

June 2011

DRAFT: Master of Science in Computational Science Central Washington University

Introduction

Central Washington University (CWU) proposes to offer a self-supporting Master of Science in Computational Science degree beginning Fall 2011. Computational scientists implement mathematical models and analyze complex scientific problems. By promoting understanding through computer simulations and other computing methods, a computational science approach complements traditional scientific approaches of theory and experiment.

The proposed program would be administered by the Computer Science Department and offered on campus at Ellensburg. It would enroll 10 FTE students this fall, increasing to 30 FTE students in 2014. By then 15 students per year would graduate, prepared to apply computer simulation and other forms of computation to research work.

Relationship to Institutional Role and Mission and the Strategic Master Plan for Higher Education in Washington

The proposed program would support CWU's mission by producing computational scientists able to analyze large amounts of data in pursuit of solutions to human and environmental problems. Moreover, adding the proposed program to CWU's inventory would support the *Strategic Master Plan for Higher Education* policy goal of expanding advanced degree programs in science, technology, engineering, and mathematics (STEM) fields.

Program Need

The state's current employer needs assessment joint report identifies shortages of people trained for research, science, technical, and computer science positions; with a particularly large shortage in computer science.¹ This finding is consistent with Employment Security Department and Bureau of Labor Statistics projections indicating strong computer science employment growth through 2018. The proposal included letters of support from the Vice President of Oracle and the Director of Google Kirkland as concrete evidence of employer demand.

¹ Higher Education Coordinating Board, State Board for Community and Technical Colleges, and Workforce Training and Education Coordinating Board. *A Skilled and Educated Workforce: An assessment of the number and type of higher education and training credentials required to meet employer demand* (2009). Page 13.

To ascertain student demand for the proposed program, CWU conducted two surveys. The first was a 2008 survey of 100 CWU alumni. Out of 22 respondents, 11 were interested in pursuing a Computational Science graduate degree at CWU. The second was a Fall 2009-Winter 2010 survey of 53 CWU undergraduate computer science students, which had a response rate of 100 percent. Thirty-nine respondents (74 percent) expressed a strong interest in pursuing such a degree.

In addition to responding to the employer and student demand indicated above, the proposed program would respond to community demand resulting from a shift in technology that has led scientists to rely more and more heavily on computing. For example, biologists studying genomics rely heavily on computational methods to analyze DNA, and meteorologists use computer simulations to study tornadoes. A report from the national President's Information Technology Advisory Committee (PITAC) emphasizes the importance of computational science to society: "The PITAC believes that computational science is one of the most important technical fields of the 21st century because it is essential to advances throughout society."²

The proposed program would differ from traditional computer science programs by focusing more on applying simulation and computer methods to solve problems in data-driven science fields. Although CWU offers a BS in computer science, it does not offer a master's-level program in computing. Thus the proposed program would complement rather than duplicate existing programs.

Diversity

To enhance student diversity, the department intends to create partnerships with institutions like Heritage University and Yakima Valley Community College, which serve underrepresented students. The department would also work with tribal agencies and minority civic organizations to publicize the program. In addition, it would appoint at least one participant from underrepresented populations to the program's advisory board.

Program Description

The proposed 45-quarter-credit program's primary goal would be to produce professional computational scientists able to conduct original and meaningful scientific research. Its primary target audience would be students with an undergraduate major in computer science. However, it would also serve students with a minor in computer science and a major in a computational science application domain such as biology or geology. Though administered by the Computer Science Department, it would be an interdisciplinary program offered in cooperation with the departments of Biological Sciences, Chemistry, Geological Sciences, Mathematics, and Physics.

