Funding Opportunities in NSF's CISE Directorate

Almadena Chtchelkanova

Program Director

National Science Foundation

achtchel@nsf.gov

Outline

- **Overview of NSF and CISE**
  - Origins, Mission, Organization, Budgets, Funding
- **CCF Division of CISE and the CPA Cluster**
  - Research Areas & Topics of Interest
- **IIS and CNS Divisions of CISE**
  - Research Areas & Topics of Interest
- **Funding Opportunities across CISE & NSF**
  - CISE Cross-Division Programs
  - NSF Cross-Directorate Programs
- **Closing Remarks and Q&A**

NSF in a Nutshell

- **Independent federal agency under the Executive Branch**
- **Supports basic research & education**
- **Uses grant mechanism**
- **Discipline-based structure**
- **Cross-disciplinary mechanisms**
- **~ 60% Program Managers are Rotators/IPAs**
- **Oversight by the National Science Board**

NSF's Origin, Mission & Goal

- **Established in 1950 by the NSF Act**

- **Only federal agency authorized to provide funding for research across all S&E disciplines**

- **"To Promote Progress of Science" and "Advance National Health, Prosperity & Welfare by Supporting Research & Education in S&E"**

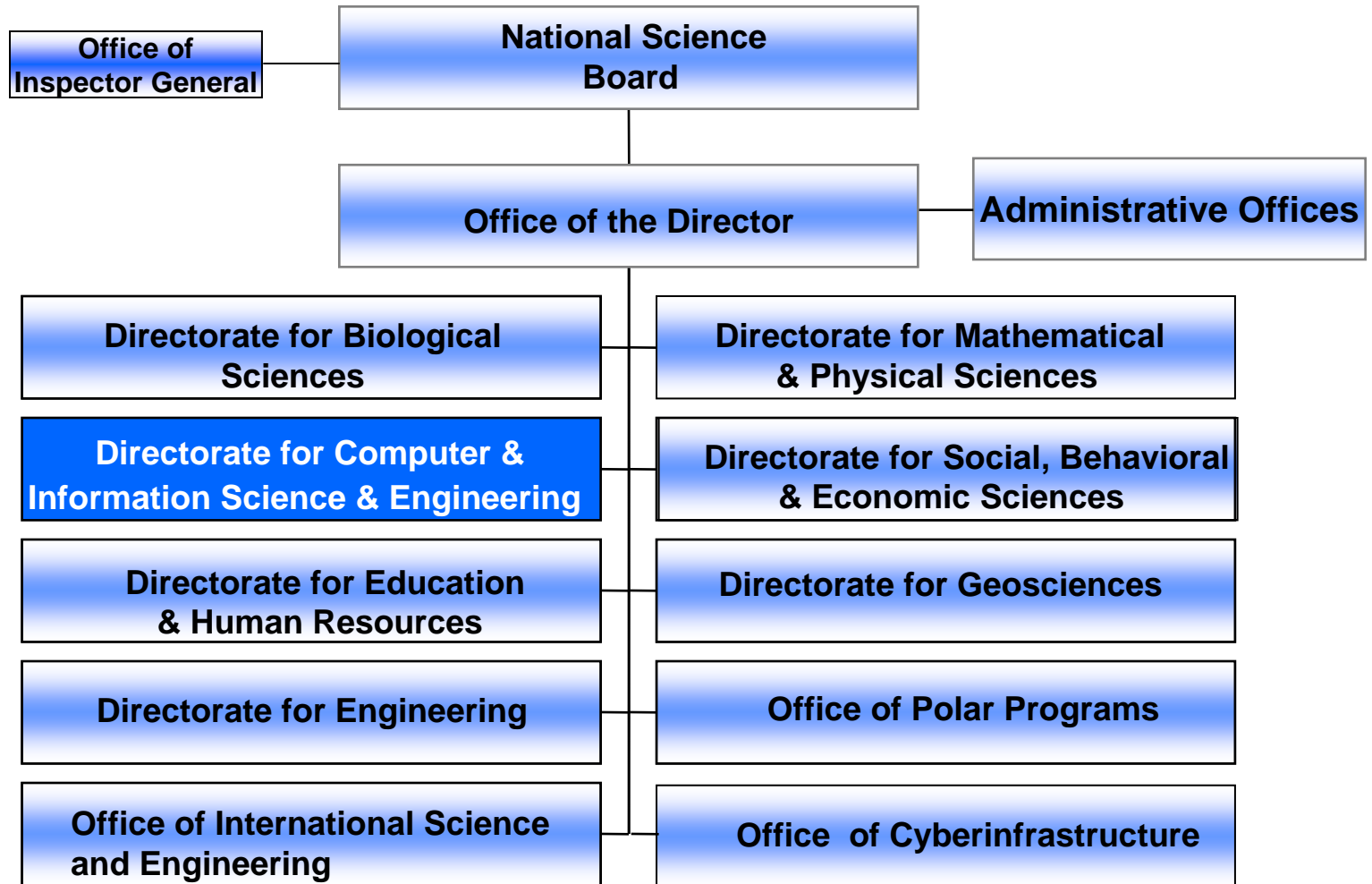- **NSF's goal is to fund *meritorious* and *broadly impacting* S&E proposals**

NSF's Target Audience*

- **U.S. Universities and Colleges**

- **U.S. Nonprofit, Nonacademic Organizations**

- **U.S. For-Profit Organizations**

- **State/Local Educational Organizations**

- **Unaffiliated U.S. Scientists, Engineers, Educators, & Citizens**

    - **NSF Rarely Supports Foreign Organizations or Other Federal Agencies**

* Program Solicitations may establish more restrictive eligibility

National Science Foundation

```
┌─────────────────┐        ┌─────────────────────┐
│ Office of       │────────│ National Science    │
│ Inspector General│       │ Board               │
└─────────────────┘        └─────────────────────┘
```

Office of Inspector General	National Science Board

Office of the Director	Administrative Offices

Directorate for Biological Sciences	Directorate for Mathematical & Physical Sciences
Directorate for Computer & Information Science & Engineering	Directorate for Social, Behavioral & Economic Sciences
Directorate for Education & Human Resources	Directorate for Geosciences
Directorate for Engineering	Office of Polar Programs
Office of International Science and Engineering	Office of Cyberinfrastructure

NSF Sponsors Research in All Fields of Science and Engineering

SCIENCES

- Astronomy
- Atmospheric Sciences
- Behavioral Sciences
- Biological Sciences
- Computer Science
- Earth Sciences
- Materials Research
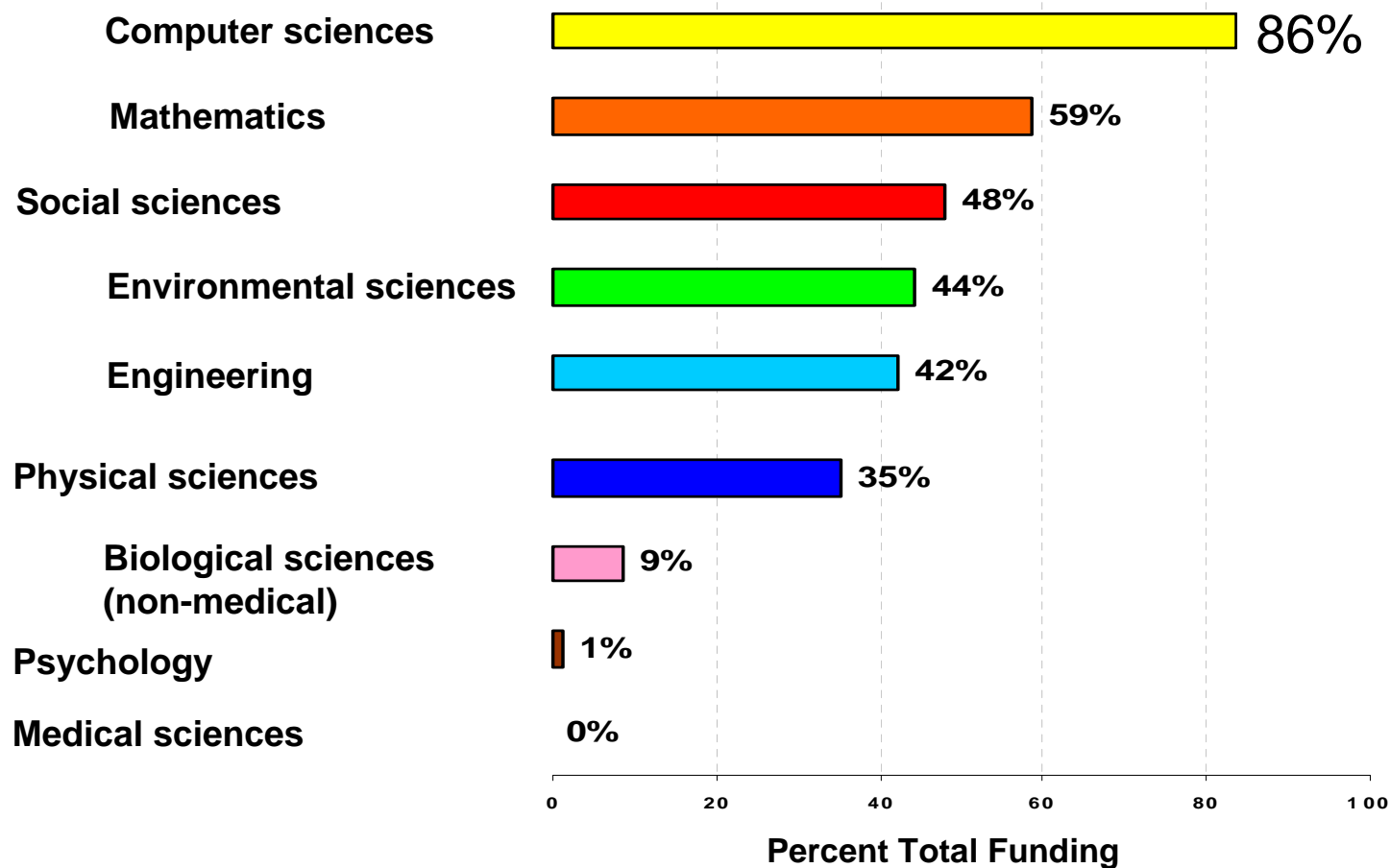- Mathematical Sciences
- Oceanography
- Physical Sciences
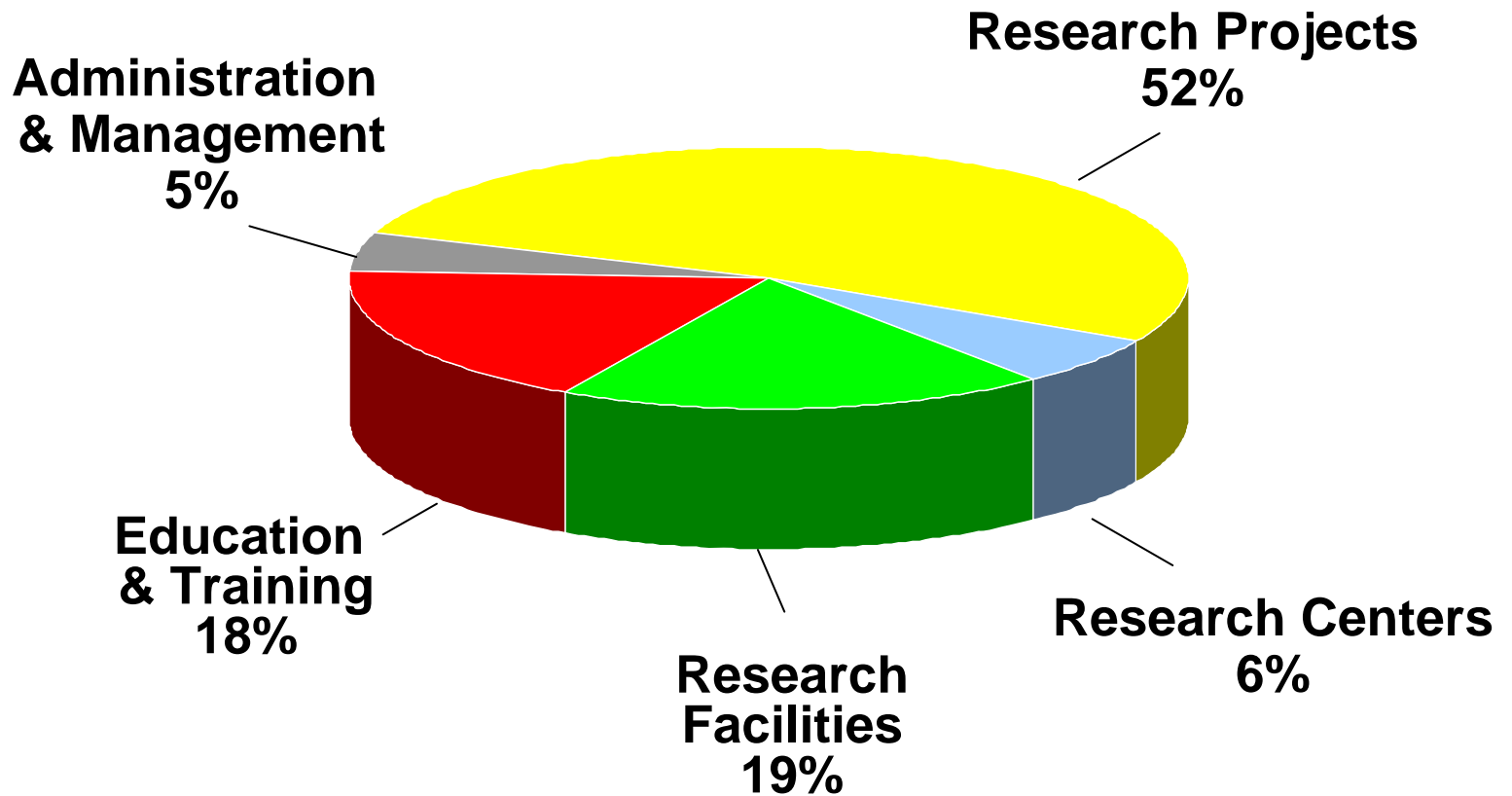- Research on Learning
- Social Sciences

