### Computer Science Program

### 2012 Self-Study Program Review

Computer Science Department, California State University, Stanislaus

Date of last program review: Spring 2005

**A. Changes Since the Last Academic Program Review**

1. Describe actions taken in response to the recommendations made in the previous academic program review.

Recommendations from 2005 CS APR

1. *The Committee commends the department for its continued overall review of the curriculum and encourages the faculty to continue with this review.*
   1. The department has continued its review of the curriculum and has made significant revisions to both the major and the minor. Details of these changes are described in Section A.2. We are monitoring the impact and effects of these changes and are considering additional revisions, particularly at the lower division level.
2. *The Committee encourages the department to look at other opportunities for growth, especially in the area of security-related issues.*
   1. Enrollments in computer science tend to be volatile. Following the dot-com bust, computer science enrollments nationwide dropped precipitously and stayed comparatively low throughout most of the following decade. In recent years enrollments have grown nationwide and our program has seen significant increases. We currently have more majors and minors than at any time in the history of the department.
   2. With respect to new areas, we have added courses in Human-Centered Design and Security & Cryptography. In addition, our courses on E-Commerce and Software Engineering were updated and include security components.
3. *The department provides many course-specific learning goals. The Committee encourages the department to also develop learning goals that apply more generally to the program, for example, critical thinking.*
   1. We have reviewed and updated both course-specific and program learning goals.
4. *While the department indicates that student development of learning goals is tracked through mandatory advising and the graduation evaluation process, the Committee encourages the department to re-examine the learning goals and develop appropriate measures to assess them. The Senior Seminar provides an excellent opportunity for developing assessment measures.*
   1. We have continued our focus on student communication skills, with particular emphasis on writing in the discipline. This is linked with our department WP course and the Senior Seminar course.
   2. We are in the process of developing a pre- and post- test assessment of student learning within the major. We are developing a database of subject matter questions and problems. These questions and problems will be linked with the learning goals for the program. This project will result in an assessment tool which students will take in an early course in the major, probably CS 2500, and again as seniors, probably in the Senior Seminar. This will give us an understanding of the value added by our curriculum.
5. *The Committee recommends a tenure track hire to replace Dr. Cunningham.*
   1. The department hired Dr. Megan Thomas to replace Dr. Cunningham, and Dr. Melanie Martin to replace Dr. Zarling. We continue with five tenure-line faculty.
6. *The Committee recommends the continued adequate support for department labs, including staffing and equipment funding.*
   1. The department has been able to secure and maintain the resources necessary to effectively staff the department computer lab, with significant contributions by work-study students.
   2. Computer lab equipment continues to be a serious issue. The lab computers were replaced with one-time monies from Clearwire four years ago, and are now reaching the end of their useful life. We do not have on-going resources to repair, replace and upgrade computer lab equipment.
7. *The Committee encourages the department to continue to explore offering a BA degree program.*
   1. The department continues to explore offering a BA degree program. With support and encouragement from Dean Kamali we are looking at the possibility of developing a BA in Information Technology with significant on-line components. We are still in the fact-finding stage, including reviewing example programs from other universities. A major concern for this project is the level of faculty and staff support that would be required for such a significant undertaking.

2. *Briefly describe program and field changes over the past seven years and how the curriculum was revised to address these changes.*

The field of computer science continues to change rapidly. The most noticeable changes to the field in the past seven years are the explosion of social media’s popularity, analyzing and learning from very large data sets (“Big Data”), the growth in “smart” personal devices and the “apps” that run on them, growing use of small, networked devices (sensor networks), cloud computing, and increasingly functional robots. Of course, previous trends like ever-increasing use of the WWW, growing hardware capability, and shrinking hardware size have continued.

In the Fall of 2008, the computer science department updated the requirements for *both* the computer science majors and minors. The revised curriculum was submitted in January 2009 and took effect in Fall 2009.

