DSA Lab08

23K2001

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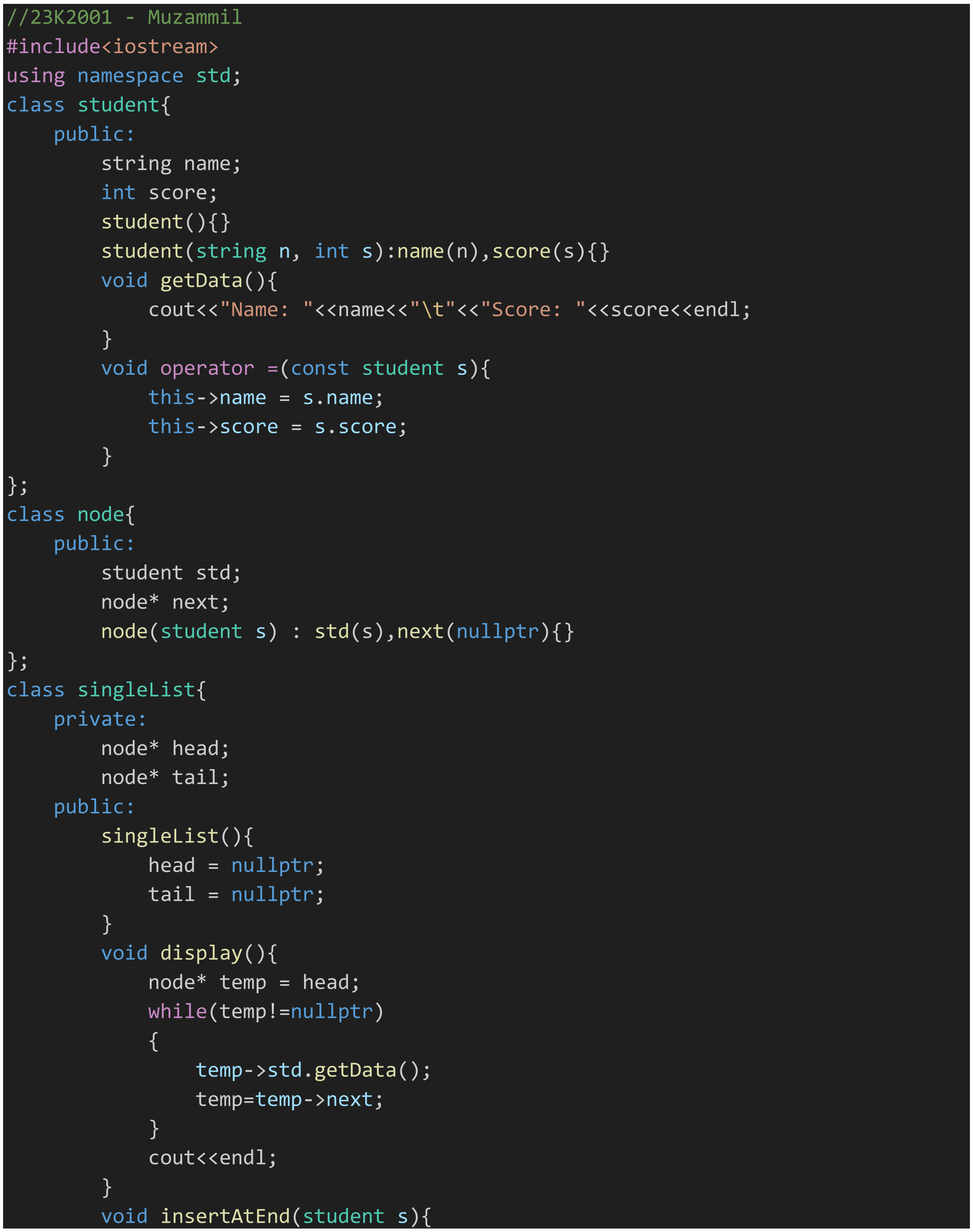
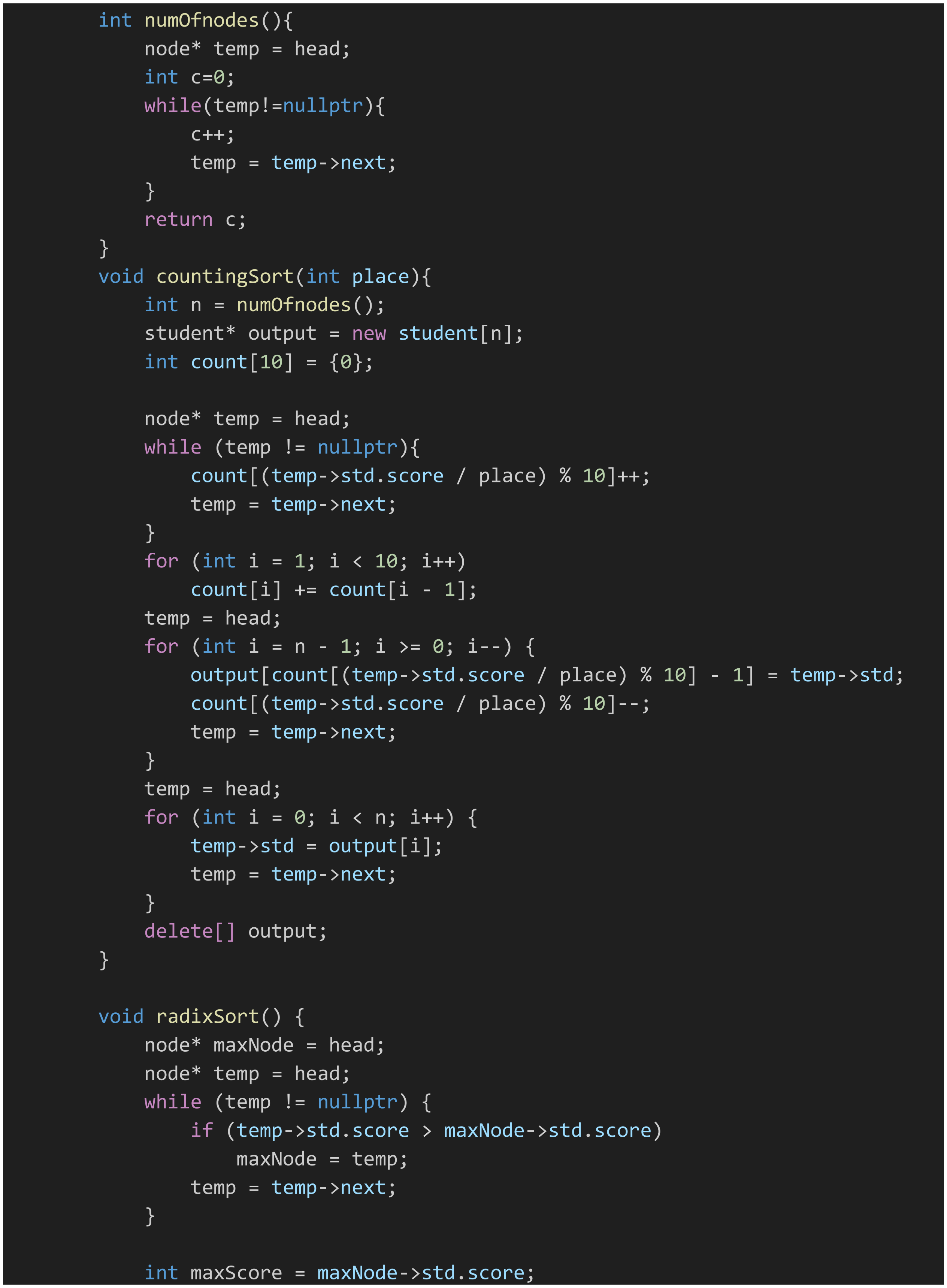
BCS-3J

Q1:



```
//23K2001 - Muzammil
#include<iostream>
using namespace std;
class student{
    public:
        string name;
        int score;
        student(){}
        student(string n, int s):name(n),score(s){}
        void getData(){
            cout<<"Name: "<<name<<"\t"<<"Score: "<<score<<endl;
        }
        void operator =(const student s){
            this->name = s.name;
            this->score = s.score;
        }
};
class node{
    public:
        student std;
        node* next;
        node(student s) : std(s),next(nullptr){}
};
class singleList{
    private:
        node* head;
        node* tail;
    public:
        singleList(){
            head = nullptr;
            tail = nullptr;
        }
        void display(){
            node* temp = head;
            while(temp!=nullptr)
            {
                temp->std.getData();
                temp=temp->next;
            }
            cout<<endl;
        }
        void insertAtEnd(student s){
```