ENGINEERING

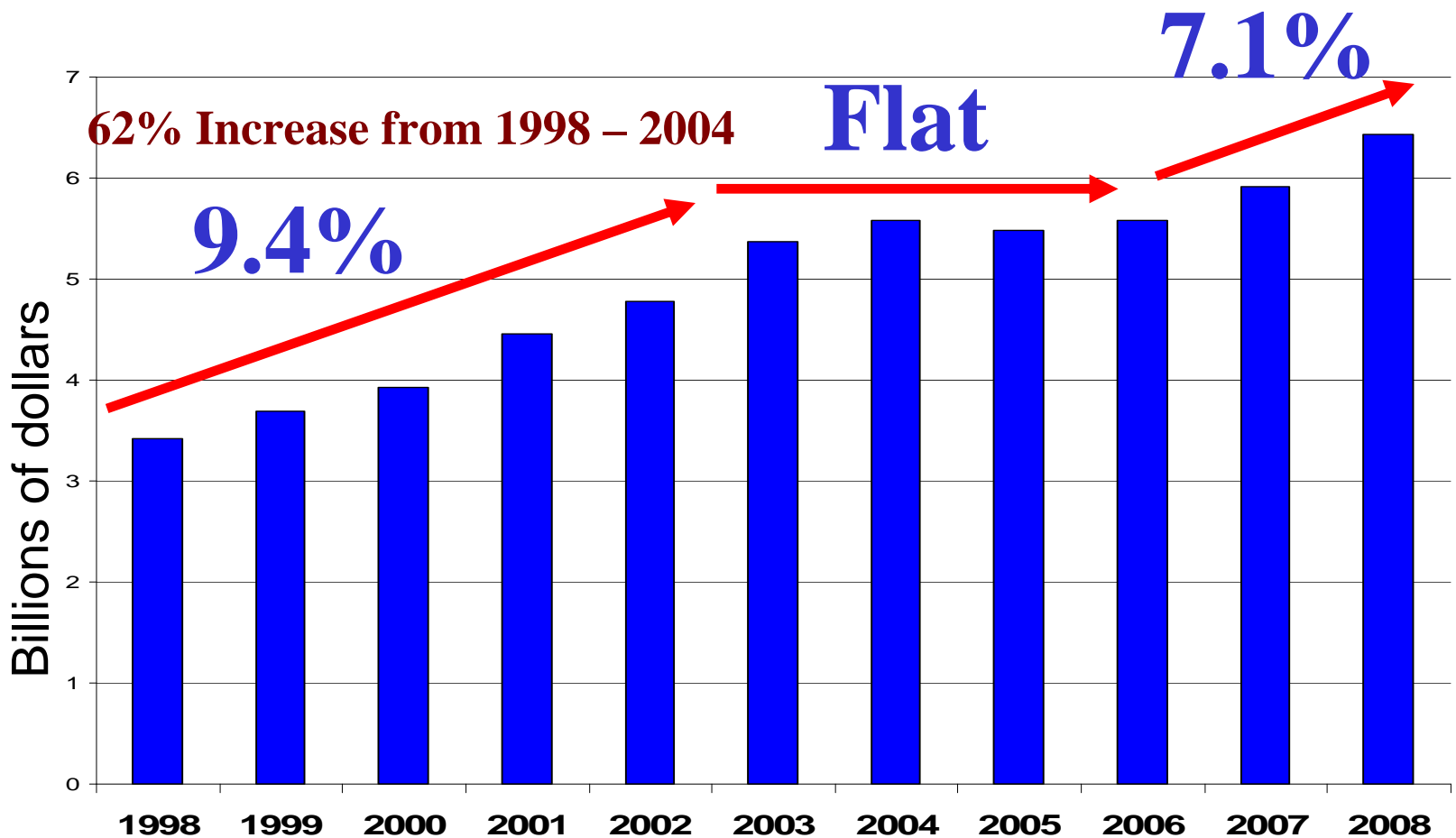- Aeronautical/Mechanical
- Chemical
- Civil
- Electrical
- Etc.

NSF Proposal Statistics (FY 2006)

- **42,376 proposal actions**

- **~ 254,000 reviews**

- **~ 58,000 reviewers**

- **10,430 awards**

- **25.0% funding rate**

     (research 21%)

NSF Research Grant Profile (FY 2006)

- Competitive awards (research):   6,635

- Average annual award: $134,800

- Median annual award: $106,800

- Average duration (research):   2.92 years
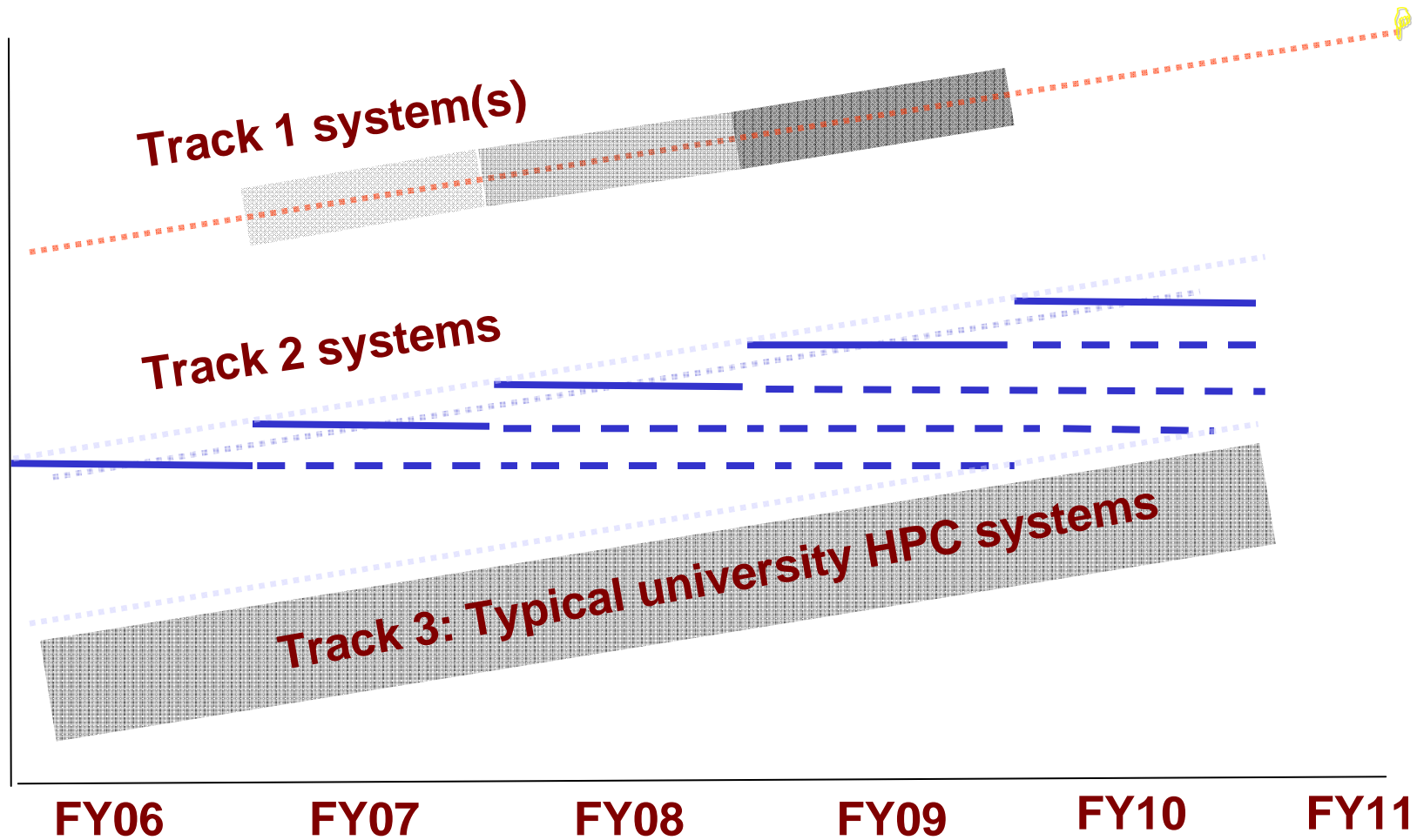
NSF OCI Key Acquisition Strategy

