Bubble sort

| **9** | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

| 6 | **9** | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

| 6 | 9 | **9** | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

| 6 | 9 | 4 | **9** | 2 | 7 | 6 | 5 | 6 | 1 |

| 6 | 9 | 4 | 2 | **9** | 7 | 6 | 5 | 6 | 1 |

Bubble sort

Repeat until sorted

Bubble sort

| 6 | **9** | 4 | 2 | 7 | 6 | 5 | 6 | 1 | **9** |

| 6 | 4 | **9** | 2 | 7 | 6 | 5 | 6 | 1 | **9** |

| 6 | 4 | 2 | **9** | 7 | 6 | 5 | 6 | 1 | **9** |

| 6 | 4 | 2 | 7 | **9** | 6 | 5 | 6 | 1 | **9** |

| 6 | 4 | 2 | 7 | 6 | **9** | 5 | 6 | 1 | **9** |

Bubble sort

| 6 | 4 | 2 | 7 | 6 | 5 | 9 | 6 | 1 | 9 |

| 6 | 4 | 2 | 7 | 6 | 5 | 6 | 9 | 1 | 9 |

| 6 | 4 | 2 | 7 | 6 | 5 | 6 | 1 | 9 | 9 |

| 6 | 4 | 2 | 7 | 6 | 5 | 6 | 1 | 9 | 9 |

....

Bubble sort

4	6	2	7	6	5	6	1	9	9
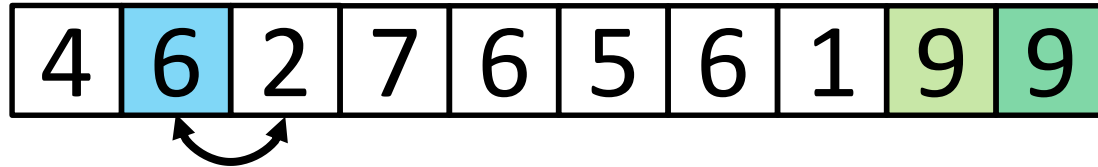
Complexity: **O(n^2)**   ....
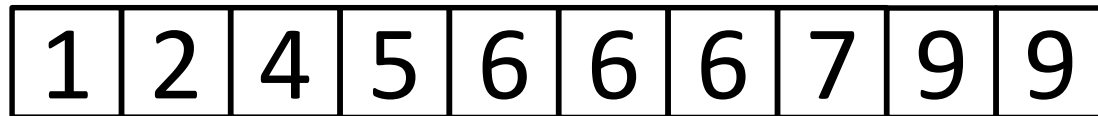It goes through all elements
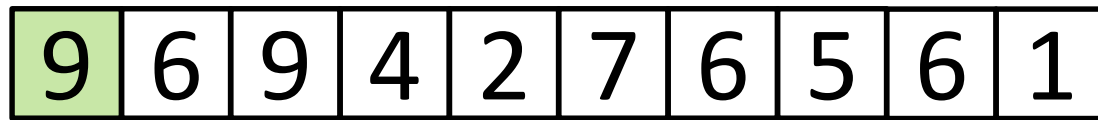Guaranteed to sort in **n** repetitions

Named bubble because large elements raise to the surface
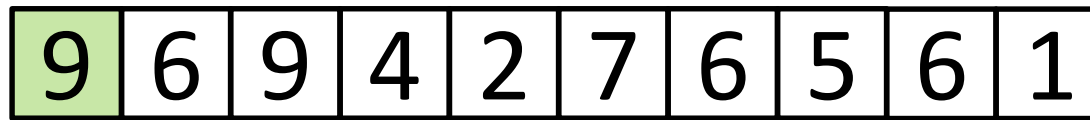(similar to bubbles in sparkling water)

