Prof. Joshua San Miguel

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Department of Electrical and Computer Engineering
UNIVERSITY OF WISCONSIN-MADISON

Faculty Appointment

Associate Professor — June 2024 - Present
Electrical and Computer Engineering
University of Wisconsin-Madison

Assistant Professor — January 2018 - June 2024
Electrical and Computer Engineering
University of Wisconsin-Madison

Affiliate Professor — May 2018 - Present
Computer Sciences
University of Wisconsin-Madison

Education

PhD — September 2012 – August 2017
Electrical and Computer Engineering
University of Toronto
Advisor: Natalie Enright Jerger

BASc in Engineering Science with Honours — September 2007 – April 2012
Electrical and Computer Engineering
University of Toronto

Research Interests

Processor architectures
Approximate computing
Stochastic and unary computing
Intermittent computing for energy-harvesting systems
Interconnection networks
Cache and memory systems
Neuromorphic architectures

Awards and Honors

CoE Award for Excellence in Graduate Student Mentoring Finalist	2025
ECE Outstanding Graduate Student Mentoring Award	2025
ISCA Best Paper Award Honorable Mention	2025
IEEE Micro Top Picks Honorable Mention	2025
Benjamin Smith Reynolds Award for Excellence in Teaching	2025
ASPLOS Distinguished Artifact Award	2024
ISCA Best Paper Award	2022
SC Best Paper Award Nominee	2021
Gerald Holdridge Excellence in Teaching Award	2021
NSF CAREER Award	2021
IEEE Micro Top Picks	2021
Grainger Faculty Scholarship Award	2020
IEEE Micro Top Picks Honorable Mention	2017
IBM PhD Fellowship	2016
IEEE Micro Top Picks	2016
HiPEAC Paper Award	2015
NOCS Best Paper Award Nominee	2015

Queen Elizabeth II/Montrose Werry Scholarship in Science and Technology 2015
Bell Graduate Scholarship 2014

Professional Service

Board of Directors — Computing Research Association - Education
Advisory Committee — Wisconsin Sloan Center for System Change
Organizer — Undergrad Architecture Mentoring Workshop 2020-2025
General Chair — NOCS 2022
Technical Program Chair — NOCS 2021
Program Chair — Workshop on Approximate Computing Across the Stack, ASPLOS 2020
ACM SRC Chair — MICRO 2019
Student Travel Grant Chair — ISPASS 2019
Finance Chair — ASPLOS 2019
Guest Editor — Special Issue on Approximate Computing, IEEE Micro 2018
Program Committee — ASPLOS, CASES, DAC, HPCA, IISWC, IPDPS, ISCA, ISPASS, LCTES, MICRO

Publications — Book Chapters

Approximate Cache Architectures
Natalie Enright Jerger and Joshua San Miguel
Chapter in Approximate Circuits, Springer, 2019

Publications — Refereed Conferences

The XOR Cache: A Catalyst for Compression
Zhewen Pan and Joshua San Miguel
ACM/IEEE International Symposium on Computer Architecture (ISCA), June 2025, 14 pages, 23.2% acceptance
// Best Paper Award Honorable Mention

The Spatial Effect of the Pinna for Neuromorphic Speech Denoising
Ranganath Selagamsetty, Joshua San Miguel and Mikko Lipasti
IEEE Neuro-Inspired Computational Elements Conference (NICE), March 2025, 10 pages

TaroRTL: Accelerating RTL Simulation using Coroutine-based Heterogeneous Task Graph Scheduling
Dian-Lun Lin, Umit Ogras, Joshua San Miguel and Tsung-Wei Huang
International European Conference on Parallel and Distributed Computing (Euro-Par), August 2024, 15 pages

Carat: Unlocking Value-Level Parallelism for Multiplier-Free GEMMs
Zhewen Pan, Joshua San Miguel and Di Wu
ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), April 2024, 17 pages
// IEEE Micro Top Picks 2025 Honorable Mention
// Distinguished Artifact Award

