Contact: Diana Gonzalez

REQUEST FOR NEW PROGRAM AT THE UNIVERSITY OF IOWA: BACHELOR OF SCIENCE PROGRAM IN ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING

Action Requested: Consider approval of the request by the University of Iowa to establish a new Bachelor of Science Program in Engineering in Computer Science and Engineering in the Department of Electrical and Computer Engineering in the College of Engineering.

Executive Summary: The proposed program will provide educational opportunities for students interested in both computer science and engineering. This proposal was reviewed by the Board Office and the Council of Provosts and is recommended for approval. No concerns were raised when it was presented to the Iowa Coordinating Council for Post-High School Education. The proposed program addresses the Board of Regents Strategic Plan priorities to "provide educational excellence and impact as well as economic development and vitality" and Goal #8 – "Iowa's public universities and special schools shall be increasingly efficient and productive."

Background:

- Description of proposed program. The proposed program will provide skills in computer science with the problem-solving and critical thinking skills in engineering. The proposed program will require course work in computer science, electrical and computer engineering, mathematics, statistics, and the engineering core. Required curricular elements include a capstone project course sequence, extensive laboratory components, a general education component from the Humanities and Social Sciences, and leadership/team-building experiences. The program will prepare students for a variety of emerging careers in industry and further advanced study in the areas requiring computational and engineering skills.

- Academic objectives. The proposed program will require a strong theoretical foundation of computer science with rigorous training in engineering problem solving. It will provide a degree designation that matches the curriculum and career objectives of computer science oriented students in the ECE computer track and will allow interested computer science students to incorporate engineering coursework into their degree program. The ECE computer track will continue to serve students who have more traditional electrical engineering interests.

- Need for proposed program. The proposed program will build on the current offerings at the university and bridge two of the most rapidly programs in the university. The Department of Electrical and Computer Engineering (ECE) offers a computer track in the Electrical Engineering program with approximately 300 students. The Computer Science (CS Department is also experiencing rapid growth with an undergraduate enrollment of 619 majors, 262 of whom are pursuing the bachelor of science degree in computer science, 243 the bachelor of arts in computer science, and 114 in the bachelor of arts or bachelor of science in informatics.

Most of the ECE computer track students have a strong interest in augmenting their engineering skills with software and computer science-related expertise because all students in the ECE computer track earn a minor in computer science and most take multiple elective computer science courses. The proposed program will allow computer science students to access upper-division engineering elective courses. The popularity of these programs, and the need for the proposed program arise from the fact that there is employer demand for new graduates whose background combine computer science and engineering skills.

- Link to institutional strategic plan. SUI's strategic plan stresses the importance of "cross-college scholarship." The university is committed to using these to "address major societal challenges" and "areas of national or global need and significance that require the collaborative efforts of multiple disciplines," including computer science and engineering. This proposed program is interdisciplinary, bringing together faculty from the Department of Computer Science in the College of Liberal Arts and Sciences and from the Department of Electrical and Computer Engineering in the College of Engineering.

  The proposed program focuses on the College of Engineering's Strategic Plan in two areas: (1) It continues the College's tradition of interdisciplinary and cross college education and scholarship; (2) It serves students better by providing a degree designation which properly indicates that they have combined a strong theoretical foundation of computer science with rigorous training in engineering problem solving and are prepared to address the nation's most important challenges. This program will better serve existing students, attract more students into the computer science and engineering field, and enhance the technical workforce for strategically important Iowa industries, including information technology, manufacturing, power industries, insurance, and financial services.

- Relationship to existing programs at SUI. The College of Liberal Arts and Sciences offers a Bachelor of Science and a Bachelor of Arts degree in Computer Science, and a Bachelor of Science and Bachelor of Arts degree in Informatics. The College of Engineering offers a Bachelor of Science degree in Electrical Engineering (EE) with two tracks. The proposed program is an alternative to the current EE Computer Track curriculum that provides extensive training in theoretical and applied areas of computer science while retaining a strong engineering focus. The proposed program will also provide a strong emphasis on team-based problem solving skills. The intent of this program is to serve students who have an interest in both computer science and engineering. It will give faculty of both colleges additional opportunities to work collaboratively.

