Bachelor's / Master's / Semester Project

Enabling Efficient Computation inside Memory

Context & background:

Data movement among computing and memory units in our current systems is a performance and/or energy bottleneck for almost all data-intensive workloads. Therefore, the computation in memory (CIM)[1] paradigm has been reignited to alleviate this problem. The CIM paradigm advocates a shift from traditional processor-centric systems to a more data-centric one where we place some compute units closer to or inside the memory where our data resides.

This project aims to further enable the paradigm shift toward CIM-enabled systems by proposing novel algorithms and specialized logic units in-memory systems, focusing on emerging memory technologies.

Expected effort:

This project can take shape as a semester, BSc, or MSc project.

In this project, the student will

- evaluate the benefits of executing several data-intensive applications inside or near memory units

- propose novel mechanisms to alleviate the data movement bottleneck and complexity of previous CIM-enabled designs

- develop simulation platforms to evaluate the proposals and previous works fairly

For preliminary readings please see:

- Seshadri, et al., "Ambit: In-memory accelerator for bulk bitwise operations using commodity DRAM technology." In MICRO, 2017.

- Xie, et al., "Scouting logic: A novel memristor-based logic design for resistive computing." In ISVLSI, 2017.

- Shafiee, et al., "ISAAC: A convolutional neural network accelerator with in-situ analog arithmetic in crossbars." ISCA, 2016.

- Ghose, et al., "Processing-in-memory: A workload-driven perspective." IBM Journal of Research and Development, 2019.

- Hamdioui, et al., "Memristor based computation-in-memory architecture for data-intensive applications." DATE, 2015.

Requirements:

- Outstanding programming skills

[1] Interchangeably known as Processing-in-Memory (PIM)

- Good knowledge of design and analysis of algorithms and data structures
- An interest in developing and evaluating new ideas, discovering why things do or do not work, making systems efficient and usable
- Strong work ethic

Plus Points:
- o Background in CIM
- o Background in computer architecture
- o Knowledge in spice simulation

Contact information:

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