NvMR: Non-Volatile Memory Renaming for Intermittent Computing
Abhishek Bhattacharyya, Abhijith Somashekhar and Joshua San Miguel
ACM/IEEE International Symposium on Computer Architecture (ISCA), June 2022, 13 pages, 16.8% acceptance
// Best Paper Award

uBrain: A Unary Brain Computer Interface
Di Wu, Jingjie Li, Zhewen Pan, Younghyun Kim and Joshua San Miguel
ACM/IEEE International Symposium on Computer Architecture (ISCA), June 2022, 14 pages, 16.8% acceptance

uSystolic: Byte-Crawling Unary Systolic Array
Di Wu and Joshua San Miguel
IEEE International Symposium on High-Performance Computer Architecture (HPCA), April 2022, 13 pages, 30.5% acceptance

Stay in Your Lane: A NoC with Low-Overhead Multi-Packet Bypassing
Hossein Farrokhbakht, Paul Gratz, Tushar Krishna, Joshua San Miguel and Natalie Enright Jerger
IEEE International Symposium on High-Performance Computer Architecture (HPCA), April 2022, 14 pages, 30.5% acceptance

Streaming Accuracy: Characterizing Early Termination in Stochastic Computing
Hsuan Hsiao, Joshua San Miguel and Jason Anderson
Asia and South Pacific Design Automation Conference (ASP-DAC), January 2022, 6 pages, 36.5% acceptance

SEEC: Stochastic Escape Express Channel
Mayank Parasar, Natalie Enright Jerger, Paul Gratz, Joshua San Miguel and Tushar Krishna
International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), November 2021, 12 pages, 23.6% acceptance
// Best Paper Award Nominee

UNO: Virtualizing and Unifying Nonlinear Operations for Emerging Neural Networks
Di Wu, Jingjie Li, Setareh Behroozi, Younghyun Kim and Joshua San Miguel
ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), July 2021, 6 pages

Pitstop: Enabling a Virtual Network Free Network-On-Chip
Hossein Farrokhbakht, Henry Kao, Kamran Hasan, Paul Gratz, Tushar Krishna, Joshua San Miguel and Natalie Enright Jerger
IEEE International Symposium on High-Performance Computer Architecture (HPCA), February 2021, 14 pages, 24.4% acceptance

Normalized Stability: A Cross-Level Design Metric for Early Termination in Stochastic Computing
Di Wu, Ruokai Yin and Joshua San Miguel
Asia and South Pacific Design Automation Conference (ASP-DAC), January 2021, 6 pages, 34.2% acceptance

Zero Correlation Error: A Metric for Finite-Length Bitstream Independence in Stochastic Computing
Hsuan Hsiao, Joshua San Miguel, Yuko Hara-Azumi and Jason Anderson
Asia and South Pacific Design Automation Conference (ASP-DAC), January 2021, 6 pages, 34.2% acceptance

Bufferless NoCs with Scheduled Deflection Routing
Chen Chen, Zirui Tao and Joshua San Miguel
ACM/IEEE International Symposium on Networks-On-Chip (NOCS), September 2020, 6 pages

CAP'NN: Class-Aware Personalized Neural Network Inference
Maedeh Hemmat, Joshua San Miguel and Azadeh Davoodi
ACM/ESDA/IEEE Design Automation Conference (DAC), July 2020, 6 pages, 23% acceptance

uGEMM: Unary Computing Architecture for GEMM Applications
Di Wu, Jingjie Li, Ruokai Yin, Hsuan Hsiao, Younghyun Kim and Joshua San Miguel
ACM/IEEE International Symposium on Computer Architecture (ISCA), May 2020, 13 pages, 18.3% acceptance
// IEEE Micro Top Picks 2021

DRAIN: Deadlock Removal for Arbitrary Irregular Networks
Mayank Parasar, Hossein Farrokhbakht, Natalie Enright Jerger, Paul Gratz, Tushar Krishna and Joshua San Miguel
IEEE International Symposium on High-Performance Computer Architecture (HPCA), February 2020, 13 pages, 19.4% acceptance

CRANIA: Unlocking Data and Value Reuse in Iterative Neural Network Architectures
Maedeh Hemmat, Tejas Shah, Yuhua Chen and Joshua San Miguel
Asia and South Pacific Design Automation Conference (ASP-DAC), January 2020, 6 pages, 34.4% acceptance

SWAP: Synchronized Weaving of Adjacent Packets for Network Deadlock Resolution
Mayank Parasar, Natalie Enright Jerger, Paul Gratz, Joshua San Miguel and Tushar Krishna