We made significant changes to the requirements for computer science majors. Listed here, in no particular order:

1. We added a year of General Biology as an alternative way for students to satisfy the "year of classical science" requirements. This change puts us slightly out of line with the CS ABET requirements but, we believe, ahead of ABET. Career possibilities in bioinformatics, medical informatics, and related fields have grown tremendously in recent years. Students interested in these careers would benefit more from a year of biology classes than from physics or chemistry. (In fact, the February 2012 draft version of “Computer Science Curricula 2013” by The Joint Task Force on Computing Curricula of the Association for Computing Machinery and the IEEE Computer Society specifically mentions life sciences courses as appropriate for CS curricula, and ‘Computational Biology’ courses as an example of new, appropriate courses for introducing CS majors to cross-disciplinary work. [http://cs2013.org])
2. We removed CS3050: File Processing, as an upper division course, and we no longer offer it. While this has led to increased problems "flowing" transfer students into our university -- we used to slide all transfer students into CS3050 -- the change modernized our curriculum. While file processing remains a valuable body of knowledge, the increasing power of computer hardware and widespread availability of software libraries providing easier (relative to the 1990's) access to files via programs means exposure to the "nitty-gritty" details of file processing is not as necessary for our students. Some of this material has been integrated into other courses such as CS3100, CS3740, and CS3750.
3. We changed our requirement of 9 “Depth” units and 12 elective units. The new requirement is 6 “Theory” units, 3 “Practice” units and 12 elective units. We feel this change makes what we require more clear to both students and to potential evaluators of our program. We require majors to experience at least a year of rigorous work on the algorithmic and mathematical core of computer science (“Theory”), and exposure to at least one of the most practical, industry-oriented courses we offer (“Practice”).
4. We regretfully removed the Linear Algebra requirement from the major, and altered the Statistics course requirement so that either MATH 1620 or 1600 would be sufficient. While we continue to prefer MATH 1620, the math department does not have enough demand to offer 1620 every semester. There were also issues with transfer students; students often had taken the equivalent of MATH 1600 in community college. Accepting MATH 1600, or the equivalent at a community college, makes it easier for majors to progress towards graduation in a timely manner.

Removing Linear Algebra as a requirement was a change made, along with the removal of CS 3050 (File Processing), in order to better align our major unit requirements with the CSU goal of a maximum of 120 units for graduation and to open more room in student schedules for minoring in other programs. Most jobs in computing are not in purest computer science; they are jobs where computers are used to accomplish work needed by people in other disciplines. We strongly feel that computing majors will best achieve success in their careers if they develop expertise in at least one other discipline, and we encourage our students to consider minors when we meet them for student advising.

1. We removed the requirement that majors “complete one upper-division course in Chemistry or Physics/Physical Sciences”. As upper division biology courses would now, also, be potentially relevant for a CS major, this requirement became, in effect, a redundant re-stating of an existing General Education requirement.

We made significant changes to the requirements for computer science minors. Listed here, in no particular order:

1. Removed CS2700 (Assembly Language Programming) from the minor. Improvements in software development environments and increasing opportunities in fields like computer gaming, web development, or special effects mean that more people than ever work in fields that require some software skills, but no knowledge of hardware.
2. Removed CS3050 (File Processing) from the minor, for the same reason we removed it from the major.
3. Changed the minor to accept either Calculus or Pre-Calculus.
4. Increased the number of electives from 3 units to 6 units, so that students may better tailor their minor to their personal interests.

We have also developed several new courses to address some of the recent changes in computing*. CS 4800: Software Engineering* (replacing a no-longer-offered CS3800), was added to our curriculum, and is one of the courses that satisfies our new “Practice” requirement. The course was changed to be a senior level course, reflecting the increasing complexity and scale of modern software engineering work.

We added *CS 4840: Computer Security & Cryptography* to cover basic computer security and the mathematical theories that make computer security possible. This course also addresses the second item in the list of recommendations from the 2005 Computer Science APR.

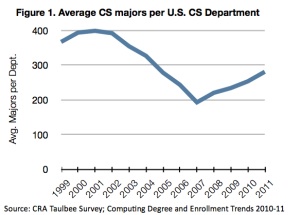
We added *CS 3500: Human Centered Design*, a course satisfying either the General Education F1 science requirement or the elective requirement for majors, because this is a relatively new field in computer science and a field whose practical significance has grown tremendously as software permeates more of day-to-day life for every person and is no longer used solely by educated office workers in controlled physical environments. As a GE course, the class can provide hands-on practice in working with people from other disciplines for CS majors, and in working with computing specialists for students from other disciplines. Human Centered Design is a field that overlaps psychology, biology, and other areas. Our course can provide, for students in other majors, an accessible introduction to some of the issues computer scientists wrestle with in their daily work.

