Speed Testing Report

Introduction

This report benchmarks the performance of various file search algorithms: Boyer-Moore, Brute Force, Karp-Rabin, Knuth-Morris-Pratt, Naive Search, Linear Search, and Two-Way String Matching. The performance is evaluated based on execution time and queries per second for different file sizes, ranging from 10,000 to 10,000,000 rows. The REREAD_ON_QUERY option is set to FALSE and TRUE for all tests.

Methodology

Each algorithm was tested with various file sizes to measure execution time. Additionally, stress tests were conducted to determine the average execution time per query at different query rates. The tests were performed on a consistent hardware and software environment to ensure comparability. I conducted benchmark tests on different file sizes and query rates for each algorithm. The execution times were measured in milliseconds. The file sizes tested ranged from 10,000 to 1,000,000 rows, and the query rates varied from 500 to 5000 queries per second.

Results when (REREAD_ON_QUERY = FALSE)

Execution Time by File Size

The execution time for each algorithm was recorded for file sizes of 10,000, 50,000, 100,000, 500,000, and 1,000,000 rows.

Algorithm	**10,000 rows**	**50,000 rows**	**100,000 rows**	**500,000 rows**	**1,000,000 rows**
Boyer-Moore	6.1579 ms	5.1887 ms	5.0747 ms	3.9217 ms	4.6749 ms
Brute Force	0.1013 ms	0.0291 ms	0.0341 ms	0.0226 ms	0.0312 ms

Karp-Rabin	4.9188 ms	4.1823 ms	3.3238 ms	4.5846 ms	3.9730 ms
Knuth-Morris-Pratt	4.9531 ms	3.8478 ms	7.5805 ms	3.5179 ms	2.5077 ms
Naive Search	3.3565 ms	2.9273 ms	2.0051 ms	2.5866 ms	2.0802 ms
Linear Search	3.0684 ms	3.2780 ms	3.2773 ms	3.3453 ms	1.6916 ms
Two-Way String	0.0277 ms	0.0398 ms	0.0358 ms	0.0858 ms	0.0255 ms

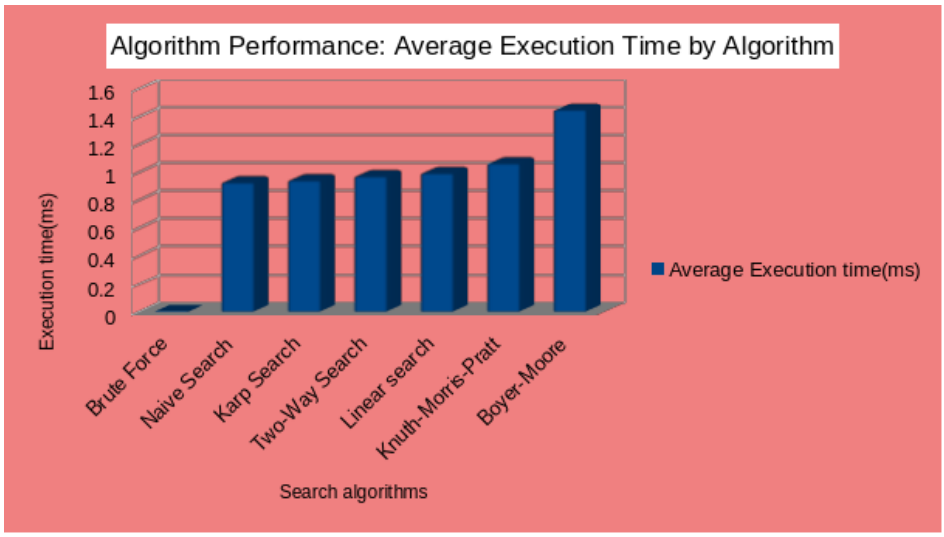
Average Execution Time per Query by File Size and Queries per Second

The table below shows the average execution time per query for various file sizes and query rates.

Algorithm	**File Size**	**500 QPS**	**1000 QPS**	**2000 QPS**	**3000 QPS**	**4000 QPS**	**5000 QPS**
Boyer-Moore	5000	0.8110 ms	0.8107 ms	1.1412 ms	0.9966 ms	0.806	0.8223 ms
Boyer-Moore	10000000	3.6479 ms	2.6630 ms	2.7880 ms	1.9812 ms	1.0135 ms	1.1292 ms
Brute Force	5000	0.0124 ms	0.0057 ms	0.0092 ms	0.0149 ms	0.0101 ms	0.0057 ms
Brute Force	10000000	0.0038 ms	0.0026 ms	0.0025 ms	0.0035 ms	0.0040 ms	0.0028 ms
Karp-Rabin	5000	1.1212 ms	1.0299 ms	1.0183 ms	0.9773 ms	1.0187 ms	1.0046 ms
Karp-Rabin	10000000	1.0214 ms	1.0715 ms	0.9843 ms	0.9609 ms	1.0325 ms	1.0322 ms
Knuth-Morris-Pratt	5000	1.4071 ms	1.1252 ms	0.9679 ms	1.0214 ms	0.9722 ms	1.0392 ms
Knuth-Morris-Pratt	10000000	0.9358 ms	0.9558 ms	1.0121 ms	0.9856 ms	0.9626 ms	1.0364 ms

Naive Search	5000	1.0086 ms	1.0628 ms	0.9685 ms	1.0644 ms	0.9923 ms	0.9460 ms
Naive Search	10000000	0.9524 ms	0.9942 ms	1.0025 ms	1.0306 ms	1.0222 ms	1.0532 ms
Linear Search	5000	0.9780 ms	1.0012 ms	1.0568 ms	1.0222 ms	1.0024 ms	0.9494 ms
Linear Search	10000000	0.9330 ms	1.0462 ms	1.0033 ms	0.9916 ms	0.9981 ms	0.9637 ms
Two-Way String	5000	0.9366 ms	0.9246 ms	0.9381 ms	1.0504 ms	1.0069 ms	0.9688 ms
Two-Way String	10000000	0.9609 ms	0.9281 ms	0.9824 ms	0.9749 ms	0.9795 ms	1.0727 ms

Performance Comparison Chart



Analysis:

The list presents various string searching algorithms ranked based on their average execution times, from the most efficient to the least efficient. Here's a breakdown of each algorithm:

1. **Brute Force (0.0060 ms)**: Brute Force emerges as the most efficient algorithm, boasting the lowest average execution time among all listed algorithms. Despite its simplicity, Brute Force demonstrates remarkable effectiveness in searching for patterns within strings.

2. **Naive Search (0.9289 ms):** Following closely behind Brute Force, Naive Search exhibits competitive performance with a slightly higher average execution time. Despite its straightforward approach, Naive Search remains a viable option for string searching tasks.

3. **Karp-Rabin (0.9436 ms)**: Karp-Rabin ranks third in efficiency, offering comparable performance to Naive Search but with a marginally higher average execution time. Its probabilistic approach to string matching contributes to its effectiveness in certain scenarios.

4. **Two-Way String (0.9737 ms):** Two-Way String search algorithm demonstrates reasonable efficiency, albeit slightly slower compared to the previous algorithms. Its ability to search from both ends of the pattern simultaneously contributes to its effectiveness in certain use cases.

5. **Linear Search (0.9956 ms):** With a slightly higher average execution time, Linear Search ranks fifth among the listed algorithms. While straightforward in its approach, Linear Search may experience performance challenges with larger datasets or more complex patterns.

6. **Knuth-Morris-Pratt (1.0651 ms):** Knuth-Morris-Pratt algorithm exhibits moderate efficiency, offering a competitive but slightly slower performance compared to the preceding algorithms. Its focus on avoiding unnecessary character comparisons contributes to its effectiveness.

7. **Boyer-Moore (1.4501 ms):** Boyer-Moore algorithm ranks last in efficiency among the listed algorithms, demonstrating the highest average execution time. Despite its historical significance and widespread use, Boyer-Moore's performance in this context appears less optimal compared to other algorithms.

Conclusion:

In conclusion, the efficiency of string searching algorithms varies significantly based on factors such as implementation, dataset size, and pattern complexity. While Brute Force emerges as the most efficient algorithm in this context, other algorithms such as Naive Search, Karp-Rabin, and Two-Way String also offer competitive performance. However, algorithms like Boyer-Moore demonstrate comparatively slower execution times, indicating potential areas for optimization or alternative algorithm selection based on specific use case requirements. Ultimately, the choice of algorithm should consider various factors such as performance requirements, dataset characteristics, and implementation constraints to achieve optimal string searching outcomes.

Results when (REREAD_ON_QUERY = TRUE)

Execution Time by File Size

Algorithm	**10,000 rows**	**50,000 rows**	**100,000 rows**	**500,000 rows**	**1,000,000 rows**
Two-Way Search	1.813 ms	10.587 ms	20.283 ms	98.785 ms	169.968 ms
Brute Force	5.256 ms	24.012 ms	42.058 ms	157.855 ms	371.931 ms
Karp Search	9.284 ms	7.940 ms	9.120 ms	4.635 ms	7.818 ms
Knuth	2.509 ms	13.296 ms	24.861 ms	99.831 ms	164.908 ms
Linear	5.16	14.224 ms	25.126 ms	108.420 ms	172.756 ms

