

Program Change Request

New Program Proposal

Date Submitted: 11/05/15 1:25 am

Viewing: : **Computer Science (MS)**

Last edit: 11/17/15 10:28 am

Changes proposed by: 1864314

In Workflow

1. COMPSCI Chair
2. LS Curriculum Committee Secretary
3. LS Curriculum Chair
4. LS Dean
5. Graduate Council Secretary
6. Graduate Council
7. PROVOST AVC
8. Registrar

Sponsor(s)	Sponsor Name	College	Department
	Zachary Oster	LS	COMPSCI
	Jiazhen Zhou	LS	COMPSCI
	Lopa Mukherjee	LS	COMPSCI
	Hien Nguyen	LS	COMPSCI
	Cheng Thao	LS	COMPSCI

Approval Path

1. 11/05/15 7:48 am
Athula Gunawardena (gunawara): Approved for COMPSCI Chair
2. 11/17/15 3:02 pm
Joan Fox-Drake (foxj): Approved for LS Curriculum Committee Secretary
3. 11/18/15 9:32 am
Elizabeth Hachten (hachtene): Approved for LS Curriculum Chair
4. 11/18/15 5:08 pm
David Travis (travisd): Approved for LS Dean

Program title: Computer Science (MS)
 Program Code:
 Department: Computer Science
 College: Letters & Sciences
 Academic level: Graduate
 Program type: Graduate Program

Intent to plan has been approved: Yes

Primary degree type: MS
 Other degree type(s):
 Number units in program: 30
 Other departments consulted:

Department(S)
Information Technology & Supply Chain Management

Catalog description of the program

Computer Science (M.S.)

The Master of Science degree in Computer Science prepares students for leadership roles in the planning, development, testing, validation, and maintenance of software systems in a range of applied areas. Students in the program acquire a thorough understanding of the essential principles of modern computing, which provide a foundation for new discoveries in the field. Building on this foundation, students develop cutting-edge technical skills, strong problem analysis abilities, and project experiences that prepare them for careers in growing industries such as cloud computing, big data, healthcare, biotechnology, advanced manufacturing, and financial services.

Code	Course List	Title	Units
Core Courses			15
COMPSCI 724	Operating Systems in Practice		
COMPSCI 732	Machine Learning		
COMPSCI 733	Advanced Algorithm Design and Analysis		
COMPSCI 766	Advanced Databases		
COMPSCI 776	Advanced Software Engineering		
Elective Courses			9-12
Select 9-12 units of COMPSCI courses numbered 700 or above from the following list:			
COMPSCI 764	Cloud Computing		
COMPSCI 767	Big Data and Data Mining		
COMPSCI 735	Optimization: Techniques and Applications		
COMPSCI 736	Image Processing and Computer Vision		
COMPSCI 762	Cryptography and Cloud Security		
COMPSCI 777	Software Testing		
COMPSCI 778	Software Specification and Verification		

Code	Title	Units
COMPSCI 796	Special Topics (Repeatable)	
Capstone: Select 3-6 total units from:		3-6
COMPSCI 789	Capstone Project	
COMPSCI 799	Thesis Research	
Total Units		30

Students pursuing the M.S. degree in Computer Science may declare either the applied research project option or the thesis option to fulfill their capstone requirement for graduation.

- Students who choose the thesis option must earn at least 3 units of COMPSCI 799 credit.
- Students who choose the applied research project option must earn at least 3 units of COMPSCI 789 credit.

Provide a concise rationale for the selection of courses in this program.

In the United States, there is no uniform curriculum guideline for a master of science program in Computer Science (CS). The core courses we chose are common to many CS M.S. programs in the United States. These courses are intended to provide essential foundational knowledge and cultivate essential skill development appropriate to a masters-level program in CS. Targeted areas include:

- Algorithm design and application: COMPSCI 732* Machine Learning, COMPSCI 733* Advanced Algorithm Design and Analysis
- Operating system design and function: COMPSCI 724* Operating Systems in Practice
- Database implementation and management: COMPSCI 766* Advanced Databases
- Software design and development techniques: COMPSCI 776* Advanced Software Engineering

Several of our proposed elective courses cover a suite of prominent, emerging fields with high talent demand by industry, as reflected in the industry survey feedback that we collected in May 2015:

- COMPSCI 736* Image Processing and Computer Vision
- COMPSCI 764* Cloud Computing
- COMPSCI 767* Big Data and Data Mining

The rest of the proposed elective courses cover more traditional areas of computer science that support a high level of computation research or practice:

- COMPSCI 735* Optimization: Techniques and Applications
- COMPSCI 777* Software Testing
- COMPSCI 778* Software Specification and Verification

All students graduating from the program must select either the Applied Research Project or Thesis option for graduation.