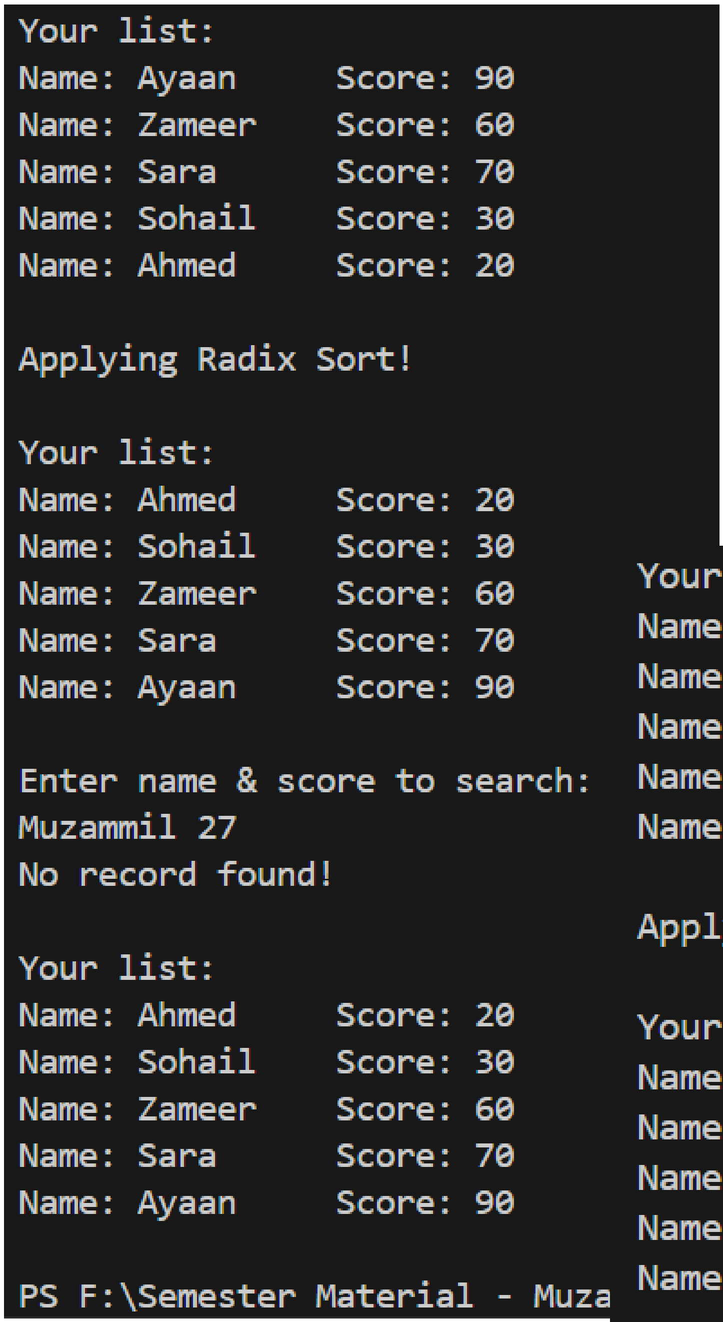
```cpp
            node* temp = head;
            node* n = new node(s);
            if(head == NULL){
                head = n;
                tail = n;
            }
            else{
                tail->next = n;
                tail = n;
            }
        }
        void deleteNode(string n,int s){
            node* before = nullptr;
            node* temp = head;

            if(temp != nullptr && temp->std.name == n && temp->std.score == s) {
                head = temp->next;
                delete temp;
                if(head == nullptr)
                    tail = nullptr;
                return;
            }

            while(temp!=nullptr){
                if(temp->std.name==n && temp->std.score==s){
                    before->next = (temp->next);
                    delete temp;
                    return;
                }
                before = temp;
                temp = temp->next;
            }
            cout<<"Record was not found!"<<endl;
        }
        student getMax(){
            node* temp = head;
            student m = head->std;

            while(temp != nullptr){
                if (temp->std.score > m.score)
                    m = temp->std;
                temp = temp->next;
            }
            return m;
        }
```



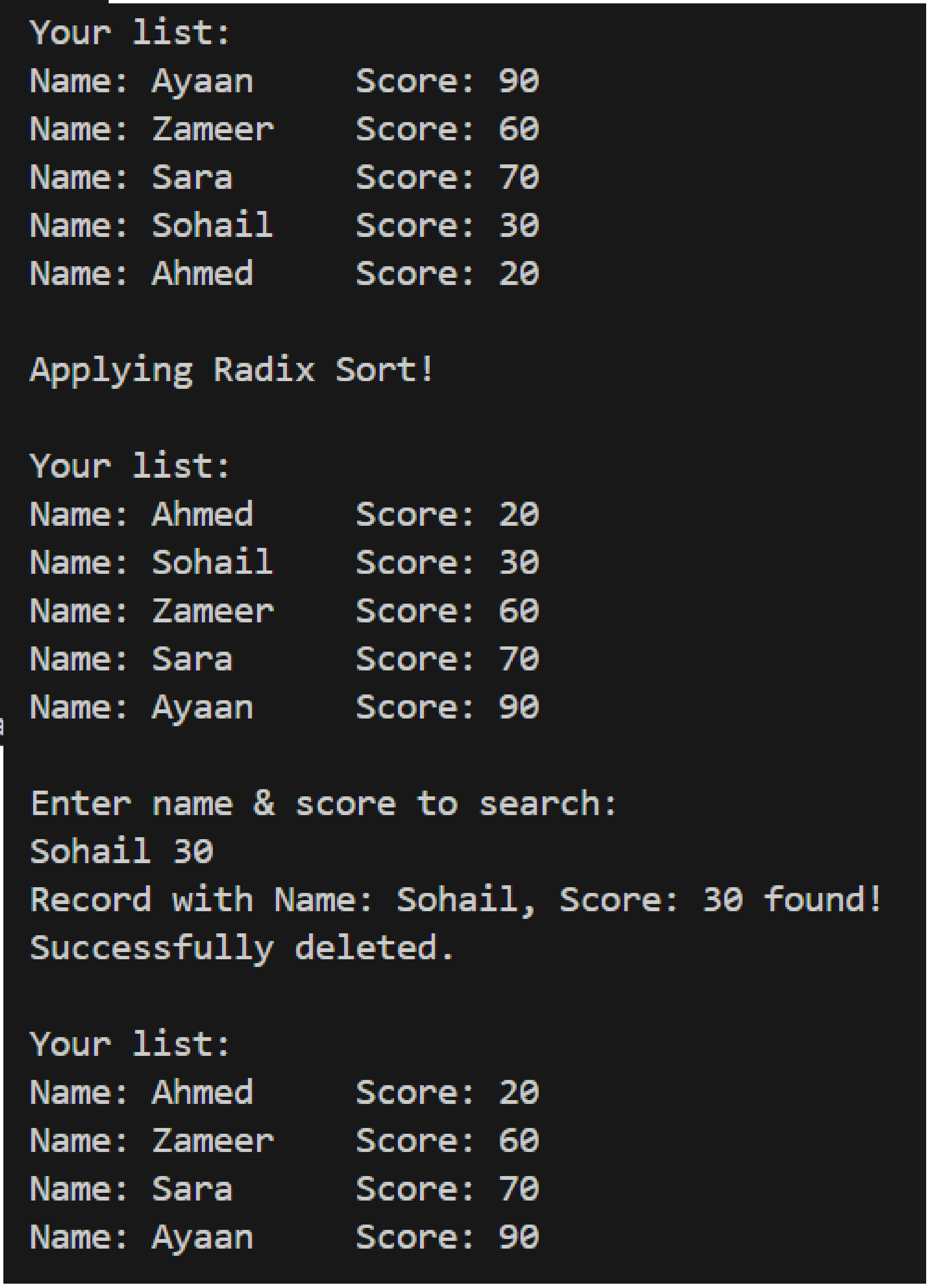
```cpp
int numOfnodes(){
    node* temp = head;
    int c=0;
    while(temp!=nullptr){
        c++;
        temp = temp->next;
    }
    return c;
}
void countingSort(int place){
    int n = numOfnodes();
    student* output = new student[n];
    int count[10] = {0};

    node* temp = head;
    while (temp != nullptr){
        count[(temp->std.score / place) % 10]++;
        temp = temp->next;
    }
    for (int i = 1; i < 10; i++)
        count[i] += count[i - 1];
    temp = head;
    for (int i = n - 1; i >= 0; i--) {
        output[count[(temp->std.score / place) % 10] - 1] = temp->std;
        count[(temp->std.score / place) % 10]--;
        temp = temp->next;
    }
    temp = head;
    for (int i = 0; i < n; i++) {
        temp->std = output[i];
        temp = temp->next;
    }
    delete[] output;
}

void radixSort() {
    node* maxNode = head;
    node* temp = head;
    while (temp != nullptr) {
        if (temp->std.score > maxNode->std.score)
            maxNode = temp;
        temp = temp->next;
    }

    int maxScore = maxNode->std.score;
```

```
            for (int place = 1; maxScore / place > 0; place *= 10)
                countingSort(place);
        }

        node* getMiddle(node* start, node* end){
            if(start == nullptr)
                return nullptr;

            node* slow = start;
            node* fast = start;
            while (fast != end && fast->next != end) {
                slow = slow->next;
                fast = fast->next->next;
            }
            return slow;
        }
        node* binarySearch(string n,int s){
            node* left = head;
            node* right = nullptr;

            while (left != right) {
                node* mid = getMiddle(left, right);
                if (mid == nullptr) return nullptr;

                if (mid->std.name==n && mid->std.score==s)
                    return mid;
                else if (mid->std.score < s)
                    left = mid->next;
                else
                    right = mid;
            }
            return nullptr;
        }

};

int main(){
    student ayaan("Ayaan", 90);
    student zameer("Zameer", 60);
    student sara("Sara", 70);
    student sohail("Sohail", 30);
    student ahmed("Ahmed", 20);

    singleList flex;
    flex.insertAtEnd(ayaan);
```

```cpp
    flex.insertAtEnd(zameer);
    flex.insertAtEnd(sara);
    flex.insertAtEnd(sohail);
    flex.insertAtEnd(ahmed);
    cout<<"Your list: "<<endl;
    flex.display();

    cout<<"Applying Radix Sort!"<<endl<<endl;
    flex.radixSort();
    cout<<"Your list: "<<endl;
    flex.display();

    string n;
    int s;
    cout<<"Enter name & score to search:"<<endl;
    cin>>n>>s;
    node* src = flex.binarySearch(n,s);
    if(src){
        cout<<"Record with Name: "<<src->std.name<<", Score: "<<src->std.score<<"
found!"<<endl;
        flex.deleteNode(src->std.name,src->std.score);
        cout<<"Successfully deleted."<<endl<<endl;
    }
    else
        cout<<"No record found!"<<endl<<endl;

    cout<<"Your list:"<<endl;
    flex.display();
    return 0;
}
```



```
Your list:
Name: Ayaan     Score: 90
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Sohail    Score: 30
Name: Ahmed     Score: 20

Applying Radix Sort!

Your list:
Name: Ahmed     Score: 20
Name: Sohail    Score: 30
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Ayaan     Score: 90

Enter name & score to search:
Muzammil 27
No record found!

Your list:
Name: Ahmed     Score: 20
Name: Sohail    Score: 30
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Ayaan     Score: 90

PS F:\Semester Material - Muza
```

