

CALIFORNIA STATE UNIVERSITY, EAST BAY

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TO: The Academic Senate

FROM: Committee on Academic Planning & Review (CAPR)

SUBJECT: Five-Year Program Review for the BS and MS degree programs in Computer Science

PURPOSE: For Approval by the Academic Senate

ACTION REQUESTED: Acceptance of the Five-Year Program Review of the Computer Science degree Programs and approval of the continuation of the programs without modification

BACKGROUND

INFORMATION: The Department of Mathematics and Computer Science offers the following degree programs: B.S. Mathematics, BS. Computer Science, Minors: Mathematics, Computer Science, Software Systems, B.S., Mathematics, M.S., Computer Science, and the M.S. in Telecommunications, Systems, Option in Computer Technologies of Telecommunications. On 12 January 2006 Bill Nico, Professor of Mathematics and Computer Science; Michael Leung, Dean of the College of Science; Ed Keller, Professor of Mathematics and Computer Science; and Eddie Reiter, Chair of Mathematics and Computer Science, met with CAPR to discuss the materials sent to the committee.

CSUEB brought in new faculty who have made major contributions to the Department. These new faculty include: C. Matthew Johnson (2001) Ph.D. William and Mary, artificial intelligence, machine learning, and genetic algorithms; Hilary Holz (2002) D.S.C., The George Washington University, pattern recognition, artificial intelligence, computer science education, women in computing; Levent Ertaul (2003): Ph.D. University of Sussex, UK, computer communication networks, network security, cryptography, and wireless networks; David Yang (2003) Ph.D., Columbia, Software Engineering and Databases, in data mining techniques; Roger Doering (2003), Ph.D., UC Berkeley, microfabrication of digital micromirrors, design of bus architectures; Madhavi Gandhi, (2004) Ph.D. UC Davis, security issues in databases, particularly intrusion detection.

Even though the number of students majoring in Computer Science are declining all over the country, those at CSU East Bay are percentage-wise not so low as similar programs. Students in the M.S. program can take comprehensive examinations, or – for the better students– write a thesis. Several theses and independent studies resulted in published papers. A list of about thirty papers with student authors or coauthors was presented in their report.

A number of curricular changes have occurred related to the last review and the stated goals of their program. A number of new courses that should be appealing to a broad spectrum of working computer scientists as well as current and future students have been introduced. Several of these new courses are cross-listed with other programs.

The degree programs in Computer Science do not require more than the minimum requirements for graduation at the University. The number of units required for both the BS and MS degrees in Computer Science are aligned with similar degrees throughout the state of California and tend toward the low end of number of units required for graduation.

CAPR RECOMMENDATION:

CAPR recommends the continuation of the Computer Science Bachelor of Science and Masters of Science degree programs without modification. The next CAPR review will be in 2009-10.

Additional Background:

Overview description of the program: Historically, at most universities, Computer Science began as part of Mathematics; however, CSUEB is the only remaining school in the CSU system where the two have not separated. This has offered unusual opportunities for collaboration, mutual assistance, and innovation.

Also, CSU East Bay has a distinctive student profile. Many students are older, working, and have family responsibilities. Many have begun – or even finished – undergraduate degrees in the near or distant past; they are coming to CSUEB to finish an interrupted education, to learn a new field, or to expand their own horizons.

The Department serves many (and often large) groups of students:

Degree programs:

- B.S. in mathematics
- B.S. in computer science
- Minors: mathematics, computer science, Software Systems
- M.S., mathematics
- M.S., computer science
- M.S. in Telecommunications, Systems, Option in Computer Technologies of Telecommunications

The Master's in Telecommunications Systems is an interdisciplinary degree between the College of Science and the College of Business at CSU East Bay. Students pursuing this degree are required to choose one of two options, Computer Technologies or Telecommunications Management. The option of Computer Technologies is housed in the Department of Math and Computer Science in the College of Science, while the Telecommunications Management option is housed in the Department of Accounting, Computer Information Systems, and Telecommunications in the College of Business. Applicants apply to a degree and an option. Advisors in the Colleges of Science and Business administer each option independently, and each option differs in GPA requirements, prerequisite course requirements, and graduate exam requirements.

Each of these sets of students has different requirements; each has seen major changes in the last five years. Meeting the needs of these students has been – and will continue to be – difficult and challenging.

