

# 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

6	9	4	2	7	9	6	5	6	1
---	---	---	---	---	---	---	---	---	---



6	9	4	2	7	6	9	5	6	1
---	---	---	---	---	---	---	---	---	---



6	9	4	2	7	6	5	9	6	1
---	---	---	---	---	---	---	---	---	---



6	9	4	2	7	6	5	6	9	1
---	---	---	---	---	---	---	---	---	---



6	9	4	2	7	6	5	6	1	9
---	---	---	---	---	---	---	---	---	---



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
---	---	---	---	---	---	---	---	---	---

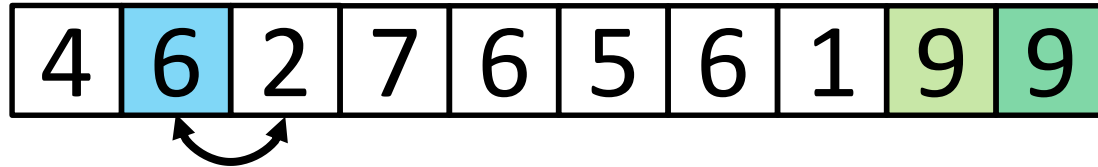


6	4	2	7	6	5	6	1	9	9
---	---	---	---	---	---	---	---	---	---



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# Bubble sort



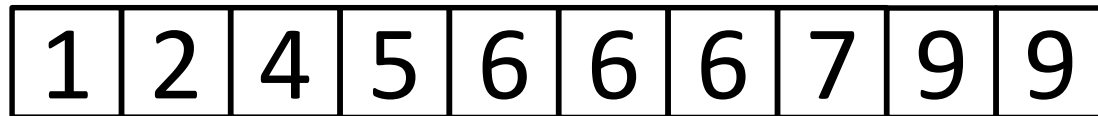
Complexity:  $O(n^2)$

It goes through all elements

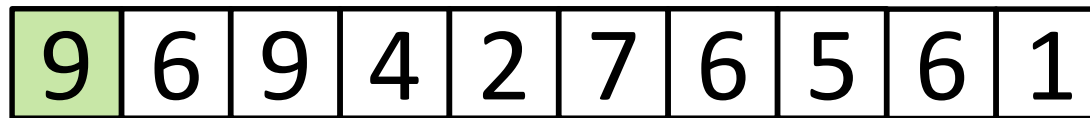
Guaranteed to sort in  $n$  repetitions

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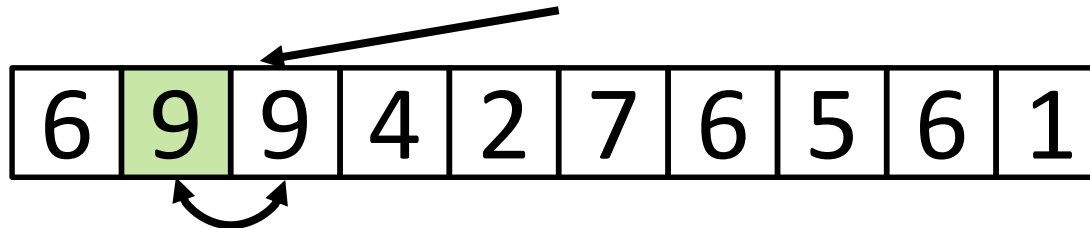
Named bubble because large elements raise to the surface  
(similar to bubbles in sparkling water)



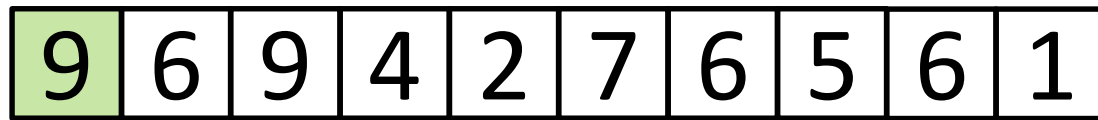
# Parallel bubble sort



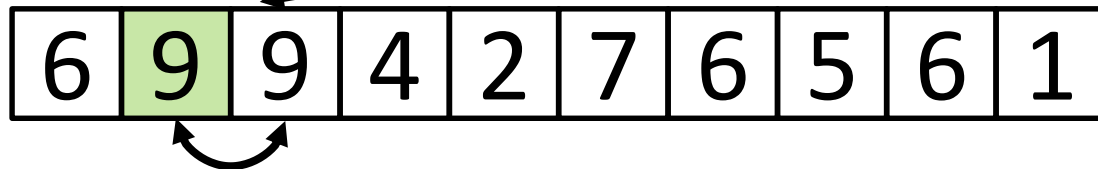
These two operations (and all pairs like them)  
**cannot** be executed in parallel



