Human Computer Interaction and Information Management (HCI&IM)

NITRD Agencies: NSF, DARPA, OSD and DoD Service research organizations, NIH, NASA, NIST, AHRQ, NOAA, EPA, NARA
Other Participants: GSA, IARPA

HCI&IM focuses on R&D to expand human capabilities and knowledge through the use and management of information by computer systems and by humans, facilitated by hardware, software, and systems technologies. These technologies include robotics, multimodal interaction technologies, visualization, agents, cognitive systems, collaborative systems, and information systems that support the organization and refinement of data from discovery to decision and action. HCI&IM outcomes support U.S. national priorities such as the American Competitiveness Initiative, transformative scientific research, national defense, homeland security, emergency planning and response, education and training, health care, space exploration, weather forecasting, and climate prediction.

President's 2009 Request

Strategic Priorities Underlying This Request
Today's increasingly data-centric world requires the effective strategic use of and access to information assets. To advance the role of HCI&IM in providing strategic support for national priorities, R&D in this area focuses on:

Information integration: To support complex human ideas, analysis, and timely decision-making, large amounts of disparate forms of raw information must be managed, assimilated, and accessible in formats responsive to the user needs. Next-generation methods, technologies, and tools are needed to fully integrate and efficiently manage massive stores of distributed, heterogeneous information (e.g., science and engineering research data, Federal records, health information). Key research issues include:
  – **Information standards:** Data interoperability and integration of distributed data; usability; provenance and integrity (metadata); generalizable ontologies; focused data structure research for complex digital objects
  – **Decision support:** Timeliness of and access to data; user-oriented techniques and tools for summarization, synthesis, analysis, and visualization of information for critical decision-making; advanced mobile, distributed information for emergency personnel; measurement, management of human responses to data
  – **Information management:** Intelligent rule-based data management, efficient integration, maintenance, and access to complex, large-scale collections of heterogeneous data; innovative systems architecture; scalable technologies; integration of policies (differential sensitivity, security, user authentication) with data; integrated distributed data repositories; testbeds; sustainability and validation of complex models
  – **Information infrastructure:** New approaches, technologies, and tools for long-term preservation, curation, sustainability, accessibility, and survivability of significant electronic data and information collections; multidisciplinary R&D in ways to convert data into knowledge and discovery; virtual organizations

Multimodal interfaces and data: HCI capabilities enabling quick, easy access to and communication and understanding of heterogeneous information (e.g., audio and text in diverse languages, video, images) for national defense and security applications and assistive devices; user-oriented interfaces

Active systems: Systems that learn, reason, and automatically adapt to new and unforeseen events; intelligent sensing and control systems; robotic devices for emergency response, hazardous environments, and exploration

Highlights of Request
Cyber-enabled Discovery and Innovation (CDI): Multidisciplinary research focused on the creation of new knowledge from digital data, including novel algorithms, data mining and dimension reduction methodologies, new visualization methods to enhance human cognition, and innovative technologies to address data confidentiality, privacy, security, provenance, and regulatory issues – NSF
Effective stewardship of science and engineering data: Issues of federation, preservation, curation, analysis, and access to large, heterogeneous collections of scientific data and information (e.g., DataNet program in sustainability of long-term, multidisciplinary data stewardship); tools for high-capacity data management; address broad needs of data-intensive science for new concepts, tools, and systems – NSF
Cognitive systems: Computational perceptual and cognitive modeling and application to joint cognitive systems design; decision-support systems/tools; improve performance (autonomy, trustworthiness, reliability) of automated and robotic systems; human-robot teaming – DARPA, ONR, NASA, NIST
Global Autonomous Language Exploitation (GALE): Software technologies to transcribe, translate, and distill huge volumes of speech and text in multiple languages, automatically and efficiently providing relevant
actionable information to military personnel – DARPA, NIST, CENTCOM, DLI, other agencies

