Computer Science

Program Review

Self Study

Spring 2009

Cover Page

Certification and Signature Page

Signature Date

_____ _____

William J. Wolfe, Ph. D.
Professor and Chair, Computer Science
CSUCI

_____ _____

Ashish K. Vaidya, Ph. D.
Dean of the Faculty

_____ _____

Dawn Neuman
Provost and Vice President of Academic Affairs

Executive Summary and Recommendations

Although it has been very challenging to design, evaluate, and re-design the computer science program while in a state of constant growth, with only a few full time faculty, and in the midst of rapid technological advances, the program has been incredibly successful. It is amazing how much has been accomplished, including 42 BSCS graduates, over the past few years. Since its inception the program has been challenged to keep up with rapid technological changes in the computer industry such as the aftermath of the Dot-Com bust, the rapid emergence of the Computer Gaming industry, and the sudden proliferation of hand-held network computing devices such as cell phones, games, iPhones, and Blackberries. However, with the cohesive efforts of excellent instructors, professors, students, and staff we have managed to build a thriving, cutting edge, computer science program, one that is making a name for itself and attracting students from all over the state of California.

The BSCS program is a rich integration of hardware, software, and mathematical methods, including much hands-on lab experience and several co-curricular activities such as field trips and programming contests. The program will be further enriched by the assimilation of the BSIT and the BSCE programs. They are on the master plan for implementation in 2010, 2011 respectively. The cross pollination that will occur between these related programs will further energize the learning environment, enriching the experience for students and faculty alike.

The BSCS students are thriving at CSUCI in many ways:

- They have ample opportunity to work as tutors and lab assistants, and for the campus IT division.
- Most students are employed part time in the computer industry by the time they are juniors or seniors in the program.
- They have excellent job opportunities when they graduate, even in the current "down market".
- They have the opportunity to compete in programming contests, including the CSUCI Programming Guru contest and the Regional ACM contest each year (Designed, organized, and implemented by Anna and AJ Bieszczad).
- They have access to newer, state of the art, equipment in most CS classes.
- They can participate in the Computer Club, including picnics and gaming nights.

Despite the successes, there are several glaring holes in our plan for future growth. If we are to continue our successful path, the program needs:

- Increased numbers of tenure track faculty. Currently we have 3 TT faculty and 97 majors. We will need several more TT faculty to keep the momentum going, and before we can apply for ABET accreditation. In particular, we have 1 associate and 2 full professors. We need a couple of assistant professors to add some balance.

- Increased lab space to accommodate growth in the programming, networking, embedded systems and robotics labs. Currently, the networking lab is maxed-out, forcing students to work in shifts, and the embedded systems lab is just a work bench crammed into the corner of the networking lab. We especially need a state of the art embedded systems lab, with appropriate equipment and facility design, include anti-static surfaces and sufficient floor space to perform robotic experiments.

- Increased resources (labs and faculty) to support the integration of the BSIT and BSCE programs as they become state-side programs in the next two years.

- Increased funding for student assistants. Currently we spend three times the budgeted amount on student assistants. We compensate by using funds from other sources to pay for the overrun. This is not a sustainable plan. The student assistants provide tutoring and technical assistance in the labs but more importantly they develop long lasting peer relationships, a very valuable part the student experience.

- Increased support for faculty research. The field of computer science is rapidly evolving, and as a result the faculty need more time to hone their skills and develop their research agendas, and improve their teaching techniques, learn about emerging software tools, etc., without which they will quickly become ineffective in the classroom.

- Support for the excellent co-curricula activities such as programming contests and field trips. This is an extremely important part of the program. Currently, AJ and Anna Bieszczad work on "overload" to design and implement these activities.

- Support for out-reach activities, including open house sessions and visits to feeder schools so we can get the word out to high school and community college students about the opportunities at CSUCI.

- Increased support for offering required classes each semester. Without these scheduling options students have a difficult time graduating within 4 years.

Table of Contents

List of Exhibits and Attachments

Appendix A: BSCS Program Flow Charts

Appendix B: BSCS 4 Year Graduation Road Map

Appendix C: Lab Development Plan

Appendix D: Student Survey Results (Spring 2009)

Appendix E: Institutional Research Data Sheet

Appendix F: Student Emails (Sample)

Appendix G: Computer Science Assessment Plan

Appendix H: Instructor Qualifications

Computer Science Self Study Report

Introduction and Overview of the Computer Science Program

The Computer Science Program offers a Bachelor of Science in Computer Science (BSCS), a degree program that has grown from about 20 majors in fall 2002 to about 97 majors today. The BSCS degree program has undergone continuous evaluation, modification, and improvement, including the development of new courses, new requirements, and new options.

The focus of this "self study report" is to evaluate the effectiveness of the BSCS degree program, but to put things in perspective it should be noted that there are 3 other degree programs, under the same chair, that are often referred to as part of the "computer science program".

Computer Science Program				
Degree Program	**Inaugural Year**	**Abbrev.**	**Admin.**	**Notes**
Bachelor of Science in Computer Science	2002	BSCS	State-Side	
Bachelor of Science in Information Technology	2004	BSIT	Extended Education	*State-Side: 2010*
Master of Science in Computer Science	2005	MSCS	Extended Education	
Bachelor of Science in Computer Engineering	*2011*	BSCE	State-Side	*Planning Stage*

What we call the Computer Science *Program* might also be called the Computer Science *Department*. To add the proper context we will describe all the activities and degree programs that come under the umbrella of the *computer science program* (see figure 1).

The BSIT and MSCS degree programs are currently administered via the Office of Extended Education and have about 25 and 35 majors respectively. The BSIT degree program is on the CSUCI master plan to become a state-side program in 2010. The BSCE degree program has not been offered yet but we are currently finalizing the design and completing the "long form". The BSCE is on the master plan for 2011.

The BSIT degree program is somewhat unique in the CSU and worthy of a few comments since it has a growing synergistic relationship with the BSCS degree program and is a good example of how closely we work with the local community colleges. Originally, the BSIT was developed as an extension program based on a "2+2" agreement with the community colleges under the auspices of an NSF grant. The main goal of the BSIT program is to provide a 4 year degree path for students who emphasize technology areas at the community colleges (e.g.: associate degree computer technology or networking). Such students typically take vendor-specific courses/training, such as Microsoft and Cisco Certification courses, course work that does not usually transfer to a

university program. Until the advent of the BSIT program at CSUCI these students did not have a clear academic path in the CSU system. Typically, they would have the choice of majoring in Computer Science/Electrical Engineering or Business/Information Systems at a CSU but those programs are not a good fit for these students. The BSIT degree at CSUCI was created to fit the gap between these extremes. As a result, the BSIT degree requires a basic scientific and mathematical background, but it is not as comprehensive as computer science or engineering requirements, and integrates business courses with technical courses while emphasizing the fastest growing segments of modern computer technology: web systems, database systems, and network analysis. Although the BSIT program is currently administered via Extended Education, students in the program take most of their required units as state-side classes, and about 12 units via extension courses, so the upcoming (2010) transition to state-side should be easy.

Since the introduction of the BSIT program (2004) the core CS courses typically have a mix of BSCS and BSIT students. This mix has been very beneficial to both programs since BSIT students have specific skills, typically of the "vendor-specific" type, that BSCS students typically do not have, while the BSCS students have a higher level of analytical skills to share. Being that both programs are relatively small, they have also helped each other by providing a sufficient number of students to run classes that might otherwise have been canceled due to low enrollment.

Along with advising and instruction for the computer science and information technology majors, the Computer Science Program also offers computer literacy and upper division interdisciplinary GE courses that service the full spectrum of student majors. This includes COMP 101 Computer Literacy, a required course (or its equivalent) for all CSUCI majors, and upper division interdisciplinary electives such as COMP 337 Survey of Computer Gaming, a popular course for all types of majors, COMP 447 Societal Issues in Computing, a popular course for all types of science majors, and COMP 449 Human Computer Interaction, a popular course for Psychology majors.

The Computer Science Program currently supports about 145 FTES per semester, having grown from about 30 FTES in 2002.

In addition to classroom lecture instruction, the Computer Science Program oversees multiple laboratories. The labs are used for computer programming (with specialized software), computer networks (with specialized networking workbenches and related gear, including routers, hubs and switches), embedded systems (robotics and other devices such as cameras and sensors), and servers (Mac, Window, and Linux) that provide a variety of services for instructional and research purposes. The Computer Science Program works closely with the CSUCI IT Division to maintain the labs and provide seamless network and other services to students, as well as efficient and timely equipment purchasing.

