



Sorting and Divide and Conquer



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Metodos Computacionales II

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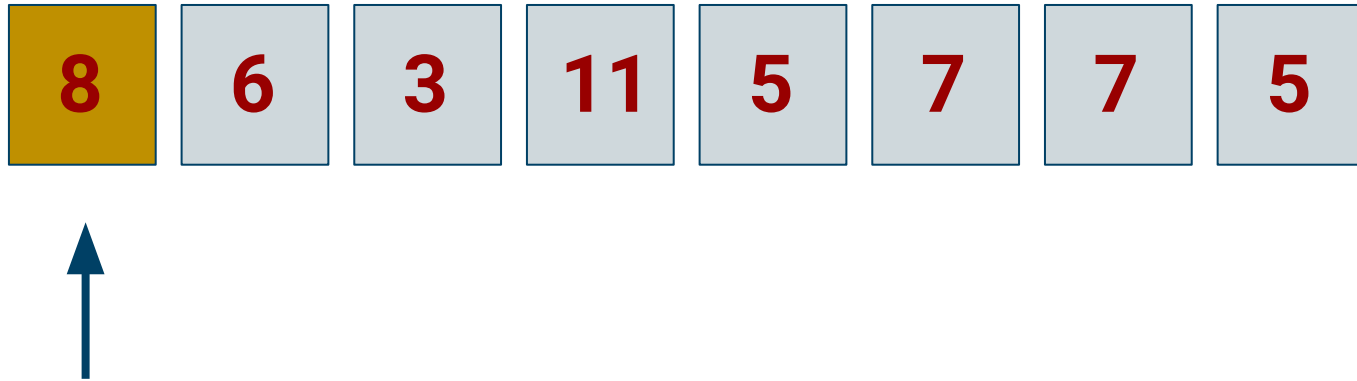
Sorting problem

- Given a set find an efficient algorithm that sorts the set.



