Day 20: Sorting

Objective

Today, we're discussing a simple sorting algorithm called *Bubble Sort*. Check out the Tutorial tab for learning materials and an instructional video!

Consider the following version of Bubble Sort:

```
for (int i = 0; i < n; i++) {
    // Track number of elements swapped during a single array traversal
    int numberOfSwaps = 0;

    for (int j = 0; j < n - 1; j++) {
        // Swap adjacent elements if they are in decreasing order
        if (a[j] > a[j + 1]) {
            swap(a[j], a[j + 1]);
            numberOfSwaps++;
        }
    }

    // If no elements were swapped during a traversal, array is sorted
    if (numberOfSwaps == 0) {
        break;
    }
}
```

Task

Given an array, a, of size n distinct elements, sort the array in *ascending* order using the *Bubble Sort* algorithm above. Once sorted, print the following 3 lines:

1. `Array is sorted in numSwaps swaps.`
   where $numSwaps$ is the number of swaps that took place.
2. `First Element: firstElement`
   where $firstElement$ is the *first* element in the sorted array.
3. `Last Element: lastElement`
   where $lastElement$ is the *last* element in the sorted array.

Hint: To complete this challenge, you will need to add a variable that keeps a running tally of *all* swaps that occur during execution.

Example

$a = [4, 3, 1, 2]$

```
original a: 4 3 1 2
round 1  a: 3 1 2 4 swaps this round: 3
round 2  a: 1 2 3 4 swaps this round: 2
round 3  a: 1 2 3 4 swaps this round: 0
```

In the first round, the 4 is swapped at each of the 3 comparisons, ending in the last position. In the second round, the 3 is swapped at 2 of the 3 comparisons. Finally, in the third round, no swaps are made so the iterations stop. The output is the following:

```
Array is sorted in 5 swaps.
First Element: 1
Last Element: 4
```

Input Format

The first line contains an integer, n, the number of elements in array a.
The second line contains n space-separated integers that describe $a[0], a[1], \ldots, a[n-1]$.

Constraints

- $2 \leq n \leq 600$
- $1 \leq a[i] \leq 2 \times 10^6$, where $0 \leq i < n$.

Output Format

Print the following three lines of output:

1. `Array is sorted in numSwaps swaps.`
   where $numSwaps$ is the number of swaps that took place.
2. `First Element: firstElement`
   where $firstElement$ is the *first* element in the sorted array.
3. `Last Element: lastElement`
   where $lastElement$ is the *last* element in the sorted array.

Sample Input 0

```
3
1 2 3
```

Sample Output 0

```
Array is sorted in 0 swaps.
First Element: 1
Last Element: 3
```

Explanation 0

The array is already sorted, so 0 swaps take place and we print the necessary 3 lines of output shown above.

Sample Input 1

```
3
3 2 1
```

Sample Output 1

```
Array is sorted in 3 swaps.
First Element: 1
Last Element: 3
```

Explanation 1

The array $a = [3, 2, 1]$ is *not sorted*, so we perform the following 3 swaps. Each line shows a after each single element is swapped.

1. $[3, 2, 1] \rightarrow [2, 3, 1]$
2. $[2, 3, 1] \rightarrow [2, 1, 3]$
3. $[2, 1, 3] \rightarrow [1, 2, 3]$

After 3 swaps, the array is sorted.