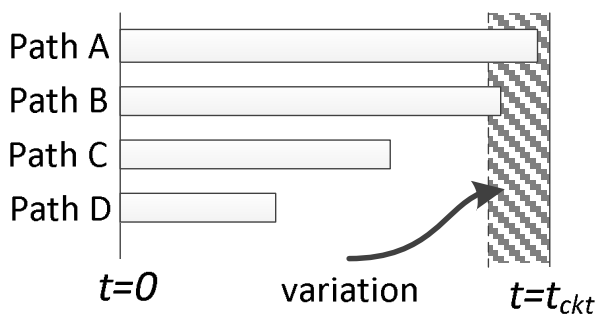


Bachelor/Master Thesis

Analog Design & Analysis of Basic Building Blocks for Approximate Computing



$$P_e(ckt) = P_e(A) \cup P_e(B)$$

Computer architecture is evolving with the workloads. Previous shifts in our workloads have led to introduction of alternative computing platforms such as GPUs and accelerators to address the changing characteristics. Modern applications have different characteristics than before: Error resilience.

Many modern application domains including decision making, computer vision, recognition, artificial intelligence (e.g. *deep neural networks*), data mining and synthesis show an intrinsic error tolerance in their computation. This tolerance can be attributed to characteristics such as attenuation of error through statistical methods or iterations. Approximate computing leverages application resilience to significantly improve energy and/or performance.

Existing research works have proposed relaxing synchronizations at task level, skipping non-critical computations at software level and reducing circuit precision/complexity or lowering the operation voltage at hardware level. These techniques are becoming an enabling technology for computing heavy workloads with limited resources (e.g. machine learning on smart phones). Commercial examples of reduced precision computing already started to appear (NVIDIA Tegra 1X & Volta, AMD Polaris, Google tensor processing unit, etc.).

In this thesis we will explore the basic building blocks used in every microchip such as the interconnect, memory and storage. We will characterize their error behavior under varying physical conditions (voltage, temperature).

Tasks:

- Implementation of basic building blocks using analog design tools
- Characterization of an ASIC library for temperature and voltages
- Analysis and characterization of energy, performance and accuracy trade-offs

Skills acquired with the Thesis:

- Implement realistic analog and mixed signal components, understand the effects of physical variations on the circuit level.
- Work in a research environment
- Technical writing
- Prior knowledge on Approximate Computing is **not** required

Required Knowledge:

- Analog design experience
- Cadence Virtuoso

Helpful skills (not required but helpful):

- Experience with EDA flow
- HSpice experience
- C/C++ and scripting skills

Start Date:

Immediately or within a couple of months

Supervision:

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