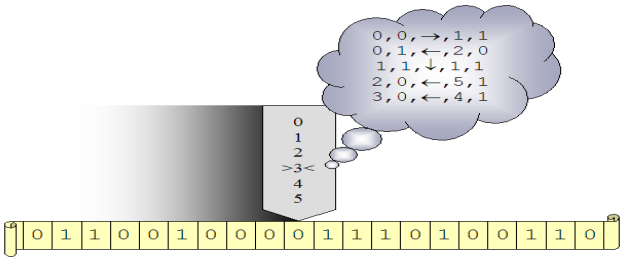
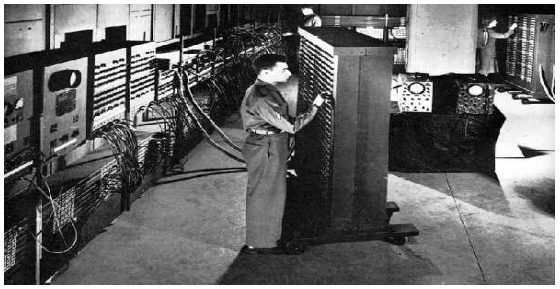
Computer and Information Science and Engineering Directorate

OVERVIEW

Computing (R)Evolution





Credit: Apple, Inc.

1935 1946 . . . 2008

Presentation Outline

- Computer and Information Science and Engineering (CISE) Overview
  - Mission, Impact, Organization
- CISE Funding Opportunities
  - Core Programs
  - CISE Cross-Cutting Programs
  - NSF Cross-Cutting Programs
  - Cross-Agency-Cutting Programs
- Highlights and Community Involvement
- Concluding Remarks

CISE Mission

- CISE has three goals:
  - to enable the United States to remain competitive in computing, communications, and information science and engineering
  - to promote understanding of the principles and uses of advanced computing, communications, and information systems in service to society
  - to contribute to universal, transparent, and affordable participation in an information-based society

Drivers of Computing

Society

7A's
Anytime
Anywhere
Affordable
Access to
Anything by
Anyone
Authorized.

Science

- What is computable?
- P = NP?
- (How) can we build complex systems simply?
- What is intelligence?
- What is information?

Technology

J. Wing, "Five Deep Questions in Computing," CACM January 2008

NSF Strategic Plan
(2006-2011 – NSF06-648)