**B. Enrollment Trends**

1. *Based on institutional research data, summarize programʹs enrollment trends, student characteristics, retention and graduation rates, degrees conferred, and time to degree, course enrollments, and student/faculty ratio.*

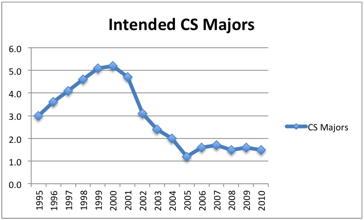
Computer science enrollments nationwide have notoriously been volatile. After a peak in 2001, enrollments dropped significantly, to 50% by 2007. Over the past 5 years, enrollments have been growing again, but are still significantly below the previous high.

Here is a summary graph of CS majors in the U.S.:



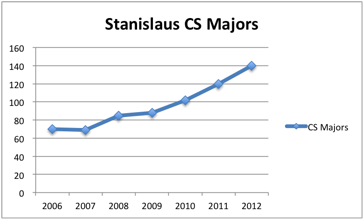
<http://cra.org/govaffairs/blog/2012/04/undergrad-computer-science-enrollments-rise-for-fourth-straight-year-cra-taulbee-report/>

The National Science Foundation has been gathering data about undergraduate enrollments. This graph shows the percentage of incoming freshmen intending to major in computer science:



<http://www.nsf.gov/statistics/seind12/c2/c2s2.htm>

As can be seen, there was a peak around 2000, with a precipitous drop thereafter. Student interest fell by nearly 80% by 2005, and has since held roughly steady from 2005 through 2010. For a campus of our size, with around 8,000 undergraduate students, following national trends we would expect to have around (0.015\*8000) = 120 computer science majors. In Fall, 2012, we had approximately 140 majors, which would put us ahead of the national trend line. Here is a summary of our majors in recent years:



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Some other ways to look at these issues come from the CSU System-wide Academic Program Database (APDB).  Here are some tables showing data from 2003 through 2012. These are Fall figures, annualized. As you can see, in the 10 years from 2003 through 2012, Computer Science at Stanislaus has experienced significant increases in FTES, student / faculty ratio (SFR), and average class size. During that same time period, we have declined in FTEF and in the number of small classes we offer.  At this point (2012), our SFR is about 25, whereas system-wide computer science SFR is about 22. Our average class size is about 32, whereas system-wide in computer science it is about 28. CSU Stanislaus accounts for about 3.26% of CSU CS FTES, which is larger than our campus portion of the CSU system. (CSUS is 2% of the CSU FTES: 7,352 out of 368,451 FTES in Fall 2012.)  You can also see that CS at CSU Stanislaus has a higher SFR than our campus average across all disciplines (25.3 vs. 23.4), and our average class size is also larger than the campus average (32 vs. 31.2). We are down to offering only 1 “small” class per semester.  CSU Stanislaus Computer Science -- from Academic Program Database (APDB) | | | | | | |
|  |  |  |  |  |  | |
|  | FTES | FTEF | SFR | CLS SIZE | SMALL | |
|  |  |  |  |  |  | |
| 2003 | 103.7 | 6.8 | 15.3 | 22.8 | 6 |
| 2004 | 110.2 | 6.2 | 17.8 | 25.9 | 2 |
| 2005 | 120.9 | 7 | 17.2 | 23 | 12 |
| 2006 | 106.7 | 6.6 | 16.2 | 22.6 | 8 |
| 2007 | 141.4 | 7.9 | 17.8 | 23.3 | 14 |
| 2008 | 118.9 | 7.2 | 16.6 | 24.8 | 9 |
| 2009 | 117.4 | 5.8 | 20.2 | 29.5 | 4 |
| 2010 | 153.6 | 6.3 | 24.6 | 31.7 | 1 |
| 2011 | 161.3 | 6 | 26.8 | 32.5 | 1 |
| 2012 | 151.3 | 6 | 25.3 | 32 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| System-wide Computer Science -- from APDB | | | | |  |
|  | FTES | FTEF | SFR | CLS SIZE | SMALL |
| 2003 | 6242.7 | 346 | 18 | 24.1 | 14 |
| 2004 | 5005.3 | 281.6 | 17.8 | 23.2 | 155 |
| 2005 | 4364.6 | 253.6 | 17.2 | 22.9 | 145 |
| 2006 | 4241.1 | 248.5 | 17.1 | 22.3 | 138 |
| 2007 | 4263.5 | 244.9 | 17.4 | 22.6 | 156 |
| 2008 | 4375.8 | 236.1 | 18.5 | 24 | 131 |
| 2009 | 4255.2 | 211 | 20.2 | 25.1 | 95 |
| 2010 | 4112.9 | 207.1 | 19.9 | 25.4 | 99 |
| 2011 | 4474 | 217.1 | 20.6 | 26.6 | 78 |
| 2012 | 4625.4 | 214.2 | 21.6 | 27.9 | 54 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stanislaus All Disciplines -- from APDB | | | | |  |
|  | FTES | FTEF | SFR | CLS SIZE | SMALL |
| 2003 | 5868.7 | 334.4 | 17.6 | 25.6 | 133 |
| 2004 | 5777.5 | 318.9 | 18.1 | 26.2 | 107 |
| 2005 | 6021.1 | 328.4 | 18.3 | 25 | 183 |
| 2006 | 6316.4 | 353.2 | 17.9 | 25.3 | 151 |
| 2007 | 7014.3 | 369.5 | 19 | 25.1 | 172 |
| 2008 | 6619.5 | 360.6 | 18.4 | 27.3 | 108 |
| 2009 | 6607.6 | 309.2 | 21.4 | 31.6 | 46 |
| 2010 | 6727.1 | 310.1 | 21.7 | 29.1 | 67 |
| 2011 | 7657.2 | 318.3 | 24.1 | 31.7 | 43 |
| 2012 | 7352.3 | 314.3 | 23.4 | 31.2 | 52 |

