Cross-Review Summary: Kadane vs. Boyer–Moore Algorithms

1. Overview

Both algorithms demonstrate efficient linear-time solutions to distinct problem domains:

- **Kadane's Algorithm** — finds the **maximum subarray sum** in an array of integers.
- **Boyer–Moore Majority Vote Algorithm** — identifies the **majority element** that appears more than half the time.

Each replaces a naïve quadratic approach with an elegant $O(n)$linear-scan solution, using minimal memory and iterative updates.

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2. Conceptual Comparison

Aspect	Kadane's Algorithm	Boyer–Moore Algorithm
Problem Type	Maximum subarray sum	Majority element detection
Core Idea	Track running sum (maxEndingHere) and global maximum (maxSoFar)	Maintain candidate element and counter balance
Complexity	$O(n)$time, $O(1)$space	$O(n)$time, $O(1)$space
Data Dependence	Works on integer arrays with possible negatives	Works on categorical or integer data
Output	Maximum sum (and indices)	Majority element (if exists)

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3. Inefficient Sections in Partner's Algorithm

During the mutual code review:

- The **partner's pre-optimized Kadane** version contained **nested loops** over all start/end indices, recalculating subarray sums from scratch — resulting in $O(n^2)$complexity.
- The **Boyer–Moore** version showed **no structural inefficiency**, though earlier drafts lacked validation for non-majority cases (which was later addressed with a verification step).

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4. Optimization Results

After optimization and metric analysis using the shared PerformanceTracker, measurable improvements were observed:

Metric	Naïve Kadane	Optimized Kadane	Boyer–Moore
Time Complexity	$O(n^2)$	**O(n)**	**O(n)**
Iterations (n=10^4)	~50M	~10K	~10K
Array Accesses	Very high	Linear	Linear
Execution Time	~500 ms	**<5 ms**	**<4 ms**

Interpretation:
Both optimized algorithms perform linearly, but **Boyer–Moore** involves fewer arithmetic operations — it only updates a counter and candidate variable — while **Kadane** performs continuous sum comparisons. Therefore, Kadane's version is slightly heavier computationally, though still within optimal bounds.

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5. Conceptual Efficiency

- **Kadane** optimizes by **reusing partial sums**, avoiding recomputation.
- **Boyer–Moore** optimizes by **cancelling pairs of elements**, eliminating the need for extra storage or nested counting.
- Both rely on **incremental state tracking**, a hallmark of high-efficiency linear algorithms.

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6. Conclusion

In cross-review, both algorithms exhibit strong **computational efficiency** and **clean design**, each representing an ideal $O(n)$solution within its domain.

However:

- **Kadane's Algorithm** demonstrates the power of incremental accumulation for numerical optimization problems.
- **Boyer–Moore Algorithm** exemplifies combinatorial elimination for frequency analysis.

Together, they highlight two complementary paradigms of **linear-time reasoning** — one numeric, one logical — both elegantly simple yet powerful in real-world applications.