# Parallel bubble sort

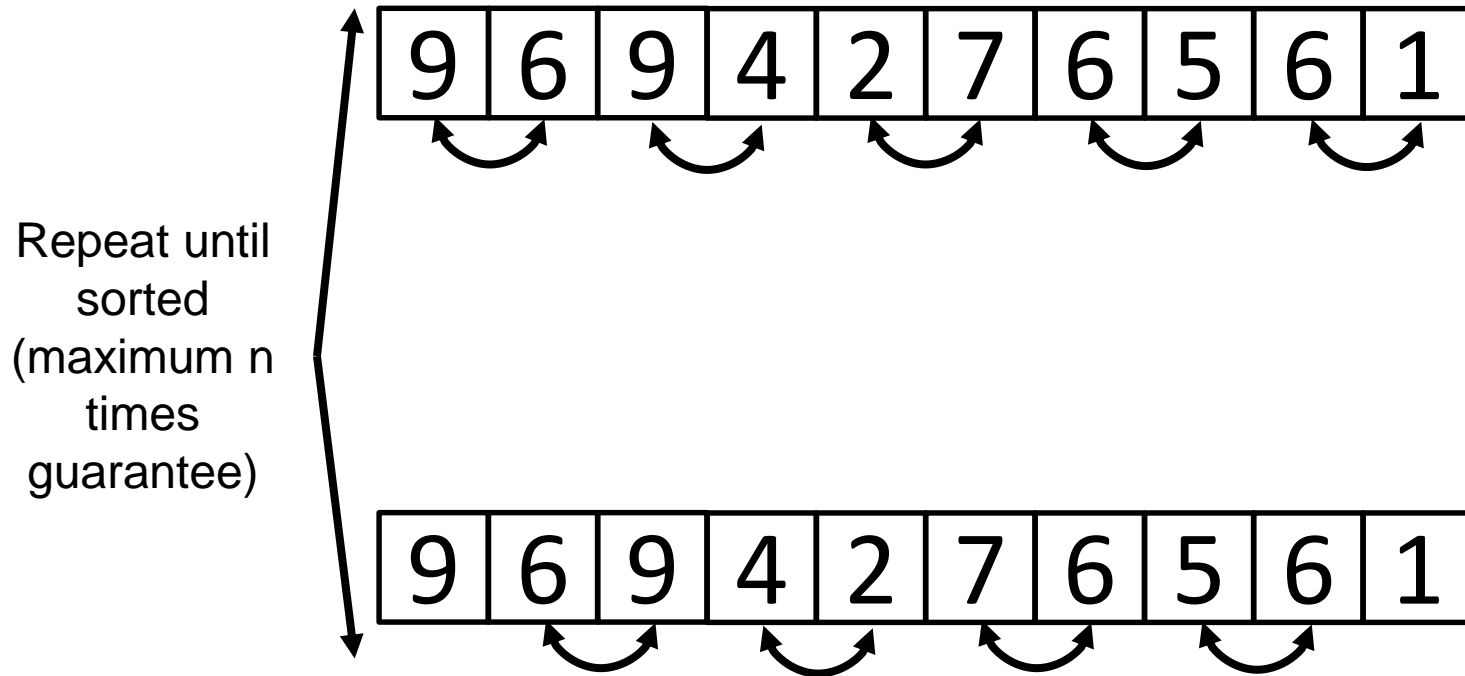


These two operations (and all pairs like them)  
**cannot** be executed in parallel



Solution hint: The operations do not need  
to be executed in exactly the same order