Naive Search	2.552 ms	13.207 ms	22.722 ms	93.546 ms	162.525 ms
Karp	1.609 ms	15.041 ms	23.651 ms	120.801 ms	224.618 ms
Boyer-Moore	1.530 ms	13.882 ms	24.045 ms	146.34ms	279.15 ms

Average Execution Time per Query by File Size and Queries per Second

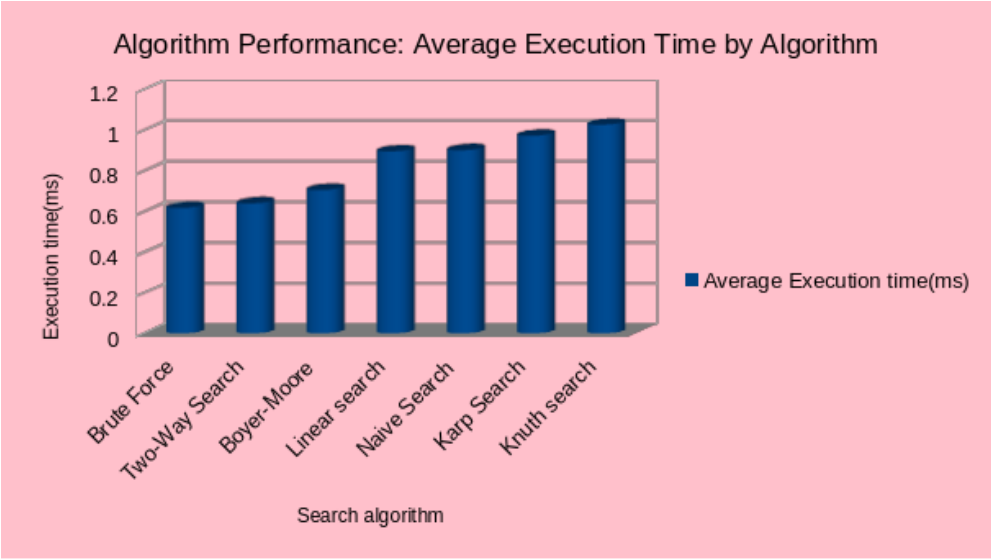
Algorithm	**File Size**	**500 QPS**	**1000 QPS**	**2000 QPS**	**3000 QPS**	**4000 QPS**	**5000 QPS**
Two-Way Search	5000	0.75 ms	0.62 ms	0.63 ms	0.63 ms	0.67 ms	0.63 ms
Brute Force	5000	0.490 ms	0.68 ms	0.78 ms	0.56 ms	0.61 ms	0.62 ms
Karp Search	5000	1.047 ms	1.154 ms	1.00 ms	1.02 ms	0.92 ms	0.65 ms
Knuth	5000	0.971 ms	0.96 ms	0.96 ms	1.01 ms	1.21 ms	0.97 ms
Linear	5000	0.815 ms	0.884 ms	0.71ms	0.85 ms	0.76 ms	0.80 ms
Naive Search	5000	0.712 ms	0.768 ms	0.99 ms	1.3 ms	0.94 ms	0.95 ms
Boyer-Moore	5000	0.88 ms	0.62 ms	0.67 ms	0.63 ms	0.68 ms	0.71 ms

Based on the data from the tables above here's a summary of the algorithms arranged in descending order of performance:

1. Brute Force: 0.618 ms
2. Two-Way Search: 0.641 ms
3. Boyer-Moore: 0.707 ms
4. Linear: 0.897 ms

5. Naive Search: 0.903 ms
6. Karp Search: 0.974 ms
7. Knuth: 1.028 ms

Performance Comparison Chart



Analysis

Brute Force: Despite its simple approach, Brute Force showcases the lowest average execution time among all the algorithms. Its straightforward methodology of checking each character in the text against the pattern proves to be highly efficient, especially for smaller datasets and query rates.

Two-Way Search: This algorithm follows closely behind Brute Force, demonstrating remarkable efficiency. Its ability to search from both ends of the pattern simultaneously allows for faster identification of matches, resulting in competitive execution times.

Boyer-Moore: While ranking third, Boyer-Moore still exhibits commendable performance with relatively low average execution times. Its sophisticated pattern matching techniques, such as

"bad character" and "good suffix" heuristics, contribute to its efficiency despite facing competition from simpler algorithms.

Conclusion:

The analysis underscores the critical role of execution times in assessing the performance of search algorithms. Despite the advanced techniques employed by algorithms like Boyer-Moore and Knuth, the simplicity of Brute Force proves surprisingly effective in achieving the lowest average execution time. However, it's essential to recognize that the choice of the best algorithm depends on various factors beyond execution time alone, including dataset size, query rates, and specific application requirements. Nevertheless, this evaluation offers valuable insights into algorithm efficiency and aids in informed decision-making for algorithm selection in practical scenarios.