HPC Education

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Open Science Grid Council Meeting
Wednesday October 22 2014

COMPUTERWORLD 100

PC MAGAZINE 2006 TOP WIRED COLLEGES

COMPUTERWORLD 100 BEST PLACES TO WORK IN IT 2006

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Outline

- Education
  - Supercomputing in Plain English (SiPE)
  - Supporting courses statewide
- Outreach
  - SiPE Overview Talk, Cyberinfrastructure tours
- Training
  - Various technology trainings (run by vendors)
- Faculty/Staff Development
  - Summer workshops
- Workforce Development
  - Oklahoma IT Mentorship Program
  - ACI-REF Virtual Residency

Please feel free to ask questions at any time. I love interacting.

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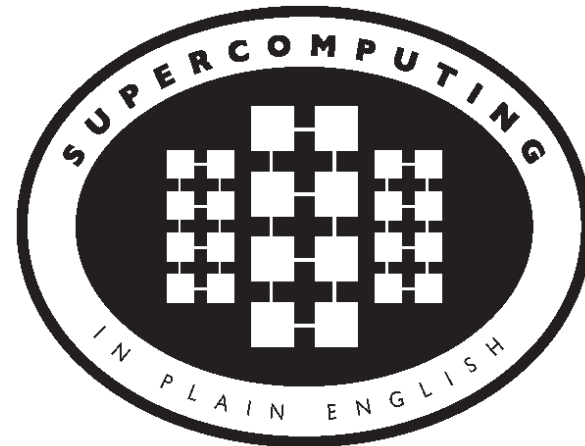THE UNIVERSITY OF OKLAHOMA

Education

How to Teach HPC to Non-CS

If someone needs to learn HPC but their computing background is minimal, how do we teach them?
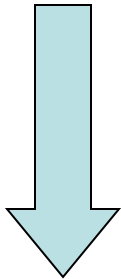
- Analogies
- Storytelling
- Play

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Analogies

Fast, expensive, few

Slow, cheap, a lot

The Storage Hierarchy

- Registers
- Cache memory
- Main memory (RAM)
- Hard disk
- Removable media (CD, DVD etc)
- Internet

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Storytelling

MPI Message Tags

My daughter was born in mid-December.

So, if I give her a present in December, how does she know which of these it's for?

- Her birthday
- Christmas
- Hanukkah

She knows because of the tag on the present:

- A little cake with candles means birthday
- A little tree or a Santa means Christmas
- A little menorah means Hanukkah

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Play

Science and engineering faculty from all over the US learn HPC by playing with a jigsaw puzzle (NCSI @ OU 2004).

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Supercomputing in Plain English

- **FREE and OPEN TO ALL**
- Provided every other spring (upcoming Spring 2015)
- Available LIVE via videoconferencing
- Topics   http://www.oscer.ou.edu/education/
    1. Overview: What the Heck is Supercomputing?
    2. The Tyranny of the Storage Hierarchy
    3. Instruction Level Parallelism
    4. Stupid Compiler Tricks
    5. Shared Memory Multithreading
    6. Distributed Multiprocessing
    7. Application Types and Parallel Paradigms
    8. Multicore Madness
    9. High Throughput Computing
    10. GPGPU: Number Crunching in Your Graphics Card
    11. Grab Bag: Scientific Libraries, I/O Libraries, Visualization

