

Computer Engineering

Substantive Statement of Need

November 2011

University of Washington Bothell

FORM 1

**COVER SHEET
NEW DEGREE PROGRAM PLANNING NOTIFICATION OF INTENT
(PLANNING NOI)**

Program Information

Program Name: Computer Engineering
Institution Name: University of Washington Bothell

Degree Granting Unit: CSS
(e.g. College of Arts and Science)

Degree: BS Computer Engineering Level: Bachelor Type: Science
(e.g. B.S. Chemistry) (e.g. Bachelor) (e.g. Science)

Major: Computer Engineering CIP Code: 14.0901
(e.g. Chemistry)

Minor: NA
(if required for major)

Concentration(s): TBD
(if applicable)

Proposed Start Date: Autumn 2013

Projected Enrollment (FTE) in Year One: 20 At Full Enrollment by Year: 2017 : 40
(# FTE) (# FTE)

Proposed New Funding: 100,000

Funding Source: State Self Support Other

Mode of Delivery

Single Campus Delivery Bothell
(enter locations)

Off-site _____
(enter locations)

Distance Learning: HYBRID
(enter formats)

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Attach Sheet

Contact Information (Academic Department Representative)

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Endorsement by Chief Academic Officer

HECB P.O. Box 43430 Olympia, WA 98504-3430 www.hecb.wa.gov/autheval

December 5, 2011

Date

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I. Degree program description and rationale

“The work of computer hardware engineers is similar to that of electronics engineers in that they may design and test circuits and other electronic components; however, computer hardware engineers do that work only as it relates to computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of these engineers.”¹

The University of Washington Bothell proposes to offer a Bachelor of Science degree in Computer Engineering (BSCE). The existence of the field and profession of computer engineering for over 25 years recognizes that modern computing systems include inextricable combinations of hardware and software. This requires workforce members who are knowledgeable in both domains, and understand how the domains interact, restrict or enable the interdependent capabilities. As we enter an era in which small computing systems — sensor motes, RFID chips, mobile computing platforms, embedded systems, etc. — become ubiquitous, demand for individuals with backgrounds in both hardware and software will continue to increase.

The goal of the UW Bothell Computer Engineering (CE) degree is to create broadly-educated professionals who can work at the intersection of computing hardware and software. We will accomplish this through an interdisciplinary curriculum that combines foundational knowledge in analysis, problem solving, physical and mathematical sciences, and interpersonal and management skills with technical competencies in areas such as programming, hardware design, systems, and business. A capstone experience will allow students to synthesize their education in a comprehensive hardware/software design experience.

¹ Occupation Outlook Handbook 2010 – 2011 Ed. <http://www.bls.gov/oco/ocos027.htm#nature> accessed 12.2010.

This degree will interact heavily with the existing UWB degrees in Computing and Software Systems (CSS) and Electrical Engineering (EE), drawing much of its core and elective courses from existing CSS and EE courses and adding specialized CE courses where appropriate. As such, it will incorporate the strengths of both programs, including close ties with area industry, a hybrid instructional model that combines on-campus classes with distance learning, and institutional experience with the ABET accreditation process. Accordingly, CSS will seek ABET accreditation for the CE degree program when it is eligible.

II. Relationship to institutional and unit priorities

We have an overriding commitment to providing our students with the best possible university education through challenging programs of study and innovative methods of instruction. We value engaging our students in transformational learning experiences that challenge their expectations, broaden their horizons, and stimulate their ambitions. UWB Core Value Statement²

A. UWB Mission

UW Bothell mission reads, “We provide access to excellence in higher education through innovative and creative curricula, interdisciplinary teaching and research, and a dynamic community of multicultural learning.” Our mission further holds that we, “Encourage and support collaborative, interdisciplinary and cross-program initiatives.” The proposed BSCE degree supports the mission in a number of ways.

It is an inherently interdisciplinary and cross-programmatic degree that will be jointly administered by the CSS and EE faculties. It will include a substantial number of courses that will be offered in a hybrid mode, combining on-campus with online learning. The BSCE degree will combine the strengths of the two supporting programs with the UWB commitment to providing access and support for a diverse

² <http://www.uwb.edu/about/vision>, accessed 1.2011

student body to create a pathway for greater participation in high-demand science, technology, engineering, and math (STEM) professions.

B. UWB Strategic Priorities

All of the above fits well with the UWB 21st Century Initiative, a strategic plan that establishes priorities for growth until 2020 for the University of Washington Bothell. This plan places special emphasis on developing new degree programs that respond to the economic development needs of the state and region. Specifically, the STEM areas were identified as top priorities for immediate growth.