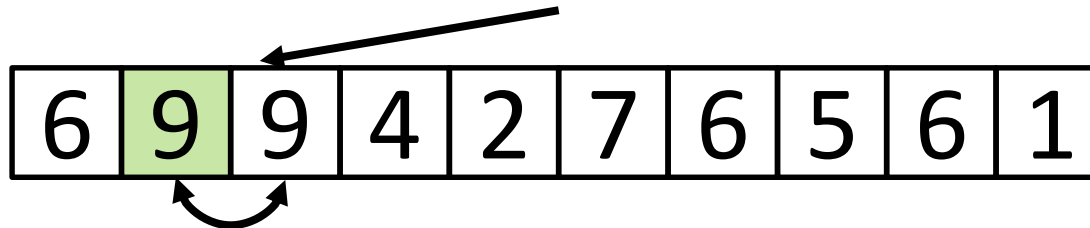| 1	2	4	5	6	6	6	7	9	9

Parallel bubble sort

9	6	9	4	2	7	6	5	6	1

These two operations (and all pairs like them)
cannot be executed in parallel

6	9	9	4	2	7	6	5	6	1

Parallel bubble sort

9	6	9	4	2	7	6	5	6	1

These two operations (and all pairs like them)
cannot be executed in parallel

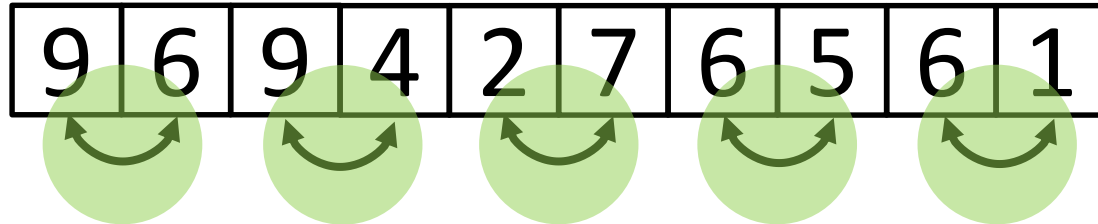| 6	9	9	4	2	7	6	5	6	1
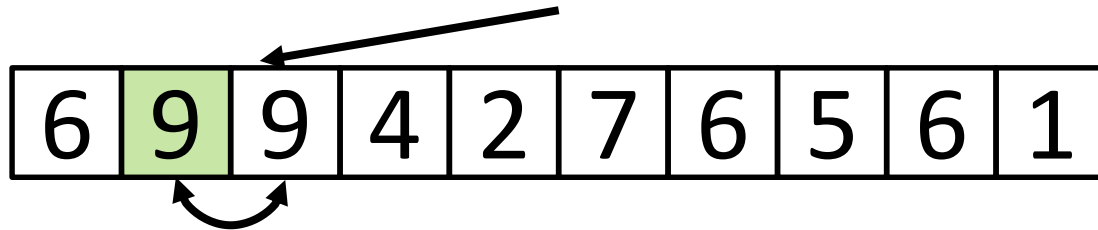
Solution hint: The operations do not need
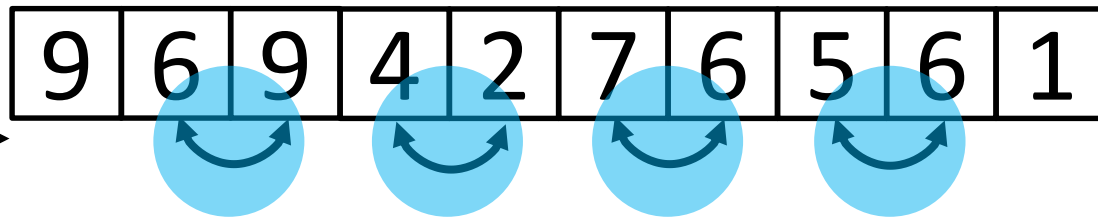to be executed in exactly the same order

OETS: Odd-Even Transposition Sort

Repeat until sorted (maximum n times guarantee)