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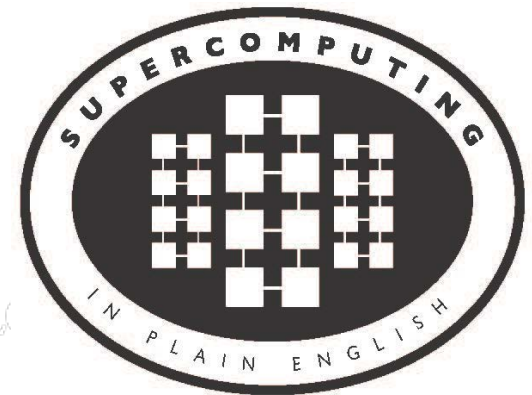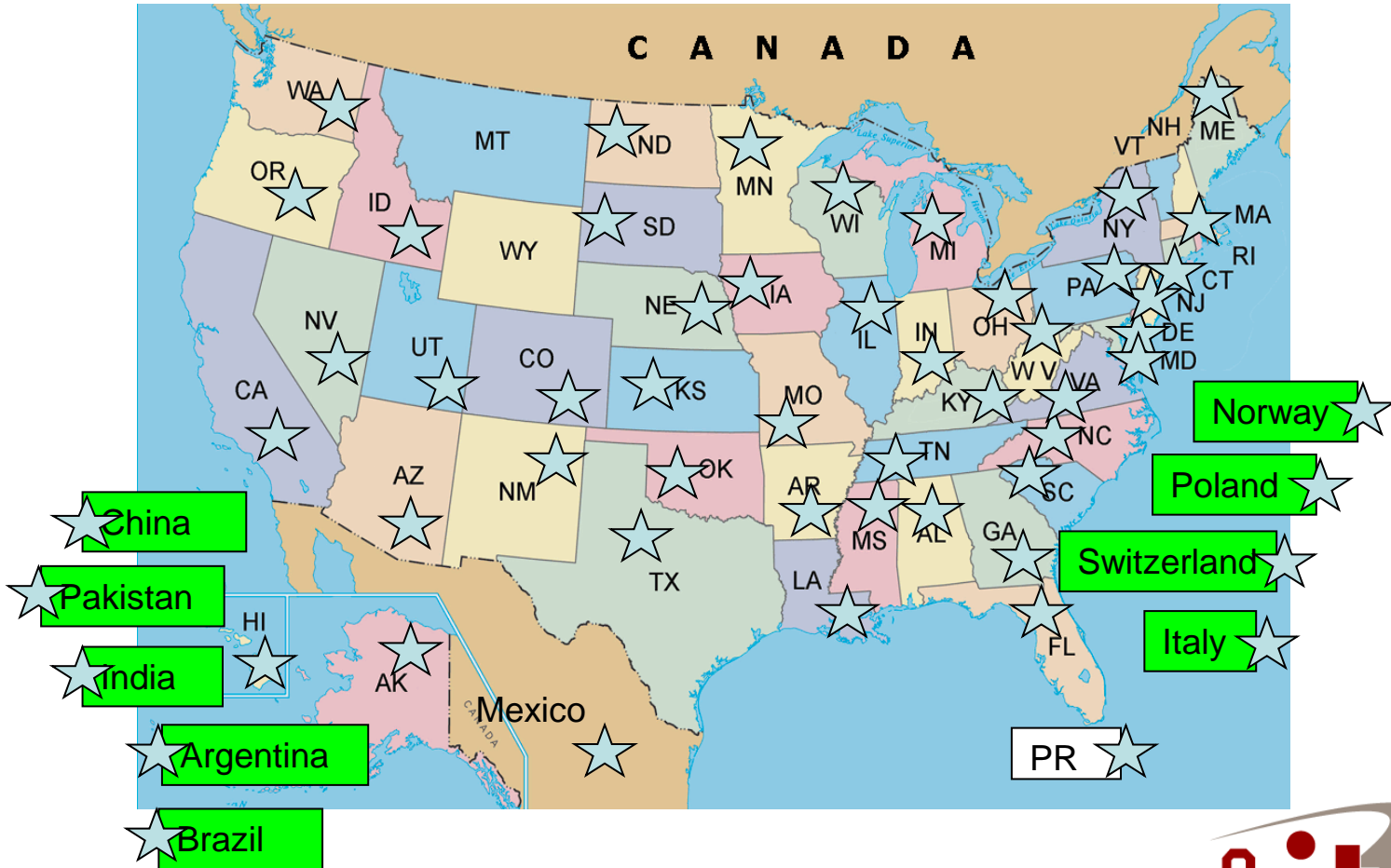
SiPE Participants

