Directorate for Computer and Information Science and Engineering (CISE)

The National Science Foundation's (NSF's) Directorate for Computer and Information Science and Engineering (CISE) has three goals:

- to enable the United States to hold a position of world leadership 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; and
- to contribute to universal, transparent, and affordable participation in an information-based society.

To achieve these goals, the CISE Directorate supports investigator-initiated research in all areas of computer and information science and engineering; helps develop and maintain cutting-edge national computing and information infrastructure for science and engineering research and education in general; and contributes to the education and training of the next generation of computer scientists and engineers.

The research and education activities in which the CISE Directorate directs or participates in are organized into two crosscutting categories and four subdisciplinary divisions:

- NSF Priority Areas
- CISE Emphases for FY 2004
- Division of Computing and Communication Foundations (CCF)
- Division of Computer and Network Systems (CNS)
- Division of Information and Intelligent Systems (IIS)
- Division of Shared Cyberinfrastructure (SCI)

For More Information
Visit the CISE Directorate website, http://www.cise.nsf.gov/.

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

NSF Priority Areas

The CISE Directorate plays an active role in the following NSF-wide priority areas:

- Biocomplexity in the Environment
- Human and Social Dynamics
- Information Technology Research
- Mathematical Sciences
- Nanoscale Science and Engineering

Information Technology Research

CISE activities are core to NSF's efforts in information technology, including the priority area Information Technology Research (ITR). In fiscal year 2004 (FY 04), the ITR Program will focus on advancing current national priorities. A complete description of the program and details on proposal submission are available at http://www.cise.nsf.gov/funding/pgm_display.cfm?pub_id=11995.

For More Information
Further information about these priority areas and other NSF crosscutting programs can be found in chapter 1, "Crosscutting Investment Strategies" in this guide; or visit the NSF crosscutting programs home page, http://www.nsf.gov/home/crssprgm.

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

CISE Emphases for FY 2004

The CISE Directorate has identified a number of emphasis areas for advancing computer and information science and engineering in fiscal year 2004. They are:

1. Cyber Trust
2. Education & Workforce
3. Information Integration
4. Science of Design

1. Cyber Trust

Networked computers reside at the heart of systems on which people now rely, both in critical national infrastructures and in their homes, cars, and offices. Today, many of these systems are far too vulnerable to cyber attacks that can inhibit their function, corrupt important data, or expose private information. Cyber Trust promotes a vision of a society in which these systems are more predictable, more accountable, and less vulnerable to attack and abuse; are developed, configured, operated, and evaluated by a well-trained and diverse workforce; and are used by a public educated in their secure and ethical operation. Trustworthiness is a system property and economic, legal, social, and organizational factors--as well as technical ones--influence how systems are put together. Cyber Trust research aims to advance the science and technology of trustworthy system design and development and better understand the factors that will enable that technology to be incorporated in systems on which the public depends. Specific technical research and education topics may include but are not limited to: efforts addressing security and privacy needs of applications, including improved policy specification, accountability mechanisms, privacy assurance, and comprehensible user interfaces; research in systems software, including trustworthy operating system architectures and mechanisms and middleware for trustworthy software-controlled real-time systems; advances in the trustworthiness of networks at all scales, including affordable network security designs, secure collaboration and Grid computing mechanisms, denial of service prevention and avoidance, and improved accountability and network forensics; and research to establish a sound scientific foundation and technological basis for trustworthy computing, including means to specify and reason about the trustworthiness of individual components and combinations of trustworthy and untrustworthy components. Integrative research that addresses these technical areas in combination with social, organizational, economic, and legal influences on system design is also sought. For more information, see http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf04524.

