A Stack Cache for Real-Time Systems

Real-time systems need time-predictable computing platforms to allow for static analysis of the worst-case execution time. Caches are important for good performance, but data caches are hard to analyze for the worst-case execution time. Stack allocated data has different properties related to locality, lifetime, and static analyzability of access addresses compared to static or heap allocated data. Therefore, caching of stack allocated data benefits from having its own cache.

In this paper we present a cache architecture optimized for stack allocated data. This cache is additional to the normal data cache. As stack allocated data has a high locality, even a small stack cache gives a high hit rate. A stack cache added to a write-through data cache considerably improves the performance, while a stack cache compared to the harder to analyze write-back cache has about the same average case performance.