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |
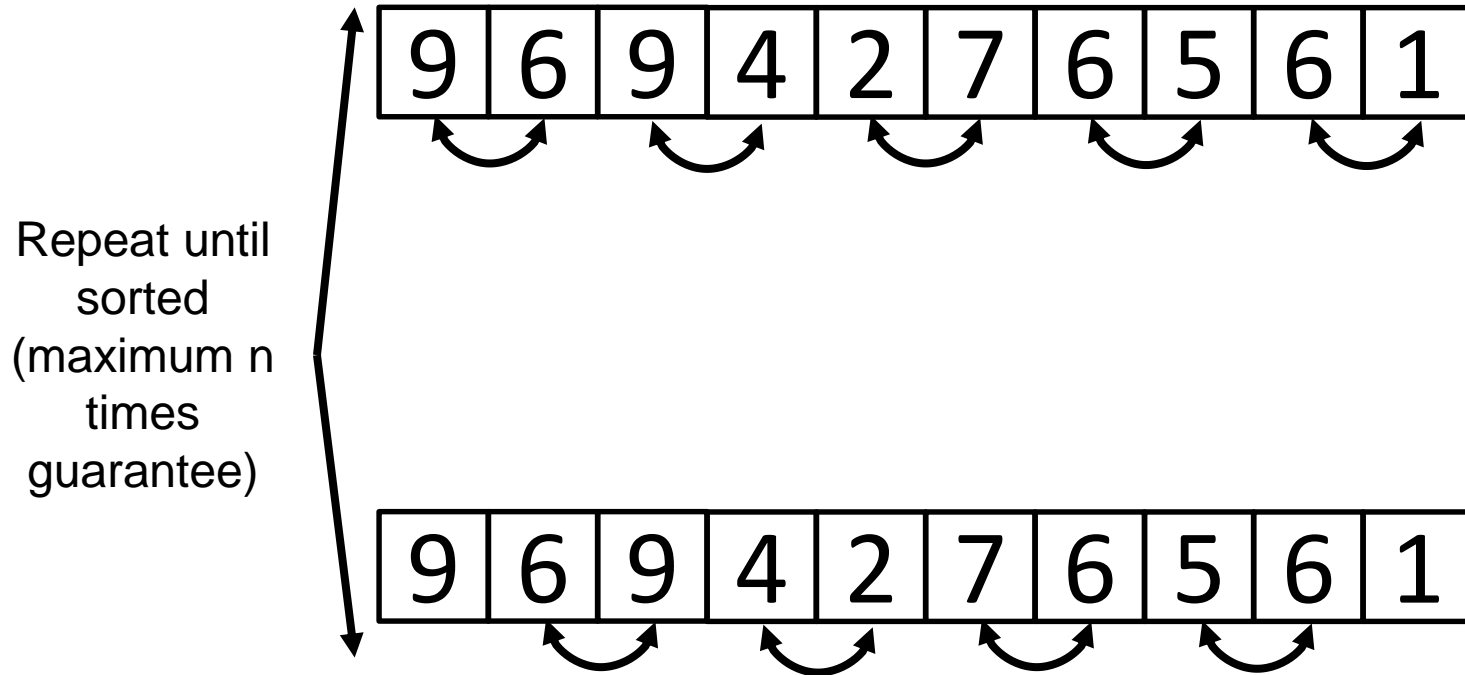
OETS: Odd-Even Transposition Sort

Can be executed in parallel →

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

....

Can be executed in parallel →

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

....

....

OETS: Odd-Even Transposition Sort

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

....

Can **NOT** be executed in parallel

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 |

....

....

