Data Structure Practical 1

Aim: Implementation of different sorting techniques.

a) Bubble Sort

Algorithm:

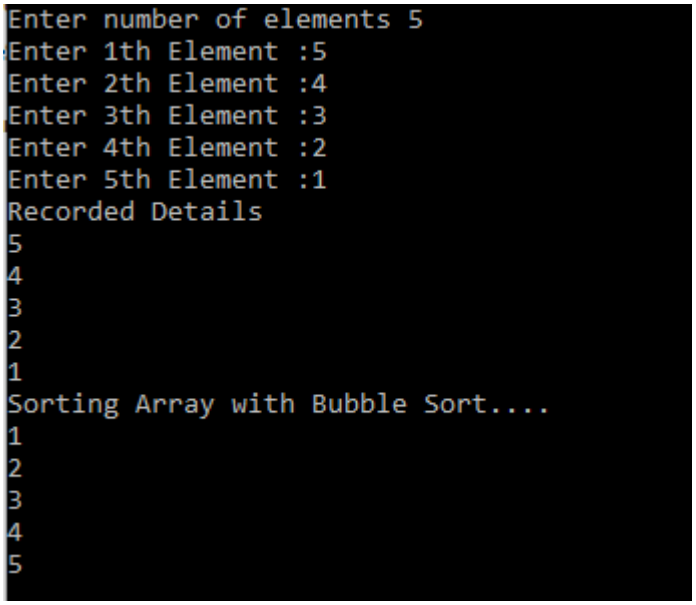
```
begin BubbleSort(list)

  for all elements of list
    if list[i] > list[i+1]
      swap(list[i], list[i+1])
    end if
  end for

  return list

end BubbleSort
```

Code:

```
#include<iostream>

using namespace std;

void showArray(int *entries,int size) {

        //cout<<"Saved Array is \n";

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

                cout<<entries[i]<<"\n";

        }

}

void bubbleSort(int *entries,int n) {

        int i,j,temp;

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

                for(j=0;j<n-1;j++){

                        if(entries[i] < entries[j]){

                                temp=entries[j];

                                entries[j]=entries[i];

                                entries[i]=temp;

                        }
```

```
                }
        }
        showArray(entries,n);
}
int main() {
        int n,i;
        cout<<"Enter number of elements ";
        cin>>n;
        int arr[n];
        int *ptr=arr;
        for(int i=0;i<n;i++) {
                cout<<"Enter "<<i+1<<"th Element :";
                cin>>ptr[i];
        }
        ptr=arr;
        cout<<"Recorded Details \n";
        showArray(ptr,n);
        cout<<"Sorting Array with Bubble Sort....\n";
        bubbleSort(ptr,n);
        return 0;
}
```

Output:



b) Insertion Sort

Algorithm:

Step 1 − If it is the first element, it is already sorted. return 1;
Step 2 − Pick next element
Step 3 − Compare with all elements in the sorted sub-list
Step 4 − Shift all the elements in the sorted sub-list that is greater than the value to be sorted
Step 5 − Insert the value
Step 6 − Repeat until list is sorted

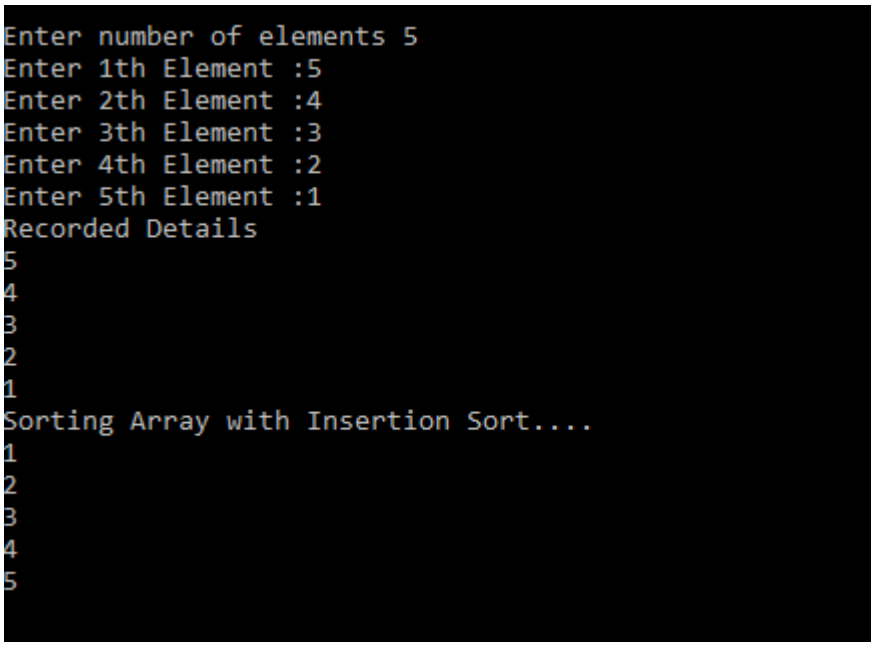
Code:

```
//Insertion Sort

#include<iostream>

using namespace std;

void showArray(int *arr,int size) {

        //cout<<"Saved Array is \n";

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

                cout<<arr[i]<<"\n";

        }

}
```

```
void insertionSort(int *arr,int n) {
	int value, empty, i;
	for(i=1;i<n;i++){
		value=arr[i];
		empty=i;
		while(arr[empty-1]>value && empty!=0){
			arr[empty]=arr[empty-1];
			empty--;
		}
		arr[empty]=value;
	}
	showArray(arr,n);
}
int main() {
	int n,i;
	cout<<"Enter number of elements ";
	cin>>n;
	int arr[n];
	int *ptr=arr;
	for(int i=0;i<n;i++) {
		cout<<"Enter "<<i+1<<"th Element :";
		cin>>ptr[i];
	}
	ptr=arr;
	cout<<"Recorded Details \n";
	showArray(ptr,n);
	cout<<"Sorting Array with Insertion Sort....\n";
	insertionSort(ptr,n);
	return 0;
```

