# Pair Submission

## 1. Cross-Review Summary: Joint Comparison of Both Algorithms

This pair report compares Kadane’s Algorithm and the Boyer–Moore Majority Vote Algorithm — both linear-time, constant-space solutions optimized for different computational tasks.

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| Aspect | Kadane’s Algorithm (Sagyn Aktore) | Boyer–Moore Algorithm (Yerkebulan Sarsenbek) |
| Problem Solved | Maximum subarray sum (numerical optimization) | Majority element detection (pattern analysis) |
| Time Complexity | Θ(n) — single scan through array | Θ(n) — two linear scans (selection + verification) |
| Space Complexity | O(1) — only integer variables | O(1) — constant number of variables |
| Stability to Input | Very stable across all distributions | Stable but shows slightly higher variance on random and worst-case data |
| Implementation Highlights | Uses dynamic programming with running maximum tracking | Maintains candidate–counter pair and verifies candidate |
| Key Optimization Targets | Handle empty arrays, track comparisons, ensure robustness | Start iteration at index 1, remove redundant operations, disable tracker during timing |
| Empirical Behavior | Execution time scales linearly and uniformly | Execution time scales linearly with slightly larger constants |

Summary of Cross-Review Observations:  
• Both implementations achieve their theoretical asymptotic bounds and demonstrate consistent Θ(n) performance in practice.  
• Kadane’s algorithm exhibited lower constant factors, attributed to a single-pass iteration and minimal branching.  
• Boyer–Moore showed excellent scalability but required correction in initialization (loop start from index 1) to avoid double counting.  
• After peer review, both reports agreed on adding edge-case handling and performance instrumentation for empirical comparison.

## 2. Optimization Results: Measured Improvements from Suggested Optimizations

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| Algorithm | Optimization Applied | Improvement Observed |
| Kadane | Added input validation and eliminated redundant variable checks | Up to 8–12 % reduction in execution time on random datasets; more stable results across runs |
| Kadane | Introduced empirical tracking (comparisons, updates) | Enabled quantitative profiling without noticeable performance drop |
| Boyer–Moore | Corrected loop start index and reduced conditional nesting | Up to 10–15 % faster on average across all distributions |
| Boyer–Moore | Disabled performance tracker during timed benchmarks | More accurate time measurement and smoother scaling curve |
| Both | Improved code clarity, maintainability, and edge-case resilience | No asymptotic change, but measurable runtime consistency |

Overall Outcome:  
The optimizations refined both implementations to their asymptotic best form (Θ(n), O(1)) while improving empirical runtime by 10 % on average and reducing variance between input distributions. The cross-review confirmed that Kadane’s method remains superior for numeric optimization tasks, whereas Boyer–Moore retains its advantage in symbolic or categorical data analysis.