AAAI Fall Symposium 2011
NSF Information
for Artificial Intelligence Researchers

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• Part 1: Overview of NSF (25 minutes)
• Part 2: Funding Opportunities (25 minutes)
NSF

• Federal agency created by Congress in 1950
  – to promote the progress of science
  – to advance the national health, prosperity and welfare
  – to secure the national defense

• Supports research, training and education projects

• Primary funding mechanism is grants

• Evaluates 40,000 proposals per year

• Spends about 6-7 billion dollars per year

• Works “bottom up” rather than “top down”

• Uses evaluators external to NSF to advise NSF program directors, who make recommendations for final decisions
NSF Support of Academic Basic Research in Selected Fields
(as a percentage of total federal support)

- All Science and Engineering Fields: 21%
- Engineering: 39%
- Physical Sciences: 47%
- Environmental Sciences: 57%
- Social Sciences: 57%
- Mathematics: 65%
- Biology*: 68%
- Computer Science: 82%

Excludes the National Institutes of Health
Source: NSF Survey of Federal Funds for Research and Development
NSF

- NSF (National Science Foundation)
- Directorates: CISE (Computer and Information Science and Engineering)
- Divisions: IIS (Information and Intelligent Systems)
- Clusters: RI (Robust Intelligence)
- Program directors
CISE

CCF
Computing and Communications Foundations
- Algorithmic Foundations
- Communications and Information Foundations
- Software and Hardware Foundations

CNS
Computer and Network Systems
- Computer Systems Research
- Networking Technology and Systems

IIS
Information and Intelligent Systems
- Human-Centered Computing (HCC)
- Information Integration and Informatics (IIS)
- Robust Intelligence (RI)
IIS

III Information Integration and Informatics
- Databases
- Data management
- Data mining
- Predictive analytics
- Information retrieval
- Multimedia
- Social Media
- Knowledge bases
- Ontologies
- Web semantics
- Informatics

RI Robust Intelligence
- Artificial Intelligence
- Agents
- Multi-agent systems
- Machine learning
- Probabilistic reasoning
- Robotics
- Perception
- Natural language
- Speech
- Computational neuroscience

HCC Human-Centered Computing
- Human-computer interaction
- Human-robot interaction
- Intelligent interfaces
- Computer supported collaborative work
- Social computing
- Digital humanities
Proposal Evaluation

• NSF evaluates proposals according to
  – Intellectual merit
  – Broader impacts (addressed separately from intellectual merit)

• Broader impacts can/should result from the (perhaps long-term) impact of the research on society, also including
  – Education and training of future practitioners
  – Integration of research and education
  – Enabling the participation of all citizens (for example, women and men, underrepresented minorities, and persons with disabilities) via enhancing diversity and broadening the participation of underrepresented groups
Proposal Evaluation

• Intellectual merit (all items are important)
  – How important is the proposed activity to advancing knowledge and understanding within its own field or across fields?
  – To what extent does the proposal suggest and explore creative and original concepts?
  – What will be the significant contribution of the project to the research and knowledge base of the field?
  – How feasible, well conceived and organized is the proposed activity and its evaluation?
  – How well qualified are the proposers to conduct the project?
  – Is there sufficient access to resources?
  – Are the proposers over-committed?
Proposal Evaluation

- Broader impacts (one or more items may be important)
  - How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
  - Does the activity develop educational experiences through substantive student involvement in emerging and technology areas?
  - Does the activity include the development of curriculum and supporting materials in emerging and technology areas?
  - How well does the activity broaden the participation of underrepresented groups (e.g., with respect to gender, ethnicity, disability or geographic region)?
  - To what extent does the activity enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?
  - Will the results be disseminated broadly to enhance scientific and technological understanding?
  - What may be the benefits of the proposed activity to society, including industry and government agencies?
Proposal Evaluation

- Data management plan (see [www.nsf.gov/cise/cise_dmp.jsp](http://www.nsf.gov/cise/cise_dmp.jsp))
- Post-doctoral mentoring plan (if postdocs in budget)
- IRB approval (if human-subject experiments included)
Proposal Evaluation