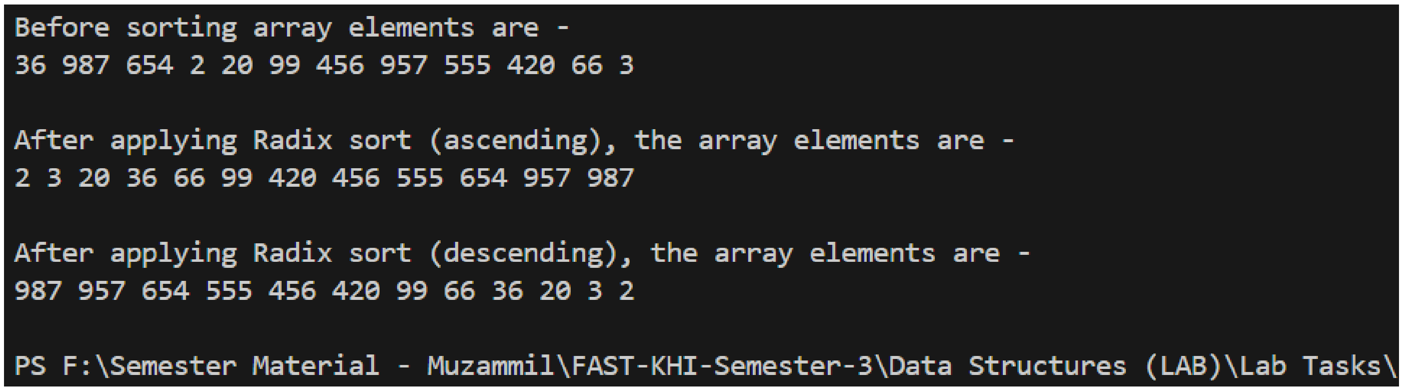


```
Your list:
Name: Ayaan     Score: 90
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Sohail    Score: 30
Name: Ahmed     Score: 20

Applying Radix Sort!

Your list:
Name: Ahmed     Score: 20
Name: Sohail    Score: 30
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Ayaan     Score: 90

Enter name & score to search:
Sohail 30
Record with Name: Sohail, Score: 30 found!
Successfully deleted.

Your list:
Name: Ahmed     Score: 20
Name: Zameer    Score: 60
Name: Sara      Score: 70
Name: Ayaan     Score: 90
```

Q2:

```
//23K2001 - Muzammil
#include<iostream>
using namespace std;

int getMax(int a[], int n) {
   int max = a[0];
   for(int i = 1; i<n; i++) {
      if(a[i] > max)
        max = a[i];
   }
   return max;
}

void countingSortAsc(int a[], int n, int place){
  int output[n + 1];
  int count[10] = {0};

  for (int i = 0; i < n; i++)
    count[(a[i] / place) % 10]++;
  for (int i = 1; i < 10; i++)
    count[i] += count[i - 1];
  for (int i = n - 1; i >= 0; i--) {
    output[count[(a[i] / place) % 10] - 1] = a[i];
    count[(a[i] / place) % 10]--;
  }
  for (int i = 0; i < n; i++)
    a[i] = output[i];
}
void countingSortDesc(int a[], int n, int place){
    int output[n + 1];
    int count[10] = {0};

    for (int i = 0; i < n; i++)
        count[(a[i] / place) % 10]++;
    for (int i = 8; i >= 0; i--)
        count[i] += count[i + 1];
    for (int i = n - 1; i >= 0; i--) {
        output[count[(a[i] / place) % 10] - 1] = a[i];
        count[(a[i] / place) % 10]--;
    }
    for (int i = 0; i < n; i++)
        a[i] = output[i];
```

```cpp
}

void radixSortAscend(int a[], int n){
  int max = getMax(a, n);

  for (int place = 1; max / place > 0; place *= 10)
    countingSortAsc(a, n, place);
}
void radixSortDescend(int a[], int n){
    int max = getMax(a, n);

    for (int place = 1; max / place > 0; place *= 10)
        countingSortDesc(a, n, place);
}

void display(int a[], int n) {
    for(int i = 0; i < n; ++i)
        cout<<a[i]<<" ";
    cout<<endl<<endl;
}

int main(){
    int a[] = {36,987, 654, 2, 20, 99, 456, 957, 555, 420, 66, 3};
    int b[] = {36,987, 654, 2, 20, 99, 456, 957, 555, 420, 66, 3};
    int n = sizeof(a) / sizeof(a[0]);
    cout<<"Before sorting array elements are - \n";
    display(a,n);

    radixSortAscend(a, n);
    cout<<"After applying Radix sort (ascending), the array elements are - \n";
    display(a, n);

    radixSortDescend(b, n);
    cout<<"After applying Radix sort (descending), the array elements are -
\n";
    display(b, n);
    return 0;
}
```



```
Before sorting array elements are -
36 987 654 2 20 99 456 957 555 420 66 3

After applying Radix sort (ascending), the array elements are -
2 3 20 36 66 99 420 456 555 654 957 987

After applying Radix sort (descending), the array elements are -
987 957 654 555 456 420 99 66 36 20 3 2

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```
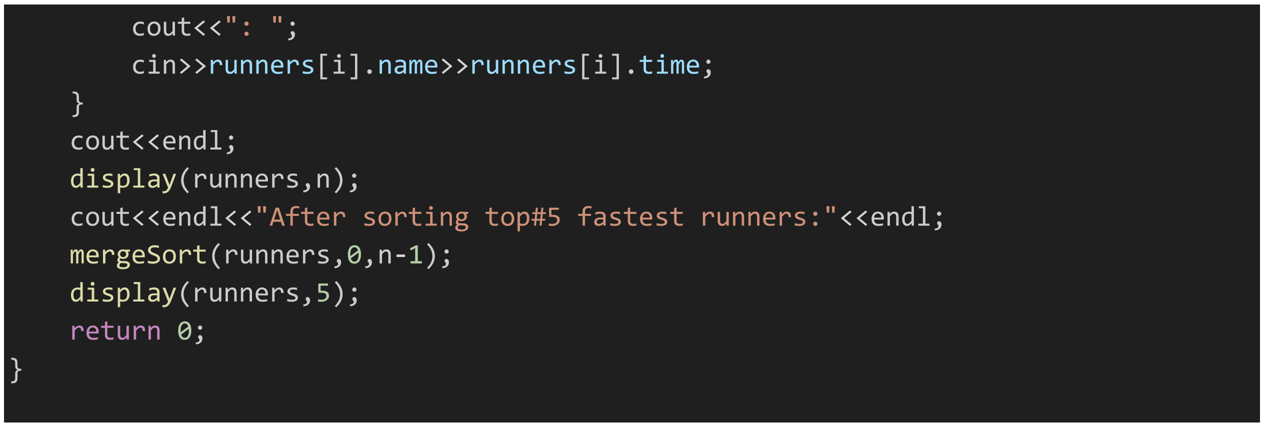
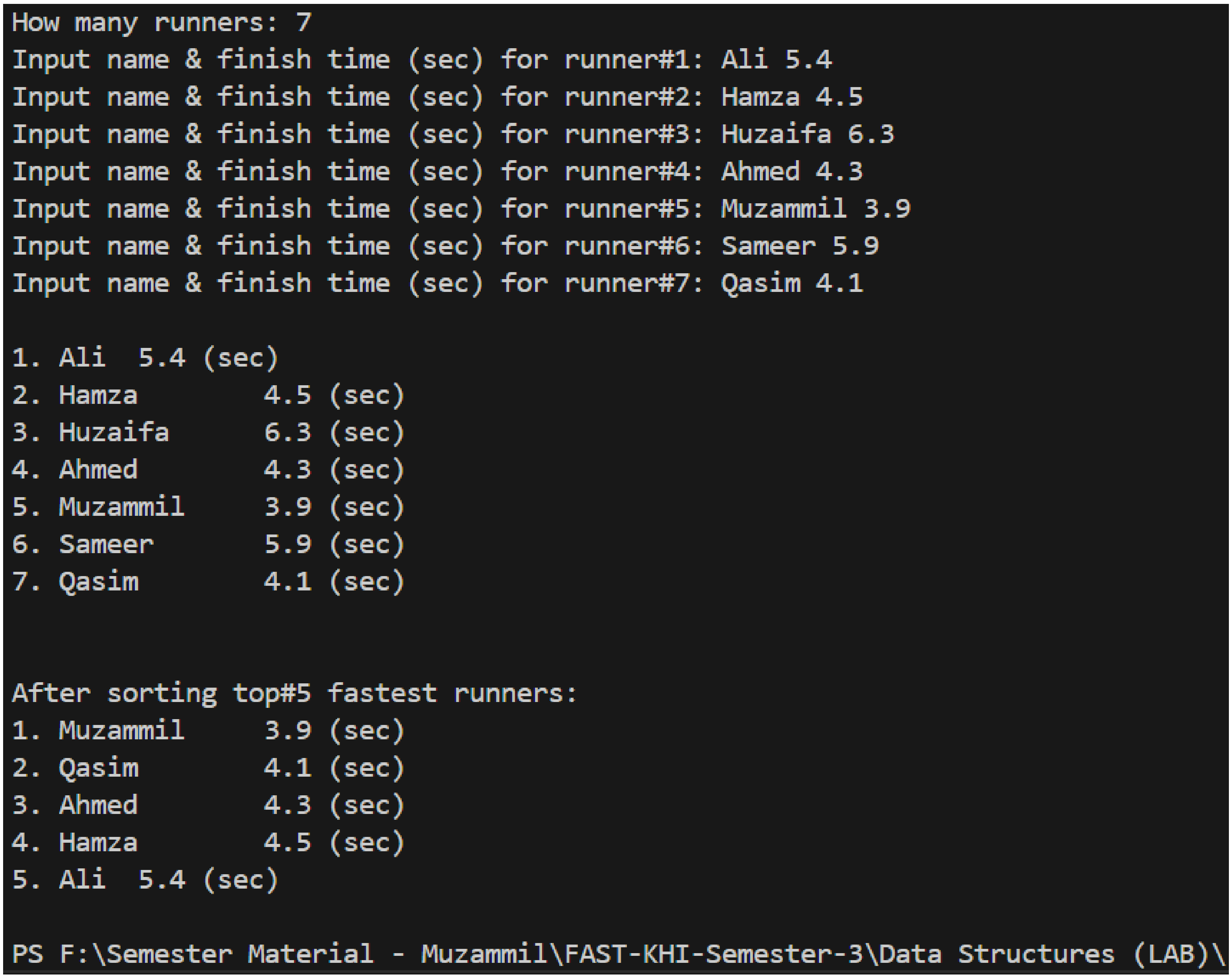

Q3:

```cpp
//23K2001 - Muzammil
#include<iostream>
using namespace std;

class runner{
    public:
        string name;
        float time;

        runner(){}
        runner(string n,float t):name(n),time(t){}
};

void merge(runner *a, int beg, int mid, int end){
    int i, j, k;
    int n1 = mid - beg + 1;
    int n2 = end - mid;

    runner LeftArray[n1], RightArray[n2];

    for (int i = 0; i < n1; i++){
    LeftArray[i].time = a[beg + i].time;
    LeftArray[i].name = a[beg + i].name;
    }
    for (int j = 0; j < n2; j++){
    RightArray[j].time = a[mid + 1 + j].time;
    RightArray[j].name = a[mid + 1 + j].name;
    }

    i = 0;
    j = 0;
    k = beg;

    while (i < n1 && j < n2)
    {
        if(LeftArray[i].time <= RightArray[j].time)
        {
            a[k].name = LeftArray[i].name;
            a[k].time = LeftArray[i].time;
            i++;
        }
        else
        {
            a[k].name = RightArray[j].name;
            a[k].time = RightArray[j].time;
            j++;
        }
        k++;
    }
    while (i<n1)
    {
        a[k].time = LeftArray[i].time;
        a[k].name = LeftArray[i].name;
        i++;
        k++;
    }

    while (j<n2)
    {
        a[k].time = RightArray[j].time;
        a[k].name = RightArray[j].name;
        j++;
        k++;
    }
}
void mergeSort(runner *a, int beg, int end){
    if (beg < end)
    {
        int mid = (beg + end) / 2;
        mergeSort(a, beg, mid);
        mergeSort(a, mid + 1, end);
        merge(a, beg, mid, end);
    }
}
void display(runner *a, int n){
    for(int i = 0; i < n; ++i)
        cout<<i+1<<". "<<a[i].name<<"\t"<<a[i].time<<" (sec)"<<endl;
    cout<<endl;
}

int main(){
    int n;
    cout<<"How many runners: ";
    cin>>n;
    runner *runners = new runner[n];
    for(int i=0;i<n;i++){
        cout<<"Input name & finish time (sec) for runner#"<<i+1;
```



```
        cout<<": ";
        cin>>runners[i].name>>runners[i].time;
    }
    cout<<endl;
    display(runners,n);
    cout<<endl<<"After sorting top#5 fastest runners:"<<endl;
    mergeSort(runners,0,n-1);
    display(runners,5);
    return 0;
}
```



```
How many runners: 7
Input name & finish time (sec) for runner#1: Ali 5.4
Input name & finish time (sec) for runner#2: Hamza 4.5
Input name & finish time (sec) for runner#3: Huzaifa 6.3
Input name & finish time (sec) for runner#4: Ahmed 4.3
Input name & finish time (sec) for runner#5: Muzammil 3.9
Input name & finish time (sec) for runner#6: Sameer 5.9
Input name & finish time (sec) for runner#7: Qasim 4.1

1. Ali  5.4 (sec)
2. Hamza        4.5 (sec)
3. Huzaifa      6.3 (sec)
4. Ahmed        4.3 (sec)
5. Muzammil     3.9 (sec)
6. Sameer       5.9 (sec)
7. Qasim        4.1 (sec)


After sorting top#5 fastest runners:
1. Muzammil     3.9 (sec)
2. Qasim        4.1 (sec)
3. Ahmed        4.3 (sec)
4. Hamza        4.5 (sec)
5. Ali  5.4 (sec)

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```
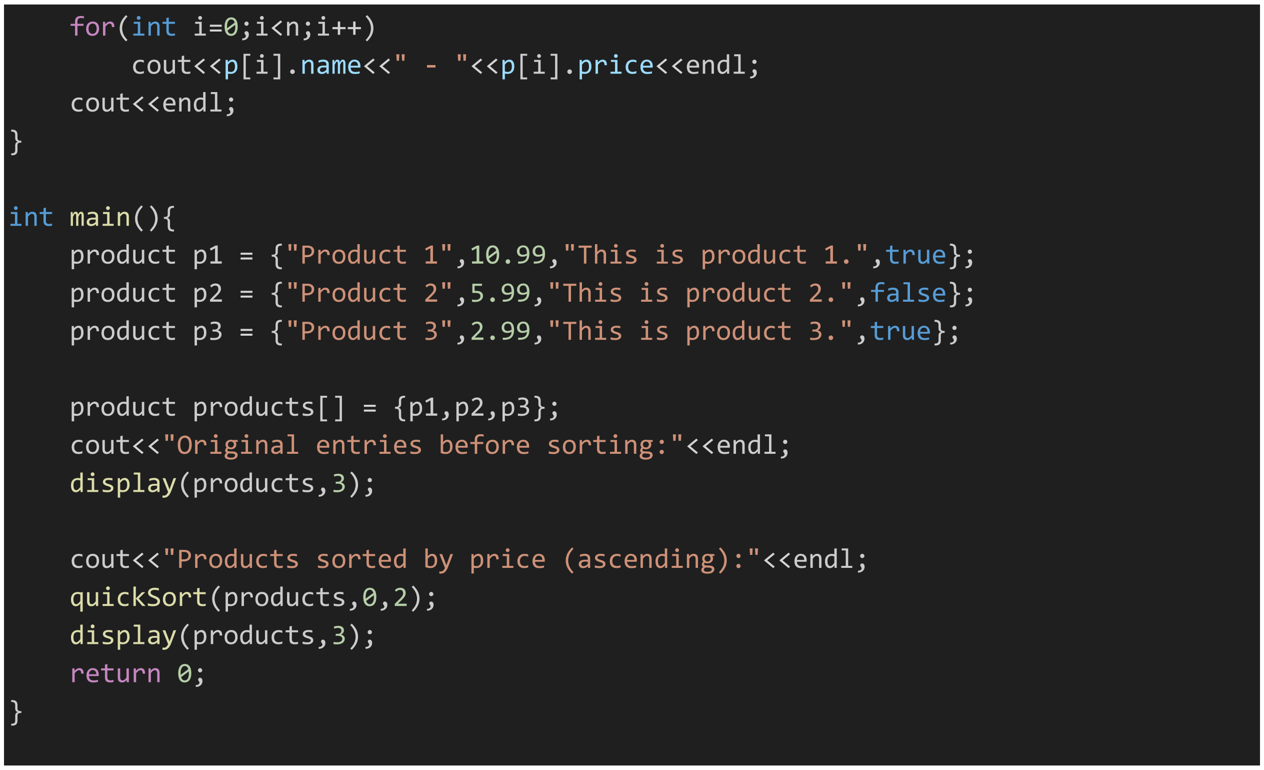
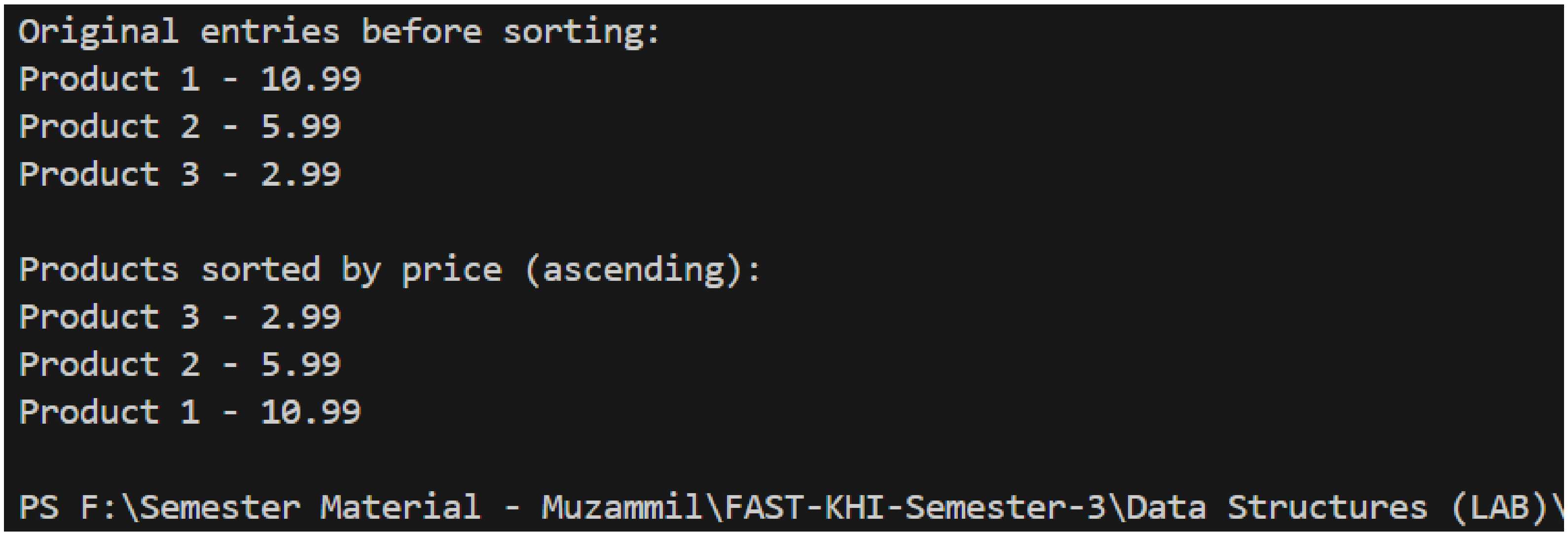