The Computer Science Program also:

- Manages its own website. The website, developed and maintained by Professor Bieszczad, has been mentioned by several prospective students, parents, and faculty members as a valuable resource:

  http://oak.cs.csuci.edu/cms/

- Supervises approximately 10 student assistants each year. The assistants support open lab time with tutoring and technical services, including more advanced network and server maintenance and management.

- Offers co-curricular activities such as on-campus programming contests, trips to the regional ACM contests, and trips abroad to visit other universities. These activities are currently organized by AJ and Anna Bieszczad.

- Provides referrals for CS and IT students seeking jobs on the campus, typically with the IT Division.

- Provides referrals for CS and IT students seeking jobs with local industry.

- Supports the Minor in Computer Science.

- Supports the Minor in Computer Game Design and Development.

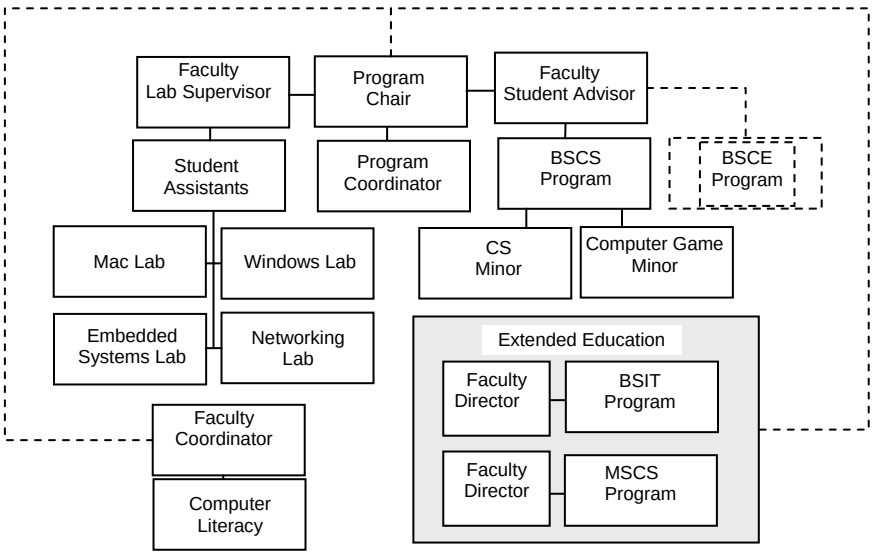

Figure 1: Overview of the Computer Science Program and its related parts. The Computer Science Program as we call it here at CSUCI might be called The Computer Science Department at other schools.

I. Defining Program Purposes and Ensuring Educational Outcomes

Element I Defining Purposes and Practices and Ensuring Educational Outcomes

The program defines its objectives and establishes educational outcomes aligned with its goals and the university mission.

Criteria I.1 Statement of Purpose and Operating Practices

The program has a statement of purpose and operating practices.

The goals of the BSCS degree program are driven by a combination of forces. Developments in Science, Business, and Industry shape most of the applications of computer science, including highly interdisciplinary ones, while an international accrediting agency (ABET) provides specific academic guidelines. Our goals include the preparation of students for future careers, including graduate work and long term professional development.

> **Computer Science Program Mission Statement**
> The Computer Science degree offers the latest cutting edge education for various industrial and applied fields. Students are given a strong background in computer hardware and software, as well as substantial hands-on experience. The program stresses interdisciplinary applications in other sciences and business and prepares students for graduate studies.

The BSCS program provides students with a rich set of theoretical and analytical skills while also providing hands-on laboratory experience with specific hardware, software, and computer systems. The analytic skills and hands-on experience prepare them for industry applications, while the depth of mathematics and science helps them succeed in future studies such as in graduate school. The students also work in teams, develop a capstone project, analyze societal issues related to computing, take a variety of upper division technical electives, and take 9 units of upper division interdisciplinary GE course work.

I.1.1 ABET

ABET (Accreditation Board for Engineering and Technology) is an external agency that accredits several types of engineering and technology programs, in particular they accredit undergraduate CS and IT programs. ABET publishes "Criteria for Accrediting Computer Programs", a document that provides broad guidelines for Computer Science and Information Technology programs:

http://www.abet.org/

We have designed our CS and IT programs in anticipation of seeking ABET accreditation some time in the future.

Criteria I.2 BSCS Degree Program Educational Objectives

The program has clearly stated educational objectives and has developed indicators of evidence to ascertain the level of achievement of its purposes and educational outcomes.

The computer science learning objectives are broad statements that describe the types of professional accomplishments that we expect of graduates.

BSCS Degree Program Learning Objectives	
1	Demonstrate critical thinking and problem solving skills by identifying, evaluating, analyzing and presenting fundamental software solutions and their applications.
2	Demonstrate the knowledge of current computing practices and broad technology use in industry and society, including a working knowledge of software development techniques.
3	Be cognizant of emerging new technologies and industrial practices connected to the computer industry.
4	Demonstrate communication, research and cooperation skills by working effectively with others in interdisciplinary group settings - both inside and outside the classroom.
5	Demonstrate a sense of exploration that enables them to pursue rewarding careers in high-tech industries with life-learning.

I.2.1 Distinctiveness of CSUCI BSCS Program

Our computer science program is distinctive in many ways. We have stressed small classroom sizes for core classes, a high level of student-faculty interactions including programming contests and field trips, interdisciplinary experiences from upper division GE classes and project classes, and a rich mathematical experience. Our laboratory classes are small and supported by student assistants to encourage peer and mentor learning experiences that supplement classroom instruction.

I.2.2 Relation to University Mission

CSUCI Mission Statement
Placing students at the center of the educational experience, California State University Channel Islands provides undergraduate and graduate education that facilitates learning within and across disciplines through integrative approaches, emphasizes experiential and service learning, and graduates students with multicultural and international perspectives.

The BSCS degree program objectives dovetail nicely with the university mission. Our primary emphasis is on excellence within the discipline but we capitalize on the many applications and projects that demand more than superficial understanding of other disciplines and domains. Applications of computer science to mathematics and other sciences are typical examples of student computer projects, but many projects go beyond the nearby sciences, such as projects in psychology (e.g.: human computer interactions) and sociology (e.g.: social behavior in computer gaming). Website development, a very

common computer science project, usually requires that the student obtain more than a passing knowledge of the website sponsor's domain.

Almost all computer science majors, often before they are upper division students, have employment that relates to their major, including internships. This provides many of the students with ample experiential/service service learning to compliment their academic experience. It is in the nature of technical fields such as computer science to attract international students, especially ESL students, since that is one of the quickest ways to excel. Computer science majors are often an eclectic bunch, many foreign born. Furthermore, the computer science program sponsors international trips, the most recent being summer trips to Hidalgo, Mexico, and Jajaning, Poland, with more trips in the planning stages.

I.2.3 Indicators of Student Achievement

The primary evidence of student achievement is their academic performance in the required classes as indicated by official grades and project evaluations. However, we have several other indicators.

1. Participation in on-campus programming contests.
2. Participation in the ACM regional contest, which includes preparation and practice sessions.
3. Membership and participation in the Computer Club.
4. Successful completion of a Capstone Project, including presentation.
5. Employment as a student assistant, tutoring junior students in the labs.
6. Employment in the campus Division of Information Technology.
7. Employment in computer-intensive jobs outside the campus.
8. Participation in trips abroad to visit other universities.
9. Involvement in student research, working closely with a professor (e.g.: UNIV 498).

All of these indicators are taken into account, for example, when the program selects students for "Program Honors" each academic year. The students who receive this award are seniors who have demonstrated excellence not only in terms of grade point average (gpa) but also via participation in most, if not all, of the indicators listed above.

Criteria I.3 Publication of Academic Goals, Programs, and Services

The program accurately publicizes its academic goals, programs, and services to students, with the university and to the larger public.

The computer science mission statement, program goals, and learning outcomes are readily available on the CSUCI website:

http://oak.cs.csuci.edu/cms/

Below are screenshots of just a few of the many web pages that describe and promote our programs. Along with photos and contact information of the instructors, the website

publishes the learning goals and promotes student activities such as contests, trips, and club functions. We receive many compliments about the value and effectiveness of this website (developed and maintained by Professor AJ Bieszczad).

Figure 2: Screen captures from the computer science website.

