Lightning
Introductions

Digital Computing Beyond Moore’s Law
May 3-4, 2018
Rethinking the hardware-software interface
Heterogeneous memory systems
Approximation
Srinivas Aluru/Georgia Tech

- Expertise at the intersection of high performance computing and biology/medicine
- Application-specific and architecture-aware parallel algorithms research in bioinformatics/computational biology
What do you hope to bring to the workshop?
Daniel Armbrust/Silicon Catalyst

Expertise in semiconductor processing, design and materials

Experience in consortia and collaborations

Experience in hardware incubator

Beyond Moore’s Law perspective
Experiences in building open-source silicon community.
Development of productive environments for building and deploying specialized silicon with accessible NRE.
Automatic synthesis of programs

Applications in mapping SW to accelerators.

Beyond synthesis of programs: generate specs, consistency models, new instructions, compilers, interfaces.
Scalable parallel algorithms for scientific data analysis problems:

- Machine learning
- Graphs as matrices ([http://graphblas.org](http://graphblas.org))
- Computational biology
Experience developing programming models for new software/hardware domains.

Perspective that advances in programming languages create new opportunities for programmability, performance, correctness, and reliability.
Customizable Domain-Specific Computing --
Architecture, compilation, & runtime support

FPGA-based acceleration in the cloud

High-level synthesis (Vivado-HLS)

Acceleration of computational genomics
Perspectives from the IEEE Rebooting Computing Initiative and The International Roadmap for Devices and Systems 2017 edition

and bad jokes
Christopher De Sa/Cornell University

A machine learning perspective.

Interest in ML accelerators as a major class of new beyond-Moore’s-law architectures.
How can we continue to build on the outcomes of the workshop?
An understanding of how we can bring this community together to ensure continued growth
Mattan Erez/UT Austin

Expertise in memory systems, resilience, and the interactions of architecture with runtimes and programming models

An eagerness to learn and interact
Expertise in: compiler and programming system technology for high-performance computing

Interest in: new programming system technology requirements for novel high-performance architectures
Hoping to learn what a research agenda in this area looks like and how we can best convey that to policymakers.
With apologies to “Field of Dreams” [1989]:

If we build them, will they come?
we==hardware designers
them==accelerators
they==application developers

Mark D. Hill/University of Wisconsin-Madison

UW-Madison & CCC Vice Chair & Google Hardware Sabbatical
What do you hope to bring to the workshop?
Interest in improving performance, energy efficiency, and resilience in the face of software errors and approximation opportunities.

Experience in probabilistic program analysis and compiler optimization under uncertainty.
Kunle Olukotun/Stanford University/SambaNova

Domain Specific Languages
High-level Compilers
Domain Specific Accelerators
Machine Learning
Domain-specific languages
Halide (dense, **differentiable**)
Simit (sparse)
Opt / ProxImaL (optimization)

Domain-specific architectures
Experience with Machine Learning and Data Applications (Software 2.0)

New ML Algorithms with interesting systems aspects (Low-precision, compression, coordination-free)
A perspective: programming languages and compilers can take responsibility for concepts that traditionally live in the hardware domain.

An application: real-time, embedded vision.
Experience in hardware-software codesign for data-intensive and hard-to-parallelize algorithms.

Interest in graph analytics and other irregular applications.
What do you hope to bring to the workshop?

A vertical approach to programming systems that spans programming models, compilers, and runtimes, for a wide variety of hardware platforms.
What do you hope to bring to the workshop? Low latency, real-time and forensic application based technical insights from DoD C4ISR perspective. Where to compute, what compute with, and what to provision & where?
Discussion of how we can link discoveries in fundamentally new materials and devices up to computer architecture and computer science.

Cross-link to DOE’s Exascale (former deputy director for Hardware) and to emerging Cross-agency (DOE/DOD) efforts in Beyond Moore technologies.
Experience in programming systems
Program synthesis
Applications of ML to programming problems
Perspectives on key challenges in parallelism and communication cost for numerical algorithms and applications, in particular, tensor methods, software, and computational quantum chemistry on parallel architectures.
Basic hardware architecture primitives to use in specialized platforms

One example is in graph applications
Experiences and perspectives on integrating emerging technologies (GPUs, NVM, FPGAs, Quantum) into HPC architectures, and preparing the software ecosystem and application community.

PMES17: http://j.mp/pmes2017
Kathy Yelick/UC Berkeley

Understanding of scientific applications and high performance computing, as well as code generation and performance optimization
Cliff Young/Google Brain

Perspective from building TPUs for machine learning and Anton supercomputers for molecular dynamics.

A focus on application requirements and non-requirements.