SAFARI

Bachelor's / Master's / Semester Project

Rethinking Virtual Memory for Modern Computing Systems

Modern computing systems heavily depend on virtual memory to provide many features, all of which integral to the overall performance and functionality of the system. However, **virtual memory is facing important challenges today** that puts efficiently maintaining this critical component, as it is, at a serious risk. These challenges are fundamentally due to the fact that virtual memory was originally designed decades ago, not having the diversity and the complexity of today's computing systems in mind. As a result, while the core concepts of virtual memory have remained mainly unchanged, the nature of the other components of the system (e.g., workloads, underlying hardware architectures) have changed significantly over the years. This mismatch between the existing virtual memory design and the other continuously evolving and diversifying components of the systems has led to **virtual memory officially becoming a performance bottleneck in modern computing systems**.

Our goal is to fundamentally rethink and redesign the virtual memory, in order to achieve the flexibility required in virtual memory abstraction for adopting today's massively diverse system configurations while preserving widely-used programmer abstractions.

In this project, you (along with other researchers) will be involved in (1) designing and performing evaluations to **study the behavior of modern workloads and system configurations**, and (2) using the insights gained from these evaluations to lead our research towards solutions for the challenges that the conventional virtual memory framework faces today. Some example challenges we aim to solve in projects under this umbrella are in the interactions of virtual memory with new execution paradigms, heterogeneous memory and computing systems, virtualization, and reliability, and data-aware performance, energy, reliability, security optimizations.

Requirements

- Outstanding programming skills (C/C++)
- Computer architecture background
- Interested in rethinking the conventional methods to create optimization opportunities
- Keen on driving impact
- Willing to learn, improve, and take on challenge
- Strong work ethic

For **example studies** that you may perform, please see:

- "The Virtual Block Interface: A Flexible Alternative to the Conventional Virtual Memory Framework", ISCA 2020.
- "Intelligent Architectures for Intelligent Machines", VLSI 2020.

If you are interested, please email
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