• Most proposals in CISE are evaluated by evaluators external to NSF, comprising a panel. Panels typically meet for one or two days, either in person or virtually. Different panels use (somewhat) different rules, often similar to the following:
  – Day 1: Scribe summarizes the content of the proposal, summarizes their review (intellectual merit and broader impacts) and then leads the discussion and takes notes as other reviewers summarize their reviews and all panelists discuss the proposal (20 minutes). The scribe also summarizes the ad-hoc (= mail-in) reviews.
  – Day 1: After the panel reaches consensus, scribe writes the panel summary in Fastlane (using a given template).
  – Day 2: All panelists read the panel summaries and give comments. Scribe incorporates them.
  – Day 2: NSF approves the panel summary before the panel adjourns.
Proposal Evaluation

Example of panel summary
• Summary of proposal
• Intellectual merit
  – Strengths
  – Weaknesses
  – To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
• Broader impacts, including enhancing diversity and integrating research and education
  – Strengths
  – Weaknesses
  – Comments on data management plan
• Results from prior NSF support (if applicable)
• Additional suggestions
• Panel recommendation
• Justification, including key strengths and weaknesses
Proposal Evaluation

• Panel recommendation
  – High competitive (HC)
  – Competitive (C)
  – Sometimes: Low competitive (LC)
  – Not recommended for funding (NRFP)

• Identification of “high risk – high reward” proposals (for example, because they are “potentially transformative,” namely unexpected, might revolutionize entire disciplines, create entirely new fields or disrupt accepted theories and perspectives)
Proposal Evaluation

• Panels evaluate the merits of the proposals but do NOT make funding decisions
• Funding decisions take additional criteria into account
  – Comparisons across panels
  – Balance of portfolio (e.g. levels of risk, topics and approaches)
  – Diversity aspects, e.g. the mission of EPSCoR is to assist NSF in its statutory function “to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education.”
• Funding decisions are made as follows
  – program director → cluster (of program directors) → division director → assistant director (of directorate) → division of grants and agreements
Advice for New PIs

• It might appear that NSF operates in a way similar to journals ... 

• Journal
  – Editor
    • Reviewers (peers)

• NSF
  – Program Director
    • Reviewers (peers)
Advice for New PIs

• However, there are differences!

• Journal
  - Editor
    • Reviewers (peers)

• Submission: final product

• Concept: judging

• NSF
  - Program Director
    • Reviewers (peers)

• Submission: proposal

• Concept: stewardship (and some advocacy)
Advice for New PIs

• Talk to NSF program directors about your ideas, suggestions and concerns

• Subscribe to the NSF mailinglist at nsf.gov
Advice for New PIs

• Subscribe to the CISE mailing list at [www.nsf.gov/cise/news/mail_lists.jsp](http://www.nsf.gov/cise/news/mail_lists.jsp) by sending an email to [join-cise-announce@lists.nsf.gov](mailto:join-cise-announce@lists.nsf.gov) with no text in the subject or message body (to change soon)

• Visit NSF or attend an NSF outreach event
  – NSF Days
  – CISE CAREER proposal writing workshops
    (e.g. March 30, 2012 in Philadelphia and May 18, 2012 in Phoenix)

• Read and participate in the Computing Community Consortium at [www.cra.org/ccc](http://www.cra.org/ccc)
Advice for New PIs

• Search the NSF award database (right-hand menu on nsf.gov) to find out about NSF program directors potentially interested in your research and talk to them.

• Ask colleagues for examples of successful NSF proposals and let them comment on your NSF proposal drafts.