2. Education & Workforce

Rapid advances in computing technology lead to the need to transfer research results into the classroom. Developing and making effective use of new research results requires a well educated and diverse computer and information science and engineering workforce that is representative of and able to interact with the entire populace. This emphasis involves all CISE divisions and supports projects that integrate research and education, study the causes of the current lack of diversity in the information technology workforce, and lead to a broadening of participation by all underrepresented groups in the CISE workforce. Specific activities include:

- **CISE Combined Research and Curriculum Development and Educational Innovation Program (CRCD/EI)**—Supports innovative activities in the computer and information science and engineering disciplines by encouraging the transfer of state-of-the-art research results into undergraduate and introductory graduate curricula; disseminating best practices in information technology (IT) education; investigating emerging areas; and implementing new IT programs. The CRCD/EI Program supports the design, development, testing, and dissemination of innovative approaches to increase the effectiveness of educational experiences. CRCD/EI projects may involve integrating research results into courses and curricula (the research may be ongoing or completed and may be drawn from any research activities in the computer and information sciences and engineering fields); planning and implementation of formal activities designed to publicize effective innovative programs and IT concepts through workshops, publication, and other dissemination mechanisms; and the creation of educational programs and tools that address cutting edge IT. The CRCD/EI Program places special emphasis on curricular approaches that address the recruitment and retention of women and underrepresented minorities in IT educational programs. For more information, see http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf04001.

- **Information Technology Workforce (ITWF)**—Since its inception in 2000, the Information Technology Workforce Program (ITWF) has supported basic research studies on the under representation of women and minorities in information technology (IT). ITWF is expanding its portfolio to include implementation and intervention projects that--based on research findings--seek to increase the numbers of women and underrepresented minority students and faculty in IT in the nation's colleges and universities. Implementation projects must incorporate rigorous programs of evaluation and dissemination. For more information, see http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf03609.
- CISE also participates in a number of NSF-wide education and workforce programs, including:
    - Graduate Research Fellowships Program (see http://www.nsf.gov/od/lpa/news/publicat/nsf04009/ehr/dge.htm#1)
    - Graduate Teaching Fellows in K-12 Education (GK-12) (see http://www.nsf.gov/od/lpa/news/publicat/nsf04009/ehr/dge.htm#2)
    - Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE) (see http://www.nsf.gov/home/crssprgm/advance/)
    - IGERT: Integrative Graduate Education and Research Traineeship Program (see http://www.nsf.gov/od/lpa/news/publicat/nsf04009/ehr/dge.htm#3)
    - REU: Research Experiences for Undergraduates (see http://www.nsf.gov/home/crssprgm/reu/start.htm)

3. Information Integration

Traditionally, an individual researcher developed hypotheses, designed experiments to test these hypotheses, collected observational data, and published results based on experiments. The data were often published in print to allow others to build upon or verify the results. In nearly every field of 21st century science and engineering, including all of the disciplines funded by NSF, research is now achieved by teams of researchers analyzing data sets that are far too large to publish in journals and sometimes collected independently by other scientists with different goals in mind. The goal of information integration research is to provide the necessary foundations to provide science and engineering researchers seamless access to a multitude of independently developed, heterogeneous data sources. Information integration seeks to maximally exploit available information to create new scientific knowledge. Effective information integration will also enhance public education by facilitating comprehensive access to distributed information resources. Topics may include, but are not limited to: integrating many different, disparate, and possibly distributed sources; supporting automated discovery of new data sources and information within them; integrating structured, semi-structured, text, image, video, time-series, 3D images, citations, graphs, and data streams; unifying data models and system descriptions; reconciling heterogeneous formats, schemas, and ontologies; web semantics; decentralized data-sharing; data-sharing on advanced cyberinfrastructure; and on-the-fly integration. For more information, see http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf04528.

4. Science of Design

Supports science and engineering research and education that develops the foundations of a Science of Design, leading to more effective development, evolution, and understanding of systems of large scale, scope, and complexity. The emphasis of this program is on software-intensive computing, information, and communication systems (ex, systems for which software is the principal means to conceptualize, define, model, analyze, develop, integrate, operate, control, and manage such systems). In other disciplines with a longer history than computing and software, there are scientifically discovered and validated facts, volumes of codified experience, and formalized, teachable principles. Analogous foundations are needed for a Science of Design for software-intensive systems. Research may address theories, models, principles, formalisms, empirical studies, and the nature and limits of design.