III. Need for Program

As the only Senator holding an engineering degree, I remember when engineering ranked far ahead of business administration as the premier college degree for those who had ambition and the determination to succeed. – Senator Edward Kaufman³

In 2009, Senator Edward Kaufman noted that the US was producing fewer and fewer engineers. This also paralleled decreased investment in STEM education over the last twenty-five years. Kaufman's point was to underscore that much of the innovation that created opportunity and economic prosperity in the preceding years was generated by STEM professions. The movement away from investment in STEM education and research may be a contributing factor to the economic downturn of 2008 from which we are recovering. Thus, it is critical for academia and policy makers to focus on how best to bring engineering education to the forefront and produce more graduates in STEM education.

According to the US Department of Labor, eighty percent of the jobs created in the next ten years will require STEM education. The increase in national demand for computer engineers is also supported by National Association of Colleges and Employers in their 2010 Job Outlook Survey. The survey reports

³<http://blogs.asee.org/engineeringand/senator-kaufman-want-to-rebuild-the-economy-ask-an-engineer/>

that CSE was fourth on the “top ten” list in terms of job offers by employers.⁴ It was also reported that wages were in the top range as well.

A. National Demand

“What kinds of jobs get outsourced? In a nutshell, jobs that satisfy clearly defined functions in the context of mature sectors with intense competition. Functions that require constant adjustment to changing consumer tastes or client demands are poor candidates for outsourcing. For example, it’s often efficient to outsource the writing of blocks of software code but it isn’t efficient to outsource the process of defining the software’s features, design and documentation.”⁵

According to the occupational Outlook Handbook (OOH), computer software engineers and computer programmers held approximately 1.3 million jobs in 2008. Additionally, computer software engineers and computer programmers are employed in a wide range of industries; however, 32 percent were employed in computer systems design and related services. The range of employers includes software publishers, manufacturers of computers and related electronic equipment, financial institutions, and insurance providers.⁶

The job outlook for computer software engineers and computer programmers is projected to increase much faster than the average rate for all occupations. Thus, job prospects are reported to be excellent with the best opportunities available for individuals with practical experience and at least a bachelor's degree in a computer-related field.⁷

⁴ http://www.nacweb.org/so09292010/top_employers_majors/?referral

⁵ <http://goldsea.com/Text/index.php?id=2288>

⁶ OOH: <http://www.bls.gov/oco/ocos303.htm>

⁷ Ibid.

| Occupational Title | Employment, 2008 | Projected Employment 2018 | Change, 2008-18 | |
|--|---------------------|---|--------------------|---------|
| | | | Number | Percent |
| | | Computer and information scientists, research | 28,900 | 35,900 |
| Computer software engineers and computer programmers | 1,336,300 | 1,619,300 | 283,000 | 21 |
| Computer programmers | 426,700 | 414,400 | -12,300 | -3 |
| Computer software engineers | 909,600 | 1,204,800 | 295,200 | 32 |
| Computer software engineers, applications | 514,800 | 689,900 | 175,100 | 34 |
| Computer software engineers, systems software | 394,800 | 515,000 | 120,200 | 30 |
| Computer systems analysts | 532,200 | 640,300 | 108,100 | 20 |
| Computer and information systems managers | 293,000 | 342,500 | 49,500 | 17 |

Table 1 Projections data from the National Employment Matrix

B. Washington State

The past year has seen a positive change in demand for jobs in Washington State. Jobs in computer and math related profession are second only to health care occupations in terms of projected growth through 2018. It is essential now more than ever that Washington support and strengthen its technology sector. Labor Market Economic Analysis (LMEA) reports show that information technology occupations are recession proof. In job vacancies by major occupations, both Software/Computer and Arts/Design occupations are listed in the top twenty occupations. Positions also require education beyond high school including baccalaureate degrees with 94% of the openings in Software/Computer occupations requiring more education than a high school degree.⁸

Industry growth supports the need for more graduates. The industry added \$497.2 million to the state economy, which equates to a growth rate of 14.4 percent, more than double Washington's overall

⁸ Roubinchtein, Alex & Mary Ayala (2008). "Identifying Washington's Recession-Resistant Industries" in *Washington Labor Market Quarterly Review*, LMEA, 32(4), p15.