Driven by the needs of the science and engineering research community

- **Workshops to identify those needs**
- **Work with the other federal agencies**
  - **Benchmarking/model problems**
  - **Runtime/support software**
  - **Programming languages/paradigms**
- **Cost of ownership is an important issue**

NSF HPC Acquisition Strategy

Track 1 system(s)

Track 2 systems

Track 3: Typical university HPC systems

Science and engineering capability (logrithmic scale)

FY06   FY07   FY08   FY09   FY10   FY11

Track 1 Acquisition (FY07-10)

- A Leadership-Class System

- University of Illinois at Urbana-Champaign (UIUC) will receive $208 million over 4.5 years to acquire and make available a petascale computer it calls "Blue Waters," which is 500 times more powerful than today's typical supercomputers. The system is expected to go online in 2011.

- Under the direction of Dr. Thomas Dunning, Blue Waters will reside at UIUC where it will be operated by the National Center for Supercomputing Applications and its academic and industry partners in the Great Lakes Consortium for Petascale Computation.

- UIUC and its partners, including the Southeast Universities Research Association, the Great Lakes Consortium and the Shodor Education Foundation, will integrate petascale computing into pre-college and college education and develop a new virtual school of computational science and engineering that will have an impact on a national scale..

Track 1 Acquisition (FY07-10)

Examples of research problems:

- **The origin and nature of intermittency in turbulence**

- **The interaction of radiative, dynamic and nuclear physics in stars**

- **The dynamics of the Earth's coupled carbon, nitrogen and hydrologic cycles**

- **Heterogeneous catalysis on semiconductor and metal surfaces**

- **The properties and instabilities of burning plasmas and investigation of magnetic confinement techniques**

- **The formation of planetary nebulae**

- **The interaction of attosecond laser pulse trains with polyatomic molecules**

- **The mechanisms of reactions involving large bio-molecules and bio-molecular assemblages**

- **The structure of large viruses**

- **The interactions between clouds, weather and the Earth's climate**

Track 2 Acquisitions

- A four-year activity designed to fund the deployment and operation of up to four leading-edge computing systems that will greatly increase the availability of computing resources to U.S. researchers.

- Individual systems - provide capabilities beyond those typically obtainable with university or state funds

- Collectively, as part of TeraGrid - provide a diverse HPC portfolio to meet the HPC needs of the academic research community

- Annual competition: roughly $30M/year for acquisition costs

- O&M costs via a » TeraGrid RP* award

- Primary selection criterion: Impact on science and engineering research

- *The TeraGrid is the world's largest, most powerful and comprehensive distributed cyberinfrastructure for open scientific research. It currently supports more than 1,000 projects and over 4,000 researchers geographically spanning the entire United States.

Track 2 Acquisitions

- Last year, the Foundation made a 5-year, $59 million Track 2 award to the Texas Advanced Computing Center at The University of Texas at Austin and its partners at Arizona State University and Cornell University.

- University of Tennessee at Knoxville Joint Institute for Computational Science (JICS). The $65 million, 5-year project will include partners at Oak Ridge National Laboratory, the Texas Advanced Computing Center, and the National Center for Atmospheric Research. Under the direction of Dr. Thomas Zacharia, the group will acquire and provide to the research community a system with a peak performance of just under one petaflop that is almost four times the capacity of the current NSF-supported Teragrid.

ACCELERATING DISCOVERY IN SCIENCE AND ENGINEERING THROUGH PETASCALE SIMULATIONS AND ANALYSIS

- **NSF 07-559: PetaApps   July 2007**
  - **Several NSF Directorates participating**
- **develop the future simulation, optimization and analysis tools that can use petascale computing to advance the frontiers of scientific and engineering research**
- **beyond the current state-of-the-art.**
  - **emphasis is on implementation and exploitation of forefront techniques.**
- **research problem that *requires* or can exploit petascale computing capabilities**
- **$21.5M (11 – 22 awards)**
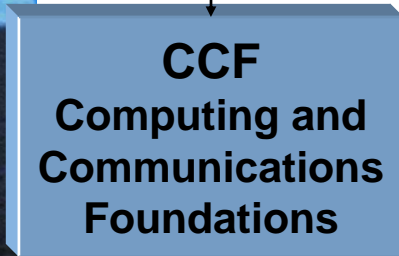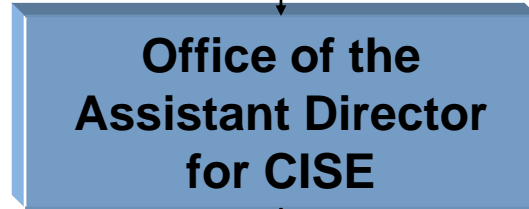
We are exploring
Ways to repeat this activity

Directorate for Computer and Information Science and Engineering (CISE)

CISE's 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
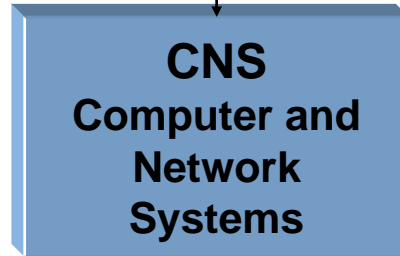- **CISE provides > 85% of _all_ Federal support for computer science research**
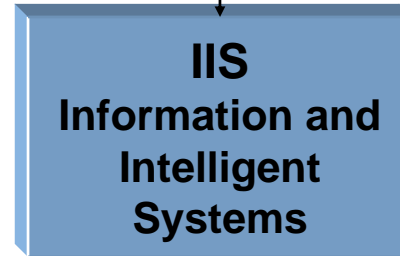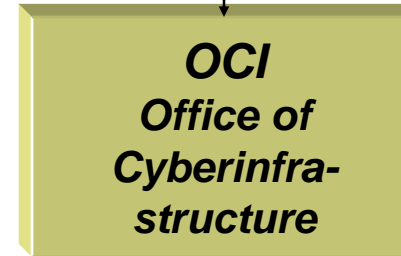
CISE Organization

Office of the Director

Directorate for Computer & Information Science & Engineering

Office of the Assistant Director for CISE

CCF
Computing and Communications Foundations

CNS
Computer and Network Systems

IIS
Information and Intelligent Systems

OCI
Office of Cyberinfra-structure

(formerly SCI, now an NSF-wide mission, reporting to Director of NSF since 2006)

Clusters
- **EMT**
- **CPA**
- **TF**

Clusters
- **NeTS**
- **CSR**
- **CRI**

Clusters
- **HCC**
- **III**
- **RI**

Cross-Divisional Programs and CISE/NSF Emphasis Areas
- **CT**
- **SRS**
- **CDI**
- **Expeditions**
- **BPC**
- **CPATH**

Computing and Communication Foundations Division (CCF)

- **Emerging Models and Technologies for Computation (EMT)**
  - Computational biology; quantum computing; nano-scale computing; biologically-inspired computing
- **Foundations of Computing Processes and Artifacts (CPA)**
  - Advanced computation research; compilers; computer architecture; design automation (micro/nano); graphics & visualization; software engineering & languages
- **Theoretical Foundations (TF)**
  - Computer science and communication theory; numeric symbolic/graphic computation; theory of computing; computational algebra and geometry; signal processing

Computer and Network Systems Division (CNS)

- **Computer Systems Research (CSR)**
  - Distributed systems; embedded and hybrid systems; next-generation software; parallel systems
- **Networking Technology and Systems (NeTS)**
  - Programmable wireless networks; networking of sensor systems; networking broadly defined; future internet design (GENI)
- **Computing Research Infrastructure (CRI)**
  - Equipment and infrastructure to advance computing research
- **Cross-Directorate Emphasis Areas & Activities**
  - Cybertrust (CT); Science of Design (SoD); Broadening Participation in Computing (BPC); IT workforce and special projects: REU sites, IGERT, ADVANCE, CPATH

Information and Intelligent Systems Division (IIS)

- ## Human-Centered Computing (HCC)
  - Digital society & technologies; human computer interaction; universal access; intelligent spaces (active displays, sensory devices, immersive experiences) and personal agents (feature-rich gadgets and appliances)

- ## Information Integration and Informatics (III)
  - Digital government; digital libraries & archives; information, data, and knowledge management; science & engineering information integration and informatics

- ## Robust Intelligence (RI)
  - Artificial intelligence & cognitive science; computational neuroscience; computer vision; human language & communication; robotics

NSF & CISE Budget in $M FY'06 to FY'08 (*Requested*)

CISE Divisions	FY'05	FY'06	FY'07
CNS	$141.53	$162.98 (+15%)	$191.98 (+18%)
CCF	$105.46	$122.82 (+16%)	$149.15 (+21%)
IIS	$103.62	$119.30 (+15%)	$154.63 (+30%)
ITR (across divisions)	$145.80	$121.59 (-16%)	$78.24 (-36%)
CISE Total * (Research)	$496.41	$526.69 (+6%)	$574.00 (+9%)
NSF Total	$5,605	$6,020 (+7.4%)	$6,430 (+6.8%)