Proposals are expected to be crosscutting and topics may include, but are not limited to: design structures and composition techniques leading to robust and evolvable systems; representation of problem formulations and requirements for software-intensive systems, coupled with problem-solving and reasoning techniques to find designs that meet requirements; studies of designs, designers, and design methodology for software-intensive systems; design automation or computer-aided design for these systems; development and integration of design education into curriculum and training for computer scientists, software engineers, and systems engineers. (Note: A Science of Design solicitation is pending; please monitor http://www.cise.nsf.gov/ for more information.)

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Division of Computing and Communication Foundations

The Division of Computing and Communication Foundations (CCF) supports research and education activities that explore the foundations of computing and communication devices and their usage. The CCF Division seeks advances in computing and communication theory; algorithms for computer and computational sciences; and architecture and design of computers and software. CCF-supported projects also investigate revolutionary computing paradigms based on emerging scientific ideas and integrate research and education activities to prepare future generations of computer science and engineering workers.

CCF is organized into three clusters, each of which represents and sponsors activities based on its foci.

1. Emerging Models and Technologies for Computation Cluster
2. Formal and Mathematical Foundations Cluster
3. Foundations of Computing Artifacts and Processes Cluster

For More Information

Write to the Division of Computing and Communications Foundations, National Science Foundation, 4201 Wilson Boulevard, Room 1145, Arlington, VA 22230; or contact the division by telephone, 703-292-8910; or visit the CCF home page, http://www.cise.nsf.gov/div/index.cfm?div=ccf.

1. Emerging Models and Technologies for Computation Cluster

This cluster seeks to explore computational models, techniques, and systems based on emerging and future technologies. Research and education projects are supported in computing systems based on nanotechnology, quantum computing and communication, and computational devices and architectures inspired by the processing of information in living matter. Sponsored projects examine concepts in new computing architecture, quantum, and biologically inspired computing, as well as micro- and nanosystems. Topical areas include computational algorithms and simulation techniques for nanoscale systems; design and architecture of systems based on molecular scale devices; quantum algorithms for computation, communication, and coding; realization of quantum computing; algorithms and computational modeling of biological processes; and computing models and systems for future technologies.

2. Formal and Mathematical Foundations Cluster

This cluster seeks to determine inherent limits of computation and communication and obtain optimal solutions within those limits. Sponsored projects examine information representation methods and computational techniques for advancing information technology and all scientific and engineering disciplines. Topical areas include models of computation; computational complexity; parallel and distributed computation; random and approximate algorithms; algorithmic algebra, geometry, topology, and logic; computational optimization; computational algorithms for high-end scientific and engineering applications; techniques for representing, coding and transmitting information; mobile communication; optical communication; signal processing systems; analysis of images, video, and multimedia information.

3. Foundations of Computing Artifacts and Processes Cluster

This cluster seeks to advance the science, formalisms, and methodologies for building computing and communication systems. Sponsored projects examine software engineering, programming language design and implementation, graphics and visualization systems, computer architecture, and design automation. Topical areas include software design methodologies; tools for software testing, analysis, and verification; semantics, design, and implementation of programming languages; microarchitecture; memory and I/O subsystems; application-specific architectures; performance metrics; VLSI electronic design; analysis, synthesis, and simulation algorithms; system-on-a-chip; and architecture and design for mixed or future media (e.g., nanotechnology).

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Division of Computer and Network Systems

The Division of Computer and Network Systems (CNS) supports research and education activities that invent new computing and networking technologies and explore new ways to make use of existing technologies. The CNS Division seeks to develop a better understanding of the fundamental properties of computer and network systems and create better abstractions and tools for designing, building, analyzing, and measuring future systems. The division also supports the computing infrastructure required for experimental computer science and coordinates cross-divisional activities that foster the integration of research, education, and workforce development.