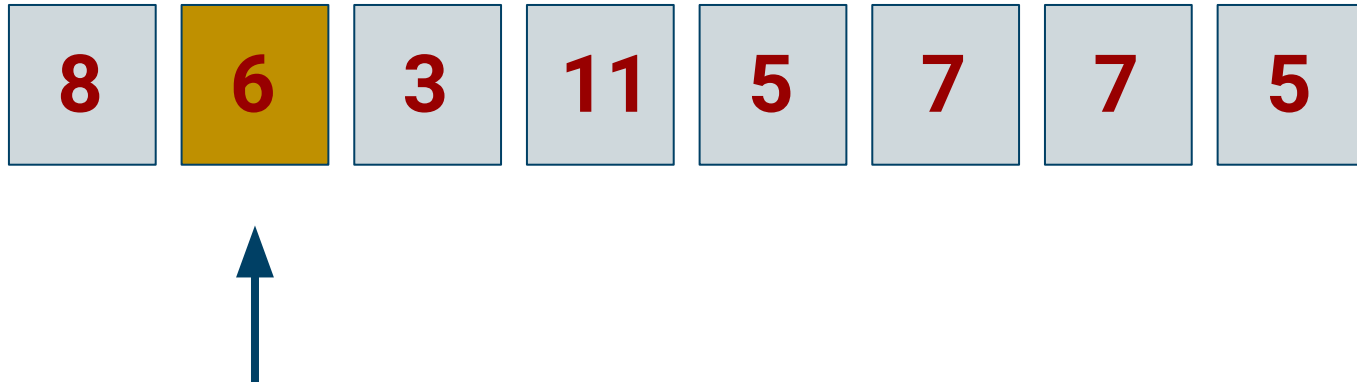
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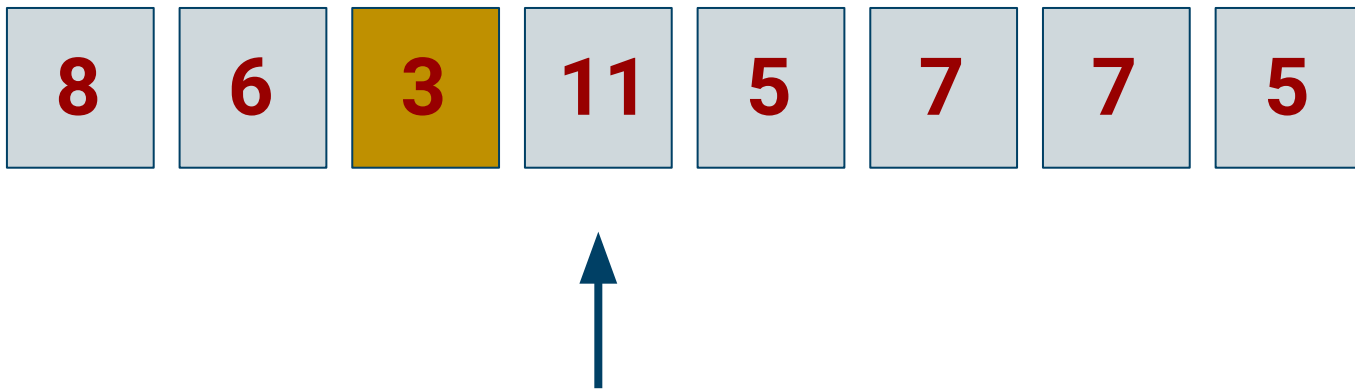
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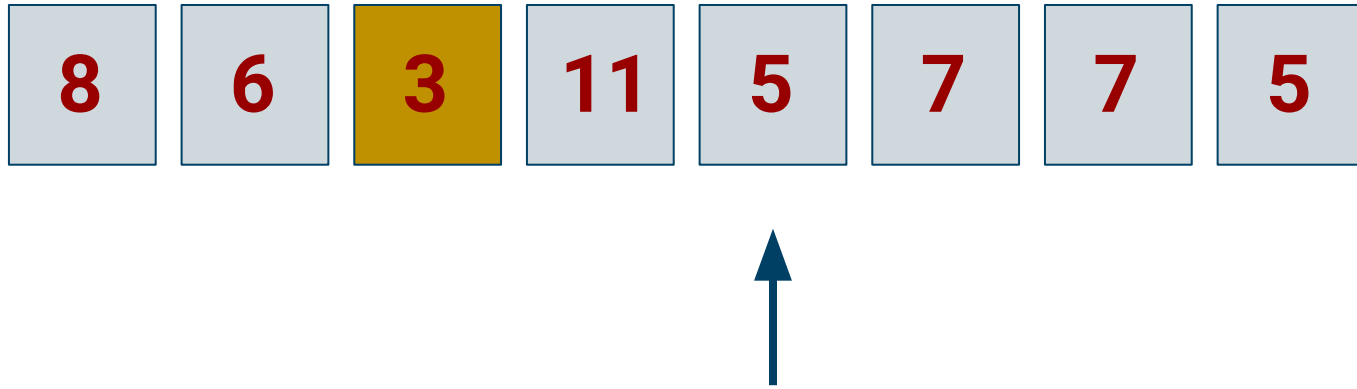
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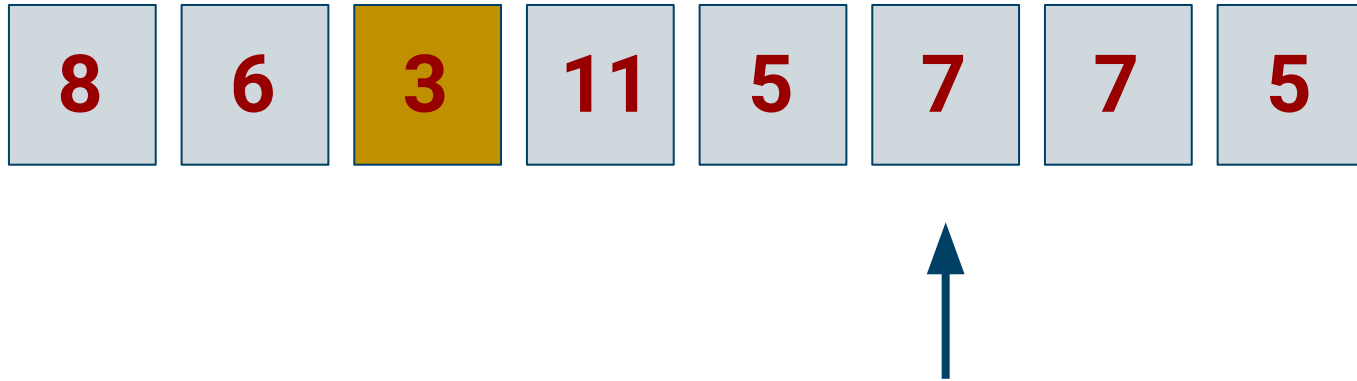
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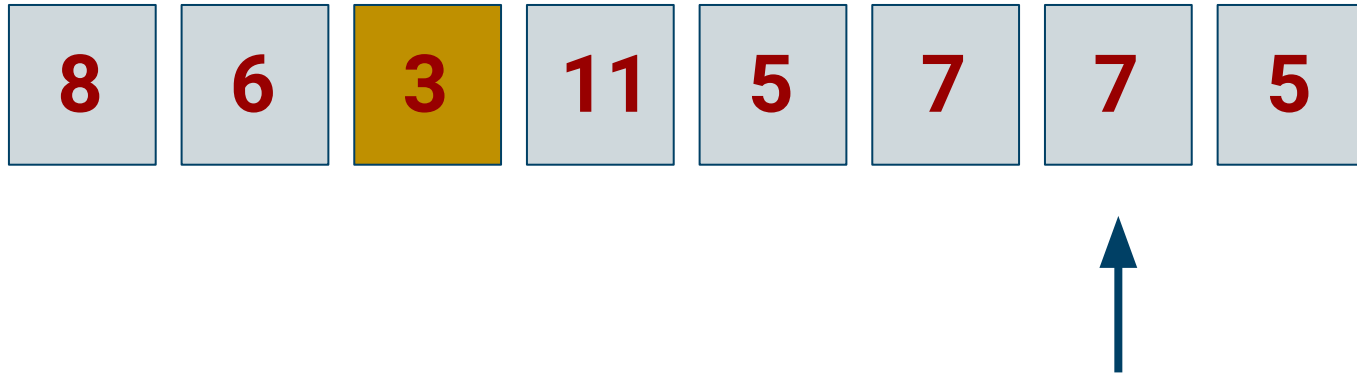
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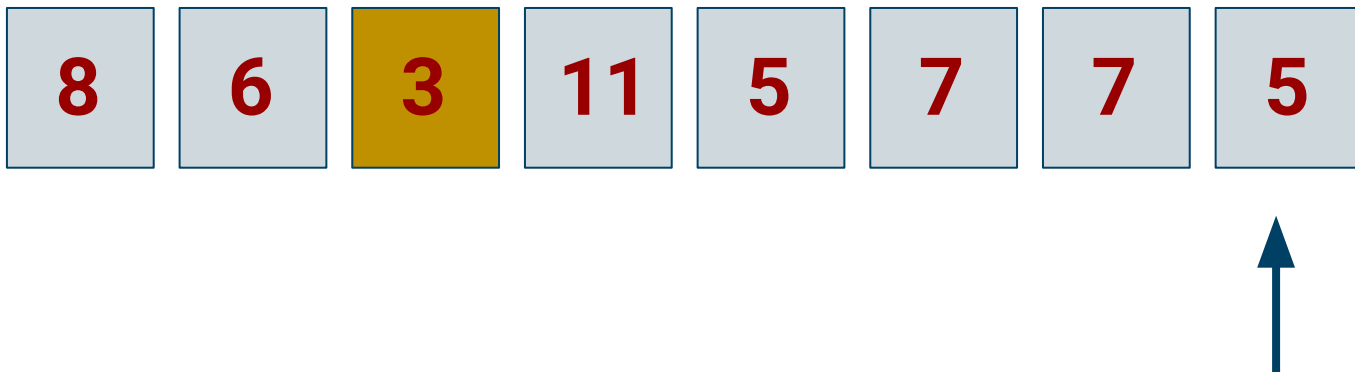