}

Output:



c) Selection Sort

Algorithm:

Step 1 − Set MIN to location 0
Step 2 − Search the minimum element in the list
Step 3 − Swap with value at location MIN
Step 4 − Increment MIN to point to next element
Step 5 − Repeat until list is sorted

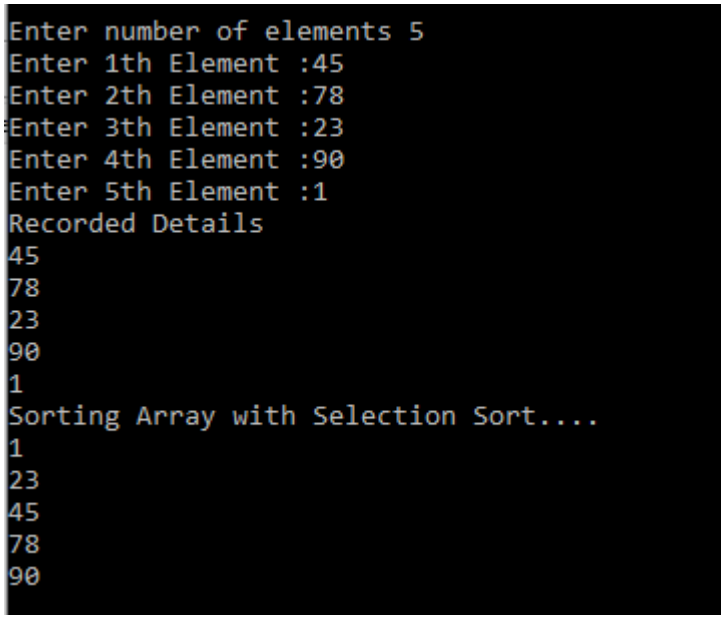
Code:

```
//Selection Sort

#include<iostream>

using namespace std;

void showArray(int *arr,int size) {

        //cout<<"Saved Array is \n";

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

                cout<<arr[i]<<"\n";

        }

}
```

```
void selectionSort(int *arr,int n) {
	int minimumValueIndex,temp,i,j;
	for(i=0;i<n;i++) {
		minimumValueIndex=i;
		for(j=i+1;j<n;j++){
			if(arr[minimumValueIndex] > arr[j]){
				minimumValueIndex=j;
			}
		}
		temp=arr[i];
		arr[i]=arr[minimumValueIndex];
		arr[minimumValueIndex]=temp;
	}
	showArray(arr,n);
}
int main() {
	int n,i;
	cout<<"Enter number of elements ";
	cin>>n;
	int arr[n];
	int *ptr=arr;
	for(int i=0;i<n;i++) {
		cout<<"Enter "<<i+1<<"th Element :";
		cin>>ptr[i];
	}
	ptr=arr;
	cout<<"Recorded Details \n";
	showArray(ptr,n);
	cout<<"Sorting Array with Selection Sort....\n";
```

```
        selectionSort(ptr,n);
        return 0;
}
```

