Master of Science in Computing and Information Sciences

Concept Paper

Ph.D. Program

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Abstract

We propose a research-focused M.S. degree in Computing and Information Sciences that will develop graduates' research capabilities through the application of computational techniques to solve computing and domain-specific problems. Additionally, this program will support faculty research across the Golisano College. The program fits RIT's mission by developing and delivering innovative curriculum that will support research relevant to emerging technologies and social conditions. Graduates of the proposed M.S. program in Computing and Information Sciences will be highly employable in government, healthcare, and industrial research and development; those who wish to pursue a doctoral degree will be well prepared.

Description of the New Program

1. Overview and Justification of new program

This research-focused master's degree is designed to develop graduates who will become researchers and professionals in computing and interdisciplinary computational environments. Students in the program will work with faculty from any department within GCCIS, providing a wide variety of opportunities to participate in faculty research. Due to the interdisciplinary nature of the degree, the proposed M.S. program's curriculum parallels the first two years of Computing and Information Sciences Ph.D. program. As a result, this M.S. program will be able to:

1. identify talented graduates and provide a pathway to our interdisciplinary doctoral program.
2. support Golisano College faculty, including masters-prepared faculty, in research and scholarship to work on grants and publications.
3. connect M.S. and Ph.D. students in a scholarly environment.
4. allow a limited number of Ph.D. students who choose not to continue Ph.D. study to graduate with a M.S. degree upon finishing the M.S. program requirements.

The M.S. degree incorporates computing skills and interdisciplinary work. It provides graduates with research and intra-disciplinary skills (within the field of computing) and teaches students to work in an interdisciplinary application domain. Intra-disciplinary computing has three fundamental components: interaction (software technologies that facilitate the interaction between humans and computational entities), infrastructure (the integration of hardware, software and communication), and informatics (the techniques applied to the understanding of data-driven systems). Interdisciplinary research focuses on domain-specific computing in science, engineering, arts, humanities, and business, or the interaction between computing and non-computing disciplines. By working on problems from an interdisciplinary perspective, students will learn how to use computational techniques to solve domain specific problems in areas such as bio-medical informatics, environmental informatics, computational biology, astro-informatics, computational science and electronic commerce.

According to the US Bureau of Labor Statistics Occupational Outlook Handbook [1, 2], several occupations including Computer Scientists, Operations/Market Research Analysts, Healthcare workers, Geographers, Psychologists, and Environmental Scientists, are among the fastest growing careers that require a research oriented masters degree.

The proposed M.S. degree offers preparation for a broad range of research and development positions in government, academia, and industry, including computer scientists, management, domain specific specialists, and analysts. Graduates will be well prepared to help advance scientific technologies and development in computing and interdisciplinary areas.

This degree will require 30 semester-credits including intra-disciplinary computing courses specifically in the interaction, informatics, and infrastructure subareas. The degree also requires elective courses from an interdisciplinary domain area and faculty-guided, use-inspired thesis research throughout the program. Students who have demonstrated strong research fit and potential along with good academic standing during their M.S. studies may apply to be directly admitted to RIT's Ph.D. in Computing and Information Sciences program if they take and pass the PhD Research Potential Assessment.

Educational objectives include the ability to:
1. Describe and explain the general literature of the discipline of computing and information sciences.
2. Apply knowledge from the literature of a domain area.
3. Critically evaluate existing research in order to propose and execute viable research directions, strategies, methods, and evaluations.
4. Explain technical material via written reports and oral presentations.

Career outcomes include:
1. Employment in a position requiring mastery of concepts in computing and information sciences and the application of use-inspired research in a specific domain.
2. The ability to perform research that advances the discipline as a whole.
3. Preparation to continue studies in a doctoral program.

This program differs from the other computing M.S. programs as follows:
1. M.S. students in existing programs, even those on thesis track, only spend 1-2 semesters working with their advisers, while in this program students are required to work with their advisers through the entire duration of the program. They are also required to submit thesis-based paper(s) for publication.
2. It is more feasible for M.S. students in this program to move directly into the Ph.D. program since it addresses all of the required coursework due to its overlap with the Ph.D. program's curriculum.
3. The existing Golisano College M.S. programs are more career-focused graduate degrees while the proposed program offers a research-focused master's degree.
4. The curriculum of this program is designed to develop graduates who will become researchers and professionals in interdisciplinary computational environments through working with advisors and faculty members from interdisciplinary areas such as bio-medical informatics, environmental informatics, computational biology, astro-informatics, etc.

2. Summary of new program curriculum

This program's flexible course scheduling will allow entry into the program during any semester and allow students to study full time (about 2 years) or part-time. The curriculum is comprised of the following areas:

	Description	CHs
Foundation Courses	Three Ph.D. core courses: *Research Foundations*, *Quantitative Foundations*, and *Cyber-infrastructure Foundations* provide methodology, background knowledge, and foundational skills.	9
Core Electives	Students choose two *I-courses*, from the categories of **I**nteraction, **I**nfrastructure, and **I**nformatics that provide an intra-disciplinary approach to computing foundations. Sample courses are shown in Table 1 below.	6
Domain Area Electives	Two graduate courses, approved by the advisor and committee members and selected from across the breadth of graduate courses offered at RIT provide interdisciplinary computational knowledge in the students' thesis research area.	6
Thesis and Research	Students will be required to conduct use-inspired research in computing or in a specific domain involving knowledge of interaction, informatics, and infrastructure. Students will also be required to submit their thesis work to a peer-reviewed conference or journal for publication	9
TOTAL		30

Table 1. Program Curriculum

The following table lists examples of the I-courses.

