Bubble Sort

Legend

🔴	= Swap
🟢	= No Swap

Pass 1

3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	456	123	23	9	7	200	308	196	345	6
3	5	78	89	123	456	23	9	7	200	308	196	345	6
3	5	78	89	123	23	456	9	7	200	308	196	345	6
3	5	78	89	123	23	9	456	7	200	308	196	345	6
3	5	78	89	123	23	9	7	456	200	308	196	345	6
3	5	78	89	123	23	9	7	200	456	308	196	345	6
3	5	78	89	123	23	9	7	200	308	456	196	345	6
3	5	78	89	123	23	9	7	200	308	196	456	345	6
3	5	78	89	123	23	9	7	200	308	196	345	456	6
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**

Pass 2

3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	123	23	9	7	200	308	196	345	6	**456**
3	5	78	89	23	123	9	7	200	308	196	345	6	**456**
3	5	78	89	23	9	123	7	200	308	196	345	6	**456**
3	5	78	89	23	9	7	123	200	308	196	345	6	**456**
3	5	78	89	23	9	7	123	200	308	196	345	6	**456**
3	5	78	89	23	9	7	123	200	196	308	345	6	**456**
3	5	78	89	23	9	7	123	200	196	308	345	6	**456**
3	5	78	89	23	9	7	123	200	196	308	**6**	**345**	**456**

Pass 3

3	5	78	89	23	9	7	123	200	196	308	6	345	456
3	5	78	89	23	9	7	123	200	196	308	6	345	456
3	5	78	89	23	9	7	123	200	196	308	6	345	456
3	5	78	89	23	9	7	123	200	196	308	6	345	456
3	5	78	23	89	9	7	123	200	196	308	6	345	456
3	5	78	23	9	89	7	123	200	196	308	6	345	456
3	5	78	23	9	7	89	123	200	196	308	6	345	456
3	5	78	23	9	7	89	123	200	196	308	6	345	456
3	5	78	23	9	7	89	123	200	196	308	6	345	456
3	5	78	23	9	7	89	123	196	200	308	6	345	456
3	5	78	23	9	7	89	123	196	200	308	6	345	456
3	5	78	23	9	7	89	123	196	200	6	**308**	345	456

Pass 4

3	5	78	23	9	7	89	123	196	200	6	308	345	456
3	5	78	23	9	7	89	123	196	200	6	308	345	456
3	5	78	23	9	7	89	123	196	200	6	308	345	456
3	5	23	78	9	7	89	123	196	200	6	308	345	456
3	5	23	9	78	7	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	200	6	308	345	456
3	5	23	9	7	78	89	123	196	6	200	308	345	456
3	5	23	9	7	78	89	123	196	6	**200**	308	345	456

Pass 5

3	5	23	9	7	78	89	123	196	6	200	308	345	456
3	5	23	9	7	78	89	123	196	6	200	308	345	456
3	5	23	9	7	78	89	123	196	6	200	308	345	456
3	5	23	9	7	78	89	123	196	6	200	308	345	456
3	5	9	23	7	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	196	6	200	308	345	456
3	5	9	7	23	78	89	123	6	196	200	308	345	456

Pass 6

3	5	9	7	23	78	89	123	6	196	200	308	345	456
3	5	9	7	23	78	89	123	6	196	200	308	345	456
3	5	9	7	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	123	6	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456

Pass 7

3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	89	6	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456

Pass 8

3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	78	6	89	123	196	200	308	345	456
3	5	7	9	23	6	78	89	123	196	200	308	345	456

Pass 9

3	5	7	9	23	6	78	89	123	196	200	308	345	456
3	5	7	9	23	6	78	89	123	196	200	308	345	456
3	5	7	9	23	6	78	89	123	196	200	308	345	456
3	5	7	9	23	6	78	89	123	196	200	308	345	456
3	5	7	9	23	6	78	89	123	196	200	308	345	456
3	5	7	9	6	23	78	89	123	196	200	308	345	456

Pass 10

3	5	7	9	6	23	78	89	123	196	200	308	345	456
3	5	7	9	6	23	78	89	123	196	200	308	345	456
3	5	7	9	6	23	78	89	123	196	200	308	345	456
3	5	7	9	6	23	78	89	123	196	200	308	345	456
3	5	7	6	9	23	78	89	123	196	200	308	345	456

Pass 11

3	5	7	6	9	23	78	89	123	196	200	308	345	456
3	5	7	6	9	23	78	89	123	196	200	308	345	456
3	5	7	6	9	23	78	89	123	196	200	308	345	456
3	5	6	7	9	23	78	89	123	196	200	308	345	456

Final Result

After all the passes, the array is sorted in ascending order:

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	7	9	23	78	89	123	196	200	308	345	456

