

# Performance Laboratory Report

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## Benchmark Test Results

Test Name	Timestamp	Avg Response	Throughput	Memory	Success Rate
Load Test - 1000 Users	2025-12-31 10:45:23	12.4 ms	8547 req/s	247 MB	99.97%
Stress Test - 5000 Users	2025-12-31 09:30:15	45.8 ms	6234 req/s	512 MB	99.82%

## Algorithm Comparison - Response Time

Load Level	Trie	HashMap	Hybrid
10 users	8 ms	12 ms	6 ms
100 users	15 ms	28 ms	12 ms
500 users	42 ms	89 ms	35 ms
1K users	78 ms	156 ms	65 ms
5K users	245 ms	512 ms	198 ms
10K users	487 ms	1024 ms	389 ms

## Algorithm Comparison - Throughput

Load Level	Trie	HashMap	Hybrid
10 users	950 req/s	820 req/s	1,100 req/s
100 users	8,500 req/s	7,200 req/s	9,800 req/s
500 users	35,000 req/s	28,000 req/s	42,000 req/s
1K users	65,000 req/s	48,000 req/s	78,000 req/s
5K users	245,000 req/s	180,000 req/s	298,000 req/s
10K users	420,000 req/s	310,000 req/s	512,000 req/s

# Complexity Analysis

Algorithm	Best	Average	Worst	Space
Trie Autocomplete	$O(k)$	$O(k)$	$O(k)$	$O(n \cdot k)$
HashMap Frequency	$O(1)$	$O(1)$	$O(n)$	$O(n)$
Hybrid Intelligence	$O(k)$	$O(k + \log n)$	$O(k \cdot n)$	$O(n \cdot k + n)$
Edit Distance (Spell Check)	$O(m \cdot n)$	$O(m \cdot n)$	$O(m \cdot n)$	$O(m \cdot n)$