Discovery

Advancing the frontiers of knowledge

Learning

Science and engineering workforce and scientific literacy

Research Infrastructure

Advanced instrumentation and facilities

Stewardship

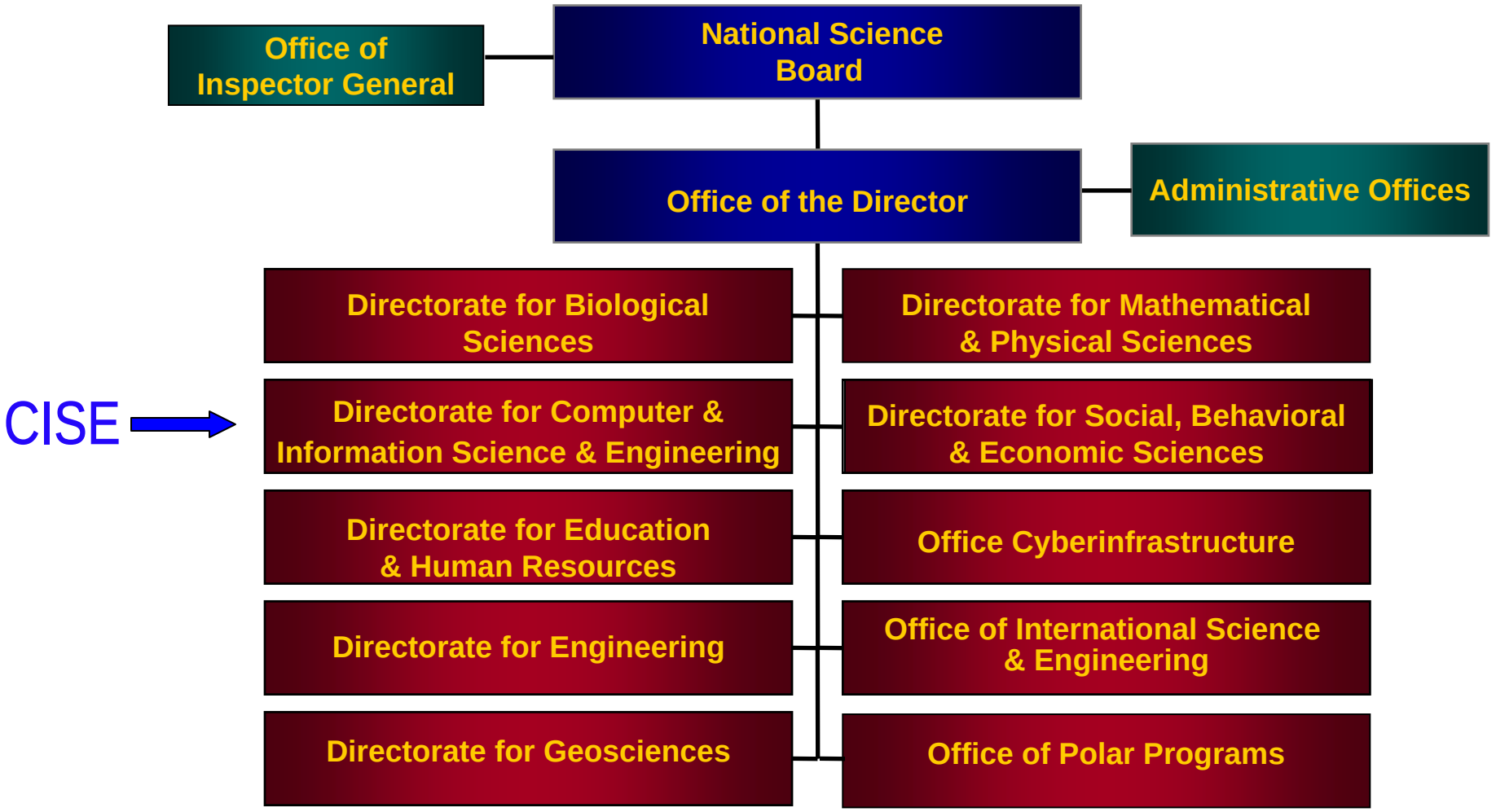
Supporting excellence in science and engineering research and education

CISE Programmatic Philosophy

- **CISE** is about advancing the computing frontier

  within the context of the NSF Mission
- Supporting good ideas submitted by creative people in broad range of academic institutions and organizations
- It's about "high risk" long term impact
  - Impact may be far in the future.
  - Impact is long-lasting (it's about new knowledge).
  - Impact can create new economies and change societal behavior

National Science Foundation



CISE Core Research Programs

CCF Computing and Communications Foundations	CNS Computer and Network Systems	IIS Information and Intelligent Systems
Core Programs		
▪ Algorithmic Foundations ▪ Communications and Information Foundations ▪ Software and Hardware Foundations	▪ Computer Systems Research ▪ Networking Technology and Systems	▪ Human-Centered Computing ▪ Information Integration and Informatics ▪ Robust Intelligence