* Major Research Equipment and Facilities Construction (MREFC) since '05: $165.6M add'l

Professor Jeannette M. Wing
Assistant Director
Computer and Information Science and Engineering Directorate

- **Vision: Computational Thinking For All**
- **5 Deep Questions in Computing**
  - **P = NP?**
  - **What is computable?**
  - **What is intelligence?**
  - **What is information?**
  - **How can we build complex systems simply?**
- **5 Broad Themes**
  - **Math ↔ Computing**
  - **Parallel and Distributed Thinking**
  - **Software for Complex Systems**
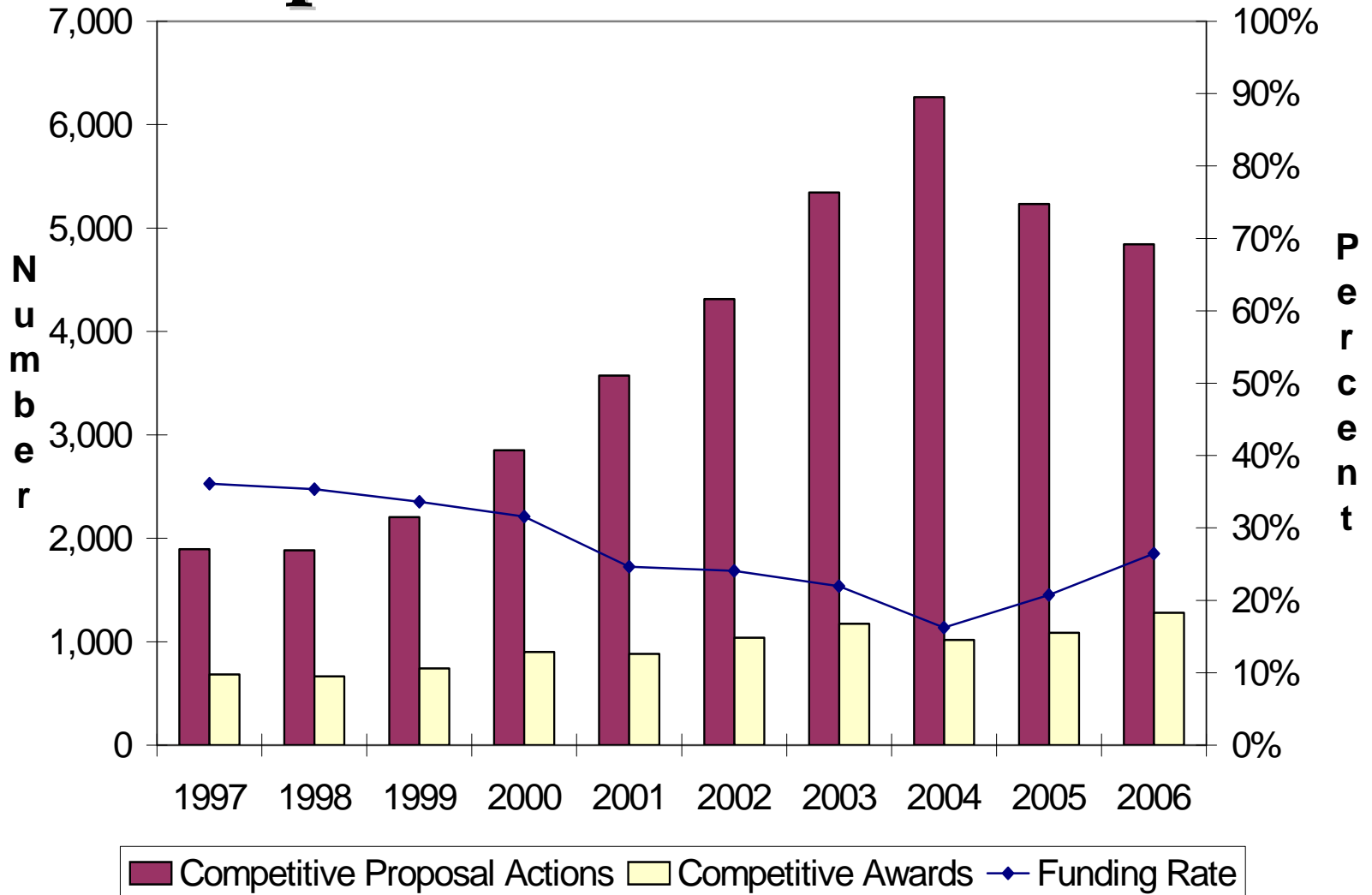 - **Human-in-the-Loop**
  - **Understanding the Brain**

CISE Budget
2003 – 2008
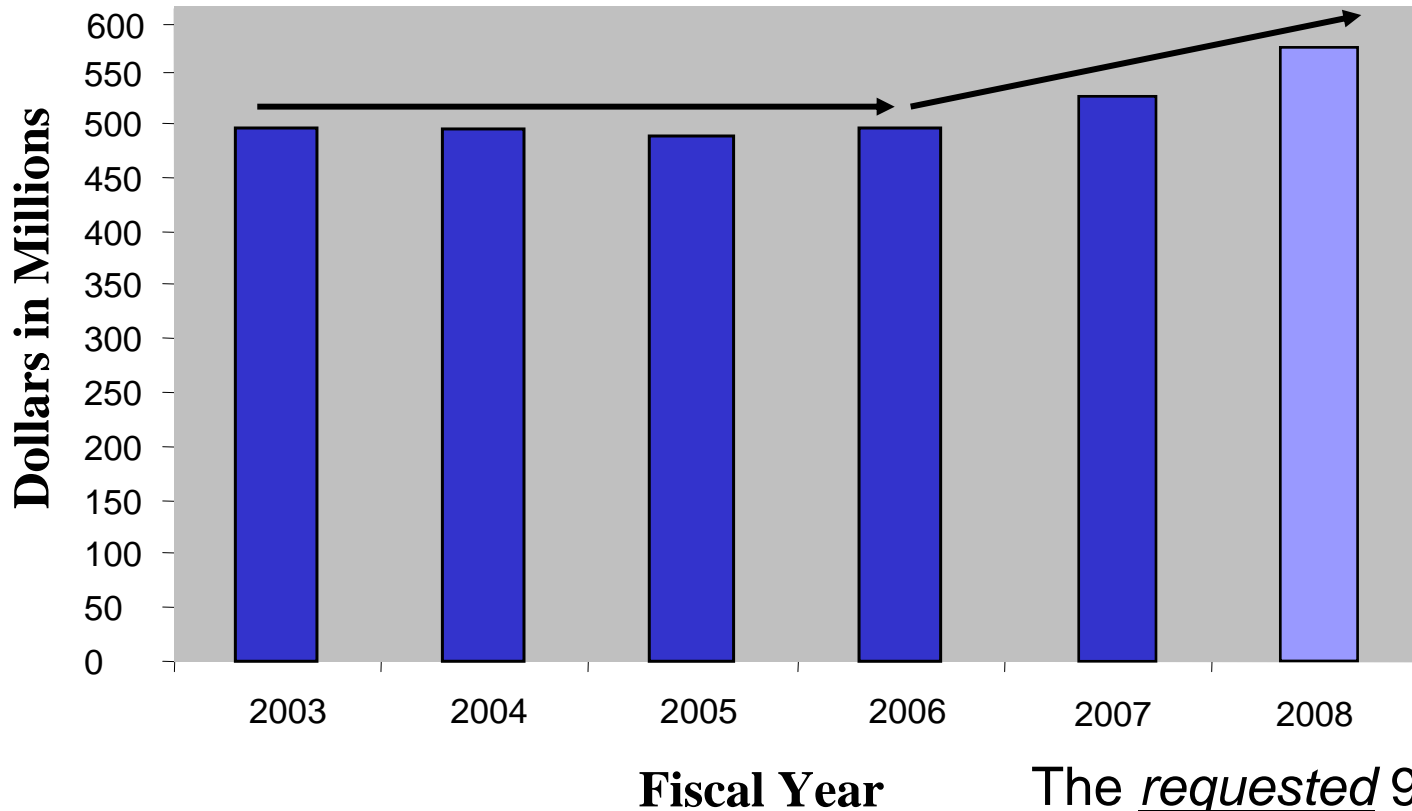
The _requested_ 9% increase includes $30M for Expeditions and $20M for CDI
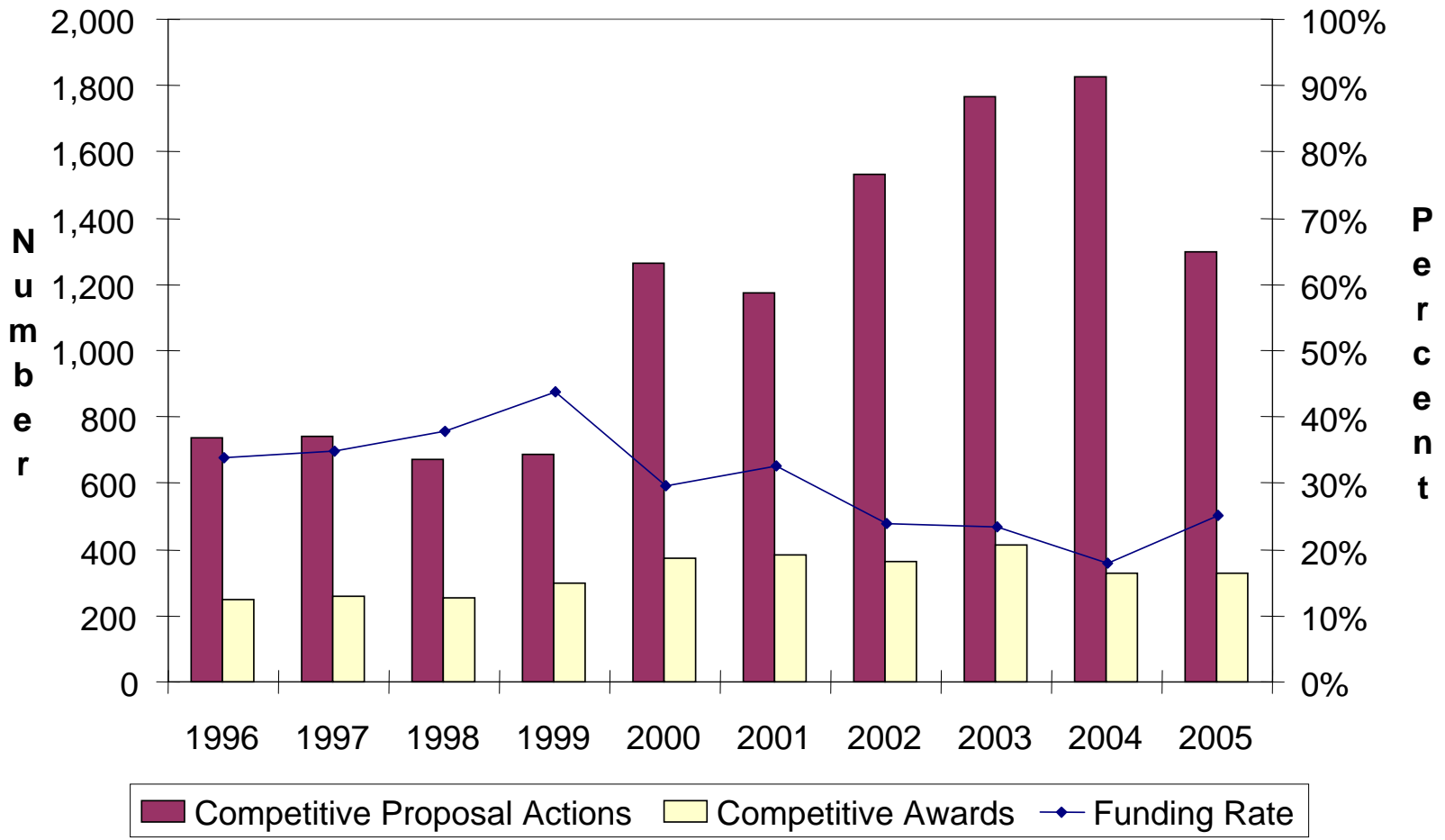
Funding Rate for Competitive Awards in CISE