ACM/IEEE International Symposium on Microarchitecture (MICRO), October 2019, 13 pages, 23.0% acceptance

SECO: A Scalable Accuracy Approximate Exponential Function Via Cross-Layer Optimization
Di Wu, Tianen Chen, Chienfu Chen, Oghenefego Ahia, Joshua San Miguel, Mikko Lipasti and Younghyun Kim
ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), July 2019, 6 pages

In-Stream Stochastic Division and Square Root via Correlation
Di Wu and Joshua San Miguel
ACM/ESDA/IEEE Design Automation Conference (DAC), June 2019, 6 pages, 24.8% acceptance

The What's Next Intermittent Computing Architecture
Karthik Ganesan, Joshua San Miguel and Natalie Enright Jerger
IEEE International Symposium on High-Performance Computer Architecture (HPCA), February 2019, 13 pages, 19.7% acceptance

The EH Model: Early Design Space Exploration of Intermittent Processor Architectures
Joshua San Miguel, Karthik Ganesan, Mario Badr, Chunqiu Xia, Rose Li, Hsuan Hsiao and Natalie Enright Jerger
ACM/IEEE International Symposium on Microarchitecture (MICRO), October 2018, 13 pages, 21.1% acceptance

The Bunker Cache for Spatio-Value Approximation
Joshua San Miguel, Jorge Albericio, Natalie Enright Jerger and Aamer Jaleel
ACM/IEEE International Symposium on Microarchitecture (MICRO), October 2016, 12 pages, 21.6% acceptance

The Anytime Automaton
Joshua San Miguel and Natalie Enright Jerger
ACM/IEEE International Symposium on Computer Architecture (ISCA), June 2016, 13 pages, 19.9% acceptance
// IEEE Micro Top Picks 2017 Honorable Mention

The Runahead Network-On-Chip
Zimo Li, Joshua San Miguel and Natalie Enright Jerger
IEEE International Symposium on High-Performance Computer Architecture (HPCA), March 2016, 12 pages, 22.1% acceptance

Doppelganger: A Cache for Approximate Computing
Joshua San Miguel, Jorge Albericio, Andreas Moshovos and Natalie Enright Jerger
ACM/IEEE International Symposium on Microarchitecture (MICRO), December 2015, 12 pages, 21.6% acceptance

The Inner Most Loop Iteration Counter: A New Dimension in Branch History
Andre Seznec, Joshua San Miguel and Jorge Albericio
ACM/IEEE International Symposium on Microarchitecture (MICRO), December 2015, 11 pages, 21.6% acceptance
// IEEE Micro Top Picks 2016
// HiPEAC Paper Award

Data Criticality in Network-On-Chip Design
Joshua San Miguel and Natalie Enright Jerger
ACM/IEEE International Symposium on Networks-On-Chip (NOCS), September 2015, 8 pages
// Best Paper Award Nominee

Load Value Approximation
Joshua San Miguel, Mario Badr and Natalie Enright Jerger
ACM/IEEE International Symposium on Microarchitecture (MICRO), December 2014, 13 pages, 19.4% acceptance

Wormhole: Wisely Predicting Multidimensional Branches
Jorge Albericio, Joshua San Miguel, Natalie Enright Jerger and Andreas Moshovos
ACM/IEEE International Symposium on Microarchitecture (MICRO), December 2014, 12 pages, 19.4% acceptance

Publications — Refereed Journals and Magazines

Camouflage: Utility-Aware Obfuscation for Accurate Simulation of Sensitive Program Traces
Asmita Pal, Keerthana Desai, Rahul Chatterjee and Joshua San Miguel
ACM Transactions on Architecture and Code Optimization, May 2024, 23 Pages

CAP'NN: A Class-Aware Framework for Personalized Neural Network Inference
Maedeh Hemmat, Joshua San Miguel and Azadeh Davoodi
ACM Transactions on Embedded Computing Systems, December 2022, 24 pages

As-Is Approximate Computing
Mitali Soni, Asmita Pal and Joshua San Miguel
ACM Transactions on Architecture and Code Optimization, November 2022, 26 Pages

In-Stream Correlation-Based Division and Bit-Inserting Square Root in Stochastic Computing
Di Wu, Ruokai Yin and Joshua San Miguel
IEEE Design and Test, December 2021, 7 pages