~ 70-75% of CISE Budget in these Core Programs

CISE Budget and Budget Outlook

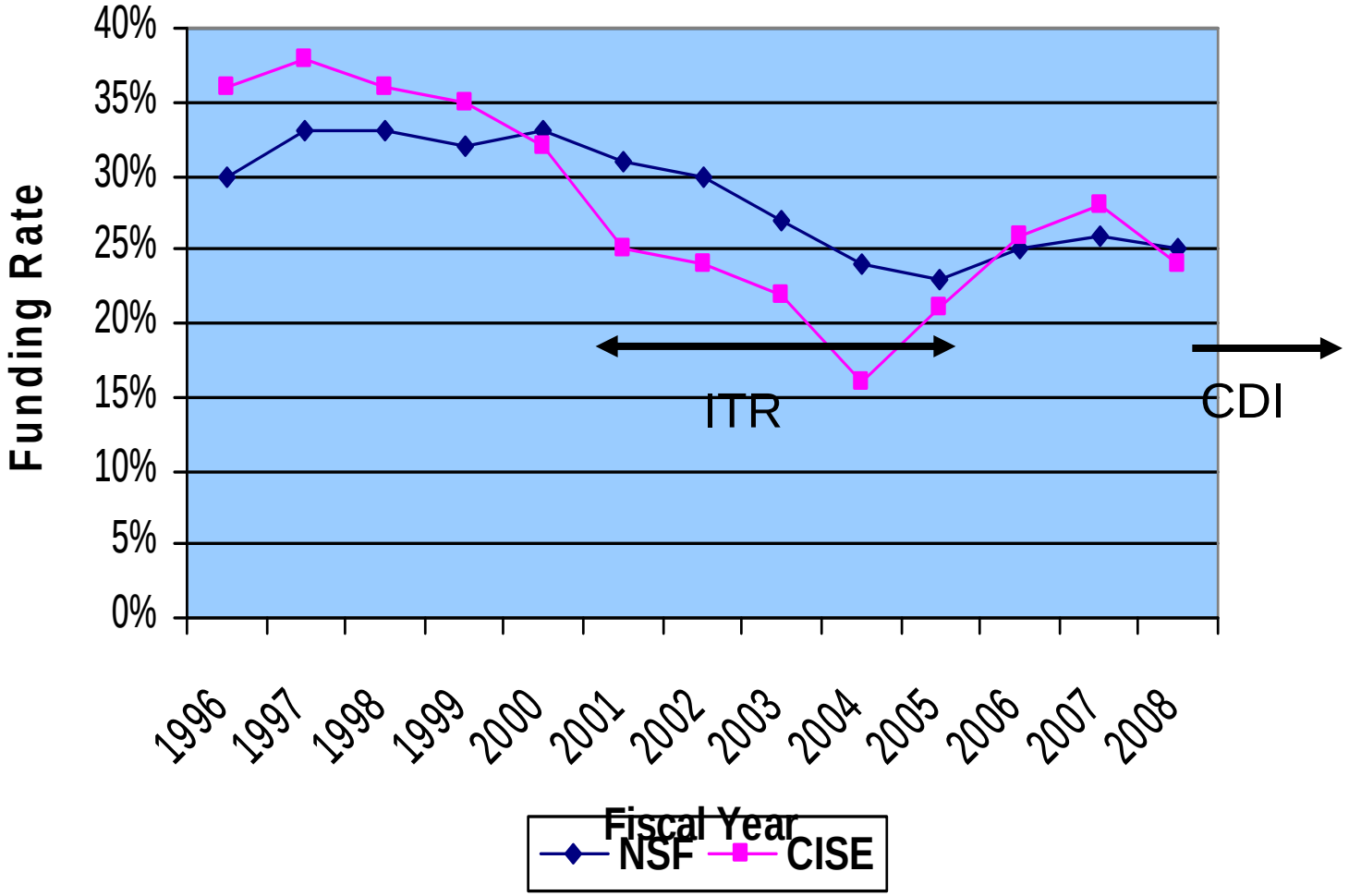
- FY 2008 Budget = $535M, $8M increase over FY 2007
- FY 2009 Budget Request = $639M, a 19% increase over FY 2008
- American Competitiveness Initiative calls for NSF funding to double over next 10 years
- America Competes Act authorizes additional NSF funding, setting pace for doubling of the NSF Research and Related Activities account over the next 7 years

NSF provides 87% of all Federal support for basic research in computer science

FY 2008 Proposal Statistics NSF and CISE

Statistic	NSF	CISE
No. of Proposal Actions	44,438	5,566
No. of Reviews	245,743	27,886
No. of Reviewers	42,036	2,829
No. of Awards	11,162	1,352
Funding Rate (Research Only)	25% (21%)	24% (20%)