II. Achieving Educational Outcomes

The program achieves its educational objectives through teaching and learning, scholarship and creative activity, and support for student learning. It demonstrates that these objectives are performed effectively and that they support the University's efforts to attain educational effectiveness.

Criteria II.1: Expectations for Student Learning

The program's expectations for learning and student attainment are reflected in its academic programs and policies, including curriculum requirements.

The BSCS degree program (122 units) is a very rigorous program with extremely high expectations. The first evidence of this is in the curriculum requirements, including advanced mathematical requirements. With the addition of 12-14 units of additional advanced mathematics the student can earn a dual degree in both computer science and mathematics, which many students do. The student is expected to master advanced hardware, software, and mathematical concepts defined in the required course work (i.e. the *core* courses). In addition, students are required to take 9 units of upper division technical electives, a year and a half of lab science, a course on societal issues, and a capstone preparation/project sequence. The students are also required to have a grade of "C-" or better in all prerequisite courses (this is a recent modification).

II.1.1 Summary of the BSCS Degree Program Curriculum Requirements

It is helpful to view the BSCS curriculum as having 3 fundamental *threads*:

1. Hardware: This thread provides the core knowledge of how computers work "under the hood".
    a) Comp 162 Computer Architecture and Assembly Language
    b) Comp 262 Computer Organization and Architecture
    c) Comp 362 Operating Systems

2. Software: This thread provides the core knowledge of software design, development, testing and implementation, including proficiency in at least one computer programming language (Java) and a comparative study of several modern programming languages.
    a) Comp 150 Object Oriented Programming
    b) Comp 151 Data Structures and Program Design
    c) Comp 232 Programming Languages
    d) Math 354 Analysis of Algorithms
    e) Comp 350 Software Engineering

3. Mathematics: This thread supports the other threads by providing the mathematical abstractions and analytical skills required to master difficult design and technical concepts.
    a) Math 230 Logic and Mathematical Reasoning
    b) Math 150 Calculus I

c) Math 151 Calculus II
d) Math 240 Linear Algebra
e) Math 300 Discrete Math
f) Math 352 Probability and Statistics
g) Comp 454 Automata (Theory of Computation)

In addition to successfully completing these threads the student must also complete Comp 464 Computer Graphics or Comp 420 Database Systems, and take 9 units of upper division technical electives chosen from a list of courses such as:

Comp 429 Networks
Math 448 Scientific Computing
Comp 345 Digital Imaging
Comp 469 Artificial Intelligence
Comp 452 Computational Bioinformatics
…….
(the list of all elective choices is available in the catalog and on our website).

To further ensure that CS students develop a deep understanding of science, they are also required to take either

a) 1 year of calculus-based Physics and an additional lab science class
or
b) 1 year of Biology and 1 semester of calculus based Physics.

This is a recent change to our program. Previously, there was a wide set of science requirement options, but after careful consideration the faculty decided that knowledge of physics was specifically required for understanding the hardware aspects of computer science and networking, while knowledge of biology has become more and more important in modern scientific advancements.

The student must also complete Comp 447 Societal Issues in Computing, Comp 491 Capstone Preparation, Comp 499 Capstone Project. The capstone sequence, the result of much faculty reflection on the overall goals of the program, includes working in teams and making a final presentation to a wide audience. Team work is also emphasized in Comp 350 Software Engineering, a prerequisite to the Capstone sequence.

The students are also required to take 9 units of Upper Division Interdisciplinary General Education classes. 6 units can be "Comp" but the other 3 cannot. Since Comp 447 is an UDIGE course the CS majors have 3 units of UDIGE designed into their BSCS program.

Criteria II.2: Learning Outcomes are Assessed and Evaluated on a Regular Basis

The program has identified its program learning outcomes and these are widely available to faculty, students and external stakeholders. Its learning outcomes are assessed and analyzed on a regular basis. Where appropriate, evidence from external constituencies such as alumni, employers and professional societies is included in such reviews.

The learning outcomes in the computer science program are frequently evaluated, often sparked by an email thread that brings up a timely concern. All of the computer science course learning goals, and some of the historical BSCS program modifications, can be found on the www.csuci.edu website at:

http://senate.csuci.edu/comm/curriculum/programs/computerscience.htm

Criteria II.2.1 Recent Program Evaluation and Modifications

Program modifications have been submitted each year since the program's inception. Examples of recent modifications include, with justifications that were approved by the curriculum committee:

1. **Require C-:** A crucial factor in student success is their level of preparedness for advanced courses in their major. A grade lower than C- indicates that the student has not sufficiently mastered the material necessary to move up to the next level of course work. A student who gets a grade lower than C- is better off retaking the course. This will also help the instructors of advanced courses because they will not have to do extensive amounts of review and will allow them to cover the advanced material in a proper manner.
2. **3 Additional Technical Elective Units:** The field of Computer Science is wide and deep. We feel that the current curriculum lays a solid foundation, but we also believe that the student needs more exposure to advanced topics to be sufficiently prepared for industry or graduate school. To obtain that experience the student must take a couple of additional upper division electives. These electives would be chosen from such courses as Computational Bioinformatics, Unix, Advanced Object Oriented Programming, Artificial Intelligence, Embedded Systems, Digital Image Processing, Operations Research, Technical Writing and other advanced topics in Computer Science. These additional courses will help solidify the depth and breadth of the student's undergraduate experience. To offset the increase in total units to the program, we also move Math 448 from a required course to an elective course. Since Math 448 is an Upper Division Interdisciplinary class and as such students will be inclined to take it as an elective choice anyway.
3. **Revised Science Requirement:** First of all, the current catalog wording for the science requirement is ambiguous. The phrase "with lab" is in parentheses, and students (and advisors) have difficulty making the correct associations. To clear that up, and to customize the requirements to more closely fit the needs of the computer science student, we have identified specific science courses that we feel have the most relevance to the computer science major, while also keeping the GE requirements in mind. To that end we identified two sets of science courses that

would serve the needs of the CS student well: Physics I and II, plus one additional course from GE section B2; OR Physics I, Biology 200, and Biology 212. Either of these sequences would provide the CS major with an excellent science background while also satisfying GE requirements.

4. **Revised Computer Science Minor:** We have revised the CS minor to be in line with the required 9 units of upper division course work that is required of all minors, while retaining the same number of total units (23). We achieved this by removing the lower division Math 230 requirement and adding an additional upper division elective.

Criteria II.2.2: New Courses Added to the Program Since Inception

Past program modifications include the introduction of several new courses

Comp 110	Computer Literacy for Educators
Comp 221	Introduction to Unix and C for Programmers
Comp 337	Survey of Computer Gaming
Comp 351	Distributed Computing
Comp 421	Unix for Programmers
Comp 425	Computer Game Programming
Comp 437	Foundations of Computer Game Development
Comp 462	Embedded Systems
Comp 491	Capstone Preparation
Comp 499	Capstone Project

Criteria II.2.3: Evaluation and Modification of the Hardware Thread

An example of our regular evaluation and improvement of the BSCS program is the recent re-evaluation of the hardware thread. After considerable discussion and debate it was decided that the hardware sequence (162-262-362) needed more breadth and depth. To build up that thread we added Comp 462 (Embedded Systems) and Comp 351 (Distributed Computing) as upper division electives that students could choose to deepen their knowledge of hardware systems. In addition, the hardware sequence requires some knowledge of C programming, a skill that most computer science students can acquire when they need it but it creates awkwardness for the instructors as they have to make special arrangements for those students who have very little C programming skill and are unable to acquire it in a short time. To alleviate this problem we created Comp 221 (Introduction to Unix and C) as an elective that students could take to strengthen their C programming skills before or during the hardware sequence, and we also introduced Comp 421 as an elective that students could use to strengthen their skills in systems level programming.

Criteria II.2.4: Evaluation and Modification of the Capstone Sequence

Another area that we focused on as a weakness in the program that needed strengthening was in the area of capstone project. Originally the program required only 1 unit of course work to complete a team project (it was called "Senior Colloquium"). Faculty agreed that if the student were to develop meaningful team projects and presentations then they would need a 2 semester sequence. As a result we added Comp 491 (1 unit) and Comp

499 (3 units) as a 4 unit sequence, with 1 unit for Capstone Preparation as a prerequisite for 3 units of Capstone Project. This allows sufficient time for the instructor to guide the students in a team project and presentation.