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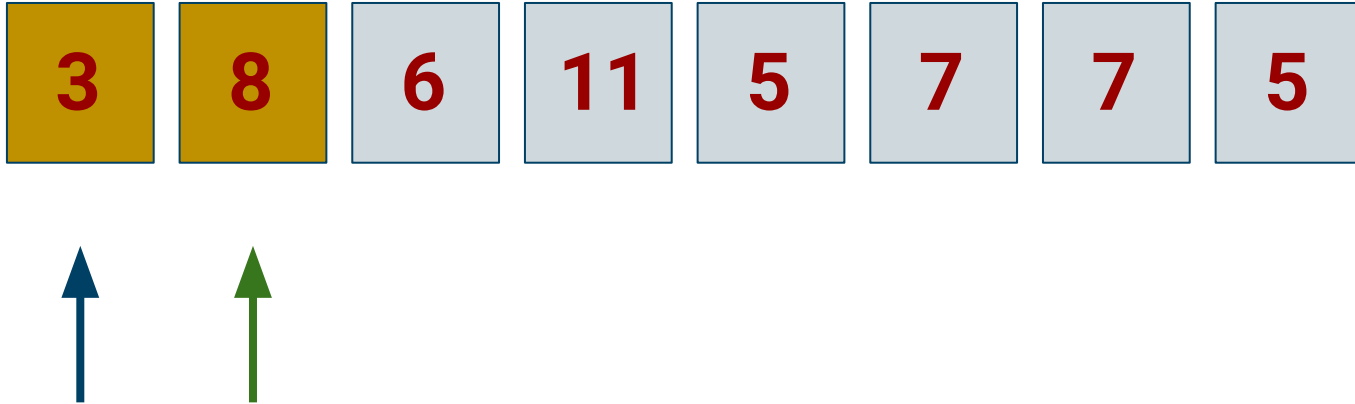
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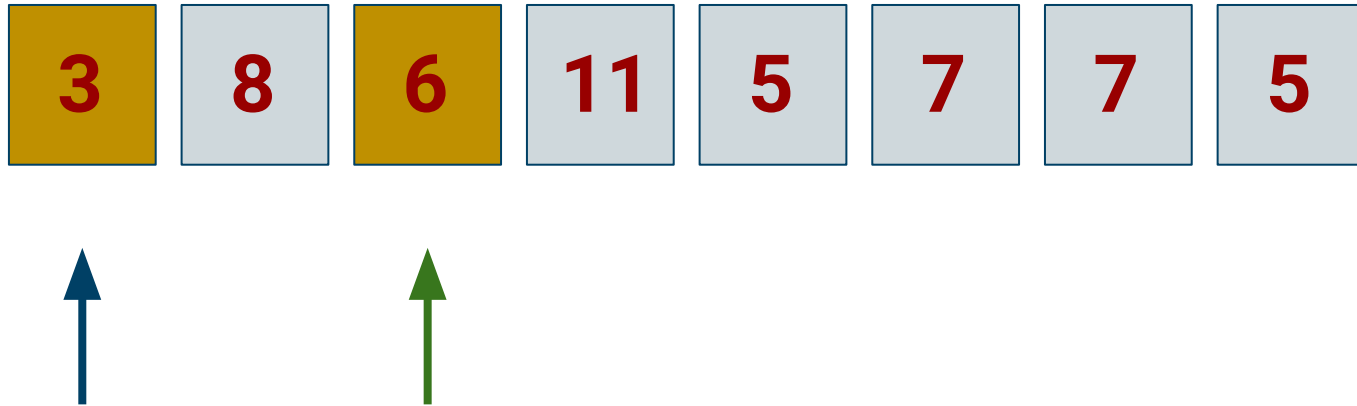
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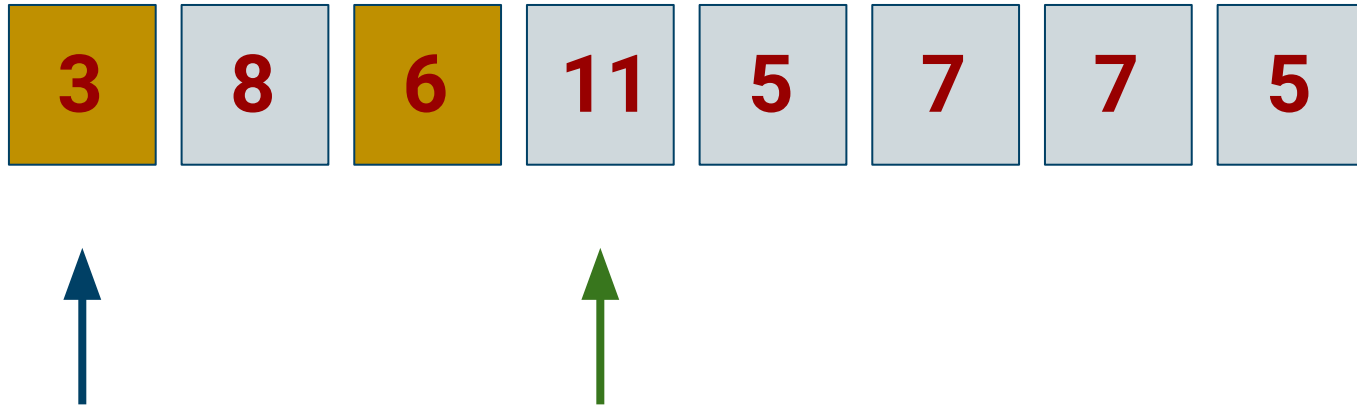
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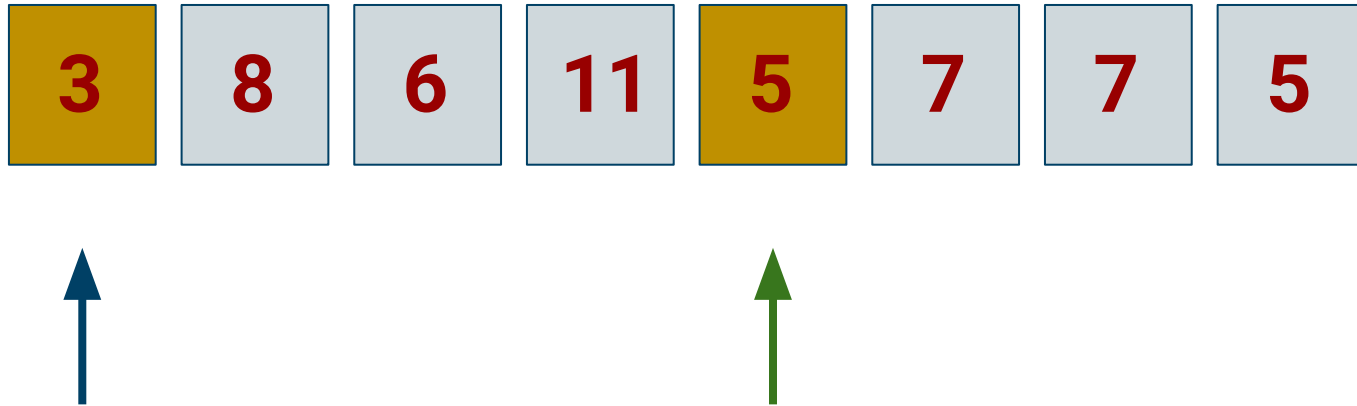
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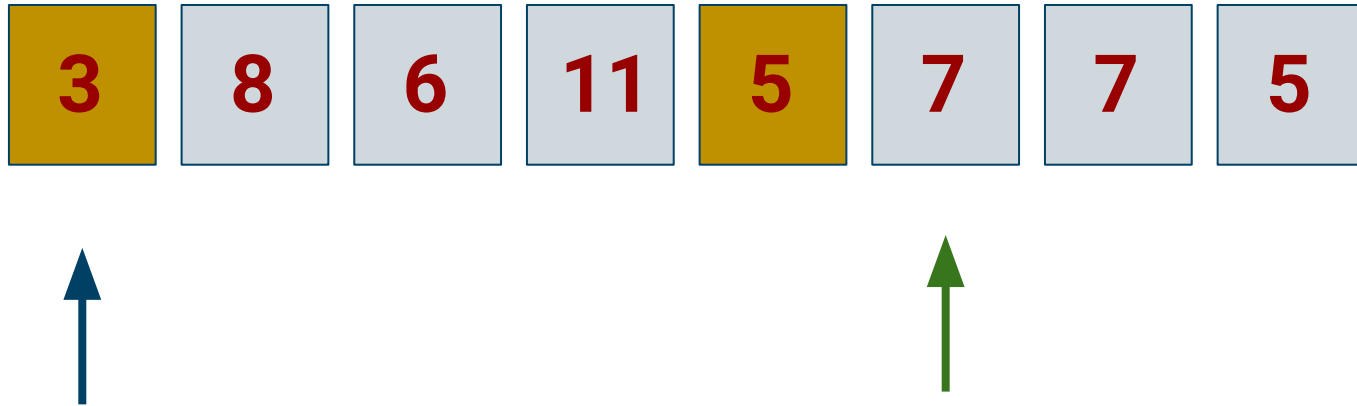