NSF and CISE Funding Rate Trends



CISE Core Programs

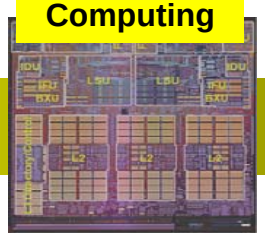
- Funding Opportunities
  - CCF: NSF 08-575
  - IIS: NSF08-575
  - CNS: NSF08-576
- Project Types:
  - Medium and Large
    - team awards of larger funding levels and longer durations
    - multi-investigator collaborative projects
  - Small: one or two investigator projects
  - CISE-wide Deadlines (Time Windows):
  - Medium: Oct. 1 – 31, 2008 (August 1-30, 2009; Annually Thereafter)
  - Nov. 1 – 28, 2008: Large (same dates annually thereafter)
  - Dec. 1 – 17, 2008: Small (same dates annually thereafter)

Computing and Communications Foundation (CCF) Mission

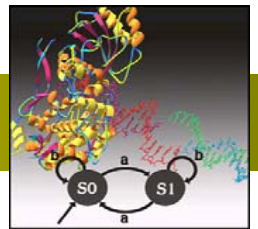
- Supports research and education projects that explore the foundations of computing and communication devices and their usage.
- Seeks advances in computing and communication theory, algorithms for computer and computational sciences, and architecture and design of computers and software.
- Investigates revolutionary computing models and technologies based on emerging scientific ideas
- Integrates research and education activities to prepare future generations of computer science and engineering workers

Moore's Law Ending!... Emerging:

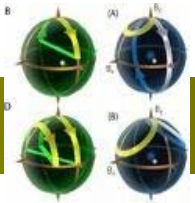
Multicore Computing



BioComputing



QuantumComp



CCF Core Programs

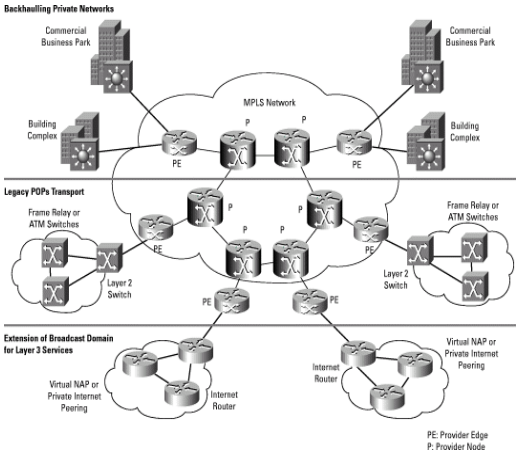
- Three programmatic areas
  - Algorithmic Foundations
  - Communications and Information Foundations
  - Software and Hardware Foundations
- Program Solicitation: NSF 08-577

- CCF also participates in CISE cross-cutting programs

- Of particular note: recent Dear Colleague Letter on Computer Graphics and Visualization opportunity: http://www.nsf.gov/cise/funding/2008_comp_graphics.jsp

Computer and Network Systems Division (CNS) Mission

- Supports research and education activities that invent new computing and networking technologies and that explore new ways to make use of existing technologies.
- Seeks to develop a better understanding of the fundamental properties of computer and network systems
- Seeks to create better abstractions and tools for designing, building, analyzing, and measuring future systems.
- Supports the computing infrastructure that is required for experimental computer science.



CNS Core Programs

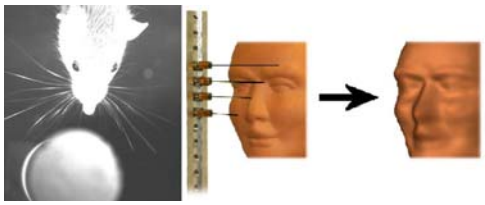
- Two programmatic areas
  - Computer Systems Research
  - Networking Technology and Systems
- Program Solicitation: NSF 08-576
- CNS also participates in CISE cross-cutting programs

Information and Intelligent Systems Division (IIS) Mission

Studies the inter-related roles of people, computers, and information, and supports research and education activities that 1) develop new knowledge about the role of people in the design and use of information technology;

2) increase our capability to create, manage, and understand data and information in circumstances ranging from personal computers to globally-distributed systems; and

3) advance our understanding of how computational systems can exhibit the hallmarks of intelligence.