Criteria II.2.5: Industry and Partners

We are often in contact with industry representative who offer their ideas on what constitutes a solid computer science curriculum. That includes discussions with many industry representatives, including:

- David Balaban, Systems Informatics, Amgen.
- Ron Reiger, CEO of Reiger & Milliken Associates.
- Puneet Sharma, Network Manager for the Oxnard Union High School District.
- Avi Carmi, Global Systems, Inc.
- Kevin Craig, Division of Information Technology, CSUCI.
- Peter Mosinskis, Web Development, CSUCI IT Division.
- Stefan Lauxtermann, Teledyne Imaging, Camarillo, CA.
- John Andelman, Citrix Online.
- Peter Tabor, Navy Base Ventura.
- Jonathan Hops, Teradyne, Agoura Hills, CA.

Reiger, Sharma, Carmi, and Craig are also adjuncts who teach computer science courses in our program. Many of these industries have hired our students and have a first hand knowledge of the effectiveness of our educational methods.

Criteria II.2.6: Student Partners

Students are also encouraged to comment on the program. As an example please see the email from student Douglas Whitesell to the chair.

In the recent anonymous survey (see Appendix) students had a lot to say about the BSCS program. 27 students responded: 15 seniors, 5 juniors, 4 sophomores, and 3 freshman. Here is a compilation of the observations, comments, and suggestions that they submitted.

In the "strengths" category:

- Several students commented on:
    - Best faculty, great teachers, teacher passion, knowledge, availability, concern for students, willingness to help, with particular note of excellent teaching in Comp 150, 151 (instructors AJ and Anna Bieszczad) and Comp 232, 350 (instructor Kevin Craig).
    - Small class sizes, individual attention.

- Isolated comments addressed these strengths:
    - Online classes.
    - New equipment.
    - Chance to work with 3 different operating systems.

- Broad range, variety of topics in the curriculum.
- Program prepares students for flexible career options.
- Tutoring lab.
- The many opportunities to get involved outside the class.
- Interaction between lower and upper division students.
- The high standards.

In the "weaknesses" category:

- Three or more students commented on these perceived weaknesses:
  - Class availability and scheduling problems (6 students).
  - Some instructors are not that good (3 students).
  - Lack of a C/Unix program requirement (3 students).

- Isolated comments addressed these perceived weaknesses:
  - Too much focus on software instead of hardware.
  - Incompatibility problems between home and lab computers.
  - Program is not focused enough on workplace skills.
  - A lot of time consuming work.
  - Inconsistencies from teacher to teacher.
  - Need improved web space for ASP, JSP, PHP.
  - Algorithms (Math 354) should be a CS class, with more programming.
  - Class level/depth should be higher/deeper.
  - Automata should not be an online class.
  - Need stricter grading and prerequisites.
  - Need better public relations about the great CS program.
  - Long class sessions should be shorter, meet more frequently.

In the "comments" category:

- Really good department, but could be amazing.
- Program going in the right direction.
- Thank you!
- I am enjoying the CS major.
- Would like to share what I have learned with younger students.
- Program should have more for overachievers to do.
- Most students are not interested in going beyond the classes.
- Move away from Java to C#.
- Comp 162 is difficult to do in one meeting per week.
- Make sure a class is ready, with clear lab manuals, before offering.
- Some teachers use power point exclusively -- not a good strategy.
- A tentative next semester schedule would be useful.

We are still evaluating these observations and suggestions. Most of the comments are encouraging, but a few of them point to specific concerns that we will be addressing in the near future. The raw, unedited, comments are in the Appendix.

Criteria II.3: Alignment of Course and BSCS Program Learning Outcomes

Course learning outcomes are aligned with program learning outcomes disseminated to students and to faculty, including adjunct faculty.

The BSCS Degree program learning outcomes are printed below and are available at:

http://faculty.csuci.edu/william.wolfe/csuci/assessment/Chair_ASP/HighLevelLearningGoals.asp

The computer science learning outcomes are specific statements of the capabilities, skills, knowledge, and behaviors that we expect of our graduates.

Program Learning Outcomes	
1	Demonstrate understanding of algorithms.
2	Demonstrate understanding of data structures.
3	Demonstrate understanding of software design.
4	Demonstrate understanding of programming language concepts.
5	Demonstrate understanding of computer organization and architecture.
6	Demonstrate awareness of the evolution of computer science.
7	Demonstrate the ability to solve computing problems.
8	Demonstrate knowledge of a variety of programming languages.
9	Demonstrate proficiency in at least one high level language.
10	Demonstrate understanding of discrete mathematics.
11	Demonstrate understanding of differential and integral calculus.
12	Demonstrate understanding of probability and statistics.
13	Demonstrate ability to collect, analyze and interpret data.
14	Demonstrate awareness of emerging technologies.
15	Demonstrate ability to use available software development tools.
16	Demonstrate knowledge of principles of software design and development.
17	Demonstrate ability to apply software design principles to real problems.
18	Demonstrate ability to communicate effectively.
19	Demonstrate ability to work in a team environment.
20	Demonstrate understanding of the societal impact of computing.
21	Demonstrate understanding of professional and ethical considerations.
22	Be competitive in the job market or be admitted to a good graduate program.
23	Demonstrate ability to acquire new knowledge and engage in life-long learning.

As the program goals and outcomes indicate, our BSCS degree program integrates deep technical and scientific knowledge with communications, ethical, and interpersonal goals.

We have developed a survey mechanism for evaluating how well the program goals align with course learning outcomes. It asks each instructor to rate the depth of the course in each of 23 learning outcomes. Here is a screen shot of the survey web page for Comp 232:

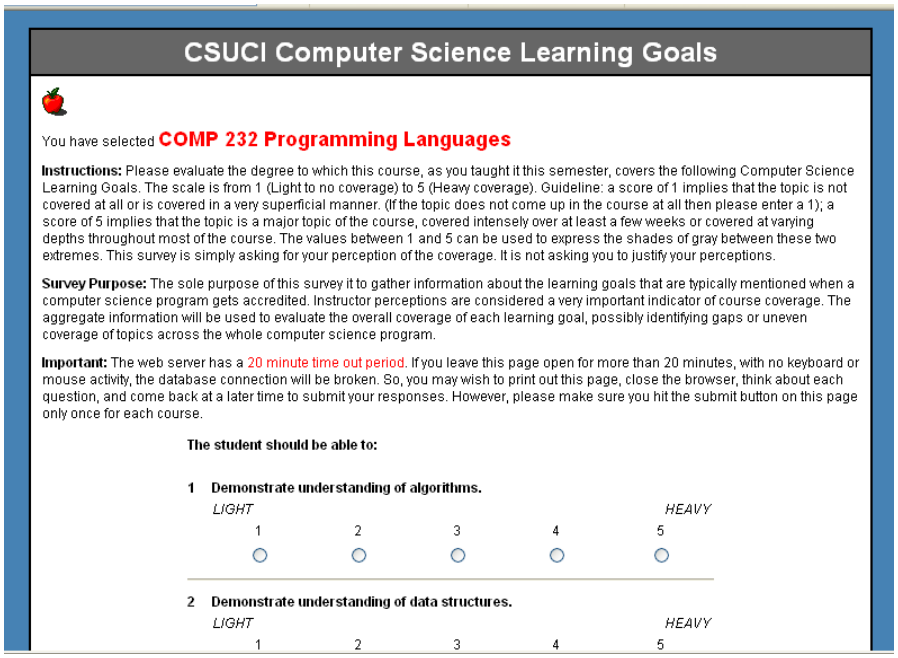

Figure 3: Screen capture of the course questionnaire page.

One of the outcomes of this evaluation is that there does not appear to be a tight connection between the required math and the required computer science. The conventional wisdom is that the mathematical training provides the students with a sufficient set of tools to deal with the high level of abstractions required in advanced hardware and software design. However it is not clear that students are using their advanced mathematical skills in the advanced computer science classes, at least not at the undergraduate level. This is an issue that we will be evaluating more closely in the future, in close consultation with the Mathematics faculty.

