Graduate Study in Information Science at Cornell University

Lori Lorigo[1]
PhD Candidate in Information Science

Claire Cardie[1]
Co-director of Information Science

Geri Gay[2]
Director, HCI Lab

Phoebe Sengers[2]
Assistant Professor of Information Science

[1] 4130 Upson Hall
Cornell University, Ithaca, NY 14850

[2] 301 College Ave.
Cornell University, Ithaca, NY 14850

ABSTRACT

A new interdisciplinary graduate program in Information Science is now being offered at Cornell University. As of June 3, 2004, full approval was granted to Cornell to offer PhDs in Information Science, and we are currently supporting our first group of graduate students in this program. The design of this program is the culmination of careful research, discussions, and planning by many. Still, we view these early stages of deployment as a critical time to review and further shape the nature and directions of this interdisciplinary program and to share philosophies, experiences, and lessons with our colleagues in the HCI and Information Science communities. We hope to contribute to this workshop by sharing our goals, program design, and early experiences, and likewise benefit from the related efforts and experiences of others.

PHILOSOPHY AND GOALS

Digital technologies have become pervasive in culture, economy, law, government, and research, dramatically changing the way people work and live. We believe that the proliferation and significance of these complex technological systems of information demands a new focus in academic scholarship - one committed to cross-disciplinary study, astute about both the technical and the social, and devoted to integrating theory, investigation, design, and practice. Information Science at Cornell brings together faculty, students and researchers who share an interest in combining computer science with the social sciences of how people and society interact with information. The program brings together information systems and HCI, a fruitful merger which has also been made is programs at UC Berkeley, Carnegie Mellon, University of Maryland, and others.

The focus of the Information Science Ph.D. program at Cornell is on systems and their *use*. Moreover, Information Science examines the social, cultural, economic, historical, legal, and political contexts in which information systems are employed, both to inform the design of such systems and to understand their impact on individuals, social groups, and institutions. The field's interdisciplinary research combines multiple methodologies, including mathematical analysis, computer modeling, software system design, experimental studies, and critical social evaluations, from such traditional disciplines as computer science, cognitive psychology, social science, cultural studies, and history.

To reflect these interdisciplinary goals, the program consists of four concentration areas.

Information Systems examines the computer science problems of representing, organization, storing, manipulating, and using digital information.

Human Computer Interaction uses an interactive, user-centered design approach to study the interplay between technology and what people do with technology.

Cognition focuses on the human mind, the ultimate producer and user of information.

Social Aspects of Information studies the cultural, economic, historical, legal, political, and social contexts in which digital information is a major factor.

A student with knowledge in these four areas will be well prepared to make significant, socially-aware and effective contributions in this age where we are saturated with information. Such knowledge becomes indispensable as the amount of digital information grows exponentially and the consequent interactions with multiple ubiquitous and embedded devices overwhelm us..

As an aside, Cornell has also established an undergraduate major and minor in Information Science[1], both of which espouse the same emphasis on the human-centered design and use of information systems in context.

[1] See http://www.infosci.cornell.edu/ugrad/ for more information.

REQUIREMENTS & CURRICULUM

A student who is awarded a Ph.D. in Information Science needs to achieve three objectives:

> *(a) breadth in the disciplines that contribute to the field*
>
> *(b) depth in several aspects of the field*
>
> *(c) original research, on a topic from one or more of the Information Science concentrations.*

The methods for achieving these objectives are discussed below.

Core Required Courses

To achieve *breadth*, and to learn the fundamental concepts and techniques of Information Science, several courses are required. These include one course in statistics, one course in research methods, and, depending on skills, one course in computer programming. In addition, to acquire knowledge in each of the concentrations that comprise the field, each of the following courses is required. (Catalog-style course descriptions of this core curriculum are included below.)

Information Systems

INFO 630/CS 630: Representing and Accessing Digital Information

4 credits, Prerequisites: COM S 472 or 478 or 578 or the equivalent (courses in AI and Machine Learning).

This course covers the representation, organization, and access of digital information with an emphasis on textual information. Topics include structured and semistructured data, information retrieval, natural language processing, and machine learning, with links to work in databases, data mining, and computational linguistics.

INFO 685/CS 685: The Structure of Information Networks

4 credits, Prerequisite: COM S 482 (algorithms course).

Information networks such as the World Wide Web are characterized by the interplay between heterogeneous content and a complex underlying link structure. This course covers recent research on algorithms for analyzing such networks and models that abstract their basic properties. Topics include combinatorial and probabilistic techniques for link analysis, centralized and decentralized search algorithms, generative models for networks, and connections with work in the areas of social networks and citation analysis.

Human Computer Interaction

INFO 640/COMM 640: Advanced Human Computer Interaction Design

3 credits, Prerequisites: graduate standing or permission of instructor.

