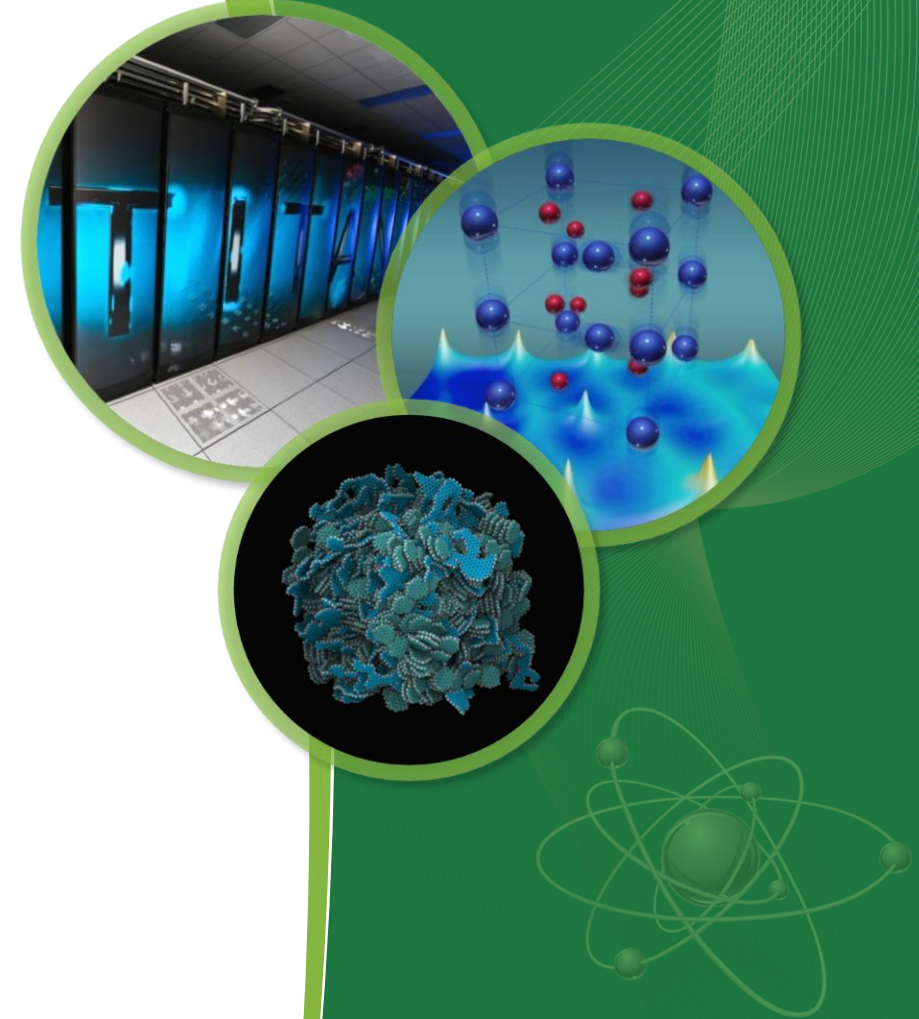


Breakout: Programming Systems Support for Post Moore's Computing

Moderators:

- Jeffrey Vetter
- Bob Lucas



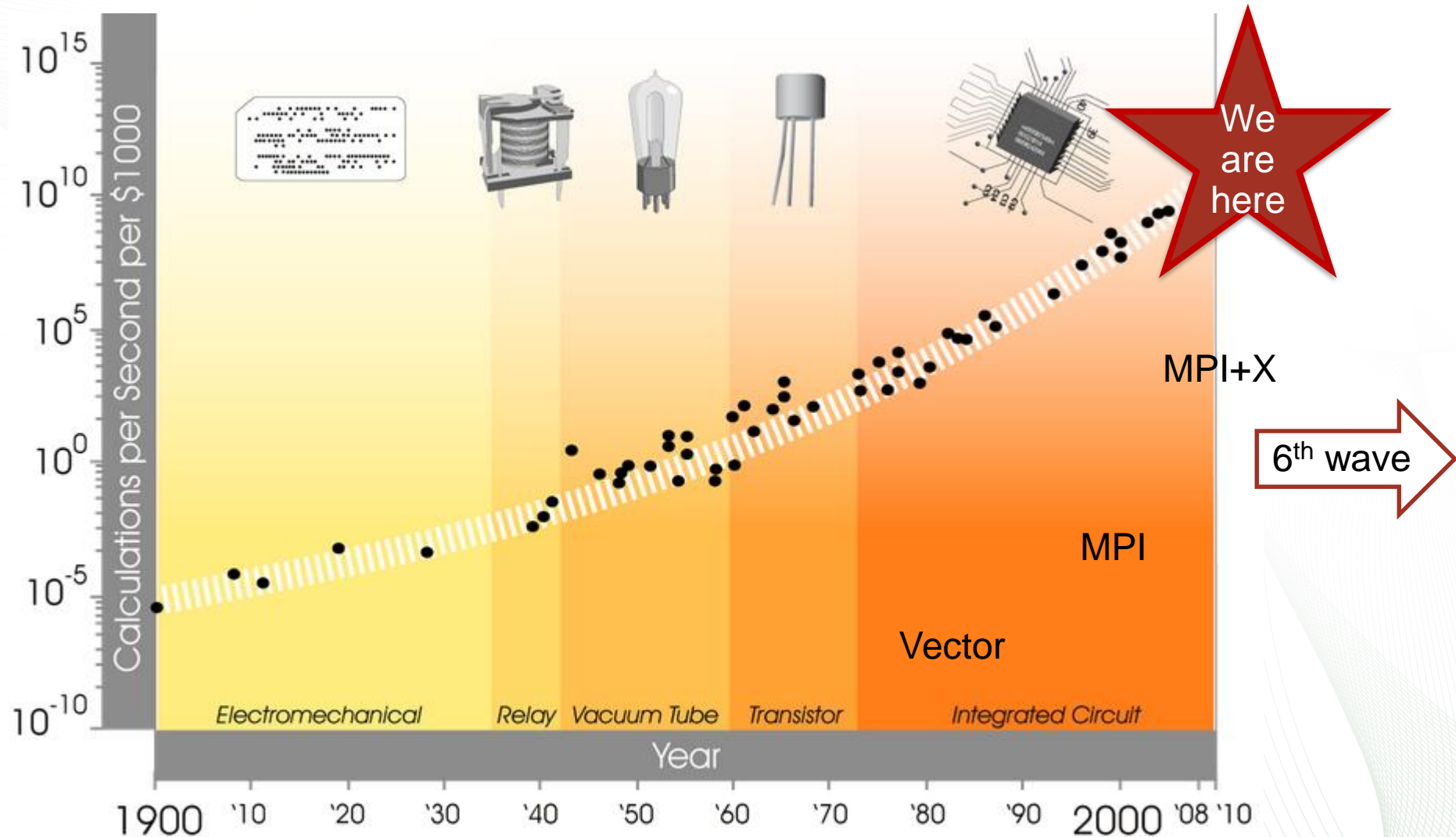
Partial List of Participants

- Bob Lucas
- Jeff Hollingsworth
- Alice Koniges
- Allan Porterfield
- Benoit Meister
- Mary Hall
- Sonia Sachs
- Dan Quinlan
- Paul Woodward
- Jeffrey Vetter
- Wen-Mei Hwu
- Pei Hunglin
- Josh Fry
- David Scott
- Gustav Jansen
- Andrew Chien
- Mattan Erez

Seed Questions

- “How do we capture the salient features of these paradigms in the programming system?”
- “What programming abstractions might insulate applications from these changes?”
- “What architectural abstractions should be in place to represent the traditional concepts like hierarchical parallelism, multi-tier data locality, and new concepts like variable precision and resource tradeoff directives?”
- “will OpenMP5 work on my quantum computer?”

Beyond Moore's Law: Maximizing Concurrency



Challenge: Squeezing out the last bit out of CMOS!

