CPU Benchmarking Survey Report

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*Abstract*— CPU benchmarking is a critical aspect of evaluating the performance and efficiency of processors, guiding both hardware developers and end-users in decision-making. This report explores the evolution of CPU benchmarking, from early simplistic tests to sophisticated modern methodologies that account for diverse workloads. It examines widely used benchmarks, distinguishing between open-source tools like Geekbench and proprietary licensed suites such as SPEC CPU and Cinebench. Additionally, key performance metrics—including instructions per cycle (IPC), throughput, latency, and power efficiency—are discussed in terms of their relevance to real-world applications. These metrics offer insights into computational capability, energy consumption, and responsiveness under varying conditions.

Keywords—History, CPU benchmarking, Performance metrics

# Introduction

In computing, a benchmark is the act of running a computer program, a set of programs, or other operations, in order to assess the relative performance of an object, normally by running a number of standard tests and trials against it. The performance or speed of a processor depends on, among many other factors, the clock rate (generally given in multiples of hertz) and the instructions per clock (IPC), which together are the factors for the instructions per second (IPS) that the CPU can perform [1]. The performance of the memory hierarchy also greatly affects processor performance, an issue barely considered in IPS calculations. Because of these problems, various standardized tests have been create often called "benchmarks".

Use the enter key to start a new paragraph. The appropriate spacing and indent are automatically applied.

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# history of cpu benchmarking

Benchmarking in computing emerged in the 1960s to address the challenges of evaluating diverse system configurations and vendors. Early efforts, such as Auerbach Corporation's Standard EDP Reports, standardized tasks to compare performance but faced limitations due to reliance on vendor-provided data. By the mid-1960s, application benchmarks were introduced to test specific workloads, but issues of representativeness and cost persisted. The late 1960s saw the advent of synthetic programs, which emulated real workloads and allowed parameterization for flexibility and comparability across systems. In the 1970s and 1980s, the concept of standard benchmark libraries gained traction, with efforts like the USDA's synthetic programs demonstrating the feasibility of standardized tools while exposing challenges like vendor tuning biases. The U.S. government played a significant role in institutionalizing benchmarking, mandating its use in procurement to ensure fairness and accuracy. Despite its evolution into a sophisticated performance evaluation tool, benchmarking continues to grapple with issues of cost, workload representativeness, and maintaining fairness in competitive environments

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##### Acknowledgments

“Acknowledgment(s)” is spelled without an “e” after the “g” in American English.

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This template was adapted from those provided by the IEEE on their own website.

##### References

1. “CPU Frequency”. CPU World Glossary. 25 March 2008
2. B. Rieder, *Engines of Order: A Mechanology of Algorithmic Techniques*. Amsterdam, Netherlands: Amsterdam Univ. Press, 2020.
3. I. Boglaev, “A numerical method for solving nonlinear integro-differential equations of Fredholm type,” *J. Comput. Math.*, vol. 34, no. 3, pp. 262–284, May 2016, doi: 10.4208/jcm.1512-m2015-0241.

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| **Category** | **Benchmark** | **Description** |
| ***Industry Standard*** | [Embedded Microprocessor Benchmark Consortium (EEMBC)](https://en.wikipedia.org/wiki/EEMBC) | An industry organization that creates and maintains benchmarks for evaluating the performance of embedded systems and microprocessors. |
|  | [Standard Performance Evaluation Corporation](https://en.wikipedia.org/wiki/Standard_Performance_Evaluation_Corporation) (SPEC) | A non-profit organization that develops benchmarks and performance evaluation tools for computer systems. |
| ***Open Source*** | Coremark | Embedded computing benchmark |
|  | Dhrystone | integer arithmetic performance, often reported in DMIPS (Dhrystone millions of instructions per second) |
|  | Whetstone | floating-point arithmetic performance, often reported in millions of Whetstone instructions per second (MWIPS) |
|  | Phoronix Test Suite | A comprehensive and flexible open-source testing framework that supports CPU, GPU, and other hardware components. |
|  | Sysbench | A multi-threaded benchmark tool designed to test various system parameters, including CPU, memory, and disk I/O |
| ***Other*** | AnTuTu | commonly used on phones and ARM-based devices. |
|  | GeekBench | A cross-platform benchmark for Windows, Linux, macOS, iOS and Android. |
|  | CineBench | A widely used benchmark from Maxon that evaluates CPU performance based on rendering tasks. |