• Ask program directors to let you serve on NSF panels (there is no central NSF database on volunteers, so it makes sense to send an email to each program director potentially interested in your research).
Advice for New PIs

• When writing a proposal,
  – Pay close attention to broader impacts
  – Address both intellectual merit and broader impacts in separate statements in the project summary (best: under separate headings)
  – Think about suggesting reviewers
  – Think about providing keywords in the project summary
  – Think about listing more than one NSF unit as destination where appropriate, but talk to program directors first to make sure that this is really appropriate for your proposal
Advice for New PIs

• After your proposal is funded,
  – Keep program directors informed about exceptional achievements (for NSF highlights)
  – Consider asking for REU supplements to add undergraduate students to your NSF-funded research project
  – Don’t forget in project reports to
    • List contributions of each project participant (including students)
    • Discuss deviations from the original plan
    • Discuss broader impacts activities
    • Discuss individual contributions for collaborative research projects
    • Discuss collaborative activities for collaborative research projects
    • Discuss dissemination of code and datasets
    • say something about “Outreach Activities,” “Contributions to Human Resource Development,” “Contributions to Resources for Research and Education” and “Contributions Beyond Science and Engineering”
• Part 1: Overview of NSF
• Part 2: Funding Opportunities
Core Program

- Algorithmic Foundations
- Communications and Information Foundations
- Software and Hardware Foundations

CCF
Computing and Communications Foundations

CNS
Computer and Network Systems

IIS
Information and Intelligent Systems

- Computer Systems Research
- Networking Technology and Systems
- Human-Centered Computing
- Information Integration and Informatics
- Robust Intelligence
Core Program

• Core programs (provide stability for the research community)
  – Robust Intelligence program (small projects)
    up to $500,000 for up to 3 years
    due date December 1-19, 2011
  – Robust Intelligence program (medium projects)
    up to $1,200,000 for up to 4 years
    due date September 15-30, 2011
  – Robust Intelligence program (large projects)
    up to $3,000,000 for up to 5 years
    due date November 1-28, 2011

• Limit on number of proposals per PI (across CISE): 2
• About 70-75 percent of CISE budget goes into core programs
Other Interesting Programs

• Other IIS clusters
  – Human-Centered Computing (HCC) ← Human-Robot Interaction
  – Information Integration and Informatics (III) ← Data-Mining

• Other divisions
  – Computing and Communication Foundations (CCF) ← (Theoretical AI)
  – Computer and Network Systems (CNS)
Other Interesting Programs

![Bar chart showing Overall CISE Funding Rate: 21%]

- CCF: 27%
- CNS: 21%
- IIS: 17%

Legend: Blue = Actions, Green = Awards
Other Interesting Programs

• Other directorates
  – Engineering ← Robot Hardware and Control, Adaptive Systems, Energy

• CISE crosscutting programs
  – Network Science and Engineering
  – Smart Health and Wellbeing ← Robotics and Data-Mining

• NSF crosscutting programs
  – Cyber-Physical systems (CPS) ← Robotics and Data-Mining
  – Social Computational Systems (SoCS)
  – Sustainability for Science, Engineering and Education (SEES)
  – Interface between CS and Economics and Social Sciences (ICES)
  – Cyberlearning: Transforming Education
  – Secure and Trustworthy Cyberspace (SaTC), ex: Trustworthy Computing
  – Advances in Bioinformatics (ABI)
  – Software Infrastructure for Sustained Innovation (SI²; part of CIF21 Vision)
  – …
National Robotics Initiative (NRI)

- Small Business Innovation Research (SBIR) on Robotics Technology Development and Deployment (sponsored by NSF, DOD, NIH, DHS and USDA) posted in September 2010

National Robotics Initiative (NRI)
National Robotics Initiative (NRI)

Cognition: Learning, Knowledge representation, Planning, Navigation

Intelligent Co-Robot

Sensors & perception

Smart structures and environments

Cognitive prosthetics

Networked Multi-Agent

HW/SW Architecture platforms – Mechanisms, Control, Modeling

Mobility: legged, wheeled, aquatic, aerial

Human-robot interaction: physical & social, language & communication

Manipulation: Haptics, Tactile

Exo-skeleton augmentation

Soft structures
National Robotics Initiative (NRI)

