Date: March 9, 2020

To: Cathy Sandeen, Chancellor

From: John Stalvey, Interim Provost

Cc: Kenrick Mock, Interim Dean, College of Engineering
                Frank Moore, Professor, Department Chair, Program Committee Chair, Computer Science
                    & Engineering
                Shawn Butler, Term Assistant Professor, Computer Science & Engineering
                Christoph Lauter, Assistant Professor, Computer Science & Engineering
                Sebastian Neumayer, Assistant Professor, Computer Science & Engineering
                Frank Witmer, Assistant Professor, Computer Science & Engineering
                Susan Kalina, Vice Provost for Academic Affairs
                Claudia Lampman, Vice Provost for Student Success

Re: **AY20 Expedited Program Review Findings – Computer Systems Engineering BS**

I have reviewed the dean's findings and the completed Expedited Program Review Template for the
Computer Systems Engineering BS. The Provost's Office did not receive an Optional Program Response
Form from the program.

Recommendations

My recommendation is to change the recommendation to continued review, accepting the
recommendations of the dean with the additional commentary that the program must conduct an
analysis of its high attrition rate and develop a plan to address this. An interim progress report on all
recommendations and including a plan to address the high attrition rate is due to the dean by March 1,
2021. The dean will submit a review along with the program's interim progress report to the provost by
April 1, 2021. A follow-up Program Review will be conducted in AY22.

Decision

Recommend Continued Review

UAA College of Engineering
UNIVERSITY *of* ALASKA ANCHORAGE

Date: February 14, 2020

To: John Stalvey, Interim Provost

From: Kenrick Mock, Interim Dean, College of Engineering

Cc: Frank Moore, Professor & Department Chair, Program Committee Chair
                 Shawn Butler, Term Assistant Professor
                 Christoph Lauter, Assistant Professor
                 Sebastian Neumayer, Assistant Professor
                 Frank Witmer, Assistant Professor

Re: AY20 Expedited Program Review Findings

Program/s in this review: Comp Systems Engineering (BS)

Specialized accrediting agency: ABET – Engineering Accreditation Commission (EAC)

Campuses where the program is delivered: UAA

Members of the program review committee:

- Frank Moore, Professor & Department Chair, Program Committee Chair, UAA
- Shawn Butler, Term Assistant Professor, UAA
- Christoph Lauter, Assistant Professor, UAA
- Sebastian Neumayer, Assistant Professor, UAA
- Frank Witmer, Assistant Professor, UAA

Centrality of Program Mission and Supporting Role

The program meets UAA's mission to support workforce development for the high demand job field of computing professionals. In Alaska, nationally, and globally there is strong demand for computer engineers. EMSI data indicates that 70% of program graduates work in Alaska and the program has built many community and industry collaborations that revolve around research, internships, and capstone projects. ConocoPhillips recently donated a high-performance computing cluster to the department.

Program Demand (including service to other programs), Efficiency, and Productivity

Industry demand is very strong both within and outside Alaska.

The number of majors has been relatively steady with an average of approximately 60 students over the past three years. The number of awards is very low, with only 2 awards in 2019 and 6 in 2018. While it may be the case that students are still making their way through the program since CSE was split as a standalone degree from the BSE in 2015, it is worth noting that the other BSE programs have had more significant numbers of students graduate under their respective standalone degrees starting in 2016, suggesting that enrollment is simply lower in the CSE program. Nevertheless, the number of majors do suggest there should be an uptick in the number of awards.

The program is taught primarily by CS&E faculty but also by EE faculty. There has been little to no excess instructional CS&E staff capacity due to the relatively small number of faculty to offer the program. This in turn has helped the program be cost effective in instruction delivery.

Classroom seat utilization is relatively strong at an average class size of 19.

The program does provide some service courses to the EE program.

Program Quality, Improvement and Student Success

The program has been continuously accredited by ABET since 2007 and the faculty participate regularly in program assessment. The program has been revised several times to meet changing demand and changing technologies. The program also implements high impact practices such as internships and undergraduate research experiences that are integrated into the curriculum. The successful placement of graduates is a strong indicator of the quality of the program.

