Basic Sorting
(Algorithm)

What is Sorting?

⇒ Sorting means to arrange of the elements in ascending order...

Unsorted

5	3	1	4	2	0

Sorted

5	3	1	4	2	0

Sort in decreasing -> put elements in decreasing order...

Bubble Sort algorithm:-

Example: In first pass:-

Given arr = 5 1 4 3 2 — 5>1

1 5 4 3 2 — 5>4

1 4 5 3 2 — 5>3

1 4 3 5 2 — 5>2

1 4 3 2 5 — Not Completely Sorted...

Second Pass

1 4 3 2 5 — 1>4 ✗

1 4 3 2 5 — 4>3

1 3 4 2 5 — 4>2

1 3 2 4 5

Third pass:

1 3 2 4 5 1>3 ✗
1 3 2 4 5 3>2
1 2 3 4 5 Sorted

for worst case: 5 4 3 2 1

1st Pass
5 4 3 2 1 5>4
4 5 3 2 1 5>3
4 3 5 2 1 5>2
4 3 2 5 1 5>1
4 3 2 1 5

2nd Pass
4 3 2 1 5 4>3
3 4 2 1 5 4>2
3 2 4 1 5 4>1
3 2 1 4 5

3rd Pass
3 2 1 4 5 3>2
2 3 1 4 5 3>1
2 1 3 4 5 3>4 ✗

4th pass
2 1 3 4 5 2>1
1 2 3 4 5 Sorted Array

Coding implementation:—

Complexity analysis...

```
for(int i=0;i<n-1;i++){//i i
number of operations in each
  for(int j=0;j<n-1-i;j++){
    if(arr[j]>arr[j+1]){
      int temp = arr[j];
      arr[j] = arr[j+1];
      arr[j+1] = temp;
    }
  }
}
```

Suppose Array have n elements...

⇒ the outer for loop will run from 0 to n-2 times...

for i:0 { j:0 to j: n-1-1-0 n-2

for i:1 { j:0 to j: n-1-1-1 n-3

for i:2 { j:0 to j: n-4

⋮

for i: n-2 { j:0 to j: n-1-(n-2)

j: n-1-n+2

j: 1

Total Number of Operations:—

$1+2+3+\ldots+n-2 \Rightarrow$ formula $\frac{n(n+1)}{2} \Rightarrow \frac{(n-2)(n-2+1)}{2}$

$\Rightarrow O\left(\frac{n^2}{2}\right) \Rightarrow O(n^2)$

The code reduces several checks within the loop for a particular i...

Scope of further optimisation:

```
for(int i=0;i<n-1;i++){
  bool flag = true;
  for(int j=0;j<n-1-i;j++){
    if(arr[j]>arr[j+1]){
      int temp = arr[j];
      arr[j] = arr[j+1];
      arr[j+1] = temp;
      flag = false;
    }
  }
  if(flag == true) break;
}
```

→ to check if the array to be processed is sorted or not

→ No Not Sorted Yet

→ if found to be sorted imidiately Break Complete Loop...