Output:



d) Shell Sort

Algorithm:

```
shellSort(array, size)
  for interval i <- size/2n down to 1
    for each interval "i" in array
        sort all the elements at interval "i"
end shellSort
```

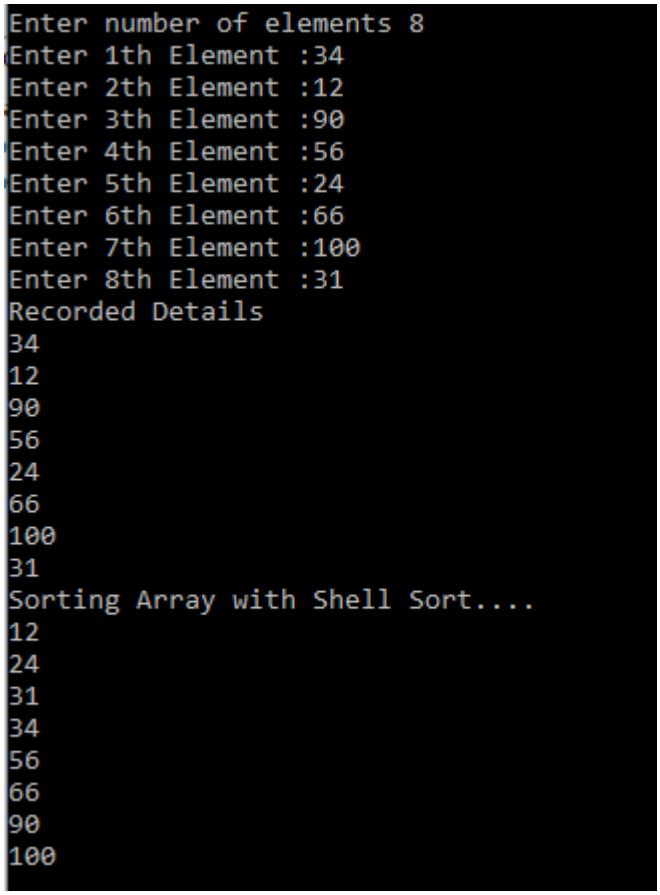
Code:

```
#include<iostream>
using namespace std;
void showArray(int *entries,int size) {
        //cout<<"Saved Array is \n";
```

```
	for(int i=0;i<size;i++){
		cout<<entries[i]<<"\n";
	}
}
/* function to sort arr using shellSort */
void shellSort(int *list,int arraySize)
{
	int gap,j,i;
	for(gap=arraySize/2;gap>=1;gap=gap/2)
	{
		for(j=gap;j<arraySize;j++)
		{
			for(i=j-gap;i>=0;i=i-gap)
			{
				if(list[i+gap]>list[i])
				{
					break;
				}
				else
				{
					int temp = list[i+gap];
					list[i+gap]=list[i];
					list[i]=temp;
				}
			}
		}
	}
	showArray(list, arraySize);
}
```

```
int main() {
	int length,i;
	cout<<"Enter number of elements ";
	cin>>length;
	int arr[length];
	int *ptr=arr;
	for(int i=0;i<length;i++) {
		cout<<"Enter "<<i+1<<"th Element :";
		cin>>ptr[i];
	}
	ptr=arr;
	cout<<"Recorded Details \n";
	showArray(ptr,length);
	cout<<"Sorting Array with Shell Sort....\n";
	shellSort(ptr,length);
	return 0;
}
```

Output:



e) Radix Sort

Algorithm:

Step 1 - Define 10 queues each representing a bucket for each digit from 0 to 9.

Step 2 - Consider the least significant digit of each number in the list which is to be sorted.

Step 3 - Insert each number into their respective queue based on the least significant digit.

Step 4 - Group all the numbers from queue 0 to queue 9 in the order they have inserted into their respective queues.

Step 5 - Repeat from step 3 based on the next least significant digit.

Step 6 - Repeat from step 2 until all the numbers are grouped based on the most significant digit