- COMPSCI 789* Capstone Project: provides the Applied Research Project option for students who prefer to complete a software development project with a more limited research component
- COMPSCI 799* Thesis Research: provides the Thesis option for students who prefer a more research-intensive capstone experience, with less specific focus on software development

All courses being proposed for inclusion in this program are new courses. All of these courses are being proposed simultaneously with this program except for COMPSCI 799 Thesis Research, which uses a university-wide course number.

Student learning outcomes for the program

(what students should know and be able to do upon completion)

Graduates with a Master of Science degree in Computer Science from UW-Whitewater will be able to:

1. Frame a real-world problem such that it can be addressed computationally.
2. Apply theoretical and empirical evaluation techniques to identify and design an appropriate computational solution for a problem.
3. Build, test, and document software and systems that are robust, reliable, and maintainable.
4. Evaluate a computer-based system and its components with respect to correctness, efficiency, cost, and possible harmful effects.
5. Work effectively in teams to design and implement software systems, manage conflicts, optimize resource usage, and meet deadlines.
6. Communicate effectively with colleagues and stakeholders across disciplines.
7. Learn emerging concepts and acquire new skills independently, connecting them to previous knowledge.

Plan for assessing the program's student learning outcomes

Please see the attachment in "Other Supporting Documents".

Select any baccalaureate learning outcomes emphasized in the program and those assessed:

Rationale for program:

Justification for request

Organizations in many industries rely on the newest tools and methods from computer science, especially from emerging computer science fields such as cloud computing, big data, bioinformatics, and financial engineering. Compared with the B.S. degree in computer science, an M.S. degree offers substantial advantages including wider and more in-depth knowledge, technical leadership abilities, better critical thinking skills, and better ability to handle interdisciplinary problems.

To support the UWW mission in assisting economic development in southern Wisconsin, the Department of Computer Science has been actively building partnerships with local industries through advisory board meetings, connections with the Whitewater University Technology Park and especially the Innovation Center, and relationships with employers that have hired or showed strong interest in our graduates. During this process, we received increasingly intensive requests for M.S. graduates that will take technical leadership roles and help regional businesses to cope with growth needs in emerging computing-related areas (see the market demand section for more details). On the other hand, we have seen strong growth in both quantity and quality from our undergraduate program in the past few years. Our current students have expressed strong interest in a master's program built on the current undergraduate program that will help elevate them to a new level in their future career.

Based on these needs, we propose a 30 credit program composed of core courses, elective courses in emerging Computer Science fields, and capstone projects that will prepare students for a promising career in computing-related areas. To attract top-performing undergraduate computer science students at UW-Whitewater and other schools, the program will offer an accelerated and tuition-saving 4+1 program option that allows well-qualified undergraduates to take up to 9 credits of graduate Computer Science coursework while completing their bachelor's degrees. In addition, an industry fellowship program will also be available, where M.S. students work 20 hours with our partners in industry while taking 6 credits per semester. This fellowship program will provide funding and practical experience for students who have financial need while still allowing them to complete the program within five terms in two years. It will be a tool for recruiting and retaining highly proficient technical professionals in southern Wisconsin, which will help businesses in the region to grow.

