

Computer Science & Electrical Engineering Seminar Series

A Subarray Based Usage and Cost Aware Cache Capacity Allocation

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We propose a cache design such that its capacity can be allocated based on the usage and cost of misses at the block and Subarray granularity. We call it an S_Cache. The S_Cache can place a block into any subarray, different from that specified by the block address, to control the cache capacity allocation. This is achieved through replacing the conventional tag subarray decoders with Bloom filters. To achieve true demand-driven cache capacity allocation, the cache replacement policy needs to be redesigned. We propose a simple replacement policy for the S_Cache, in which consecutively requested blocks are placed into subarrays in serial to achieve better capacity usage. We also propose a cache miss cost aware capacity allocation policy, in which the S_Cache's subarrays are divided into two groups: high cost and low cost. We develop a run-time technique to determine the cost threshold to classify cache misses into high and low cost misses. High cost misses are allocated to the high cost group with a larger capacity and the low cost misses are allocated to the low cost group with a smaller capacity. Execution driven experiments show that performance in terms of IPC is increased by an average of 14.5%. The total energy consumption of the S_Cache is reduced by 9% due to improved performance and reduced execution time.

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Dr. Chuanjun Zhang is currently an assistant professor in the Department of Computer Science and Electrical Engineering at the University of Missouri-Kansas City. His research interests include high performance processor architecture, low power configurable embedded systems, VLSI chip and system design, CAD, and design automation. He has published numerous refereed journal and conference papers in embedded systems, computer architecture, VLSI, CAD, and design automation. He received his PhD from the University of California at Riverside in 2004. Prior to this, he was a principal engineer of communication satellite control system design at the Beijing Institute of Control Engineering for eight years.

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