The CNS Division is organized into three clusters, each of which is responsible for a related set of activities, as defined below:

- Computer Systems Cluster
- Computing Research Infrastructure Cluster
- Network Systems Cluster

For More Information
Write to the Division of Computer and Network Systems, National Science Foundation, 4201 Wilson Boulevard, Room 1160, Arlington, VA 22230; or contact the division by telephone, 703-292-8980; or visit the CNS home page, http://www.cise.nsf.gov/div/index.cfm?div=cns.

• Computer Systems Cluster

Future computing systems will be required to control a greater variety of computing, communication, storage, and external devices; support a broader range of increasingly demanding applications; and to manage hundreds of asynchronous activities correctly, securely, and reliably. The Computer Systems cluster supports research and education activities that address these requirements in a variety of systems, including distributed, mobile, and embedded systems; sensing and control systems; dynamically configured, multiple-component systems; parallel systems; and trusted systems.

Topical areas include new ways to organize systems (ex. peer to peer); software architectures that scale to handle thousands of components or a spectrum of heterogeneous components; ways to handle complex combinations of requirements, such as meeting real-time constraints and coordinating control in an embedded, failure-prone environment; methods that enable systems to detect problems and to take corrective action without human intervention; tools to analyze and predict the behavior of entire computing systems; techniques for developing complex, dynamically changing applications and for managing them at runtime; storage systems that are low-cost, scalable, and reliable; and operating systems and libraries for new technologies.

Specific sponsored activities include the following:

1. Distributed Systems
2. Embedded and Hybrid Systems
3. Next Generation Software

For More Information
Visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=cns&cluster_id=208.

1. Distributed Systems

Sponsors research and education on methodologies and designs of system software and runtime support for

distributed applications in order to achieve efficient, flexible, and robust computing in a parallel/multiprocessor/network execution environment. Focus is on novel concepts for design of distributed systems to capture the dynamic and open nature of the underlying system platforms. The program encompasses areas ranging from fundamental operating systems, cluster and grid computing, and middleware, to emerging pervasive agent/mobile systems and peer-to-peer web-based computing. Experimental designs and formal methods and analytical/simulation tools for such systems are also encouraged.

Topics of interest fall into two program components:

- Topics in the Distributed Systems component include system architectures for global-scale networked applications, programming paradigms for parallel and distributed systems, and mobile system architectures for pervasive and ubiquitous computing.
- Topics in the Operating Systems component include system architectures, run-time systems, and hardware impacts. Special emphasis is placed on operating system support for middleware and distributed applications and on creative system concepts brought forth from hardware innovations.

2. Embedded and Hybrid Systems

Supports research and education in scientific principles and technology to revolutionize the design and development of embedded systems for a broad range of applications. Software has enabled increasingly ambitious, often safety-critical systems such as transportation, manufacturing, medical devices and systems, environmental control, and energy management. These include distributed and coordinated embedded systems that demand high levels of autonomy, adaptability, and component integration, such as multi-modal sensing and control.

The goal of the program is to create and unify the foundations for managing interacting physical and computational systems, and to supply the technologies needed for building reliable software- and network-enabled embedded systems. Relevant research includes areas such as hybrid (discrete and continuous) modeling and control of physical systems; domain-specific design, programming, and software synthesis approaches for embedded systems; verification and analysis technology for checking and certifying correct operation of embedded systems; real-time open systems, middleware, and virtual machine strategies for embedded systems; dynamic scheduling that accommodates both hard and soft real-time processes; and program composition approaches for synthesizing software while preserving essential properties.

