Marwadi University	**Marwari University** **Faculty of Technology** **Department of Information and Communication Technology**	
Subject: Design and Analysis of Algorithms (01CT0512)	**Aim: Implementing the Sorting Algorithms and understanding the time and space complexities**	
Experimrnt 1	**Date: 03-08-2025**	**Enrollment No: 92301733054**

❖ Insertion Sort

Code:

```
#include <iostream>
#include <vector>
using namespace std;
void Print_Array(vector<int> Array)
{
   for (int i = 0; i < Array.size(); i++)
   {
      cout << Array[i] << " ";
   }
   cout << endl;
}
void Insertion_Sort(vector<int> &Array)
{
   for (int i = 1; i < Array.size(); i++)
   {
      int key = Array[i];
      int j = i - 1;
      while (j >= 0 && Array[j] > key)
      {
         Array[j + 1] = Array[j];
         j--;
      }
      Array[j + 1] = key;
   }
}
int main()
{
   vector<int> Array = {12, 45, 57, 78, 89, 62, 7, 49, 21, 23};
   cout << "Array Before Sorting :- " << endl;
   Print_Array(Array);
   Insertion_Sort(Array);
   cout << "Array After Sorting :- " << endl;
   Print_Array(Array);
   return 0;
}
```

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Output:

Time Complexity: O(n)
Space Complexity: O(1)

❖ Bubble Sort
Code:

```
#include <iostream>
#include <vector>
using namespace std;

void Print_Array(vector<int> Array)
{
    for (int i = 0; i < Array.size(); i++)
    {
        cout << Array[i] << " ";
    }
    cout << endl;
}

void Swap(int &x, int &y)
{
    int temp = x;
    x = y;
    y = temp;
}

void Bubble_Sort(vector<int> &Array)
{
    int size = Array.size();
```

```
    for (int i = 0; i < size - 1; i++)
    {
        bool Swapped = false;

        for (int j = 0; j < size - i - 1; j++)
        {
            if (Array[j] > Array[j + 1])

            {
                Swap(Array[j], Array[j + 1]);
                Swapped = true;
            }
        }
        if (Swapped == false)
        {
            break;
        }
    }
    return;
}

int main()
{
    vector<int> Array = {11,4,54,24,35,22,55,65,33,15,76,63};
    cout << "Array Before Sorting :- " << endl;

    Print_Array(Array);
    Bubble_Sort(Array);

    cout << "Array After Sorting :- " << endl;
    Print_Array(Array);

    return 0;
}
```

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Output:

Time Complexity: $O(n^2)$
Space Complexity: $O(1)$

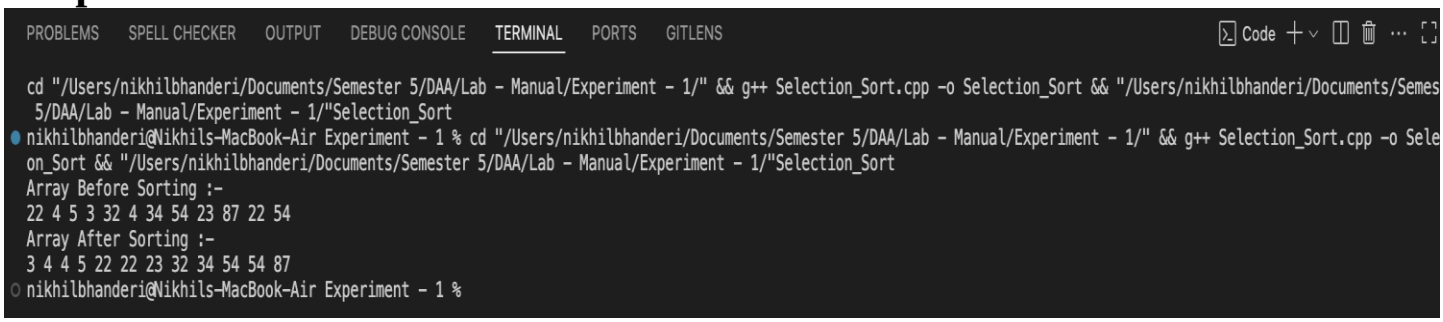
❖ Selection Sort

Code:

```
#include <iostream>
#include <vector>
using namespace std;
void Print_Array(vector<int> Array){
    for (int i = 0; i < Array.size(); i++){
        cout << Array[i] << " ";
    }
    cout << endl;
}
void Swap(int &x, int &y){
    int temp = x;
    x = y;
    y = temp;
}
void Selection_Sort(vector<int> &Array){
    for (int i = 0; i < Array.size(); i++){
        int min_index = i;
        for (int j = i + 1; j < Array.size(); j++){
            if (Array[j] < Array[min_index]){
                min_index = j;
            }
        }
        Swap(Array[i], Array[min_index]);
    }
    return;
}
```

```
int main()
{
    vector<int> Array = {22,4,5,3,32,4,34,54,23,87,22,54};
    cout << "Array Before Sorting :- " << endl;
    Print_Array(Array);
    Selection_Sort(Array);
    cout << "Array After Sorting :- " << endl;
    Print_Array(Array);
    return 0;
}
```

Output:



Time Complexity: $O(n^2)$
Space Complexity: $O(1)$

❖ Counting Sort
Code:

```
#include <iostream>
#include <vector>
using namespace std;
void Print_Array(vector<int> Array)
{
    for (int i = 0; i < Array.size(); i++)
    {
        cout << Array[i] << " ";
    }
    cout << endl;
}
int Find_Max(vector<int> Array)
{
```

```
    int max_num = Array[0];
    for (int i = 1; i < Array.size(); i++)
    {
        if (Array[i] > max_num)
        {
            max_num = Array[i];
        }
    }
    return max_num;
}
void Counting_Sort(vector<int> &Array)
{
    int max_num = Find_Max(Array);
    vector<int> count(max_num + 1, 0);

    for (int i = 0; i < Array.size(); i++)
    {
        count[Array[i]]++;
    }
    int index = 0;
    for (int i = 0; i <= max_num; i++){
        while (count[i] > 0){
            Array[index++] = i;
            count[i]--;
        }
    }
    return;
}
int main()
{
    vector<int> Array = {11,3,35,55,76,34,24,2,42,67,45};
    cout << "Array Before Sorting :- " << endl;
    Print_Array(Array);
    Counting_Sort(Array);
    cout << "Array After Sorting :- " << endl;
    Print_Array(Array);
    return 0;
}
```

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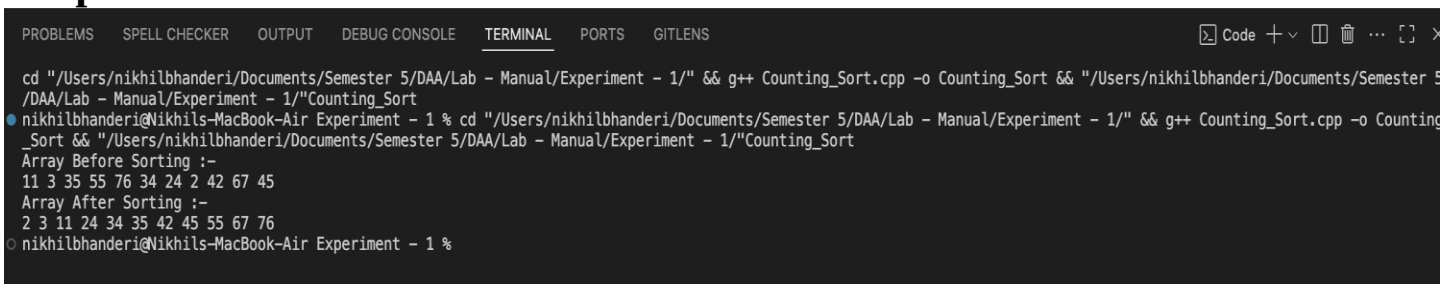
Output:



Time Complexity: O(n + k)
Space Complexity: O(k + n)