Program Duplication / Distinctiveness

UAF has the only other CSE program in the state and also has a relatively small number of faculty. The faculty expertise at the two campuses complement rather than compete with each other, and the programs are also quite different. The UAF program focuses on hardware while the UAA program focuses on software. Additionally, the programs collaborate on shared courses.

Commendations and Recommendations

The faculty are commended for being at the forefront of sharing core courses by distance with UAF's CS department – the department has the strongest enrollments in shared courses on both campuses and has identified and begun finding solutions to issues that need to be addressed to increase course sharing in the College. Additionally, the faculty are commended on maintaining a quality program with a relatively small number of faculty members.

It is noted that the CSE program is composed primarily of courses required by the CS program and courses required by the EE program. As such, there is a high dependency on those other programs and little cost savings would be realized through the elimination of the CSE program.   Nevertheless, the low number of awards and modest number of majors does raise a concern. The program should carefully monitor the progress of students, identify hurdles/bottlenecks toward degree completion, and take any necessary actions to ensure students will be successful completing the degree.

Decision: Continuation

Submission date: 11 February 2020

Program/s in this review: Comp Systems Engineering (BS)

Specialized accrediting agency (if applicable): ABET

Campuses where the program is delivered: University of Alaska Anchorage

Members of the program review committee:

- Frank Moore, Professor and Chair, Program Committee Chair, UAA
- Shawn Butler, Term Assistant Professor, UAA
- Christoph Lauter, Assistant Professor, UAA
- Sebastian Neumayer, Assistant Professor, UAA
- Frank Witmer, Assistant Professor, UAA

1. Centrality of Program Mission and Supporting Role (700 words or less)

Program relevancy

The Computer Systems Engineering program (BSCSE) at UAA plays a key role in supporting the UAA Strategic Plan 2020. In particular, Goal 3 aspires to graduate more students to fill Alaska's needs. Since its inception as a separate degree program in 2016, the BSCSE program has shown significant growth, and our surveys of CSCE alumni indicate most are working in the computer science field and employed by companies in the State of Alaska. EMSI data from 2008-2019 indicates that approximately 70% of our graduates remain in Alaska to work.

Our graduates have little trouble finding employment, which is not surprising given both the state and national demand for computing professionals, as well as the quality of our graduates. For students interested in graduate studies, UAA BSCSE Alumni have had good success in being admitted to Computer Science and Engineering graduate programs at prestigious universities, including Carnegie-Mellon University and Concordia University.

Support for other academic programs

Our Computer Science & Engineering program formally supports two other academic programs, and informally we attract students from a variety of fields. The BS in Electrical Engineering (BSEE) requires four courses taught by our department, and the Developers track of the BS Geomatics requires three. See Section 2 for more detail.

Partnerships with outside agencies, business, and organizations

The Computer Science and Engineering department has strong ties to State and business organizations. The advisory board members represent local companies and organizations such as Resource Data Inc, Alaska Railroad Corporation, Anchorage School District, Alaska Developer's Alliance, Honeywell, Olgoonik and Stage 2 Studios. Furthermore, we have developed research connections with companies such as Axiom Data Science and ConocoPhillips, and government agencies such as NASA, NOAA Alaska Sea Grant, NSF EPSCoR, Department of Homeland Security (DHS) Arctic Domain Awareness Center (ADAC), UAF Alaska Center for Energy and Power (ACEP), the UAA Institute for Circumpolar Health Studies (ICHS) and the Army Corp of Engineers. We also have strong connections with the Alaska Developer's Alliance, a group dedicated to creating a community of programmers within Alaska. We have worked with this organization to host multi-day hackathons coordinated across UAA, UAF, and UAS campuses. Lastly, we have supported the creation of the newly formed Alaska Data Science and AI Lab (ADSAIL). This lab has partnered with McKinley Capital Management to provide internships and learning opportunities to our students in the fields of machine learning and artificial intelligence.

Workforce development and employment opportunities

Computer Systems Engineering students often complete internships with local and regional employers. BSCSE students have recently participated in internships at NASA Langley, Federal Aviation Administration, and GCI. BSCSE graduates go on to work as systems engineers, computer network architects, computer systems administrators, and computer engineers for employers such as Intel Corporation, the Alaska Railroad Corporation, Assistive Technology Group, Statlab Medical Product, and University of Alaska Anchorage.

