ResilienceP Analysis: Bounding Cache Persistence Reload Overhead for Set-Associative Caches

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1. Motivation
- Caches induce time variability in task executions due to CRPD/CPRO.
- Lower priority tasks may need to account for cache evictions due to preemptions by the higher priority tasks (CRPD).
- Memory demand of the preemption tasks depends on the execution of all other tasks (CPRO).
- SoA approaches for CPRO calculation only consider direct-mapped caches.

2. Contributions
- Three approaches to calculate CPRO for set-associative caches.
  - PCB-ECB approach
  - ResilienceP Analysis
  - Improved ResilienceP Analysis
- The proposed approaches accounts for both CRPD and CPRO and dominates the SoA Resilience analysis that only accounts for CRPD.

3. PCB-ECB Approach
- In a set-associative cache one Evicting Cache Block (ECB) of a task may evict several Persistent Cache Blocks (PCBs) of other tasks.

4. ResilienceP Analysis
- Assuming one ECB of any task (other than the task under analysis) in cache set S may evict all PCBs (of the task under analysis) in S is Pessimistic.

5. Improved ResilienceP Analysis
- For tasks with more than one execution paths, resilience of PCBs may vary depending on the execution path taken by the task.

6. Preliminary Results

7. Future Work
- In future, we will investigate how to efficiently build the CPRO table for PCBs under the improved ResilienceP analysis.
- We also plan to extend the analysis to cache hierarchy and shared caches in multi-core systems.
- Perform extensive experiments to evaluate our solutions.