IIS Core Programs

- Three programmatic areas
  - Human-Centered Computing
  - Information Integration and Informatics
  - Robust Intelligence
- Program Solicitation: NSF 08-575

- IIS also participates in CISE cross-cutting programs

- Of particular note: recent Dear Colleague Letter on Computer Graphics and Visualization opportunity: http://www.nsf.gov/cise/funding/2008_comp_graphics.jsp

Objectives of CISE Cross-Cutting Programs

- Cut across CISE Divisions
- Program Directors from all divisions participate
- Complement the divisional core programs or address scientific and national priorities
- Funding opportunity may be long-term or may be expected for specific durations
- Emphasis may change yearly or over time

CISE New Cross-Cutting Program:

"CISE Cross-Cutting Programs: FY2009 and FY2010"

New solicitation: NSF08-578

Three focus areas

- Data-Intensive Computing
- Network Science and Engineering
- Trustworthy Computing

– cover areas that cut across the CISE divisions and that could benefit from intellectual contributions of researchers with expertise in a number of fields or sub-fields

(cont'd)

Cross-Cutting Programs *(cont'd)*

- Proposal Deadlines (time windows)
  - Medium Projects: October 1, 2008 - October 31, 2008

    (August 1-30, 2009; and Annually Thereafter)
  - Large Projects: November 1, 2008 - November 28, 2008

    (November 1- 28, 2009; and Annually Thereafter)
  - Small Projects : December 1, 2008 - December 17, 2008

    (December 1 - December 17, Annually Thereafter

Data-Intensive Computing
(a component of NSF 08-578)

- Rethinking how we store, retrieve, explore, analyze, and communicate enormous digital datasets
- Computation is data-intensive
- Demands a fundamentally different set of principles, e.g., based on parallelism
- Requires real-time responsiveness and high degrees of fault-tolerance

(cont'd)

Data-Intensive Computing *(cont'd)*

- Questions:
  - How can we best program data-intensive computing platforms to exploit massive parallelism
  - What new programming abstractions can exploit these capabilities?
  - How can new designs support appropriate power consumption, human maintainability, and economic feasibility?
  - How must this computing paradigm evolve to best support new data-intensive applications?

Network Science and Engineering (NetSE)

(a component of NSF08-578)

- Considers computer networks as complex, global socio-technical infrastructure
- Encourages researchers to reason about the dynamics and behavior of current and future large-scale networks and the interdependence among the physical, informational and communications technologies
- Promotes research in radical design in network architectures by building on the predecessor FIND Program
- Seeks to improve or enable existing or new classes of applications, such as multi-player games, virtual worlds, augmented reality and tele-presence.

Trustworthy Computing

(a component of NSF08-578)

- Builds on its predecessor program – Cyber Trust
- Supports research and education activities that explore novel frameworks, theories, and approaches toward realizing a trustworthy computing future
- Seeks new knowledge about scientific foundations of trustworthiness – reliability, security, privacy and usability -- to inform trustworthy technologies
- Encourages researchers to explore the integration of hardware, networking protocols, systems software and applications through new security architectures.
- Seeks to explore trade-offs between security and privacy
- Encourages proposals in the area of usability

Additional CISE-wide Programs

- Expeditions in Computing
- Cluster Exploratory
- CISE PATHways (CPATH) to Revitalized Education in Computing
- Broadening Participation in Computing (BPC)
- Computer Research Infrastructure (CRI)

Cross-Cutting Programs – *CISE & Beyond*

- Cyber-Enabled Discovery and Innovation (CDI)
- Cyber-Physical Systems (CPS)
- Multicore Chip Design and Architecture
- Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps)
- Creative IT
- Community-Based Data Interoperability Networks (INTEROP)
- Sustainable Digital Data Preservation and Access Network Partners (DataNet)
- Science and Technology Centers (STC): Integrative Partnerships
- High-End Computing University Research Activity (HECURA)
- Foundations of Data and Visual Analytics (FODAVA)
- Collaborative Research for Computational Neuroscience (CRCNS)
- Advanced Learning Technologies (ALT)
- Domestic Nuclear Detection Office/National Science Foundation Academic Research Initiative (ARI)
- EPSCoR Research Infrastructure Improvement Grant Program

