REQUEST FOR AUTHORIZATION TO IMPLEMENT A BACHELOR OF ARTS IN COMPUTER SCIENCE AT UNIVERSITY OF WISCONSIN (UW-MILWAUKEE) PREPARED BY UW-MILWAUKEE

ABSTRACT

The University of Wisconsin-Milwaukee proposes to establish a Bachelor of Arts in Computer Science (B.A. CompSci). The development of the program responds to the demonstrated need for graduates with software skills combined with specialization in a different area. It has been shown that so-called ``CS+X'' programs broaden the representation of participants in Computer Science, with respect to race and gender. Establishing the program will provide students with marketable skills alongside an existing major, or two minor areas. Graduates will be better equipped to lead in their chosen field with additional computer-science-related skills. The program will be comprised of 120 credits, including 38 credits of major course requirements (mathematics and computer science). Students are also required to have a second major (in any field) or two minor areas of concentration (which can be demonstrated in a variety of different ways). Thus, the remaining 82 credits are used to satisfy general university requirements (including general education requirements) and the additional major or two minor areas. In this way, students will have gained competency in at least two, perhaps three areas, including computer science.

PROGRAM IDENTIFICATION

Institution Name
University of Wisconsin-Milwaukee

Title of Proposed Program
Computer Science

Degree/Major Designations
Bachelor of Arts

Mode of Delivery
Single institution
Face-to-face

Projected Enrollments and Graduates by Year Five

Table 1 represents enrollment and graduation projections for students entering the program over the next five years. It is anticipated that 10 existing students will switch out of the existing B.S. Computer Science (BSCS) program in the first two years so that they can graduate more easily. The assumption is that starting at a low level, intake eventually reach 20 new students each year entering the program. The average student retention rate is conservatively projected using the (more rigorous) existing CEAS programs to be 85% in year 2, 72% in year 3, 61% in year 4, and 52% in year 5. By the end of Year 5, it is expected conservatively that 85

students will have enrolled in the program and 40 students will have graduated from the program.

Table 1: Five-Year Degree Program Enrollment Projections

Students/Year	Year 1	Year 2	Year 3	Year 4	Year 5
New Students	5	10	15	20	20
Continuing Students	10	13	24	32	45
Total Enrollment	15	28	39	52	65
Graduating Students	5	5	10	10	10

Tuition Structure

For students enrolled in the B.A. CompSci, standard tuition and fee rates will apply. For the current academic year, residential tuition and segregated fees total $4799.21 per semester for a full-time student enrolled in 12-18 credits per semester. Of the total amount, $753.65 is attributable to segregated fees. Nonresident tuition and segregated fees total $10,584.17 per semester for a full-time student enrolled in 12-18 credits per semester. Again, of the total amount, $753.65 is attributable to segregated fees and the remainder to tuition.

Classes in the College Engineering and Applied Science, including all Computer Science classes have an additional "differential tuition" of $21.63 per credit. As the proposed program requires 34 credits of Computer Science, differential tuition adds $735.42 to the total cost of the entire degree.

Department or Functional Equivalent

Department of Electrical Engineering and Computer Science

College, School, or Functional Equivalent

College of Engineering and Applied Science

Proposed Date of Implementation

August 2020

DESCRIPTION OF PROGRAM

Overview of the Program

The program requires 120 credits including general education credits. Of these 38 are major requirements, as detailed below. Additionally, the student must complete a second major or have two minor areas of concentration.

Student Learning Outcomes and Program Objectives

Graduates of the program will have an ability to
1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements.

3. Communicate efficiently in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

The program education objectives are as follows:
- Alumni of the program will have successful careers built on their understanding of formal and applied methods of solving problems using computer science in their chosen context.
- In their professional lives, alumni of the program will demonstrate problem-solving and design skills, including the ability to formulate problems and their solutions, think creatively, communicate effectively, and work collaboratively.
- Alumni of the program will exercise professional responsibility and be able to adapt to an ever-changing professional environment.

Program Requirements and Curriculum

This proposed program is housed within the College of Engineering and Applied Science (CEAS). It will follow the College's existing admission requirements which are repeated here.

Admission to the College is based on an overall assessment of both academic and non-academic qualifications. The primary review factors for admission are the strength and quality of the high school curriculum, high school class percentile, grade point average, and the result of the ACT or SAT. Well-prepared freshman applicants will have four years of mathematics (including one-and-a-half years of algebra, one year of geometry, and one-half year of trigonometry) and four years of natural science (including biology, chemistry, and physics). The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity. Freshmen applicants will be considered for admission directly to the major or to the First-Year Program. Admission directly to the major is selective.

Transfer student admission is based on an overall assessment of both academic and non-academic qualifications. For transfer applicants, the primary factors considered for admission are the grade point average on transferable courses and the level of curriculum completion. The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity.   Transfer applicants will be considered for admission directly to the major or the Transfer Transition Program based on the number of transfer credits and GPA.