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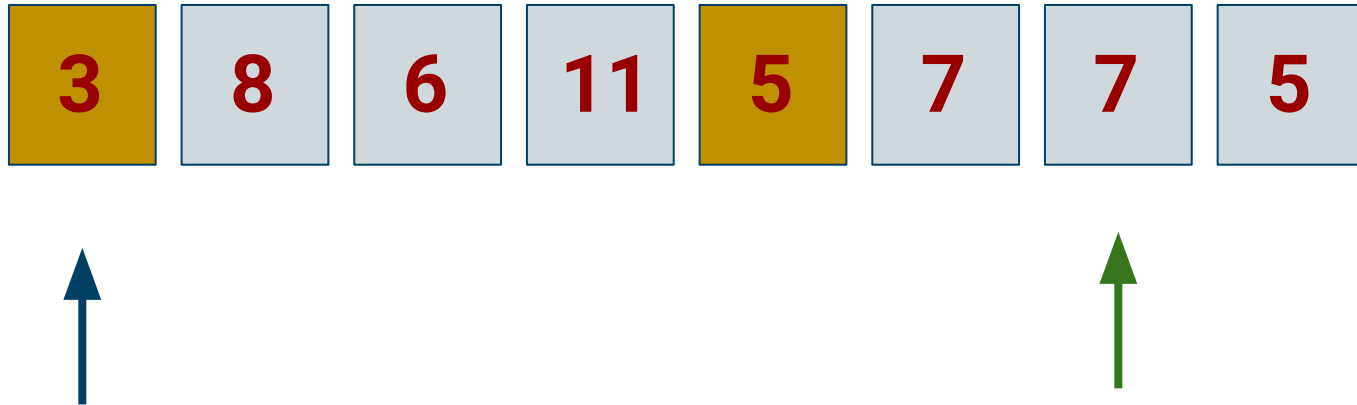
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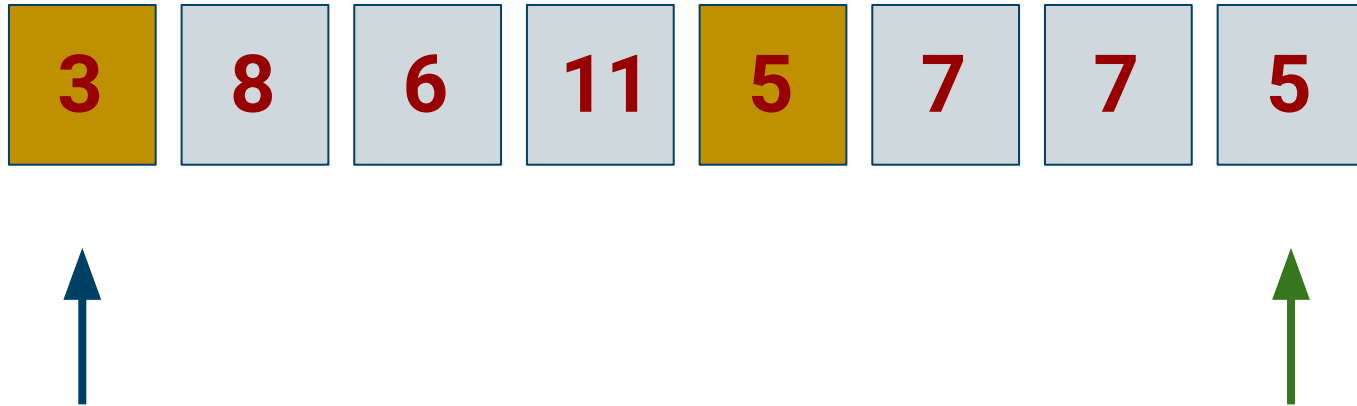
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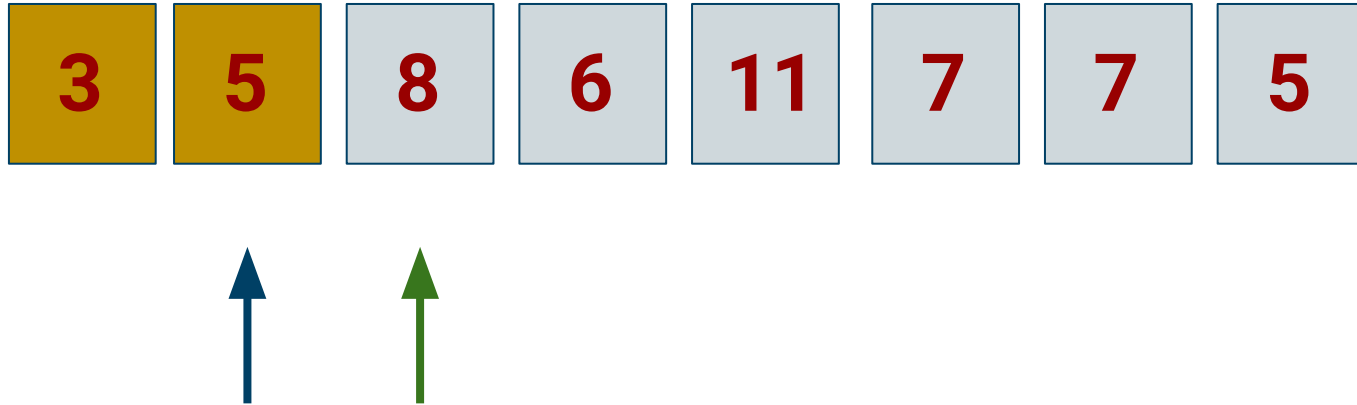
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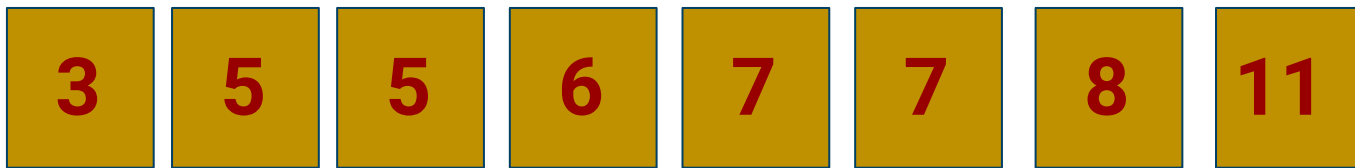
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- Complexity $O(n^2)$