Selection Sort

Legend	
🔴	= Swap
🟡	= Sub-sorted array

Pass 1

| 3 | 5 | 78 | 89 | 456 | 123 | 23 | 9 | 7 | 200 | 308 | 196 | 345 | 6 |

Pass 2

| 3 | 5 | 78 | 89 | 456 | 123 | 23 | 9 | 7 | 200 | 308 | 196 | 345 | 6 |

Pass 3

| 3 | 78 | 89 | 456 | 123 | 23 | 9 | 7 | 200 | 308 | 196 | 345 | 6 |

Pass 4

| 3 | 6 | 89 | 456 | 123 | 23 | 9 | 7 | 200 | 308 | 196 | 345 | 78 |

Pass 5

| 3 | 6 | 7 | 456 | 123 | 23 | 9 | 89 | 200 | 308 | 196 | 345 | 78 |

Pass 6

| 3 | 6 | 7 | 9 | 123 | 23 | 456 | 89 | 200 | 308 | 196 | 345 | 78 |

Pass 7

| 3 | 6 | 7 | 9 | 23 | 123 | 456 | 89 | 200 | 308 | 196 | 345 | 78 |

Pass 8

| 3 | 6 | 7 | 9 | 23 | 78 | 456 | 89 | 200 | 308 | 196 | 345 | 123 |

Pass 9

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 456 | 200 | 308 | 196 | 345 | 123 |

Pass 10

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 200 | 308 | 196 | 345 | 456 |

Pass 11

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 196 | 308 | 200 | 345 | 456 |

Pass 12

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 196 | 200 | 308 | 345 | 456 |

Pass 13

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 196 | 200 | 308 | 345 | 456 |

Pass 14

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 196 | 200 | 308 | 345 | 456 |

Pass 15

| 3 | 5 | 6 | 7 | 9 | 23 | 78 | 89 | 123 | 196 | 200 | 308 | 345 | 456 |

Final Result

After all the passes, the array is sorted in ascending order:

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	7	9	23	78	89	123	196	200	308	345	456

Quick Sort

Legend

🔴	= Swap
🟢	= Sub-sorted elements
🟡	= Sub array

Consider 6 as the pivot element

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	78	89	456	123	23	9	7	200	308	196	345	6

Pass 1
i=0, j=1
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	78	89	456	123	23	9	7	200	308	196	345	6

i   j

Pass 2
i=0, j=2
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	78	89	456	123	23	9	7	200	308	196	345	6

i   j

Since j (78) > pivot (6), swap the elements

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	78	89	456	123	23	9	7	200	308	196	345	6

i   j

Pass 3
i=1, j=3
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

   i   j

Pass 4
i=1, j=4
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78
	i			j									

Pass 5
i=1, j=5
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78
	i				j								

Pass 6
i=1, j=6
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78
	i					j							

Pass 7
i=1, j=7
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78
	i						j						

Pass 8
i=1, j=8
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

Pass 9
i=1, j=9
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

i (at 1), j (at 9)

Pass 10
i=1, j=10
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

i (at 1), j (at 10)

Pass 11
i=1, j=11
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

i (at 1), j (at 11)

Pass 12
i=1, j=12
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78

i (at 1), j (at 12)

Pass 13
i=1, j=13
pivot=6

0	1	2	3	4	5	6	7	8	9	10	11	12	13

3	5	6	89	456	123	23	9	7	200	308	196	345	78
	i												j

Now that we have reached the end of the array, we partition the array into two sub-arrays: **[3, 5]** and **[89, 456, 123, 23, 9, 7, 200, 308, 196, 345, 78].**

Pass 14
Consider sub array [3,5]

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	89	456	123	23	9	7	200	308	196	345	78
i													j

Since the sub-array has only two elements, it is already sorted.

Pass 15
Sorting sub-array [89, 456, 123, 23, 9, 7, 200, 308, 196, 345, 78]