3. Next Generation Software (NGS)

Fosters multidisciplinary group and single investigator software research. The overall thrusts of NGS are research and development for new software technologies integrated across the systems architectural layers; supporting the design and operation cycle of applications and computing and communications systems; and delivering quality of service (QoS). Topics of interest fall into two program components:

- Technology for Performance Engineered Systems (TPES) component, supports research and education leading to the development of performance frameworks for modeling, measurement, analysis, evaluation, and prediction of performance of complex computing and communications systems; and of the applications executing on such systems.
- Complex Application Design and Support Systems (CADSS) component, supports research on novel software for the development and run-time support of complex applications executing on complex computing platforms; CADSS-fostered technology breaks down traditional barriers in existing software components in the application development, support and runtime layers, and leverages technology for performance engineered systems-developed technology for delivering QoS.

• Computing Research Infrastructure Cluster

An important component of experimental computing is building prototypes and test beds, and this requires having an experimental infrastructure. The Computing Research Infrastructure cluster provides support for the acquisition, enhancement, and operation of experimental facilities for all CISE research and education areas. Supported facilities range from instrumentation needed by a few projects, to major experimental facilities for an entire department. Support is also provided to enhance the computational and human infrastructure in minority-serving institutions and to support the equipment needs of collaborative, distributed research projects. An emphasis is to expand support to include a wider range of infrastructure needs, research projects, and institutions. Topical areas

include:

1. CISE Research Infrastructure
2. CISE Research Resources
3. Minority Institutions Infrastructure

For More Information
Visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=cns&cluster_id=920.

1. CISE Research Infrastructure

Provides support to aid in the establishment, enhancement, and operation of major experimental facilities that are planned for the support all the research areas in the CISE Directorate. The program may also assist activities for integration of research and education. The program recognizes the emergence of research groups requiring strengthening of experimental facilities in a variety of environments—those solely within a single academic department; those drawing from several departments in a single institution; and those spanning several different institutions. This program supports the areas of research supported by the CISE Directorate that are described in this *Guide to Programs*.

2. CISE Research Resources

Increases the capability and capacity to carry out basic research in information technology at U.S. institutions. The program supports the acquisition and development of advanced resources for research and integrated research and education activities. Resources may include research equipment, instrumentation, software, data repositories, or services. Resources supported under this program are those generally not supported by other programs due to cost, complexity, level of shared use, or other reasons. Three elements comprise this program: CISE instrumentation, collaborative research resources, and distributed research resources.

3. Minority Institutions Infrastructure

Provides awards to aid efforts that might significantly expand the numbers of minority students attracted to and retained in computer and information science and engineering disciplines. Eligible institutions must be minority institutions as defined by significant percentages of minority students. The program considers a variety of activities including research programs involving minority students, curriculum development projects, mentoring, and outreach. Both 1-year planning grants and continuing grants of up to 5 years in duration are awarded.

• Network Systems Cluster

In the future, networks are likely to exhibit unpredictable, complex behavior and dynamics. They are likely to span a broad range of technologies and bandwidths--from wireless sensors to a high-performance core--and to carry increasingly large amounts of increasingly demanding traffic. The Network Systems cluster supports a range of research and education activities in network systems, including networking research, new technologies, and networking research test beds. Topical areas include rethinking the architecture of the core of the network to accommodate orders of magnitude increases in traffic; sensor networks that are self-diagnosing, self-healing, and self-organizing; overlay networks that seek to build a rich layer of support for application-level functionality on top of the current IP infrastructure; extensible networks that provide a framework by which new services and applications can be added dynamically; adaptable networks that detect and respond to threats; and wireless networking systems that support more users, have higher bandwidth, require less power, have longer range, and integrate seamlessly with wired networks.

For More Information
For information on specific CNS-sponsored activities, visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=cns&cluster_id=207.

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Division of Information and Intelligent Systems

The Division of Information and Intelligent Systems (IIS) supports research and education that will increase the capabilities of human beings and machines to create, discover, and reason with knowledge by advancing the ability to represent, collect, store, organize, locate, visualize, and communicate information. The division contributes to interdisciplinary research on how observational data leads to discovery in the sciences and engineering.

