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Merge Sort

6 5 3 1 8 7 2 4

Merge Sort

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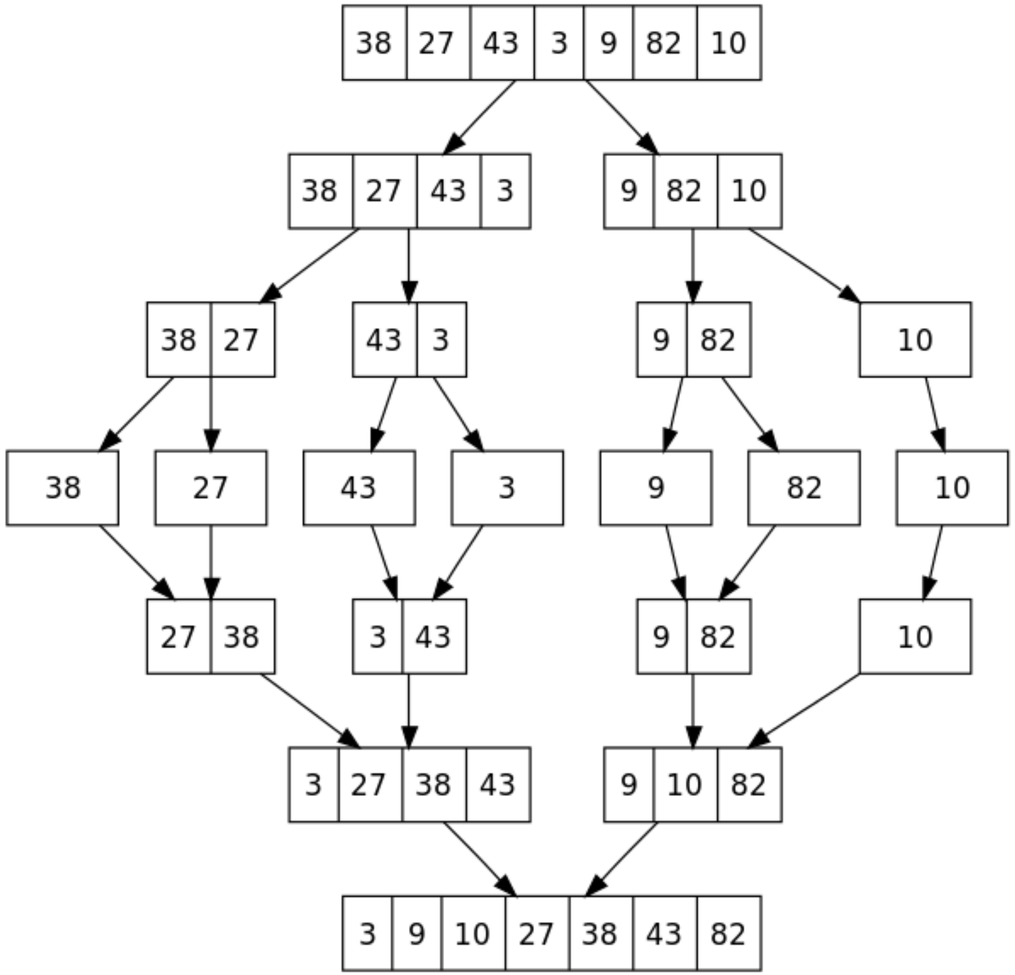
Merge Sort


38 27 43 3 9 82 10
38 27 43 3
9 82 10
38 27
43 3
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27 38
3 43
9 82
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3 27 38 43
9 10 82
3 9 10 27 38 43 82

Merge Sort (iterative)

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2. Merge neighboring arrays in sorted order

Merge Sort (iterative)

1. Divide array of n elements into n arrays of 1 element
2. Merge neighboring arrays in sorted order
3. Repeat 2 until there's only one array

Merge Sort (recursive)

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2. Otherwise, split the array and merge sort each half
3. Merge combined halves into sorted whole