AirNN: A Featherweight Framework for Dynamic Input-Dependent Approximation of CNNs
Maedeh Hemmat, Joshua San Miguel and Azadeh Davoodi
IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, October 2021, 14 pages

uGEMM: Unary Computing for GEMM Applications
Di Wu, Jingjie Li, Ruokai Yin, Hsuan Hsiao, Younghyun Kim and Joshua San Miguel
IEEE Micro, May–June 2021, 7 pages

SHASTA: Synergic HW-SW Architecture for Spatio-Temporal Approximation
Gokul Subramanian Ravi, Joshua San Miguel and Mikko Lipasti
ACM Transactions on Architecture and Code Optimization, September 2020, 26 pages

Value Locality Based Approximation with ODIN
Rahul Singh, Gokul Subramanian Ravi, Mikko Lipasti and Joshua San Miguel
IEEE Computer Architecture Letters, September–December 2020, 4 pages

The EH Model: Analytical Exploration of Energy-Harvesting Architectures
Joshua San Miguel, Karthik Ganesan, Mario Badr and Natalie Enright Jerger
IEEE Computer Architecture Letters, January–June 2018, 4 pages

A Taxonomy of General Purpose Approximate Computing Techniques
Thierry Moreau, Joshua San Miguel, Mark Wyse, James Bornholt, Armin Alaghi, Luis Ceze, Natalie Enright Jerger and Adrian Sampson
IEEE Embedded Systems Letters, March 2018, 4 pages

Practical Multidimensional Branch Prediction
Andre Seznec, Joshua San Miguel and Jorge Albericio
IEEE Micro, May–June 2016, 10 pages

Publications — Refereed Workshops

Characterizing Memory Side Channels in FHE Applications
Asmita Pal, Karthik Swaminathan, Subhankar Pal and Joshua San Miguel
Workshop on Data Integrity and Secure Cloud Computing (DISCC), October 2022, 3 pages

Ghostwriter: A Cache Coherence Protocol for Error-Tolerant Applications
Henry Kao, Joshua San Miguel and Natalie Enright Jerger
Workshop on Embedded Multicore Systems (ICPP-EMS), August 2021, 10 pages

The What's Next Computing Architecture
Karthik Ganesan, Joshua San Miguel and Natalie Enright Jerger
Workshop on Approximate Computing Across the Stack (WAX), March 2018, 3 pages

Texture Cache Approximation on GPUs
Mark Sutherland, Joshua San Miguel and Natalie Enright Jerger
Workshop on Approximate Computing Across the Stack (WAX), June 2015, 3 pages

Wormhole Branch Prediction using Multi-Dimensional Histories
Jorge Albericio, Joshua San Miguel, Natalie Enright Jerger and Andreas Moshovos
Championship Branch Prediction (CBP-4), June 2014, 4 pages

Load Value Approximation: Approaching the Ideal Memory Access Latency
Joshua San Miguel and Natalie Enright Jerger
Workshop on Approximate Computing Across the System Stack (WACAS), March 2014, 6 pages

Publications — Technical Reports

A Systolic Approach to Deriving Anytime Algorithms for Approximate Computing
Joshua San Miguel, Vijayalakshmi Srinivasan, Ravi Nair and Daniel A. Prener
IBM Research Report RC25600, April 2016

A Taxonomy of Approximate Computing Techniques
Thierry Moreau, Joshua San Miguel, Mark Wyse, James Bornholt, Luis Ceze, Natalie Enright Jerger and Adrian Sampson
UW CSE Technical Report UW-CSE-2016-03-01, March 2016

Publications — Invited

When Dataflows Converge: Reconfigurable and Approximate Computing for Emerging Neural Networks
Di Wu and Joshua San Miguel
IEEE International Conference on Computer Design (ICCD), October 2021, 4 pages

Approximate Hardware Techniques for Energy-Quality Scaling Across the System
Younghyun Kim, Joshua San Miguel, Setareh Behroozi, Tianen Chen, Kyuin Lee, Yongwoo Lee, Jingjie Li and Di Wu
IEIE/IEEE International Conference on Electronics, Information and Communication (ICEIC), January 2020

