MEng Design Project Announcement – 2018-19 AY

Project title: Co-Design for Digital Intelligence

Brief Description of Design Project Goals: The following projects are being offered in Dr. Zhang’s research group, where the main theme is building intelligent and highly efficient digital computing systems through co-design of algorithm, programming language, and hardware.

TOPIC I - [Algorithm]
Lightweight Deep Learning with Applications to Object Detection for Drones -- We will be building lightweight deep neural networks (DNNs) to enable fast and efficient object detection for drones. We have received a realistic training dataset provided by DJI. The first phase of the project explores quantization, sparsity, and dynamic pruning to optimize the DNN compute and memory efficiency without compromising accuracy. The second phase focuses on implementing the inference model on a low-power GPU or FPGA.

TOPIC II - [Programming Language]
Domain-Specific Programming for Data-Centric Computing -- We are developing a highly productive domain-specific programming language (DSL) for compute- and data-intensive applications that demand near- or in-memory computing. Some key features of the language include supporting joint compute and data placement, and providing clean abstraction for data quantization to explore trade-offs between accuracy and efficiency. We will implement these language features in a Python-Based DSL, and apply them on common kernels in machine learning and data analytics (such as recommendation systems).

TOPIC III - [Hardware]
Accelerating Machine Learning Workload on Cloud FPGAs -- This project investigates a reconfigurable hardware accelerator architecture targeting emerging machine learning applications, esp. those featuring both dense and sparse computation patterns. The proposed architecture consists of an array of parallel, lightweight, and rapidly programmable processing elements (PE) to achieve highly energy-efficient acceleration. We will extensively leverage the open-source RISC-V instruction set architecture (https://riscv.org) to realize the PE architecture.

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Number of MEng Students Needed: 2 students per topic

Required Skills: Comfortable with Python or C++ programming under Linux.
Interested in machine learning, parallel computing, and/or embedded systems.

Estimated Project Time Frame:
2018-19 Academic Year, Two (2) Semesters