

**<u>Aim:</u>** Implementing the Sorting Algorithms

**<u>IDE:</u>** Visual Studio Code

#### **Insertion Sort**

#### Theory: -

Algorithm. -

- Insertion sort is a sorting algorithm that places an unsorted element at its suitable place in each iteration.
- Insertion sort works similarly as we sort cards in our hands in a card game.
- We assume that the first card is already sorted then, we select an unsorted card. If the unsorted card is greater than the card in hand, it is placed on the right otherwise, to the left. In the same way, other unsorted cards are taken and put in their right place.

#### **Working of Insertion Sort**

- 1) The first element in the array is assumed to be sorted. Take the second element and store it separately in the key. Compare the key with the first element. If the first element is greater than the key, then the key is placed in front of the first element.
- 2) Now, the first two elements are sorted. Take the third element and compare it with the elements on the left of it. Placed it just behind the element smaller than it. If no element is smaller than it, place it at the beginning of the array.
- 3) Similarly, place every unsorted element in its correct position.

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## **Faculty of Technology**

## Department of Information and Communication Technology

**Subject: Design and Analysis of Algorithms (01CT0512)** 

**Aim:** Implementing the Sorting Algorithms

**Experiment No: 01 Date: 02-08-2024** 

**Enrollment No: 92200133030** 

**Programming Language: -** C++

```
<u>Code :-</u>
```

```
#include<iostream>
#include <vector>
using namespace std;
void Print_Array(vector<int> Array) {
    for (int i = 0; i < Array.size(); i++) {</pre>
        cout << Array[i] << " ";</pre>
    }
    cout << endl;</pre>
}
void Insertion Sort(vector<int>& Array) {
    for (int i = 1; i < Array.size(); i++) {</pre>
        int key = Array[i];
        int j = i - 1;
        while (j \ge 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;</pre>
    Print Array(Array);
    Insertion Sort(Array);
    cout << "Array After Sorting :- " << endl;</pre>
    Print Array(Array);
    return 0;
}
```

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Subject: Design and Analysis of Algorithms (01CT0512)	Aim: Implementing the Sorting Algorithms	
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#### Output :-

PS D:\Aryan Data\Usefull Data\Semester - 5\Semester-5\Design And Analysis of Algorithms\Lab - Manual\Experiment - 1> cd "d:\Aryan Data\Usefull Data\Semester - 5\Semester-5\Design And Analysis of Algorithms\Lab - Manual\Experiment - 1\"; if (\$?) { g++ Insertion_Sort.cpp -o Insertion_Sort }; if (\$?) { .\Insertion_Sort }  Array Before Sorting :- 12 45 57 78 89 62 7 49 21 23  Array After Sorting :- 7 12 21 23 45 49 57 62 78 89
PS D:\Aryan Data\Usefull Data\Semester - 5\Semester-5\Design And Analysis of Algorithms\Lab - Manual\Experiment - 1>
Space Complexity: Justification: -
Time Complexity:
Best Case Time Complexity: Justification: -
Worst Case Time Complexity: Justification: -

### **Bubble Sort**

#### Theory: -

- Bubble sort is a sorting algorithm that compares two adjacent elements and swaps them until they are in the intended order.
- Just like the movement of air bubbles in the water that rise up to the surface, each array element moves to the end in each iteration. Therefore, it is called a bubble sort.

## **Working of Bubble Sort**

- 1) First Iteration (Compare and Swap)
  - 1) Starting from the first index, compare the first and the second elements.
  - 2) If the first element is greater than the second element, they are swapped.
  - 3) Now, compare the second and the third elements. Swap them if they are not in order.
  - 4) The above process goes on until the last element



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- 2) Remaining Iteration
  - The same process goes on for the remaining iterations.
  - After each iteration, the largest element among the unsorted elements is placed at the end.
  - The array is sorted when all the unsorted elements are placed at their correct positions.