Based on a 2018 survey of recent (2008-2017) graduates from CS&E, 78% of respondents reported being currently employed in the computing field. Furthermore, nearly three quarters (70%) were interested in pursuing a Master's degree or were already enrolled in a Master's program.

Extramural support and funding

In addition to the ConocoPhillips High Performance Computing (HPC) hardware donation (approximate value: $141,000), ConocoPhillips provides a yearly cash donation of $500 for the College of Engineering to support the maintenance of the HPC hardware.

High demand job designation

In Anchorage and beyond, demand currently exceeds the supply of locally produced BSCSE graduates. This need is echoed by our Computer Science & Engineering Industry Advisory Board and state and national statistics. The U.S. Bureau of Labor and Statistics notes that Computer Technology Occupations are projected to grow 12 percent through 2028, much faster than the average for all occupations. The median annual wage in May 2018 was between $86,320 and $118,370, which is 2.2 to 3.1 times higher than the national average. Within the State of Alaska, the Department of Labor and Workforce Development projects an increase in demand for computer occupations of 3% through 2026.

2. **Program Demand (including service to other programs), Efficiency, and Productivity (7 year trend; 1400 words or less)**

Prior to AY2015, the BSCSE degree existed as one of three concentrations within the Bachelor of Science in Engineering (BSE) degree, the others being electrical engineering and mechanical engineering. It was difficult historically to keep track of which BSE students belonged to which concentration and accurate data are difficult to come by. Therefore, the data presented in the accompanying data sheet only pertains to students enrolled in the BSCSE program after AY2015, and students enrolled in the BSE with concentration CSE are left out of these values.

Student demand for our program is steadily increasing. Since its inception as a separate degree program in 2016, the BSCSE program has achieved significant growth in the number of majors, in alignment with the national trend. Although the number of degrees awarded remains relatively low, we expect that number to also grow substantially as more students make their way through the program. Students are also earning these degrees over fewer years and semesters.

Our department experiences lower pass rates for our lower level courses. We are currently addressing this situation by revising our curriculum to add a CSCE A101 requirement, which will provide a gentler introduction to programming. These pass rates for lower level courses are in-line with the national average of 68% for introductory computer science courses (Watson & Li, 2014). Once students pass the lower level courses, they achieve good pass rates in the upper level courses.

The number of in-major student credit hours (SCH) has nearly doubled since 2016. Out-of-major SCH is driven primarily by BSEE students and shows little trend.

We also draw out-of-major students due to other program dependencies. The BS Electrical Engineering program requires the following courses taught by Computer Science & Engineering faculty:
1. CSCE A201 Computer Programming I (or CSE A205)
2. CSE A205 Introduction to C Programming for Engineers (or CSCE A201)

3. CSCE A248 Computer Organization and Assembly Language Programming
4. CSCE/EE A241 Computer Hardware Concepts
5. Advanced engineering electives: CSCE A365, CSCE A445, CSCE A465

In addition to the BS EE degree, the BS Geomatics degree has a Developers track that requires the following courses:
1. CSCE A201 Computer Programming I
2. CSCE A222 Object Oriented Programming
3. CSCE A360 Database Systems

As another example, the CSCE A415 Machine Learning course attracts undergraduate and graduate students from across the university since it is a cross-disciplinary course that is in high demand. Students from biology and geomatics regularly enroll in other courses, such as CSCE A490 Geospatial Programming.

The Instructional Efficiency of our program is very strong. Based on our department student credit hours, our average annual Full Time Equivalent Faculty (FTEF) number is 6.5. Given our current staffing of about 5.3 faculty, we are demonstrating better than expected efficiency in delivering our classes.

For the UAA campus, SCH/FTEF is 463.5, Enrollment/FTEF is 168.1, FTES/FTEF is 15.7, and average class size is 17.7. For each of these metrics, our program numbers exceed the campus-wide values by 5.4%, 10.5%, 4.5%, and 8.5% respectively.