Assessment Data	We have conducted a survey of students in the current undergraduate computer science program at UWW. Also, we conducted a survey of local industry employers. Detailed data are in the student demand and market demand section right below.
Student demand	<p>In a survey of computer science alumni and current students at UW-Whitewater, 43 out of 44 respondents showed strong interest in this M.S. program. In addition, 75% indicated they would definitely enroll in the M.S. program if the 4+1 option is provided, and a majority are intrigued by the industry-fellowship option.</p> <p>The survey results also revealed demand for a wide variety of specialty areas in computer science. While respondents are strongly interested in traditional areas such as software engineering, networking and security, artificial intelligence, and fundamental computer science, they are also excited about emerging areas including big data, bioinformatics, financial engineering, and game programming. These specialty demands are well matched by the background and research interests of current UW-Whitewater faculty members in computer science.</p>
Market demand for graduates	<p>Organizations in many industries rely on the newest tools and methods from computer science, especially from emerging computer science fields such as cloud computing, big data, bioinformatics, and financial engineering. The U.S. Bureau of Labor Statistics projects that employment of software developers and managers will grow by 30% between 2010 and 2020 (BLS, Occupational Outlook Handbook, 2012-13 edition) which is much faster than average job market growth. A 2012 Microsoft report indicated that in the United States alone there will be a gap of 80,000 employees in the computing-related area each year between 2010 and 2020, and there is little reason to believe that the need for employees with advanced technical skills will diminish at any point in coming decades.</p> <p>Regarding the local market, we have conducted an industry survey in April 2015. In total, we received responses from 16 companies. The list of companies that responded includes both small business and big companies, most of them from southern Wisconsin. Among them, 81% indicated that it was somewhat hard or very hard to find qualified job candidates with master's degrees in computer science, 63% were strongly interested in collaborating with us in education and training, and 88% expressed a strong intent to offer industry fellowships to our future master's students. Furthermore, a supporting letter from the Whitewater University Technology Park vice president showed that many companies, including several from Illinois, plan to move into the Technology Park in part because of the master's program we are planning to launch.</p>

Relation of the program to other programs:

On campus	<p>No other program at UW-Whitewater provides graduate-level education in software development. The IT Management emphasis within the M.B.A. program "[p]repares business professionals to effectively manage technology, systems, projects and IT personnel", according to its catalog description. In contrast, the Computer Science M.S. program will prepare software development professionals for leadership roles in developing, testing, improving, and maintaining software.</p> <p>We intend to create a "4+1" program to allow well-qualified students in our undergraduate Computer Science program to complete the M.S. degree in Computer Science within one year after graduation with the B.S. or B.A. degree.</p>
In the UW system	<p>UW-Madison and UW-Milwaukee offer research-oriented M.S. and Ph.D. degrees in computer science. UW-Madison now offers a professional option for working professionals who want to complete an M.S. degree in computer science within two years. UW-Milwaukee also offers an industry-oriented M.S.</p>

degree and allows well-qualified undergraduates to take up to 6 credits of graduate work while completing their B.S. degree. UW-Platteville offers a joint international M.S. in computer science with universities in Germany and Australia. UW-River Falls is planning a M.S. for working professionals in northwestern Wisconsin and nearby areas of Minnesota. UW-La Crosse offers a M.S. in software engineering.

Although UW-Parkside and UW-Stout do offer master's degrees in computing-related fields, these programs divide their coverage between material that is traditionally included in an M.S. program in computer science and more business-oriented material that is traditionally considered part of the information technology (IT) or management information systems (MIS) fields.

However, the program that we propose is keenly needed to better serve the SE Wisconsin area for the following reasons:

- 1) We focus on emerging computing areas such as computational financial engineering, big data, and cloud computing.
- 2) Due to the geographic proximity and transportation convenience, the addition of our master's program will greatly enhance the ability for computing-related companies located outside the Madison and Milwaukee areas, especially those from Whitewater, Janesville, and Betoit, to collaborate with the UW System for workforce development and economic development. This geographic proximity is especially important for startups that the Whitewater Innovation Center and Technology Park has attracted (and will attract).

In the region

Several non-UW System institutions within 100 miles of UW-Whitewater, including Marquette University and Northern Illinois University, offer M.S. and Ph.D. degrees in computer science.