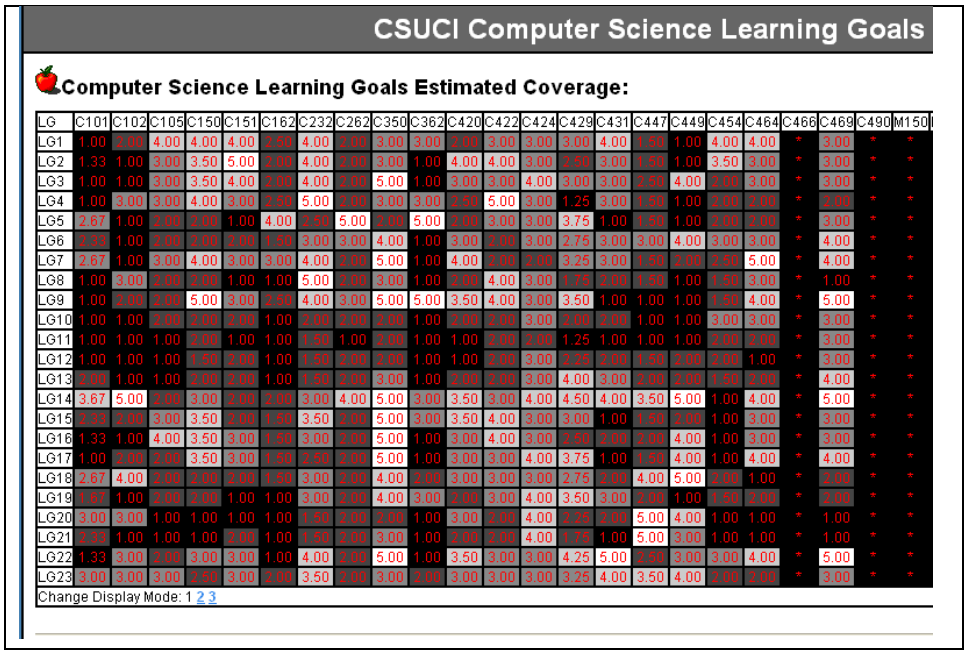

Figure 4: Screen capture of the "learning goal mapping to course" web page.

Criteria II.4: Students Actively Involved in the Learning Process

The program actively involves students in the learning process, challenging them with high expectations, and providing them with appropriate feedback about their performance and how it can be improved.

Students are tested and graded in each of their courses, providing valuable feedback about their progress in the program. Many of the core classes are configured as hands-on labs with lots of exercises that require in class performance that is supervised by the instructor with the help of tutors and student assistants. This creates an engaging environment where students learn that they must come to class ready to participate.

Students must complete several lab assignments in Comp 150, 151, 350, 362, and 429. In addition they must complete the capstone sequence where they design and implement a project, and make a presentation to a wide audience, including CS faculty, at the end of the semester.

Senior students are expected to present their capstone projects at the end of the spring semester at a campus celebration in the Library (see figure 5).

Figure 5: Photos of student presentation of capstone projects, spring 2008.

Criteria II.5: Graduates Consistently Achieve Expectations

The program demonstrates that its graduates consistently achieve its stated levels of attainment and ensures that its standards are embedded in criteria faculty use to evaluate student work.

The primary evidence that our BSCS graduates consistently achieve stated levels of attainment is that they succeed in the rigorous curriculum and participate in co-curricular activities, and the fact that they are highly sought after by the computer industry. The vast majority of the graduates are employed in the computer industry or are going to graduate schools (or both). Two of our BSCS graduates are currently in the computer science Ph. D. program at UCSB, while others are working for companies such as:

- Countrywide
- Amgen
- Government Center
- Getty Museum
- Haas Engineering
- Citrix Online
- U.S. Navy (Civilian)
- IBM (Internship)

Many of our students, and graduates, work for small computer companies, a long list of which were indicated in the recent survey (see Apendix). Many of our graduates are attending graduate schools; several are in the MS/CS program at CSUCI. A few of our BSCS graduates have stayed on at CSUCI to work full time for the Information Technology Division here on campus. The chair receives regular phone calls and emails

from local industry seeking our students and graduates and such requests indicate that the demand for computer science graduates far exceeds the supply.

The following quote from the 3/25/2008 Computing Research Association Bulletin reporting on an employment survey describes the CSUCI CS graduates fairly accurately:

http://www.cra.org/wp/index.php?p=141

> "*CS graduates were most likely to be employed in business and industry and to be working full-time. At the bachelor's level, 82% of CS majors were employed in business and industry and 91% of them (along with engineering majors) had full-time jobs. At the master's level, 76% worked in business/industry and 93% had full-time jobs.*"

Many of the computer science courses are based directly on a standard text book in the field. Most of the instructors use such texts and test/grade the students according to those standards, standards that match the learning outcomes listed for that course.

Sample student projects can be found at:

http://oak.cs.csuci.edu/cms/index.php?page=capstone-projects-2008

Criteria II.6: Program Contributes to the Mission-based Elements of CSUCI

The program contributes to the mission-based elements of the University such as internationalism, interdisciplinarity, service learning and civic engagement, and multiculturalism, and general education, as appropriate to the discipline.

The BSCS degree program contributes to the mission-based elements of the University in a variety of ways. BSCS students have been on trips to Mexico and Poland to visit with universities there. Many computer science projects require a wide knowledge of other disciplines, and students are provided several science classes to provide the underpinning necessary for branching out into other application areas. Computer science projects often address concepts from other disciplines. Civic engagement is not typically promoted in the BSCS program since that area is covered in other GE components of the curriculum, but oftentimes a computer science student is asked to set up a website for an organization involved in civic engagement. Service learning is another area that does not so easily apply to computer science since most computer science students are gainfully employed and get most of their experience from paid positions. Multiculturalism is often a component of the computer science experience since the field attracts many students from other countries, which plays a role when students form teams in the software engineering and capstone project classes. Again, the GE components of the curriculum address this issue better than the BSCS degree program.

Criteria II.7: Timely Degree Completion

The program demonstrates its academic degrees can be completed in a timely fashion.

The BSCS degree program demonstrates that the degree can be completed in a timely way by publishing a four year plan of study in the catalog (see Appendix). Students have access to the Student Advising Office where professional advisors work with them to explain degree requirements and the need for effective planning and scheduling. They also have access to academic advisors in the computer science program, as well as access to the chair.

Due to our small size, some classes are offered only once a year and some classes are canceled because of low enrollment. And, it is rare that we offer multiple sections of upper division computer science classes because of our size, so students do not generally have a wide set of options. This has created some scheduling problems for students, but special independent and directed studies have been created to fill these gaps. We also offer some classes in the evening, and some online, to help students with scheduling problems.

Several factors play a role in class availability and scheduling:

- Small size of the program limits the number/frequency of offerings.
- Students often have part time jobs that they are scheduling classes around.
- Students enter the program with varying degrees of prior preparation, especially the transfer students (more than 60% of our students are transfer students).
- Part time instructors from instructors have restricted time availability.
- Full time instructors need reasonable schedules for their workload impact.
- Coordination with other programs can be difficult.

The results of a recent student survey (see Appendix) indicate that class availability/scheduling is a "hot button" for students. Students complain that classes are not offered often enough and/or are not scheduled at the best times. We have been doing our best to offer a sufficient set of classes, at convenient times, each semester but we are hamstrung by low enrollments and limited funding which causes us to offer one section of some classes only once per year. Students who need a specific course for graduation are often accommodated either by offering a special directed study course (sometimes without instructor compensation) or by making other special arrangements.

Some of the things we have done to address these scheduling issues:

- Broadcast (blast email to all CS students) a tentative/draft schedule ahead of official publication, asking for student comment/input.
- Worked closely with the Mathematic program to minimize conflict with required math classes.
- Encouraged instructors to be flexible and reminded them of how important the scheduling options are to the students.
- Offered some classes online.

Criteria II.8: Program Promotes Scholarship, Instructional Innovation

The program values and promotes scholarship, curricular and instructional innovation, and creative activity, as well as their dissemination.

The BSCS degree program promotes scholarship, curricular and instructional innovation, and creative activity as well as their dissemination. For tenure track faculty to be promoted and to receive raises there is a requirement for excellence in teaching and scholarship. Such scholarship typically takes the form of journal and conference presentations and publications. Additionally, faculty in the computer science program are encouraged to explore and develop instructional innovation. In particular faculty have been experimenting with hybrid classes, student peer review systems, clickers, smart boards, monitor control software, and streaming video.

Criteria II.9: Co-Curricular Programs

As appropriate, the program implements co-curricular programs and activities that are integrated into its academic goals and programs, and supports student professional and personal development. Examples include clubs, lectures, sponsored activities, field trips, competitions and professional experiences.