Naive algorithm Pseudo Code

Input: An array $A[1..n]$ of n elements.

Output: $A[1..n]$ sorted in descending order

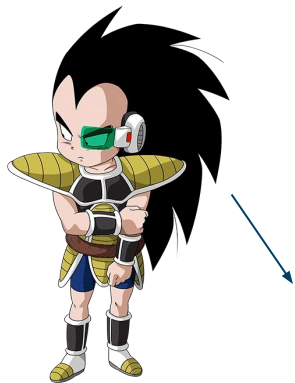
1. for $i \leftarrow 1$ to $n - 1$
2. $\text{min} \leftarrow i$
3. for $j \leftarrow i + 1$ to n {Find the i th smallest element.}
4. if $A[j] < A[\text{min}]$ then
5. $\text{min} \leftarrow j$
6. end for
7. if $\text{min} \neq i$ then interchange $A[i]$ and $A[\text{min}]$
8. end for

Other algorithms for sorting


Method	Average Complexity
Bubble Sort	$O(n^2)$
Selection Sort	$O(n^2)$
Insertion Sort	$O(n^2)$
Heap Sort	$O(n \log (n))$
Quick Sort	$O(n \log (n))$
Radix Sort	$O(n)$
Merge Sort	$O(n \log (n))$

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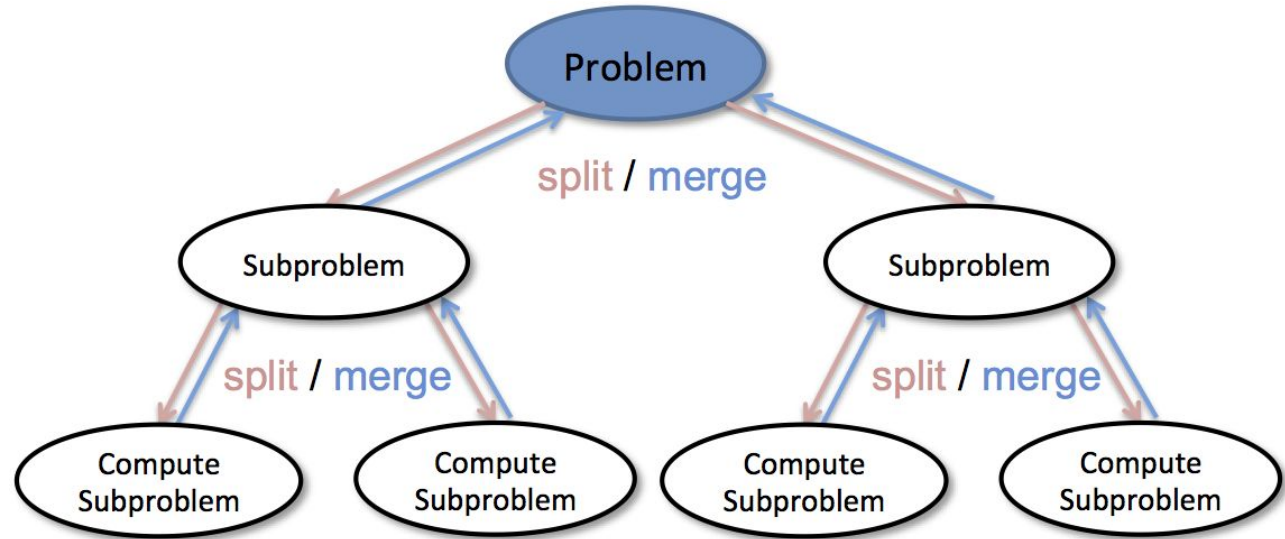
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Merge Sort (Divide and Conquer Algorithm)

- Divide the problems into subproblems, solve iteratively the subproblems.



Divide and Conquer Algorithm Applications

- Binary Search
- Merge Sort
- Quick Sort
- Closest Pair of Points
- Strassen's Multiplication
- Karatsuba Algorithm
- Cooley-Tukey Algorithm
- Fast Fourier Transform