Overview of the documents submitted to CAPR: As required, the report to CAPR included a self study; plan for the degree programs; program assessment plan; outside review; a departmental response to the outside review; applications submitted for new tenure-track positions since 1998; the outcome of those searches; and enrollment and graduation data.

Five-Year Program Review/Self-Study (AY2004-2005)

- Summary of specific areas of the Self-Study from the previous program review plans in CS:
(1) re-examine introductory courses, considering, among other issues, whether to retain the current use of C++ in these courses; (2) propose a new Computer Science minor in Software Systems; (3) consider revision of Computer Engineering option; (4) study the advisability of designing a new B.S. degree in Software Engineering and (5) determine changes necessary to obtain CSAB accreditation (Computer Science Accreditation Board) and decide whether to pursue accreditation.

All of the above have been done, although the issue of seeking accreditation is still open. The Department did review C++ as its introductory language, did implement options in the major (in

networking & data communications, in software engineering, and in computer engineering) and did add a minor in software systems.

The Department has studied – and continues to study – the issue of CSAB/ABET accreditation. One of the issues before the Computer Science Advisory Council is the issue of accreditation; it is also a topic that we will take up with Dr. Michael Feldman, the outside reviewer. The main disadvantage is that it will increase the size of the major, and surveys have found that a large fraction of CS majors have chosen CSU East Bay because the major is smaller than it is at similar campuses.

- See faculty trends and accomplishments below under planning for an analysis of faculty.
- Assessment: Gateway courses reflect the challenging nature of CS courses – no automatic good grades in any course. The relatively low pass rate in the required course Math 2304 (roughly 2/3 of those who begin manage to end the course with a C or better; more than 10% usually withdraw) reflects also the many non-math majors who must take this course.

Computer Science Gateway Classes

Gateway Course	Total	Exc	Good	Adequate	Poor	Fail	Withdraw	Number Succeed	PerCent Succeed
CS 2360	1,316	21	21.6	19.7	5.5	12.7	19.1	825	62.7
CS 3240	1,869	25.3	23.2	21.7	6.8	9.2	13.7	1,314	70.3
CS 4560	1,682	34.9	26.4	20	3.3	6.4	8.9	1,370	81.5
CS 6260	795	49.9	37.5	6.9	0.8	1.3	3.6	750	94.3

This table accurately reflects what the Department knows well – that many students do not survive the first courses in Computer Science, and will decide on another major. It also accurately reflects that sophomore level courses (Math 2304 and CS 2360) are often the places where students drop out of a math or C.S. major.

One might also note the high withdrawal rate in CS 2360. This reflects at least two factors – students who decide the course and the major are too difficult, and also the difficulty of the quarter system (if one falls behind in an intensive programming class for whatever reason, it is very hard to catch up).

Whether the high attrition in CS 2360 is good or bad is open to debate. Many students at many different schools start out as majoring in mathematics and computer science, but change their minds. Many faculty will complain that students in the lower level courses don't have either the skills or the tenacity for a difficult major; these faculty often say that they are quite impressed with the quality of students in senior and graduate-level classes.

- Basic comparisons:
In comparing CSUEB with other campuses, several things stand out. First, there is the small size of the computer science major, even when compared to other schools without ABET accreditation. Second, there is the unusual flexibility – not only the usual major, but also tracks in Computer Engineering, Software Engineering, or Data Communications/Networking.
- Summary of supporting data:
As these data show and the review discusses, enrollments are, for the short term at least, declining. Given the reliance of society on the computer, enrollments are expected to increase again in the future.

Outside Reviewer's Comments & the Department's Response

Dr. Michael B. Feldman, Professor of Computer Science, George Washington University, spent more than a day visiting the Department. Dr. Feldman has been involved with computer science accreditation – one of the main concerns of the CSUEB department.

The reviewer observed that :

- The CS faculty is well-qualified, enthusiastic, and supportive of the CS role in advancing the University's mission.
- The CS curriculum is solid and up to date.
- The students are generally very positive about their CSUEB experience and think they are being well-prepared for careers, for graduate school, and for well-educated citizenry.
- Dean Leung seems quite supportive of the program and its role in the university's mission, and the faculty think highly of the Dean.

