Solutions

2.1

- 3 inversions: $(3,1), (3,2), (4,2)$ ✓.

2.2

- Insertion and merge ✓.

2.3

- Quicksort; $O(n^2)$ ✓.

3.1

- Insert 8: $[4, 8]$, 0 shifts ✓.
- Insert 2: $[2, 4, 8]$, 2 shifts ✓.
- Insert 5: $[2, 4, 5, 8]$, 1 shift ✓.
- Insert 1: passes $8, 5, 4, 2$ – 4 shifts, giving $[1, 2, 4, 5, 8]$; running total $0 + 2 + 1 + 4 = 7$ ✓.
- Inversions of $[4, 8, 2, 5, 1]$: 7 – equal to the shift total: every shift fixes exactly one inversion ✓.
- Comparisons: 9 – the 7 shift comparisons plus failed ends at 8-vs-4 and 5-vs-4 (the passes that reach the front stop at the boundary, not a comparison) ✓.

3.2

- Tree: $[4, 8, 2, 5, 1] \to [4, 8], [2, 5, 1] \to [4], [8], [2], [5, 1] \to [5], [1]$ ✓.
- Merge $[5], [1]$: 1 comparison $\to [1, 5]$ ✓.
- Merge $[2], [1, 5]$: 2 comparisons $\to [1, 2, 5]$; running 3 ✓.
- Merge $[4], [8]$: 1; final merge $[4, 8], [1, 2, 5]$: 4 comparisons $\to [1, 2, 4, 5, 8]$; total $1 + 2 + 1 + 4 = 8$ ✓.
- Insertion used 9 comparisons here – merge 8; worst cases: merge $\Theta(n \log n)$, insertion $\Theta(n^2)$ ✓.

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