The IIS Division is divided into three clusters, each of which supports a specific set of related activities, as defined below:

1. Data, Inference and Understanding Cluster
2. Science and Engineering Informatics Cluster
3. Systems in Context Cluster

For More Information
Write to the Division of Computer and Network Systems, National Science Foundation, 4201 Wilson Boulevard, Room 1115, Arlington, VA 22230; or contact the division by telephone, 703-292-8930; or visit the CNS home page, http://www.cise.nsf.gov/div/index.cfm?div=iis.

• Data, Inference And Understanding Cluster

The Data, Inference and Understanding cluster supports basic computer science research and education with the goal of creating general purpose systems for representing, storing, and accessing data, information, and knowledge. It also supports research and education in automated methods of drawing conclusions from data and knowledge. Topical areas include:

1. Artificial Intelligence and Cognitive Science
2. Computer Vision
3. Human Language and Communication
4. Information and Data Management

For More Information
Visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=iis&cluster_id=3948.

1. Artificial Intelligence and Cognitive Science

Supports research and related education activities that are fundamental to the development of computer systems capable of performing a broad variety of intelligent tasks and to the development of computational models of intelligent behavior across the spectrum of human intelligence. Examples of performance-oriented topics include intelligent agents, planning, automated reasoning, machine learning, case-based reasoning, knowledge representation methodologies, and architectures for combining intelligent tasks such as perception, reasoning, planning, learning, and action. Examples of cognitive-oriented topics include analogical reasoning, concept formation and evolution, argumentation, integration of knowledge from diverse sources and experience, knowledge acquisition by human learners, manipulation and development of taxonomies and classification systems, collaborative behavior, and adaptation and learning.

2. Computer Vision

Supports research and education activities to develop novel ideas into projects that have the potential to lead to advanced visual perception and intelligent systems. The emphasis is on image representation and interpretation for

systems designed to infer properties of the environment from imaging data, and advanced vision systems providing cognitive abilities. Research topics include recognition, classification, and identification of objects, people, events, and activities; scene understanding, including algorithms for the geometric and photometric description of objects from visual data; methods for grouping, comparing, matching, indexing, and retrieving visual data; and 2D and 3D video.

3. Human Language and Communication

Supports research and related education activities fundamental to the development of computer systems capable of analyzing, understanding, and generating language, speech, and other forms of communication that humans use naturally across a wide variety of situations. The program's ultimate objective is to transform the human-computer communication experience so that users can address a computer at any time and any place at least as effectively as if they were addressing another person.

4. Information and Data Management

Supports research and education fundamental to the design, implementation, development, management, and use of databases, information retrieval, and knowledge-based systems. Topics include design methodologies, data, metadata, information, knowledge and process/event modeling, information access and interaction, knowledge discovery and visualization, and systems architecture and implementation. Research areas span web-based systems, novel data types, efficient data gathering and storage/archival, information and data organization and management, including security/privacy issues, information flow, dynamic/evolutionary systems, change maintenance, and information life-cycle management, interoperability in heterogeneous systems, highly scalable, data-intensive, and distributed/mobile information systems, and performance and quality of service issues.

• Science And Engineering Informatics Cluster

The Science and Engineering Informatics cluster supports research and education focused on advances in information technology that address problems in specific sciences and engineering domains such as biology, geology, or chemistry. Characteristics of the research and education activities within the cluster include integrative, focused on tools and analysis, supportive of the data infrastructure across all fields of science and engineering, and focused on a significant computer science problem that is a barrier to achieving a domain challenge.

The cluster sponsors projects through the following activities:

1. Collaborative Research in Computational Neuroscience
2. Science and Engineering Information Integration and Informatics

For More Information
Visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=iis&cluster_id=3945.

1. Collaborative Research in Computational Neuroscience

Seeks to enhance our understanding of nervous system function by providing analytical and modeling tools that describe, traverse, and integrate different levels of information. The most exciting and difficult challenge facing neuroscientists is to understand the functions of complex neurobiological systems. Computational approaches are needed in the study of neuroscience as the requirement for comprehensive analysis and interpretation of complex data sets becomes increasingly important. Collaborations among computer scientists, engineers, mathematicians, statisticians, theoreticians, and experimental neuroscientists are imperative to advance our understanding of the nervous system and mechanisms underlying brain disorders. Computational understanding of the nervous system may also have a significant impact on the theory and design of engineered systems.