- 248 institutions, firms, agencies and organizations in 47 US states & territories and 10 other countries
  - Academic: 178 institutions in 46 US states & territories and 6 other countries
    - 69 institutions in 23 EPSCoR jurisdictions
      - 15 institutions in Oklahoma
  - Industry: 26 firms in the US and 1 other country
  - Government: 29 – US federal and state plus 4 other countries
  - Non-Governmental: 15 (US and 1 other country)
- Missing US states & territories
  - EPSCoR states: MT, NH, RI, VT, WY
  - EPSCoR territories: US Virgin Islands, Guam (no PhD-granting)
  - Other territories: American Samoa, Northern Marianas Islands

H. Neeman, H. Severini, D. Wu and K. Kantardjieff, 2008: "Teaching Supercomputing via Videoconferencing." *Proc. TeraGrid 2008*. **Best Paper: Education, Outreach & Training Track**.
H. Neeman, J. Mullen, L. Lee and G. Newman, 2002: "Supercomputing in Plain English: Teaching High Performance Computing to Inexperienced Programmers." *Proc. 3rd LCI International Conference on Linux Clusters: The HPC Revolution 2002*.

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SiPE Participants 2001-13

China
Pakistan
India
Argentina
Brazil

Norway
Poland
Switzerland
Italy

PR

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Supporting Courses Statewide

Teaching: 9 institutions including 3 MSIs

- Teaching/taught parallel computing using OneOCII resources:
  - **Cameron U (16.6% AA)** – multiple times
  - **East Central U (NASNI, 16.9% AI)**
  - Oklahoma City U – multiple times
  - Southwestern Oklahoma State U

  C. Carley, B. McKinney, L. Sells, C. Zhao and H. Neeman, 2013: "Using a Shared, Remote Cluster for Teaching HPC." *Proc. IEEE Cluster 2013*.

- Taught parallel computing via LittleFe baby supercomputer and OneOCII resources:
  - **Southeastern Oklahoma State U (NASNI, 21.0% AI)** – multiple times
- Taught computational chemistry using OSCER resources:
  - **Northeastern State U (NASNI, 22.4% AI)** – multiple times
  - Southern Nazarene U
  - **Rogers State U (12.9% AI)** – multiple times
- Taught Bioinformatics using OCII resources:
  - U Tulsa – 2 semester sequence

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Outreach

Outreach: Presentations & Tours

- Courses at OU
    1. Chem Engr: Industrial & Environmental Transport Processes (D. Papavassiliou)
    2. Engineering Numerical Methods (U. Nollert)
    3. Math: Advanced Numerical Methods (R. Landes)
    4. Electrical Engr: Computational Bioengineering (T. Ibrahim)
- Research Experience for Undergraduates at OU
    1. Ind Engr: Metrology REU (T. Reed Rhoads)
    2. Ind Engr: Human Technology Interaction Center REU (R. Shehab)
    3. Meteorology REU (D. Zaras)
- External
    1. American Society of Mechanical Engineers, OKC Chapter
    2. Engineering Club of Oklahoma City
    3. Association for Computing Machinery (ACM) Special Interest Group on Computer Science Education (SIGCSE) 2010
    4. Oklahoma State Chamber of Commerce
    5. National Educational Computing Conference 2006 (virtual tour via videoconference)
    6. Norman (OK) Lions Club
    7. Society for Information Technology & Teacher Education conference 2008, 2009, 2010
    8. Acxiom Conference on Applied Research in Information Technology 2008
    9. Shawnee (OK) Lions Club
    10. Oklahoma Louis Stokes Alliance for Minority Participation (@ OSU) 2010 (Keynote)
    11. Norman (OK) Science Café
    12. Tech Forum Texas 2010
    13. Texas Computer Education Association 2011
    14. Tinker Air Force Base
    15. Consortium for School Networking 2011
    16. Consortium for Computing Sciences in Colleges 2011 (Keynote)
    17. SC07-13