- Relationship to existing programs at other colleges and universities. The proposed program is different from existing programs offered in the state. The three Regent universities offer a liberal arts based program in computer science. UNI offers a Bachelor of Science and a Bachelor of Arts degree in Computer Science in the College of Humanities, Arts and Science; this program does not include engineering training. ISU offers a Bachelor of Science program in Computer Science in the College of Liberal Arts and Sciences. ISU's Department of Electrical and Computer Engineering offers a Bachelor of Science program in Computer Engineering and with the Department of Computer Science offers a Bachelor of Science program in Software Engineering.

- Unique features. The Colleges of Engineering and Liberal Arts and Sciences have a history of collaboration and both support the proposed program. The ECE and CS departments have a relationship that includes cross-listed courses with shared teaching responsibilities. The ECE computer track students are required to complete a minimum of three computer science courses and most take additional elective computer science courses. All ECE computer track students earn a minor in computer science.

- Resources. The proposed program will use existing classrooms, computer laboratory facilities and personnel of the ECE and CS departments. The curriculum will use existing CS and ECE courses. The proposed program will be administratively housed in the ECE department and will use existing departmental and collegiate administrative resources.

- Student demand. The enrollment in the ECE department has doubled during the last five years; the majority of the growth has been in the computer track. The Computer Science program has tripled its enrollment during the same period. The university anticipates that this trend will continue for the foreseeable future and that the proposed program will attract high quality students.

- Duplication. The university proposes that the program is sufficiently different from the programs offered at Iowa State University and that there is significant demand for the program to warrant its development. The proposed program is designed to be more computer science oriented than ISU's Computer Engineering curriculum. It includes required coursework in programming language foundations and computer science theory that are not required by ISU program. It also includes one more required programming course than ISU's program. These courses are necessary for components of CAC accreditation.

  The proposed program is more computer science oriented than ISU's Software Engineering curriculum. It required more basic science, math and core engineering work (circuits, thermodynamics, statics, electronics, and linear systems). The proposed program includes required coursework in programing language foundations and computer science theory that are not required by ISU's program. ISU students have an option to complete a course in embedded systems but are not required to do so. The proposed program requires that all students take embedded systems. It does not include coverage of software project management or other specific software engineering topics included in ISU's curriculum.

  The proposed program is different from the ISU Computer Science program because it includes all engineering core requirements as well as coursework in electronic circuits, linear systems, embedded systems, and a year-long capstone design experience which are not required in ISU's program.

- Workforce need/demand. The demand by Iowa businesses for graduates in computer-related fields currently exceeds available supply. The recent Battelle Institute Iowa Economic Development Report notes that Iowa ranks last among a set of 15 benchmark states in post-secondary degrees in STEM-related areas. The report states: "It suggest that Iowa's current economic potential is being held back by shortages of qualified workforce. Employers in the Synchronist surveys commonly identify the following middle- and high-skilled occupations in high demand with talent shortages in the state – information technology professionals…"

"To achieve the level of economic success desired, Iowa must generate and attract the skilled workforce demanded by Iowa's businesses. While the state can work toward attract of workers from elsewhere, its future lies in the current and future generations of Iowa students. Improvements to Iowa's education system, development of career awareness and training, and additional marketing of the viable career paths offered in Iowa will create a robust and predictable pipeline of talent ensuring the state's businesses can compete at the highest levels."[1]

As the state addresses the workforce development recommendations of the Battelle Report, the university believes that the Regent universities should provide as many opportunities as possible for students to pursue careers in information technology-related areas and believes that the proposed program will not adversely affect enrollments in any existing programs.

There is a national need for computer science and engineering graduates as pointed out by Mark Zuckerberg, founder of Facebook, who said, "Our policy at Facebook is literally to hire as many talented engineers as we can find. There just aren't enough people who are trained and have these skills today."

BSE graduates of the Department of Electrical and Computer Engineering received the highest average salary of any major at the university - $63,212 for the Class of 2014 graduates. Computer Science graduates received an average salary of $53,333. Placement rates for both majors ranged from 96% to 100% during the last two years.

The university hosts an Engineering Career Fair twice each year to help match employers and students for internships, co-ops, and permanent positions. Sixty-two percent of the companies that attended the fair during 2014-2015 recruited electrical and computer engineering or computer science majors, which exceeded the number of graduates in this area produced by the College of Engineering. There are typically more positions available than qualified students to fill them.