2. Science and Engineering Information Integration and Informatics

Focuses information technology research on addressing problems that will enable scientific discovery via analysis of large data sets or information resources. This component sponsors collaboration between computer scientists

and engineers and scientists and engineers from other domains to address significant, real requirements of an application. Topics include science and engineering data models and systems; analysis of science databases and information resources; analysis of scientific and engineering images; and construction of shared resource environments. This component is among the CISE Emphases for fiscal year 2004 (for a complete description, see CISE Emphases for Fiscal Year 2004, elsewhere in the CISE section).

• Systems In Context Cluster

The Systems in Context cluster supports research and education on the interaction between information, computation, and communication systems and users, organizations, government agencies, the scientific community, and the external environment. Research results provide requirements for the design and construction of future systems so that more system deployments are successful by design. The result of the integration of research and education ensures that future generations of researchers and educators are well prepared to support new discovery over the long run. Topical areas include:

1. Digital Government
2. Digital Society and Technologies
3. Human-Computer Interaction
4. Robotics
5. Universal Access

For More Information
Visit the cluster's Web page, http://www.cise.nsf.gov/div/cluster.cfm?div=iis&cluster_id=3947.

1. Digital Government

Government, on a large scale, is a collector and provider of data and information; a provider of information-based services; and a user of information technologies. The Digital Government Program has two goals that reflect the importance of information technology on the conduct and services of government: (1) projects will support computer and information science research on the application of information/computer technologies to government missions, in partnership with government agencies; and (2) projects will support multidisciplinary research on the design and use of information technologies in democratic processes; the impact of information technologies on government institutions; and the interaction between citizens and government. Digital government research and education may be conducted in government contexts, such as environmental management; electronic rule making; long-term archiving of digital objects; urban and land-use planning; social services; criminal justice and law enforcement; crisis management and emergency response; public transportation; public records and libraries; and the collection, maintenance, and confidentiality of government statistics.

2. Digital Society and Technologies

The future and well being of the nation depend on the effective integration of information technologies (IT) into its various enterprises and social fabric. ITs are designed, used, and have consequences in a number of social, economic, legal, ethical, and cultural contexts. With the rise of unprecedented new technologies (ex., smart homes, shop-bots, pedagogical agents, wearable computers, personal robots, multi-agent systems, sensors, grids, knowledge environments) and their increasing ubiquity in our social and economic lives, large-scale social, economic, and scientific transformations are predicted. In order to make progress and advance science, scientists and scholars need to work across disciplinary boundaries to develop new interdisciplinary knowledge at the interstices of computer and information sciences and the social, behavioral and economic sciences. Areas of interest include but are not limited to, universal participation in a digital society; collaborative intelligence; management of knowledge intensive enterprises; knowledge environments for science and engineering; and enterprise transformation.

3. Human-Computer Interaction (HCI)

Supports research and education fundamental to the design of systems that mediate between computers and humans, and that lead to the creation of tomorrow's exciting new user interface software and technology. The program's ultimate objective is to transform the human-computer interaction experience so the computer is no longer a distracting focus of attention, but instead is an invisible tool that empowers the individual user and

facilitates natural and productive human-human collaboration. HCI research topics include but are not limited to, development and formal experimental evaluation of foundational models and theories; augmented cognition and novel uses of computer technologies in education; multi-media and multi-modal interfaces in which combinations of text, graphics, gesture, movement, touch, sound, etc. are used by people and machines to communicate with one another; intelligent interfaces; information visualization; virtual and augmented reality; immersive environments; wearable, mobile, and ubiquitous computing; and new I/O devices.

