

MARCO APOLINARIO

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ABOUT

Electronic Engineer interested in Hardware/Software Co-design for Brain-Inspired Computing. Previous experience developing bio plausible deep learning models, managing research projects and small teams, and working with multidisciplinary teams. Seeking a Research Engineering Internship position in Hardware for AI for Summer 2023.

EDUCATION

Purdue University, Graduate School of Electrical and Computer Engineering West Lafayette, IN
Ph.D. in Electrical and Computer Engineering (Expected graduation: December 2025) January 2021-Present
Advisor: Prof. Kaushik Roy – Research Topic: Brain-Inspired Computing – GPA: 3.9

National University of Engineering, School of Electrical and Electronics Engineering Lima, Peru
B.Sc. in Electronics Engineering – GPA: 3.5 – Rank: 3/28 March 2013-December 2017

RESEARCH EXPERIENCE

Purdue University – Center for Brain-Inspired Computing (C-BRIC) West Lafayette, IN
Graduate Research Assistant August 2021-Present

- Conducted research on neuro-inspired machine learning algorithms for emerging hardware.
- Designed a novel ADC-Less In-memory Computing Hardware for Spiking Neural Networks based on a HW/SW co-design approach achieving 2-7x energy and 9-24x latency improvements over conventional architectures.
- Implemented a quantization-aware training methodology for spiking neural networks with less than 3% performance degradation on image classification and gesture recognition tasks.

National Institute for Research and Training in Telecommunications (INICTEL-UNI) Lima, Peru
Research Assistant in Computer Vision July 2017-December 2020

- Developed several types of machine learning models for various applications, such as identification of timber species, underwater acoustic inversion, cloud segmentation in satellite images, and estimation of river levels.
- Embedded ML algorithms in low-power electronic systems to be used for real-time inference.
- Proposed a new lightweight CNN model to perform recognition of timber species on microscope images, achieving more than 90% accuracy on open-set scenarios.
- Produced three software copyright for remote sensing and health monitoring applications.
- Authored one journal paper and three conference papers.

RELEVANT RESEARCH PROJECTS

Hardware/Software co-design of In-memory Computing for Spiking Neural Networks December 2021-Present

- Designed energy-efficient In-memory Computing hardware for spiking neural networks (SNN) to deploy such models for real-time edge applications achieving low latency and energy consumption.

Open-Set Recognition of Peruvian Timber Species January 2018-March 2020

- Produced one low-power field-deployable electronic prototype to perform open-set recognition of 16 Peruvian timber species in real-time with high accuracy based on a lightweight convolutional neural network.

Software for Cloud Segmentation of PERUSAT-1 Multispectral Satellite Images July 2019-December 2019

- Developed a software product for the Space Agency of Peru (CONIDA) to generate accurate cloud masks over PERUSAT-1 images (high-resolution multispectral satellite images) based on deep learning models.

PUBLICATIONS

- **Apolinario, M., A. Kosta, U. Saxena, and K. Roy** (Under Review, 2022). “Hardware/Software co-design with ADC-Less In-memory Computing Hardware for Spiking Neural Networks”. ArXiv: [10.48550/arxiv.2211.02167](https://arxiv.org/abs/10.48550/arxiv.2211.02167).

- Biswas, S., A. Kosta, C. Liyanagedera, **M. Apolinario**, and K. Roy (Under Review, 2022). “HALSIE – Hybrid Approach to Learning Segmentation by Simultaneously Exploiting Image and Event Modalities”. ArXiv: [10.48550/arxiv.2211.10754](https://arxiv.org/abs/10.48550/arxiv.2211.10754).
- **Apolinario, M.**, D. Urcia, and S. Huaman (2019). “Open Set Recognition of Timber Species Using Deep Learning for Embedded Systems”. In IEEE Latin America Transactions.
- López, L., **M. Apolinario**, and S. Huamán (2019). “Method of Estimating River Levels with Reflective Tapes Using Artificial Vision Techniques”. In the 5th Brazilian Technology Symposium (BTSym).
- **Apolinario, M.**, S. Huamán, G. Morales, and D. Diaz (2019). “Estimation of 2D Velocity Model using Acoustic Signals and Convolutional Neural Networks”. In IEEE International Conference on Electronics, Electrical Engineering and Computing.
- **Apolinario, M.**, S. Huamán, and G. Orellana (2018). “Deep Learning Applied to Identification of Commercial Timber Species from Peru”. In IEEE International Conference on Electronics, Electrical Engineering and Computing.

RELEVANT COURSEWORK

- **VLSI design courses:** Advanced VLSI Design (Spring’22), MOS VLSI Design (Fall’21), Solid State Devices (Spring’21).
- **Computer Science courses:** Artificial Intelligence (Fall’21), Computational Methods in Optimization (Spring’22).

ACADEMIC PROJECTS

Multi-bit dot-product operation with SRAM-cells [ECE695 – Advanced VLSI Design] Spring 2022

- Implemented an analog-like in-memory multi-bit dot-product engine using standard 8T-SRAM cells.
- Skills: Cadence Virtuoso, mixed-signal design, and corner analysis.

Compressed Sensing Algorithms [CS520 – Computational Methods in Optimization] Spring 2022

- Programmed, compared, and applied three compressed sensing algorithms (OMP, GPSR, and SpaRSA) for audio signal compression, image reconstruction, and image classification applications.
- Skills: Python programming and optimization analysis.

In-memory bitwise NOR operation with 8T-SRAM [ECE559 – MOS VLSI Design] Fall 2021

- Designed and simulated a 128x16 8T-SRAM array to perform in-memory bitwise NOR operations.
- Skills: Cadence Virtuoso, layout design, and schematic design.

Near-Lossless Analog to Spiking Neural Networks Conversion [ECE570 – Artificial Intelligence] Fall 2021

- Studied the role of reset mechanism in ANN-to-SNN conversion schemes to train deep spiking networks.
- Skills: Python programming, PyTorch, and Deep Neural Networks.

AWARDS

- **Fully funded Graduate Peruvian Fellowship “Beca Generacion del Bicentenario” (2020):** Awarded to outstanding young Peruvian professionals by the Peruvian Ministry of Education.
- **“Julio Urbina Arias” Award (2017):** Awarded to outstanding student member in research and projects of the IEEE Student Branch at the National University of Engineering, Lima, Peru.

TECHNICAL STRENGTHS

Programming Skills: Python, C++, VHDL/Verilog, Pytorch, Tensorflow/Keras.

Software and Additional Applications: Cadence Virtuoso, Quartus Prime, and Eagle PCB.

Spoken Languages: Spanish (Native), English (Professional working proficiency).