Multimodal language recognition and translation: Improve multilingual language technology performance in areas such as speech-to-text transcription, spontaneous two-way communications translation, text retrieval, document summarization/distillation, automatic content extraction, speaker and language recognition, term detection, multimodal interfaces, usability – NSF, DARPA, ONR, NIST, IARPA, with NARA, other agencies

Information integration, accessibility, and management: Advanced scalable technologies and tools for high-capacity data integration, management, exploitation, and grid computing with increasingly complex, heterogeneous scientific data; fusion of massive-scale data sets (e.g., Earth System Modeling Framework, GEOSS, electronic health records); modeling, analysis, visualization techniques and tools; ontologies and metadata; efficient data access and transmission; automated integration, image understanding – NSF, ONR, NIH, NASA, NIST, AHRQ, NOAA, EPA, NARA

Engineered clinical knowledge: Clinical decision support systems and standards; physician/personal electronic health records; preventable adverse drug effects – AHRQ, NIH, NIST, FDA, HHS (CMS), other agencies

Human-in-the-loop: HCI and systems integration; decision-support systems and tools; distributed collaboration and knowledge management; computational cognitive process modeling and measurement; virtual reality technologies for simulation and training – NSF, DARPA, ONR, NASA, NIST, NOAA, EPA

Biomedical imaging: For detection, diagnosis, monitoring, image-guided therapies – NSF, DARPA, NIH, NIST

Text Retrieval Conference and TREC Video Retrieval: Evaluation of information-discovery technologies – NIST, NSF, NARA. IARPA

Planning and Coordination Supporting Request

HCI&IM research needs: Develop document identifying R&D agenda in key topic areas – HCI&IM CG

Joint Workshop on Data Path: Proposed workshop targeting architectures, technologies, and information-management processes needed to optimize "full data path" processing of ultra-large data and electronic records collections – NARA and other HCI&IM agencies

Biodiversity and ecosystem informatics: Interagency task group – NSF, NIH, DOE/SC, USDA, USGS

Environmental databases and data distribution: Multiagency collaboration to expand sharing, interoperability of diverse large-scale data sets – NASA, NOAA, EPA

Information access and preservation: Systems architectures to support optimizable and scalable ingest of processing petascale electronic records; data management architectures – NARA, NSF, OSD and DoD Service research organizations, NASA, NIST

Multiscale modeling: Explore possible joint R&D effort in areas of common interest – NSF, NIH

Additional 2008 and 2009 Activities by Agency

NSF: Academic R&D in information privacy; intelligent robots, vision technology; integrative intelligence (systems of agents, modalities, domains); data in ubiquitous network environments; interoperability; user-controlled data abstraction and display; collaborative environments, virtual organizations; affective computing; multidisciplinary research emphasis on Adaptive Systems Technology (AST), including research to replicate the physical behaviors of living systems in computing systems

NIH (NLM): Africa Medical Informatics Initiative; new Discovery Initiative for searching medical and biological data resources; MedLinePlus "information for the people"; Visible Human Web2 initiative

NASA: Prototypes for new exploration vehicle flight deck; human-centered automation for aviation safety; decision-support systems and technologies for mission control; hyperwalls for petascale visualization

NIST: Biometrics evaluation, usability, and standards (fingerprint, face, iris, voice/speaker, multimodal biometrics); evaluation methods for multimedia (video retrieval, motion image quality, audio and video analysis, content extraction and standards, smart-space technologies); performance measurement of interactive systems; usability of voting systems; ontologies for manufacturing information integration, supply chain; engineering informatics; computational biology; mathematical knowledge management

AHRQ: Patient safety and quality improvement program to reduce medical errors in ambulatory care; health care IT data standards; regional, state health information networks; metrics of economic implications of health IT

NOAA: Technologies for disseminating weather and climate data in multiple formats to a variety of citizen users

EPA: Computational toxicology; grid-based applications (human exposure modeling, air quality, energy models); distributed data and modeling center; Advanced Monitoring Initiative testbeds, GEOSS demonstration projects

NARA: Advanced decision-support technologies for ultra-high-confidence processing of very large Presidential electronic records collections