Q4:

```
//23K2001 - Muzammil
#include<iostream>
using namespace std;

class product{
    public:
        string name,desc;
        float price;
        bool availability;

        product(){}
        product(string n,float p,string d,bool a):
name(n),desc(d),price(p),availability(a){}
};

int partition(product a[], int start, int end){
    float pivot = a[end].price;
    int i = start - 1;

    for(int j = start; j < end; j++) {
        if (a[j].price <= pivot) {
            i++;
            product t = a[i];
            a[i] = a[j];
            a[j] = t;
        }
    }
    product t = a[i + 1];
    a[i + 1] = a[end];
    a[end] = t;

    return i + 1;
}
void quickSort(product a[], int start, int end){
    if (start < end)
    {
        int p = partition(a, start, end);
        quickSort(a, start, p - 1);
        quickSort(a, p + 1, end);
    }
}
void display(product *p,int n){
```



```
    for(int i=0;i<n;i++)
        cout<<p[i].name<<" - "<<p[i].price<<endl;
    cout<<endl;
}

int main(){
    product p1 = {"Product 1",10.99,"This is product 1.",true};
    product p2 = {"Product 2",5.99,"This is product 2.",false};
    product p3 = {"Product 3",2.99,"This is product 3.",true};

    product products[] = {p1,p2,p3};
    cout<<"Original entries before sorting:"<<endl;
    display(products,3);

    cout<<"Products sorted by price (ascending):"<<endl;
    quickSort(products,0,2);
    display(products,3);
    return 0;
}
```



```
Original entries before sorting:
Product 1 - 10.99
Product 2 - 5.99
Product 3 - 2.99

Products sorted by price (ascending):
Product 3 - 2.99
Product 2 - 5.99
Product 1 - 10.99

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```
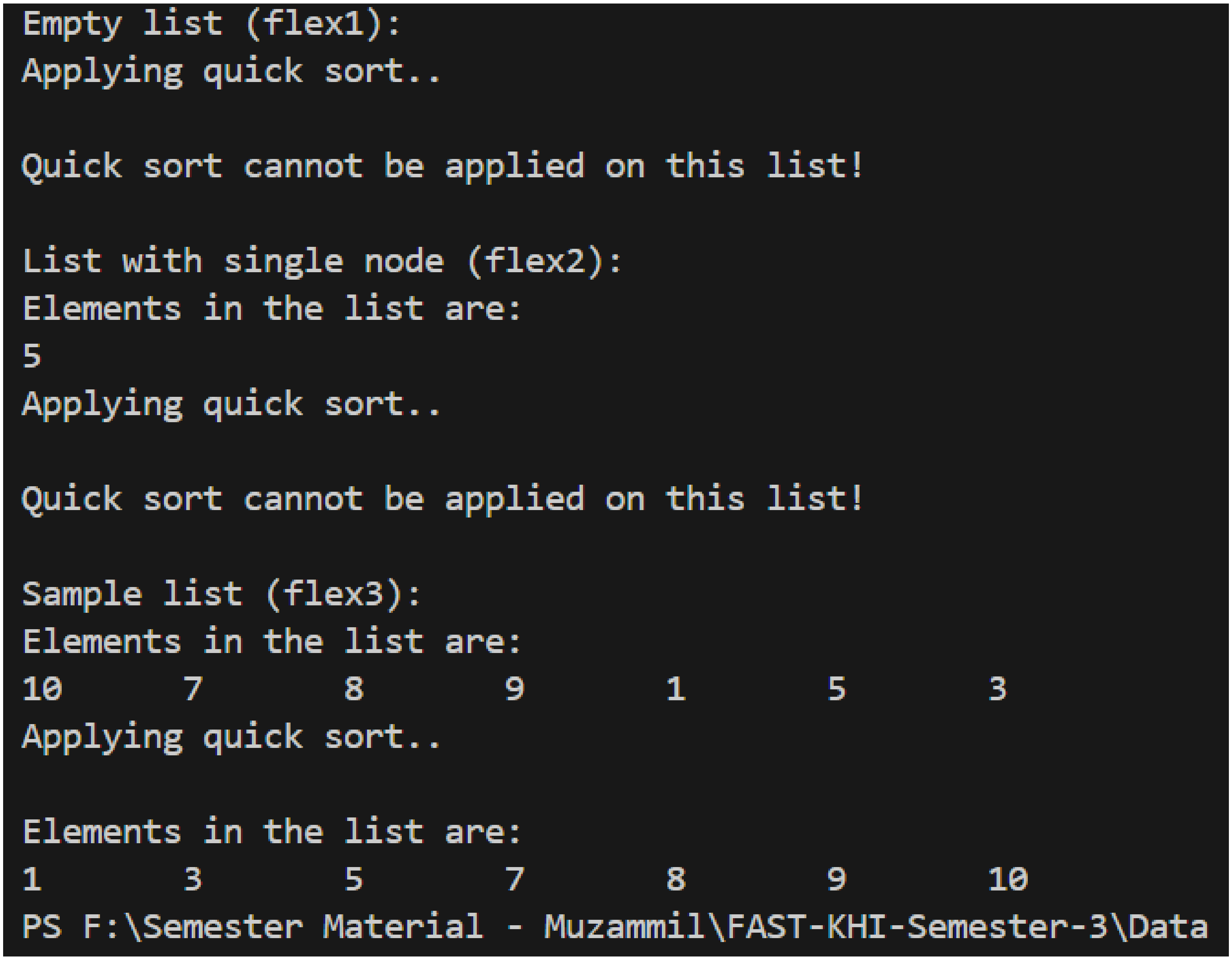

Q5:

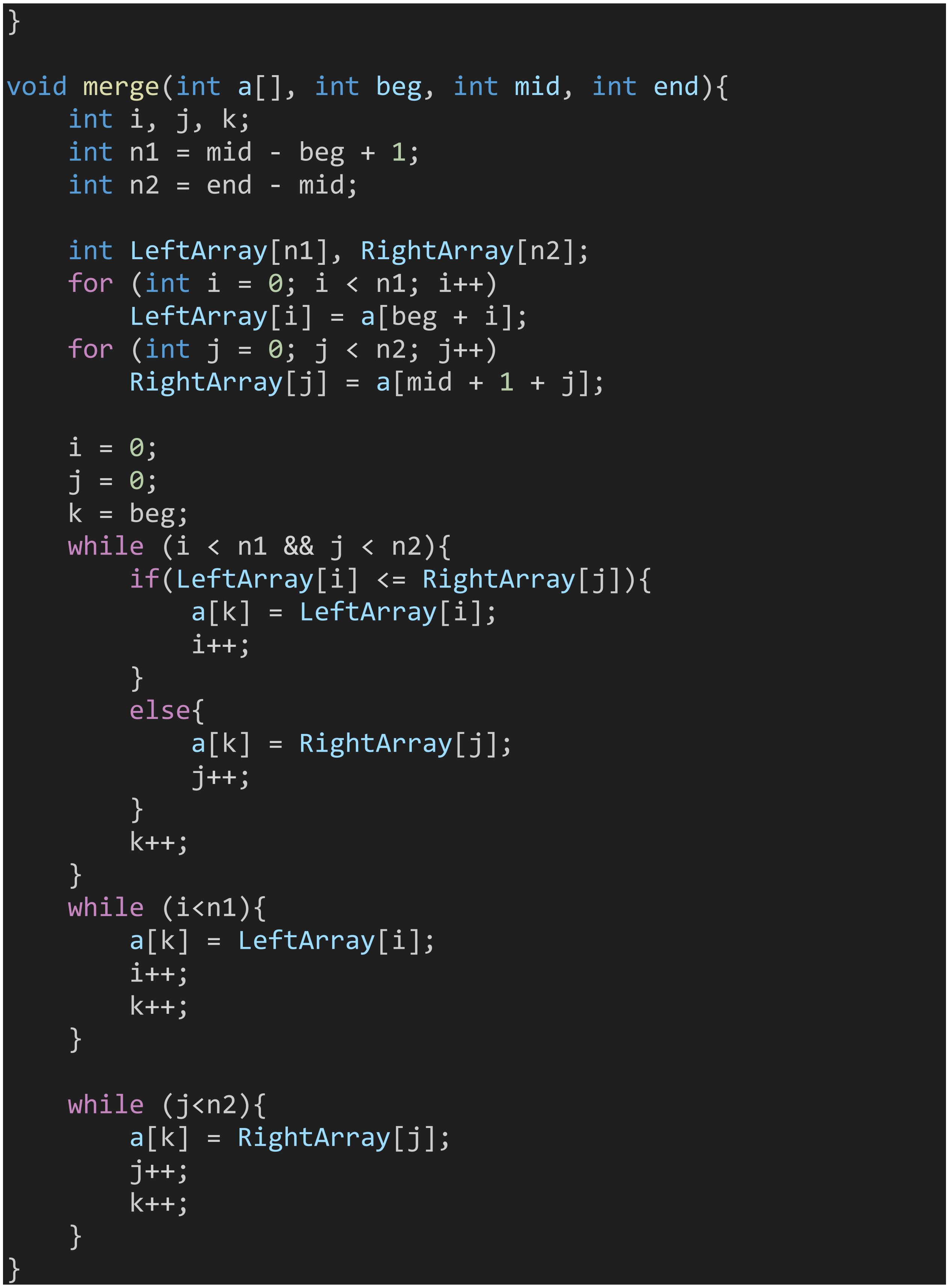
```cpp
//23K2001 - Muzammil
#include<iostream>
using namespace std;

class node{
    public:
        int data;
        node* next;

        node() : next(nullptr) {}
        node(int d) : data(d), next(nullptr){}
        void setNext(node* n){ next = n; }
        void setData(int d){ data = d; }
};
class singleList{
    public:
        node* head;
        node* tail;
        singleList() : head(nullptr), tail(nullptr){}
        void display(){
            if(!head){
                cout<<"List is empty!"<<endl;
                return;
            }
            cout<<"Elements in the list are:"<<endl;
            node* temp = head;
            while(temp){
                cout<<temp->data<<"\t";
                temp = temp->next;
            }
            cout<<endl;
        }
        void insertAtEnd(int d){
            node* n = new node(d);
            if(!head){
                head = n;
                tail = n;
            }
            else{
                tail->next = n;
                tail = n;
            }
        }
        void deleteNode(int d){
            if(!head){
                cout<<"List is empty!"<<endl;
                return;
            }
            node* before = nullptr;
            node* temp = head;
            while(temp->data!=d){
                before = temp;
                temp = temp->next;
            }
            if(!temp){
                cout<<"Value "<<d<<" not found in the list."<<endl;
                return;
            }
            if(temp == head)
                head = head->next;
            else
                before->next = temp->next;

            delete temp;
            cout<<"node with value "<<d<<" deleted.\n";
        }
        void swap(node* a, node* b){
            if (a == b) return;
            int temp = a->data;
            a->data = b->data;
            b->data = temp;
        }

        node* partition(node* start, node* end){
            int pivot = end->data;
            node* i = start;
            node* j = start;

            while (j != end) {
                if (j->data < pivot) {
                    swap(i, j);
                    i = i->next;
                }
                j = j->next;
            }
            swap(i, end);
            return i;
        }
        void quickSort(node* start, node* end) {
            if(head == nullptr || head->next == nullptr){
                cout<<"Quick sort cannot be applied on this list!"<<endl;
                return;
            }

            if(start != end){
                node* pivot = partition(start, end);

                node* temp = start;
                while(temp && temp->next != pivot)
                    temp = temp->next;

                if (temp != nullptr)
                    quickSort(start, temp);
                quickSort(pivot->next, end);
            }
        }
};

int main(){
    singleList flex1,flex2,flex3;
    cout<<"Empty list (flex1):"<<endl;
    cout<<"Applying quick sort.."<<endl<<endl;
    flex1.quickSort(flex1.head,flex1.tail);

    flex2.insertAtEnd(5);
    cout<<endl<<"List with single node (flex2):"<<endl;
    flex2.display();
    cout<<"Applying quick sort.."<<endl<<endl;
    flex2.quickSort(flex2.head,flex2.tail);

    flex3.insertAtEnd(10);
    flex3.insertAtEnd(7);
    flex3.insertAtEnd(8);
    flex3.insertAtEnd(9);
    flex3.insertAtEnd(1);
    flex3.insertAtEnd(5);
    flex3.insertAtEnd(3);
    cout<<endl<<"Sample list (flex3):"<<endl;
    flex3.display();
    cout<<"Applying quick sort.."<<endl<<endl;
    flex3.quickSort(flex3.head,flex3.tail);
    flex3.display();
    return 0;
}
```



```
Empty list (flex1):
Applying quick sort..