To be admitted, students must hold a bachelor's degree with a 3.25 grade point average or higher. Once admitted, students would study a curriculum designed to cover core computing and

² *Computational Science: Ensuring America's Competitiveness*, Report to the President from the President's Information Technology Advisory Committee (2005). Page iii.

mathematics principles and allow specialization in one or more application areas. Students would take 22 credits of mathematical and computing core courses covering advanced algorithms, data structures, high-performance computing, and numerical methods. Students would then choose 18 credits from among specialization tracks in computational biology, computational chemistry, eco-informatics, geology, computational methods, computational mathematics, and computational physics. Students would complete their course of study with a 5-credit master's thesis or project, which could have either a research or professional orientation. Courses would be taught primarily by tenured/tenure-track faculty, and thesis committees would include at least 3 members.

Learning outcomes include the ability to design and implement an original research project and present research results. Both student learning and program assessment would use multiple measures. Student learning would be assessed through homework, exams, class participation, term computing projects, and a capstone thesis or project. Program assessment would employ entry and exit surveys, informal group conversations with students, course evaluations, faculty peer review of teaching materials, alumni surveys, industry partner surveys, capstone project client surveys, and advisory board feedback.

Program Costs

The budget includes compensation for 1.5 FTE instructional faculty and 0.7 FTE administrative personnel (including 0.4 FTE for a faculty program director). It does not include equipment or facilities expenditures because existing infrastructure would be used. At full enrollment of 30 FTE students, the direct cost of instruction would be \$230,160, or \$7,672 per average annual FTE student. This lies within the graduate computer science cost range reported in the HECB's *2005-06 Education Cost Study* (July 2007). At current tuition rates, a student enrolling in 2011 would pay about \$11,500 to complete the program. According to program planners, this is comparable to what students would pay for MS degrees at CWU and at the low end of the cost range of comparable degrees across the country.

External Review

Three reviewers evaluated the proposal: Dr. Robert Brigantic, Operations Research Scientist and Adjunct Professor of Operations Research, Washington State University; Dr. Sukhamay Kundu, Associate Professor of Computer Science, Louisiana State University; and Dr. Stephen Olariu, Professor of Computer Science, Old Dominion University.

All three reviewers supported the proposal, two of them "wholeheartedly." All three spoke positively about faculty. For example, Dr. Olariu noted faculty experience in research and in mentoring graduate students. All three spoke positively of the curriculum as well, especially the required mathematical and computing core.

However, Dr. Olariu raised a concern regarding electives. Since electives would serve two different audiences (computational science students and natural sciences/math students), CWU would need to take care to ensure the needs of both sets of students are met. He specifically suggested special assessment of elective courses, and program planners responded by stating their

intent to review elective courses periodically during curricular meetings with all instructors involved.

Staff Analysis

The proposed program would support the *Strategic Master Plan for Higher Education* and CWU's mission. In addition, it would respond to employer, student, and community demand at a reasonable cost without duplicating other programs. State and federal projections indicate employer demand, and student and alumni surveys indicate student demand. A National President's Information Technology Advisory Committee report indicates community demand.

Students would study a curriculum designed to cover core computing and mathematics principles and allow specialization in one or more application areas. The curriculum would be taught by tenured/tenure track academic faculty whose quality was noted by the proposal's external reviewers. Student and program assessment would employ multiple measures.

As CWU's first graduate-level computer science-related offering, the proposed program would complement CWU's existing baccalaureate programs. Because of its interdisciplinary nature, it would strengthen collaborative educational and research efforts across CWU's College of the Sciences.

Staff Recommendation

After careful review of the proposal and supporting materials, the staff recommends approval of the Master of Science in Computational Science at Central Washington University.

RESOLUTION NO. 11-15

WHEREAS, Central Washington University proposes to offer a Master of Science in Computational Science; and

WHEREAS, The program would support the Strategic Master Plan for Higher Education, as well as the university's mission; and

WHEREAS, The program would respond to student, employer, and community demand without duplicating existing programs; and

WHEREAS, The program has support from external reviewers; and

WHEREAS, The program would be offered at a reasonable cost;

THEREFORE, BE IT RESOLVED, That the Higher Education Coordinating Board approves the Master of Science in Computational Science at Central Washington University effective June 30, 2011.

Adopted:

June 30, 2011

Attest:

Ethelda Burke, Chair

Earl Hale, Vice Chair