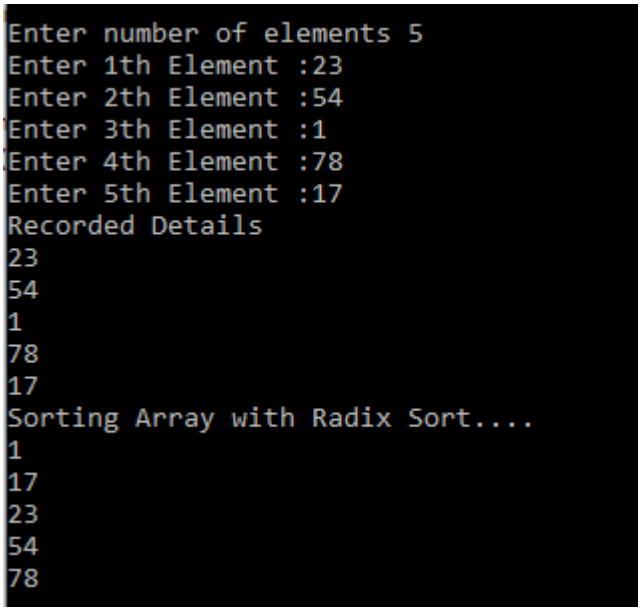
Code:

```
#include<iostream>
using namespace std;
void showArray(int *entries,int size) {
	for(int i=0;i<size;i++){
		cout<<entries[i]<<"\n";
	}
}
int getMax(int *list,int length) {
	int max = list[0];
	for(int i=1;i<length;i++){
		if(list[i]>max){
			max = list[i];
		}
	}
	return max;
}
void countSort(int *list,int arraySize,int pos){
	int count[10]= {0};
	int i;
	int output[arraySize];
	//fill the bucket count based on digit
	for(i=0;i<arraySize;i++){
		count[(list[i]/pos)%10]++;
	}
	//find actual positions of elements
	for(i=1;i<=9;i++){
		count[i]=count[i]+count[i-1];
	}
```

```
	//build array based on result from count array (start from last index to maintain stability)
	for(i=arraySize-1;i>=0;i--)
	{
		output[count[(list[i]/pos)%10]-1]=list[i];
		count[(list[i]/pos)%10]--;
	}
	for(i=0;i<arraySize;i++){
		list[i]=output[i];
	}
}
void radixSort(int *list,int arraySize) {
	int max = getMax(list,arraySize);
	for(int pos=1;max/pos>0;pos=pos*10)
	{
		countSort(list,arraySize,pos);
	}
	showArray(list,arraySize);
}
int main() {
	int n,i;
	cout<<"Enter number of elements ";
	cin>>n;
	int arr[n];
	int *ptr=arr;

	for(int i=0;i<n;i++) {
		cout<<"Enter "<<i+1<<"th Element :";
		cin>>ptr[i];
	}
```

```
        ptr=arr;
        cout<<"Recorded Details \n";
        showArray(ptr,n);
        cout<<"Sorting Array with Radix Sort....\n";
        radixSort(ptr,n);
        return 0;
}
```

Output:



f) **Quick Sort**

Algorithm:

Step 1 − Choose the highest index value has pivot
Step 2 − Take two variables to point left and right of the list excluding pivot
Step 3 − left points to the low index
Step 4 − right points to the high
Step 5 − while value at left is less than pivot move right
Step 6 − while value at right is greater than pivot move left
Step 7 − if both step 5 and step 6 does not match swap left and right
Step 8 − if left ≥ right, the point where they met is new pivot

Code:

```
//Quick Sort - 16-02-2021
```

```
#include<iostream>
using namespace std;
int partition(int *arr, int lower, int upper) {
	int pivot = arr[lower]; // consider first element as pivot element
	int start = lower;
	int end = upper;
	int temp;
	while(start<end) {
		while(arr[start]<=pivot){
			//check for element location which is greater that pivot element from start
			start++;
		}
		while(arr[end]>pivot){
			//check for element location which is smaller that pivot element from end
			end--;
		}
		if(start<end){
			temp=arr[start];
			arr[start]=arr[end];
			arr[end]=temp;
		}
	}
	temp= arr[lower];
	arr[lower]=arr[end];
	arr[end]=temp;

	return end;
}
```

```
void showArray(int *arr,int size) {
	for(int i=0;i<size;i++){
		cout<<arr[i]<<"\n";
	}
}
void quickSort(int *arr,int lower, int upper) {
	int location;
	if(lower<upper){
		location=partition(arr,lower,upper);
		quickSort(arr,lower,location-1); // sorting elements in left section of pivot element
		quickSort(arr,location+1,upper); // sorting elements in right section of pivot element
	}
}
int main() {
	int n,i;
	cout<<"Enter number of elements ";
	cin>>n;
	int arr[n];
	int *ptr=arr;
	for(int i=0;i<n;i++) {
		cout<<"Enter "<<i+1<<"th Element :";
		cin>>ptr[i];
	}
	ptr=arr;
	cout<<"Recorded Details \n";
	showArray(ptr,n);
	cout<<"Sorting Array with Quick Sort....\n";
	quickSort(arr,0,n-1);
```

```
    showArray(arr,n);

    return 0;
}
```

Output: