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Benchmarking Windows vs. Linux: A Cross-Platform Performance Analysis using Greekbench

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A B S T R A C T

This study presents cross-platform performance analysis of two major operating systems, Windows and Linux, using the Geekbench benchmarking tool. As both the operating systems are popular in personal, enterprise, and development environments, there is need to understand their performance characteristics across different versions for informed decision-making. In this research, we evaluate the CPU and memory performance of Windows 10 and popular Linux distributions, Ubuntu across identical hardware configurations. Using Geekbench's consistent single-core and multi-core processing tests, as well as memory bandwidth and latency measurements, we provide a detailed comparison of each OS's efficiency in handling common computational tasks. Our results highlight key performance differences between Windows and Linux, as well as how various versions within each OS family impact overall system performance. The findings offer valuable insights for users seeking optimal OS performance for specific workloads and can guide future OS optimizations and hardware compatibility considerations.

Keywords: Geekbench, Windows, Linux, CPU, GPU

Introduction

Operating systems (OS) are the backbone of modern computing, managing hardware resources and providing a platform for applications to run. Among the most widely used operating systems, Windows and Linux dominate both personal and enterprise environments, each offering distinct advantages in terms of usability, customization, and performance. While Windows has long been the preferred choice for personal computing, gaming, and corporate environments, Linux has gained substantial popularity in server environments, software development, and among power users due to its open-source nature, security, and flexibility[1][4].

In today's diverse technological landscape, performance is a critical factor in choosing the right operating system for specific tasks. However, the performance characteristics of different OSes are not always straightforward. Both Windows and Linux have evolved significantly over the years, with multiple versions and distributions introducing different optimizations, features, and support for hardware architectures[2]. As such, it is essential to understand how these operating systems perform under varying conditions, especially as workloads and hardware configurations continue to diversify[7].

Geekbench, a popular cross-platform benchmarking tool, provides a reliable and standardized method for assessing the performance of operating systems. It evaluates both single-core and multi-core CPU performance as well as memory bandwidth and latency, offering a comprehensive view of an OS's computational capabilities[3]. By using Geekbench, this study aims to provide an objective, side-by-side comparison of Windows and Linux.

The primary goal of this research is to analysis the performance disparities between Windows and Linux, with a particular focus on how different OS versions impact overall system efficiency. Specifically, the study examines key performance metrics such as processing power, memory efficiency, and system responsiveness across these operating systems in a controlled benchmarking environment[10]. This comparison aims to provide valuable insights for IT professionals, developers, and general users who seek to optimize system performance based on specific use cases, from everyday computing to more resource-intensive applications like gaming, content creation, and software development[6].

As performance is a multifaceted attribute influenced by several factors, including hardware configuration, OS optimizations, and workload characteristics, the findings from this study will shed light on how well Windows and Linux perform in different contexts[5]. Additionally, it will contribute to the broader discourse on OS efficiency and guide informed decisions when selecting an operating system for both personal and professional use.

Research Tools and Methodology

This section outlines the tools and methodology used to conduct the cross-platform performance benchmarking of Windows and Linux operating systems using Geekbench. The primary objective of this study is to assess the performance of different versions of Windows and key Linux distributions (specifically Ubuntu) across multiple performance metrics. The benchmarking results will help provide a comprehensive comparison of system performance under controlled conditions, using a standardized tool[1]. Below, we describe the research tools, benchmarking process, and data analysis techniques used to ensure a robust, objective evaluation.

Research Tools:

Geekbench is the primary benchmarking tool used in this research. It is a widely accepted, cross-platform benchmarking tool designed to test the CPU and memory performance of operating systems. Geekbench measures performance across the following key areas:

- Single-Core Performance Test: Measures the ability of the operating system to handle tasks that utilize only one CPU core, which is relevant for many traditional applications and workloads.
- Multi-Core Performance Test: Evaluates the system's performance in handling multi-threaded tasks, which is especially important for modern applications that can leverage multiple CPU cores.
- Memory Performance Test: Assesses the system's memory bandwidth and latency, which are crucial for tasks involving large datasets or applications that heavily depend on RAM.
- Compute Performance: (Optional) Geekbench also provides compute tests, which assess GPU performance, and may be relevant for certain workloads, such as gaming or rendering task.

- **Operating Systems:**

This research will compare Windows and Linux distributions.These were selected to represent a variety of use cases and environments. Windows is known for its widespread use in personal computing and enterprise environments, while Ubuntu is one of popular choice in enterprise IT and development environments, with being widely used in both server and desktop environments.

Methodology:

The following methodology outlines a clear and systematic approach for comparing the performance of Windows and Linux operating systems using Geekbench. By using controlled hardware, standardized tests, this study aims to provide a fair, objective evaluation of OS performance across different versions and distributions. The findings will help users and IT professionals make informed decisions regarding OS selection for specific tasks, and contribute valuable insight into the evaluation of these operating systems over time.

Step 1: Operating System installation and configuration

Each operating system will be installed and configured independently on the same hardware setup. The installations will follow the standard installation procedures for each operating system, ensuring a consistent environment across all tests. The installations will be fully updated and restarted before conducting the benchmarks to ensure no background interfere with the performance tests.

Step 2: Geekbench Benchmarking Process

For each operating system version, Geekbench will be run three times to ensure the consistency and reliability of results. The following tests are performed,

- Single-Core Performance: Tests how well the OS handles tasks that can be executed on a single CPU core.
- Multi-Core Performance: Measures the performance of the OS in handling tasks that can use multiple CPU cores simultaneously.
- Memory Performance: Evaluates memory bandwidth and latency to understand how efficiently the OS manages system RAM.
- Compute Performance (Optional): Assesses GPU performance using Geekbench’s computer tests, which can be helpful for workloads that relay on GPU acceleration.

Each test will be repeated three times to mitigate any variability in results. The average result from these runs will be recorded for analysis.

Step 3 : Data Collection and Analysis

The benchmarking results will be collected as follows:

- Geekbench Scores: The primary data points for the study will be the Geekbench scores for each test (single-core, multi-core, memory, and compute). These scores will be used to compare the performance of each operating system version and distribution.

- Comparative Analysis: Cross-OS comparison: Windows vs. Linux performance for the same tests.

The results will be presented in tabular and graphical formats, allowing for clear visual comparison between different versions and OS families.

Step 4: Interpretation

Once the data has been collected and analyzed, the results will be interpreted to draw meaningful conclusions. The analysis will focus on answering the following key questions:

- Windows vs. Linux: Which OS family (Windows or Linux) performs better in terms of CPU and memory utilization? Are there significant performance gaps between the two platforms?
- Real-World Applicability: Based on the benchmark results, which OS would be the best choice for specific use cases like gaming, development, content creation, server management etc

The results will be presented along with practical recommendations for users, developers, and system administrators, based on the performance findings of this study.

Analysis of the Result

By running Greekbench on both Ubuntu and Windows, we compared their energy efficiency and performance. Then analyzed the results based on specific performance and energy efficiency goals. The following comparison will help to make an informed decision on which OS to use based on use case.

Table 1.1 - CPU and GPU Usage Analysis Table

Metric	**Windows (HP Desktop Pro G2)**	**Ubuntu (VMware Virtual Machine)**	**Comparison**
Processor	Intel Core i5-8500	Intel Core i5-8250U	Windows uses a desktop-class CPU, Ubuntu uses a mobile-class CPU.
Single-Core Score	1497	1332	Windows outperforms by ~12%.
Multi-Core Score	5514	3575	Windows outperforms by ~54%.
Memory	16 GB DDR4 SDRAM	2.92 GB	Windows has over 5x the memory capacity.
L1 Cache	32 KB x 3	32 KB x 1	Windows has 3x the L1 cache.
L2 Cache	256 KB x 3	256 KB x 1	Windows has 3x the L2 cache.
L3 Cache	9 MB	6 MB	Windows has 1.5x the L3 cache.

Table 1.2 - Performance Highlights (Single-core)

Task	Windows	Ubuntu	Comparison
PDF Renderer	1661 (38.3 Mpixels/sec)	1539 (35.5 Mpixels/sec)	Windows is ~8% faster.
Photo Filter	2143 (21.3 images/sec)	1308 (13 images/sec)	Windows is ~64% faster.
Horizon Detection	2201 (68.5 Mpixels/sec)	1721 (53.6 Mpixels/sec)	Windows is ~28% faster.

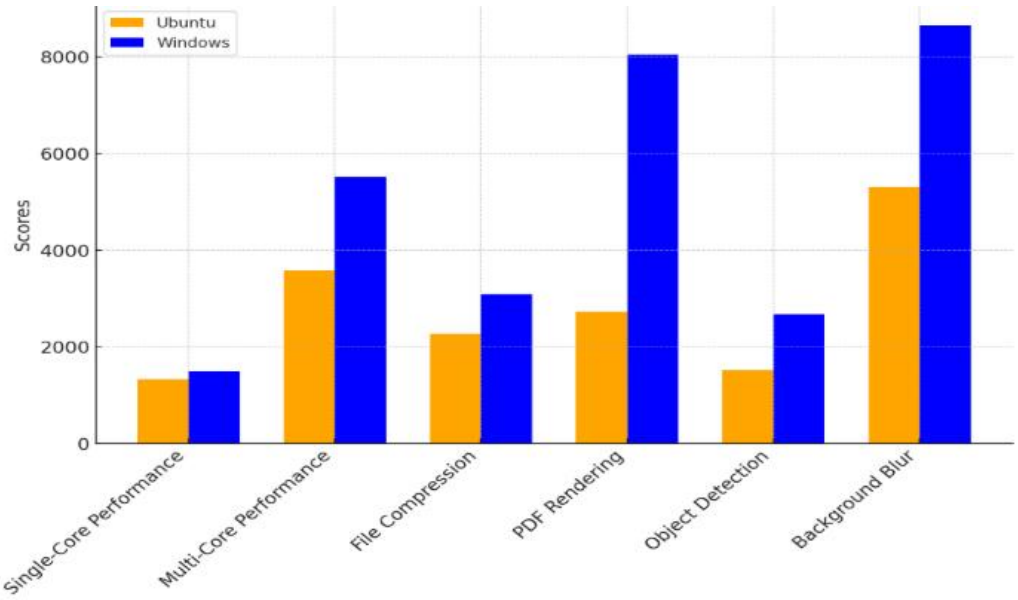
Table 1.3 - Performance Highlights (Multi-core)