How is this proposal related to:

Institutional mission	The Computer Science program at UW-Whitewater has been the most rapidly growing undergraduate program on campus for the past three years and has close to 300 majors. An M.S. program in Computer Science will allow UW-Whitewater to provide a graduate degree that builds on the strength of its burgeoning undergraduate Computer Science program and will support the campus mission by preparing graduates for rewarding careers in business, education, communication, and other settings.
Campus strategic plan	Aside from the clear connection to the "Programs and Learning" area of the university's strategic plan, the Computer Science M.S. program will contribute toward the "Educator-Scholar Community" and "Regional Engagement" areas. Several software-related companies in the Whitewater area have expressed interest in developing new corporate-research partnerships and growing existing partnerships that will benefit from our graduate students' expertise. This will help grow the area's high-tech economy while providing students with funding and experience working on commercial software projects. To the extent that our program enrolls international students (as many graduate programs in computer science do), it will also contribute toward the "Diversity and Global Perspectives" objective.
College/Department mission and strategic plan	The mission of the College of Letters and Sciences is achieved, in part, as "[f]aculty and staff create, expand, and disseminate knowledge and understanding through research, scholarship, and creative work, with students as essential participants and contributors." Students pursuing the M.S. degree in Computer Science will be able (and expected) to participate in the research efforts of the Computer Science faculty at a more advanced level than our undergraduate students. Further, as the College mission statement goes on to say, "[t]he College seeks to use the knowledge and expertise of faculty and students to improve society by participating in programs that meet the needs and engage the interests of the University campus and the broader community." Our graduate students' work with area businesses and other organizations will help accomplish this objective.

Resources needed to support the program:

Staffing?	Yes
	<p>Please explain:</p> <p>We anticipate using a self-supporting budget model for the new master's program and hiring one or two additional faculty or academic staff to support the M.S. program.</p> <p>We may need additional lab staff to support open labs so that students can use special software for their courses or research projects.</p>
Equipment?	No
	<p>Please explain:</p> <p>Current computing equipment in McGraw 115, McGraw 122, and Hyer 210, along with the existing Computer Science servers, should be enough to support the master's program.</p>
Library?	Yes

	Please explain:	A new subscription to the ACM Digital Library might be needed to support MS-level research and course study for this program. Subscribing to this database might indirectly benefit the MAGD and Information Technology programs, in addition to fulfilling the needs of this program.
Technology?	Yes	
	Please explain:	* VMware and cloud service subscriptions might be needed for the cloud computing (COMPSCI 764) course. * Matlab software might be needed for the image processing (COMPSCI 736) course. * GAMS and CPLEX software might be needed for the optimization (COMPSCI 735) course.
Space/Facilities?	Yes	
	Please explain:	There will be a need for office space and supplies for new faculty and a small number of graduate assistants.
Other?	No	

Projected source of resources :

Reallocation	The present undergraduate curriculum requires students to select elective courses from two out of four emphasis areas. We plan to conduct undergraduate curriculum revisions in Fall 2016 to allow students more flexibility with upper-level electives. This will release faculty time to teach a few graduate courses without reducing the quality of the undergraduate program.
Request for new funds	There is no request for new funds. The department chair and two coauthors of the proposal had a budget planning meeting in September with Vice Chancellor for administration affairs Jeff Arnold, Interim Provost John Stone, Associate Vice Chancellor Greg Cook, Graduate School Interim Dean Seth Meisel, and College of Letters and Sciences Dean David Travis. The group came to a consensus that the new MS program in Computer Science will use a self-supporting (cost-recovery) model together with an augmented tuition plan. It is expected to support one tenure-track faculty position and one academic staff position with the program's revenue.
External funds	Mainly from the tuition income. The tuition plan will be decided based on anticipated enrollment, cost, and related factors.
Other (Please explain)	N/A
Other Comments	
Attach a 4-year rotation of course offerings for this program	MS-CS-Course-Rotation-2015-10-25-B.docx
Other Supporting Documents	AssesmentPlan_SLO_Masters.docx
Course Reviewer Comments	1021755[Tue, 17 Nov 2015 16:28:28 GMT]Clarify that students in the 4+1 program (here and at UWM) can take graduate coursework while finishing their BA/BS degree; undergrad credits cannot be used for grad work. Per Zach Oster, from discussion at CCC 11/12/15.-jfd, Curric Secy

Key: 384

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