Graduate-level readings and research supplementing COMM 440. This course focuses on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

Cognition

INFO 614/PSYCH 614: Cognitive Science

4 credits.

The course introduces the idea of cognition as information processing or computation, using examples from perception, attention and consciousness, memory, language, and thinking. Participants acquire conceptual tools that are essential for following the current thought on the nature of mind and its relationship to the brain. Additional weekly meetings review new and state of the art research articles in the field.

Social Aspects of Information

INFO 634/S&TS 634: Information Technology in Sociocultural Context

4 credits.

In this course, we will analyze information technology using historical, qualitative, and critical approaches. We will discuss questions such as: In what ways is information technology--often portrayed as radically new--actually deeply historical? How do information technologies represent and intervene in debates and struggles among people, communities, and institutions? How is the design of information technology tools entangled in the realms of law, politics, and commerce? In what ways are the social consequences of information technologies produced as much by the claims we make about the technologies as about the raw functionality of the tools themselves? This course will investigate these issues through the lenses of long-standing debates and current controversies.

Concentration and Minors

In addition to the above course requirements, the student is required to have a minor in another graduate field at Cornell. This will often be a closely related field, such as Cognitive Studies, Communication, Computer Science, Science & Technology Studies, Economics, Linguistics, Mathematics, Operations Research, Psychology, or Sociology.

Students from other PhD programs at Cornell are encouraged to minor in Information Science by taking 600-level courses from three of the concentrations, outside their own graduate field.

While not required, our current lists of recommended courses for each of the concentrations are included below.

Information Systems

CS 478/578 or 678: Machine Learning; CS 501: Software Engineering; CS 576/577 (a.k.a ECON 476/477): Decision Theory; ORIE 629: Foundations of Game Theory and Mechanism Design for Engineering Applications; CS 632: Advanced Database Systems; INFO 635: Applications of Information Science; INFO 648: Speech Synthesis; CS 672: Advanced Artificial Intelligence; CS 674: Natural Language Processing

Human Computer Interaction

DEA 651: Ergonomics, anthropometrics, biomechanics; DEA 670: Applied ergonomics methods; COMM 645: Seminar in Computer-Mediated Communication; COMM 650: Language and Technology; S&TS 652: Technologies of Communication

Cognition

Cogst 501: Issues in Biological Information Processing (this is the same as the 2-credit graduate section of Psych 614); PSYCH 530: Representation of Structure in Vision and Language; PSYCH 531: Topics in Cognitive Studies; PSYCH 616: Modeling Perception and Cognition

Social Aspects of Information

INFO 515: Culture, Law, and Politics of the Internet; S&TS 525: Seminar in the History of Technology ; S&TS 532: Inside Technology: The Social Construction of Technology; S&TS 631: Qualitative Research Methods for Studying Science; S&TS 652: Technologies of Communication; ECON 669: Economics of Information; CS 676/677: Reasoning about Knowledge/Uncertainty; INFO 740: Social & Economic Data; COMM 694/INFO 694: The Internet as a Social Phenomenon: Issues and Methods

Thesis

Students are expected to contribute original research and to make a thesis proposal by the end of their third year. Before making a thesis proposal, a Ph.D. committee will be formed with (at least, but typically) three members, one of whom will be a minor advisor, representing the required minor outside of Information Science. As part of the thesis proposal, the student will be required to demonstrate depth in two of the four concentrations within Information Science, sufficient to carry out fundamental research. These two concentrations will make up the student's major and minor concentration areas within Information Science. The student's Ph.D. committee will decide how this expertise will be evaluated.

Recently, the first Information Science committee has been formed, and the first evaluation (also known as the "A" exam) has been completed, which will likely set a precedent for future thesis proposal reviews. Its format was inspired by both the Computer Science Department's oral format and the Communication Department's written format.

The exam consisted of two components

1. The student gives a 45 minute presentation on completed (and ongoing) research and plans for future thesis work. This presentation is open to the public, who may ask questions. A further questioning period follows and is only open to the committee (and student). The research topic in our earliest case was knowledge management and interactive search in a digital library of mathematics.

2. One written question each from two of the three committee members, excluding the committee chair, is assigned to the student at least one month prior to the exam. The committee chair is expected to be more deeply involved with the work in the presentation. The question topics are intended to be related to the student's research, and serve also examine breadth by focusing on the expertise of the minor committee members. In our first and only case thus far, the two question responses were approximately 15 pages each and were about eye tracking applications in information science and adaptive user interfaces.

In addition to the required group of 600-level courses, the student's committee may require additional courses before approving the thesis proposal.

Following the A exam, the student is believed to be ready to fully devote time to his/her thesis. Approximately one year following the A exam, a thesis defense is planned, and a degree is granted with the successful defense and completion of the student's dissertation.