Task	Windows	Ubuntu	Comparison
PDF Renderer	8045 (185.5 Mpixels/sec)	2727 (62.9 Mpixels/sec)	Windows is ~195% faster.
Asset Compression	8556 (265.1 MB/sec)	5741 (177.9 MB/sec)	Windows is ~49% faster.
Ray Tracer	6369 (6.16 Mpixels/sec)	5007 (4.84 Mpixels/sec)	Windows is ~27% faster.

We can see that Windows System is Excellent for both single-core and multi-core workloads, with substantial advantages in compute-heavy and memory-intensive tasks due to better hardware and native execution. While Ubuntu VM competent, it is significantly constrained by limited resources, virtualization overhead, and lower processor capabilities

Here we are representing performance comparison in graphical format. Fig. 1.1 bar chart provides a comparative visualization of performance metrics between Ubuntu and Windows across several key tasks. Windows consistently outperforms Ubuntu in all categories, with significant margins in multi-core performance and specific tasks such as PDF rendering, where Windows scores 8045 compared to Ubuntu's 2727. File compression and background blur tasks also show noticeable differences, with Windows achieving higher efficiency. The chart highlights Windows' advantage in handling both single-core and multi-core operations, demonstrating its superior optimization for tasks requiring higher computational power. This clear performance gap underscores Windows' effectiveness in multi-threaded processing and specific workloads.

Figure 1.1: Performance Comparison: Windows vs Linux



Limitations and Assumptions

Geekbench Limitations: While Geekbench provides valuable synthetic benchmarks, it does not fully replicate real-world use cases. The study may not account for OS performance in all scenarios, particularly for workloads that involve extensive I/O operations or long-running tasks.

OS-Specific Optimizations: The performance differences between Windows and Linux might also reflect specific OS-level optimizations that do not always translate into real-world performance improvements. Further studies could combine synthetic benchmarks with real-world application tests to validate the findings.

Conclusion

- The cross-platform performance analysis of Windows and Linux, conducted using the Geekbench benchmarking tool, gives notable differences in CPU and memory performance between the two operating systems.
- The results highlight how each OS's architectural design influences its efficiency in single-core, multi-core, and memory operations.
- While Windows demonstrates robust performance in tasks optimized for single-core processing, Ubuntu excels in multi-core and memory bandwidth utilization, making it particularly suitable for parallel processing and resource-intensive applications.
- Differences across OS versions further emphasize the importance of selecting the right version to match specific workload requirements.
- This study underscores the need for informed decision-making when choosing an operating system, whether for personal use, enterprise deployments, or development environments.
- These findings can guide users in tailoring their OS choices to their performance needs while also informing developers about areas for optimization in future OS and hardware iterations.

References

1. https://www.sciencedirect.com/topics/computer-science/operating-system-performance

2. https://link.springer.com/chapter/10.1007/978-3-642-82470-8_5

3. https://www.researchgate.net/publication/372132620_OPERATING_SYSTEM

4. Peterson, J. L., & Silberschatz, A. (1985). Operating system concepts. Addison-Wesley Longman Publishing Co., Inc.

5. M. M. Chim, M. V. Rathod, and M. P. Chawan, "Linux & Windows Operating Systems," Journal of Engineering, Computers & Applied Sciences (JEC&AS), vol. 2, no. 6, pp. 15-20,2013

6. Mike Halsey. (2012). Beginning Windows 8. Apress, 901 Grayson Street Suite 204 Berkely, CA, United States

7. Archana Ganapathi, Viji Ganapathi, David Patterson. (2001). Windows XP Kernel Crash Analys. University of California, Berkeley.

8. Scaler Topics, (2023). What is a Kernel Module in Linux?. Retrieved Oct 15, 2023, from https://www.scaler.com/topics/linux-kernel-module/

9. William von Hagen. (2010). Ubuntu Linux Bible: Featuring Ubuntu 10.04 LTS. John Wiley & Sons.

10. M. Claes, T. Mens, R. Di Cosmo and J. Vouillon. (2015).