REACT: A Framework for Rapid Exploration of Approximate Computing Techniques

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Motivation

Understand current research

Investigate new techniques

Evaluate impact of existing techniques

Overview

Taxonomy

Dimensions

Conclusions

Framework

Details

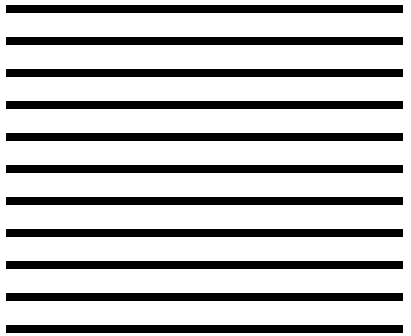
Early Results

Taxonomy

Determinism

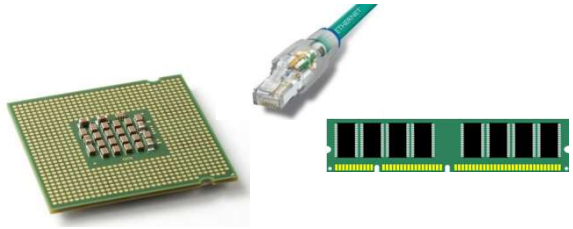
$$|P(x) - A(x)| \leq \varepsilon \; \forall \; x$$
$$\Pr(|P(x) - A(x)| > \varepsilon) < P \; \forall \; x$$

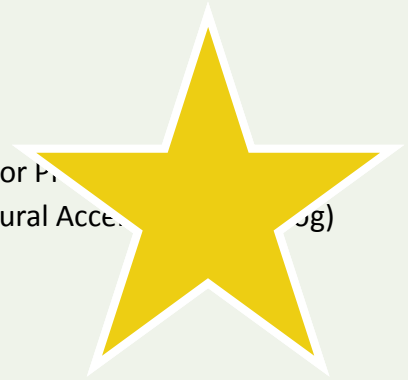
Granularity



Hardware/Software

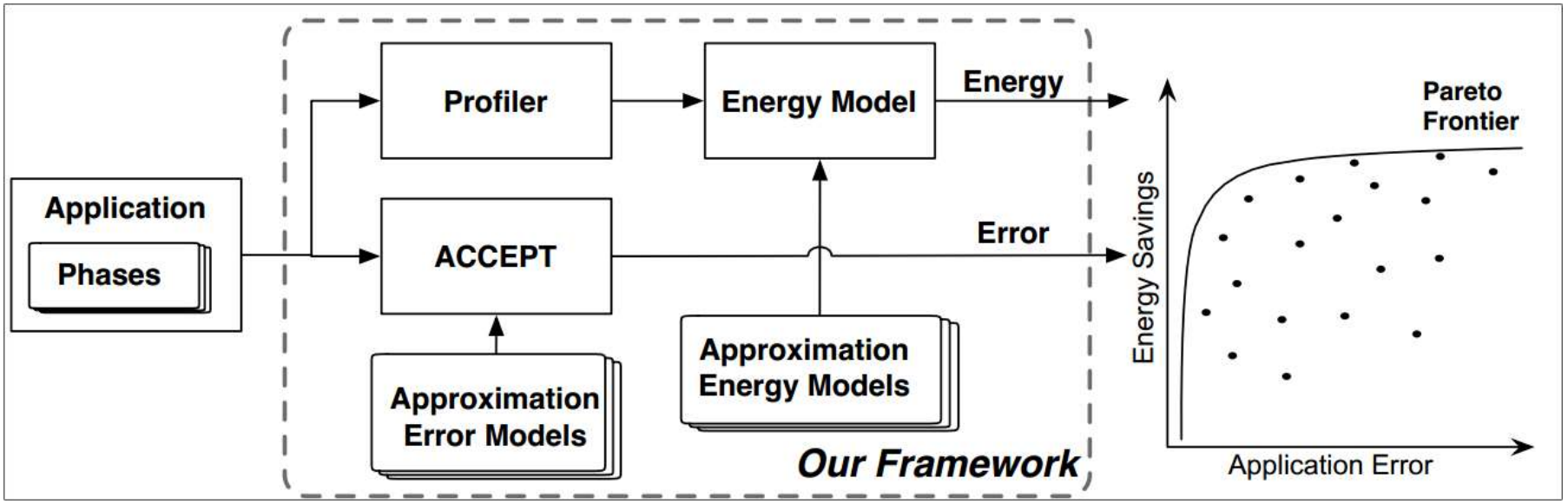
Computational Resource(s)