As noted, nationwide, computer science enrollments tend to be volatile. There is, unfortunately, a nationwide trend that has happened over many years. In the mid 1980s typically around 35% of Computer Science bachelors degrees were granted to women. Since then, things have changed. In 2009, out of 38,496 bachelors degrees in computer science, only 6,894 were earned by women (about 18%). For 2010, the NSF reported that 2.9% of male incoming freshmen planned to major in computer science, whereas only 0.4% of female incoming freshmen intended to go into computer science. (That means only 10% to 15% of the incoming freshmen class of computer science majors would be women.)

In our program in Fall 2012, out of 140 majors, 22 were women (about 16%), which, as noted above, is generally in accordance with national numbers.

With respect to general diversity in our program, below is a table from the Office of Institutional Research. Note that it only covers the years up to Fall 2010.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Computer Science (07011)** |  |  |  |  |  |
|  | **Bachelor** | | | | |
| **Fall 2006** | **Fall 2007** | **Fall 2008** | **Fall 2009** | **Fall 2010** |
| **STATUS** | 56 | 51 | 68 | 50 | 88 |
| Full-time |
| Part-time | 14 | 18 | 17 | 38 | 14 |
| **CLASSIFICATION** | 22 | 30 | 33 | 31 | 32 |
| Freshman |
| Sophomore | 12 | 7 | 10 | 15 | 16 |
| Junior | 14 | 13 | 15 | 17 | 26 |
| Senior | 20 | 17 | 24 | 24 | 27 |
| Post-Baccalaureate | 2 | 2 | 3 | 1 | 1 |
| **ETHNICITY** |  | 1 | 1 |  |  |
| American Indian |
| Asian / Pacific Islander | 4 | 10 | 15 | 10 | 13 |
| Black | 5 |  | 2 | 1 | 1 |
| Hispanic | 15 | 16 | 18 | 20 | 29 |
| Nonresident Alien | 3 | 2 | 3 | 6 | 7 |
| Other | 7 | 9 | 12 | 17 | 14 |
| White | 36 | 31 | 34 | 34 | 38 |
| **GENDER** | 8 | 8 | 14 | 15 | 12 |
| Female |
| Male | 62 | 61 | 71 | 73 | 90 |
| **AGE** | 52 | 54 | 61 | 70 | 79 |
| 24 and Younger |
| 25 and Older | 18 | 15 | 24 | 18 | 23 |
| Computer Science | **Bachelor** | | | | |
|  | **Fall 2006** | **Fall 2007** | **Fall 2008** | **Fall 2009** | **Fall 2010** |
| **ORIGIN INSTITUTION** | 23 | 23 | 29 | 31 | 36 |
| California Community College |
| California Independent College or University |  |  |  |  |  |
| California Private High School | 2 |  |  | 1 | 3 |
| California Public High School | 37 | 41 | 47 | 46 | 52 |
| California State University | 2 | 1 | 1 | 3 | 3 |
| California State University, Stanislaus |  | 1 | 2 | 2 | 2 |
| Foreign Institution | 3 |  | 1 | 3 | 3 |