The BSCS program implements co-curricular programs and activities that are integrated into its academic goals and programs, and supports student professional and personal development:

- Computer Club
- CSUCI Programming GURU Contest
- ACM Regional Programming Contest
- Travel Abroad

Criteria II.9.1: Computer Club

Students are encouraged to participate in the Computer Club (see email from this year's club president, Shahab Lashkari, Appendix). About 75 % of the BSCS majors are members and the club sponsors several events, such as gaming nights, bowling nights, and picnics.

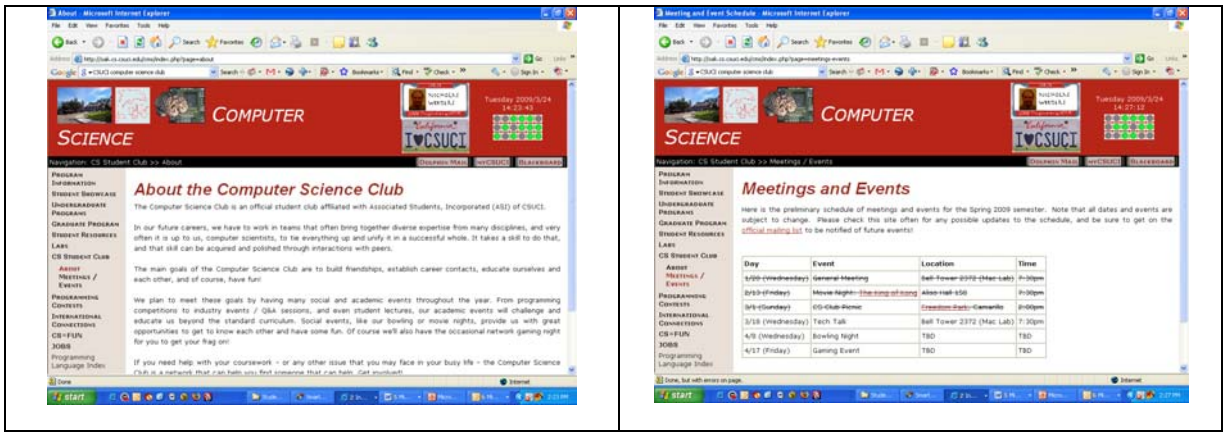

Figure 6: Screen capture of Computer Science Club web pages.

Criteria II.9.2: CSUCI Programming GURU Contest

Students are also encouraged to participate in the CSUCI programming contest, run each year. The winner is declared the "CSUCI Programming Guru". This contest has been very popular. We give out various awards and prizes. Anna and AJ Bieszczad organize and implement this innovative and exciting contest. The winner is declared the CSUCI Programming Guru and has his or her picture posted on our website (see figure 7).

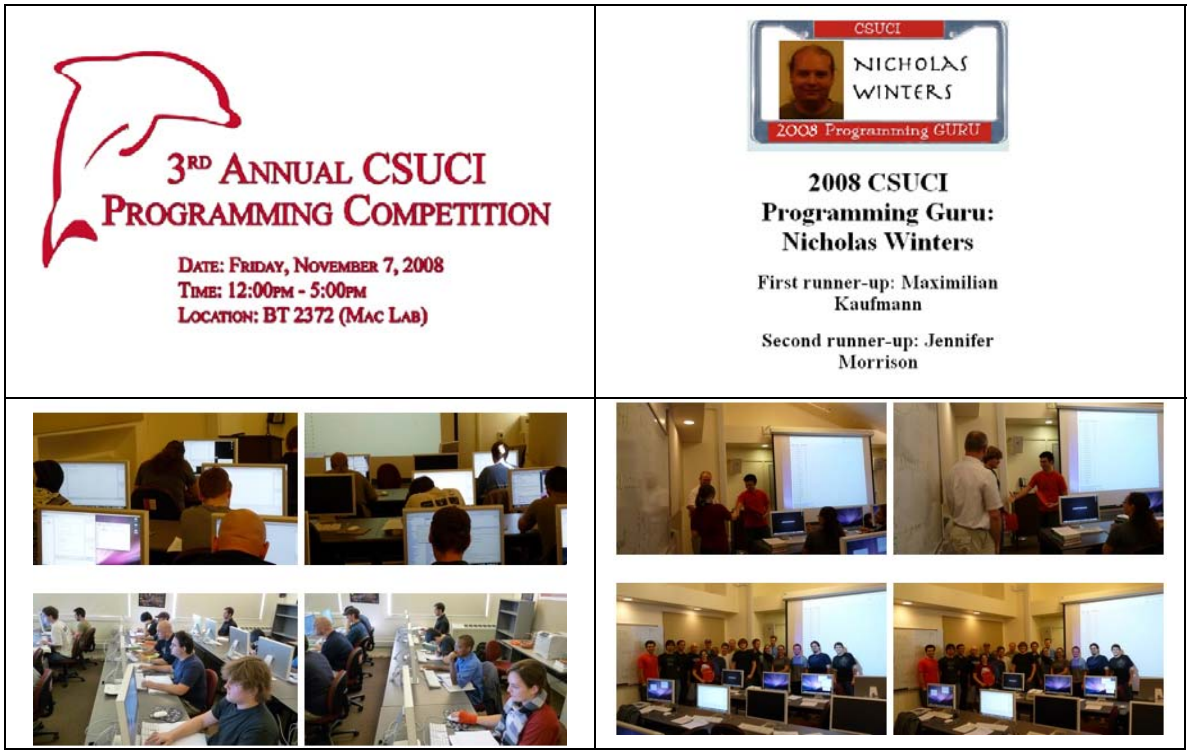

Figure 7: Photos of the CSUCI Programming GURU Contest, spring 2008.

Criteria II.9.3: ACM Contest

In addition to the yearly CSUCI programming contest (Programming GURU), there is an international programming contest run by the Association for Computing Machinery (ACM). CSUCI has sent teams of students to the regional competition each year. Anna and AJ Bieszczad have organized this event for the past 6 years, including practice sessions and travel accommodations. Students have expressed great appreciation for the opportunity to participate in this regional contest.

Figure 8: Photos of the fall 2008 ACM Regional Programming Contest.

Criteria II.9.4: Co-Curricular Programs

Students are also encouraged to participate in international travel to visit other universities, such as the trip to Poland last year. Anna and AJ Bieszczad organized this event last year, traveled with the student to Poland, and visited the universities that they had attended.

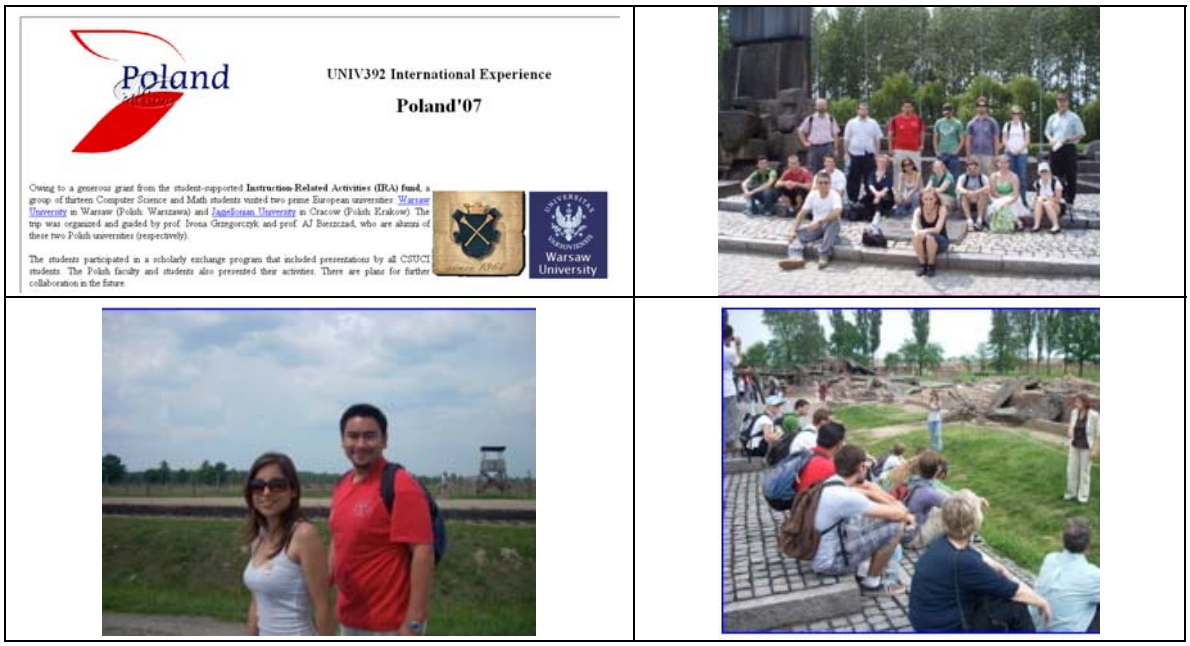

Figure 9: Photos of the trip to Poland.