4. Robotics

Provides opportunities to develop novel ideas into projects that have the potential to lead to advanced, intelligent robotic systems. The Robotics Program supports fundamental research and related education activities in robotics (ex., machines with sensing, intelligence, mobility). The emphasis is on systems operating in unstructured environments with a high level of uncertainty; interaction and cooperation of humans and robots; and advanced robotic sensory systems. Topics include but are not limited to, theoretical, algorithmic, experimental, and hardware issues in robotics; robotics for unstructured environments; personal robots with an emphasis on human-centered end use; novel and advanced approaches to sensing, perception, and actuation; representation, reasoning, and planning for complex physical tasks; robots to extend human capabilities into unknown and hazardous environments; communication and task sharing between humans and machines, and among machines; and intelligent control architecture for robotic systems.

5. Universal Access (UA)

Supports fundamental research and related education activities in computer science that advance computer systems technology so that all people can possess the skills needed to fully harness the power of computing. The program's mission is to empower people with disabilities, young children, seniors, and members of other underrepresented groups, so that they are able to participate fully in the new information society. UA research topics derive from all aspects of human-computer interaction, but topics of special interest include development of new models, architectures, and programming languages that emphasize interface speed and usability by all; definition of semantic structures for multimedia information to support cross-modal I/O; development of specific solutions to address the special needs of communities such as those enumerated above; and experimental studies to evaluate the success of attempts to provide access in all its varied forms.

For More Information
Write to the Division of Information and Intelligent Systems, National Science Foundation, 4201 Wilson Boulevard, Room 1115, Arlington, VA 22230; or contact the division by telephone, 703-292-8930; or visit the IIS home page, http://www.cise.nsf.gov/div/index.cfm?div=iis.

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Division of Shared Cyberinfrastructure

The Division of Shared Cyberinfrastructure (SCI) supports the design, development, and deployment of a set of interconnected computational engines, data repositories, digital libraries, sensors and field-specific instruments known as cyberinfrastructure. Such resources are widely shared across multiple scientific and engineering domains and enable the creation of shared digital knowledge environments where researchers and educators create and promulgate new knowledge across distance, time, and fields of expertise. Some of the areas of activity include:

- **High-Performance Computational Infrastructure**—The SCI Division supports the acquisition, operation, and upgrade of national infrastructure in support of high-end computation for the academic research community. These resources may include supercomputers, high-capacity mass-storage systems, system software suites and programming environments, productivity software libraries and tools, large-scale data repositories, and the experts and support staff that create and maintain the facilities.
- **Advanced Networking Technologies and Infrastructure**—The SCI Division supports networks of various research and granularity—from high-speed backbone networks that connect high-performance computational resources and high-end instrumentation sites, to wireless networks that connect embedded sensor nodes in remote scientific field sites. SCI fosters deployment of networks and development and fielding of networking technologies that enhance cyberinfrastructure. Some of the key areas include end-to-end networking protocols; performance monitoring tools and measurement infrastructure; wireless networks; strategic international collaborations; and testbeds to support trial deployment.
- **Advanced Services and Cybertools**—There is a need for development and SCI supports development of an array of software tools and services that hide the implementation complexities and heterogeneity while offering clean logical interfaces to users. These tools and services include information management systems and data services; scalable interactive visualization tools; middleware service building blocks for high-end computational resources; and networked instrumentations and sensors.

In each of the above areas, the SCI Division stresses fielding, testing, and ongoing support of advanced technologies beyond basic proof-of-concept demonstrations. SCI collaborates with all NSF Directorates and Offices to ensure that the advancement of cyberinfrastructure will meet the demands of tomorrow's science and engineering communities.

For More Information

For a list of programs supported by the SCI Division and further information about them, visit the SCI home page, http://www.cise.nsf.gov/div/index.cfm?div=sci; or write to the Division of Shared Cyberinfrastructure, National Science Foundation, 4201 Wilson Boulevard, Room 1122, Arlington, VA 22230; or contact the division by telephone, 703-292-8970.