Quick sort cannot be applied on this list!

List with single node (flex2):
Elements in the list are:
5
Applying quick sort..

Quick sort cannot be applied on this list!

Sample list (flex3):
Elements in the list are:
10      7       8       9       1       5       3
Applying quick sort..

Elements in the list are:
1       3       5       7       8       9       10
PS F:\Semester Material - Muzammil\FAST-KHI-Semester-3\Data
```

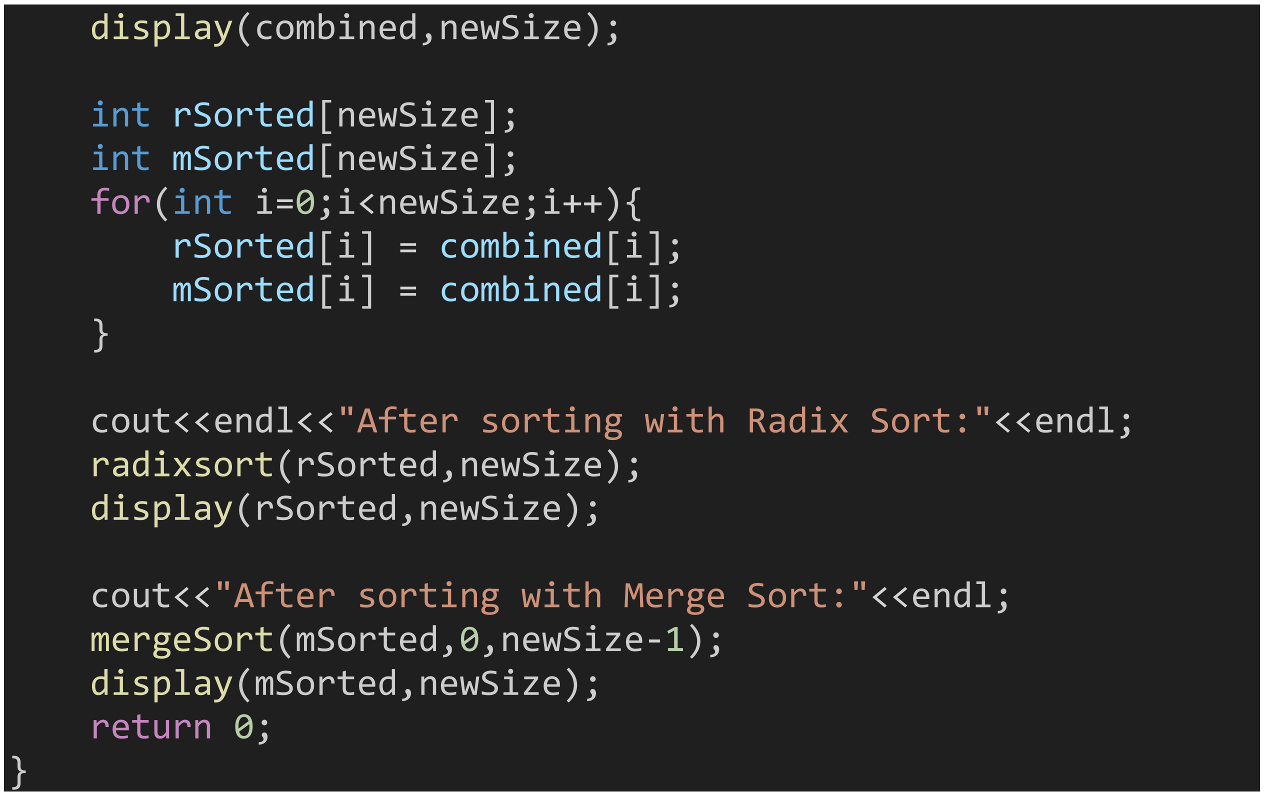
Q6:

```cpp
//23K2001 - Muzammil
#include<iostream>
using namespace std;

int getMax(int a[], int n) {
   int max = a[0];
   for(int i = 1; i<n; i++) {
      if(a[i] > max)
         max = a[i];
   }
   return max;
}

void countingSort(int a[], int n, int place){
  int output[n + 1];
  int count[10] = {0};

  for (int i = 0; i < n; i++)
    count[(a[i] / place) % 10]++;

  for (int i = 1; i < 10; i++)
    count[i] += count[i - 1];

  for (int i = n - 1; i >= 0; i--){
    output[count[(a[i] / place) % 10] - 1] = a[i];
    count[(a[i] / place) % 10]--;
  }

  for (int i = 0; i < n; i++)
    a[i] = output[i];
}

void radixsort(int a[], int n){
  int max = getMax(a, n);

  for (int place = 1; max / place > 0; place *= 10)
    countingSort(a, n, place);
```

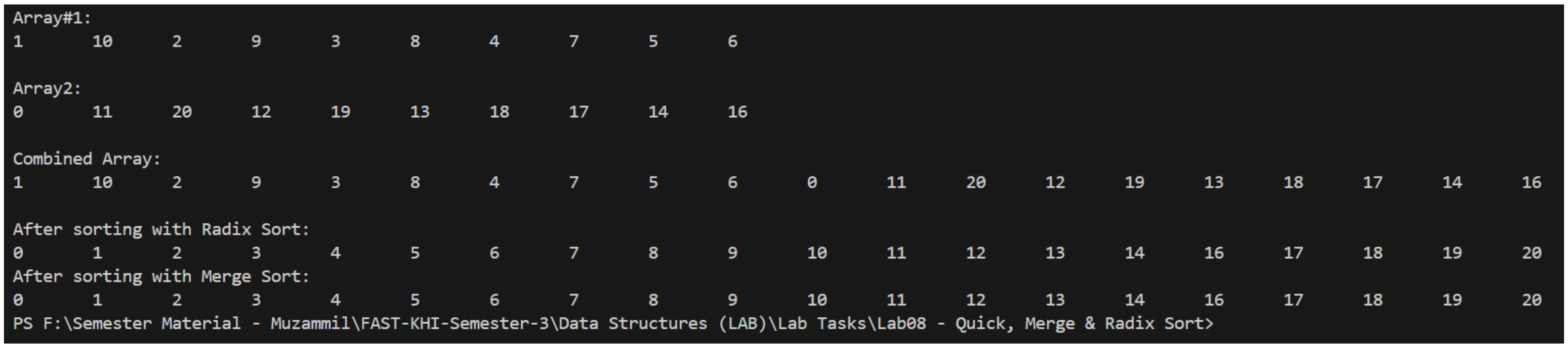


```
}

void merge(int a[], int beg, int mid, int end){
    int i, j, k;
    int n1 = mid - beg + 1;
    int n2 = end - mid;

    int LeftArray[n1], RightArray[n2];
    for (int i = 0; i < n1; i++)
        LeftArray[i] = a[beg + i];
    for (int j = 0; j < n2; j++)
        RightArray[j] = a[mid + 1 + j];

    i = 0;
    j = 0;
    k = beg;
    while (i < n1 && j < n2){
        if(LeftArray[i] <= RightArray[j]){
            a[k] = LeftArray[i];
            i++;
        }
        else{
            a[k] = RightArray[j];
            j++;
        }
        k++;
    }
    while (i<n1){
        a[k] = LeftArray[i];
        i++;
        k++;
    }

    while (j<n2){
        a[k] = RightArray[j];
        j++;
        k++;
    }
}
```

```
void mergeSort(int a[], int beg, int end){
    if (beg < end){
        int mid = (beg + end) / 2;
        mergeSort(a, beg, mid);
        mergeSort(a, mid + 1, end);
        merge(a, beg, mid, end);
    }
}

void combineArr(int *&dest,int arr1[],int arr2[],int n1,int
n2,int &destSize){
    dest = new int[n1+n2];
    destSize = n1+n2;
    int i;
    for(i=0;i<n1;i++)
        dest[i] = arr1[i];
    for(int j=0;j<n2;j++)
        dest[i+j] = arr2[j];
}

void display(int arr[],int n){
    for(int i=0;i<n;i++)
        cout<<arr[i]<<"\t";
    cout<<endl;
}

int main(){
    int arr1[10] = {1,10,2,9,3,8,4,7,5,6};
    int arr2[10] = {0,11,20,12,19,13,18,17,14,16};

    cout<<"Array#1:"<<endl;
    display(arr1,10);
    cout<<endl<<"Array2:"<<endl;
    display(arr2,10);
    int newSize;
    int *combined;
    combineArr(combined,arr1,arr2,10,10,newSize);
    cout<<endl<<"Combined Array:"<<endl;
```



