<<endl;
      quickSort(arr, low, pi - 1);
      cout<<"Arrangement after right division"<<endl;
      quickSort(arr, pi + 1, high);
```

```
    }
}


int main()
{
    int n;
    cin>>n;
    int arr[n];
    for(int i=0;i<n;i++){
        int x;
        cin>>x;
        if(x<=n){
            arr[i]=x;
        }
        else{
            cout<<"students till n roll no. to be entered"<<endl;
        }
    }
    cout<<"*****Quick Sort*****"<<endl;
    quickSort(arr,0,n-1);
    cout<<"Final arrangement of Students is : ";
    for(int i=0;i<n;i++){
        cout<<arr[i]<<" ";
    }
```

```
  return 0;

}
```

```
*****Quick Sort*****
students in focus : 9 8 7 6 5 4 3 2 1
The Pivot element is (in this case last element) 1
1 is swapped with 9
Arrangement after swapping : 1 8 7 6 5 4 3 2 9
Arrangement after left division
Arrangement after right division
students in focus : 8 7 6 5 4 3 2 9
The Pivot element is (in this case last element) 9
8 is swapped with 8
Arrangement after swapping : 8 7 6 5 4 3 2 9
7 is swapped with 7
Arrangement after swapping : 8 7 6 5 4 3 2 9
6 is swapped with 6
Arrangement after swapping : 8 7 6 5 4 3 2 9
5 is swapped with 5
Arrangement after swapping : 8 7 6 5 4 3 2 9
4 is swapped with 4
Arrangement after swapping : 8 7 6 5 4 3 2 9
3 is swapped with 3
Arrangement after swapping : 8 7 6 5 4 3 2 9
2 is swapped with 2
Arrangement after swapping : 8 7 6 5 4 3 2 9
9 is swapped with 9
Arrangement after swapping : 8 7 6 5 4 3 2 9
Arrangement after left division
students in focus : 8 7 6 5 4 3 2
The Pivot element is (in this case last element) 2
2 is swapped with 8
Arrangement after swapping : 2 7 6 5 4 3 8
Arrangement after left division
Arrangement after right division
students in focus : 7 6 5 4 3 8
The Pivot element is (in this case last element) 8
7 is swapped with 7
```

```
7 is swapped with 7
Arrangement after swapping : 7 6 5 4 3 8
6 is swapped with 6
Arrangement after swapping : 7 6 5 4 3 8
5 is swapped with 5
Arrangement after swapping : 7 6 5 4 3 8
4 is swapped with 4
Arrangement after swapping : 7 6 5 4 3 8
3 is swapped with 3
Arrangement after swapping : 7 6 5 4 3 8
8 is swapped with 8
Arrangement after swapping : 7 6 5 4 3 8
Arrangement after left division
students in focus : 7 6 5 4 3
The Pivot element is (in this case last element) 3
3 is swapped with 7
Arrangement after swapping : 3 6 5 4 7
Arrangement after left division
Arrangement after right division
students in focus : 6 5 4 7
The Pivot element is (in this case last element) 7
6 is swapped with 6
Arrangement after swapping : 6 5 4 7
5 is swapped with 5
Arrangement after swapping : 6 5 4 7
4 is swapped with 4
Arrangement after swapping : 6 5 4 7
7 is swapped with 7
Arrangement after swapping : 6 5 4 7
Arrangement after left division
students in focus : 6 5 4
The Pivot element is (in this case last element) 4
4 is swapped with 6
Arrangement after swapping : 4 5 6
Arrangement after left division
Arrangement after right division
```

```
Arrangement after swapping : 4 5 6
Arrangement after left division
Arrangement after right division
students in focus : 5 6
The Pivot element is (in this case last element) 6
5 is swapped with 5
Arrangement after swapping : 5 6
6 is swapped with 6
Arrangement after swapping : 5 6
Arrangement after left division
Arrangement after right division
Arrangement after right division
Arrangement after right division
Arrangement after right division
Final arrangement of Students is : 1 2 3 4 5 6 7 8 9
```

ALGO

```
/* low --> Starting index, high --> Ending index */
quickSort(arr[], low, high)
{
    if (low < high)
    {
        /* pi is partitioning index, arr[p] is now
           at right place */
        pi = partition(arr, low, high);