Many companies from different industries hire students; most sponsor paid internships as a way to recruit students and to provide practical training to augment the curriculum. Between 2010 and 2015, 115 companies hired electric and computer engineering majors for internships and co-ops. The average salaries for ECE internships and co-ops are approximately $18-$19/hour.

Job forecasts indicate that demand for software and IT professionals will remain strong and, in fact, grow even stronger, for the foreseeable future. For instance, the U.S. Bureau of Labor Statistics predicts that the demand for B.S. level software developers will grow by 17% in the 10-year period from 2014-2024, much faster than the average for all occupations[2]. In the broader context of hardware/software systems, such as the burgeoning "Internet of Things" (IoT), the forecasts are even more significant. As reported recently in Forbes Magazine, Cisco estimates that IoT will create $19 trillion in new economic value by the year 2020[3]. VisionMobile predicts that this massive growth will spur a 15-fold increase in the demand for IoT developers by 2020[4].

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[1] http://www.iowaeconomicdevleopment.com/battelle
[2] Bureau of Labor Statistics Occupational Outlook Handbook, http://bis.gov
[3] http://www.forbes.com/sites/gilpress/2014/08/22/internet-of-things-by-the-numbers-market-estimates-and-forecasts/#6829e35e2dc9
[4] http://vmob.me/IoT

- Consultation with representatives of other programs. The university indicated that no consultations occurred.

- Letters of support. No letters of support were provided.

- Cost. No new courses are anticipated for the proposed program because the coursework will be drawn from existing courses taught by the Department of Electrical and Computer Engineering and Computer Science. The proposed program will be administered by the Department of Electrical and Computer Engineering jointly with the Department of Computer Science. Faculty will serve as student advisors and mentors. Therefore, no additional expenses are anticipated for instruction, advising, or lab space.

- Projected enrollment. The enrollment is expected to be 300 students during year one, increasing to 600 by year seven.

- Anticipated sources of students. Initially, some students will enter the program from the current computer track in ECE and from CS. The proposed program is expected to attract additional students interested in an engineering-based computer science program.

- Articulation agreement. The proposed program will be covered by existing articulation agreements. The College of Engineering has course transfer guides and/or articulation agreements with more than 40 community colleges and universities.[5] These agreements will apply to courses required by the proposed program. New courses developed for the program will be evaluated for equivalence with courses offered by these institutions and on a case-by-case basis as requested by incoming students.

- Off-campus delivery. The proposed program will be offered on campus.

- Accreditation. The proposed program will apply for accreditation from both the Engineering Accreditation Commission (EAC) and the Computing Accreditation Commission (CAC) of ABET. The curriculum as designed to meet the criteria both commissions.

- Opportunities for internships. The proposed program will provide opportunities for internships throughout the program.

- Marketing plan. None was provided.

- Evaluation plan. None was provided.

- Advisory boards. The proposed program was presented to the College of Engineering Advisory Board and the Advisory Board of the Department of Electrical and Computer Engineering.[6] Both boards were supportive of the proposed program. The members of the board include Rockwell Collins; John Deere; Amazon; DuPont; Caterpillar; Alliant; Accenture; Alcoa; Siemens; Healthcare-Diagnostics; Shive-Hattery; Emerson Process Management; Boyd Industry, Pella; and Stanley Consultant.

[5] http://www.engineering.uiowa.edu/future-students/transfer-students
[6] http://www.engineering.uiwowa.edu/ece/people/advisory-board-ece

- Date of implementation. Creation of the proposed program will become effective upon approval by the Board of Regents and will be included in the University's General Catalog. The anticipated implementation date is Fall 2016.