The gap between cost and tuition per student credit hour has closed from over $60 in 2015 to less than $30 in 2019. Though both values have increased over time, the Tuition Revenue/SCH increase has dominated, driven in part due to the "differential tuition" extra cost of 20% that College of Engineering students have paid over the last three years. This higher tuition also explains why our recent Tuition Revenue/SCH values are about 20% higher than the UAA values for those years.

External sources of revenue

Several of our faculty members are actively engaged in research activities. These external funding sources (e.g. NSF, NIH, NASA, NOAA Alaska Sea Grant) provide funding for undergraduate research projects, equipment, and faculty course buyouts.

3.   Program Quality, Improvement and Student Success (1500 words or less)

Accreditation and program quality

Since 2007, the BSCSE program (and its predecessor, the BS in Engineering with a concentration in CSE) has been continuously accredited by the Computing Accreditation Commission of ABET. This is a robust accreditation process with high standards. For instance, ABET Criterion 5 requires us to show that our curriculum is modern and rigorous, and Criterion 4 requires us to show continuous improvement in the extent to which student outcomes are being attained. At each required review period, we have met or exceeded these standards.

Currency of the curriculum

The BSCSE curriculum is continually reviewed and frequently updated to maintain high quality and relevance. For example, we recently added CSCE A101, Introduction to Programming, as a required class. This course will be taught using the Python programming language, a popular language and relatively easy to learn. Our goal is to improve the pass rate and increase student retention. This is in direct support of the UAA Strategic Plan 2020, Goal 2 of having more students persist and complete their educational goals.

Our Machine Learning class, CSCE A415, provides an example of a course in high demand both within and beyond the major. It currently has nearly 40 students enrolled, of which 15% are either graduate or undergraduate students in non-

computer science disciplines. These students have said that the machine learning class is highly relevant to their field, or that there is high demand for this expertise in their workplace. One of the fastest growing disciplines in computer science is machine learning. One of the reasons that it is in high demand is that machine learning is applicable across most engineering and science disciplines. ConocoPhillips is investing in high performance parallel distributed computers so that they can process terabytes of data using machine learning techniques. In addition, they donated more than $141,000 of equipment and time to the College of Engineering in support of educating students in machine learning and parallel computing skills. Graduating students will be able to bring those skills to Alaska's financial, oil & gas, and health fields in both the public and private sectors.

Innovative program design

There are several components of our program that are innovative. The BSCSE program bridges the gap between software and hardware, and so our program requires foundational coursework in both the Electrical Engineering and CSCE departments. We also added lab sections to the introductory level programming courses, CSCE A201 and CSCE A211. These lab sections used to be delivered by faculty, but we changed to hiring upper-level students to teach the lab sections. This resulted in increased efficiency and cost reductions without sacrificing the quality of delivery. Overall, these innovative changes have improved student learning and retention.

Distance course offerings

We have recently increased our distance offerings, both for UAA students, and also as part of an effort to increase collaboration with the UAF computer science department. We have delivered the following courses via distance: CSCE A201, CSCE A321, CSCE A342, CSCE A415, CSCE A448, and CSCE A490. These courses have been highly enrolled on both campuses.

Program Student Learning Outcomes

While data are collected and reviewed for all seven ABET Program Student Learning Outcomes (PSLOs), during the most recent academic year we chose to carefully assess Student Outcome 3: An Ability to Communicate Effectively with a Range of Audiences, Including Technical and Non-technical Audiences for Business, End-user, Client, and Computing Contexts. (NOTE: This outcome aligns closely to UAA GER Student Learning Outcome 1: Communicate effectively in a variety of contexts and formats.)

Our assessment results for PSLO 3 show a positive trend, as summarized by the following data from CSCE A470. The number of students achieving Excellent (E), Satisfactory (S), Developing (D), and Poor (P) in each category is given by the following:

a. Organization and Structure: E = 2, S = 2, D = 0, P = 0 (E/S 100%)
b. Content and Knowledge: E = 1, S = 3, D = 0, P = 0 (E/S 100%)
c. Effectively Communicates Details: E = 2, S = 2, D = 0, P = 0 (E/S 100%)
d. Visual Aids and Graphics: E = 2, S = 2, D = 0, P = 0 (E/S 100%)
e. Spelling and Grammar: E = 4, S = 0, D = 0, P = 0 (E/S 100%)
f. Delivery and Speaking Skills E = 2, S = 1, D = 1, P = 0 (E/S 75.0%)

This evidence suggests that our emphasis on communicating effectively resulted in marked improvement in our students' ability to communicate their project results to a general audience.