PRESENT DATA AND EXPERIENCES

Because of the very recent inception of the program, we have few statistics about student's progresses. Currently the program houses four students, one who has transferred from Computer Science, and three others who began the graduate program this past fall. The two males and two females each have a diverse and rich background: all had master's degrees prior to entering the program as well as some industry experience.

The most advanced graduate student in the program, for example, has chosen Information Systems as her major concentration, HCI as her minor concentration, and Cognitive Studies as her minor outside the field, having very nearly completed all the core requirements.

In its first year of existence, there are approximately 30 or so students officially affiliated with the undergraduate major, six of whom will graduate with a B.S. or B.A. in Information Science in May 2005.

STRUCTURAL MODEL

In addition to the details listed above, we wish to describe the unique outreach of the IS program across the university, and its placement with respect to other departments and colleges at Cornell. The information revolution together with the new academic and industrial demands that merge social and technical expertise motivated this outreach and are described in a faculty report by Huttenlocher et. al (1999). In particular, because of its multidisciplinary nature, Information Science is not simply a subfield of an existing field within one of Cornell's seven colleges (e.g. Arts & Sciences, Engineering); it instead impacts and benefits from disciplines that span the university's academic structures. As a result, it might have been difficult to find a home for the Information Science program.

Four existing structural models were initially considered to serve as the structure for such a program, and are described in Huttenlocher et. al. (1999):

1. A *department* that has the bulk of the expertise, with additional expertise in a few other departments. Many disciplines at Cornell operate this way, including Computer Science.

2. A *center or laboratory*, with participation from faculty in a number of departments, focused on research rather than education. The Theory Center at Cornell operates this way.

3. A *division* or other structure that cuts across departments and colleges, focused on research and education. The former Division of Biological Sciences at Cornell operated this way.

4. A *college or school*, offering undergraduate degrees, focused on both research and education. In the computing area, Carnegie-Mellon and Georgia Tech's Computer Science programs both operate this way.

As described in the report, none of these options best suited Cornell's mission or adequately supported the university-wide needs in the area of computing and information science. As a result, a new structure was created, called the Faculty of Computing and Information (FCI). "The mission of the FCI is to create broad-based programs of education and research that span the campus. Given the high student demand and the fast pace of change in this area we believe that there must be a particularly tight coupling of education and research. Thus a key part of our reasoning is that the FCI have both teaching and research missions." (Huttenlocher et al. 1999).

QUESTIONS

We include here some questions and issues that we are invested in addressing with respect to emerging graduate fields in Information Science and HCI.

Definition of the field and placement with respect to other fields and other university programs. There are clearly many strong ties between information science, HCI, computer science, cognitive studies, and others. There are also strong differences that can be overlooked, and distinctions can be ambiguous. We would like to share our philosophies on the ties and differences, and more so, hear from others on this topic.

Joint appointments for faculty and their interdisciplinary roles. Currently, faculty members in Information Science have joint appointments with another existing discipline at Cornell, such as computer science, science and technology studies, psychology, communication, and others. In particular, tenure cannot be granted by the Information Science program and must be obtained in the faculty member's "other" field. There are advantages and disadvantages to this appointment and tenure protocol, and it will be important to evaluate it both in the context of other interdisciplinary graduate programs and as our experiences with the new Information Science program expand.

Jobs & careers for graduating students. We are interested in discussing with colleagues at academic institutions and in industry, jobs and careers for graduate students in information science and HCI.

Interdisciplinary courses and course material. While information science is a largely interdisciplinary field, it is not best served by simply aggregating courses from multiple pre-existing fields. It is important to have targeted, core information science courses that are designed to match the philosophy and motivations of the program. The design of the appropriate course structure and materials continues to be of interest to us as the field continues to grow.

Physical space and interactions between students. In information science, more than in other traditional fields, thus far, we see PhD committees constructed of professors from various related fields. Thus, graduate students' advisors are often housed in different departments. What type of office space or environment would best encourage interaction between students in the program as well as with their advisors and minor committee members? Cornell has just adopted plans for a new information science building so space and environment are also of interested currently.

CONCLUSION

We are delighted to be part of and to share our experiences further with the Georgia Tech HCC digital library. [2]

More information about Cornell's graduate new program can be found at http://www.infosci.cornell.edu/grad/.

REFERENCES

1. Huttenlocher et. al. (1999) Cornell in the Information Age: Initial Report of the Task Force on Computing and Information Science, Cornell University Faculty Report

2. Georgia Tech Human Centered Computing Digital Library, http://hcc.cc.gatech.edu

ACKNOWLEDGEMENTS

Special thanks to all the members of the CIS Task Force, and also to Co-Director William Arms and Dean Robert Constable, each of whom have made tremendous efforts to the field, and have formed the vision described here.

ADDITIONAL COURSE SUPPLEMENTS

Additional course information such as course syllabi can be made available upon request to the authors.