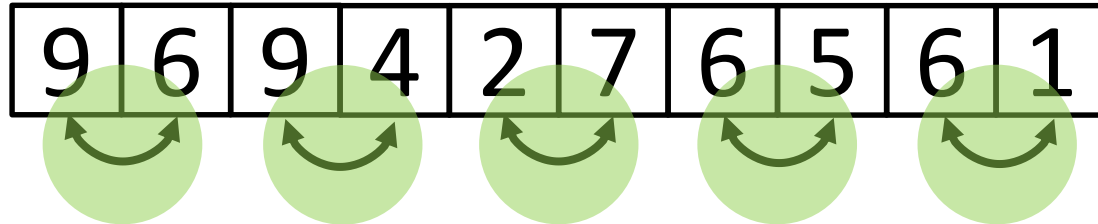
# OETS: Odd-Even Transposition Sort



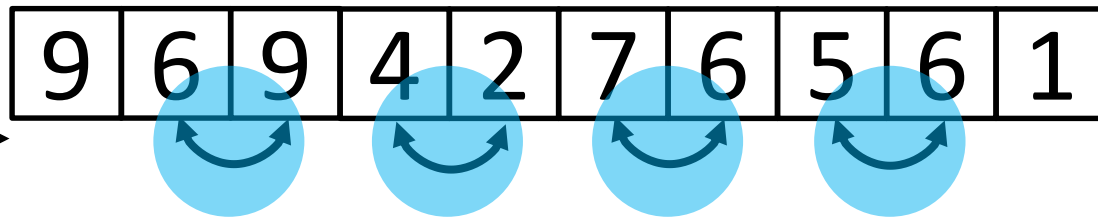


# OETS: Odd-Even Transposition Sort

Can be  
executed  
in parallel →

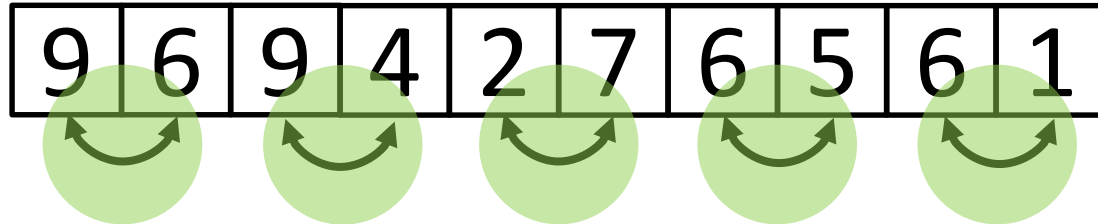


Can be  
executed  
in parallel →

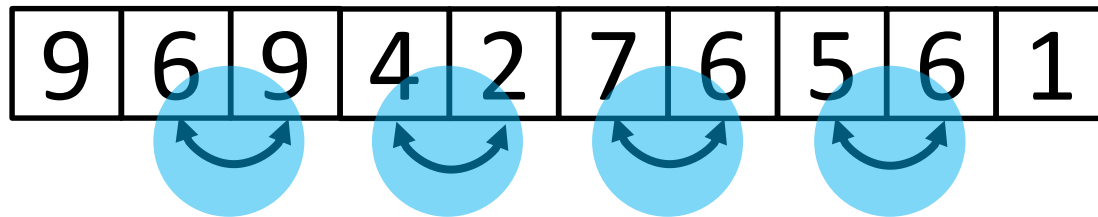


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# OETS: Odd-Even Transposition Sort