- Other Universities
    1. SUNY Binghamton (NY)
    2. Bradley University (IL)
    3. Cameron University (OK)
    4. The Citadel (SC)
    5. College of the Muscogee Nation (OK)
    6. Comanche Nation College (OK)
    7. DeVry University (OK)
    8. East Central University (OK)
    9. El Bosque University (Bogota Colombia)
    10. Southwestern University (TX)
    11. Langston University (OK)
    12. Louisiana State University
    13. Midwestern State University (TX)
    14. Northeastern Oklahoma State University
    15. Northwestern Oklahoma State University
    16. Oklahoma Baptist University
    17. Oklahoma City University
    18. Oklahoma State University x 2
    19. Oklahoma State University – OKC
    20. Oral Roberts University (OK) x 2
    21. Rogers State U (OK)
    22. Philander Smith College (AR)
    23. St. Gregory's University (OK) x 2
    24. Southeastern Oklahoma State University x 2
    25. Southern Nazarene University (OK)
    26. Southwestern Oklahoma State University x 2
    27. Texas A&M-Commerce
    28. University of Arkansas Fayetteville
    29. University of Arkansas at Little Rock
    30. University of Arkansas at Pine Bluff
    31. University of Central Oklahoma
    32. University of Oklahoma-Tulsa
    33. University of Science & Arts of Oklahoma
    34. University of Texas Brownsville
    35. University of Tulsa (OK)
- High Schools and High School Programs
    1. Oklahoma School of Science & Mathematics x 2
    2. Oklahoma Christian University's Opportunity Bytes Summer Academy
    3. Dept of Energy National Scholarship Finalists
    4. Ardmore High School (OK)
    5. Elgin Middle School

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Training

Vendor-led Training

- MathWorks MATLAB: Feb 2010, Feb 2012
- IBM General Parallel File System: Apr 2010
- Mathematica: Apr 2011
- Intel Xeon Phi: Oct 2014

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Faculty/Staff Development

Fac/Staff Dev: Summer Workshops

- National Computational Science Institute workshops
  - Intro to Parallel Programming & Cluster Computing weeklong: summer 2004, summer 2005, summer 2008, summer 2009, summer 2012
  - Intro to Parallel Programming & Cluster Computing daylong: fall 2003, fall 2007-11
  - Intermediate Parallel Programming & Cluster Computing weeklong: summer 2010, summer 2011
    - LittleFe baby supercomputer buildout (summer 2011 – first ever anywhere; summer 2012)
  - Computational Chemistry for Chemistry Educators weeklong: summer 2009, summer 2011
  - Many of these were co-sponsored by Oklahoma EPSCoR (2008-2012) and/or the SC Education Program (2007-9, 2011)

Fitz Gibbon, P. Gray, D. A. Joiner, T. Murphy, H. Neeman, R. M. Panoff, C. Peck and S. Thompson, 2010: "Teaching High Performance Computing to Undergraduate Faculty and Undergraduate Students." *Proc. TeraGrid 2010*,. **Best Paper: Education, Outreach & Training Track**.

Fac/Staff Dev: Summer Workshops

- Linux Clusters Institute workshops: June 2005, Feb 2007
  - Selected to host the next LCI workshop (2015)
- Virtual School for Computational Science & Engineering weeklong
  - 2012: Programming Heterogeneous Parallel Computing Systems; Proven Algorithmic Techniques for Many-core Processors (both on GPU computing)
  - 2013, 2014: Data Intensive Summer School (big data)
- Software Carpentry Bootcamp (2013): Python, scripting, version control etc
- Bioinformatics weeklong (2012, 2014)
- SUMMARY: Every summer 2004-2013 except 2006, 2007.

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Workforce Development

OK IT Mentorship Program

The <u>Oklahoma Information Technology Mentorship Program</u> is sending networking professionals to universities, colleges, career techs and even a high school statewide.