The following sections discuss curriculum, potential ABET accreditation, math and CS in a single department, the future of CS as a discipline, and the MCS space issue, all of which were subjects of discussion during the outside review visit.

Program's Five-Year Strategic Plan (2004-2009)

There will be several key issues in this curriculum:

ACM (Association for Computing Machinery) is developing a new recommended curriculum. It is currently in the draft stage. CSUEB must analyze its recommendations and consider curriculum revisions to meet the new suggestions.

ABET (Accreditation Board for Engineering and Technology) accredits Computer Science programs. Up to this point, CSUEB has not sought accreditation for several reasons – primarily because of concern about the impact the required changes might have on success with non-traditional issues. However, this issue must be continually revisited and reevaluated.

Other Computer Science curriculum plans are to:

- explore new areas of math/CS applications for possible courses (bioinformatics, computer games, database security, etc., timeline is ongoing; persons responsible include CS undergraduate committee in consultation with department faculty; cost is negligible)
- gather and use meaningful feedback from the Computer Science Advisory Committee (timeline is ongoing, one meeting per quarter; persons responsible include CSAC liaison; cost is negligible)
- consider options in the Computer Science M.S. program (timeline is '06-'07 AY; persons responsible include CS graduate committee in consultation with department faculty; cost is negligible.)
- cooperate with Dept. of Engineering to offer B.S. in Computer Engineering (timeline is unknown; persons responsible are Doering and Sagahyoon; cost is negligible)
- explore new undergraduate CS option in computational intelligence (timeline is '06-'07 AY; persons responsible are Holz and Johnson; cost is negligible)
- increase opportunities for undergraduate research (timeline is ongoing; persons responsible include CompCore core (Holz, Morgan and Thibault); cost analysis is in the CompCore budget)

New curriculum ideas are also surfacing. In an article "Recentering Computer Science" in November, 2005, CACM, Peter Denning and Andrew McGetrick suggest an innovative curriculum to engage students early – beginning by focusing on "great innovations of computing", perhaps including multimedia computation. They say that the ACM Education Board will "endorse experiments to find curriculum formulations that express better what computing is about and are more appealing to prospective students."

- **Students and changing trends:**

As a department, Computer Science enrollment has two unique ethnic profiles. It has always been proud of its diversity. So far, it has managed to remain diverse, even with changes in a post 9/11 world. Currently, the profiles show:

Undergraduate majors (2004)

- Women 28%; Men 72%
- Minorities Asian 67%; AfricAm 6%; Latino 6%; other min. 2%, white 18%
- Part time: 26%; Full time: 74%
- Transfer: 62%
- Avg. (mean) age: 27
- Second degree: 13%

Graduate students (2004)

- Women: 61%; Men 39%
- Minorities: Asian 91%; AfricAm. 1%; Latino 1%; Other Min. 1%; White 6%
- Part time: 63%; Full time: 37%
- B.S. CSUH 3%; other 97%
- Avg. (mean) age: 29

Undergraduate trends show a decline in percent women (37% in 1999), although in pure numbers, the trend has shown an increase instead, of the overall increase followed by a decline (36/36/47/44/52 from 1999-2004). There has been an increase in Asian students (44% in 1999). The graduate program has always been mainly female (varying between 60-75% without any clear trend). As with the undergraduates, the count of women seems to show a reasonably steady increase (68/78/92/87/102). There have always been a large percent of students from India, China, Japan and other Asian countries.

Student enrollment: Computer Science expects a slow decrease in the number of majors – given the continued decrease at the community college level – followed by an increase as the job market improves. It is very hard to guess when the increase will occur, and how big it will be. As an example to student success: Madhavi Gandhi in C.S. went on to a Ph.D. program and returned to CSUEB as faculty in Computer Science.

Plan for retention and growth:

- Continue offering classes at a variety of times, ensuring that any degree can be earned by courses taken after 4 PM to enhance retention and to draw in working students.
- Continue offering administrative support through the Math/CS Student Center – which has been of great help to the students in learning how to meet the official add/drop/file-to-graduate and other requirements.
- Survey alumni using the University alumni survey effort (this has already been initiated; it should not require more resources since the CS form has been added to the standard University form).
- Design focus-group research projects for in-depth study of students, both in math and CS. Run focus groups, analyze results. Include these in Assessment efforts.
- Target June 2006 graduates for a follow-up four months after graduation; this should improve knowledge of employment and graduate school prospects for alumni.
- Continue supporting non-class experiences for students. This means that: The Department will encourage students to be involved with active clubs in computer science; the

Department will continue to organize colloquia in computer science; the Department will sponsor events that give students opportunities to socialize; the Department will provide funding for students to attend regional professional meetings; the Department will continue to develop opportunities for students to participate in internships and service learning experiences.