Student success and high impact teaching practices

We promote student success by requiring a capstone course, facilitate internship opportunities, and provide research experiences. Our CSCE A470 Capstone course requires students to utilize a broad range of skills to analyze, design, document, implement, and present a real-world project of moderate complexity under the supervision of an industry or faculty mentor.

Many students complete internships (CSCE A395 and/or CSCE A495) in a professional work setting. Others perform research under faculty supervision (CSCE A498). Recently, students have worked at internships at GCI Inc, the Federal Aviation Administration, and NASA Langley.

Student support and academic advising

For academic advising, the Computer Science & Engineering Department requires all students to meet with a faculty advisor (or visit the College Advising Center) each semester prior to registration. The purpose of this "mandatory advising" is to assure that students stay on the best path towards graduation.

Student accomplishments

Our student success can also be measured by their accomplishments. For instance, they consistently place in the 80th percentile for the ETS Major Field Test for Computer Science. This is a nationally administered exam, providing evidence that students leaving the department are well above average when compared with students from other institutions.

Our students have been recognized through competitive internships with organizations such as NASA Langley.

Our students are active in the UAA CyberSecurity club, Computer Science club, and Robotics club. These are all active clubs that provide additional learning and leadership opportunities for students. The CS club regularly hosts speakers both from within the department and outside (last semester they hosted a Visiting Fulbright Scholar from Pakistan). The UAA CyberSecurity club has recently had great success in national competitions, finishing 1st place in the National Cyber League Team Game (2019) and 4th place in the National Collegiate Cyber Defense Competition (2019). The UAA Robotics club was invited to compete in the 2019 University Rover Challenge (36 teams were selected out of 84 submissions).

4.   Program Duplication / Distinctiveness (300 words or less)

The University of Alaska Fairbanks (UAF) offers a BS program in Computer Engineering within the Department of Electrical and Computer Engineering. The UAF student body differs substantially from our students at UAA. UAF students typical live on campus and are full-time students, whereas our students frequently commute from Anchorage, Eagle River, or the Mat-Su valley and are working part-time or even full-time. Though there are similarities between the programs (as expected given they are both accredited by ABET), the UAF program has more of a focus on hardware/electrical engineering, whereas the UAA BSCSE program is more focused on computer science topics.

As mentioned above, we collaborate with the UAF department to offer common courses at the other campus using distance delivery. We have been at the forefront in such course sharing both in terms of the number of courses and volume of students. The UAF CS department has lost several faculty in recent years, and so such cooperation helps deliver courses efficiently and meet demand.

Even with the program at UAF, there are not enough graduates to fill the needs of Alaska employers. With 70% of UAA BSCSE graduates accepting employment in Alaska, growing the BSCSE program will result in more students placed into stimulating and lucrative careers.

5.   Summary Analysis (500 words or less)

The Computer Systems Engineering program at UAA is growing rapidly, helping to fill an urgent gap in computing professionals within the state of Alaska. Since its inception as a separate degree program in 2016, the BSCSE program has shown significant growth and our students have little trouble finding employment within the state, specifically Anchorage. Moving forward, we expect the number of students enrolling in UAA's BSCSE program to grow substantially over the next several years. We have strong demand from students to continue to offer our high-quality degrees, and we are delivering the degrees with higher than average SCH/FTEF and Enrollment/FTEF ratios.

Computer Systems Engineering is currently among the best career choices in the US. Looking forward, we hope to continue to expand the number of students graduating from our degree programs through outreach and recruitment efforts. By increasing the number of students graduating with computing degrees, we can help to fulfill the needs of Alaska employers and enable Alaskans to contribute meaningfully to the betterment of society. To help make our graduates competitive, we will maintain the high quality of teaching, course offerings, and supporting organizations such as student clubs and the newly created Alaska Data Science and AI Lab.