Simulation Assignment 1.

240C Winter 2022

January 9, 2022

1 Instruction Prefetcher Infrastructure

In this homework, you will explore the state-of-the-art Instruction Prefetching techniques using the 1st Instruction Prefetching Championship infrastructure and data. Simulation framework is based on ChampSim. It has user replaceable prefetchers, cache replacement, and branch predictors. ChampSim focuses on ease-of-use above accuracy or performance. Core and cache parameters vaguely resemble an Intel Sunny Cove core, including 32KB L1-I cache 128KB to implement your best L1-I instruction prefetcher. Prefetchers have access to both instruction cache accesses and branch patterns. Find the infrastructure and traces on the competition website (click here). Workloads contain (1) public traces, a combination of SPEC, client, and server workload. (2) Secret traces generated at Intel from client workloads. The evaluation metric is geomean of all traces in the evaluation trace list with equal weight. You can find the winners source code and slides on the website (click here).

2 Deliverable

For your homework, you are expected to deliver the following:
1. Summarize the ideas of three winners of the Prefetching contest at a high level.
2. choose <u>two</u> winner prefetchers. For each Prefetcher, list all the meta-data, including details such as the length of histories, etc. Explain the key design of those prefetchers , *e.g.* update strategy, etc.
3. Reproduce their results. Plot main graphs and report the error.
4. Explore the design space of each design for at least "two" main parameters e.g., thresholds. Explain why you picked those parameters and plot the performance numbers as you vary those parameters.
5. Analyze your observation from step 4 e.g., explain the trend.
6. Identify the first-order size structures kept for each Prefetcher, show how each performs using a different hardware budget. For example, which Prefetcher performs best with a large hardware budget and performs best under more constraints.
7. Analyze your observations from step 6. Why does one design perform best with a lower budget? List three ideas.
8. Explain why one Prefetcher is more timely than the other? Start with listing the main computations responsible for the delay in each Prefetcher.
9. **Submit by Jan 27, 2022, at 11:59 PM on Canvas under HW1. (Recommended Finish Time Jan 24.)**