Other Continuing Cross-Foundation Programs

- **Faculty Early Career Development (CAREER) Program**
  NSF 08-557; CISE Deadline: July 21, 2009
- **Integrative Graduate Education and Research Traineeship (IGERT)**
  NSF 08-540; Deadline: October 20, 2008
- **Research Experiences for Undergraduates (REU and REU Sites)**
  NSF07-569; Deadlines: Supplements contact PO; other June 5, 2009
- **Research in Undergraduate Institutions (RUI)**
  NSF 00-144; Deadline: Proposals Accepted Anytime
- **NSF Graduate Teaching Fellows in K-12 Education (GK-12)**
  NSF 08-556 (deadlines and other specifics – see solicitation)
- **Office of International Science and Engineering Programs**
  - **Targeted opportunities, workshops, supplements**
    - e.g. Partnerships for International Research and Education (PIRE); NSF 09-505; Deadlines - TBD ***(cont'd)***

Other Continuing Cross-Foundation Programs *(cont'd)*

- **Science and Technology Centers (STC): Integrative Partnerships**
  NSF 08-580 (Refer to solicitation for deadline details)
- **Major Research Instrumentation Program (MRI)**
  NSF 08-503- Update to be posted
- **Industry/University Cooperative Research Centers Program (I/UCRC)**
  - NSF 08-591 (Refer to solicitation for deadline details and submission procedures)
- **Grant Opportunities for Academic Liaison with Industry (GOALI)**
  - NSF 07-522; (refer to solicitations for Deadlines; Supplement requests accepted anytime – contact cognizant PO)
- **Small Business Programs: Small Business Innovation Research (SBIR)** ***and*** **Small Business Technology Transfer (STTR):** NSF 08-548 and NSF 08-608 **(respectively)**

Expeditions In Computing

- Pursue ambitious, fundamental research that promises to define the future of computing
- Investigators collaborate across disciplinary and institutional boundaries
- Catalyze far-reaching research explorations motivated by deep scientific questions
- Inspire current and future generations of Americans, especially those from under-represented groups
- Stimulate significant research and education outcomes that promise scientific, economic and/or other societal benefits

Preliminary Proposal Due Date *(required)*: September 10, yearly

Full Proposal Deadline: January 10, yearly

CluE (Cluster Exploratory Program)

Future Deadline: TBD

- Through CluE, NSF-funded researchers will use software and services running on a Google-IBM cluster to explore innovative research ideas in data-intensive computing
- The Cluster Exploratory (CluE) program has been designed to provide academic researchers with access to massively-scaled, highly-distributed computing resources supported by Google and IBM.
- Proposals funded are expected to cover a range of activities that **first** lead to advances in computing research, but that also explore the potential of this computing paradigm to contribute to science and engineering research and to applications that promise benefit to society as a whole.

CISE PATHways (CPATH) to Revitalized Education in Computing

- The CPATH vision is:
  - ***a U.S. workforce with the computing competencies and skills crucial to the Nation's health, security and prosperity in the 21st century.***
  - advancing the field of computing and its impact - to ***transform undergraduate computing education on a national scale***,
  - meet the challenges and opportunities of a world where computing is essential to U. S. leadership.

(cont'd)

CPATH Program *(cont'd)*

- CPATH will support three *types* of projects in two major track categories:
  - Community Building Track
    - Community Building (CB) Grants
  - Institutional Transformation Track:
    - Conceptual Development and Planning (CDP) Grants
    - Transformative Implementation (TI) Grants
- Deadlines – will be posted with new solicitation announcement (previous NSF 08-516, deadline August 2008)

Broadening Participation in Computing (BPC) - NSF 07-548

- The BPC program aims to significantly increase the number of U.S. citizens and permanent residents receiving post secondary degrees in the computing disciplines; emphasis on students from communities with longstanding under-representation in computing: women, persons with disabilities, and minorities
- The program seeks to engage the computing community in developing and implementing innovative methods to improve recruitment and retention of these students at the undergraduate and graduate levels. The program also aims to develop effective strategies for encouraging individuals to pursue academic careers in computing and become these role models