These professionals will give talks on the practicalities of being a networking professional – what that career choice means day by day.

We also provide both live and virtual job shadowing opportunities – students can follow networking professionals around to see what their work looks like, either in person or via Twitter and Facebook.

So far we've done 95 events for 36 institutions, with 2 new institutions scheduled in fall 2014.

H. Neeman, D. Brunson, J. Deaton, Z. Gray, E. Huebsch, D. Gentis and D. Horton, 2013: "The Oklahoma Cyberinfrastructure Initiative." *Proc. XSEDE 2013*.

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# OITMP Institutions So Far

- PhD-granting Universities
  1. Oklahoma State U
  2. U Oklahoma
  3. U Tulsa
- Regional
  1. **Cameron U (16% AA)**
  2. **East Central U (NASNI, 16% AI)**
  3. **Langston U (HBCU, 77.2% AA)**
  4. **Northeastern State U (NASNI, 22.4% AI)**
  5. Oklahoma Baptist U
  6. Oklahoma Christian U
  7. Oklahoma City U
  8. Oklahoma Panhandle State U
  9. **Oral Roberts U (17.7% AA)**
  10. **Southeastern Oklahoma State U (NASNI, 21.0% AI)**
  11. **Southern Nazarene U (16.0% AA)**
  12. Southwestern Oklahoma State U
  13. U Central Oklahoma
- High Schools
  1. Lawton Christian School
  2. Oklahoma School of Science & Mathematics
  3. Tahlequah-Sequoyah High School

- Community Colleges
  1. **Eastern Oklahoma State College (24.9% AI)**
  2. **Northeastern Oklahoma A&M College (NASNI, 22.6% AI)**
  3. Oklahoma City Community College
  4. **Oklahoma State U Institute of Technology (19.9% AI)**
  5. **Oklahoma State U – Oklahoma City (16.0% AA)**
  6. **Rose State College (18.0% AA)**
  7. Tulsa Community College
- Career Techs
  1. Canadian Valley Tech Ctr
  2. Chisholm Trail Tech Ctr
  3. Eastern Oklahoma County Tech Ctr
  4. Francis Tuttle Tech Ctr
  5. **Gordon Cooper Tech Ctr (13.5% AI)**
  6. **Great Plains Tech Ctr (11.5% AI)**
  7. **Kiamichi Tech Ctr (18.5% AI)**
  8. Mid-America Tech Ctr
  9. Moore Norman Tech Ctr
  10. **Northeast Tech Ctr (21.5% AI)**
  11. **Pontotoc Tech Ctr (41.6% AI)**
  12. **Southern Oklahoma Tech Ctr (10.7% AI)**

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OneOK STEM Mentorship Program