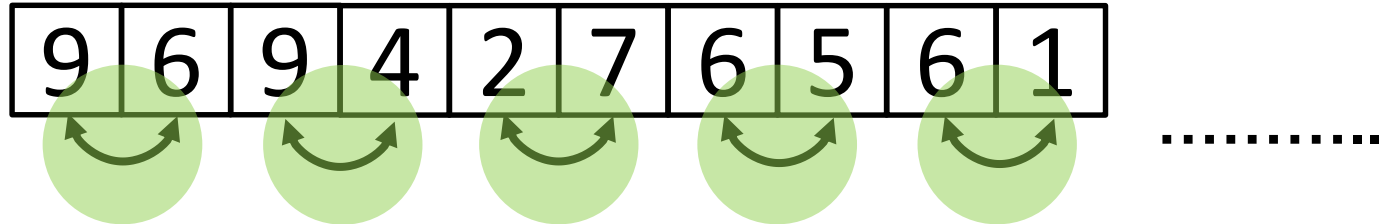


Can **NOT** be  
executed  
in parallel

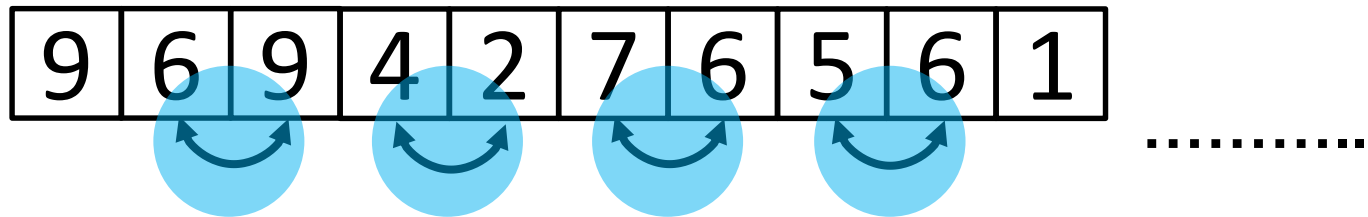


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# OETS: Odd-Even Transposition Sort

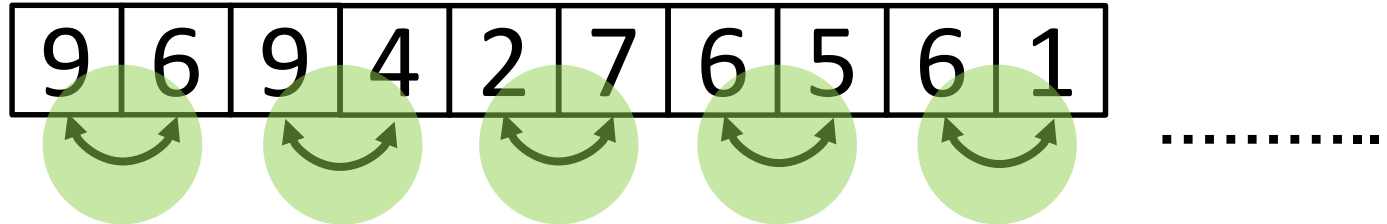


Solution:  
**Barrier**  
between  
each  
iteration



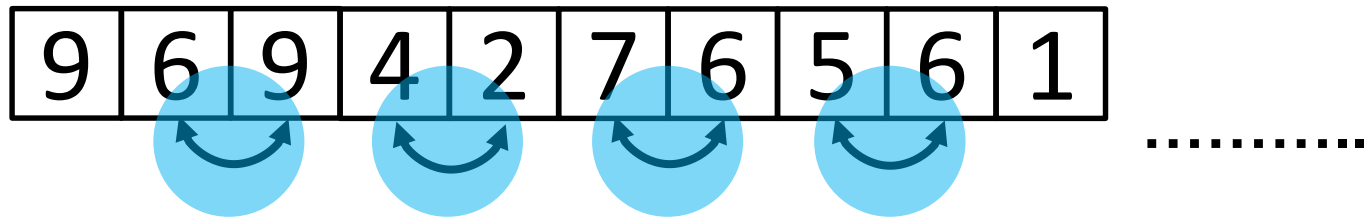
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# OETS: Odd-Even Transposition Sort