(cont'd)

Broadening Participation in Computing BPC *(cont'd)*

- Three program components:
  - Alliances: Broad Alliances across institutions and organizations
  - Alliance Extensions: Successful BPC Alliances, can seek additional funding
  - Demonstration Projects: Pilots of innovative projects

- Proposal Deadline: May 20, 2009
  (Third Wednesday in May, Annually Thereafter)

Computing Research Infrastructure (CRI) - NSF 08-570

- The CRI program supports two classes of awards: **Institutional Infrastructure and Community Infrastructure**
  - **Institutional Infrastructure** for the creation of new computing research infrastructure or the enhancement of existing computing research infrastructure to enable world-class research and education opportunities ***at the awardee and collaborating institutions***.

(cont'd)

Computing Research Infrastructure (CRI) *(cont'd)*

- **Community Infrastructure** for the planning for computing research infrastructure, or the creation of new computing infrastructure, or the enhancement of existing computing research infrastructure to enable world-class research and education opportunities ***for broadly-based communities of researchers and educators that extend well beyond the awardee institutions.***

  and support the operation of such infrastructure, ensuring that awardee institutions are well-positioned to provide a high quality of service to community researchers and educators

- Also refer to CRI FAQ page for changes in emphasis in 2009
- Deadlines:
  - August 05, 2009 (First Wednesday in August, Annually Thereafter)

Cyber-Enabled Discovery and Innovation (CDI)

Bold Five-Year Initiative

- NSF-wide Program
- Create revolutionary science and engineering research outcomes made possible by innovations and advances in computational thinking.
- Seeks ambitious, transformative, multidisciplinary research proposals within or across the following thematic areas:
  - From Data to Knowledge
  - Understanding Complexity in Natural, Built, and Social Systems
  - Building Virtual Organizations

Deadlines (see solicitation for details):

Preliminary Proposal Deadline (Dec 8, 2008; Dec 9, 2008)

Full Proposal Deadline: may 20, 2009

Cyber-Physical Systems (CPS) (NSF 08-611)

- The term cyber-physical systems refers to the tight conjoining of and coordination between computational and physical resources
- The program address research challenges in *Foundations*; *Methods and Tools*; and *Components, Run-time Substrates, and Systems*
  - *Foundations research will develop new scientific and engineering principles, algorithms, models, and theories for the analysis and design of cyber-physical systems*
  - *Research on Methods and Tools will bridge the gaps between approaches to the cyber and physical elements of systems*

Proposal Deadline: February 27, 2009 (last Friday in February annually thereafter)

Collaborative Research for Computational Neuroscience (CRCNS) – NSF 08-514

- NSF-NIH cosponsored program
- Computational neuroscience provides a theoretical foundation and a rich set of technical approaches for understanding the functions of complex neurobiological systems, building on the theory, methods, and findings of computer science, neuroscience, and numerous other disciplines.
- The CRCNS program support innovative interdisciplinary collaborative research to make significant advances in the understanding of nervous system function, mechanisms underlying nervous system disorders, and computational strategies used by the nervous system.

(cont'd)

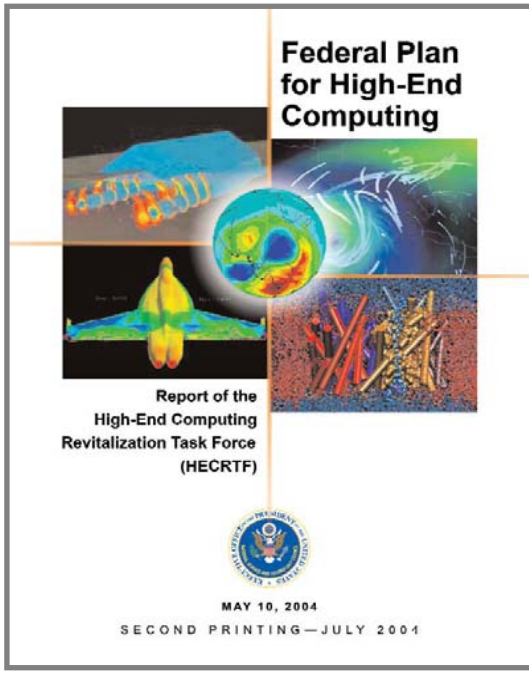
Collaborative Research for Computational Neuroscience (CRCNS) *(cont'd)*

- Two classes of proposals will be considered in response to this solicitation:
  - **Research proposals** describing new collaborative research projects, and
  - **Data sharing proposals** to enable sharing of data and other resources.

