

# Deeksha Dangwal

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## Research Summary

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I work in computer architecture, and broadly, I am interested in privacy in computer systems. Currently, I am exploring privacy of program traces; the intent is to minimize information leakage in program traces when sharing program behavior. The key tradeoff is balancing number of bits leaked while maintaining utility of traces shared.

Previously, I have worked on [PyRTL](#), a Python-based RTL specification language, and built the [OpenTPU](#) on it. I have also worked on [Charm](#), a high-level architecture modeling language. During my internship at Microsoft Research, I implemented parameterizable architecture-aware machine learning graph primitives for custom hardware instructions.

## Education

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**University of California, Santa Barbara** **2016-Present**

*Doctor of Philosophy, Department of Computer Science*

Advised by [Dr. Timothy Sherwood](#); member of the [ArchLab](#)

**University of California, Santa Barbara** **2014-2016**

*Master of Science, Department of Electrical and Computer Engineering*

**M. S. Ramaiah Institute of Technology** **2010-2014**

*Bachelor of Engineering, Department of Instrumentation and Electronics*

## Experience

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**Graduate Student Researcher, ArchLab, UC Santa Barbara** **Sept. 2015-Present**

Advised by [Dr. Timothy Sherwood](#)

- Safer program behavior sharing with Trace Wringing
- Examining and Quantifying Crosstalk Leakage in USB Protocols
- High-level architecture modeling with Charm
- Evaluating architectures for cryptographic algorithms
- Pythonic RTL design with PyRTL

**Research Intern, Microsoft, Redmond, WA** **June-Sept. 2018**

Advised by [Dr. Eric Chung](#) and [Dr. Jeremy Fowers](#), Silicon Systems Futures, Brainwave Team

- Implemented parameterizable architecture-aware machine learning graph primitives for custom hardware instructions
- Wrote tools to automatically convert hardware instructions to high-level graph primitives for machine learning models that remain true-to-hardware
- Designed computational experiments to compare and verify accuracy of neural network models

**Research Assistant, Oracle Labs, Austin, TX** **June-Sept. 2016**

- Setup testing environment for measuring throughput of network of RAPID Data Processing Unit (DPU), a bandwidth-optimized architecture for big data computation.
- The DPU provides acceleration for core-core communication via a unique hardware RPC mechanism. I implemented network congestion tests for best and worst case traffic conditions.

## Conference Publications

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### [Safer Program Behavior Sharing through Trace Wringing](#)

*D. Dangwal, W. Cui, J. McMahan, T. Sherwood*

Proceedings of the 24th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), April 2019, Providence, RI

### [Charm: A Language for Closed-form High-level Architecture Modeling](#)

*W. Cui, Y. Ding, D. Dangwal, A. Holmes, J. McMahan, A. JavadiAbhari, G. Tzimpragos, F. Chong, T. Sherwood*

Proceedings of the 45th International Symposium on Computer Architecture (ISCA), June 2018, Los Angeles, CA

### **A Pythonic Approach for Rapid Hardware Prototyping and Instrumentation**

*J. Clow, G. Tzimpragos, D. Dangwal, S. Guo, J. McMahan, and T. Sherwood*

Proceedings of the International Conference on Field-Programmable Logic and Applications (FPL), September 2017, Ghent, Belgium.

## **Workshops Publications, Posters, and Presentations**

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### **Prototyping ML Accelerators with PyRTL**

*D. Dangwal*

Neural Inspired Computing - Systems & Applications track, IEEE Space Computing Conference (SCC), July 2019, Caltech, Pasadena, CA. **(Invited Talk)**

### **PyRTLMatrix: an Object-Oriented Hardware Design Pattern for Prototyping ML Accelerators**

*D. Aboye, D. Kupsh, M. Lim, J. Mai, D. Dangwal, D. Mirza and T. Sherwood*

The 4th Workshop on Energy Efficient Machine Learning and Cognitive Computing for Embedded Applications (EMC2) held in conjunction with 46th International Symposium on Computer Architecture (ISCA), June 2019, Phoenix, AZ. **(Paper and Presentation)**

### **PyRTL in Early Undergraduate Research**

*D. Mirza, D. Dangwal, T. Sherwood*

Workshop on Computer Architecture Education (WCAE) held in conjunction with 46th International Symposium on Computer Architecture (ISCA), June 2019, Phoenix, AZ. **(Paper and Presentation)**

### **PyRTL: Hardware design for the masses**

*D. Dangwal, J. Clow, G. Tzimpragos, J. McMahan, S. Guo, and T. Sherwood*

Career Workshop for Women and Minorities in Computer Architecture (CWWMCA) held in conjunction with International Symposium on Microarchitecture (MICRO), November 2017. Cambridge, MA. **(Poster and Presentation)**