        quickSort(arr, low, pi - 1); // Before pi
        quickSort(arr, pi + 1, high); // After pi
    }
```

2.Microsoft organized an App fest for students wherein 10 students participated and posted applications. Students were given prizes based on the number of applications posted. Arrange the students in the increasing order of applications using merge sort.

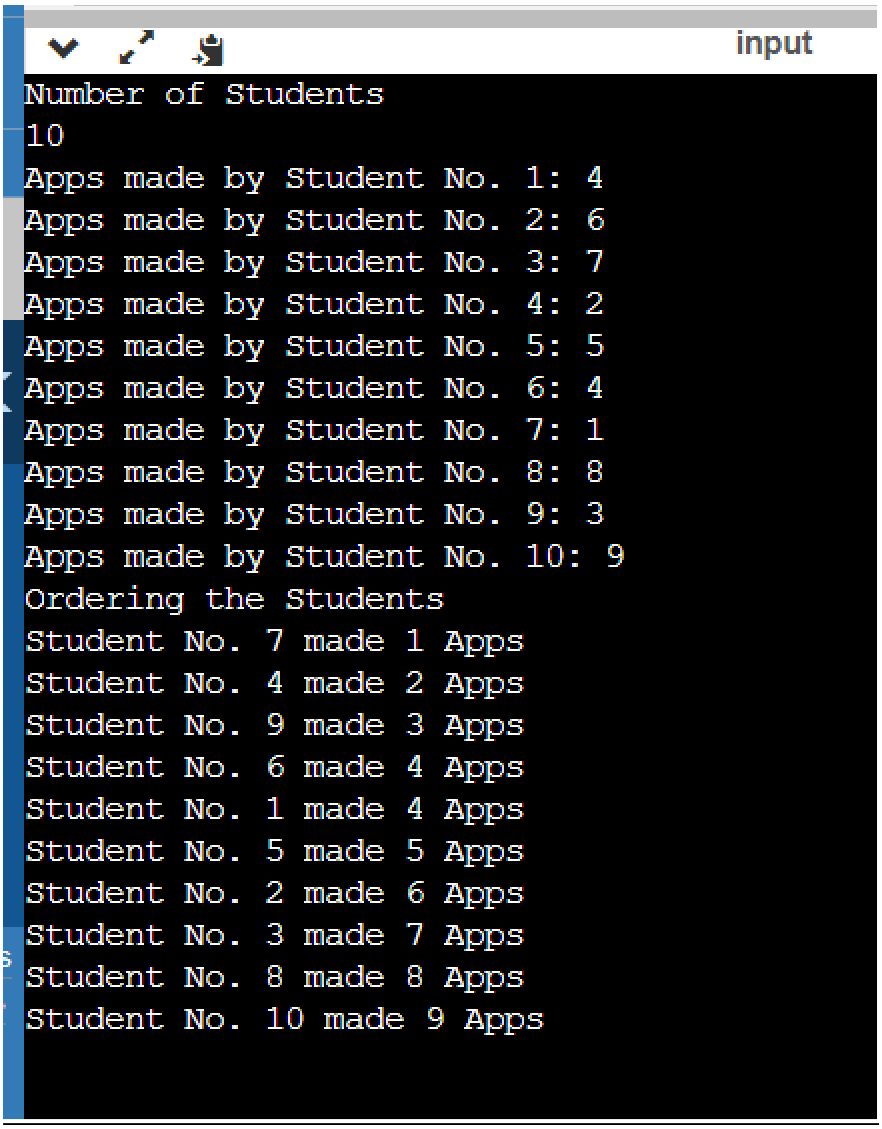
Student Number	No.of App's posted
1	4
2	6
3	7
4	2
5	5
6	4
7	1
8	8
9	3
10	9

Code;

```
#include<iostream>

using namespace std;

struct stud{

int n,ap;

};

void copy(struct stud &a,struct stud &b){

a.ap=b.ap;

a.n=b.n;

}

void merge(struct stud ar[],int l,int r,int mid){

int i=l,j=mid+1,k=l;
```

```
struct stud b[100];
while(i<=mid && j<=r){
if(ar[i].ap<ar[j].ap){
copy(b[k],ar[i]);
i++;k++;
}else{
copy(b[k],ar[j]);
j++;k++;
}
}if(i>mid){
while(j<=r){
copy(b[k],ar[j]);
j++;k++;
}
}else{
while(i<=mid){
copy(b[k],ar[i]);
i++;k++;
}
}
for(k=l;k<=r;++k) copy(ar[k],b[k]);
}
void mergesort(struct stud ar[],int l, int r){
if(l<r){
int mid=(l+r)/2;
```

```
mergesort(ar,l,mid);

mergesort(ar,mid+1,r);

merge(ar,l,r,mid);

}

}
int main(){

int n;cout<<"Number of Students\n";

cin>>n;
struct stud apps[n];

for(int i=0;i<n;++i){

cout<<"Apps made by Student No. "<<i+1<<": ";

cin>>apps[i].ap;

apps[i].n=i+1;

}
mergesort(apps,0,n-1);

cout<<"Ordering the Students\n";

for(int i=0;i<n;++i) cout<<"Student No. "<<apps[i].n<<" made "<<apps[i].ap<<" Apps\n";

cout<<endl;

}
```



Algo

```
MergeSort(arr[], l,  r)
If r > l
     1. Find the middle point to divide the array into two halves:
             middle m = l+ (r-l)/2
     2. Call mergeSort for first half:
             Call mergeSort(arr, l, m)
     3. Call mergeSort for second half:
             Call mergeSort(arr, m+1, r)
     4. Merge the two halves sorted in step 2 and 3:
             Call merge(arr, l, m, r)
```