We're now expanding from just IT to other STEM disciplines.
We'll see how it goes ….
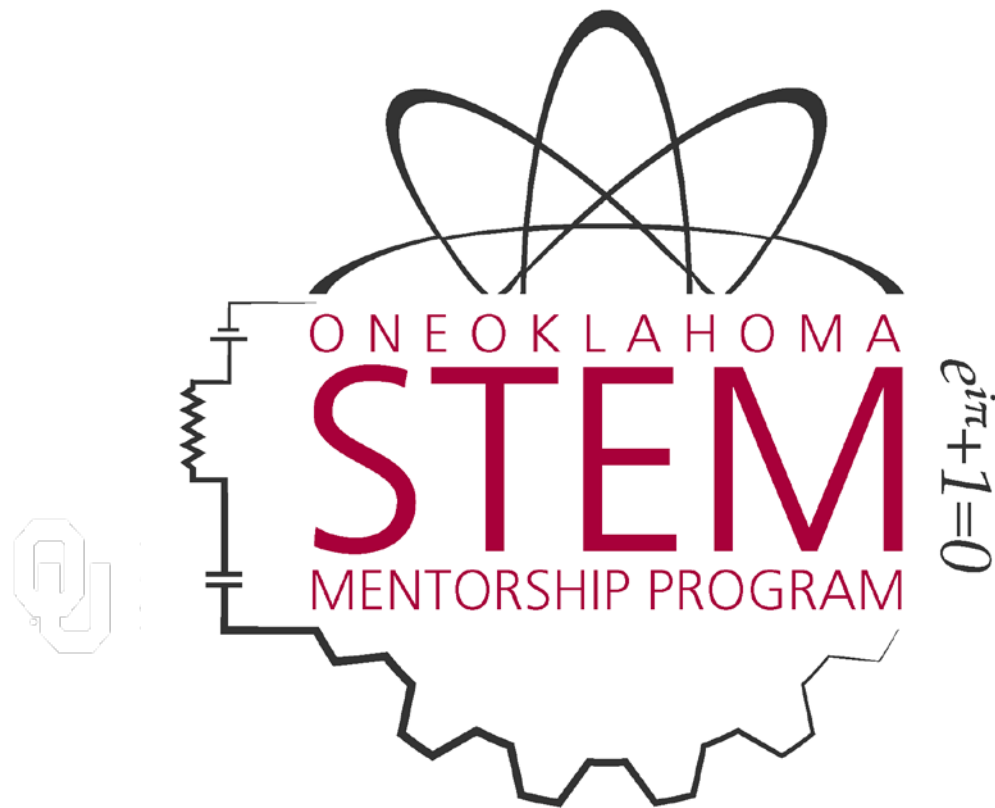
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ACI-REF Virtual Residency

- Advanced Cyberinfrastructure - Research & Education Facilitators
- Summer workshops in 2015, 2016 (NSF CC*IIE grant)
- How to help HPC users be productive

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ACI-REF Workshop Agenda

- SUNDAY (evening pizza party)
  - Welcome and virtual residency overview
  - Introduction to Research Cyberinfrastructure consulting
  - How to Give a CI Tour
- MONDAY
  - Early AM: Effective Communication: How to Talk to Researchers about Their Research
  - Computational and Data-enabled Science & Engineering TRACK
    - Mid AM: Deploying Community Codes
    - Early PM: Real users present their CDS&E research
    - Mid PM: Real users: CI consulting practicum
  - SCIENCE DMZ TRACK
    - Mid AM: OpenFlow - Lecture
    - Early PM: OpenFlow - Lab
    - Mid PM: Facilitating Research on Your Science DMZ

- TUESDAY
  - Very Early AM: Project Guidelines
  - Early AM: Faculty: Tenure, Promotion, Reward System (guest lecture)
  - CDS&E TRACK
    - Mid AM: Benchmarking & Tuning
    - Early PM: Real users present CDS&E research
    - Mid PM: Real users: CI consulting practicum
  - SCIENCE DMZ TRACK
    - Mid AM: Northbound APIs - Lecture
    - Early PM: Northbound APIs - Lab
    - Mid PM: Real users' high bandwidth research
- WEDNESDAY
  - Early AM: Using Videoconferencing and Collaboration Technologies for Consulting
  - Mid AM: Writing Grant Proposals (guest presenter)
  - PM: BREAK (free time)

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ACI-REF Workshop Agenda

- THURSDAY
  - Early AM: Recruiting and Retaining Talent
  - CDS&E TRACK
    - Mid AM: Finding and Provisioning Remote Resources (XSEDE, OSG etc)
    - Early PM: Real users present CDS&E research
    - Mid PM: Real users: CI consulting practicum
  - SCIENCE DMZ TRACK
    - Mid AM: The Software in SDN - Lecture
    - Early PM: The Software in SDN - Lab
    - Mid PM: Real users' high bandwidth research

- FRIDAY
  - Early AM: The Shifting Landscape of CI Funding Opportunities
  - Mid AM: Panel: Stories from the Trenches
  - Early PM: Project work time
  - Mid PM: Project work time
  - Late PM: Project presentations from early departers
- SATURDAY
  - AM: Project presentations

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Thanks for your attention!
QUESTIONS?

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