### **Novel Neural Computing Architectures**

*D. Dangwal, A. Rajagopal, and T. Sherwood*

CRA-W Grad Cohort Poster Session, Washington, D.C., April 2017. **(Poster)**

### **Cultivating Students' Interest in STEM**

*D. Dangwal and C. Endacott*

Tech Savvy Conference, UC Santa Barbara, May 2017 and May 2018. **(Presentation)**

## **Mentorship and Teaching**

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### **NSF ERSP Mentor, Department of Computer Science, UCSB**

**Oct. 2018-June 2019**

The Early Research Scholars Program (ERSP) is an academic-year, team-based research apprenticeship program that places special emphasis on mentoring women and underrepresented groups in the second year of their studies.

- o Mentored and hosted a team of four UCSB Computer Science sophomores at the ArchLab
- o The students submitted and presented "PyRTLMatrix: an Object-Oriented Hardware Design Pattern for Prototyping ML Accelerators" in the 4th Workshop on Energy Efficient Machine Learning and Cognitive Computing for Embedded Applications (EMC2) held in conjunction with 46th International Symposium on Computer Architecture (ISCA), June 2019, Phoenix, AZ

### **Women in STEM Mentorship Program, UCSB**

**Oct. 2016-March 2018**

Mentored undergraduate women in the Computer Science program. Mentorship included monthly meetings and weekly email discussions about various issues, both technical and non-technical.

### **Teaching Assistant, Research Mentorship Program (RMP), UCSB**

**June-Aug. 2019**

Teaching assistant for Research Methods in STEM for RMP summer program that engages high-achieving high school students in hands-on, university-level research.

### **EUREKA Mentorship Program, California NanoSystems Institute (CNSI), UCSB**

**June-Aug. 2015**

- o Designed summer research project in hardware security: hardware implementation of AES-128 in PyRTL and mentored a UCSB ECE sophomore student

Teaching Assistant, Department of Physics, UC Santa Barbara  
PHYS 6AL, PHYS 6BL (Experimental Physics)

Jan.-June 2015

Grader, Department of Physics, UC Santa Barbara  
PHYS 132, Stellar structures and evolution

Sept.-Dec. 2014

## Activities

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**Co-President, Women in Computer Science (WiCS)**, Department of Computer Science, UCSB 2018-2020  
WiCS is a student-run group open to students, staff, and alumni in the Computer Science department at UCSB. It organizes social, mentoring and outreach events to connect with women in technology in and around the Santa Barbara area.

**Graduate Representative for Diversity**, Department of Computer Science, UCSB 2018-2019  
The Diversity Committee is responsible for coordinating outreach and diversity efforts in the department. As the graduate student representative, I was the interface between the committee and diversity-promoting groups within the department, such as Women in Computer Science (WiCS).

**Grace Hopper Celebration of Women** October 2017, 2018, 2019  
Awarded department scholarship to attend Grace Hopper Celebration of women.

**CRA-W Grad Cohort** April 2017, 2018  
Awarded travel scholarship to attend the workshop.

**Cultivating Students' Interest in STEM**, Tech Savvy Conference, UCSB May 2017, April 2018  
Tech Savvy is an annual conference at UC Santa Barbara for young women in grades 6-9 (and their parents) to explore STEM related careers. Tech Savvy brings them together with female role models who are succeeding in these educational and professional fields. I designed modules for and conducted a workshop for the parents of young women. The focus was on methods young women could use to overcome biases in STEM fields.

**I HEART STEM Conference**, UCSB November 2016  
I HEART STEM is an annual conference that promotes STEM-literacy for young women (and female-identified students) in grades 9-12. Hands-on workshops and mentorship opportunities are facilitated by STEM-graduate students, faculty, and advanced undergraduates at UCSB. I conducted the "I HEART CODE" workshop which introduced the young women in to coding in Python.

**Make a Difference Fellowship**, Bangalore, India December 2012-April 2014  
Make A Difference is an Indian non-profit organization, working to ensure better outcomes for children in orphanages and shelters. As a fellow, I supervised operations as Center Head at the St. Patrick's Boys' Home, made key organizational decisions, and led 250 volunteers across Bangalore. I also volunteered as an English teacher.

## Technical Skills

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Python, C, C++

Valgrind, Pin tool, TensorFlow, z3py

PyRTL, Verilog, Yosys, Verilator, Icarus Verilog, ModelSim, Design Compiler, Vivado

## Relevant Coursework

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advanced computer architecture; applied cryptography; runtime systems; computing on encrypted data; operating systems; applications of formal methods to computer architecture; mobile embedded systems; VLSI validation; neuromorphic computing; parallel architectures; computer arithmetic; image processing; signal compression; matrix analysis