- CMOS will continue; even if Moore's Law halts
- Massively Customized
- Grand challenges
 - Motif specialization
 - Many different kinds of systems
 - 10-100x improvements v. ECP in cost/power/performance
- Co-design in the extreme
 - Rethink entire software and hardware stack
 - Enable exploration of alternatives around “cluster of motifs”
 - What abstractions do we need to target these new systems?

Challenge: Abstractions

- Increase return on DOE's ongoing investment in software
 - Productivity
 - Portability
 - Sustainability
 - Flexibility
- Can we raise the level of abstraction to promote
 - Preservation of application investments
 - Enablement new capability in software and hardware
 - Driving hardware solutions (rather than reverse)
 - E.g., declarative languages, Mathematica, SQL

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Quantum programming languages: survey and bibliography

SIMON J. GAY

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Cognitive Computing Programming Paradigm: A Corelet Language for Composing Networks of Neurosynaptic Cores

Arnon Amir, Pallab Datta, William P. Risk, Andrew S. Cassidy, Jeffrey A. Kusnitz,
Steve K. Esser, Alexander Andreopoulos, Theodore M. Wong, Myron Flickner,
Rodrigo Alvarez-Icaza, Emmett McQuinn, Ben Shaw, Norm Pass, and Dharmendra S. Modha
IBM Research - Almaden, San Jose, CA 95120

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Abstract—Marching along the DARPA SyNAPSE roadmap, IBM unveils a trilogy of innovations towards the TrueNorth cognitive computing system inspired by the brain's function and efficiency. The sequential programming paradigm of the von Neumann architecture is wholly unsuited for TrueNorth. Therefore, as our main contribution, we develop a new programming paradigm that permits construction of complex cognitive

TrueNorth architecture—that was featured on the covers of *Science* [8] and *Communications of the ACM* [1].

We unveil a series of interlocking innovations in a set of three papers. In this paper, we present a programming paradigm for hierarchically composing and configuring cognitive systems that is effective for the programmer and ef-

ScaffCC: A Framework for Compilation and Analysis of Quantum Computing Programs


Ali JavadiAbhari*, Shruti Patil*, Daniel Kudrow†, Jeff Heckey†, Alexey Lvov**,
Frederic T. Chong†, Margaret Martonosi*

Challenge: Explore and Incorporate New Technologies

- How can we exploit new technologies for science?
 - QC/QA
 - FPGA
 - Optical: FFT
 - Molecular computing
 - Neuromorphic and brain-inspired computing
 - Probabilistic and stochastic computing
 - Memory/storage: richer array of technologies
 - X-point or ReRam
- Evolution v. Revolution
 - how do we incorporate such technologies into DOE science process?

Shameless Plug

- <https://j.mp/pmes2016>
- @SC16
- Position papers due June 17



Search this site

2016 Post-Moore's Era Supercomputing (PMES) Workshop Home

Co-located with [SC16](#) in Salt Lake City
Monday, 14 November 2016

Workshop URL: <http://j.mp/pmes2016>
CFP URL: <http://j.mp/pmes2016cfp>
Submission URL (EasyChair): <http://j.mp/pmes2016submissions>
Submission questions: pmes16@easychair.org

This interdisciplinary workshop is organized to explore the scientific issues, challenges, and opportunities for supercomputing beyond the scaling limits of Moore's Law, with the ultimate goal of keeping supercomputing at the forefront of computing technologies beyond the physical and conceptual limits of current systems. Continuing progress of supercomputing beyond the scaling limits of Moore's Law is likely to require a comprehensive re-thinking of technologies, ranging from innovative materials and devices, circuits, system architectures, programming systems, system software, and applications.