We will not attempt detailed analysis of these numbers. We think they generally speak for themselves. We would like to mention that in Fall 2010 we had 29 Hispanic majors (out of 102), or 28% -- well above the national trends for that population. (About 8%, according to <http://www.nsf.gov/statistics/seind12/c2/c2s2.htm>.)

1. *Provide an evaluation of the program’s success in recruiting, retaining, and graduating students—overall and disaggregated by demographic characteristics (e.g., gender, ethnicity, and transfer/native).*

As can be seen above, the number of students majoring in computer science at Stanislaus has been increasing significantly in recent years. The number of majors doubled between 2006 and 2012.

In general, we are reasonably satisfied with our success in recruiting, retaining, and graduating students. See the table above concerning diversity within our program. As noted, there is a known nationwide issue with respect to women majoring in computer science.

We are continuing to work to make our program a welcoming environment for all students.

Here is a table of some data concerning retention and graduation rates:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | FTF | Y2Spr | Grad Y4 | Grad Y5 | Grad Y6 | Grad Y7 |
|  | N | **%** | **%** | **%** | **%** | **%** |
| **1996** | 3 | 33.3 |  |  | 33.3 | 33.3 |
| **1997** | 6 | 16.7 |  |  |  |  |
| **1998** | 9 | 55.6 | 11.1 | 11.1 | 11.1 | 11.1 |
| **1999** | 11 | 72.7 | 18.2 | 27.3 | 27.3 | 27.3 |
| **2000** | 10 | 20.0 |  | 10.0 | 10.0 | 10.0 |
| **2001** | 7 | 57.1 | 28.6 | 42.9 | 42.9 | 42.9 |
| **2002** | 9 | 33.3 |  | 22.2 | 22.2 | 22.2 |
| **2003** | 4 | 100.0 | 25.0 | 25.0 | 25.0 |  |
| **2004** | 12 | 50.0 | 25.0 | 33.3 |  |  |
| **2005** | 7 | 71.4 | 57.1 |  |  |  |
| **2006** | 11 | 36.4 |  |  |  |  |
| **2007** | 12 | 75.0 |  |  |  |  |
| **2008** | 11 |  |  |  |  |  |

