Workshop Goals

• Assess the nature and needs for instrumentation development, acquisition, utilization, and sharing for purposes of ongoing and anticipated research in different CISE areas

• Discuss the opportunities and limitations of existing funding mechanisms available to the CISE community and provide feedback on possible improvements
Instrumentation Evolution

~ 1980s: instrumentation was mostly concerned with acquisition and providing access to computers and networks

~ 1990s: instrumentation evolved to acquisition of specialized hardware in support of collaborative research projects

~ 2000s: instrumentation extended to development and support of community resources, testbeds, and infrastructures
Key Factors

- Declining cost of hardware and increasing cost of maintenance and support
- Increasingly critical role that software plays in instrumentation
- Emergence of utility computing resources, grids, and clouds
- Broadening of the CISE constituents in need of instrumentation beyond HPC
Funding Mechanisms

• Research grants from NSF, DOE, DOD, industry and other sources

• NSF grants for instrumentation acquisition or development
  – Major Research Instrumentation (MRI) program
  – CISE Computing Research Infrastructure (CRI) program

• Grants from other agencies such as DOE, DOD & NIH (e.g. DURIP)

• Industry funding for equipment acquisition or infrastructure use (e.g. the IBM SUR program)
NSF CISE Instrumentation

• Evolved over the years to match the CISE community needs – RI, MII, CCLI, CRI

• Current CRI solicitation distinguishes between two types of infrastructures:
  – Institutional Infrastructure (II)
  – Community Infrastructure (CI)
NSF/CISE CRI Instrumentation

• CRI II proposals must not be for infrastructure or instruments available through existing CI awards

• CRI CI proposals must show community need and buy-in
  – CI Planning grants of up to $100K for 1 year
  – CI Acquisition, Development, Deployment and/or Operations (CI-ADDO) grants of up to $4 million for durations of up to 4 years
NSF MRI Instrumentation

• Seeks to “increase access to scientific and engineering equipment for research and research training” – awards up to $4M
• Managed under the Office of Integrative Activities (OIA)
• Separate budget that supports various directorates at NSF – an MRI award increases the CISE funding base
• Allocation of funds to a directorate is dependent on “proposal/budget pressure” from that division
NSF MRI Instrumentation

• Limit of three proposals per institution
  – Need advocacy by chairperson

• Requires 30% institutional cost sharing
  – Need advocacy by chairperson

• Must adhere to scope & use the right lingo
  – Need to inform the community of MRI caveats
MRI Caveats

• Acquisition or development must be for a **single instrument** (which itself could be made up of many components) with an **identifiable location**

• MRI does not support general purpose laboratory equipment that does not have a common or specific research focus

• MRI does not support instrumentation for medical research or education, or research with disease-related goals
Workshop Outcomes

• Resulted from reports by 7 workgroups

• 5 workgroups organized around research topics
  – Computer Artifacts
  – Intelligent Systems
  – Distributed Systems
  – Formal and Software Systems
  – HPC and Data-Intensive Computing

• 2 workgroups organized around nature of collaboration
  – Collaboration across multiple CISE disciplines
  – Collaboration involving CISE and non-CISE disciplines
Workshop Outcomes

- The necessity of educating the various constituents on the evolving nature of CISE research and instrumentation

- The importance of balancing inter-disciplinary efforts so that CISE research is leveraged by other disciplines as much as CISE leverages other disciplines
Nature of Research

Issues impacting instrumentation needs:

- Dealing with emerging behavior of large-scale software systems
- Software systems are embedded, and increasingly safety-critical
- Integration of computing systems with the human in the loop – man-machine composition
- Needed instruments cannot be readily acquired; they need to be developed (possibly stitching together many acquired pieces)
Spectrums

• User of instrument
  – A single PI in a “cave”
  – A community of PIs, scientists, students, …

• Role of instrument
  – Enabling new research
  – Sustaining successful research

• Lifecycle of instrument
  – Short-term – prove a concept and create a community
  – Long-term – nurture and transform a community

• Nature of instrument
  – Classical – e.g., simulators and visualizers
  – Emerging – e.g., web-scale auctions, SN games
Examples of Classical Instruments

• A simulator of the interplay between abstractions and computing fabrics at very large scales
• An instrument that enables visualization of emergent behaviors at large scales
• Acquisition of electrical source imaging to help with neuroscience for brain research
• Intelligent spaces, e.g., in museums, that enable new research involving social science topics
Examples of Emerging Instruments

• A software system for testing mechanism design on a web-scale auction
• A programming workbench that allows the composition of various verification theories
• An echo system for certification / quality control of open-source software
• An internet-scale virtual machine – think about building a VM out of cloud resources
• A data collection & associated tools that enable multi-disciplinary experimentation at scale
Instrumentation Impact

• Needed instruments provide higher abstractions that enable advancement in
  – CS Research
  – CS Education
  – K-12 Education

• Large instrumentation projects enhance the visibility within the university – a good strategy to improve a department’s standing
  – Builds a community within a department
  – Facilitates acquisition of resources from administration
  – Effective for recruitment of graduate and undergraduate students
Observations

• A limitation of current MRI funding is that software development is not viewed favorably – yet it is critical

• Evolving nature of what constitutes a CISE instrument is hard for other disciplines to accept now – only a matter of time
Observations

- Good “science” is key to success – must argue that science cannot advance without the instrument

- CS community must bring advances in other disciplines to bear on CS research – to make allies and change perceptions
Observations

• Need to train the CS community on how to develop successful MRI proposals
  – Focus on development as opposed to acquisition proposals

• Need to train the CS community on how to evaluate impact and potential impact
  – What may be incremental within a community may be transformative for another or for industry and society – e.g., SLAM
Observations

• On the role of industry
  – Reaching out to industry to underwrite the development of instruments adds legitimacy
  – But academia’s role is crucial in providing a neutral “echo system” for instrumentation and to ensure scientific trustworthiness
  – Talking points: The Haskell story at MS, industrial involvement in EU and Brazil
Take-Home Messages

• Importance of educating CS faculty about funding opportunities for instrumentation
• Importance of increasing the MRI proposal and budget pressure from CISE
• MRI proposals need chairs’ support to push them through the institution
• Importance of recognizing/rewarding good science – not if you build they will come!