Criteria II.10: Timely and Useful Information about Advising and Academics

The program ensures students receive timely and useful information and advising about their academic requirements.

The BSCS program ensures that students receive timely and useful information about their academic requirements. Critical information is posted online in a timely fashion. Students are encouraged to visit the Student Advising Office and to visit our website, and they are encouraged to visit with an academic advisor or chair of the program.

The chair sends out regular blast emails to all students concerning announcements and job opportunities.

Criteria II.11: Treatment of Transfer Students

The program serves transfer students by providing accurate information about transfer requirements and ensures the equitable treatment of transfers with respect to its policies on degree completion.

The BSCS program serves transfer students by providing accurate information about transfer requirements and ensures the equitable treatment with respect to its policies on degree completion. A four year degree plan is posted in our catalog, and articulation agreements are posted on the CSU ASSIST website. We meet with community college faculty and advisors on a regular basis. The majority of our BSCS majors are transfer students. They receive a thorough orientation before arriving on campus, organized and run by the Student Advising Office and attended by a faculty advisor.

Transfer students account for more than 60% of the CS students, so they receive a lot of advising attention.

III. Developing and Applying Resources to Ensure Sustainability

The program sustains its operations and supports the attainment of educational objectives through investment in human, physical, fiscal, and information resources. Its use of resources creates a high quality environment for student and organizational learning.

Criteria III.1: Sufficient Faculty

The program employs faculty in sufficient number, and with appropriate ranks, professional qualification, and diversity, to support its academic program consistent with its educational objectives.

The BSCS program is currently supported by 4 full time faculty:

AJ Bieszczad	Associate Professor of Computer Science
Peter Smith	Professor of Computer Science
William Wolfe	Professor of Computer Science
Anna Bieszczad	Full Time Instructor.

Professors Bieszczad, Smith, and Wolfe have Ph.D.'s in EE, CS, and Mathematics respectively. Anna Bieszczad and Professors Bieszczad and Wolfe have extensive computer industry experience to add to their academic experience. This provides wide breadth of knowledge and experience to support the many facets of the program. Specific faculty accomplishments are documented in the resumes provided in the appendix.

In addition, the program employs about 12 instructors on a part time basis each semester. Most of them are computer industry professionals, with a passion for education, with at least a Masters degree. Currently three of them have PhDs. Please see the Appendix for a summary of the qualifications of our instructors.

Criteria III.2: Sufficient Staff

The program employs professional staff in sufficient numbers and with appropriate experience to maintain and support its academic programs.

The Computer Science Program shares a full time Program Coordinator with the Mathematics Program. Last year we had a full time technical person to help manage our labs, but this year we moved to a cooperative arrangement with the IT division, as well as using student assistants to help out. After this experience it is clear that we again need a full time technical person and cannot rely on the combination of IT and student assistant support. The Student Advising Office provides much of the student advising but for particular academic, degree program specific, advising we rely on a faculty advisor who currently receives 3 units of reassign time for the whole academic year. This should be increased to 6 units because of the time it takes and because it is nearly impossible to schedule 1.5 units in the workload to make it come out 12 units a semester. The program

also receives 3 units of assign time for coordination of the Comp 101 Computer Literacy course. This course had 17 sections this semester and requires significant coordination among instructors including the syllabus and software installations in the IT labs used for these courses. Again, the program needs at least 6 units to effectively fulfill this function and to assign the appropriate workload.

Criteria III.3: Faculty Workload, Incentives and Evaluation Practices

Faculty workload, incentives and evaluation practices are aligned with institutional practices.

Faculty workload amounts to 12 units per semester for each tenure track faculty and 15 units per semester for the full time instructor. Full time faculty are encouraged to apply for mini-grants to support research and instructional innovation (3 unit course release and/or $7K for equipment or travel). Faculty are evaluated based on their Professional Development Plan, RTP requirements, class room sit ins, review of instructional materials, and SETE evaluation forms submitted at the end of the semester. These policies are aligned with institutional practices.

Based on the rapid advance in computer science, faculty need more time to hone their research skills and stay current with the technology.

Criteria III.4: Faculty Development

The Computer Science Program supports appropriate and sufficient faculty development opportunities that are designed to improve teaching and learning.

CSUCI has a full time Faculty Development Coordinator. The Office of Faculty Development at CSUCI organized mini grant competitions, classroom evaluations, video taping of instruction, trips to seminars and workshops, and an online monthly publication, and well as links to the CSU Office of Faculty Development and activities promoted form there.

Faculty are also provided with $1200 in travel funds for attending conferences and workshops.

Criteria III.5: Fiscal and Physical Resources are Aligned with Goals

Fiscal and physical resources are aligned with program educational goals and are sufficiently developed to support and maintain the kind of educational programs it delivers.

The Computer Science Programs supports several labs. The Mac and PC labs are used primarily for instruction of the computer science classes. We also have a small amount of lab space for a networking lab, and the space crunch is further exacerbated by the fact that we squeeze our embedded systems/robotics lab into the same room. We need to expand these labs into two distinct labs to make sufficient room for the growth in our Networking and Embedded Systems class sizes. The computer science program also

supports its own network, a sub network of the CSUCI network. We have configured Linux and Windows servers to support student class assignments and research projects.

Currently we have been supporting student assistants to provide technical and tutorial services with CERF funds. This is not a sustainable plan since CERF funds are needed for other purposes.

Criteria III.6: Access to Information Resources, Technology, and Staff

The program has access to information resources, technology, and staff sufficient in size and skill to support its academic offerings and scholarship of faculty.

The new library and its staff have been huge resources in supporting our programs. Requests for research articles or interlibrary loan are evaluated and discharged very quickly. There are on online journals and other subscriptions that provide an adequate research infrastructure both for students and faculty.

The IT Division provides help desk support that is also of a superior nature.

Criteria III.7: Program's Organizational Structure and Decision Making Processes

The program's organizational structure and decision-making processes are clear and consistent with university practices, and effective in supporting the program.

Our simple organizational structure is outlined in figure 1. It supports effective decision making. Most of the decisions are made at the chair level, although the extended education programs operate somewhat independently. The Program Coordinator, Lab Supervisor, Academic Advisor and Computer Literacy Coordinator report to the chair. The Lab Supervisor plays the additional role of interface with the IT Division.

Criteria III.8: Advisory Board

Where appropriate, the program has an advisory board or other links to community members and professional groups to support its educational mission.

The computer science program has many connections to local industry. Some of our part time instructors provide such links. We also have links to industry representatives that are interested in hiring our students. We have not yet formed an official advisory board, but we are building relationships with local industry and the local chapter of the IEEE. For example, Ron Rieger, CEO of Rieger & Milliken Corp, and Puneet Sharma, CIO of Oxnard Union High School District, are both part time instructors and employers of several of our computer science students. We are planning to inaugurate a Computer Science Advisory Board, with invitations to the industry representatives that have been mentioned above. Right now we do this in an informal way, but we plan to formalize this group.

IV. Creating an Organization Committed to Learning and Improvement

The program faculty and staff reflect about how effectively the program is accomplishing its purposes and achieving its educational objectives. These reflections are evidence-based and participatory, and are used to establish program priorities and practices in teaching learning and scholarship.

Criteria IV.1: Planning Activities

The program periodically engages in planning activities which assess its strategic position, articulate priorities, and examine the alignment of its core functions with those of the institution.

Program faculty often engage in planning activities that assess our strategic position, articulate our priorities, and examine the alignment of our core functions with those of CSUCI. Please see the "CS Lab Planning Report", by Professor Bieszczad, attached to this report as an example of the detailed planning that the program engages in on a regular basis.