OETS: Odd-Even Transposition Sort

| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 | ....
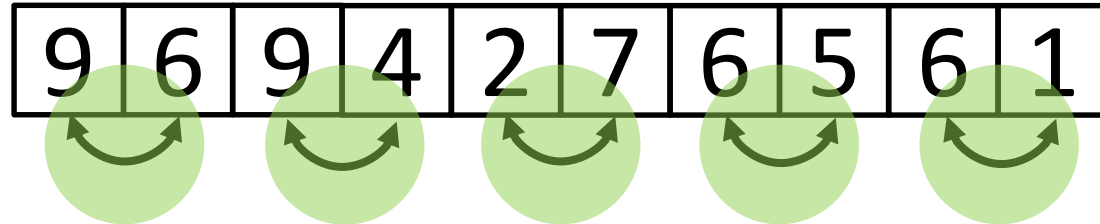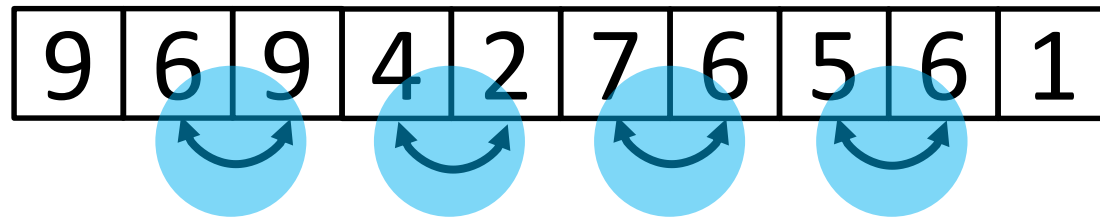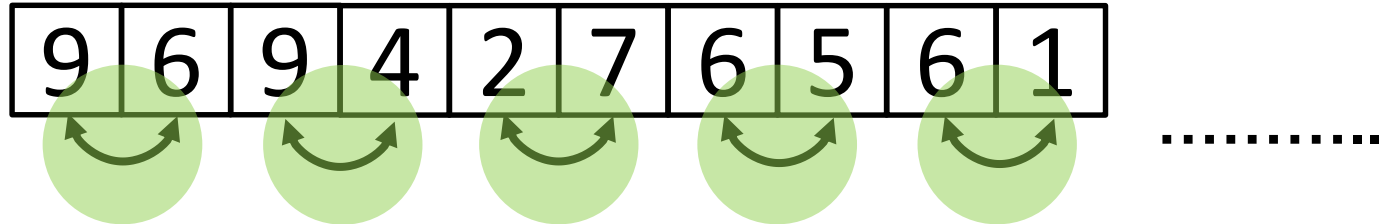
Solution:
Barrier
between
each
iteration

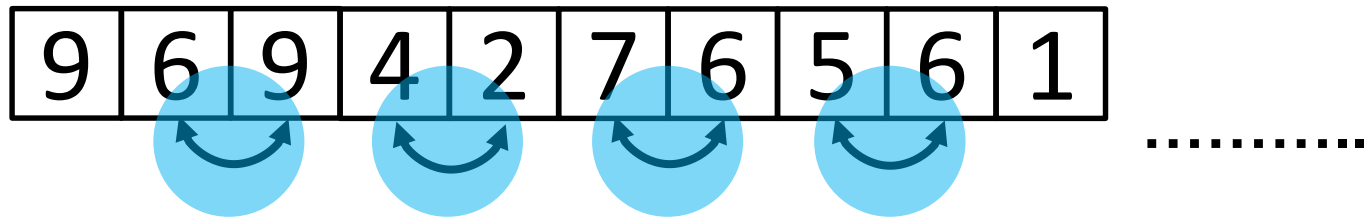| 9 | 6 | 9 | 4 | 2 | 7 | 6 | 5 | 6 | 1 | ....

....