Here is a corresponding table for the University as a whole:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fall Cohort** | **Yr1 Fall** | **Yr2 Fall** | | **Yr3 Fall** | | **Yr4 Fall** | | **Grad Year 4** | | **Grad Year 5** | | **Grad Year 6** | | **Grad Year 7** | |
| **N** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Fall 1990** | 311 | 235 | 75.6 | 194 | 62.4 | 164 | 52.7 | 40 | 12.9 | 104 | 33.4 | 134 | 43.1 | 140 | 45.0 |
| **Fall 1991** | 273 | 210 | 76.9 | 170 | 62.3 | 158 | 57.9 | 39 | 14.3 | 95 | 34.8 | 122 | 44.7 | 132 | 48.4 |
| **Fall 1992** | 307 | 238 | 77.5 | 195 | 63.5 | 173 | 56.4 | 32 | 10.4 | 103 | 33.6 | 126 | 41.0 | 134 | 43.6 |
| **Fall 1993** | 387 | 311 | 80.4 | 240 | 62.0 | 218 | 56.3 | 60 | 15.5 | 134 | 34.6 | 161 | 41.6 | 173 | 44.7 |
| **Fall 1994** | 407 | 307 | 75.4 | 248 | 60.9 | 223 | 54.8 | 58 | 14.3 | 142 | 34.9 | 170 | 41.8 | 185 | 45.5 |
| **Fall 1995** | 354 | 282 | 79.7 | 231 | 65.3 | 212 | 59.9 | 75 | 21.2 | 141 | 39.8 | 168 | 47.5 | 185 | 52.3 |
| **Fall 1996** | 382 | 311 | 81.4 | 260 | 68.1 | 233 | 61.0 | 85 | 22.3 | 163 | 42.7 | 195 | 51.0 | 202 | 52.9 |
| **Fall 1997** | 409 | 338 | 82.6 | 277 | 67.7 | 252 | 61.6 | 84 | 20.5 | 159 | 38.9 | 178 | 43.5 | 200 | 48.9 |
| **Fall 1998** | 444 | 359 | 80.9 | 304 | 68.5 | 271 | 61.0 | 84 | 18.9 | 172 | 38.7 | 202 | 45.5 | 221 | 49.8 |
| **Fall 1999** | 470 | 396 | 84.3 | 320 | 68.1 | 282 | 60.0 | 100 | 21.3 | 196 | 41.7 | 243 | 51.7 | 261 | 55.5 |
| **Fall 2000** | 565 | 459 | 81.2 | 384 | 68.0 | 355 | 62.8 | 113 | 20.0 | 225 | 39.8 | 283 | 50.1 | 299 | 52.9 |
| **Fall 2001** | 516 | 434 | 84.1 | 357 | 69.2 | 317 | 61.4 | 96 | 18.6 | 215 | 41.7 | 266 | 51.6 | 287 | 55.6 |
| **Fall 2002** | 550 | 449 | 81.6 | 383 | 69.6 | 348 | 63.3 | 116 | 21.1 | 245 | 44.5 | 290 | 52.7 | 314 | 57.1 |
| **Fall 2003** | 551 | 441 | 80.0 | 383 | 69.5 | 328 | 59.5 | 119 | 21.6 | 240 | 43.6 | 273 | 49.5 | 286 | 51.9 |
| **Fall 2004** | 653 | 535 | 81.9 | 452 | 69.2 | 396 | 60.6 | 154 | 23.6 | 278 | 42.6 | 328 | 50.2 |  |  |
| **Fall 2005** | 741 | 597 | 80.6 | 512 | 69.1 | 459 | 61.9 | 153 | 20.6 | 313 | 42.2 |  |  |  |  |
| **Fall 2006** | 846 | 685 | 81.0 | 570 | 67.4 | 530 | 62.6 | 148 | 17.5 |  |  |  |  |  |  |
| **Fall 2007** | 910 | 743 | 81.6 | 641 | 70.4 | 582 | 64.0 |  |  |  |  |  |  |  |  |
| **Fall 2008** | 899 | 742 | 82.5 | 658 | 73.2 |  |  |  |  |  |  |  |  |  |  |
| **Fall 2009** | 798 | 684 | 85.7 |  |  |  |  |  |  |  |  |  |  |  |  |

Again, we won’t go into any detailed analysis of these data. We feel that our numbers are reasonably in line with University numbers. However, the “N” for our program for FTF (first time freshman) are small, so meaningful statistical analysis is not possible. Note also that these data do not include transfer students, who make up a significant portion of our major.

**C. Commitment to Student Learning**

1. List the learning goals for students majoring in the program. Other than grades, describe how achievement of each of these learning outcomes is evaluated and documented through both indirect and direct methods.

Without delving too deeply into the metaphysics of learning goals and assessment, we will describe some of our approach to these issues, and respond to some questions.

First, our program is not just the upper division major courses, but also the lower division requirements (sometimes labeled as “prerequisites”). We thus include both lower division and upper division learning goals.

Second, concerning how we can track and assess so many goals: we believe that the value of any learning goals must be specific to each individual student. We track and guide each student’s development through mandatory advising every semester. We do a summative assessment of the student’s fitness to graduate through the graduation evaluation process.

Third, we believe there is significant value in tying many of the learning goals for our students directly to specific curricular elements in the program. Thus, many of our goals relate directly to individual courses, or to categories of required courses (such as elective courses).

Fourth, a “passing grade” is a grade that is not a “failing grade” (i.e., not an “F”), as described in the University Catalog section on grades.

