CSCE 614: Project Proposal

Cache Replacement Improvement on Last-Level Caches

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Our team will focus on the topic of cache replacement algorithms for last-level caches (LLCs) as we implement the "Back to the Future: Leveraging Belady's Algorithm for Improved Cache Replacement" paper [1]. Currently, most cache replacement algorithms are based on Least Recently Used (LRU) and Most Recently Used (MRU), but these policies are limited to a specific access pattern and simplistic scenarios. The paper selected demonstrates that by modifying the Belady's algorithm to consider accessing past caches, we can more accurately predict future cache replacements. In addition, Belady's algorithm removes the dependency of one specific access pattern and uses a variety of access patterns based on past actions. This approach will consist of two main parts: (1) constructing Belady's algorithm to consider accesses from the past cache and (2) developing a predictor that will learn from this past behavior and decide future cache replacement. Prior work has also demonstrated the variety of cache replacement algorithms that have been taken into consideration along with their limitations, which is what Belady's algorithm focuses on improving [2, 3].

In order to evaluate this approach, we will be using the Simplescalar simulator to reproduce similar results to those the original paper has presented. The simulator will allow us to demonstrate that this algorithm is able to improve miss reductions and speed up while also proving the advantage of being able to learn from past behavior instead of one specific access pattern.

References

[1] L. A. Belady. A study of replacement algorithms for a virtual-storage computer. *IBM Systems Journal*, pages 78–101, 1966.

[2] J. Akanksha, and C. Lin. Back to the Future: Leveraging Belady's Algorithm for Improved Cache Replacement. *2016 ACM/IEEE 43rd Annual International Symposium on Computer Architecture (ISCA)*, 2016, doi:10.1109/isca.2016.17.

[3] T. R. Puzak. Analysis of Cache Replacement-algorithms. *PhD thesis, University of Massachusetts Amherst*, 1985.