```
    display(combined,newSize);

    int rSorted[newSize];
    int mSorted[newSize];
    for(int i=0;i<newSize;i++){
        rSorted[i] = combined[i];
        mSorted[i] = combined[i];
    }

    cout<<endl<<"After sorting with Radix Sort:"<<endl;
    radixsort(rSorted,newSize);
    display(rSorted,newSize);

    cout<<"After sorting with Merge Sort:"<<endl;
    mergeSort(mSorted,0,newSize-1);
    display(mSorted,newSize);
    return 0;
}
```

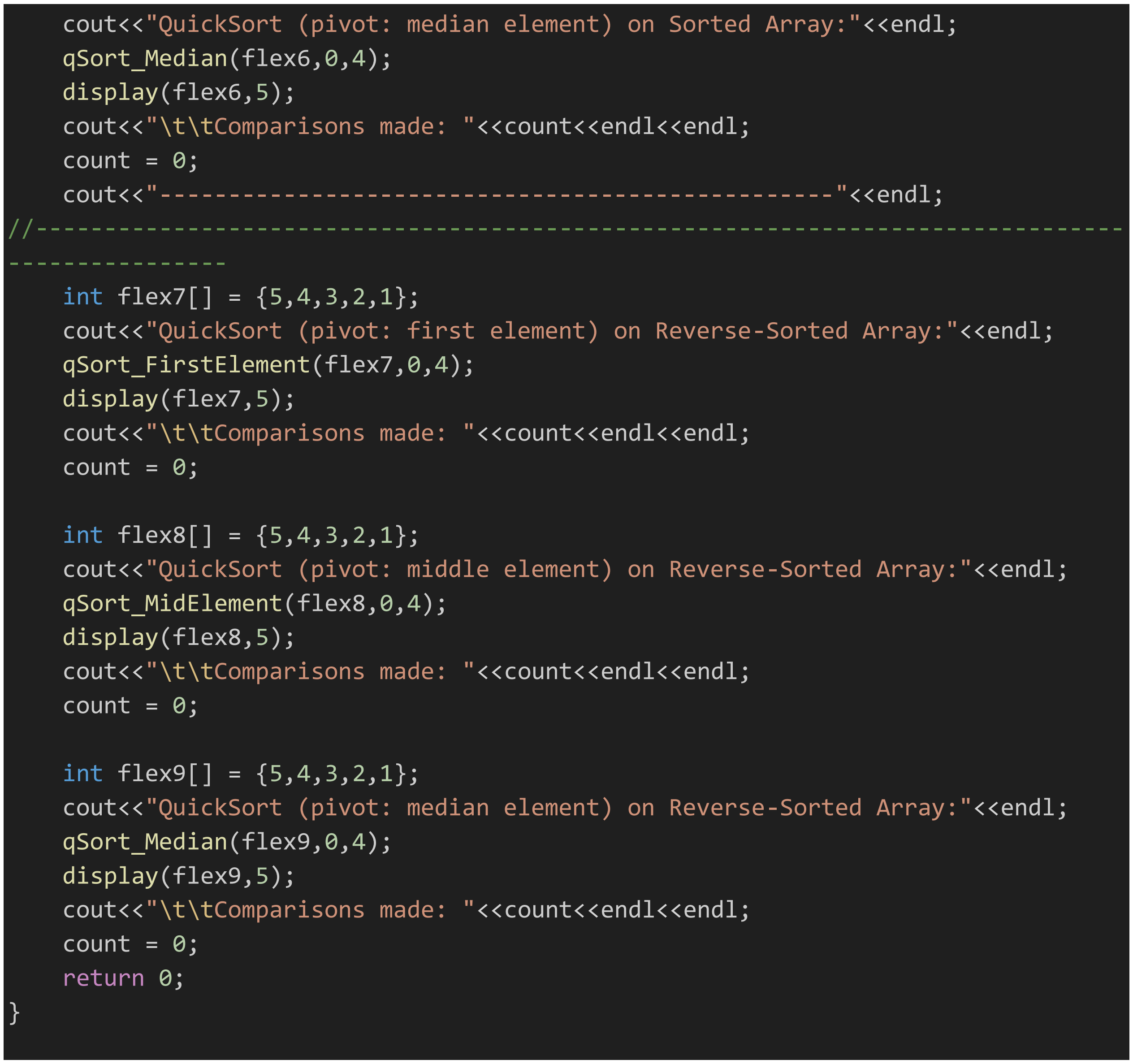


```
Array#1:
1       10      2       9       3       8       4       7       5       6

Array2:
0       11      20      12      19      13      18      17      14      16

Combined Array:
1       10      2       9       3       8       4       7       5       6       0       11      20      12      19      13      18      17      14      16

After sorting with Radix Sort:
0       1       2       3       4       5       6       7       8       9       10      11      12      13      14      16      17      18      19      20
After sorting with Merge Sort:
0       1       2       3       4       5       6       7       8       9       10      11      12      13      14      16      17      18      19      20
PS F:\Semester Material - Muzammil\FAST-KHI-Semester-3\Data Structures (LAB)\Lab Tasks\Lab08 - Quick, Merge & Radix Sort>
```

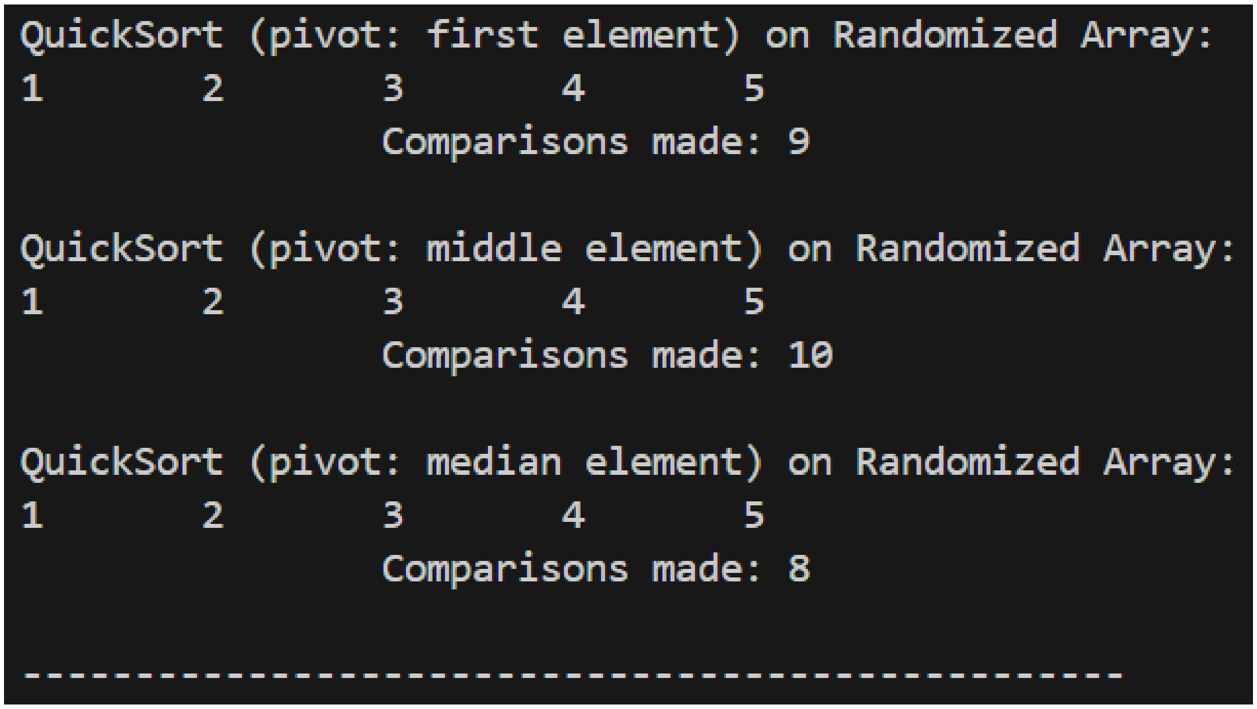
Q7:

```cpp
//23K2001 - Muzammil
#include<iostream>
#include<cstdlib>
#include<time.h>
using namespace std;

int random(int i,int j){
    return (i + rand()%(j-i+1));
}
void swap(int &a,int &b){
    int temp = a;
    a = b;
    b = temp;
}
int count = 0;
int partition(int a[], int start, int end, int pivot){
    int i = start;
    int j = end;

    while (i < j){
        while (a[i] <= a[pivot] && i < end){
            i++;
            count++;
        }
        while (a[j] > a[pivot] && j > start){
            j--;
            count++;
        }
        if (i < j)
            swap(a[i], a[j]);
    }
    swap(a[start], a[j]);
    return j;

}
void qSort_FirstElement(int a[],int start,int end){
    if (start < end)
    {
        int pivot = start;
        int p = partition(a, start, end, pivot);
        qSort_FirstElement(a, start, p - 1);
        qSort_FirstElement(a, p + 1, end);
    }
}
void qSort_RandomElement(int a[],int start,int end){
    if (start < end)
    {
        int r = random(start,end);
        swap(a[start],a[r]);
        int pivot = start;
        int p = partition(a, start, end, pivot);
        qSort_RandomElement(a, start, p - 1);
        qSort_RandomElement(a, p + 1, end);
    }
}
void qSort_MidElement(int a[],int start,int end){
    if (start < end)
    {
        int mid = start+(end-start)/2;
        swap(a[start],a[mid]);
        int pivot = start;
        int p = partition(a, start, end, pivot);
        qSort_MidElement(a, start, p - 1);
        qSort_MidElement(a, p + 1, end);
    }
}
void qSort_Median(int a[],int start,int end){
    if (start < end)
    {
        int mid = start + (end-start)/2;
        if ((a[start] <= a[mid] && a[mid] <= a[end]) || (a[end] <= a[mid] &&
a[mid] <= a[start]))
            swap(a[start], a[mid]);
        else if ((a[mid] <= a[start] && a[start] <= a[end]) || (a[end] <=
a[start] && a[start] <= a[mid]))
            swap(a[start], a[start]);
        else
            swap(a[start], a[end]);

