



UMII Vision and goals

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Executive Summary

The mission of the University of Minnesota Interdisciplinary Informatics Initiative (UMIII) is to further research, innovation, discovery, and learning in the interdisciplinary approach of informatics to study complex problems or systems.

The National Academies Committee on Facilitating Interdisciplinary Research defines interdisciplinary research as follow:

Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice.¹

The UMII goals are:

- To facilitate the development of an informatics community that will support the University strategic plan to attract, retain and promote investigators that are working at the frontier of interdisciplinary research using computation and quantitative methods.
- To develop a strong informatics infrastructure which by meeting and anticipating the researcher's needs improves the University readiness in the area of interdisciplinary research and the application of computational thinking to research.

The UMII supports its mission by establishing resources, incentives and training opportunities for University investigators planning to engage in interdisciplinary research and teaching efforts that rely or integrate informatics methodologies or tools. These [resources](#) include:

- Seed grant program
- Fast track training program
- Graduate School post-doctoral fellowships
- Colloquiums
- *Support for hiring of Interdisciplinary and computational faculty*

The intended outcome of the UMII efforts is a cohesive, synergistic university-wide informatics community that provides a rich environment to foster informatics and interdisciplinary research across the arts and humanities, medicine, the life sciences and the engineering and physical sciences.

¹ National Academies, *Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering and Public Policy*

I. Introduction

Propelled by simultaneous and rapid technological advancements in many diverse fields, the practice of, and fundamental necessity for, thinking across disciplines and domains of information has reached new heights and breadth. The ability to access multitudes of information resources that enable thinking across boundaries is no longer the sole province of a technology-savvy few as wide access to effective and personalized technology has equalized the access to information. However, global access to data, both worldwide and across disciplines, does not equate to systematic gain of knowledge. Indeed, some disciplines are described as data rich but knowledge poor. Through the instantaneous access of information and data, the challenge of thinking globally, using a comprehensive or holistic approach, has become an urgent issue.

In today's science, researchers regularly face the daunting challenge of exploring, interpreting, and discovering new meaning in data sets daily increasing in numbers, sizes, types, content and diversity. Though we may intuitively recognize that some data sets are inter-dependent, thereby reinforcing or complementing each other, very few researchers have the necessary all-in-one understanding, sophistication and expertise to take advantage of connections between disciplines as diverse, for example, as mathematics, biochemistry, engineering, biology and computer sciences. From this recognition and the drive to advance our understanding and knowledge of complex systems naturally arises the need to create interdisciplinary research teams.

Cognizant of the role and benefits of interdisciplinary research (IDR), the University of Minnesota Interdisciplinary Informatics Initiative (UMII) is designed to support University investigators tackling scientific problems or questions that require the use of informatics methodologies and multidisciplinary approaches.

Because interdisciplinary research is central to the UMII vision and goals, this document will first provide key observations about interdisciplinary research. These, and other factors, will guide the UMII strategic development and activities that are presented later in this document.

II. Interdisciplinary Research

The National Academies Committee on Facilitating Interdisciplinary Research provides the following definition:

Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice.²

As the UMII vision and goals are inherently connected to this definition, we propose that this definition of IDR be recognized at a University level.

² National Academies, Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering and Public Policy

Obstacles to IDR implementation and practice can be quite significant, often deeply rooted in research cultural traditions that permeate many levels from the individual investigators, to entire research communities, to institutional organization structures. The fate of an IDR program hinges on the institution's supporting organization, its infrastructure and its investigator's abilities to communicate and, pragmatically, recognizing and rewarding successful interdisciplinary research in the same way as traditional research.

IDR - a social contract

At its core, interdisciplinary research carries an important social component. Successful IDR demands that communication bridges be established between the different IDR team members, and an important prerequisite for that is recognition of the multi-contextual nature of success for the venture. That basis for communication requires an understanding of, and respect for, the specific community culture and personal expectations of each team member not only as a member of the team but also in the context of an individual investigator furthering his or her career. Thus, a precursor for a successful IDR collaboration might be to first identify a problem providing all parties a common benefit in solving. In the era of translational research, the demonstration of how computational methods translate into a practical benefit of new knowledge is becoming one of the scientific priorities for federal agencies. The NSF Cyber-enabled Discovery and Innovation, CDI³, started in 2007 illustrates that scientific trend. This cross-directorates foundation-wide initiative is designed to promote computational thinking through use of computational approaches and interdisciplinary teamwork to solve complex problems.

Beyond the implementation phase, the sustaining and further development of IDR demands that these communication bridges be maintained and actively developed. Only through a sustained effort will the different participants become conversant in the ideas, languages and thought process customary of the other disciplines. As each member becomes more educated in the other's disciplines, a deeper, more stimulating, challenging, and fruitful dialogue can ensue, conducive of discovery and transformative research. We can easily envision that building such an understanding of the other's fields of expertise will have two direct effects:

- Sustaining and enriching the practice of interdisciplinary research and thus counteracting the propensity of a multidisciplinary team to dissolve upon milestone or project completion. This also allows positive momentum developed in the course of an effort to continue within the University.