	Nondeterministic	Deterministic
Fine Grained	DRAM Refresh Rate SRAM Soft Error Exposure Approximate Storage (PCM) Soft Fault Tolerance Synchronization Elision Voltage Overscaling	Bit-Width Reduction Float-to-Fixed Conversion Fuzzy Memoization Hierarchical FPU Load Value Approximation Lossy Compression and Data Packing Precision Scaling ALU Reduced-Precision FPU Underdesigned Multiplier
Coarse Grained	Error P… Neural Acce… …g) 	Algorithm Selection Code Perforation Interpolated Memoization Neural Acceleration (ASIC, FPGA, GPU) Parallel Pattern Replacement Parameter Adjustment

REACT

A Framework for **R**apid **E**xploration of **A**pproximate **C**omputing **T**echniques



Application Profiler & Energy Model

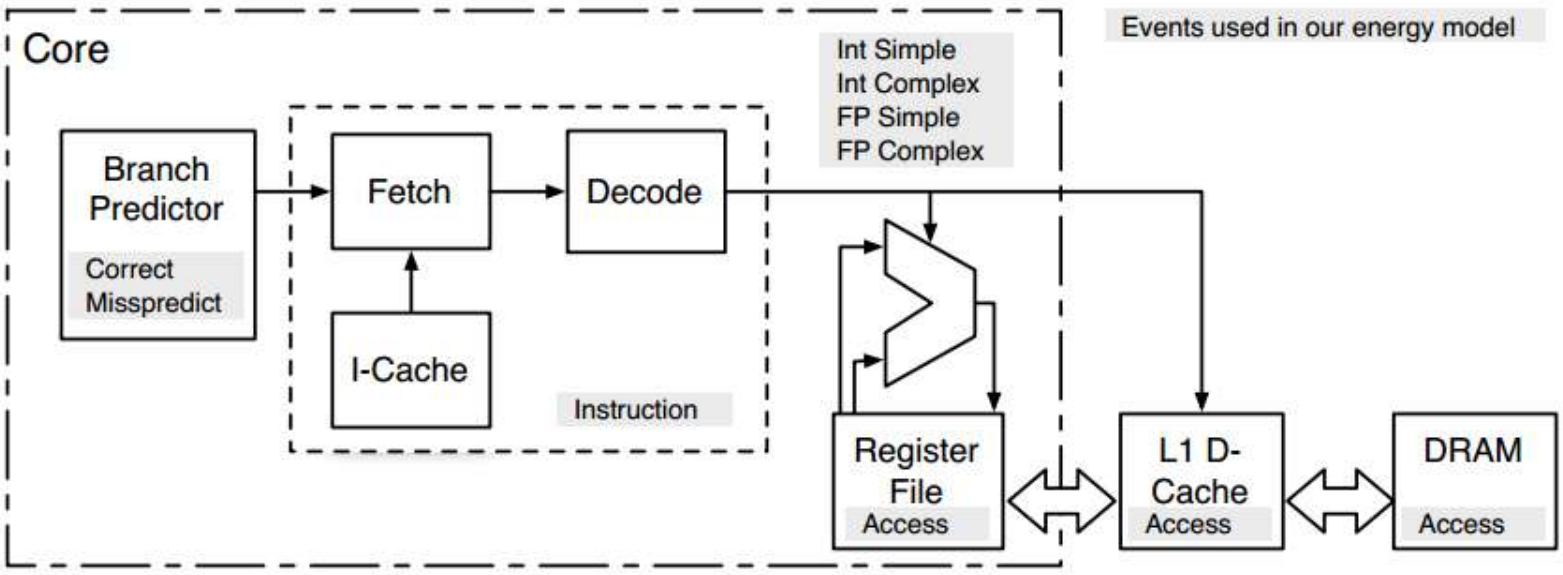
Intel Pin tool

Insn Count + Arch Events

Custom, linear model

Simple, understandable

Validated against McPAT



Error Injection

ACCEPT

Runtime error injection

Simple API

Arbitrary error models

```
int i, p;
APPROX int a;
APPROX int data[N];
a = data[i] * p;
```

