

Bachelor's / Master's / Semester Project

Machine-Learning Assisted Intelligent Architectures

Modern processors employ numerous human-driven policies such as prefetching, cache-replacement, data management, and memory scheduling. These techniques rely on statically chosen design features that favor specific workload and/or device characteristics over the other. However, the complexity of designing a highly-effective, high-performance, efficient policy, which can effectively adapt to the changes in workload behavior for a broad range of workloads, usually is well beyond human capability. Yet, these policies have been traditionally designed and dictated by human architects [2]. Therefore, it is necessary to develop machine-learning-assisted policies that can provide a near-ideal, robust improvement across varying workloads and system conditions.

You will work with other researchers to develop, implement, and evaluate machine learning-based techniques for different aspects of computer architecture. In our group, we have demonstrated the benefits of designing machine learning-based techniques for computing systems such as using reinforcement learning (RL)-based memory scheduler [1] that can significantly outperform a human-designed memory scheduler; and the use of supervised learning [3] to enable fast early-stage design space exploration without having to rely on time-consuming simulations.

Requirements:

- Programming experience in C++ and Python
- Experience using machine learning packages (PyTorch, TensorFlow)
- Experience in deep learning or reinforcement learning
- Computer architecture background
- An interest in developing and evaluating new ideas
- Self-motivated and strong work ethics

For **background and example past studies**, please see:

[1] "Self-optimizing memory controllers: A reinforcement learning approach", in ISCA 2008.

[2] "Intelligent Architectures for Intelligent Machines", in VLSI 2020.

[3] "NAPEL: Near-memory computing application performance prediction via ensemble learning", in DAC 2019.

If you are interested, please email:

Professor Onur Mutlu, onur.mutlu@safari.ethz.ch

Rahul Bera, rahbera@ethz.ch

Dr. Juan Gomez Luna, juan.gomez@safari.ethz.ch

<https://people.inf.ethz.ch/omutlu/>

<https://safari.ethz.ch>