Students admitted to the First-Year Program or Transfer Transition Program (Computer Science-Intended) may apply for major status with their academic advisor at the time they believe they meet the requirements.
1. Complete first semester calculus with a C or better grade.
2. Complete GER Oral and Written Communication Part A.
3. Computer Science majors must complete CompSci 251 with a C or better grade.
4. Obtain a 3.00 GPA or a lower minimum grade point as set by the department (currently 2.50).
5. Major required courses (see below) may be repeated only once. No more than two courses may be repeated.

First-Year students have a maximum of three semesters to complete the admission to major requirements. Part-time students may be granted an extension by their academic advisor.

Transfer Transition students have a maximum of two semesters to complete the admission to major requirements. Part-time students may be granted an extension by their academic advisor.

Table 2 illustrates the program curriculum for the proposed program. Students must satisfy the general education requirements of the University: Oral and Written Communication levels A and B, and Quantitative Literacy levels A and B (the latter are satisfied through the Mathematics requirement specified below), and breadth requirements (3 credits of arts, 6 of humanities, 6 of natural sciences (of which the calculus course will provide 4-5 credits) and 6 of social sciences). The program requires one semester of calculus and also 34 credits of major course requirements. In addition, a student must either complete (or have completed) a second major, or demonstrate two minor areas of concentration. The alternate major or minor areas of concentration must overlap no more than six credits total with major course requirements of this degree. Furthermore, at least fifteen credits of the major course requirements should be completed at UW-Milwaukee.

Table 2: Bachelor of Arts in Computer Science Program Curriculum
Mathematics Requirements:

	MATH 211 or 213 or 221 or 231 (Calculus)	4-5 credits

Major course requirements (34 credits total):

Core		COMPSCI 150 (Survey of Comp. Sci.)	3 credits
		COMPSCI 250 (Intro. Programming)	3 credits
		COMPSCI 251 (Intermediate Prog.)	3 credits
		COMPSCI 315 (Comp. Org. & Assem. Prog.)	3 credits
		COMPSCI 317 (Discrete Info. Structures)	3 credits
		COMPSCI 351 (Data Structures & Algorithms)	3 credits
		COMPSCI 395 (or similar) (Soc. Prof. Ethic.)	3 credits
		EAS 200 (or similar) (Professionalism and Career)	1 credit
Computer Science Electives		COMPSCI 300-level or higher	12 credits

Other Credits

General Education	Arts		3 credits
	Humanities		6 credits
	Natural Science (with lab)		1-2 credits
	Social Sciences		6 credits
Electives	This must include an additional major or two minor areas of concentration		65 credits

Total Credits	120 credits

Minor Areas of Concentration

For the purposes of this degree program, a "minor area of concentration" can be any of the following:

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- An Associate's degree at UWM or another school;
- A declared UWM Minor;
- A declared UWM Certificate;
- At least fifteen credits of courses in a single curricular code (other than CompSci), of which at least six credits are at the 300-level or higher.

As described above, the two minor areas of concentration can overlap with the major course requirements by no more than six credits total.

Assessment of Outcomes and Objectives

Courses in Computer Science are regularly assessed for program improvement as part of the ABET accreditation of the BSCS. This assessment work can be used to assess student outcomes in the major course requirements. In particular, the four student outcomes listed above are already assessed in CompSci 351 (1 and 2), CompSci 395 (3 and 4), and EAS 200 (4). The program will also regularly survey the graduates of the program to determine whether the educational objectives are being met.

Diversity

The major will help both in broadening participation in Computer Science with respect to race and gender, and also will also make it easier for students from diverse backgrounds to graduate with a degree in Computer Science.

The department is a founding institution in the BRAID initiative of AnitaB.org (https://anitab.org/braid-building-recruiting-and-inclusion-for-diversity/). One of the commitments is to build joint majors that encourage broader participation. Instead of building specific joint majors (e.g., CS + Biology), this proposed program will enable anyone with interest in another field to have a second major in Computer Science by requiring fewer than 40 additional credits.

The smaller major requirements will also make it easier for students from diverse backgrounds to graduate with a Computer Science degree since the requirements are substantially less rigorous than those of the (current) BSCS. Students transferring in with an associates' degree and/or with a partially completed major will be able to use this prior work as a "minor area of concentration."

Collaborative Nature of the Program

Given that the program accepts an associate's degree as a minor area, approving this program will make transfer after completion of such a degree at other UW schools (or UW-Milwaukee branch campuses) more attractive.

Projected Time to Degree

A full-time student would be able to complete the major course requirements in six semesters taking no more than six credits of CompSci along with other courses. Because of pre-requisite chains, it would be difficult to complete all requirements in fewer than five semesters, but since this program is intended to be taken alongside another major (or two minors), this constraint is unlikely to prevent timely graduation. Students who transfer in with an associate's degree, or two years of prior post-secondary coursework will typically require five additional semesters unless they had completed introductory programming and at least pre-calculus before arriving. In that case, completion within four semesters should be possible.

