EXPERIMENTAL SOFTWARE SYSTEMS

Program Announcement

DIRECTORATE FOR COMPUTER AND INFORMATION
SCIENCE AND ENGINEERING

PROPOSAL SUBMISSION DEADLINE: ***December 16, 1997***

NATIONAL SCIENCE FOUNDATION

Introduction

The National Science Foundation (NSF) Directorate for Computer and Information Science and Engineering (CISE) is committed to enhancing the understanding of the principles and uses of advanced computing, communications, and information systems. Recognizing that experimental investigations have made valuable contributions to improving knowledge of information technology and its underlying principles, CISE announces a research program in Experimental Software Systems (ESS).

Objectives

The objectives of the Experimental Software Systems (ESS) Program are:

- To promote the discovery, integration, dissemination, and employment of new knowledge of computer and information science and engineering by supporting experimental investigations conducted by research teams dedicated to making fundamental advances through innovations in software and software engineering

- To provide opportunities for investigators from different research areas of computer and information science and engineering to collaborate on addressing a research question that requires the multiple perspectives and talents of the team members

- To improve the experimental computer science expertise of principal investigators and students in research institutions.

Program Description

The ESS program supports research projects which have in common a software focus, experimental content, and a small team of investigators. The composition of the research team, the nature of the experimentation, and the particular aspects of software may be different across projects. Appropriate research may include software engineering experiments, prototyping and evaluating novel software systems, experiments in distributed and parallel computing, experimental evaluation of algorithms, or other topics.

Projects funded by the ESS program may build upon the maturation of earlier research that may have been pursued through analytical or simulation studies; and the ESS program will support efforts to evaluate the most promising such results.

The following examples are provided to expand on the notion of experimental software systems, not to restrict proposed research:

- Conducting experiments comparing the performance of information retrieval algorithms based on extent and nature of structure in scientific data bases

- Investigating the scalability of promising ideas for process management support to teraflops-level scientific computing

- Designing, implementing, and evaluating novel policies for managing network traffic required by distributed multimedia applications

- Prototyping and evaluating innovative user interfaces and environments for computation and problem-solving by scientists

- Conducting experimental evaluations to compare and contrast specific visual programming technologies

- Designing and implementing a novel language and support environment for vision and robotics tasks

- Experimentally investigating the merits of alternative software architectures for cognitive processing systems.

The following descriptions summarize two broad types of projects envisioned as appropriate for ESS support. These descriptions are not intended to be restrictive, but rather to provide examples of types of projects, team composition, and impacts.

- Build and Evaluate a Novel Software System — implement a working system that provides demonstrable capabilities to identified users, where the software in the system exhibits a novel concept, and implementing the system is essential to demonstrate the feasibility or scalability of the concept.

  The research team may include software architects and builders, and experts from application domains and functional specialties addressed by the software. Researchers are encouraged to use available components (e.g., commercial products

or components accessible to the research community), where possible, in building software systems, to focus effort on the novel elements and to facilitate cooperative research through a component-based infrastructure.

Any proposed implementation of a software system must be strongly motivated, when compared to alternative approaches, as being an appropriate course of action to address the fundamental research questions. The implemented system must be instrumented to facilitate experimentation with its constituent elements and evaluation of its operational and performance characteristics. This technical evaluation of the system must be an integral part of the proposed research.

Examples of potential impacts include —

- demonstrating to a user community an experimental software support system with significantly enhanced capabilities

- calibrating the performance of a novel algorithm

- creating infrastructure artifacts usable on subsequent experimental software systems

- improving the systems-building and experimentation expertise in research institutions

- Experiments in Software Engineering — design and execute experiments to test hypotheses about software performance and usability, and about the effectiveness of processes, environments, methods, and tools for software development, integration, and evolution.

The research team may include specialists in software architecture, system performance, usability, and other software engineering technologies addressed by the experiments; industrial software development professionals; and specialists in the computational models, domains, or functional areas addressed by the software.

The ESS program intends to enable controlled and reproducible experiments, which have been difficult to conduct, in contrast to other kinds of empirical studies, such as case studies, surveys, or observational studies.