According to the Bureau of Labor Statistics website:

http://www.bls.gov/oco/ocos267.htm#emply

> *Employment of computer software engineers is projected to increase by 38 percent over the 2006 to 2016 period, which is much faster than the average for all occupations. This occupation will generate about 324,000 new jobs, over the projections decade, one of the largest employment increases of any occupation.*
>
> *Employment growth will result as businesses and other organizations adopt and integrate new technologies and seek to maximize the efficiency of their computer systems. Competition among businesses will continue to create incentive for sophisticated technological innovations, and organizations will need more computer software engineers to implement these changes.*

Projections Data [About this section] Back to Top

Projections data from the National Employment Matrix

Occupational title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-16		Detailed statistics	
				Number	Percent		
Computer software engineers	15-1030	857,000	1,181,000	324,000	38	PDF	zipped XLS
Computer software engineers, applications	15-1031	507,000	733,000	226,000	45	PDF	zipped XLS
Computer software engineers, systems software	15-1032	350,000	449,000	99,000	28	PDF	zipped XLS

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

Figure 10: Data from the BLS website.

Criteria IV.2: Planning Aligns Needs with Goals

The planning process aligns curricular, personnel, fiscal, and physical needs with the program's educational goals, and these planning processes are informed by data and student learning outcomes.

The BSCS program has been growing steadily for 7 years. Concomitant with the growth in FTES, majors, and graduates is the growing need for lab equipment and floor space. The students not only need labs for instructional and project purposes they also need labs for doing assignments, collaboration, team work, and project development.

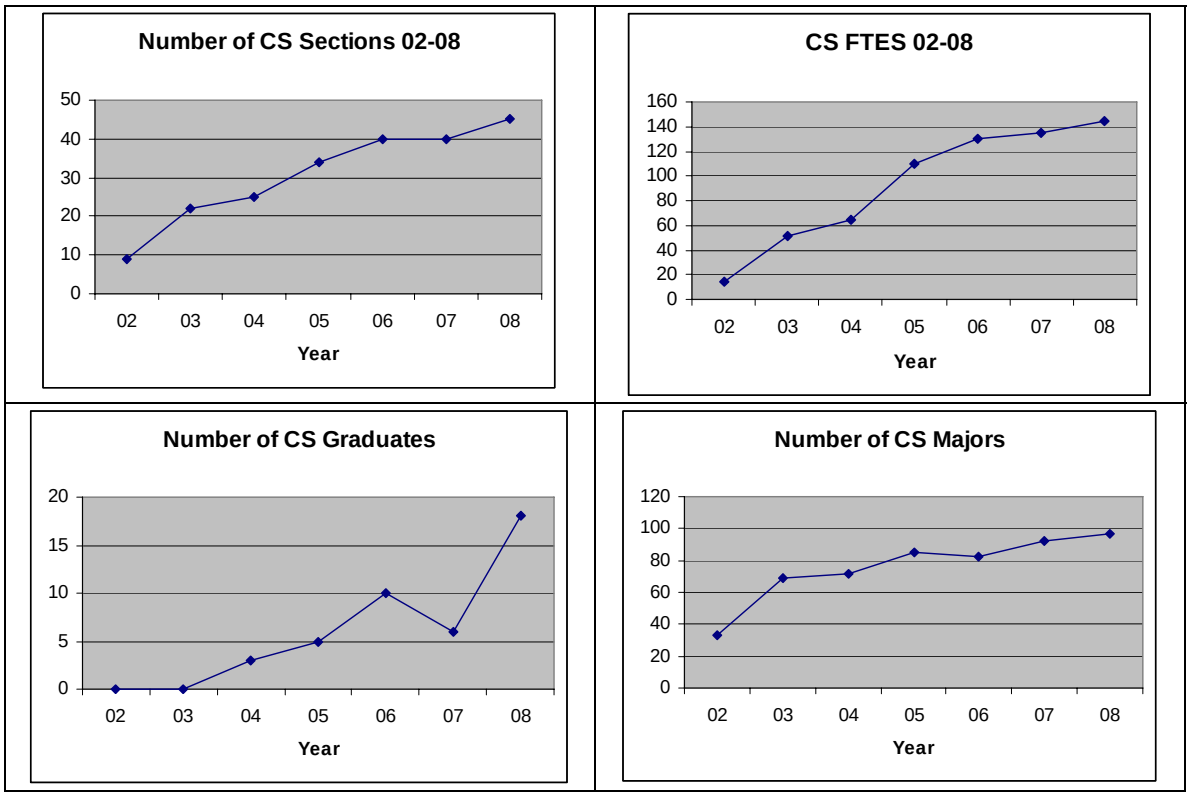

Figure 11: Statistical growth of the Computer Science Program.

Criteria IV.3: External Professional Accreditation (ABET)

The program has external professional accreditation or is seeking such accreditation; it has aligned its priorities consistent with that objective.

The BSCS program was designed with ABET accreditation in mind. Our core curriculum, mathematics and science requirements are well within the published ABET criteria. However, we will not be able to seek ABET accreditation until the number of tenure track faculty is increased significantly, and our labs are expanded in proportion to the number of majors.

Criteria IV.4: Professional Development Plans

The program has faculty professional development plans (PDP's) in place, designed to facilitate scholarship and professional growth.

Each tenure track faculty member is encouraged to develop a professional development plan. The plan helps customize faculty goals with RTP requirements. CSUCI also has a full time Director of Faculty Development who assists faculty in evaluating and planning their careers, including assistance with video taping class lectures, knowledge surveys, and workshops on various aspect of pedagogy.

List of Recommendations for Improvement

- Increase the number of tenure track faculty. Currently we have 3 TT faculty and 97 majors. We will need several more TT faculty to keep the momentum going, and before we can apply for ABET accreditation. In particular, we have 1 associate and 2 full professors. We need a couple of assistant professors to add some balance.

- Increase the lab space to accommodate growth in the programming, networking, embedded systems and robotics labs. Currently, the networking lab is maxed-out, forcing students to work in shifts, and the embedded systems lab is just a work bench crammed into the corner of the networking lab. We especially need a state of the art embedded systems lab, with appropriate equipment and facility design, include anti-static surfaces and sufficient floor space to perform robotic experiments.

- Increase the resources (labs and faculty) to support the integration of the BSIT and BSCE programs as they become state-side programs in the next two years.

- Increase the funding for student assistants. Currently we spend three times the budgeted amount on student assistants. We compensate by using funds from other sources to pay for the overrun. This is not a sustainable plan. The student assistants provide tutoring and technical assistance in the labs but more importantly they develop long lasting peer relationships, a very valuable part the student experience.

- Increase the support for faculty research. The field of computer science is rapidly evolving, and as a result the faculty need more time to hone their skills and develop their research agendas, and improve their teaching techniques, learn about emerging software tools, etc., without which they will quickly become ineffective in the classroom.

- Provide support for the excellent co-curricula activities such as programming contests and field trips. This is an extremely important part of the program. Currently, AJ and Anna Bieszczad work on "overload" to design and implement these activities.

- Provide support for out-reach activities, including open house sessions and visits to feeder schools so we can get the word out to high school and community college students about the opportunities at CSUCI.

- Increase the support for offering required classes each semester. Without these scheduling options students have a difficult time graduating within 4 years.

Appendices

Appendix A: BSCS Program Flow Charts

Appendix B: BSCS 4 Year Graduation Road Map

Appendix C: Lab Development Plan

Appendix D: Student Survey Results (Spring 2009)

Appendix E: Institutional Research Data Sheet

Appendix F: Student Emails (Sample)

Appendix G: Computer Science Assessment Plan

Appendix H: Instructor Qualifications

Appendix A

BSCS Course Flow Chart

Appendix B

BSCS 4 Year Graduation Road Map

Appendix C

Lab Development Plan

Appendix D

Student Survey Results (Spring 2009)

Appendix E

Institutional Research Data Sheet

Appendix F

Student Emails (Sample)

Appendix G

Computer Science Assessment Plan Report

Appendix H

Instructor Qualifications

References

[1] Unlocking the Clubhouse: Women in Computing by Jane Margolis, Allan Fisher, The MIT Press; 1st edition (December 1, 2001).

[2} CSUCI Computer Science Website:

http://oak.cs.csuci.edu/cms/

[3] CSUCI Computer Science Student Capstone Projects:

http://oak.cs.csuci.edu/cms/index.php?page=capstone-projects-2008

[4] ABET (Accrediting Board fro Engineering and Technology) Website:

http://www.abet.org/

[5] University of Idaho Computer Science Home Page:

http://www.cs.uidaho.edu/YourFutureInCS.html

[6] Computing Research Association Bulletin, 3/25/2008:

http://www.cra.org/wp/index.php?p=141

[7] Bureau of Labor Statistics:

http://www.bls.gov/oco/ocos267.htm#emply