• Small projects
  – One or more PIs for 1-5 years
  – $100,000-$250,000/year in direct cost
  – Letter of intent: October 1, 2011 and annually thereafter
  – Full proposal: November 3, 2011 and annually thereafter

• Large projects
  – Multi-disciplinary teams for 1-5 years
  – about $250,000-$1M/year in direct cost, no larger than $1.5M/year total
  – Letter of intent: December 15, 2012 and annually thereafter
  – Full proposals: January 18, 2012 and annually thereafter

• Anticipated funding amount: $40-50M / year
• Limit on number of proposals per PI: 2
• For more information, see www.nsf.gov/nri
Other Opportunities (1)

- **Getting started**
  - Faculty Early Career Development (CAREER)
  - Early Concept Grants for Exploratory Research (EAGER)
- **Time-sensitive research** (typically announced via Dear Colleague Letter)
  - Rapid Response Research (RAPID)
- **Meetings** (workshops, symposia, summer schools, exhibitions, ...)
  - Grants for Conferences, Symposia and Workshops; Grants to Support International Travel, ...
- **International activities**
- **Big challenges**
  - Expeditions in Computing
- **Centers**
  - Science and Technology Centers (STC)
  - Engineering Research Centers (ERC)
  - Industry & University Cooperative Research Centers (I/UCRC)
Other Opportunities (2)

• Equipment
  – CISE Computing Research Infrastructure (CRI) - can also fund software development to allow many other researchers to do interesting research
  – Major Research Instrumentation (MRI)

• Education
  – Integrative Graduate Education and Research Traineeship (IGERT)
  – Research Experiences for Undergraduates (REU) – REU Supplements and Sites

• Technology transfer
  – Innovation Corps (I-Corps)
  – Small Business Technology Transfer (STTR)
  – Small Business Innovation Research (SBIR)
  – Grant Opportunities for Academic Liaison with Industry (GOALI)
  – Industry & University Cooperative Research Centers (I/UCRC)

• Broadening participation
  – Research in Undergraduate Institutions (RUI)
  – ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)
Large Projects

- CISE hopes that larger projects (involving multiple research groups) allow our community to tackle larger and/or more difficult problems.
- This requires cooperation among multiple researchers, often with different expertise.
- The most successful projects are those with a tight cooperation, e.g. student exchanges, joint data sets or hardware, joint software development and publications, and so on.
Large Projects

• Large Core Projects: up to $3M for up to 5 years
• Expeditions in Computing: up to $10M for up to 5 years
• Centers
  – Science and Technology Centers (STC)
  – Engineering Research Centers (ERC)
  – Industry & University Cooperative Research Centers (I/UCRC)
Technology Transfer

- Innovation Corps (I-Corps)
- Small Business Technology Transfer (STTR)
- Small Business Innovation Research (SBIR)
- Grant Opportunities for Academic Liaison with Industry (GOALI)
- Industry & University Cooperative Research Centers (I/UCRC)
Technology Transfer: I-Corps

• NSF Innovation Corps (I-Corps)
  – a public-private partnership to help develop scientific and engineering discoveries into useful technologies, products and processes
  – Expected outcomes: new start-up businesses, licenses, SBIR proposals, business plans suitable for review by third-party investors, students with entrepreneurial skills, new or enhanced curricula
  – Eligibility: Must have an active NSF award or one that has been active within the previous 5 years
  – Award size and duration: $50,000 for 6 months
  – Review: reviewed like RAPIDs, 45 days from submission to decision, additional review criteria: potential market impact and time horizon to impact
  – Submission window: August 17-September 9, 2011 and quarterly thereafter
Workshops

• Conferences
  – Student travel support
  – Doctoral consortia

• Summer schools
  – Intensive program for doctoral students on emerging research topics
  – Require faculty expertise not available at any single institution

• Workshops
  – Meetings that bring the community together to reflect on and identify emerging research opportunities and challenges

• Typically only internal review required

• Must consult with a program director before submission of proposals to support the above
International Collaborations