INTERACTION	INFRASTRUCTURE	INFORMATICS
Current Topics in Human Computer Interaction	High Performance Architectures	Advanced Computer Vision
Global Illumination	Connectivity	Pattern Recognition
Agent-Based and Cognitive Modeling	Computing and Information Modeling and Simulation	Statistical Machine Learning

Table 2. I-Courses Examples

Fit with RIT Mission and Strategy

The M.S. in Computing and Information Sciences emphasizes innovative research in both computing and interdisciplinary domains, which fulfills the goals of the RIT mission statement: "We develop and deliver curricula and advance scholarship and research relevant to emerging technologies and social conditions. Teaching, learning, scholarship, research, innovation, and leadership development for promoting student success are our central enterprises."

The proposed M.S. program, by design, integrates research with M.S. education and offers great flexibility and value to those who wish to study in emerging, computationally-intensive areas, especially those in which research programs do not yet

exist or where the ability to span multiple domains of expertise is vital.

Synergy with Other Programs

The M.S. in Computing and Information Sciences will complement the existing graduate programs in the Golisano College in providing and promoting research in computing and domain specific areas. It will be greatly beneficial in sharing research ideas, opportunities, projects, resources, facilities, and faculty. It will also produce talented researchers who are prepared to enter Ph.D. programs.

While faculty mentors play a crucial role in the success of graduate students, the graduate students from this program will also assist faculty in their research and scholarship since the students are required to conduct and submit their research work for publication. As the Golisano College puts more emphasis on supporting research through externally funded grants, access to qualified graduate students is a crucial step for faculty members to fulfill their research goals.

The interdisciplinary nature of this program focuses on development and support of computing principles to enhance capabilities within one or more domains, which will promote integration of research from a wide variety of fields and will encourage collaboration with other M.S. degrees in the Golisano College and other involved colleges.

Administrative Structure for the New Program

The M.S. in Computing and Information Sciences will be administered by the Ph.D. Program in the Golisano College of Computing and Information Sciences.

This program shares all tenured and tenure-track faculty in the Golisano College as well as faculty from other colleges who are affiliated with the Ph.D. program. A faculty member with his/her needs in research and scholarship will submit a request to the Ph.D. enrollment committee indicating his/her research interests, student qualifications, and mentoring plan. The admission committee will do the initial screening to ensure minimum qualifications of students, while interested faculty will make final selections from the qualified pool through conversations and interactions with the candidates.

Enrollment Management Expectations and Sustainment

It is expected that this degree will attract students who are interested in acquiring a Master's degree with the expectation of continuing into a doctoral program or interested in acquiring a terminal Master's degree with the expectation of obtaining research-based employment.

The admission requirements for the M.S. program are the same as the Ph.D. program. A Baccalaureate degree or equivalent degree in a computing-related discipline is required. We seek students from a wide variety of disciplines who have sufficient computing and mathematical backgrounds and strong records of academic achievement, as indicated by official transcripts.

We estimate that about 5 M.S. students will be accepted to this program each year in the initial stage. In a steady state, we expect to accept about 10 M.S. students per year. Based

on enrollment statistics data from previous years, the Ph.D. program has received 80-100 applicants each year with 1/3 of the candidates holding a Bachelor's degree. Since the Ph.D. program can only support 8-9 full-time Ph.D. students annually under the current Ph.D. budget, it is likely that some of those applicants will be interested in the M.S. program as a means of preparing for further study. Although we will not have full scholarships for the M.S program, we expect that the standard M.S. tuition discount will be an incentive to applicants.

With faculty's support and the stimulating research environment and atmosphere in the Ph.D. program, the M.S. students will be well prepared from courses and research to finish the degree and pursue their future endeavors.

Impact on Resources

There is no significant impact on resources for this program.
- This program will use the same library resources, computing labs, and support personnel within the Golisano College as the Ph.D. program.
- The Ph.D. admission committee will be responsible to accept the M.S. students.
- All the M.S. required and elective courses are shared with the Ph.D. curriculum. The current enrollment for the Ph.D. courses is usually less than 10 students. To support this M.S. program, the Ph.D. class sizes may be increased to 15 at the beginning stage.
- M.S. students will have a Golisano College faculty or Ph.D. program-affiliated faculty as their instructors and thesis advisors.
- The Director of the Ph.D. program will also function as the M.S. program director.

Conclusion

The M.S. in Computing and Information Sciences will complement the existing graduate programs in the Golisano College by developing research focused graduates who are prepared to help advance scientific technology and development in computing and interdisciplinary areas. This program will be unique among other computing M.S. programs with its curriculum and its interdisciplinary-focused research.

Reference

[1] US Bureau of Labor Statistics Occupational Outlook Handbook, http://www.bls.gov/ooh/

[2] Top Careers for masters Degrees, http://www.bestmastersprograms.org/top-careers-for-masters-degrees/