HARP: Practically and Effectively Identifying Uncorrectable Errors in Memory Chips That Use On-Die Error-Correcting Codes

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Session 6A: Wednesday 20 October, 7:45 PM CEST
HARP Summary

Motivation: state-of-the-art memory error mitigations often require the processor to identify which bits are at risk of error (i.e., profiling)

Problem: on-die ECC complicates error profiling by altering how errors appear outside of the memory chip

Goal: understand and address the challenges on-die ECC introduces

Contributions:
1. Analytically study on-die ECC’s effects and identify three key challenges
   i. Exponentially increases the number of at-risk bits
   ii. Makes individual at-risk bits harder to identify
   iii. Interferes with commonly-used memory data patterns
2. Hybrid Active-Reactive Profiling (HARP):
   i. Separately identify (1) raw bit errors and (2) errors introduced by on-die ECC
   ii. Effectively reduces profiling with on-die ECC into profiling without on-die ECC

Evaluation: demonstrate that HARP overcomes the three challenges
• HARP identifies all errors faster than two baselines, which sometimes fail to achieve full coverage of at-risk bits
• Case study showing that HARP identifies all errors faster than the best-performing baseline (e.g., by 3.7x for a raw per-bit error probability of 0.75)
Artifacts are Open-Sourced

https://github.com/CMU-SAFARI/HARP
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