ABSTRACT

Model Swapping in Architectural Simulation

Authors:

Patrick Lavin, CSE, Georgia Tech
Jeffrey Young, CS, Georgia Tech
Jonathan Beard, Arm Research;

As systems grow more complex, detailed simulation takes an ever-increasing amount of time. Likewise, real applications of interest often evolve faster than representative micro-benchmarks (e.g. machine learning), driving a need for real one-shot online simulation techniques that enable reasonable workload execution within the simulated environment. The prospect of increased simulation time and subsequent slower design iteration forces architects to use simpler models (e.g. spreadsheets) when they want to iterate quickly on a design. However, the task of migrating from a simple simulation to one with more detail often requires multiple executions to find where simple models could be effective, which could be more expensive than running the detailed model. With looming product and paper deadlines, many architects rely not on detailed model comparison but on intuition to select simple models. Our work, however, could allow architects to close this modeling control flow loop, reducing overall simulation time while enabling automation to make principled decisions as to when to select a simpler model. In this work, we present Online Model Swapping, a method of bridging the gap between simple and detailed architectural simulation by automatically swapping out detailed models with simpler statistical approximations when possible. We demonstrate the potential of our methodology as a proof of concept by implementing it in the open-source simulator SVE-Cachesim. Specifically, we show that we can swap out the level one data cache (L1D) within a memory hierarchy. Our simulation swaps out the built-in L1 cache model with only an 8% error in the simulated cycle count while using the approximated cache models for over 90% of the simulation.