Examples of potential impacts include —

- settling open questions concerning the relative effectiveness of methods and tools for similar purposes

- stimulating software development organizations to modify their processes because the experiments produced quantitative evidence concerning the nature and extent of improvement potentially realizable through the use of particular practices or tools

- encouraging the adoption of a novel architecture by software producers, because the experiments showed it to have superior properties to alternatives

- strengthening the experimentation expertise of research institutions

Content of Proposals

All proposals must be prepared in accordance with the instructions contained in the new Grant Proposal Guide (NSF 98-2). In addition, ESS proposals should address the following issues:

a. Research Objectives: Describe the broad research goals and define the specific objectives for this project; describe how the proposed research is motivated by the significance, to specific communities, of questions which will be answered by the research.

b. Need for Experimentation: Explain why this experimental approach is necessary to answer the research questions; for example, the question being addressed (e.g., scalability, performance, technical feasibility, evaluation, or usability) is intrinsically one requiring (or strongly encouraging) experimentation, or the experimental approach is appropriate now, because of promising results (which should be cited) from previous smaller-scale studies, analysis, or simulation. State the alternatives to experimentation that were considered and not chosen, and why.

c. Research Plan: Describe clearly the designs of experiments (including explicit statements of testable hypotheses, experimental design, experimental controls, measures, statistical tests, threats to validity, and interpretation of results) or the steps to build and evaluate the novel software systems; discuss the organization and roles of the research team members; define intermediate milestones corresponding to demonstrable capabilities, completion of tasks which answer specific research questions, or other project-defined stages of progress (project teams should expect site visits for capability demonstrations and project status reviews); describe plans to evaluate the results of the research; identify risks to completing the project and describe planned

steps to manage risks over the life of the project.

d. Expected Impact: Describe the anticipated impact of the research on specific communities; discuss the applicability of the results to other settings.

e. Research Infrastructure: Describe the support facilities and capabilities enabling the research, especially environments for system-building and experimentation; discuss any plans to make artifacts from the project available to the research community, thereby contributing to a broader distributed research infrastructure.

Scope of Support

The ESS program expects to make 5-10 grants in Fiscal Year 1998 (FY98). Budgets are expected to average between $200,000 and $400,000 per year, although not necessarily at uniform levels each year. Requested budgets should be consistent with planned research activities. Expected project duration is two to four years.

Smaller, 12-18 month planning grants may also be requested to support preparation for a more comprehensive experimental project through detailed planning, specific analytical and simulation studies, or other preliminary research.

Proposals may request support for principal investigators, postdoctoral researchers, graduate students, research programmers, equipment, and indirect costs.

Proposal Submission Deadline

For support beginning in FY98, proposals for the ESS program must be received by NSF no later than December 16, 1997.

Proposal Preparation

All proposals must be prepared in accordance with the instructions contained in the new NSF Grant Proposal Guide (NSF 98-2), which includes the Proposal Forms Kit (NSF 98-3). Single copies of this Guide are available at no cost; a request may be submitted by electronic mail to pubs@nsf.gov, by telephone to (301) 947-2722, or by writing to the NSF Clearinghouse, P.O. Box 218, Jessup, Maryland 20794-0218. The Grant Proposal Guide is available via the Internet at http://www.nsf.gov/bfa/cpo/gpg/start.htm.

FastLane

Proposers for the ESS program are strongly encouraged to submit proposals via FastLane, NSF's system for electronic proposal submission and review, available through the World Wide Web at the FastLane home page (http://www.fastlane.nsf.gov). To access the FastLane proposal Preparation Application, your institution needs to be a registered FastLane institution. As list of registered institutions and the FastLane registration form are located on the FastLane home page.

To use NSF FastLane to prepare and submit a proposal, applicants must use a browser that supports multiple buttons, radio buttons within tables, and file upload (e.g., Netscape 2.0 and above.) In addition, Adobe Acrobat Reader is needed to view and print forms. Instructions for downloading these software packages can be found in "How to Use FastLane" on the NSF FastLane Home Page. Detailed instructions on how to prepare and submit a standard proposal using FastLane are available on the FastLane Home Page within the "Information About FastLane" document.

Users may send technical questions and comments to the FastLane staff by e-mail message to fastlane@nsf.gov or by telephone to 703-306-1142, ext. 4686.

Mail Submissions

The ESS program also accepts proposals submitted through the mail. In this case, twelve copies should be submitted to NSF following the submission instructions in Chapter 1 of the Grant Proposal Guide (NSF 98-2).

Principal Investigators submitting a proposal to ESS through the mail are also required to send by the submission deadline one copy of the proposal to:

Dr. William W. Agresti
ESS Program Director
National Science Foundation
4201 Wilson Boulevard, Room 1145
Arlington, Virginia 22230
(703) 306-1911

Merit Review Process

Proposals to this program will be subject to the NSF peer review process which may include panel and/or mail review. Proposals will be subject to both the NEW merit review criteria of NSF and additional criteria specific to the ESS program.

The new NSF merit review criteria approved by the National Science Board on March 28, 1997 (NSB 97-72) are:

- What is the intellectual merit and quality of the proposed activity?