growth. Enterprise Seattle has identified over 150 companies and divisions dedicated to the Computing Industry in our state with the largest employers located in King County. The demand outpaces graduates almost at a rate of 10 to 1 for the state.⁹

| Washington | Employment | | Percent Change | Job Openings |
|---|------------|--------|----------------|--------------|
| | 2008 | 2018 | | |
| Computer software engineers, applications | 25,000 | 30,240 | 21% | 760 |
| Computer software engineers, systems software | 18,560 | 22,470 | 21% | 560 |
| Computer programmers | 11,500 | 13,730 | 19% | 460 |

Table 2: Workforce Explorer – Information Technology Occupation

C. Regional and Community Demand

The proposed BSCE program is enhanced by UW Bothell’s location in the “Technology Corridor.” The Bothell Technology Corridor has been designated since 2007 Innovation Partnership Zone (IPZ) by Governor Chris Gregoire, joining ten other zones designated in the state as geographic areas that promote and develop the state’s regional economies. Areas designated as Innovation Partnership Zones receive special access to state funding and resources.¹⁰ UW Bothell is identified as an IPZ partner and is doing its part by developing degree programs that are responsive to regional demand. Furthermore, According to LMEA, King, and Snohomish are two of three counties in the state to post job growth since 2009.¹¹ This is significant when reviewing the impact of the 2008 recession. It underscores the importance of this region in contributing to the economic health of the State.

⁹ CareerOneStop, U. S. Department of Labor: <http://www.bls.gov/oco/ocos303.htm>

¹⁰ Joyce Goedeke, (October 2007). Municipal Research & Services Center of WA. *Bothell Technology Corridor Designated as Innovation Partnership Zone by Governor Chris Gregoire.* <http://www.mrsc.org/GovDocs/B67InnoZoneDes.pdf>. Accessed 03/2009.

¹¹ 2010 WA State Labor Market and Economic Report, p VI.

The Economic Development Council of Snohomish County lists three industry clusters as the focus of the county: Aerospace, Life Sciences (Biotech & Medical Devices), and Clean Technology. These clusters provide the employment foundation for the county. It is worth noting that innovation, growth, and stability in all three sectors will be enhanced with STEM graduates including graduates with degrees in Computer Engineering.

The State also uses demand/decline reports to determine where resources should be allocated. Under this program resources are allocated first to individuals whose unemployment is the result of structural changes in the economy and technological advances which have rendered their skills obsolete. This may also result in a decline for a given occupation. Information is used to prioritize benefits for training where demand is apparent. The reports confirm that computer engineers are in demand in both King and Snohomish counties.¹²

IV. Student Demand

*The job market may be tough for most, but not if you're a University of Washington computer science student.*¹³

Demand for a degree program with a focus on CE is documented in three ways on campus: 1) enrollment in courses with CE focus, 2) informal surveys, and 3) recruitment and advising reports.

A. Course Enrollment

Computing and Software Systems has seen an extraordinary increase in enrollments in the last two years with more than 200 declared majors in its current programs. Although most courses are open to all students, average class size for upper level courses in the 2010 – 2011 academic year equaled 93. This

¹² Qualifying Occupations, <http://www.wilma.org/wdclists/wdaArea.asp?area=000000>.

¹³ <http://www.nwcn.com/video/featured-videos/UW-tech-students-in-high-demand-105091204.html>

will increase with Autumn 2011 enrollments. The popularity is due, in part, to the innovative interdisciplinary approach that prepares students with relevant competencies resulting in industry-ready graduates that are in high demand in our region. The CE program will create opportunity and increase access for more students to reach their educational goals.

| Computing & Software Systems Course Enrollment Academic Year 2010 - 2011 | |
|---|-------------------|
| Course | # Enrolled |
| CSS 301 | 87 |
| CSS 342 | 103 |
| CSS 343 | 89 |
| CSS 360 | 103 |
| CSS 422 | 84 |

Table 3: UW Bothell CSS Program Course Enrollment

B. Survey

Curriculum ideas are tracked by an informal survey that students or potential students can access when they visit the UW Bothell website. If students are looking for information on degree programs that UWB does not currently offer, they are directed to a survey that asks them to indicate the degree program. Information from the general survey helps to identify degrees that are not named in the survey by asking students to name which degree programs are of interest. Responses have included Computer Engineering which is not listed with potential degree programs in the general survey. However, a survey specific to CE was posted November 2010.