Legend: Competitive Proposal Actions / Competitive Awards / Funding Rate

Funding Rate for Competitive Awards in CCF

Directorate for Computer & Information Science & Engineering

Foundations of Computing Processes and Artifacts (CPA) Cluster

Why Foundations?

Foundations Everywhere

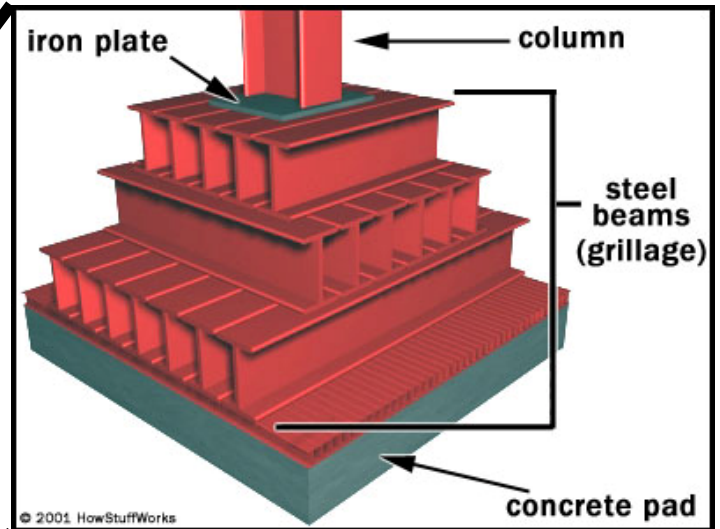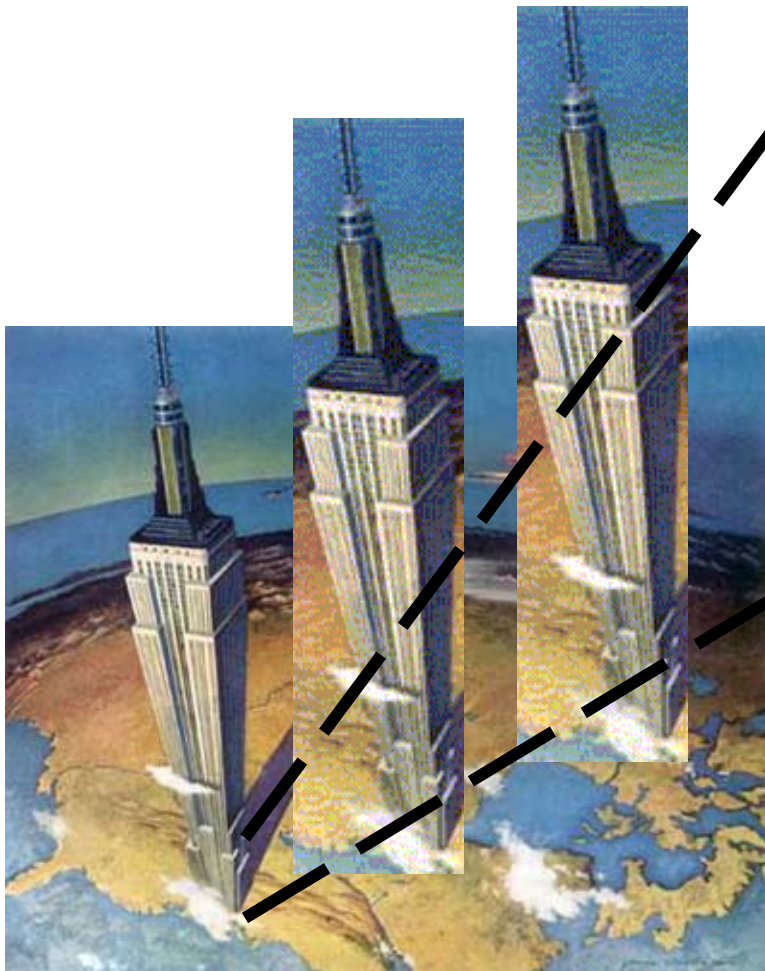iron plate   column

steel beams (grillage)

concrete pad

© 2001 HowStuffWorks

Foundations

Systems

Foundations of Computing Processes and Artifacts (CPA)

The CPA Cluster supports basic research and education projects aimed at advancing formalisms and methods pertaining to processes and artifacts for designing and building computing and communication systems

- Processes and artifacts range from formalisms, models, algorithms, theories, design principles and languages to hardware/software architectures, technology components, and a variety of physical manifestations and implementations

- The CPA cluster funds a diverse portfolio of high-quality, high-payoff _foundational research_ to meet the needs of the scientific and engineering community as well as society at large

- There are _six focus areas_ having topics of specific interest, but _clustering_ promotes research across sub-fields that may transcend individual focus area boundaries

Foundations of Computing Processes and Artifacts (CPA)

Six focus areas comprising the CPA cluster:

- **Advanced Computation**: parallel algorithms, data management, storage, I/O, high-performance computing, simulation, benchmarking

- **Compilers**: parallelization, code transformation, thread management

- **Computer System Architecture**: processor microarchitecture, memory, interconnection networks, reconfigurable computing, tools

- **Design Automation**: VLSI design, test & verification, system-on-chip

- **Graphics and Visualization**: mathematical modeling of data, graphical simulation and animation techniques, graphics processing

- **Software Engineering and Languages**: formalization of software development, correctness, reliability, programming models

Foundations of Computing Processes and Artifacts (CPA)

- Focus areas and Program Directors of the CPA Cluster

ACR	Advanced Computation Research (Algorithms, Storage, I/O, HPC)	Almadena Chtchelkanova (since 2005)
CHS	Compilers and High-performance Software	Almadena Chtchelkanova (since 2005)
CSA	Computer System Architecture	Timothy M. Pinkston (since 2006)
DA	Design Automation for Micro & Nano Systems (VLSI)	Sankar Basu (since 2003)
GV	Graphics & Visualization	Lawrence Rosenblum (since 2005)
SEL	Software Engineering & Languages	Sol Greenspan (since 2003) Joseph Urban (since 2006) Al Hevner (since 2006)

- Each focus area can have topics of specific interest, but *clustering* promotes cross-disciplinary research that may transcend focus area boundaries

Advanced Computation Research (ACR)

Hardware/software research and enabling technologies for advancing the state-of-the-art in computational science and engineering, developing efficient computational parallel algorithms, high throughput input/output (I/O) capabilities, large data storage capacities, and tools for efficiently organizing, locating, and moving data produced by different applications in numerous locations and in various formats

Topics of interest include:

- Design of multi-level (hierarchical, layered) parallel algorithms and libraries
- Scalable and latency tolerant computational/numeric algorithms
- Performance modeling of scalable algorithms
- Management of large-scale distributed file systems and data
- Novel storage devices, architectures, and middleware for high-throughput I/O
- Software and hardware processes and artifacts for design, simulation, benchmarking, tracing, performance measurement, and tuning of I/O, file, and storage systems in high-performance computing environments

Compilers & HP Software (CHS)

Foundations in compilers research and education for enabling automatic algorithm mapping, code and data transformation, translation to hardware description language (for reconfigurable architectures), advanced analysis to verify program correctness and improve programmer productivity, compiler support for automating the exploitation of parallelism (i.e., parallelizing compilers for single-threaded and multi-threaded programs for multicore & multiprocessor systems)

Topics of interest include:

- Parallelizing compilers and infrastructure for optimizing compilers for multiple platforms, including reconfigurable architectures
- Parallelization techniques for exploiting parallelism at multiple levels applicable to multiple programming models
- Software and compiler support for mapping and scheduling multiple threads on (possibly heterogeneous) multicore and multiprocessor systems
- Software and compiler techniques for managing on-chip communication, power consumption, temperature, and fault tolerance
- Compiler techniques to guarantee safety from potential deadlocks, memory leaks, race conditions, and other forms of correctness in parallel programs

Computer System Architecture (CSA)

Foundations in computer system architecture research and education for facilitating and enabling scalable performance, power and thermal management, reliability (soft and hard error detection and recovery), dynamic adaptation, real-time computation, security, reduced design complexity, programmability, and other enhanced functionalities

Topics of interest include:

- Processor microarchitecture, memory, and interconnection networks: multithreaded, multicore, and multiprocessor architectures; distributed register and cache architectures; on-chip networks
- Novel architectures and hardware primitives that facilitate concurrency and exploit parallelism at multiple levels and in multiple forms: fine-grained, instruction, data, thread, stream, task, and coarse-grained
- Architectural techniques for managing on-chip communication, power consumption, temperature, operational variability, error/fault tolerance
- Application-to-hardware mapping: application-specific processors, programmable accelerators, and reconfigurable computing
- Design and analysis of computer systems: tools and methods for design space exploration; modeling, benchmarking, simulation, synthesis, and performance evaluation