The following are suggested questions that the reviewer will consider in assessing how well the proposal meets this criterion. Each reviewer will address only those questions which he/she considers relevant to the proposal and for which he/she is qualified to make judgments.

How important is the proposed activity to advancing knowledge and understanding within its own field and across different fields?

How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)

To what extent does the proposed activity suggest and explore creative and original concepts?

How well conceived and organized is the proposed activity?

Is there sufficient access to resources?

- What are the broader impacts of the proposed activity?

The following are suggested questions that the reviewer will consider in assessing how well the proposal meets this criterion. Each reviewer will address only those questions which he/she considers relevant to the proposal and for which he/she is qualified to make judgments.

How well does the activity advance discovery and understanding while promoting teaching, training, and learning?

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, geographic, etc.)?

To what extent will it 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?

Additional ESS-Specific Criteria:

In addition to these generic NSF review criteria, reviewers will be asked to use the following additional criteria when reviewing proposals that respond to this announcement:

- Regular ESS Proposals (2 additional criteria):

  - Match of the proposed activities to the objectives and description of the ESS Program, as stated in this program announcement

  - Quality of the proposed plans to (as appropriate) conduct experiments, build software, and evaluate software systems.

- Planning Grants (1 additional criterion): Likelihood that successful completion of the planning grant will provide benefits to the research community and provide preparation for that community to conduct experimental research.

Grant Administration

Grants awarded as a result of this solicitation will be administered in accordance with the terms and conditions of NSF GC-1, "Grant General Conditions," or FDP-III, "Federal Demonstration Partnership General Terms and Conditions," depending on the grantee organization. Copies of these documents are available at no cost from the NSF Forms and Publications Unit, phone (703) 306-1130, or via e-mail pubs@nsf.gov. More comprehensive information is contained in the NSF Grant Policy Manual (GPM) (NSF 95-26) effective October 1, 1995. The complete text of the GPM is now available on the World Wide Web.

Relationship to Other NSF Programs

Distinguishing features of ESS projects are the small team orientation, experimental content, software focus, and higher levels of support. The CISE program, Experimental Systems Program (NSF 94-142), is similar except that it supports building and experimenting with hardware-software systems.

ESS-supported projects will be investigating research questions which are similar to those being studied in other programs in the CISE Directorate. However, most other CISE research programs support projects with a single investigator (rather than a team), at smaller levels of funding, and pursuing a wide range of investigative approaches, including experimental.

Other related NSF programs include the Software Capitalization Grants (NSF 90-30), CISE Research Infrastructure Program (NSF 97-146), Instrumentation Grants for Research in CISE (NSF 96-113), CISE Postdoctoral Research Associates in Experimental Computer Science (NSF 97-169), CISE Minority Institutions Infrastructure Program (NSF 96-15), CISE New Technologies Program (NSF 97-27), Special Projects in Networking and Communications (NSF 97-108), and the CISE Challenges in Computer and Information Science and Engineering (NSF 97-62).

Inquiries

Direct inquiries about the ESS program to the program director, Dr. William W. Agresti, (703) 306-1911 (fax: -1947), wagresti@nsf.gov. The mailing address is the CISE Directorate, National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230. Potential proposers are encouraged to discuss their research ideas with the program director.

For information about the ESS program, including currently supported ESS research, consult the appropriate Internet pages for CISE, the grants database, and ESS, on the NSF World Wide Web site at http://www.nsf.gov.

Other Information

The Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation.

The Foundation welcomes proposals from all qualified scientists and engineers, and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research related programs described here.

In accordance with federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from National Science Foundation.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF projects. See the program announcement or contact the program coordinator at (703) 306-1636.

Privacy Act and Public Burden. The information requested on proposal forms is solicited under the authority of the National Science Foundation Act of 1950, as amended. It will be used in connection with the selection of qualified proposals and may be disclosed to qualified reviewers and staff assistants as part of the review process; to applicant institutions/grantees to provide or obtain data regarding the application review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers as necessary to complete assigned work; and to other government agencies in order to coordinate programs. See Systems of Records, NSF-50, Principal Investigator/Proposal File and Associated Records, 60 Federal Register 4449 (January 23, 1995), and NSF-51, Reviewer/Proposal File and Associated Records, 59 Federal Register 8031 (February 17, 1994). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of your receiving an award.

Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: Gail A. McHenry, Reports Clearance Officer, Information Dissemination, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230.

The National Science Foundation has Telephonic Device for the Deaf (TDD) capability, which enables individuals with hearing impairments to communicate with the Foundation about NSF programs, employment, or general information. The telephone number is (703) 306-0090.

Activities described in this publication are in Category 47.070 (Directorate for Computer and Information Science and Engineering) in the Catalog of Federal Domestic Assistance.

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