The survey for Computer Engineering has had 26 respondents since its posting; of this number 70% were male and 30% were female. UW Bothell students make up 35 % of the respondents with 7 % of this number identifying as juniors, 50% as sophomores and 36% as freshmen. The remaining students indicated that they were from Bellevue College – 30%, Cascadia CC – 40%, Shoreline - 10%, and other - 10%. Responses to the following two questions support that CE is a strong degree to pursue at UW Bothell:

1. Are you interested in pursuing a BS in Computer Engineering? 100% of the respondents replied yes.
2. How important is it to your decision to enroll at UW Bothell or to remain at UW Bothell if a Computer Engineering degree is not available? The responses are as follow:
 - Very - 77%
 - Somewhat - 19%
 - Not at all – 4%

A sampling of comments includes the following:

- *I would be very interested in attaining a Bachelor's degree in Computer Engineering from UWB. I believe many of the classes overlap with Electrical Engineering, so it shouldn't be too difficult to add a Computer engineering degree program.*
- *Since UWB already offers degrees in Computing & Software Systems and Electrical Engineering, I would think that a Bachelor's degree in Computer Engineering would be easier to implement than other degrees. I am very interested in attending UWB for either a degree in Computer Engineering or Mechanical Engineering.*

All of the respondents were confident that they would be able to find employment with a BSCE degree.

It should be noted that 40% of the respondents expressed interest in obtaining a professional certificate or attending graduate school.

C. Recruitment & Advising

We have the opportunity to gather information from advising summits, advisor quarterly meetings and recruitment events. The summits are UWB hosted events attended by advisors from other colleges around the state. The summit includes breakout sessions to give visitors the opportunity to gain insight into UWB programs. The internal quarterly meetings include advisors and recruiters and provide an opportunity for exchanging information on student concerns. UWB advisors also attend recruiting events and host recruiting events at high schools and CCs. These activities are designed to generate

feedback that is channeled to Curriculum Development, Strategic Planning as well as our Academic programs.

V. Support for the Statewide Master Plan

The Higher Education Board outlines two primary goals in its strategic plan:

Goal 1: We will create a high-quality higher education system that provides expanded opportunity for more Washingtonians to complete postsecondary degrees, certificates, and apprenticeships.

Goal 2: We will create a higher education system that drives greater economic prosperity, innovation and opportunity. ¹⁴

UW Bothell's charge is to provide educational opportunity and increase access for the region and community. We structure programs with the goal of incorporating flexibility and support for our students, particularly those who are non-traditional or from underserved populations. The development of the BSCE degree program responds to both goals and reaches further by leveraging resources and focusing on regional demand.

The State and Regional Needs Assessment (SRNA) also holds that Washington is a leader in innovative and technology-based industries but we are not producing enough graduates; thus, the industry is forced to look outside the state for talent.¹⁵ It also describes a critical need for promoting student enrollment in STEM fields noting, "It is critical that the state's investment in the expansion of enrollments in high demand programs of study must be maintained, along with efforts to improve the

¹⁴ 2008 Strategic Master Plan for Higher Education in Washington, p II.

¹⁵ *State and Regional Needs Assessment Report*. (February, 2006) Washington Higher Education Coordinating Board, p.8.

pipeline of interested and prepared students. The SRNA and the Strategic Master Plan both show that the gap between the baccalaureate degree production in information technology-related fields and actual workforce demand is increasing.¹⁶

The program will also increase the number of spaces available to students transferring from two year institutions with an interest in CE. The State Board of Technical and Community Colleges (SBTCC) identified information technology as areas where students and industry need additional or broadened pathways.¹⁷ WSBTCC data also indicates that there are more community college graduates than available spaces.¹⁸ Thus, the proposed CE program would create a pathway for transfer students in the region and state.

¹⁶ *Strategic Master Plan for Higher Education in Washington*. (February 2006) Washington Higher Education Coordinating Board.

¹⁷ *Research Report No. 08-2*. (March 2008). WSBTCC, p.2.

¹⁸ *Research Report No.05-1*. (April 2005). WSBTCC, p.10.