- **Community ties:**

The Department needs to strengthen ties to community colleges and encourage transfer students. One suggestion made by the Computer Advisory Board – that of having one-day on-campus workshops in areas of CS attractive to community college faculty – seems to have much merit. The question would be of having the resources to mount such a workshop.

- **Faculty and changing trends:**

Faculty: The Department aims to foster research, publication, and other professional activities on the part of its faculty and to encourage collegiality among the faculty. This is necessary for a strong academic program for students.

CSUEB did bring in new faculty who have made major contributions to the Department in a wide variety of areas – each faculty is teaching at the graduate level. All new faculty are capable of teaching a range of courses at both graduate and undergraduate levels; the Department has been able to staff courses with qualified instructors with far greater confidence than in the past.

The Department will work with the Dean of the College of Science and the Provost to insure adequate release time for new faculty. The Department will continue to work with the Dean of the College of Science to obtain support in the form of release time and travel funds for all faculty. The Department will continue to work with the Dean and Associate Dean of the College of Science to identify space for a departmental faculty library/meeting room. This is particularly important since the faculty occupy offices in three different buildings on campus.

There are no glaring weaknesses in areas of expertise at this time. The Department would prefer to have more faculty from traditionally under-represented minorities; these groups are lacking good role models for students. However, the Department is diverse from both gender and ethnic perspectives. Unfortunately, given the pools of potential hires, it is not reasonable to expect much better diversity.

However, the average age of faculty is increasing. Many current faculty were hired in the 1970's; some in the 1960's. Retirements are expected over the next five years. Moreover, two faculty in CS are on leave this year and may not return. The Department must watch the department profile to be sure key subject areas are covered and that diversity is as great as possible.

Other plans for faculty support include: maintain support for new and current faculty (release time, support funds, travel, etc); properly allocate release time for necessary faculty projects (new for CTC coordinator); encourage broadening of faculty areas of expertise; particularly in Computer Science where it is not currently possible to hire outside lecturers; and new core facility for faculty research and student research training (CompCore), opening in summer 2006.

- **Resources and changing trends:**

The Department is critically short on space. The result is that: Department offices, faculty offices, student study space (e.g., math lab room), and faculty research labs are scattered throughout the Science building (and even throughout campus). Some faculty who do a large

amount of student collaboration share an office, making discussions difficult. Some faculty who do research with students do not have any laboratory space.

This shortage would be very expensive to remedy entirely. However, the new Business and Technology building and current efforts by the COS Dean to revise space allocations should lessen the severity of the shortage. Other plans include: updating computers in the two computer-equipped classrooms (now out of date); continuing maintenance and replacement of servers and workstations; and updating CS laboratories (networking lab, CS 6899 facilities, etc.)

CAPR Analysis of the Program's Five-Year Review

The program seems strong and received a strong recommendation from the outside reviewer. The self review presented a thorough review of the computer science programs, facilities, strengths and weaknesses, and most importantly, the potential for growth and improvement. The Department involves itself in outreach to the community through its Advisory Board and relationships with local community colleges. Assessments come from identified gateway courses and other methods including surveys or exit examinations in the MS program. The self study included some assessment data in its report. The Department has not clearly defined how it will use these data, but the report did ask questions that may be connected to some of data presented. We applaud the CS faculty for its careful look at accreditation. Whatever they ultimately decide together with the Dean and Advisory Board, we feel that the decision will be deliberate and collegial. Even though enrollments are declining, the East Bay campus computer science program has not had the percentage wide losses seen by many sister campuses of up to 50% decline over the past five years. We believe this lack of decline is due to the careful review and analysis that the Department maintains over its programs.

CAPR Recommendation for Continuation of the Program: CAPR recommends the continuation of the BS and MS degree programs in Mathematics without modification.

Date of the Program's next Academic Review: The next CAPR review will be in 2009-10.