

Development of a benchmarking suite to detect the causes and effects of computer ageing

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I. CONTEXT

Studying the direct and indirect impacts of digital systems has recently become an increasingly significant area of interest. The term "digital" covers a broad scope, ranging from personal devices, such as smartphones and laptops, to data centers and large-scale computing infrastructure. The recent burst of artificial intelligence (AI) usage, which has led to a sharp increase in the demand for computing power and dedicated infrastructures, is contributing to a significant rise in demand for IT equipment. Consequently, the environmental impacts of digital technology with the entire life cycle of equipment - from manufacture and use to end-of-life - are rising sharply.

In this context, extending the lifespan of equipment is a key strategy for reducing the environmental impact of computers. By limiting the replacement of hardware, this approach reduces the resources required to produce new equipment and the environmental impacts associated with its manufacture. This represents a strategic challenge in response to growing pressures on supply chains and the global availability of electronic components.

II. GOAL OF THE PROJECT

The goal of this project is to develop a software suite capable of assessing the performance of a targeted computer at different stages of its life cycle, possibly across various software configurations. Using this suite, the aim is to better characterise how a piece of equipment's performance evolves over time, and to identify the factors likely to influence this evolution.

The student will explore different types of benchmarks and select the ones better suited to assess the performance of a machine. Such benchmarks can be existing programs (computing kernels for instance), and/or the use of hardware counters with specific libraries to get performance metrics from the targeted machine.

The student will use Grid'5000, a large-scale and flexible testbed for experiment-driven research, to develop the benchmark suite. Grid'5000 offers a wide variety of hardware configurations, with a strong flexibility on operating system and software deployment.

III. WHAT YOU WILL LEARN

- Use computing infrastructures to run benchmarks (Grid5k, local cluster)
- Develop an open-source benchmarking suite (using hardware counters & dedicated programs)
- Performance analysis of the benchmarking suite results

IV. WHAT YOU SHOULD LIKE

- System programming
- Scripting for experiments and result analysis
- Versioning tool such as GitHub for reproducibility

V. CONTACTS

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