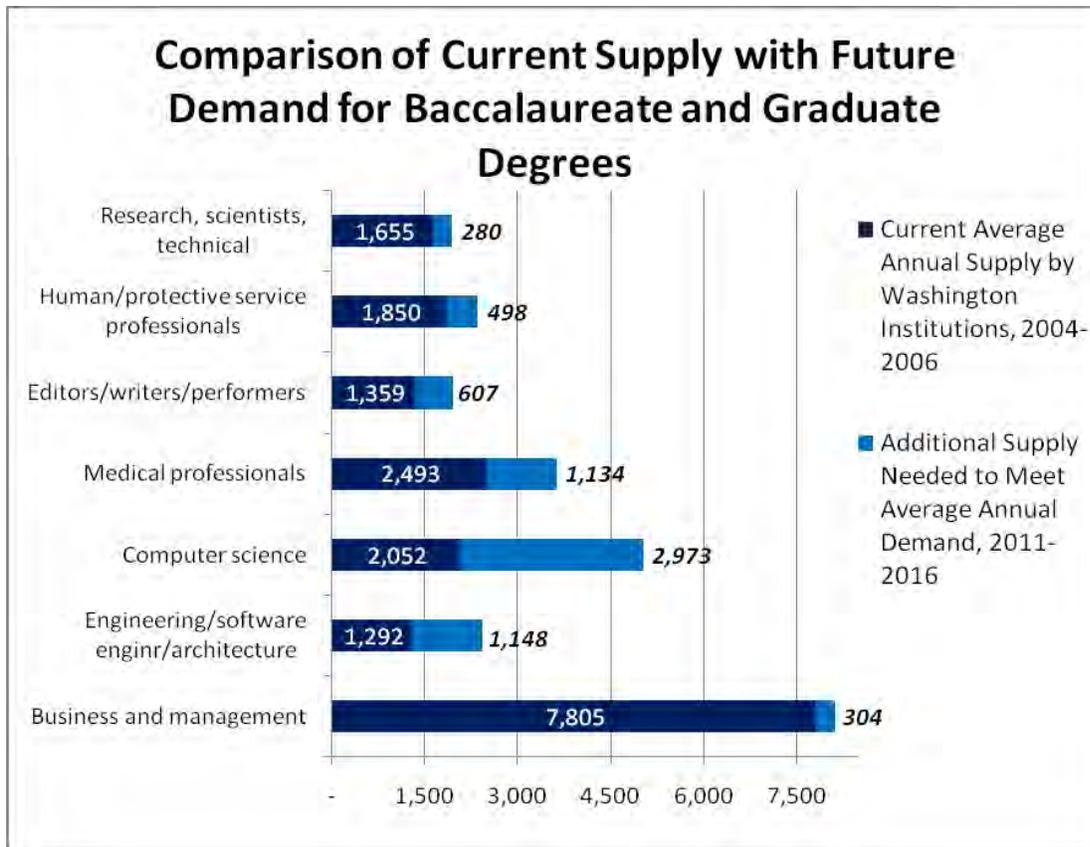


Table 4: WA HECB

A. Greater economic prosperity, innovation and opportunity

A major issue for the state is to insure that we have an, “educated and skilled workforce” to nourish innovation or as noted in the HECB System Design Plan. “We need to sustain our innovation capacity by educating more of our own citizens through certificate and degree levels.”¹⁹ Presently, the state relies on imported workers in STEM related professions.

“While some would make the case that it makes more sense to have other states educate engineers and computer and life scientists and then bring them here; the reality is that we are doing a disservice to our own citizens by not expanding degree granting capacity, especially in STEM related degrees, at Washington's four year institutions. This is because Washington state companies are still creating high-paying jobs in fields that require STEM related bachelor's degrees or higher. The regions that educate their workforces that are geared toward solving big problems will be the regions that will be prosperous over the next several decades.”²⁰

Thus again, the need to produce computer engineers is an imperative for the state and region.

¹⁹ HECB System Design Plan - Approaches to System Expansion, October 27, 2009, and p7.

²⁰ <http://washingtontechnology.org/community/blogs/wsagovtaffairs/archive/2010/10/13/1822.aspx>

VI. Program Requirements

The proposed program is interdisciplinary in focus and designed to leverage curriculum from CSS & EE.

Courses developed for the program will contribute to enhancing STEM curriculum on campus. Students will also have an opportunity to choose electives that reinforce their interests and develop soft-skills.

A. Proposed Curriculum

CE Admission Requirements (50 credits)

Written & Oral Communication (10 credits): English Composition, Interdisciplinary Writing or a second composition course, or Introduction to Technical Writing

Mathematics & Natural Sciences (40 credits): Calculus I, II, & III, Programming I & II, Mechanics, Electromagnetism and Oscillatory Motion, General Chemistry I

Areas of Knowledge (30 credits)

Visual, Literary, and Performing Arts
Individuals and Societies

CE Core Classes (55 credits)

Core classes will be upper division courses that will leverage EE and CSS courses and synthesize curriculum in CE courses.

Mathematics (20 credits)

Introduction to Differential Equations
Matrix Algebra
Multivariable Calculus
Statistics

Engineering Electives (25 credits)

Selected from B EE and CSS elective courses; a maximum of 10 credits allowed at the 200-300 level, only 10 credits of special topics allowed, and a maximum of 10 credits combined of independent study and undergraduate research allowed.