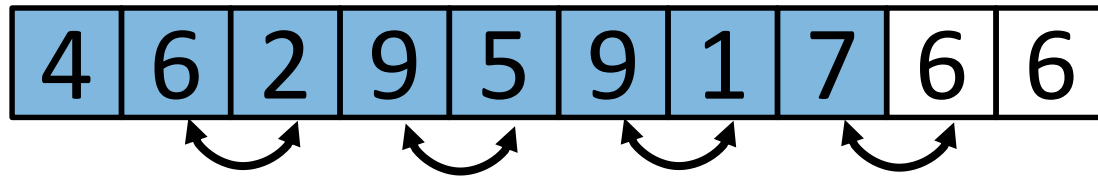
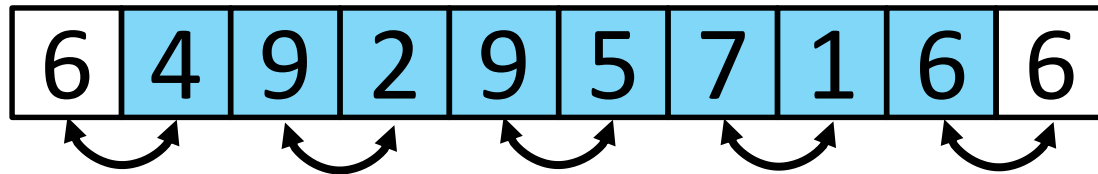
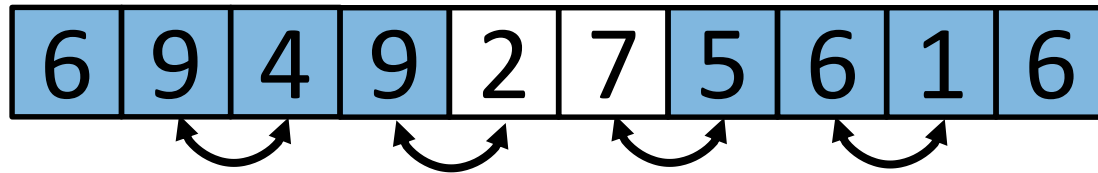
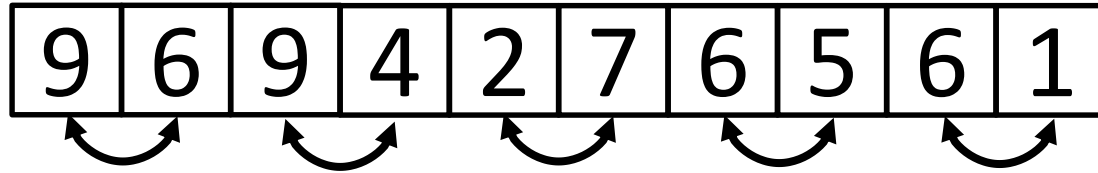
Parallel complexity:  
 $p$  = threads or  
 processor cores

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

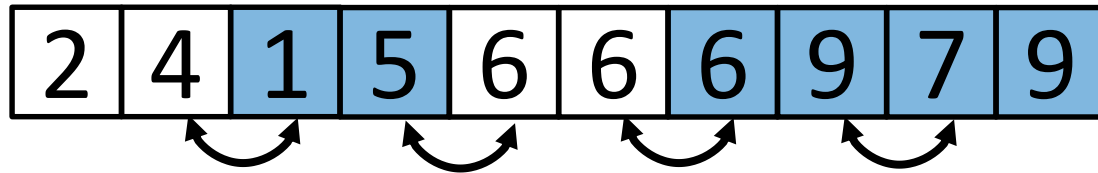
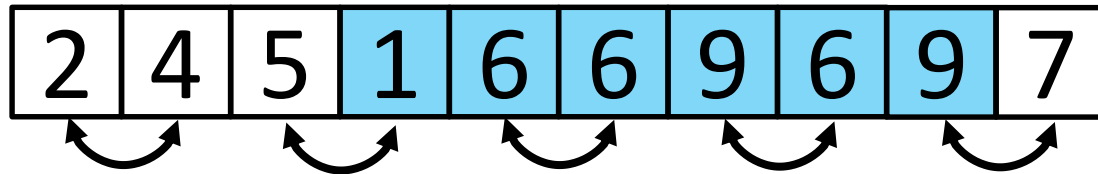
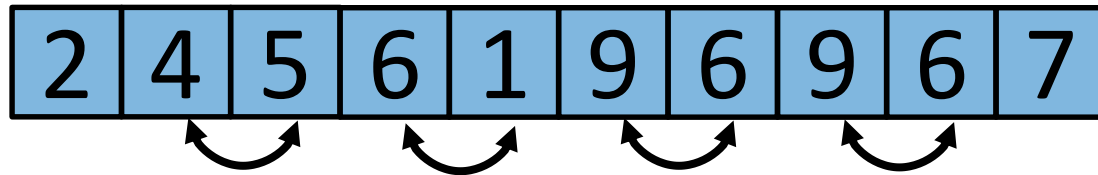
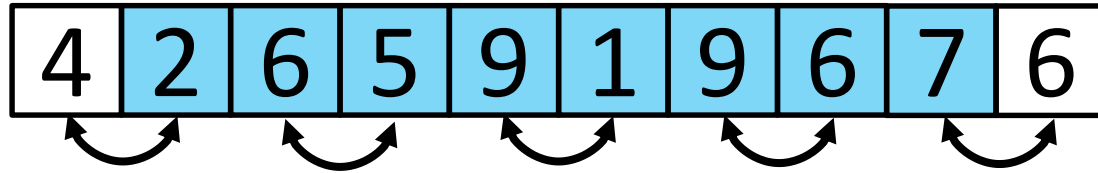


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