Computer Science and Engineering – Proposed Curriculum

1st Year	Session	Course	Course Name	SH	P: Prerequisite; C: Corequisite
	F/S	Math 1550 (22M:031)	Engineering Math I: Single Variable Calculus	4	P: HS Algebra & Trigonometry; Score of 80 on ALEKS
	F	ENGR:1100 (059:005)	Engineering Problem Solving I	3	
	ALL	CHEM:1110(004:011)	Principles of Chemistry I	4	
	ALL	RHET:1030 (010:003)	Rhetoric	4	
	F	ENGR:1000 (059:090)	Engr Success for First Year Students	1	First Semester Standing
			Total	16	
	F/S	MATH1560 (22M:032)	Engineering Math II: Multi-Variable Calculus	4	P: MATH 1550 (22M:031)
	F/S	CS:1210 (22C:016)	Computer Science I	3	C: MATH:1550 (22M:031)
	ALL	PHYS:1611 (029:081)	Introductory Physics I	4	C: MATH:1550 (22M:031)
	ALL	MATH:2550(22M:033)	Engineering Math III: Matrix Algebra	2	P: MATH:1550 (22M:031)
	ALL		General Education Component #1	3	
2nd Year			TOTAL	16	
	ALL	MATH2560(22M:034)	Engineering Math IV: Differential Equations	3	P:MATH:1560(22M:032):MATH 2550(22M:033)
	F/S	PHYS:1612 (029:082)	Introductory Physics II	4	P:PHYS:1611(029:081); C:MATH:1560(22M:032)
	ALL	ENGR:2110 (059:007)	Engineering Fundamentals I: Statics	2	P:MATH:1550(22M:031); C:MATH1560(22M:032); C:PHYS:1611(029:081)
	F/S	ENGR:2120(059:008)	Engineering Fundamentals II: Electrical Circuits	3	C:MATH:2560(22M:034)
	ALL	ENGR:2130(059:009)	Engineering Fundamentals III: Thermodynamics	3	P:CHEM:1110(004:011); PHYS:1611(029:081) C:MATH:1560 (22M:032)
			Total	15	
	ALL	CS:2210(22C:019)	Discrete Structures	3	C: ENGR: 2730(057:017)
	S	ECE:2400(055:040)	Linear Systems I	3	P: ENGR:2120(059:008); MATH2560(22M:034)
	S	ECE:2410 (055:018)	Principles of Electronic Instrumentation	4	P: PHYS:1612 (029:082); ENGR:2120(059:008)
	F/S	ENGR:2730(057:017)	Computers in Engineering	3	P: ENGR:1300(059:006)
	ALL		General Education Component #2	3	
3rd Year			Total	16	
	F/S	STAT:2020(22S:039)	Probability and Stat for Engineering & Phys Sci	3	P:MATH:1560 (22M:032)
	F	ECE:3320 (055:032)	Intro to Digital Design	3	Sophomore Status
	ALL	CS:2230 (22C:021)	Computer Science II, Data Structures	4	P: ENGR 2730 (057:017), C: CS:2210 (22C:019)
	F	ECE:3330 (055:033	Introduction to Software Design	3	P: ENGR:2730 (057:017)
	ALL		General Education Component #3	3	
	F	ECE:3000 (055:091)	Professional Seminar	1	Junior Status
			Total	17	
	ALL	CS:3330 (22C:031)	Algorithms	3	P: CS2230 (22:021) ; MATH 1550 (22M:031)
	S	ECE:3350 (055:035)	Computer Architecture and Organization	3	P: ECE:3320 (055:032); ENGR:2730(057:017)
	S	ECE:3360 (055:036))	Embedded Systems and System Software	3	P: ENGR:2730(057:017)
	ALL		Elective Focus Area #1 (technical, CS)	3	
	ALL		Elective Focus Area #2 (technical, ECE)	3	
	F/S	CS:3820(22C:111)	Programming Language Concepts	3	P: CS:2230 (22C:021) and ECE:3330 (55:033)
4Th Year			Total	15	
	F/S	t.b.d	Principles of CSE Design	3	Senior Status; P: ECE:3330, CS:3330, ECE:3350
	ALL		Elective Focus Area #3 (technical)	3	
	ALL		Elective Focus Area #4 (technical)	3	
	ALL		Systems Elective: ECE:3540 or CS:3620	3	
	ALL		General Education Component #4	3	
			Total	18	
	F/S	t.b.d	Senior CSE Design	3	P: Principles of CSE Design
	ALL		Theory Elective: CS:4330, CS:4340, or CS:4350	3	
	ALL		Elective Focus Area #5 (advanced CS)	3	
	ALL		Elective Focus Area #6 (advanced ECE)	3	
	ALL		General Education Component #5	3	
			Total	15	