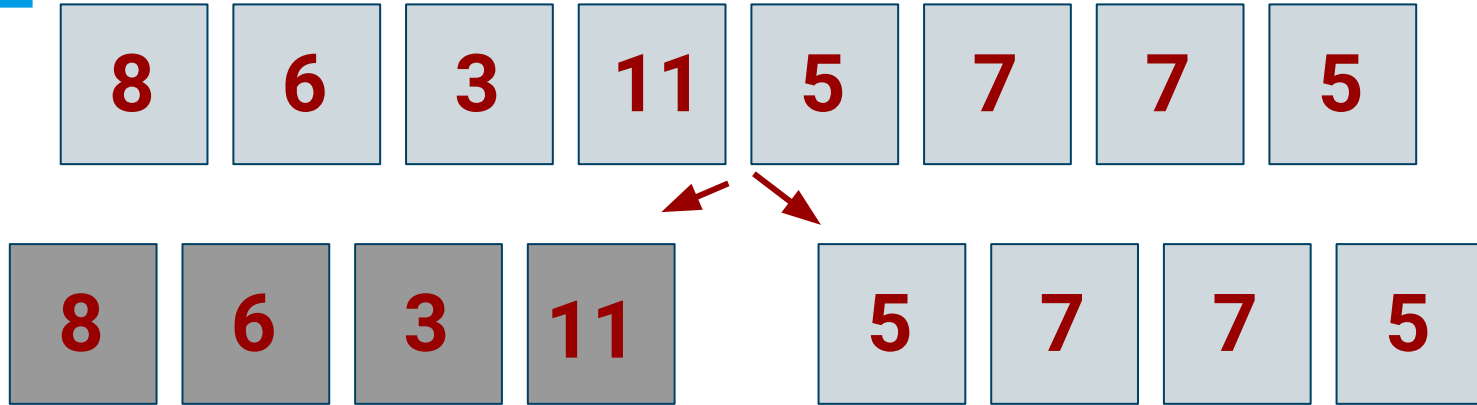
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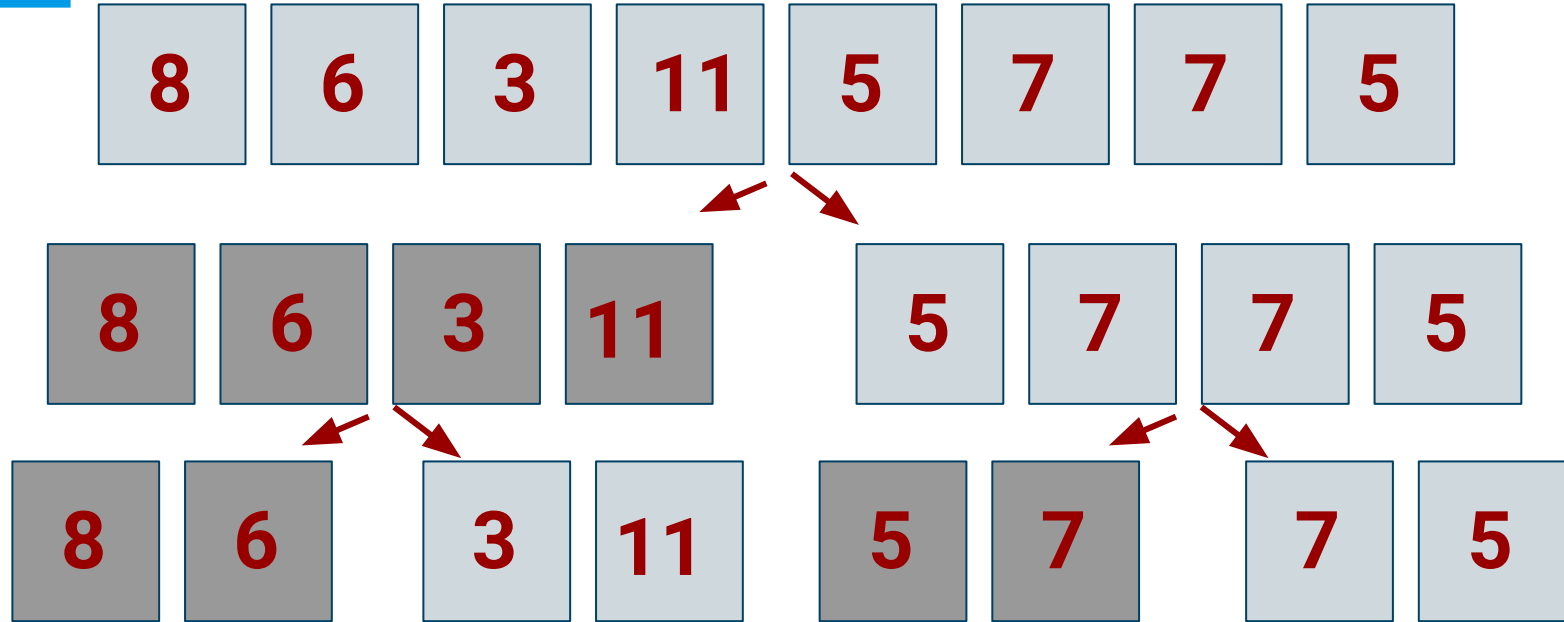
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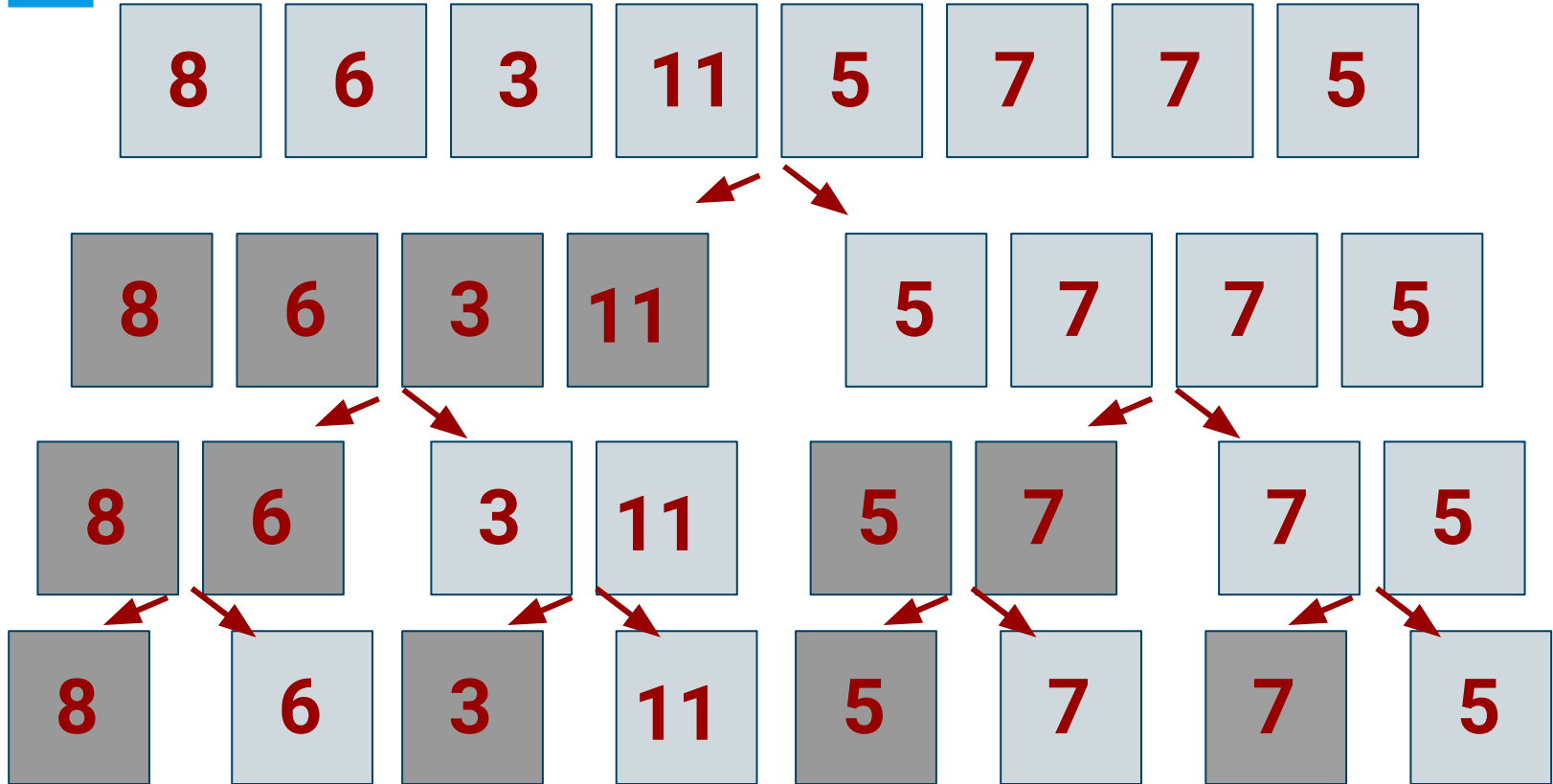
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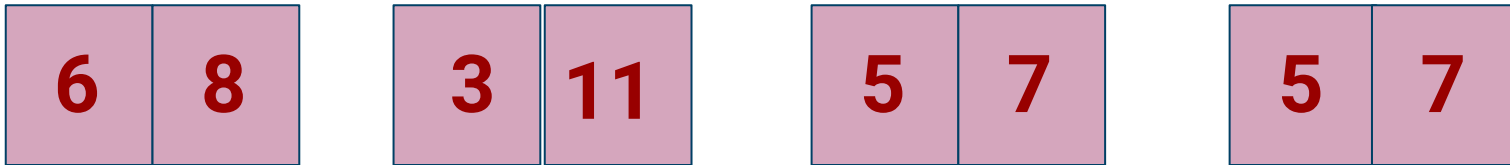
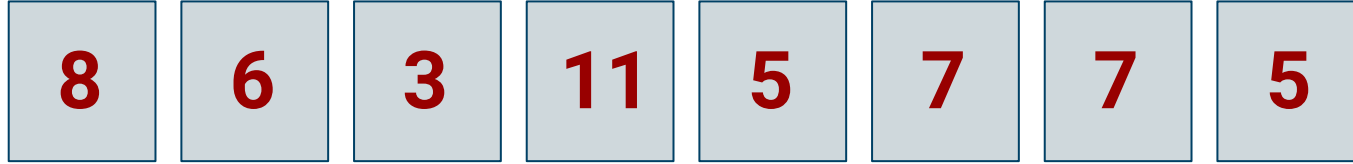
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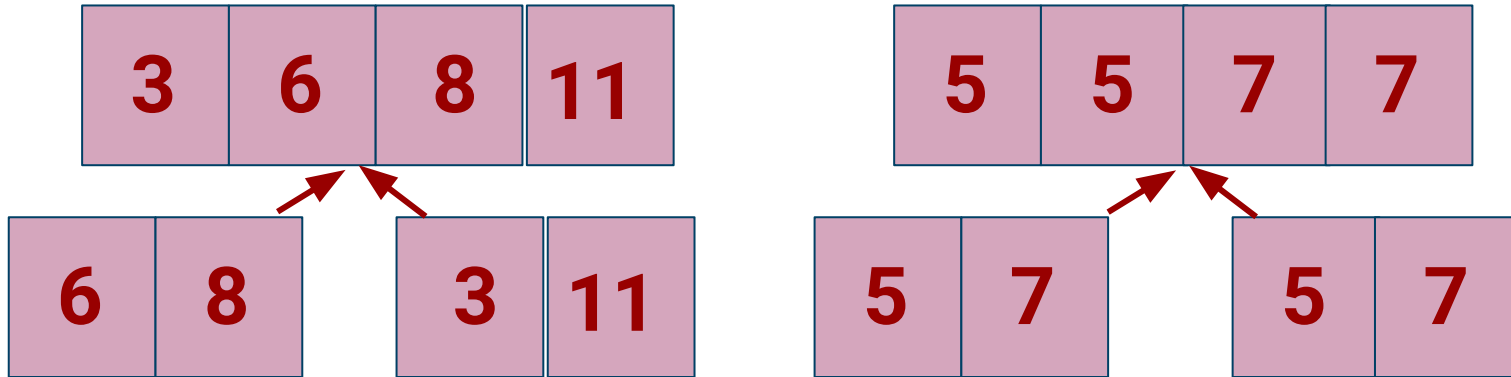