Consider 78 as the pivot
i=0, j=1

0	1	2	3	4	5	6	7	8	9	10
89	456	123	23	9	7	200	308	196	345	78
i	j									

Consider 78 as the pivot
i=0, j=1
Since 78 < 89, swap

0	1	2	3	4	5	6	7	8	9	10
89	456	123	23	9	7	200	308	196	345	78
i	j									

Pass 16

Pivot=78
i=1, j=2

0	1	2	3	4	5	6	7	8	9	10
78	456	123	23	9	7	200	308	196	345	89

i   j

Pass 17

Pivot=89
i=1, j=3
Since j < pivot, bring j to the left of the array

0	1	2	3	4	5	6	7	8	9	10
78	456	123	23	9	7	200	308	196	345	89

i   j

Pass 18

Pivot=78
i=1, j=4
Since j < pivot, bring j to the left of the array

0	1	2	3	4	5	6	7	8	9	10
78	23	456	123	9	7	200	308	196	345	89

i   j

Pass 19

Pivot=78
i=1, j=5
Since j < pivot, bring j to the left of the array

0	1	2	3	4	5	6	7	8	9	10
78	23	9	456	123	7	200	308	196	345	89

i   j

Pass 20

Pivot=78
i=1, j=6

0	1	2	3	4	5	6	7	8	9	10
78	23	9	7	456	123	200	308	196	345	89

i   j

Pass 21

Pivot=78
i=2, j=7

0	1	2	3	4	5	6	7	8	9	10
78	23	9	456	123	7	200	308	196	345	89
		i					j			

Pass 22

Pivot=78
i=2, j=8

0	1	2	3	4	5	6	7	8	9	10
78	23	9	7	456	123	200	308	196	345	89
		i						j		

Pass 23

Pivot=78
i=3, j=9

0	1	2	3	4	5	6	7	8	9	10
78	23	9	7	456	123	200	308	196	345	89
			i						j	

Pass 24

Pivot=78
i=3, j=10

0	1	2	3	4	5	6	7	8	9	10
78	23	9	7	456	123	200	308	196	345	89
			i							j

Pass 25

The pivot is placed in the correct position

0	1	2	3	4	5	6	7	8	9	10

7	23	9	78	456	123	200	308	196	345	89
				i						j

Pass 26
We now have two sub-arrays: [7, 23, 9] and [456, 123, 200, 308, 196, 345, 89]

0	1	2	3	4	5	6	7	8	9	10
7	23	9	78	456	123	200	308	196	345	89

Pass 27
Consider 9 as the pivot
i=0, j=1

0	1	2
7	23	9
i		j

Pass 28
Swapping these 2 elements

0	1	2
7	23	9
i		j

Pass 29
The sub array is sorted

0	1	2
7	9	23
i		j

Pass 30
Consider sub-array: [456, 123, 200, 308, 196, 345, 89]
i=0, j=1
Pivot=89

0	1	2	3	4	5	6
456	123	200	308	196	345	89
i	j					

Pass 31
i=0, j=1
Pivot=89
Since i > pivot, swap

0	1	2	3	4	5	6
456	123	200	308	196	345	89

i   j

Pass 32
i=1, j=2
Pivot=89

0	1	2	3	4	5	6
89	123	200	308	196	345	456

i   j

Pass 33
i=1, j=3
Pivot=89

0	1	2	3	4	5	6
89	123	200	308	196	345	456

i   j

Pass 34
i=1, j=4
Pivot=89

0	1	2	3	4	5	6
89	123	200	308	196	345	456

i   j

Pass 35
i=1, j=5
Pivot=89

0	1	2	3	4	5	6
89	123	200	308	196	345	456

i   j

Pass 36
i=1, j=6
Pivot=89

0	1	2	3	4	5	6
89	123	200	308	196	345	456

i (under 0)   j (under 6)

Now, we consider sub-array [123, 200, 308, 196, 345, 456], as 89 is already in the correct position

Pass 36
i=0, j=1
Pivot=456

0	1	2	3	4	5
123	200	308	196	345	456

i (under 0)   j (under 1)

Pass 37
i=0, j=2
Pivot=456

0	1	2	3	4	5
123	200	308	196	345	456

i (under 0)   j (under 2)

Pass 38
i=0, j=3
Pivot=456

0	1	2	3	4	5
123	200	308	196	345	456

i (under 0)   j (under 3)

Pass 39
i=0, j=4
Pivot=456

0	1	2	3	4	5
123	200	308	196	345	456

i (under 0)   j (under 4)

Pass 40
i=0, j=5
Pivot=456

0	1	2	3	4	5

123	200	308	196	345	456
i					j

Since 456 is in the correct position, therefore consider a new sub array [123, 200, 308, 196, 345]

Pass 41
i=0, j=1
Consider 345 as the pivot

0	1	2	3	4
123	200	308	196	345
i	j			

Pass 42
i=0, j=2
Pivot=345

0	1	2	3	4
123	200	308	196	345
i		j		

Pass 43
i=0, j=3
Pivot=345

0	1	2	3	4
123	200	308	196	345
i			j	

Since 345 is in the correct position, partition the array and repeat the process

0	1	2	3	4
123	200	308	196	345
i				j

Pass 44
i=0, j=1
Pivot=196

0	1	2	3
123	200	308	196
i	j		

Since j > pivot, swap the elements

0	1	2	3
123	200	308	196
i	j		

Now, 196 is in the correct position.

0	1	2	3
123	196	308	200
i			j

Since **123** is a single element, we consider the second half of the array **[308, 200]**

Pass 45

0	1
308	200

Considering 200 as the pivot, it is smaller than 308, hence we swap it

0	1
308	200

After Swapping

0	1
200	308

Final Result

After all the passes, the array is sorted in ascending order:

0	1	2	3	4	5	6	7	8	9	10	11	12	13
3	5	6	7	9	23	78	89	123	196	200	308	345	456