Design Automation for Micro and Nano Systems (DA)

Foundations in VLSI design automation in both CMOS silicon technology and future computing media (i.e., MEMs, 3-D, optical, molecular, and nano-scale technologies) to meet the needs of deep submicron VLSI computing and communication chips

Topics of interest include:

- Physical design: routing & layout, power optimization, logic synthesis, on-chip communication, modeling & device simulation

- System-level design: systems-on-a-chip, multicore, embedded, and application-specific processor design; hardware/software co-design

- Test and verification: analog and digital mixed-signal systems, built-in self-test, design for testability, formal proof of correctness

- Nano-scale design related to the circuits/architecture interface: novel approaches to parallelism suitable to nano-scale electronics, systems integration of nano-scale devices, design of reliable systems from unreliable components, defect/fault models, fundamental limits to such designs
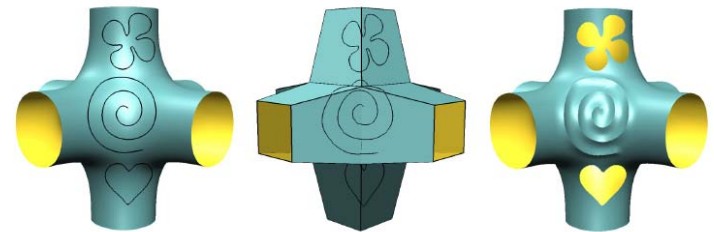
Graphics & Visualization (GV)

- Integrated research and education projects to advance the scientific foundations and engineering practices/education that underlie the ability to perform visual information transfer, address models of physical events, develop mechanisms for image production, and utilize visualization to represent and explore information

- Focus is on the ability to model, render, and display data and to understand the forms of visualization that can best transfer particular types of information

- Seek _fundamental_ advances that will enhance the numerous activities that utilize computer graphics and visualization, including science, engineering, medicine, entertainment, education, commerce, and homeland security

Computer-generated lighting effects using flash photography [Durand, MIT]

Multiresolution Subdivision Surfaces simplify the addition of sharp surface features onto surfaces [Zorin, NYU]

Graphics & Visualization (GV)

Topics of interest include:

- **Mathematical models for representing geometric and non-geometric data**

- **Algorithms for the photorealistic and non-photorealistic rendering of geometry, lighting, and materials**

- **Physical-based modeling and graphical simulation**

- **Animation techniques**

- **Multi-resolution algorithms for graphics modeling and applications**

- **Visibility algorithms**

- **Scientific visualization algorithms and systems**

- **Visualization aspects of visual analytics**

- **Visualization aspects of location-aware computing**

- **Virtual and augmented reality**

- **Novel hardware for graphics processing**

- **Graphics issues in computational photography and video**

- **Innovative multidisciplinary proposals that join visualization with other computer-science domains**
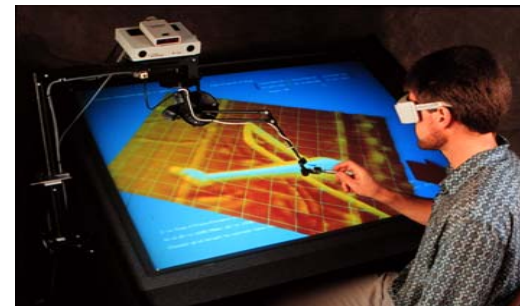
The **nanoManipulato**r system enables scientists to directly see and touch nanometer-scale objects [Taylor et al., UNC]
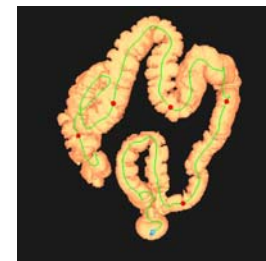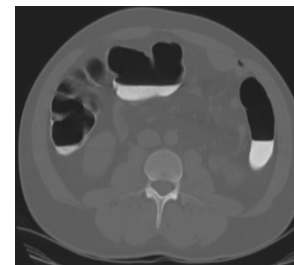
The steps of the **Virtual Colonoscopy**: CT scan of patient's abdomen; automatic segmentation and reconstruction; real-time volume rendering [Arie Kaufman, SUNYSB]
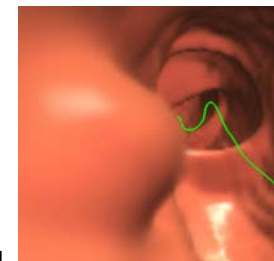
Foundations of Computing Processes and Artifacts (CPA)

- Current CPA focus areas and Program Directors

ACR	Advanced Computation Research (Algorithms, Storage, I/O, HPC)	Almadena Chtchelkanova (since 2005)
CHS	Compilers and High-performance Software	Almadena Chtchelkanova (since 2005)
CSA	Computer System Architecture	Timothy M. Pinkston (since 2006)
DA	Design Automation for Micro & Nano Systems (VLSI)	Sankar Basu (since 2003)
GV	Graphics & Visualization	Lawrence Rosenblum (since 2005)
SEL	Software Engineering & Languages	Sol Greenspan (since 2003) Joseph Urban (since 2006) Al Hevner (since 2006)

- Each focus area can have topics of specific interest, but _clustering_ promotes cross-disciplinary research that may transcend focus area boundaries

Software Engineering and Languages (SEL)

Topics of interests include:

- **Programming language principles, design and implementation**
  - **PL semantics to elucidate new features, e.g., aspects**
  - **Advancing type theory to full theorem proving**
- **Software analysis and testing**
  - **Test-case generation, fault localization**
  - **Static and dynamic checking, model checking**
  - **Monitoring and continuous testing of distributed systems**
- **Formal methods for program development – components and composition**
  - **Assembling components to meet a specification, trusted components, behavioral interfaces**
- **Software development methodology**
  - **Informal methods, integrated environments, processes, requirements, architectures, dependability, scaling up**

CPA Proposal Solicitation

- 2006 CPA Competition (NSF 06-585)
  - approx. 105 awards from 525 proposals (~20% success rate)
  - ~ $38,000,000 total funds, ave. of ~ $125,000/yr (_all_ awards)
- 2007 CPA Solicitation (NSF 07-587)
  - Proposal due date: December 7, 2007, 5pm local time
  - Anticipated funding, number, and size of awards:
    - max. of $42,000,000 anticipated funds (could be much less)
    - 70 to 95 awards of $100K/year to $125K/year for 3 years
    - 5 to 7 "team" awards of up to $500,000/yr for 3 years
    - up to 2 "major team" awards of up to $900K/yr for 3 or 4 yrs for _well-integrated projects_ of larger scope, possibly cross-area
  - Submission limitations:
    - Investigators may participate as PI, co-PI, or Senior Personnel on at most _two_ proposals; one having multiple PIs
    - PIs must come from US universities or colleges
  - See _http://nsf.gov/pubs/2007/nsf07587/nsf07587.htm_

Division of Information and Intelligent Systems (IIS)

Information and Intelligent Systems Division (IIS)

- **Human-Centered Computing**
- **Informatics and Information Integration**
- **Robust Intelligence**
- **IIS Emphasis Areas**
  - **Next Generation Networked Information**
  - **Integrative Intelligence**
- **Program Solicitation: NSF 07-577**
- **Anticipated Funding Amount: $55M**
- **Proposal due dates:**
  - **Medium Projects (up to $900K total):** October 23, 2007
  - **Large Projects   (up to $3M total):   November 19, 2007**
  - **Small Projects   (up to $450K total): December 10, 2007**

- *http://www.nsf.gov/pubs/2007/nsf07577/nsf07577.htm*

Human Centered Computing (HCC)

Cluster supports research in the following areas:

- **Digital Society and Technologies**
- **Human-Computer Interaction**
- **Universal Access**

Program officers in this cluster:
Amy Baylor, William Bainbridge, Ephraim Glinert, Wayne Lutters, Mary Lou Maher

Information Integration and Informatics (III)

Cluster supports research in the following areas:

- **Data Management Systems**
- **Digital Government**
- **Digital Libraries and Archives**
- **Information and Knowledge Management**
- **Science and Engineering Informatics**

Program officers in this cluster:
Larry Brandt, Steve Griffin, Le Gruenwald,
Frank Olken, Sylvia Spengler, Maria Zemankova

Robust Intelligence (RI)

Cluster supports research in the following areas:

- **Artificial Intelligence and Cognitive Science**
- **Computational Neuroscience**
- **Computer Vision**
- **Human Language and Communication**
- **Robotics**

Program officers in this cluster:
Daniel DeMenthon, C.S. George Lee, Tanya Korelsky, Edwina Rissland, Kenneth C. Whang

Division of Computer and Network Systems (CNS)

Networking Technologies and Systems (NeTS)

- **NeTS Program Solicitation: NSF 07-507**
- **Four programmatic areas:**
  - **Future Internet Design (FIND)—research toward a future internet with "clean-slate" design**
  - **Wireless Networks (WN)—all areas of wireless network research**
  - **Networking of Sensor Systems (NOSS)—all areas of sensor network research**
  - **Networking Broadly Defined (NBD)—all networking topics not part of the three previously described areas**
- **Anticipated Funding Amount: $40M**
- **Proposal due date: TBD (likely Jan. or Feb. 2007)**
- **Program Directors:**
  - **David Du, Darleen Fisher, Allison Mankin, Jie Wu**