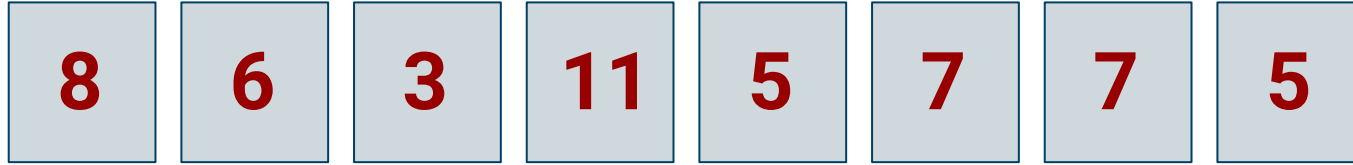
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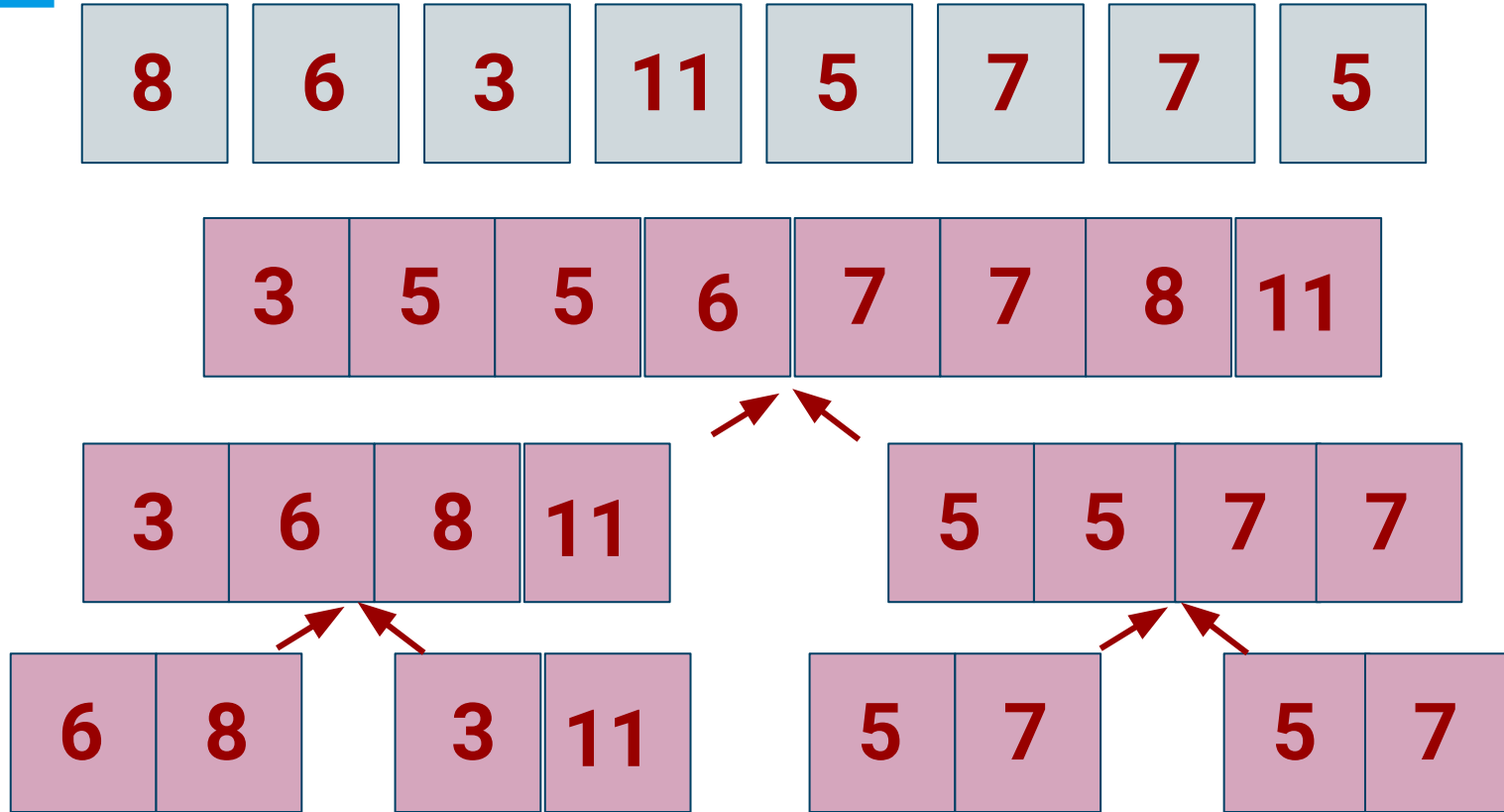
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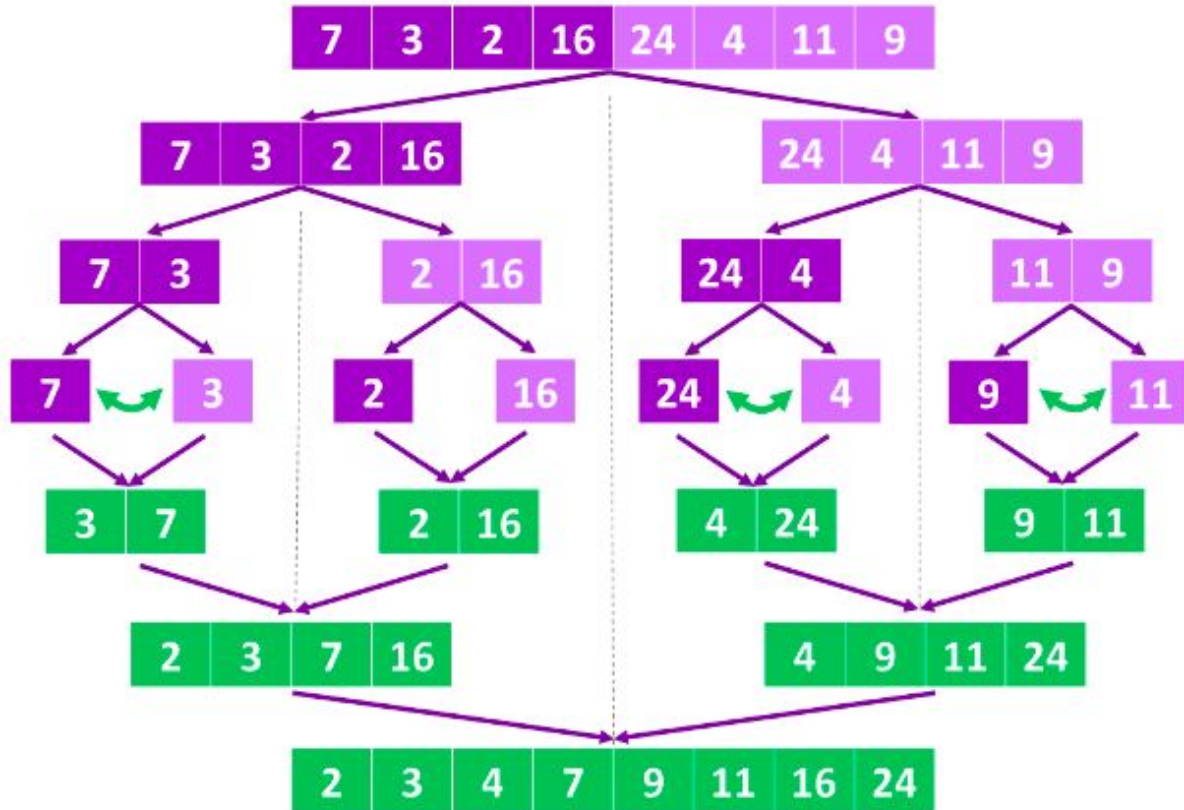
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Merge Sort

$O(n \log(n))$



Step 1:

Split sub-lists in two until you reach pair of values.

Step 3:

Sort/swap pair of values if needed.

Step 4:

Merge and sort sub-lists and repeat process till you merge to the full list.

Merge Sort Pseudo Code

— MERGE-SORT(A, p, r)

- 1 **if** $p < r$
- 2 $q = \lfloor (p + r)/2 \rfloor$
- 3 MERGE-SORT(A, p, q)
- 4 MERGE-SORT($A, q + 1, r$)
- 5 MERGE(A, p, q, r)

References

<https://www.includehelp.com/algorithms/divide-and-conquer-paradigm.aspx>

<https://dragonball.fandom.com/es/wiki/Raditz>

<https://www.101computing.net/merge-sort-algorithm/>