Week 4

Question 1:

```
#include <iostream>
using namespace std;
int getInvCount(int arr[],int n);
void merge(int a[],int l,int m,int r,int &c);
void mergesort(int arr[],int l,int r,int &c)
{
   if(l<r)
   {
      int m=(l+r)/2;
      mergesort(arr,l,m,c);
      mergesort(arr,m+1,r,c);
      merge(arr,l,m,r,c);
   }
}
void merge(int a[],int l,int m,int r,int &c)
{
   int n1=m-l+1;
   int n2=r-m;
   int L[n1],R[n2];
   for(int i=0;i<n1;i++)
   L[i]=a[l+i];
   for(int j=0;j<n2;j++)
   R[j]=a[m+1+j];
   int i=0,j=0,k=l;
   while(i<n1 && j<n2)
   {
```

```
        if(L[i]<=R[j])
        a[k++]=L[i++];
        else
        a[k++]=R[j++];
        c++;
    }
    while(i<n1)
        a[k++]=L[i++];
    while(j<n2)
        a[k++]=R[j++];
}
int getInvCount(int arr[],int n)
{
    int inv=0;
    for(int i=0;i<n-1;i++)
    for(int j=i+1;j<n;j++)
        if(arr[i]>arr[j])
        inv++;
    return inv;
}
int main()
{
    int T;
    cout<<"enter the number of test cases"<<endl;
    cin>>T;
    while(T--)
    {
        int inv=0;
        int c=0;
        int n;
        cout<<"enter the number of array elements"<<endl;
```

```
        cin>>n;
        int a[n];
        cout<<"enter the array elements"<<endl;
        for(int i=0;i<n;i++)
        cin>>a[i];
        inv=getInvCount(a,n);
        mergesort(a,0,n-1,c);
        cout<<"sorted array:"<<endl;
        for(int i=0;i<n;i++)
        cout<<a[i]<<" ";
        cout<<endl<<"Comparisons ="<<c<<endl;
        cout<<"Inversions ="<<inv<<endl;
    }
    return 0;
}
```

Output:

```
enter the number of test cases
3
enter the number of array elements
8
enter the array elements
23 65 21 76 46 89 45 32
sorted array:
21 23 32 45 46 65 76 89
Comparisons =16
Inversions =13
enter the number of array elements
10
enter the array elements
54 65 34 76 78 97 46 32 51 21
sorted array:
21 32 34 46 51 54 65 76 78 97
Comparisons =22
Inversions =28
enter the number of array elements
15
enter the array elements
63 42 223 645 652 31 324 22 553 12 54 65 86 46 325
sorted array:
12 22 31 42 46 54 63 65 86 223 324 325 553 645 652
Comparisons =43
Inversions =54

Process returned 0 (0x0)   execution time : 84.379 s
Press any key to continue.
```

Question 2:

```
#include <iostream>
using namespace std;
void swap(int *a, int *b);
int partition(int array[], int low, int high,int &c,int &s);
void quickSort(int array[], int low, int high,int &c,int &s) {
  if (low < high) {
    int pi = partition(array, low, high,c,s);
    quickSort(array, low, pi - 1,c,s);
    quickSort(array, pi + 1, high,c,s);
  }
}
int partition(int array[], int low, int high,int &c,int &s) {
int pivot = array[high];
int i = (low - 1);
for (int j = low; j < high; j++) {
      c++;
    if (array[j] <= pivot) {
i++;
swap(&array[i], &array[j]);
      s++;
    }
  }
swap(&array[i + 1], &array[high]);
  s++;
 return (i + 1);
}
void swap(int *a, int *b) {
  int t = *a;
  *a = *b;
```

```
  *b = t;
}

int main()
{
   int T;
   cout<<"enter the number of test cases"<<endl;
   cin>>T;
   while(T--)
   {
      int s=0;
      int c=0;
      int n;
      cout<<"enter the number of array elements"<<endl;
      cin>>n;
      int a[n];
      cout<<"enter the array elements"<<endl;
      for(int i=0;i<n;i++)
      cin>>a[i];
      quickSort(a,0,n-1,c,s);
      cout<<"sorted array is:"<<endl;
      for(int i=0;i<n;i++)
      cout<<a[i]<<" ";
      cout<<endl<<"Comparisons ="<<c<<endl;
      cout<<"Swaps ="<<s<<endl;
   }
   return 0;
}
```

Output:

```
enter the number of test cases
3
enter the number of array elements
8
enter the array elements
23 65 21 76 46 89 45 32
sorted array is:
21 23 32 45 46 65 76 89
Comparisons =14
Swaps =10
enter the number of array elements
10
enter the array elements
54 65 34 76 78 97 46 32 51 21
sorted array is:
21 32 34 46 51 54 65 76 78 97
Comparisons =29
Swaps =21
enter the number of array elements
15
enter the array elements
63 42 223 645 652 31 324 22 553 12 54 65 86 46 325
sorted array is:
12 22 31 42 46 54 63 65 86 223 324 325 553 645 652
Comparisons =45
Swaps =39

Process returned 0 (0x0)   execution time : 100.123 s
Press any key to continue.
```

Question 3:

```
#include<iostream>
using namespace std;
void merge(int arr[],int l,int mid,int h)
{
   int count=0;
   int i=l,j=mid+1;
   int temp[h-l+1];
   int k=0;
   while (i<=mid && j<=h)
   {
      if (arr[i]<arr[j])
         temp[k++]=arr[i++];
      else
      {
         temp[k++]=arr[j++];
         count+=mid-i+1;
      }
   }
   for (;i<=mid;)
       temp[k++]=arr[i++];
   for (;j<=h;)
       temp[k++]=arr[j++];

   for (int f=0;f<k;f++)
      arr[f+l]=temp[f];
}
void merge_sort(int arr[],int l,int h)
{
   if (l<h)
```

```
    {
        int mid=l+(h-l)/2;
        merge_sort(arr,l,mid);
        merge_sort(arr,mid+1,h);
        merge(arr,l,mid,h);
    }
}
int main()
{
    int t;
    cout<<"enter the number of test cases"<<endl;
    cin>>t;
    while (t--)
    {
        int n;
        cout<<"enter the number of array elements"<<endl;
        cin>>n;
        int arr[n];
        cout<<"enter the array elements"<<endl;
        for (int i=0;i<n;i++)
          cin>>arr[i];
        int k;
        cout<<"enter the key"<<endl;
        cin>>k;
        merge_sort(arr,0,n-1);
        int flag=0;
        cout<<arr[k-1]<<endl;
    }
}
```

Output:

```
enter the number of test cases
2
enter the number of array elements
10
enter the array elements
123 656 54 765 344 514 765 34 765 234
enter the key
3
123
enter the number of array elements
15
enter the array elements
43 64 13 78 864 346 786 456 21 19 8 434 76 270 601
enter the key
8
78

Process returned 0 (0x0)   execution time : 87.981 s
Press any key to continue.
```