Computer Systems Research (CSR) Program

- * (EHS) Embedded and Hybrid Systems   (Helen Gill)
- * (PDOS) Parallel and Distributed Operating Systems (Brett Fleisch)
- * (AES) Advanced Execution Systems   (Anita LaSalle)
- * (SMA) System Modeling and Analysis   (Anita LaSalle)
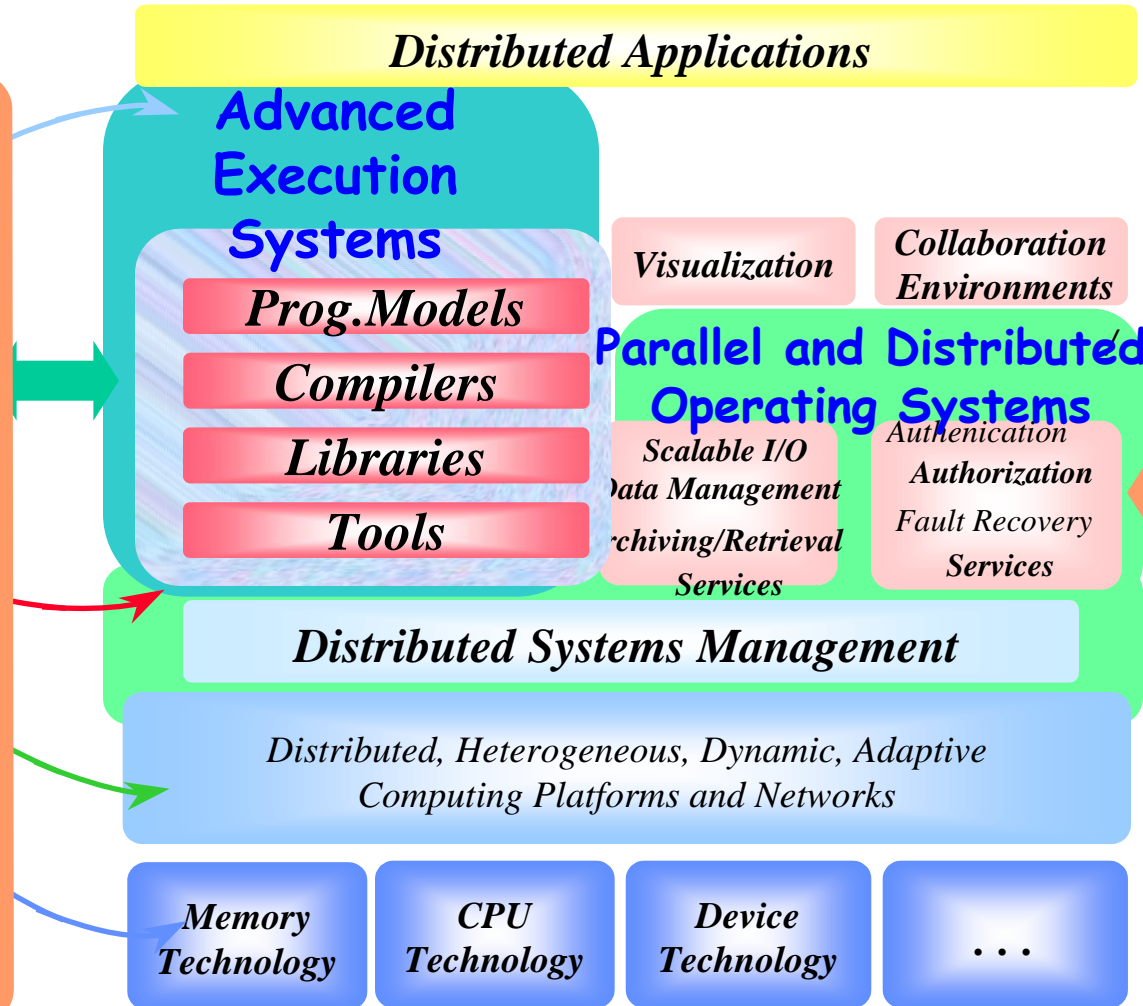
Computing Research Infrastructure (CRI)

- **Program Objectives ($18M total funds):**
  - Supports infrastructure in all areas in which CISE supports research (CRI "complements" research funding)
  - *Infrastructure Acquisition and Development track:* to support research and education of proposers; install and maintenance--$50K to $2M awards
  - *Community Resource Development track:* to create resources that support research (and education) for a national community of researchers (e.g., testbed to evaluating research results)--$300K to $2M awards
  - *Planning grants:* up to $50K awards to plan for above
  - Approximately 230 proposals/yr with~ 30% success rate
- **Proposal deadline: 1st Tuesday in August 2008**
- **Coordinating Program Directors:**
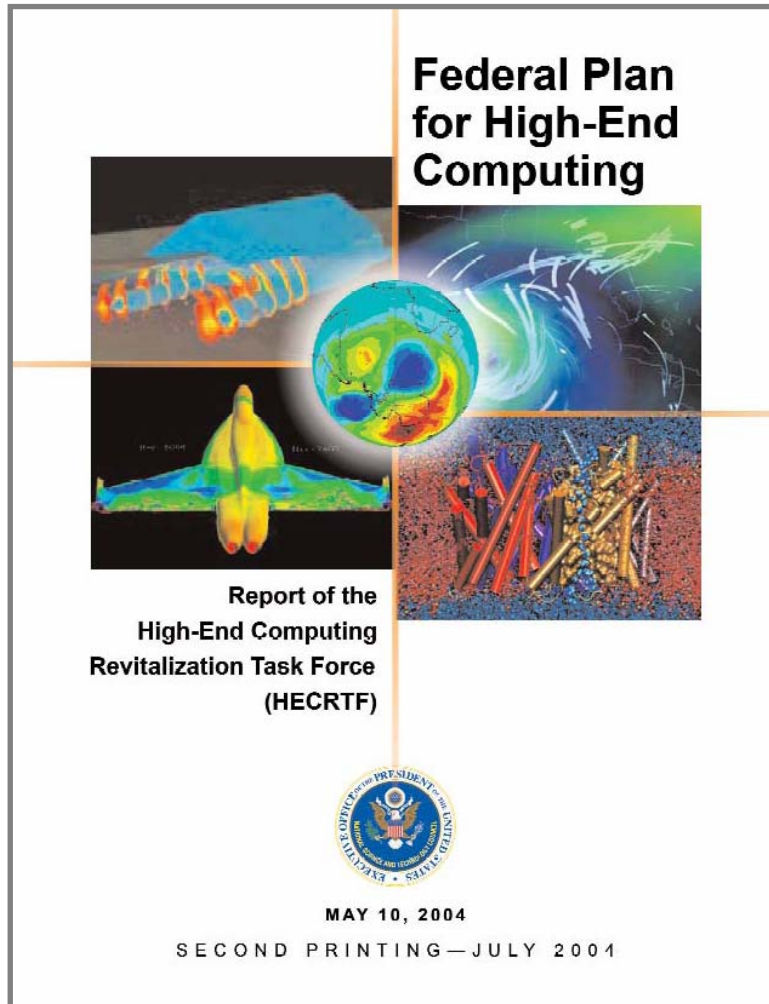 - *Tanya Korelsky, Anita LaSalle, Rita Rodriguez, Joseph Urban*

CISE Cross-Divisional Programs

High-End Computing Roadmap

- **Research and Development**
- **Resources**
  - **Production Computing**
  - **Leadership Systems**
- **Acquisitions**

High-End Computing University Research Activity (HECURA)

- **FY 2004 Budget 8M**
- **NSF/DARPA activity focused on research in**
  - Languages
  - Compilers
  - Libraries
- **100 proposals submitted in July 2004**
  - 82 projects submitted by 57 US academic institutions and non-profit organizations
    - Includes no-cost national lab and industrial lab collaborators
- **Nine projects were awarded**
  - Tools and libraries for high-end computing
  - Resource management
  - Reliability of high-end systems

High-End Computing University Research Activity (HECURA)

- FY 2006 Budget 14.5M
- NSF/DARPA/DOE/EPSCoR activity focused on
  - Input/Output capabilities
  - File Systems
  - Storage Systems
- 62 proposals submitted in February 2006
  - 52 projects submitted by 41 US academic institutions and non-profit organizations
    - Includes no-cost national lab and industrial lab collaborators
- Nineteen projects were awarded
  - I/O, file and storage systems design for efficient, high throughput data storage, retrieval and management in the HEC environment.
  - hardware and software tools for design, simulation, benchmarking, performance measurement and tuning of file and storage systems.

High-End Computing University Research Activity (HECURA)

- **FY 2008 Budget 8M (Planned)**
- **NSF activity will be focused on**
  - HEC Programming Models
  - HEC Languages
  - HEC Compilers

CISE Crosscutting Programs

- **CISE Emphasis Areas: address scientific and national priorities, with specific durations**
  - **Cyber-Enabled Discovery and Innovation**
  - **Foundations of Data and Visual Analytics**
  - **Software for Real-World Systems**
- **Core Cross-Divisional Programs:**
  - **Broadening Participation in Computing**
  - **Creative IT**
  - **CPATH**
  - **Cyber Trust**
  - **Expeditions in Computing**
  - **GENI Research Program**

Cyber-Enabled Discovery and Innovation

- CDI Objective: *Enhance American competitiveness by enabling innovation through the use of computational thinking, i.e., computational…*
  - … Concepts
  - … Methods
  - … Models
  - … Algorithms
  - … Tools
- Multi-disciplinary research contributing to more than one area of science or engineering, by innovation in, or innovative use of computational thinking
  - three types of awards categorized by scale of effort
- Scope encompasses three general themes:
  - *From Data to Knowledge*: enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data
  - *Understanding Complexity in Natural, Built, and Social Systems:* deriving fundamental insights on systems comprising multiple interacting elements
  - *Building Virtual Organizations:* enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries
- Anticipated Funding Amount: $26,000,000 for ~ 30 awards
  - Letter of Intent due November 30, 2007 (required)
  - Preliminary proposal due January 8, 2008
  - Full proposal due April 29, 2008 (by invitation only)
- See *http://www.nsf.gov/pubs/2007/nsf07603/nsf07603.htm*

Foundations of Data and Visual Analytics

- *Problem:* **Those involved with science, engineering, commerce, health, and national security all increasingly face the challenge of synthesizing information and deriving insight from massive, dynamic, ambiguous and possibly conflicting digital data**

- *This program* **seeks the creation of the mathematical and computational sciences foundations required to transform data in ways that permit visual-based understanding**

- **Research topics:**
  - **Synergistic combinations of data transformation techniques to create more meaningful representations with semantic richness and validity**
  - **Approaches that will tightly couple novel data transformations with visualization systems, including methods to capture and represent information quality and uncertainty**
  - **Novel transformations to facilitate dynamic identification of new or unanticipated events which may also include measures of usefulness**
  - **Computational and mathematical algorithms that will enable the unified representation of dynamic data of multiple types and sources**
  - **Fundamentally new approaches to identifying changes in massive data sets**

- **Awards: 5 to 7 - This will consist of 1 five-year FODAVA-Lead award totaling $3,000,000 and 4 to 6 two to three year FODAVA-Partner awards totaling $300,000 to $500,000 each**