        int pivot = start;
        int p = partition(a, start, end, pivot);
        qSort_Median(a, start, p - 1);
        qSort_Median(a, p + 1, end);
    }
}
void display(int *p,int n){
    for(int i=0;i<n;i++)
```

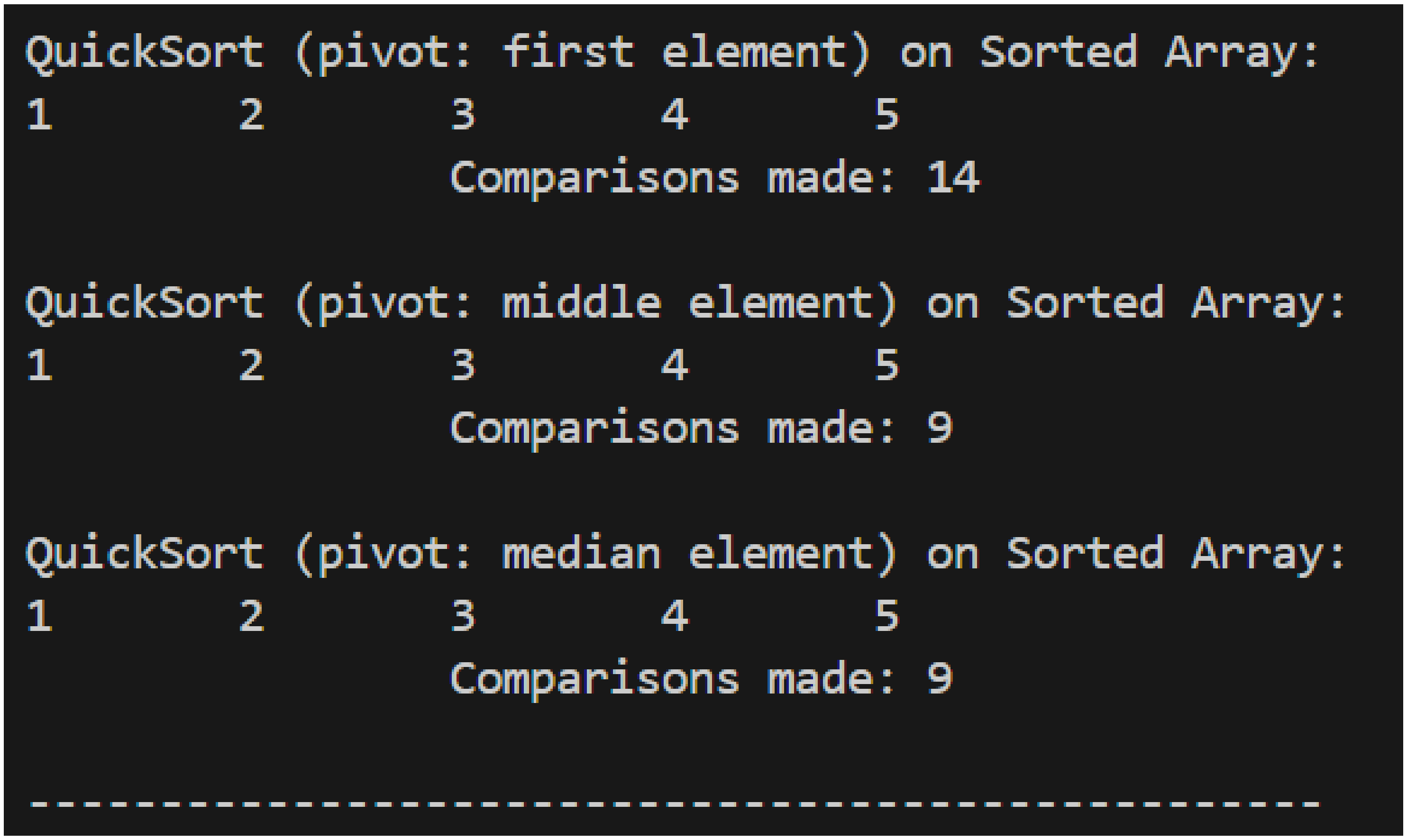
```
        cout<<p[i]<<"\t";
    cout<<endl;
}

int main(){
    srand(time(0));

    int flex1[] = {5,1,4,2,3};
    cout<<"QuickSort (pivot: first element) on Randomized Array:"<<endl;
    qSort_FirstElement(flex1,0,4);
    display(flex1,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex2[] = {5,1,4,2,3};
    cout<<"QuickSort (pivot: middle element) on Randomized Array:"<<endl;
    qSort_MidElement(flex2,0,4);
    display(flex2,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex3[] = {5,1,4,2,3};
    cout<<"QuickSort (pivot: median element) on Randomized Array:"<<endl;
    qSort_Median(flex3,0,4);
    display(flex3,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;
    cout<<"-------------------------------------------------"<<endl;
//-------------------------------------------------------------------------------
----------------
    int flex4[] = {1,2,3,4,5};
    cout<<"QuickSort (pivot: first element) on Sorted Array:"<<endl;
    qSort_FirstElement(flex4,0,4);
    display(flex4,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex5[] = {1,2,3,4,5};
    cout<<"QuickSort (pivot: middle element) on Sorted Array:"<<endl;
    qSort_MidElement(flex5,0,4);
    display(flex5,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex6[] = {1,2,3,4,5};
```



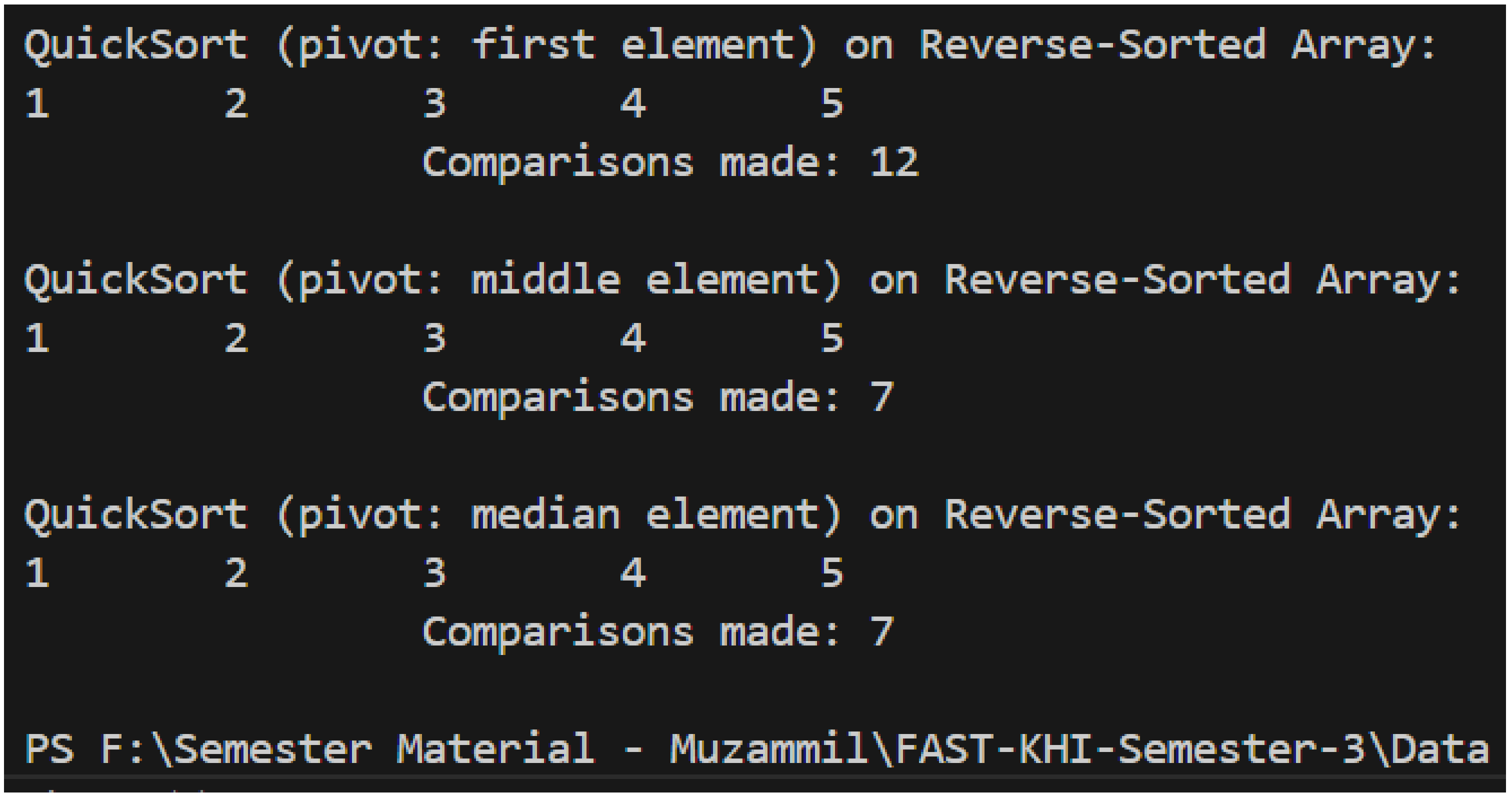
```
    cout<<"QuickSort (pivot: median element) on Sorted Array:"<<endl;
    qSort_Median(flex6,0,4);
    display(flex6,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;
    cout<<"-------------------------------------------------"<<endl;
//--------------------------------------------------------------------------------
----------------
    int flex7[] = {5,4,3,2,1};
    cout<<"QuickSort (pivot: first element) on Reverse-Sorted Array:"<<endl;
    qSort_FirstElement(flex7,0,4);
    display(flex7,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex8[] = {5,4,3,2,1};
    cout<<"QuickSort (pivot: middle element) on Reverse-Sorted Array:"<<endl;
    qSort_MidElement(flex8,0,4);
    display(flex8,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;

    int flex9[] = {5,4,3,2,1};
    cout<<"QuickSort (pivot: median element) on Reverse-Sorted Array:"<<endl;
    qSort_Median(flex9,0,4);
    display(flex9,5);
    cout<<"\t\tComparisons made: "<<count<<endl<<endl;
    count = 0;
    return 0;
}
```



```
QuickSort (pivot: first element) on Randomized Array:
1       2       3       4       5
                Comparisons made: 9

QuickSort (pivot: middle element) on Randomized Array:
1       2       3       4       5
                Comparisons made: 10

QuickSort (pivot: median element) on Randomized Array:
1       2       3       4       5
                Comparisons made: 8


-------------------------------------------------
```



```
QuickSort (pivot: first element) on Sorted Array:
1       2       3       4       5
                Comparisons made: 14

QuickSort (pivot: middle element) on Sorted Array:
1       2       3       4       5
                Comparisons made: 9

QuickSort (pivot: median element) on Sorted Array:
1       2       3       4       5
                Comparisons made: 9

-------------------------------------------------
```



```
QuickSort (pivot: first element) on Reverse-Sorted Array:
1       2       3       4       5
                Comparisons made: 12

QuickSort (pivot: middle element) on Reverse-Sorted Array:
1       2       3       4       5
                Comparisons made: 7

QuickSort (pivot: median element) on Reverse-Sorted Array:
1       2       3       4       5
                Comparisons made: 7

PS F:\Semester Material - Muzammil\FAST-KHI-Semester-3\Data
```