OETS: Odd-Even Transposition Sort

9	6	9	4	2	7	6	5	6	1

....
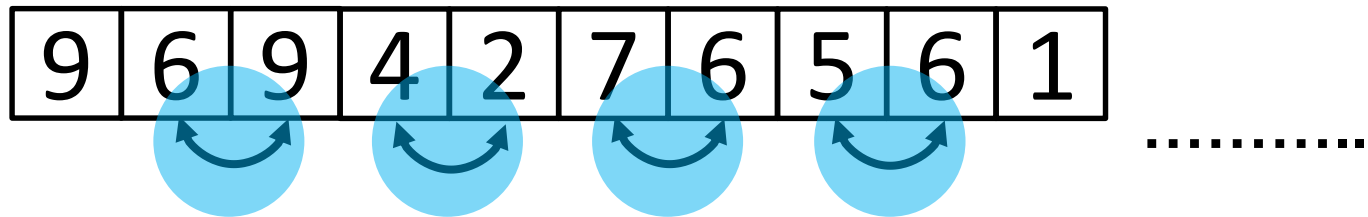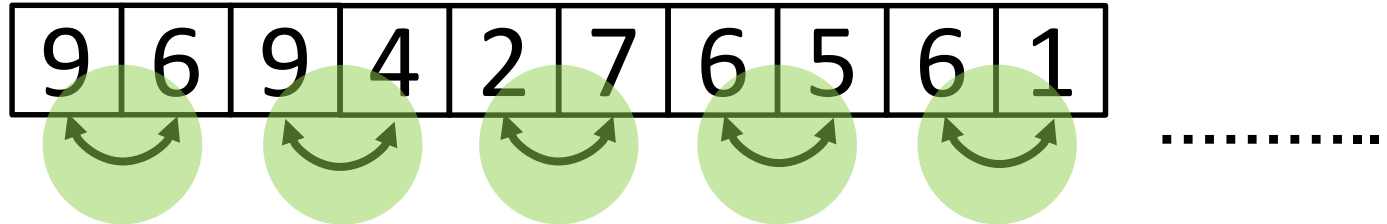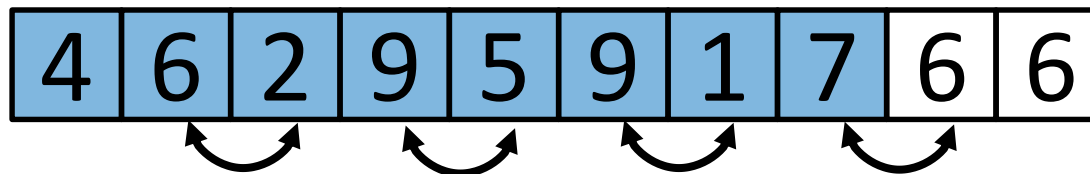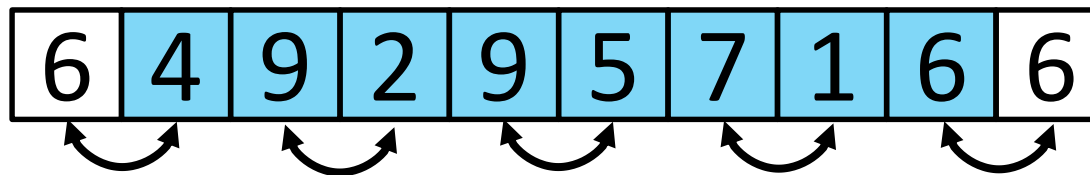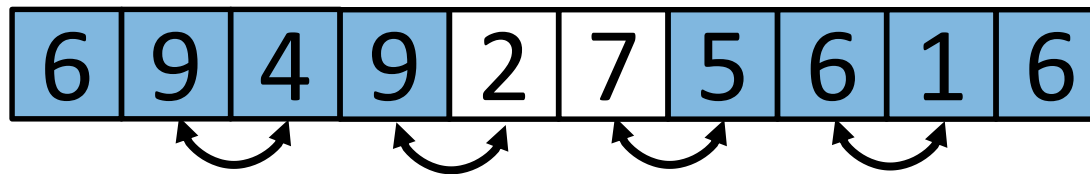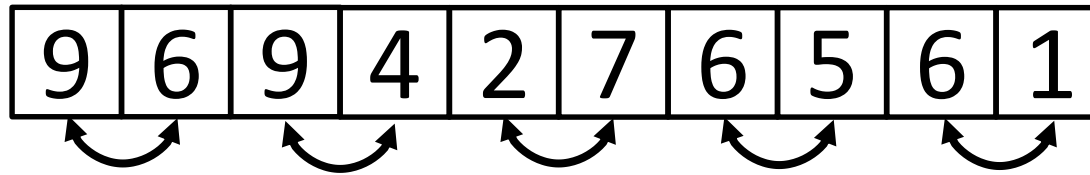
Parallel complexity:
p = threads or
processor cores

$$O(\frac{n}{p} * n) = O(n) \text{ for p=n}$$

9	6	9	4	2	7	6	5	6	1

....

....

OETS: Odd-Even Transposition Sort

9	6	9	4	2	7	6	5	6	1

6	9	4	9	2	7	5	6	1	6

6	4	9	2	9	5	7	1	6	6

4	6	2	9	5	9	1	7	6	6

OETS: Odd-Even Transposition Sort

4	2	6	5	9	1	9	6	7	6

2	4	5	6	1	9	6	9	6	7

2	4	5	1	6	6	9	6	9	7

2	4	1	5	6	6	6	9	7	9

OETS: Odd-Even Transposition Sort

by Cristian Chilipirea