- Enabling team members to be better educated in other discipline's methodologies and questions and thus empowering individual team member to redefine and expand the boundaries of their own scientific disciplines

The fostering of IDR is not to be undertaken at the expense of single discipline research. Instead, IDR should be recognized for the benefits it returns to single discipline research in added breadth and depth. Promoting IDR should not overlook that a comprehensive program also recognizes the socio-economics and ethical issues raised by its practice. Only when all included in research development and translation are on an equal footing will IDR serve its mission to further our knowledge, enhance human life while respecting its environment. This will also provide a sought for competitive advantage for research funding to the University of Minnesota.

³ http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503163

Successful IDR also feeds upon and contributes to a comprehensive education program conferring both short and long term returns on investment. There too, cultural barriers are present also tied to cross-disciplines communication, culture, and institutional organizational structure.

Achieving IDR

There is no one-size-fits-all solution to fostering interdisciplinary research. Nonetheless, findings based on the results of large surveys identify important common denominators: communication, the institution's organizational structure, collaborative research space, effective recognition and reward process for IDR stewardship (1). Many of these were noted in the 2006 University of Minnesota "Transforming the University" Task Forces recommendations (2), some of which have already been acted upon such as the section 7.11 revision of the Board of Regents Faculty Tenure Code (3), the Blueprint on the Institute for the Advancement of Science and Engineering (IASE, 2007) (4) and the Graduate School Office of Interdisciplinary Initiatives (OII)¹ to support interdisciplinary graduate educations and training programs.

III. The UMII

The UMII is a University-wide program aimed at coordinating the development and integration of informatics resources towards the establishment of a unified informatics landscape. The intended outcome of the UMII efforts is a cohesive university-wide informatics community that provides a rich environment to foster informatics and IDR, akin to an ecosystem.

The current fiscal realities invite us to review the original UMII plans and give us the opportunity to realign the UMII mission, vision and goals with the University research communities' needs. This re-alignment must include longer-term strategies that are both bold and robust and fully supportive of the integration of informatics in interdisciplinary research through improved university-level practices

Mission

The mission of the University of Minnesota Interdisciplinary Informatics Initiative (UMIII) is to further research, innovation, discovery, and learning in the interdisciplinary approach of informatics to study complex problems or systems. The UMII supports its mission by establishing resources, incentives and training for University investigators planning to engage in interdisciplinary efforts.

Goals

To create a cohesive informatics community that is supportive and able to anticipate the needs of University researchers and to improve University readiness in the area of interdisciplinary research and computational thinking.

Vision

Through its leadership and coordinating efforts, the UMII will contribute to better position the University of Minnesota for future interdisciplinary research. Two key strategies for accomplishing this involve (1) Promoting and supporting education on the theory and practice of informatics, and (2) Improving research support through better organization, planning, and acquisition of

¹ <http://www.grad.umn.edu/oii/about/index.html>

informatics resources. The latter includes professional expertise – individuals able to leverage and develop information technologies - as well as the cyberinfrastructure itself.

When considering the life sciences, now and for the next few years, raising the awareness and applicability of informatics methodologies will be achieved by educating the individual users, whether faculty, staff or student. For some disciplines, education will take place in the form of one-on-one interaction and side-by-side training with expert support staff. The UMII recognizes that the nature of the support needed differs across primary disciplines. It is the UMII intent to learn and understand these differences on an ongoing basis and to work with the appropriate parties for the University to develop responses to these needs.

The UMII strategic plans will require constant revisions in design and implementation – in effect, a continuous improvement process - to sustain innovation and competitiveness. Indeed, flexibility and adaptation are key principles in interdisciplinary research and education. Both need to reflect the innovations and methods supported by information technologies and automation in any data and information intensive science. For example, leveraging high throughput sequencing technologies in genomics and the management and analysis of data from large sensor networks in ecology (e.g. NSF National Ecology Observatory Network, NEON) and climate change are prime examples of current challenges.

Coordination

Recognizing that dedicated expert attention is required for the successful development and implementation of the UMII Program, the Office of the Vice President for Research has created the position of UMII Coordinator. The UMII Coordinator works in an advisory capacity to the senior administration and works with colleges, schools, research centers and institutes across the University to develop cohesive interdisciplinary informatics programs supportive of competitive IDR and education and taking advantage of broader developments and planning occurring within the Interdisciplinary Informatics Initiative. Coordination efforts will include working with organization such as the Institute for Health Informatics Institute (IHI)⁴, the newly formed Rochester campus' Biomedical Informatics and Computational Biology Center (BICB)⁵, the Institute of Technology and the emerging disciplines of Social Informatics, the College of Biological Sciences⁶, the College of Food, Agricultural and Natural Resource Sciences⁷, MSI, etc., as well as smaller informatics and interdisciplinary research groups and single investigators expressing an interest in the UMII and dependent on a university-wide cohesive informatics program.

