ABSTRACT

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High-performance caching and hardware prefetching are two most widely used techniques to break the memory wall problem. While intelligent caching delivers performance improvement by storing a small subset of data that are most likely to be accessed again in near-future, hardware prefetcher fetches data from slow memory into fast memory before they are actually demanded, hiding long latency of accesses. However, high-performance caching in the presence of an aggressive prefetcher loses some performance benefit because of prefetcher induced pollution. A prefetcher induces pollution by fetching unnecessary or untimely data in the cache, increasing memory bandwidth overhead and cache capacity bloat.

In this work, we discuss the destructive interference between prefetching and intelligent caching. We model performance improvements coming from adding an oracle prefetch filter to the baseline architecture. Next, we propose a practical adaptive prefetch filter, which can predict usefulness of a prefetch access on the fly and selectively reject prefetch requests. Our proposal improves performance by 8.5% and 15% on average for single core and multicore heterogeneous workloads respectively with respect to the baseline without prefetching. It also reduces off-chip memory traffic by 18.8% and 8.3%, respectively with respect to the baseline with prefetcher.