

Characterization of Benchmarks: Standard Applications for Input/Output Characteristics

Bachelor's/Master's Thesis – Open Assignment

Assigning professor:

Prof. Dr. Martin Schulz

Supervisors:

Karlo Kraljic,

Dr. Matthias Maiterth

Contact: karlo.kraljic@tum.de

November 17, 2022

Description:

Benchmarks are an essential tool for performance assessment of HPC systems. During the procurement process of HPC systems both benchmarks and proxy applications are used to assess the system which is to be procured. New generations of HPC systems often serve the current and evolving needs of the applications for which the system is procured. Therefore, with new generations of HPC systems, the selected proxy application and benchmarks to assess the systems' performance are also selected for the specific needs of the system. Only a few of these have stayed persistent over longer time periods. At the same time the quality of benchmarks is typically not questioned as they are seen to only be representatives of specific performance indicators.

This work aims to evaluate benchmarks for input and output (I/O) performance to provide a systematic approach to evaluate benchmarks targeting read and write performance of different characteristics as seen in application behavior, mimiced by benchmarks.

Problem statement:

How can benchmarks used to assess I/O performance be systematically compared amongst each others?

Anticipated Outcome

The work consists of two parts:

1. Analysis of HPC system procurements and how storage systems are evaluated, and
2. Assessment of IO-Benchmark by basis of the IO-500 benchmark, as well as examples identified in 1.

The initial part of this work discovers how current procurements evaluates their storage, which is to be procured or how storage systems are connected to new system procurements. This evaluation should identify benchmark/test sets, as used by individual centers, but which may not be standardized. These tests often include total filehandles opened, read and write latency and bandwidth, among others. The goal of this is a systematic analysis of this public information on this topic.

The basis comparison of IO systems is the IO-500 benchmark [1, 2], as it one of the few standardized test-suites to evaluate IO performance. The objective of this work is to assess the quality of this benchamrk on both the SuperMUC-NG system and the Beast system [3].

The task following is comparing benchmark/test used for procurmenet with the results and as indicated qualities of the IO-500 benchmark, as well as performance as required by the applica-tions vs. claimed by system vendors.

For collection of performance counters the LIKWID tools are used [4].

The metric, quality indicators, set of benchmark and architectures to evaluate are defined in the early stages of the thesis.

The possibility of ranking the benchmarks for specific architectures has to be assessed and may be an additional outcome.

References

- [1] Julian Kunkel. *io500 github*. URL: <https://github.com/IO500/io500> (visited on 2022-05-18).
- [2] Virtual Institute for I/O (vi4io). *IO-500*. URL: <https://www.vi4io.org/std/io500/start> (visited on 2022-05-18).
- [3] Leibniz-Rechenzentrum. *Testing HPC Technologies and Shaping the Future of Computers*. URL: https://www.lrz.de/presse/ereignisse/2020-11-06_BEAST/ (visited on 2022-05-16).
- [4] LIKWID Performance Tools git. <https://github.com/RRZE-HPC/likwid>. URL: <https://github.com/RRZE-HPC/likwid> (visited on 2020-03-19).