Immediate targets

It should be made plain that the intent is for the UMII to be comprehensive and inclusive of all fields relevant to the UMII mission, both current and emerging. However, because of urgent needs in the life sciences to integrate and apply informatics and quantitative approaches in research design and data analysis, the UMII is especially interested in the following disciplines :

⁴ <http://ihi.umn.edu/>

⁵ http://www.r.umn.edu/19_BICB.htm

⁶ <http://cbs.umn.edu>

⁷ http://www.cfans.umn.edu/Divisions_and_Departments.html

- *Bioinformatics*: Research, development, and applications of computational tools and approaches for expanding the use of biological, medical, behavioral, or health data, including methodologies to acquire, store, organize, archive, analyze, and visualize such data⁸.
- *Computational Biology*: The development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavioral, and social systems⁹.
- *Health informatics*: An integrative scientific field that draws upon information sciences, systems, and related technologies to enhance the use of the knowledge base of health sciences, and the medical and health data generated therein, to improve health care, biomedical and clinical research, education, management and policy¹⁰.
- *Systems Biology*: The coordinated study of biological systems by investigating the components of networks and their interactions, by applying experimental high-throughput, whole proteome, whole metabolome, and whole-genome techniques, and integrating computational methods with experimental efforts¹¹. Or, the interplays of different hierarchies of biological information from DNA to cells, organs and species within their environmental contexts¹².
- *Systems Ecology*: Systems ecology focuses on interactions and transactions within and between biological and ecological systems, and is especially concerned with the way the functioning of ecosystems can be influenced by human interventions¹³.

IV. UMII - Concrete actions

To foster the creation of interdisciplinary research teams and promote the applications of informatics methodologies in the studies of complex problems, the UMII is offering different opportunities pertaining to interdisciplinary informatics research, training, education, networking and community building. These opportunities will be subject to ongoing success evaluation and are expected to occur on an annual recurring basis pending their reviewed impact and interest.

❖ **Research opportunity: Seed grant call for proposal**

Aimed at fostering **new** collaborative efforts across the fields of informatics and other disciplines.

Using a problem-based approach as opposed to discipline, proposals will need to highlight the contribution of the different disciplines that are being assembled for the project, including the application of informatics methodologies. Research plans will include a minimum of two disciplines. Proposals are required to include aims that would not be possible without a cross discipline approach.

Program description and application guidelines can be found at [here](#)

⁸ <http://www.bisti.nih.gov/CompuBioDef.pdf>

⁹ <http://www.bisti.nih.gov/CompuBioDef.pdf>

¹⁰ Adapted from Don E. Detmer, 2007.

¹¹ <http://geocities.com/bioinformaticsweb/definition.html>

¹² http://www.systemsbiology.org/Systems_Biology_in_Depth

¹³ http://en.wikipedia.org/wiki/Systems_ecology

- ❖ **Training opportunity: Fast-track training grant call for proposal**
Offered to promote expedited training in areas of interdisciplinary research that emphasizes the application of informatics, computation and their practices in leading edge research. Open to faculty staff and students, attendance in these courses will provide the benefits of an immediate influx in the laboratory, classroom or department of new perspectives and knowledge on the applications and practices of informatics and IDR.

Program description and application guidelines can be found at [here](#)

- ❖ **Training opportunity: Graduate School Interdisciplinary Informatics postdoctoral fellowships**
This fellowship is part of the newly established Interdisciplinary Informatics Initiative encompassing health informatics, computational biology, bioinformatics, systems biology, and physical and computational sciences, as well as emerging fields in the social and environmental sciences. This fellowship is best suited for individuals with research and scholarly interests in these areas.

Program description and application guidelines can be found [here](#).

- ❖ **Training opportunity: UMR Biomedical informatics and Computational biology program**
The University of Minnesota Rochester Biomedical Informatics and Computational Biology (BICB) program, a UMII partner, provides grants to support interdisciplinary collaborative post-doctoral research between the University of Minnesota, Mayo Clinic and IBM in biomedical informatics and computational biology¹⁴. A Graduate traineeship Program is also offered to prepare students to be researchers and leaders in interdisciplinary sciences.¹⁵

- ❖ **Nucleating events: The UMII colloquium series**
Designed to highlight informatics practices in different research disciplines the UMII Colloquium series will profile researchers from the University campuses as well as from other institutions. The UMII will seek nominations of intra and extra mural researchers whose research program and interests best illustrate the practice, challenges and impact of informatics and interdisciplinary research. In a spirit of community building, the UMII will also co-sponsor events profiling high-visibility departmental guest speaker.

Please contact the UMII for recommendations or other inquiries.

V. References

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¹⁵ http://www.r.umn.edu/19_BICB_Collaborative_Traineeship.htm

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Document prepared by:

Anne-Françoise Lamblin, Ph.D.
Coordinator
University of Minnesota Interdisciplinary Informatics
Office of the Vice President for Research
University of Minnesota

Email: lamb1001@umn.edu

Tel: 612-625-7414