	Algorithm: -	
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-		
-		
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### **Programming Language: -** C++

#### 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;
}</pre>
```



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```
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 = { 12,45,57,78,89,62,7,49,21,23 };
    cout << "Array Before Sorting :- " << endl;</pre>
    Print Array(Array);
    Bubble Sort(Array);
   cout << "Array After Sorting :- " << endl;</pre>
    Print Array(Array);
    return 0;
}
```

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### **Output:-**

d:\Aryan Data\Useful: \$?) { g++ Bubble_Sort Array Before Sorting 12 45 57 78 89 62 7 4 Array After Sorting 7 12 21 23 45 49 57 6	49 21 23 :-	gn And Analysis of Algorithms\Lab - .\Bubble_Sort }	Manual\Experiment - 1\" ; if (
Space Complexit Justification: -	<u>y:-</u>		
Time Complexity	<u>v:</u>		
Best Case Time ( Justification: -	Complexity:		
Worst Case Time Justification: -	e Complexity:-		

### **Counting Sort**

## Theory: -

- Counting sort is a sorting algorithm that sorts the elements of an array by counting the number of occurrences of each unique element in the array.
- The count is stored in an auxiliary array and the sorting is done by mapping the count as an index of the auxiliary array.

### **Working of Counting Sort**

- 1) Find out the maximum element (let it be max) from the given array.
- 2) Initialize an array of length max+1 with all elements 0. This array is used for storing the count of the elements in the array.
- 3) Store the count of each element at their respective index in count array
- 4) Store cumulative sum of the elements of the count array. It helps in placing the elements into the correct index of the sorted array.



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- 5) Find the index of each element of the original array in the count array. This gives the cumulative count. Place the element at the index calculated.
- 6) After placing each element at its correct position, decrease its count by one.

Algorithm: -		

### **Programming Language: -** C++

#### 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;
}</pre>
```



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```
int Find_Max(vector<int> Array) {
    int max num = Array[0];
    for(int i = 1; i < Array.size(); i++) {</pre>
        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++) {</pre>
        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 = { 12,45,57,78,89,62,7,49,21,23 };
    cout << "Array Before Sorting :- " << endl;</pre>
    Print Array(Array);
    Counting Sort(Array);
    cout << "Array After Sorting :- " << endl;</pre>
    Print Array(Array);
    return 0;
}
```



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### Output :-

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Space Complexity:  Justification: -
Time Complexity:  Best Case Time Complexity:  Justification: -
Worst Case Time Complexity:
Justification: -

#### **Selection Sort**

## Theory: -

- Selection sort is a simple and efficient sorting algorithm that works by repeatedly selecting the smallest (or largest) element from the unsorted portion of the list and moving it to the sorted portion of the list.
- The algorithm repeatedly selects the smallest (or largest) element from the unsorted portion of the list and swaps it with the first element of the unsorted part. This process is repeated for the remaining unsorted portion until the entire list is sorted.

#### **Working of Selection Sort**

- 1) Set the first element as a minimum.
- 2) Compare the minimum with the second element. If the second element is smaller than the minimum, assign the second element as the minimum. Compare minimum with the third element. Again, if the third element is smaller, then assign a minimum to the third element otherwise do nothing. The process goes on until the last element.
- 3) After each iteration, the minimum is placed in the front of the unsorted list.



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4) For each iteration, indexing starts from the first unsorted element. Step 1 to 3 are repeated until all the elements are placed at their correct positions.

Algorithm: -	

## **Programming Language: -** C++

## 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;
}</pre>
```



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```
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++) {</pre>
        int min index = i;
        for (int j = i + 1; j < Array.size(); j++) {
            if (Array[j] < Array[min_index]) {</pre>
                min index = j;
            }
        }
        Swap(Array[i], Array[min index]);
    }
    return;
}
int main() {
    vector<int> Array = { 12,45,57,78,89,62,7,49,21,23 };
    cout << "Array Before Sorting :- " << endl;</pre>
    Print_Array(Array);
    Selection Sort(Array);
    cout << "Array After Sorting :- " << endl;</pre>
    Print Array(Array);
    return 0;
}
```

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```
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d:\Aryan Data\Usefull Data\Semester - 5\Semester-5\Design And Analysis of Algorithms\Lab - Manual\Experiment - 1\" ; if (
$?) { g++ Selection_Sort.cpp -o Selection_Sort } ; if ($?) { .\Selection_Sort }
Array Before Sorting :-
12 45 57 78 89 62 7 49 21 23
Array After Sorting :-
7 12 21 23 45 49 57 62 78 89
PS D:\Aryan Data\Usefull Data\Semester - 5\Semester-5\Design And Analysis of Algorithms\Lab - Manual\Experiment - 1>
 Space Complexity:-
 Justification: -
 Time Complexity:
 Best Case Time Complexity:
 Justification: -
 Worst Case Time Complexity:-
 Justification: -
Conclusion:-
```