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

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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

README.md

HARP Artifacts

This software provides the artifacts for evaluating Hybrid Active-Reactive Profiling (HARP) as described in our MICRO 2021 academic paper to appear [1]. These artifacts use a combination of Monte-Carlo simulation and a SAT solver to study the effectiveness of different strategies for profiling for memory errors.

This software will be relesed on GitHub upon publication of our paper.

Please send questions to Minesh Patel at minesh.patelh@gmail.com

Artifacts Overview

At the high level, the artifacts comprise three parts:

1. C++-based Monte-Carlo simulation of on-die ECC words across different ECC functions and error models. These files are largely an extension of the open-source BEER project [2, 3], and the individual file headers are used to indicate those files that are adapted. All source files are set up as a Makefile project contained within the `src/` directory, and library dependencies are provided within `lib/`.
2. Python-based analysis scripts that parse the output of the Monte-Carlo simulations. These scripts are found under `script/`.
3. Meta-scripts capable of reproducing the experiments in our paper. These scripts are found under `evaluation/`.

We use Doxygen to document the source code and provide a Doxyfile for building HTML and LaTeX documentation. To build the documentation, simply issue:

```
$ doxygen
```

when in the project directory, or point `doxygen` to the provided Doxyfile. The HTML documentation will be built under `doxygen/html/index.html`.

Dependencies

July 31, 2021

Software Open Access

HARP Artifacts

Patel, Minesh

Artifacts used to reproduce the experiments and data given in the paper:

Minesh Patel, Geraldo F. Oliveira, and Onur Mutlu, "**HARP: Practically and Effectively Identifying Uncorrectable Errors in Main Memory Chips That Use On-Die ECC**," to appear in the *Proceedings of the 54rd International Symposium on Microarchitecture (**MICRO**)*, 2021.

Preview

harp-artifacts.zip

The previewer is not showing all the files

harp-artifacts	
AUTHORS	145 Bytes
Doxyfile	207 Bytes
LICENSE	1.1 kB
README.md	6.5 kB
lib	
eigen-3.3.9	
.gitignore	268 Bytes
.hgeol	180 Bytes
CMakeLists.txt	24.5 kB
COPYING.GPL	35.1 kB
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COPYING.MPL2	16.7 kB
COPYING.README	779 Bytes
CTestConfig.cmake	527 Bytes

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Versions

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