PhD Dissertation

Reading Between the Bits: Uncovering New Insights in Data for Efficient Processor Design
Joshua San Miguel
University of Toronto, November 2017
// Nominated by ECE Department for ACM Doctoral Dissertation Award
// Nominated by ECE Department for CGS/ProQuest Distinguished Dissertation Award
// Nominated by ECE Department for Governor General's Gold Medal

Employment

Postdoctoral Researcher — September 2017 – December 2017
Electrical and Computer Engineering
University of Toronto, Toronto, ON

Research Assistant — September 2012 - August 2017
Electrical and Computer Engineering
University of Toronto, Toronto, ON

Teaching Assistant — September 2012 - December 2016
Electrical and Computer Engineering
University of Toronto, Toronto, ON

Research Summer Intern — June 2015 – September 2015
Exploratory Systems Architecture
IBM TJ Watson Research Center, Yorktown Heights, NY

Embedded Systems Software Developer, Intern — May 2010 – August 2011
OS Power Team, R&D
BlackBerry Limited, Waterloo, ON

Embedded Systems Software Developer, Co-op — May 2009 – August 2009
OS Platform Support Team, R&D
BlackBerry Limited, Waterloo, ON

Teaching

ECE/CS 352 — Fall 2025
Digital System Fundamentals

ECE/CS 757 — Spring 2025
Advanced Computer Architecture II

ECE 454 — Fall 2024
Mobile Computing Laboratory

ECE/CS 757 — Spring 2024
Advanced Computer Architecture II

ECE/CS 552 — Fall 2023
Introduction to Computer Architecture

ECE/CS 252 — Spring 2023
Introduction to Computer Engineering

ECE/CS 757 — Fall 2022
Advanced Computer Architecture II

ECE/CS 252 — Spring 2022
Introduction to Computer Engineering

ECE 554 — Fall 2021
Digital Engineering Laboratory

ECE/CS 757 — Spring 2021
Advanced Computer Architecture II

ECE/CS 552 — Fall 2020
Introduction to Computer Architecture

ECE/CS 757 — Spring 2020
Advanced Computer Architecture II

ECE/CS 552 — Fall 2019
Introduction to Computer Architecture

ECE/CS 752 — Spring 2019
Advanced Computer Architecture I

ECE/CS 552 — Fall 2018
Introduction to Computer Architecture

ECE/CS 757 — Spring 2018
Advanced Computer Architecture II

Former Students

Sri Harsha Bandaru — MS in ECE, 2025
First Employment: Qualcomm

Shubha Balgi — MS in ECE, 2024
First Employment: Nvidia

Brathindara Suresh — MS in ECE, 2024
First Employment: AMD

Di Wu — PhD in ECE, 2023
First Employment: Assistant Professor, UCF

Ayushi Soni — MS in ECE, 2023
First Employment: Ventana Micro Systems

Lipika Garg — MS in ECE, 2023
First Employment: Nvidia

Sufyan Khan — MS in ECE, 2023
First Employment: Rivos, Inc.

Sruthi Ganesh — MS in ECE, 2023
First Employment: Google

Prajyot Gupta — MS in ECE, 2022
First Employment: Nvidia

Winor Chen — MS in ECE, 2022
First Employment: AMD

Ruokai Yin — BS in ECE, 2021
First Employment: PhD, Yale

Yuhua Chen — MS in ECE, 2021
First Employment: Arm

Keerthana Desai — MS in ECE, 2021
First Employment: Google

Abhijith Somashekhar — MS in ECE, 2021
First Employment: Apple

Giri Prasanna Mugunda Krishnan — MS in CS, 2020
First Employment: Samsung

Rahul Singh — MS in ECE, 2020
First Employment: PhD, UIUC

Shivangi Kamat — MS in ECE, 2020
First Employment: Intel

Chen Chen — MS in ECE, 2020
First Employment: PhD, Texas A&M

Tejas Shah — MS in ECE, 2020
First Employment: Nvidia

Rui Liang — BS in ECE, 2020
First Employment: Qualcomm

Yuhua Chen — BS in ECE, 2019
First Employment: MS, UW-Madison

Mitali Soni — MS in ECE, 2019
First Employment: Google

Oghenefego Ahia — MS in ECE, 2019

First Employment: Google

Ram Prasad MS in CS, 2019
First Employment: Arm