Big O

	Bubble Sort	Merge Sort
Time	$O(n^2)$	$O(n \cdot \log n)$
Space	$O(1)$	$O(n)$

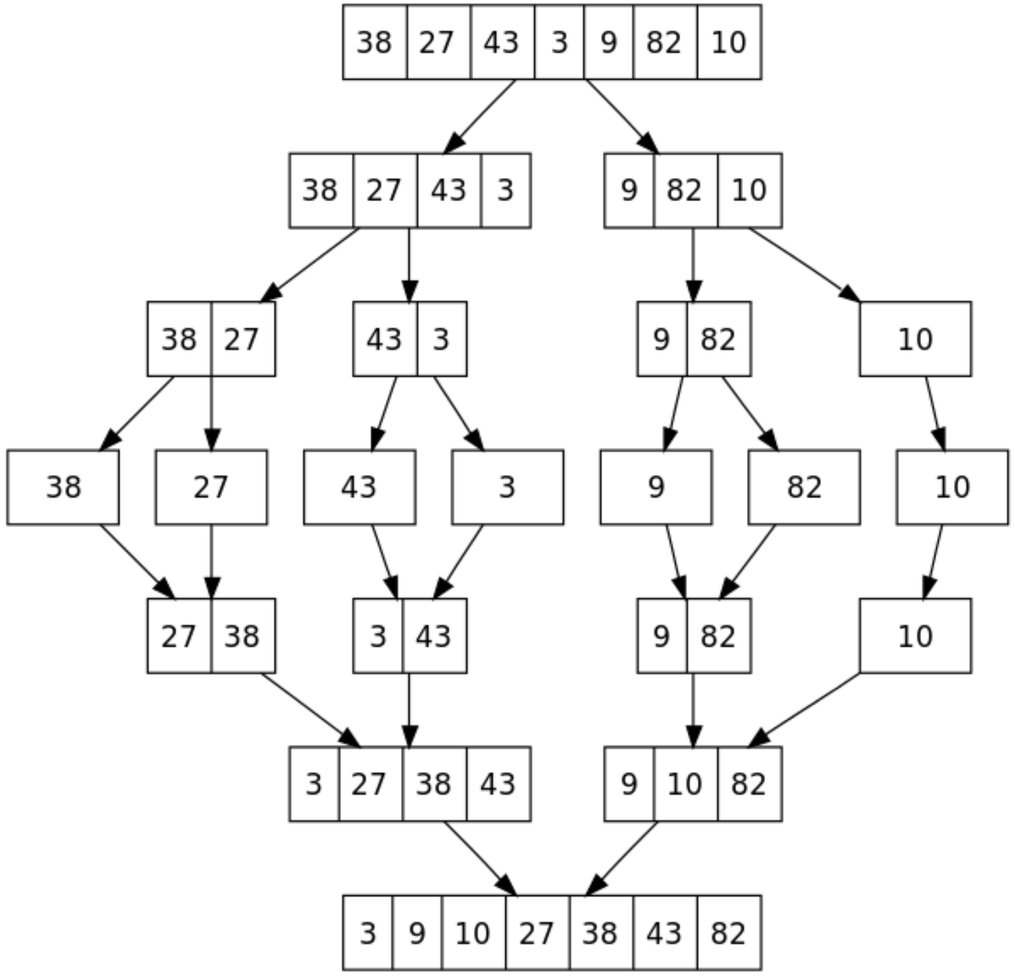
Why is merge sort faster?

Merge Sort Speedup

- Splitting a list into two sublists is a linear time operation
- Combining two lists that are each already sorted into one list that is sorted is a linear time operation
- There are $\log_2(n)$ steps needed to go from n lists of one item each to one list of n items (and vice-versa)

O(n) ops to split or merge

O(log n) times we split/merge



O(n) * O(log n) =

O(n · log n)

Intuition?

- Divide and conquer: can efficiently handle subtasks, and also efficiently combine sorted lists.
- Reduce the possible comparisons dramatically – only have to compare certain pairs of elements (avoiding vast majority of possible pairs).