Program Review

According to established UWM policy, the program will be reviewed once after five years and then every ten years henceforth.

JUSTIFICATION

Rationale and Relation to Mission

The proposed new program fits well with UWM's "Select Mission Statement" as seen online at https://www4.uwm.edu/discover/mission.cfm. In particular, UWM seeks to "develop and maintain high quality undergraduate ... programs," "attract highly qualified students," "further academic and professional opportunities for women, minority, part-time, and financially or educationally disadvantaged students," and "provide educational leadership in meeting future social, cultural, and technological challenges."

The program described here is a high-quality program that will attract students who wish to be challenged in two or more separate academic areas, in a way to boost the employment potential for students primarily working in arts or humanities. It is also common wisdom that these inter-disciplinary programs can attract a more diverse pool of students, not solely white, male, and middle-class.

Some Computer Science faculty report that having a more interdisciplinary skill set would be valuable, especially for applications related to the analysis of data from a variety of domains, including health or environment (e.g., freshwater). Support for such connections would strengthen UWM's mission.

Institutional Program Array

The proposed BA CompSci is intended to complement other degree programs. For example, this degree could usefully combined with the BS IST, or with degrees in Biological Sciences, Linguistics, Digital Arts and Culture, Criminal Justice or Theater just to name a few. The department is committed to the "CS+X" concept and intends to work with student advisers to determine good combinations. It is hoped that this program will improve multi-disciplinary collaboration at UWM.

Given that the major course requirements of the program are a subset of those of our existing BS CompSci degree, some students are expected to transfer from the BS CompSci to the new degree program. A transfer might permit those students to graduate earlier, and in the case of some students, could be a more tractable path to finishing with a computer science degree at all. However, the overall level of such "cannibalization" is likely to be low since the BA CompSci requires a second major or two minor areas. In contrast to the existing BS program, the proposed major primarily serves a different population, those students wanting a truly multi-disciplinary education.

Other Programs in the University of Wisconsin System

In Wisconsin, UW-Eau Claire, UW-La Crosse, UW-Madison, UW-Oshkosh, UW-River Flls, UW Stevens Point, UW-Superior, and UW-Whitewater currently offer a BA in Computer Science or a related field. Additionally, UW-Stout offers a BS in Computer Science with an "inter-disciplinary" concentration which functions similarly to a BA. The other UW Schools (UW-Green Bay, UW-Milwaukee, UW-Parkside, UW-Platteville) all offer a BS in Computer

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Science. Most of the other degrees require more CS and/or Mathematics credits than the program we propose here.

The BA at Madison anticipates being used as an "additional major" (as also proposed here) and the BA at Whitewater requires that the student complete an additional minor or major (as also proposed here). The inter-disciplinary concentration at Stout requires a minor, second major or other coursework for at least 24 credits. The proposed program is fulfilling a similar purpose in encouraging (or requiring) a multi-disciplinary approach.

Thus the State already has many programs substantially similar to our proposed program, but the market demand for software developers and related fields is anticipated to climb (already 19% percent in the four years 2013--17 and an anticipated 13% additionally in the next ten years nationally, and 28% regionally), and Milwaukee, as the largest metropolitan area of the state is a particularly good place to center a degree with such affinity with industry. In conclusion, market demand suggests that all programs should be able to thrive.

Need as Suggested by Current Student Demand

UW-Milwaukee contracted with EAB to survey demand for the program. They reported that schools that introduce a BA in Computer Science typically see an increase in enrollment. In the four schools they surveyed, they saw increases from 30 a year (at the lowest) to 130 a year increase (at the highest). At UWM, there is anecdotal evidence of students wanting to combine Computer Science with Art or Linguistics. Many of the students already in the BS CompSci program are second-degree students; such students would have a much faster option to a Computer Science degree with the proposed curriculum.

Need as Suggested by Market Demand

In their report, EAB described the market demand from employers for students with the skills provided in the proposed degree program:

> *Regional employers seek bachelor's-level computer science professionals in 28,237 job postings during H2 2017, a 19 percent increase from 23,646 postings in H2 2013. The Bureau of Labor Statistics (BLS) projects the national employment of "computer and information technology occupations" to increase 13 percent from 2016 to 2026, due to increased demand for workers with skills in cloud computing, big data analysis, and information security. Similarly, Wisconsin's Workforce and Labor Market Information projects statewide employment of "computer system analysts" to increase 28 percent from 2014 to 2024.*

They cite the US Bureau for Labor Statistics (https://www.bls.gov/ooh/computer-and-information-technology/home.htm) and the Wisconsin Workforce and Labor Market Information System (http://worknet.wisconsin.gov/worknet/jsoccsrch_results.aspx?menuselection=js&occ=151121&occname=&area=SW).

The EAB report also recommends that UWM encourage students to partner with local industry in providing experiential learning opportunities. The department of Computer Science is well-placed to take the lead here since our capstone course (which will be open to, but not mandatory for BA Computer Science students) was recently redesigned to use industry-initiated projects as the focus of the semester.