Approximation Models

Load Value Approximation

Neural Acceleration

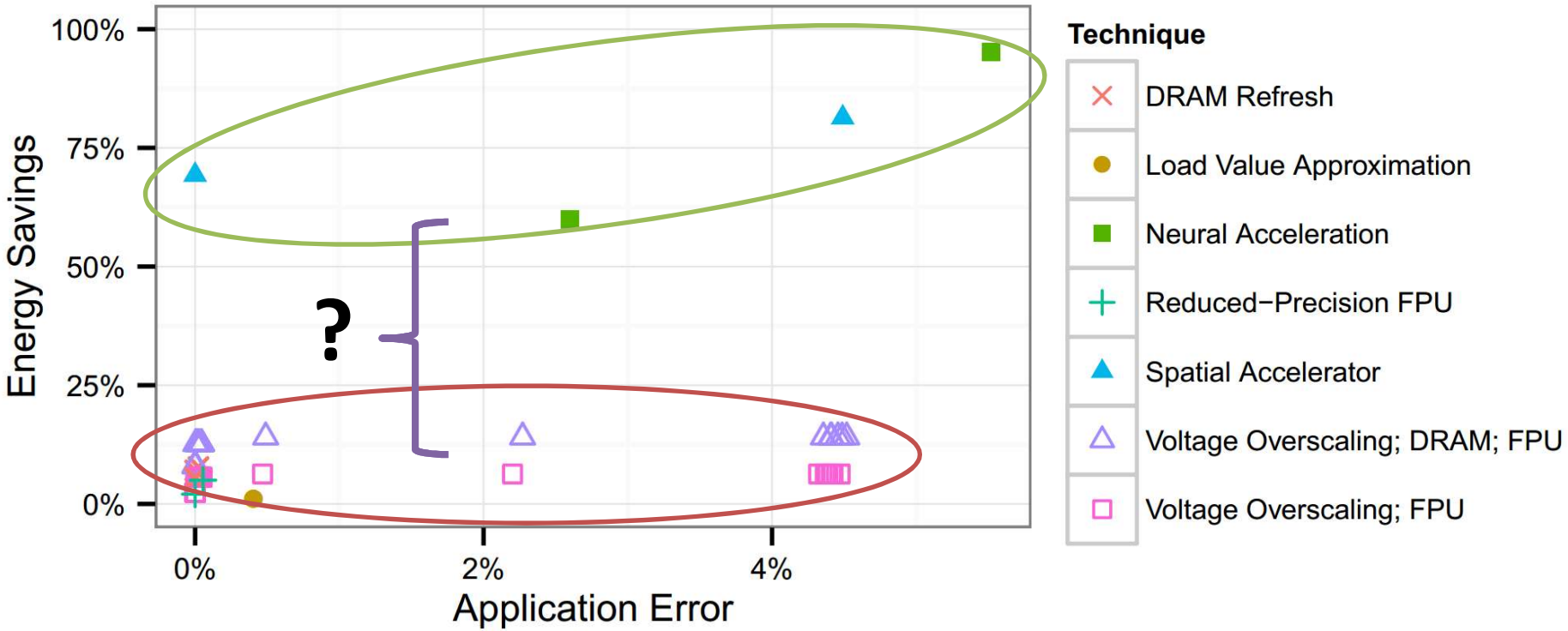
Drowsy SRAM

Reduced Precision FPU

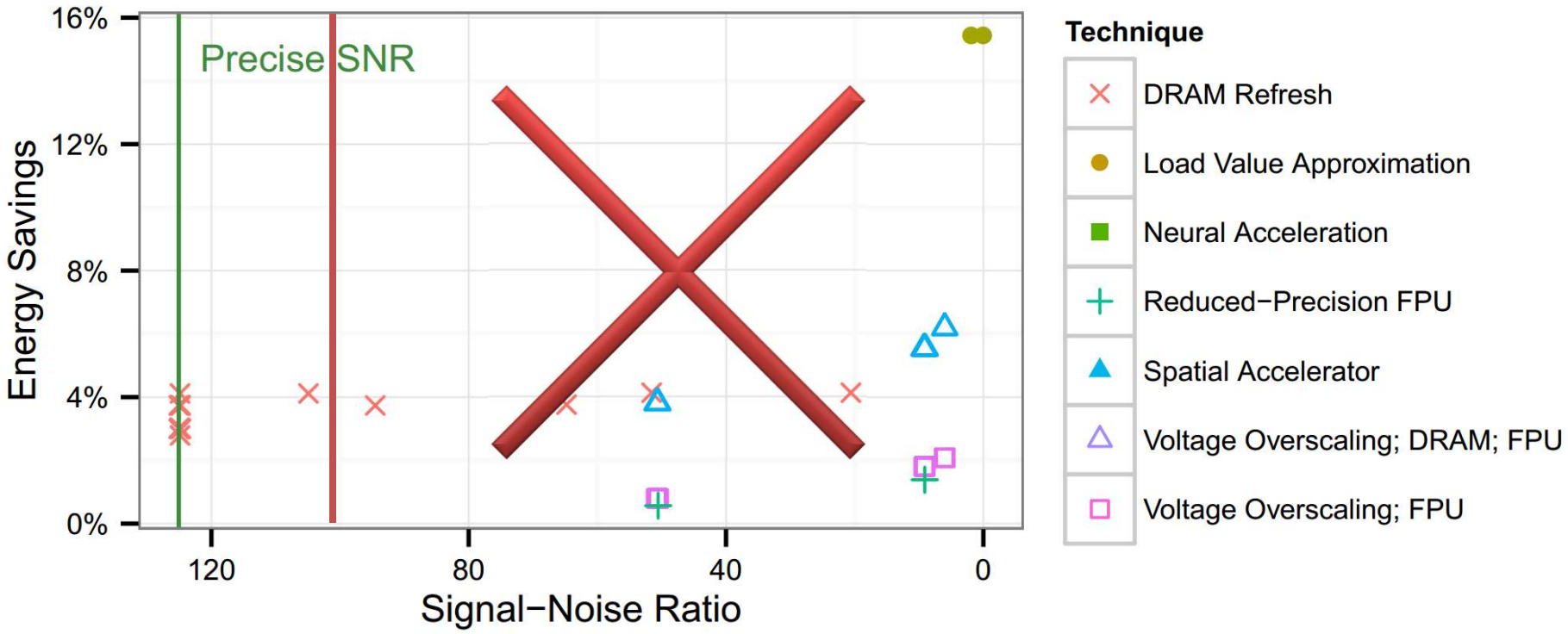
Low refresh rate DRAM

Voltage Overscaled ALU

Early Results - Sobel



Early Results – FFT1D



Conclusions

Coarse-grained superior to fine-grained

Coarse-grained, Nondeterministic!

Thank you!

Questions?