- Proposal Deadline: October 30, 2009

High-End Computing University Research Activity (HECURA)

- HECURA FY 2006 Budget 14.5M
  - Input/Output capabilities
  - File Systems
  - Storage Systems
- HECURA FY 2008 Budget 10M NSF 08-531
  - HEC Programming Models
  - HEC Languages
  - HEC Compilers
- HECURA FY 2009 Budget 10M
  - Input/Output capabilities
  - File Systems
  - Storage Systems



New Deadline April 15, 2009

http://www.nsf.gov/pubs/2009/nsf09530/nsf09530.html

Foundations of Data and Visual Analytics (FODAVA) - NSF 07-583

- Partnership between NSF and DHS
- capitalize on knowledge and expertise in the fields of mathematics, computational science, and intelligent systems
  - Produce new data representations and transformations to enable data stakeholders to detec the expected and discover the unexpected in massive data sets
  - Develop new mathematical and computational algorithms and techniques are sought that will fundamentally improve our ability to transform large, often streaming data sets into representations that better support visualization and analytic reasoning

Proposal deadline: To be Announced

See also: related Computer Graphics&Viz IIS Core Program

Get Involved

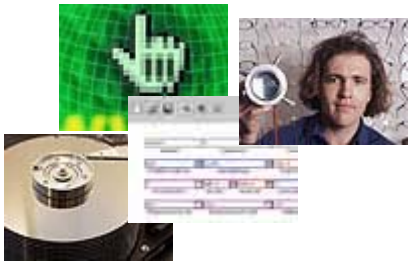
- Send your best ideas to NSF: consistent with program focus and goals
- Volunteer to be a reviewer and panelist
- Get to know your Program Directors

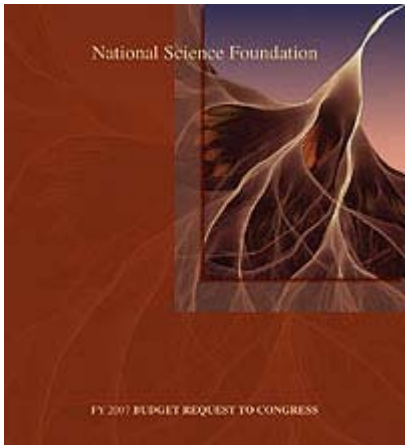
- Keep us informed of your accomplishments
- Work within your institutions to support collaborative, interdisciplinary research
- Call our attention to things that need improvement
- Suggest transition strategies from basic research to prototyping and production

- Participate in NSF-funded events, workshops, etc.
- Plan to serve as a program officer ("rotator") or division director
- Consider participating in the Computing Community Consortium: www.cra.org/ccc

NSF/CISE Repository of Highlights

- Succinct, interesting vignettes
  - Show a result, a discovery
  - in layperson's language
  - including graphics if possible





- NSF shares Highlights publicly
  - Budget requests
  - Performance reports
  - Public relations

- Convince the US public that research is worth paying for!!!

Summary Points

- CISE-funded research and education outcomes *essential* to national competitiveness
- Focus on grand vision, big ideas
- We seek potentially transformative research
  - Fundamental questions in computing
  - Potential for significant, enduring impact
  - Plausible, but high risk projects
- Multi-disciplinary, NSF-wide investments such as CDI

"We will… wield technology's wonders to raise health care's quality… harness the sun and the winds and the soil to fuel our cars and run our factories… we will transform our schools and colleges and universities to meet the demands of a new age …"

President Obama, Inaugural Address January 20, 2009

…and CISE can play a BIG role in this…..