Introduction to Sorting: Insertion and Selection Sorts

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Purpose

- Searching sorted data is faster
- Organization
- Used in Excel, databases, etc.

Different Types of Sorts

- Bubble
- Insertion
- Selection
- Merge
- Quick
- Heap
- Radix
- etc.

Why so many Sorts?

- There is no “best” way to sort data.
- There is a trade-off between time and memory.
- The $O(n^2)$ sorts are slower but require little memory, and the O(n log n) or O(n) sorts are faster but require a lot of storage space.

Insertion Sort

1. Take the first unsorted element in the list
2. Compare that element with the one before it. If the previous is larger, slide it down the list, else place the element back into the list
3. Repeat 2 until the element is in its sorted location
4. Move on to the next element in the unsorted list

7	-5	2	16	4	unsorted
7	-5	2	16	4	-5 to be inserted
?	7	2	16	4	7 > -5, shift
-5	7	2	16	4	reached left boundary, insert -5
-5	7	2	16	4	2 to be inserted
-5	?	7	16	4	7 > 2, shift
-5	2	7	16	4	-5 < 2, insert 2
-5	2	7	16	4	16 to be inserted
-5	2	7	16	4	7 < 16, insert 16
-5	2	7	16	4	4 to be inserted
-5	2	7	?	16	16 > 4, shift
-5	2	?	7	16	7 > 4, shift
-5	2	4	7	16	2 < 4, insert 4
-5	2	4	7	16	sorted

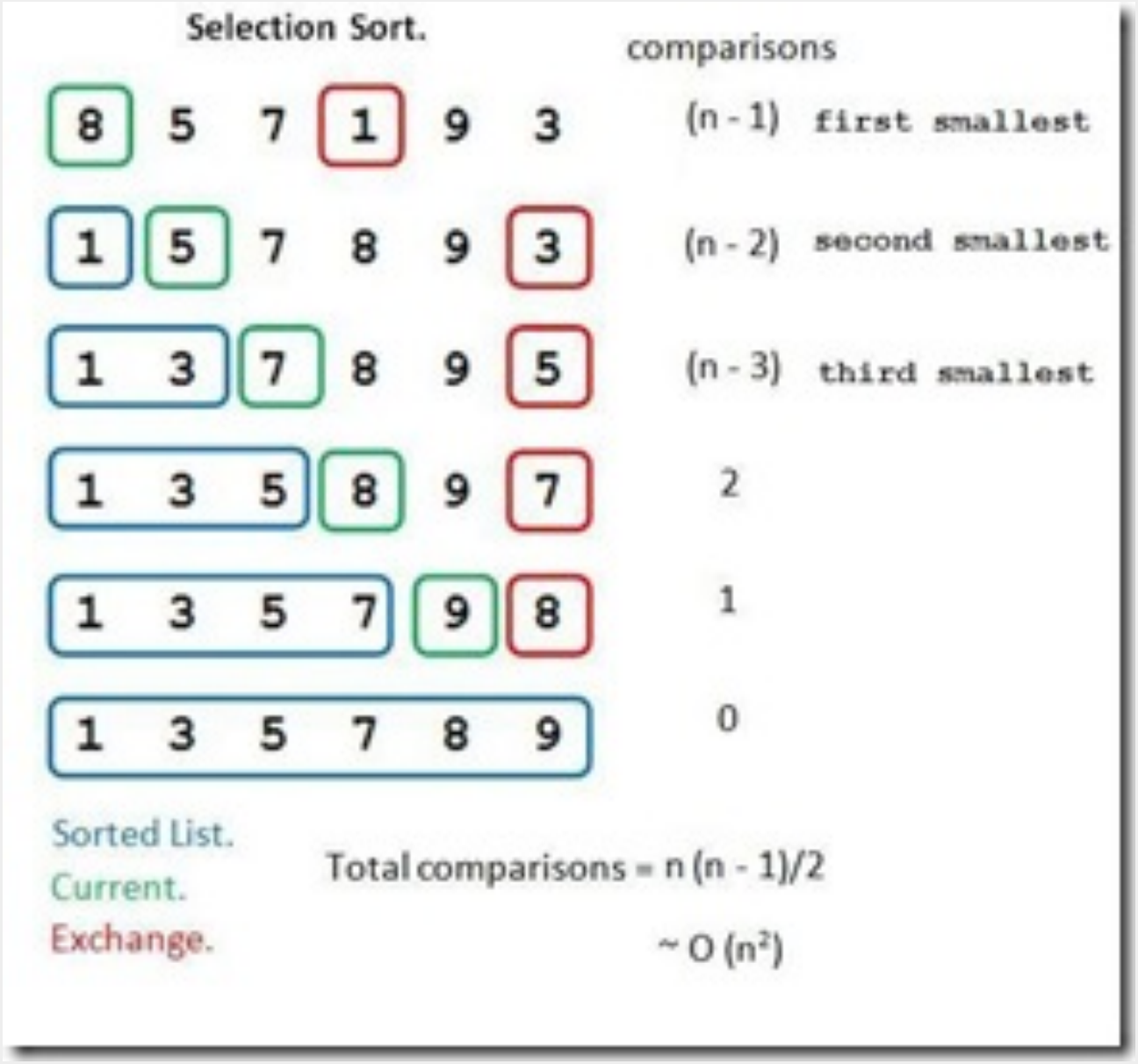
Best Case / Worst Case

- Best Case : sorted list O(n)

- Worst Case : list in reverse order $O(n^2)$

Selection Sort

1. Find the smallest element in the list
2. Swap that element with the first element in the unsorted part of the list
3. Repeat with the next smallest element



Best Case / Worst Case

- Best Case : none, a sorted list will still go through n^2 comparisons

- Worst Case : none, an unsorted list or a list in reverse order will still go through n^2 comparisons

Comparing the Sorts

Insertion

- Comparisons: between n and n^2
- Amount of writing to array: n^2
- Useful because it's usually faster than selection sort

Selection

- Comparisons: always n^2
- Amount of writing to array: n
- Useful when writing to memory is expensive compared to reading, like with flash memory