The workshop is designed to foster interdisciplinary dialog across the necessary spectrum of stakeholders: applications, algorithms, software, and hardware. Motivating workshop questions will include the following. "What technologies might prevail in the Post Moore's

2016 Post-Moore's Era Supercomputing (PMES) Workshop Home

News

- Call For Position Papers - Submission Deadline - June 17
- Invited Speakers
- Photos
- Program
- Resources
- Workshop Venue
- Sitemap

230
days until
PMES Workshop @
SC16



News

- [PMES Workshop Confirmed for SC16!](#)
- [Submissions open for PMES Position Papers on April 17](#)

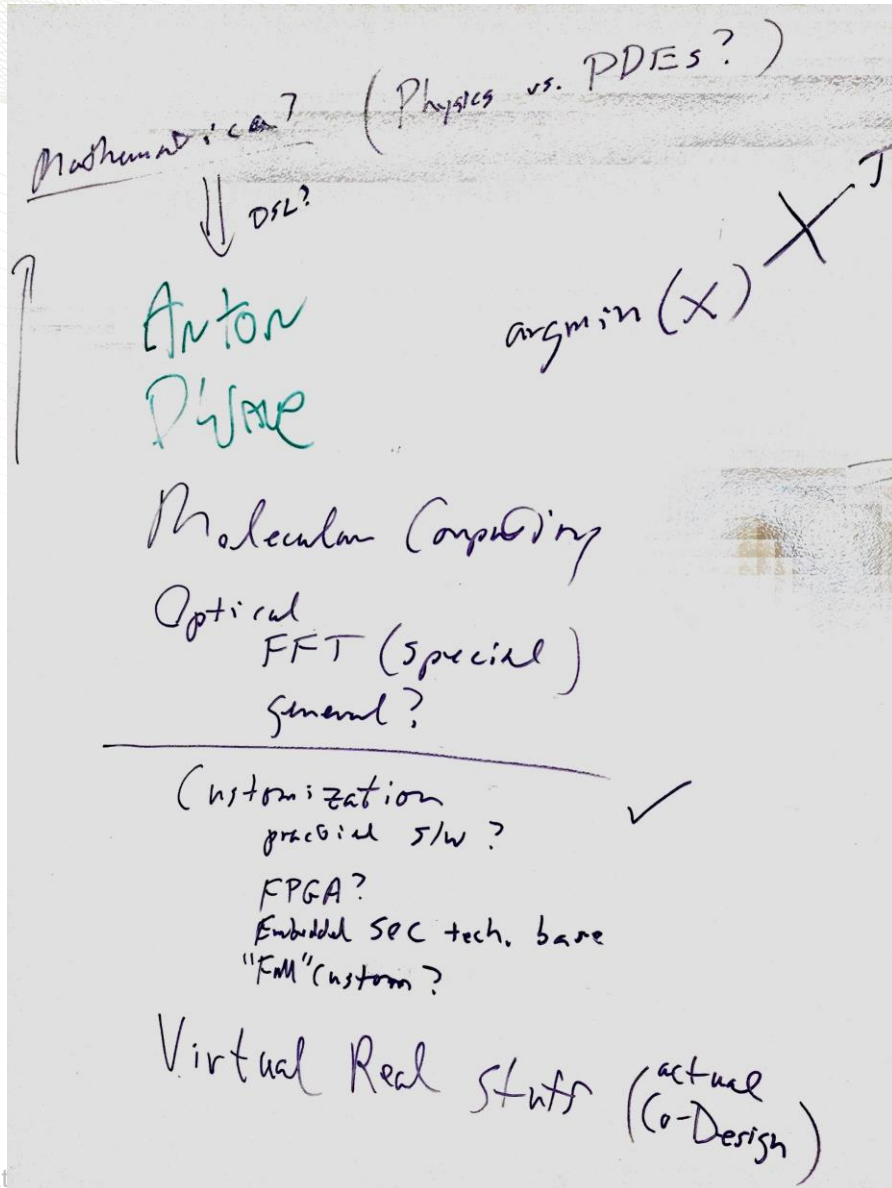
Important Dates

- Submission Site Opens: 17 April 2016
- Submission Deadline: 17 June 2016
- Notification Deadline: 17 August 2016
- Workshop: 14 November 2016

In cooperation with IEEE Computer Society



Misc



- Anton
- D-Wave
- FPGAs
- Optical FFT appliance
- Higher level simulation of future architectures