**Bubble Sort**

**Implementation:**

 void bubble\_sort(int arr[],int n)

{

int i,j,temp,flag;

for(i=0; i<n-1; i++)

{

     flag = 0;

     for(j=0; j<n-i-1; j++)

     {

         if(arr[j]>arr[j+1])

         {

             temp = arr[j];

             arr[j] = arr[j+1];

             arr[j+1] = temp;

             flag = 1;

         }

     }

     if(flag==0)

         break;

}

}

**Analysis:**

Here  we have , arr [5]={5, 1, 4, 2, 8 }

For ascending order :

**1st Iteration:**

( **5** **1** 4 2 8 ) –> ( **1** **5** 4 2 8 ), Here, algorithm compares the first two elements, and swaps since 5 > 1.

( 1 **5** **4** 2 8 ) –> ( 1 **4** **5** 2 8 ), Swap since 5 > 4

( 1 4 **5** **2** 8 ) –> ( 1 4 **2** **5** 8 ), Swap since 5 > 2

( 1 4 2 **5** **8** ) –> ( 1 4 2 **5** **8** ), Now, since these elements are already in order (8 > 5), algorithm does not swap them.

**2nd Iteration:**

( **1** **4** 2 5 8 ) –> ( **1** **4** 2 5 8 )

( 1 **4** **2** 5 8 ) –> ( 1 **2** **4** 5 8 ), Swap since 4 > 2

( 1 2 **4** **5** 8 ) –> ( 1 2 **4** **5** 8 )

( 1 2 4 **5** **8** ) –> ( 1 2 4 **5** **8** )

Now, the array is already sorted, but our algorithm does not know if it is completed. The algorithm needs one **whole** pass without **any** swap to know it is sorted.

**3rd Iteration:**

( **1** **2** 4 5 8 ) –> ( **1** **2** 4 5 8 )

( 1 **2** **4** 5 8 ) –> ( 1 **2** **4** 5 8 )

( 1 2 **4** **5** 8 ) –> ( 1 2 **4** **5** 8 )

( 1 2 4 **5** **8** ) –> ( 1 2 4 **5** **8** )

**Time Complexity (Bubble sort)**

**Best Case :**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 |

If the array is already sorted, then only inner loop will execute for (n-1) times.

Therefore, in best case the complexity of bubble sort is O(n).

**Worst Case :**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 5 | 4 | 3 | 2 | 1 |

For reversely sorted array elements, if there are n elements, for all iteration the total checked condition will be (n-1) +(n-2) +(n-3) +………………………+3+2+1

This equation can be written as,

          =   which is a polynomial equation. Considering the Highest order of n is 2.

Therefore,  in worst case, the complexity of bubble sort is O( n^2).