Abstract

Efficient memory management is a crucial aspect of modern computing, and caches play a significant role in bridging the performance gap between fast processors and slower main memory. This project presents a **Multi-Level Cache Simulator**, designed to evaluate and analyze the behavior of **L1 and L2 caches** under various configurations. The simulator allows users to **dynamically configure cache parameters**, including **cache size, block size, and associativity**, providing a flexible and interactive experience.

The simulator supports **Set-Associative Mapping**, ensuring efficient organization of cache blocks. It implements multiple **cache replacement policies**, including **FIFO (First-In-First-Out), LFU (Least Frequently Used), and LRU (Least Recently Used)**, enabling users to assess different strategies for cache management. Additionally, it incorporates **Write-Through and Write-Back policies** to handle memory writes effectively, improving the accuracy of the simulation.

A key feature of this simulator is its ability to **accept memory access traces from users** and provide **detailed per-access logging**, showing whether each access resulted in an **L1 or L2 cache hit or miss**. The program automatically calculates the **number of cache sets** based on user-defined cache sizes and block sizes, ensuring accurate simulation of real-world cache behavior.

The simulator is implemented using a **modular code structure**, with separate files for **cache logic, memory management, and user interaction**, making it easy to read, maintain, and extend. At the end of each simulation run, the program presents comprehensive **performance metrics**, including **L1 and L2 cache hit/miss rates**, offering valuable insights into cache efficiency.

This **powerful and interactive cache simulator** serves as an excellent tool for **students, researchers, and professionals** in the fields of **computer architecture and systems design**, helping them gain an in-depth understanding of cache mechanisms and performance optimizations. Its ability to simulate real-world scenarios makes it a valuable resource for educational and research purposes alike.