



Institute for Advanced Computing Applications and Technologies

Computing and information technologies are among the most significant achievements of the 20th Century. Advances in computing and information technologies are exerting a significant impact on scholarly disciplines and fields, not only in those areas of science and engineering that have provided the initial seedbed, but in new and rapidly expanding communities dealing with the life sciences, environment, business, healthcare, and the social sciences, arts and humanities. Far-reaching outcomes for the 21st century are envisioned in the way we discover new knowledge, the way we predict the behavior of complex natural and engineered systems, and the way we manage and analyze data for improved health, security, energy and economic welfare. The transformation of data to information to knowledge to applications that benefit society represents a grand challenge for the University of Illinois at Urbana-Champaign, one of the nation's premier research-intensive land grant universities.

To realize the full potential of this rapid growth, the University of Illinois at Urbana-Champaign is creating the *Institute for Advanced Computing Applications and Technologies* (IACAT). The Institute will combine faculty-initiated research in its academic units with the advanced technology capabilities at the *National Center for Supercomputing Applications* (NCSA). As the campus-specific interface to NCSA, IACAT will thus promote synergies between research faculty in different disciplines and NCSA staff, positioning both for contributing to the solution of the nation's most challenging problems, providing a supporting cyberinfrastructure that will enable extraordinary research advances, and extending the impact of that research by deploying it beyond the original point of inquiry. By forming alliances with other campus institutes and groups, IACAT will create infrastructure that facilitates the mission of these institutes and groups. In doing so, IACAT promises advances that go far beyond the knowledge of any particular researcher or community.

NCSA Inside

The great promise offered by computing and information technologies will best be realized if the experts creating and implementing new computing and information technologies and infrastructure are closely coupled with discipline-based researchers who are deeply involved in developing research applications that make full use of these new capabilities. Collaborative multidisciplinary research is at the heart of this activity. The unique role of the Institute will be to foster deep partnerships with NCSA, which has contributed significantly to the birth and growth of the worldwide cyberinfrastructure, and is today operating some of the world's most powerful supercomputers and developing the software infrastructure needed to use these systems efficiently. The Institute thus harnesses the national cyberinfrastructure and, at the same time, informs the creators of that infrastructure about important application areas where new and improved tools and methods are needed. IACAT, *with NCSA inside*, will provide unparalleled opportunities to advance domain-specific applications of advanced computing and information technologies while spurring the development of new computing and information technologies. Such activities will set the intellectual agenda of the nation for many decades to come.

Research Themes, Theme Development Activities, and White Papers

The scope and complexity of advanced computing applications and technologies requires close collaboration across many disciplines and skills. IACAT will be organized around a set of *Research Themes* that will address major opportunities and challenges that are too complex and multi-faceted for individuals or even small groups of researchers to tackle on their own. Research Themes will be defined by a combination of bottom-up creativity with the strategic positioning of NCSA and the campus. Research Themes will be broadly defined and may include a portfolio of component research projects that span multiple inter-related activities. The Research Themes will provide benefit to the participating academic units and to NCSA, while enhancing the role of UIUC in research, education and outreach, and contributing to the nation's advanced cyberinfrastructure programs. A series of workshops, begun in 2005 and continuing through 2008, are exploring possible Research Themes.

A request for White Papers from the campus with criteria for selection of Research Themes and Research Theme Development Activities will be issued in the Fall of 2006 and annually thereafter until all of the Themes have been identified. Candidate Research Themes and Research Theme Development Activities will be evaluated by both

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internal and external experts. Because different fields have different approaches to research, newly developing communities may take time to emerge and connect with NCSA. Research Theme Development Activities may include community-building activities in addition to research. It is anticipated that IACAT projects may include creation of cyberinfrastructure that facilitates the activities of other UIUC institutes and centers.

It is expected that Research Themes and Research Theme Development Activities will serve to position UIUC and NCSA researchers for emerging opportunities. For example, recently announced UIUC strategic initiatives include:

- The *Illinois Sustainable Energy and Environment Initiative*, which will use the campus' unique interdisciplinary strengths in science and technology, economics, the humanities, and the social sciences to develop new technologies, practices, and policies in the sustainable use of vital resources such as energy, water, and land.
- The *Integrated Sciences for Health Initiative*, which will apply Illinois' expertise in the physical sciences, engineering, and information, medical and life sciences to improve human health.
- The *Illinois Informatics Initiative*, which will provide an integrated approach to prepare students for the information-technology enabled workforce in the natural sciences, humanities, social sciences, and the arts and on decision support for business and government.

In addition, UIUC and NCSA researchers may seek to position themselves for national initiatives where UIUC has unique capabilities. Such initiatives would include those sponsored by the NSF, NIH, DOE, DOD, NEA, NEH and others; as well as by industry and private foundations. For example, to address the most computationally-challenging problems at the frontiers of science and engineering, new petascale computing technologies (hardware and software) need to be developed in conjunction with new applications that would draw on the expertise of faculty and staff from across campus including NCSA.

Management

The Institute will be led by Thom Dunning who, as Director of IACAT, will report to the Vice Chancellor for Research at the University of Illinois at Urbana-Champaign. Each of the Institute's Research Themes (and Research Theme Development Activities) will be led by a Theme Leader. A Campus Advisory Board consisting of UIUC faculty and NCSA professional staff will be appointed by the Director with the concurrence of the Vice Chancellor for Research. Responsibilities of the Campus Advisory Board include: providing advice and counsel to the Institute Director on the direction and operation of the Institute, and facilitating integration of the Institute's research and educational programs with related programs on the UIUC campus. An External Advisory Board, consisting of national and international leaders in the Research Theme areas and in Cyberinfrastructure, will be appointed by the Vice Chancellor for Research to provide scientific advice and counsel to the Institute Director. The External Advisory Board will also assist the Director and Vice Chancellor for Research in conducting periodic reviews of the Institute's programs.

Resources

The Institute will be staffed by faculty from UIUC academic units and by NCSA academic professionals. The University of Illinois at Urbana-Champaign is making new resources available to launch the Institute for Advanced Computing Applications and Technology. The Institute will share the new 140,000 sq. ft. building with NCSA to provide office space and computing laboratories. To ensure that the Institute has the range of expertise and experience needed to meet its goals, the UIUC Campus has committed recurring funding equivalent to 20 half-time faculty positions (four per year). The Institute will work in close partnership with participating academic units beginning in the 2006-07 academic year to identify and/or recruit Institute faculty based on the above mentioned White Papers. Seed funding for each of the selected Research Themes and Theme Development Activities will be provided beginning in the 2006-07 academic year. Seed funding will include salary support for NCSA academic professionals who participate in IACAT activities as well as support for research and development activities. Funds will be available in subsequent years to develop and sustain additional Research Themes and Research Theme Development Activities. The partnership between IACAT and participating academic units will include sharing start-up costs as well as indirect costs associated with externally-funded IACAT research grants led by faculty principal investigators. Policy guidelines will be provided in the Fall of 2006.