- **Full Proposals due Nov. 20, 2007**

- **See http://nsf.gov/pubs/2007/nsf07583/nsf07583.htm**

Software for Real-World Systems (SRS)

- *Motivation:* Software is a critical element of real-world systems, yet the science and engineering remain elusive and poorly understood for designing and building the software that will govern the essential behaviors and properties of real-world systems
- Program Goals: Support research on developing new scientific principles, engineering processes and methods, and educational pedagogy for the challenges inherent in real-world systems
  - *Design and evolution of large-scale, real-world systems with scalable, computational methods of composition*
  - *Monitoring, orchestration, and control of real-world system behaviors and interactions in dynamic, ever-changing conditions and operational environments*
  - *Amplification of human participation in the design and use of real-world systems*
- Consideration of emerging technologies (e.g., multicore systems) and innovative applications (e.g., pervasive health care computing) are encouraged, as are industrial partnerships with clearly stated research benefits
- Anticipated Funding Amount: $10,000,000 for 12 to 20 awards
- Proposals due January 17, 2008
- See *http://www.nsf.gov/pubs/2007/nsf07599/nsf07599.htm*

Broadening Participation in Computing (BPC)

- **The Broadening Participation in Computing program aims to significantly increase the number of students who are U.S. citizens and permanent residents receiving post secondary degrees in the computing disciplines**

- **Emphasis will be on students from communities with longstanding under-representation in computing:**
  - **Women, persons with disabilities, and**
  - **Minorities: African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, Pacific Islanders**

- **Anticipated Funding Amount: $14M**
  - **Proposal due date: TBD, (likely May 2008)**
  - **Check CISE web site concerning which proposals require a Letter of Intent and the due dates**

Cyber Trust (CT)

- **Vision: A society in which**
  - Computing systems operate securely, reliably, and predictably, as intended, in the presence of attacks
  - Computing systems are trusted to protect privacy of users and sensitive information
  - Systems are developed and operated by a well-trained and diverse workforce
- **Research on foundations, network security, systems software, and information systems**
  - Systems which have security as a design goal
- **Integrated education and workforce activities**
- **FY 2008 competition**
  - Solicitation due date TBD (likely February, 2008)
  - Anticipated Funding Amount: ~$19M

CISE Pathways to Revitalized Undergraduate Computing (CPATH)

- **Vision: a U.S. workforce with the computing competencies and skills imperative to the Nation's health, security and prosperity in the 21st century.**
- **CPATH will support four *types* of projects:**
  - **Community Building (CB) Grants;**
  - **Evaluation, Adoption, and Extension (EAE) Grants;**
  - **Transformation (T) Grants; and**
  - **CISE Distinguished Education Fellow (CDEF) Grants.**
- **Proposal due date: TBD**

Expeditions in Computing

Created to inspire bold, transformational research that explores new scientific frontiers that promise disruptive innovations in computing

- **Program Goals:**
  - **Catalyze far-reaching research in the computing and information fields motivated by hard, emerging problems and/or compelling applications**
  - **Inspire current & future generations to pursue CISE careers**
  - **Stimulate significant research and education outcomes that benefit society through effective knowledge transfer**
- **Scope: Research that cuts vertically or horizontally across CISE**
- **Awards: 3 anticipated, w/ budgets of $2,000,000/yr for five years**
- **Submission Requirements and Deadlines:**
  - **Letter of Intent (required) due November 5, 2007**
  - **Preliminary Proposal (required) due December 30, 2007**
  - **Full Proposal (by invitation only) due April 1, 2008**
- *See http://www.nsf.gov/pubs/2007/nsf07592/nsf07592.htm*

Global Environment for Networking Investigations Initiative (GENI)

- **The GENI Initiative envisions the creation of new networking and distributed system architectures that, for example:**
  - Build in security and robustness;
  - Enable the vision of pervasive computing and bridge the gap between the physical and virtual worlds by including mobile, wireless and sensor networks;
  - Enable control and management of other critical infrastructures;
  - Include ease of operation and usability; and
  - Enable new classes of societal-level services and applications.

NSF-wide Crosscutting Programs

Cross-Foundation Programs

- **CAREER**
- **I/UCRC**
- **IGERT**
- **REU Sites**
- **RUI**
- **RET**
- **ADVANCE**
- **GK-12**

CAREER Program

- **Foundation-wide activity that offers the National Science Foundation's most prestigious awards for new faculty**

- **NSF supports the early career development activities of those faculty members who are most likely to become the academic leaders of the 21st century**

- **CAREER awards have a 5-year duration**

- **In FY'06, the minimum CAREER award (including indirect costs) is $400,000 for all NSF directorates**

Industry University Cooperative Research Program (I/UCRC)

- **Partnering Industries and Universities to Innovate.**
- **I/UCRCs stimulate highly leveraged industry/university cooperation by focusing on fundamental research recommended by Industrial Advisory Boards.**
- **I/UCRC develops long-term partnerships among industry, academic institutions, and government.**
- **The centers are catalyzed by a small investment from the National Science Foundation (NSF) and are primarily supported by center members, with NSF taking a supporting role in their development and evolution.**

Integrative Graduate Education and Research Traineeship (IGERT)

- **Intended to meet the challenges of educating U.S. Ph.D. scientists, engineers, and educators**

- **Intended to catalyze a cultural change in graduate education – for students, faculty, and institutions – by establishing innovative new models for graduate education and training**

- **Intended to facilitate greater diversity in student participation and preparation, and to contribute to the development of a diverse globally-engaged science and engineering workforce**

Research Experiences for Undergraduates (REU) Sites

- **Enables a cohort experience for students**
- **Projects may be based in a single discipline or academic department, or on interdisciplinary or multi-departmental research opportunities with a coherent intellectual theme**
- **REU Sites are encouraged to involve students in research who might not otherwise have the opportunity, particularly those from academic institutions where research programs are limited**

Research in Undergraduate Institutions (RUI)

- **Predominantly undergrad, no more than 10 Sci/Eng PhD/yr**
- **Addition 5-page impact for institution**
- **Same review as standard proposal**
- **Look at Research Opportunity Awards (ROA) for supplements to existing NSF grants for RUI collaborators**
- **NSF 00-144, funds from disciplinary programs**

Research Experiences for Teachers (RET)

- **K-12 teachers of science and math and the NSF research community**
- **REU supplements**
  - **For teachers, up to 10K/year, 1 year supplement**
- **Site Program**
  - **From ENG, 3 years, includes community college faculty**

ADVANCE

- **Increase the representation and advancement of women in academic science and engineering careers**
- **Increase the diversity of the science and engineering workforce**
- **Increase the number of underrepresented minority groups and individuals with disabilities**

NSF Graduate Teaching Fellos in K-12 Education (GK-12)

- **Provides fellowships and training in STEM disciplines**
- **Provides institutions of higher education with an opportunity to make a permanent change in their graduate programs by including partnerships with K-12 schools**
- **Provides educational opportunities for Graduate Students**

Ingredients for a Good Proposal

Educate the reviewers and Program Director

- **What problem(s) does your work address?**

- **Why is this problem important?**

- **What will you do to contribute to a solution?**

- **What unique ideas/approaches do you have? Put in context.**

- **Why are you the best person to do this work?**

- **How will you evaluate your results?**
  - **How will we know if you were successful or if you failed?**

- **How will you assure that the work has an impact?**

Future Vision on Interdisciplinary CISE-supported Projects

1. **Involve computer scientist(s) as a part of a team; preferably at the early stage of their careers**

2. **Strong transferable CISE component - visualization, addressing I/O issues, hardware awareness, run-time dynamic resource allocations, virtualization, asynchronous communications**

3. **Application-inspired CS/computational science abstractions**
   - **Program = Algorithm + Abstract Data structure**
   - **Need to document algorithms and data structures**

4. **Reusable libraries**

Key On-line Documents

Directorate for Computer & Information Science & Engineering

- **FY 2008 NSF Budget Request**
  - http://www.nsf.gov/about/budget/fy2008

- **FY 2007 NSF Budget**
  - http://www.nsf.gov/about/budget/fy2007

- **Grant Proposal Guide (NSF 04-23)**
  - http://www.nsf.gov/publications/pub_summ.jsp?ods_key=GPG

- **Science and Engineering Indicators**
  - http://www.nsf.gov/sbe/srs/seind04/start.htm

- **General Information**
  - http://www.nsf.gov/

Response from the Community

- **Send your best ideas to NSF**
  - **Consistent with focus & goals of the program**
  - **We want high risk / high reward proposals**
- **Suggest and encourage good panelists who can do justice to the proposals and our focus**
- **Volunteer to be a reviewer and panelist**
- **Participate in the process**
- **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**
- **Serve as a program officer ("Rotator" or "IPA")**

Highlights

- **Convince the US public that research is worth paying for**
- **Succinct, interesting vignettes**
  - **Show a result, not an expense**
  - **Layman's language**
  - **Graphics if possible**
- **NSF Uses the best ones**
  - **Budget requests**
  - **Performance reports**
  - **Public relations**
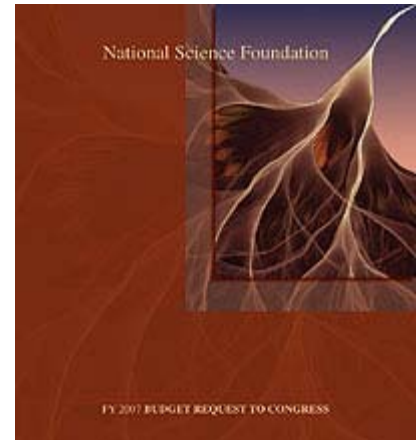
NSF CISE Career Opportunities

- **Program Directors are sought for one-year terms to four-year terms or for permanent positions in CNS, CCF, and IIS Divisions of CISE**
  - Now or coming up: software foundations, bio-inspired computing, nano/quantum computing, robotics, vision, graphics, distributed systems and ubiquitous computing, networking, education and outreach

- **Information about positions found at** *www.nsf.gov/publications/vacancy.jsp?org= CISE&nsf_org=CISE*

Concluding Remarks

- NSF's role is fundamental to all areas of our society - the most basic future investment

- Computer science and related disciplines are very important in their own right and essential to advancement in all areas of S&E

- NSF and our field are facing unprecedented pressures that can only be overcome by concerted, cooperative action

Contact Information

Almadena Chtchelkanova

Program Director

CISE Directorate

National Science Foundation

achtchel@nsf.gov

(703) 292-8910

CISE Web Site: http://www.nsf.gov/cise