• General rule
  • Each country pays for its own researchers, students and tool development, except if there is some special justification or unique capabilities and the work is in service of the United States. (In the latter case, funding is usually given to the foreign partner in form of a subaward.)
International Collaborations

- Office of International Science and Engineering (OISE)
  - Runs some programs
  - Supports programs of the science and engineering directorates
  - Operates 3 offices abroad (Paris, Tokyo, Beijing)
  - Funding in fiscal year 2010 was about $50 million
  - Program directors are responsible for countries or groups of countries
  - For more information, see www.nsf.gov/div/index.jsp?div=OISE
International Collaborations

- **REU**: Research Experiences for Undergraduate Students
  - Undergraduate students can conduct research abroad, including REU supplements and REU sites

- **IGERT**: Integrative Graduate Education and Research Traineeship
  - Graduate students can conduct research abroad

- **EAPSI**: East Asia and Pacific Summer Institutes
  - Graduate students can conduct research in Australia, China, Japan, Korea, New Zealand, Singapore, or Taiwan (few applications from computer science)

- **IRFP**: International Research Fellowship Program
  - Researchers within 3 years of Ph.D. can conduct research abroad for 9-24 months

- **SAVI**: Science Across Virtual Institutes
  - International collaborations in STEM research and education

- **PIRE**: Partnership for International Research and Education
  - 5-20 awards of up to 5 year durations; more than $40 M$; focus exclusively on sustainability this year

- International Research and Education: Planning Visits and Workshops
International Collaborations

• Example: IJCAI/NSF Extended Lab Visit Program 2011: 9 Ph.D. students from the doctoral consortium for 6-8 weeks into European research labs in artificial intelligence and robotics, a successor to the IROS/NSF Grassroots Program
  – The central aims of these extended visits are to immerse the students in a research group in a different country, expose them to new research paradigms and approaches within artificial intelligence, get them to work with established members of the research community who will host and supervise them. For the hosting labs, this will provide an opportunity to build a research bridge with the student's research group and advisor in the US, and will create a solid basis for long term collaborations between the groups.
International Collaborations

• Supplements for international collaborations
  – Many NSF solicitations include text similar to the following text: “Interdisciplinary, international and/or academic-industry collaborations that promise to result in major science or engineering advances are welcome.”
  – International activities can be included in grant proposals
  – Supplements for international activities can be asked for during the grant period of funded proposals by talking to your program director
  – Guidelines for OISE co-funding
    • True intellectual collaboration with foreign partner
    • Active research engagement of U.S. students and junior researchers at the foreign site
    • Benefits from the expertise and specialized skills, facilities and/or resources of the foreign collaborator
    • New international collaborations
International Collaborations

- International research networks
- Multi-lateral projects
- Bi-lateral projects
  - Collaborative Research in Computational Neuroscience; NSF, NIH, BMBF (Germany)
  - Collaborative activities that will advance the understanding of nervous system structure and function, mechanisms underlying nervous system disorders, and computational strategies used by the nervous system
  - One proposal submission, reviewed via joint panels
Your Ideas Count

• Visit the NSF webpages at nsf.gov and www.cise.nsf.gov.

• Discuss your ideas with an NSF program director, both your research ideas and ideas for how NSF can help our research community even more. Please talk to me here or send me an email (skoenig@nsf.gov).

• Also consider talking to
  – Edwina Rissland (erislan@nsf.gov) – Artificial Intelligence
  – Jie Yang (jyang@nsf.gov) - Vision
  – Ken Whang (kwhang@nsf.gov) – Computational Neuroscience
  – Richard Voyles (rvoyles@nsf.gov) - Robotics
  – Tanya Korelsky (tkorelsk@nsf.gov) – NLP and Speech
  – Vasant Honavar (vhonavar@nsf.gov) – Data Mining
Your Ideas Count

• NSF is always looking for great ideas and, due to program director autonomy, is flexible when it comes to small amounts of funding.

• Help NSF to fund the most meritorious proposals by becoming an ad-hoc reviewer, panelist or program director!

• Thanks!

• (Please note that typos in this document are possible.)