Fifth, while we understand that some people might prefer or feel more comfortable with a “top-down” approach to describing learning goals, we have preferred to develop our learning goals with a more “bottom-up” approach. We believe that progress of our students toward knowledge and competency is embedded in the curriculum of the program, and see value in the linkage between learning goals and specific curricular elements.

Sixth, we are in the process of developing a pre- and post- test assessment of student learning within the major. We are developing a database of subject matter questions and problems. These questions and problems will be linked with the learning goals for the program. This project will result in an assessment tool which students will take in an early course in the major, probably CS 2500, and again as seniors, probably in the Senior Seminar. This will give us an understanding of the value added by our curriculum.

Overall, we believe that knowledge and competency are life-long projects. We view undergraduate study as a beginning, not as an end in itself. The enumerated “learning goals” enable us to answer the questions, “Why is this a required piece of the Computer Science curriculum?”

Below are learning goals for students in the program. After each learning goal is a brief description of the method used to assure that students have made adequate progress toward the learning goal.

Students will gain a strong foundation in:

* the elements of natural science (physics or chemistry or biology)
  + Students must earn passing grades in the two semester sequence of introductory courses for majors in physics, chemistry or biology.
* general problem-solving skills, and implementing solutions as computer programs
  + Students must have a passing grade in the Computer Programming I and Computer Programming II courses (or equivalent from another campus).
* college-level mathematics including calculus and statistics
  + Students must have a passing grade in Calculus I, Calculus II and an appropriate probability/statistics course.
* mathematical topics specifically relevant to computer science (discrete mathematics)
  + Students must have a passing grade in the Discrete Structures mathematics course and a course in our computer science theory set of courses.
* machine-level hardware/architecture and assembly language programming.
  + Students must have a passing grade in the Assembly Language and Computer Architecture course (or equivalent from another campus).

Students will demonstrate a foundational understanding of:

* data storage systems and algorithms
  + Students must have a passing grade in the Computer Programming II course, the Data Structures and Algorithms course, the Computer Organization course, and the Operating Systems course, all of which contain assignments and course modules covering storage systems and algorithms.
* data structures, associated algorithms, and analytic techniques concerning such data structures and algorithms
  + Students must have a passing grade in the Data Structures and Algorithms course.
* ethical issues affecting professionals working in technical and other fields
  + Students must have a passing grade in the Philosophy Department’s Professional Ethics course.
* computer operating system principles and associated algorithms and implementation issues
  + Students must have a passing grade in the Operating Systems I course.

Students will demonstrate an in-depth understanding of:

* computer system organization principles and techniques
  + Students must have a passing grade in the Computer Organization course.
* principles of computer programming languages, and associated algorithms and techniques
  + Students must have a passing grade in the Programming Languages course.
* several important areas of computer science, including some of the more theoretical aspects of the field
  + Students must pass at least two computer science theory courses from a list of four eligible courses.
* Students will achieve a broad exposure to a variety of more advanced topics in computer science.
  + Students must pass twelve units of upper division electives from the available designated upper division courses.
* Students will be able to write clearly and effectively about a topic within the discipline, with language and style appropriate to the discipline.
  + Students must successfully complete the departmental upper division writing requirement. They can do this either by satisfying the WP requirement in CS 4100 (Programming Languages), or, if they satisfy the university WP requirement in another way, then they must work with the department Writing Coordinator to exhibit writing competency appropriate to the discipline.
* Students will be able to use the knowledge and skills developed throughout the degree program to do individual exploration of a specific topic in computer sciences, and to provide an oral and written presentation of this material to an audience.
  + Students must pass the Senior Seminar course. This course serves as a capstone experience for students in the program.

C. 3. *Describe changes the program faculty have made and/or plan to make as a result of surveys of current students, student exit surveys, alumni surveys, and direct methods used to evaluate student learning and program effectiveness.*

See the discussion above about curriculum revision.

Based on our direct assessment of writing skills in the Programming Languages (WP) and Senior Seminar course, we have found that our students need developmental improvement in their general writing and oral communication skills, as well as discipline-specific communication skills. This finding is consistent with nationwide analyses of science and technology majors. As a result of these assessments, we have significantly increased our emphasis on writing across our curriculum. In particular, there is now a significant emphasis on writing in various courses, including CS2500, CS3200, CS3500, CS4100, CS4250, CS4450, CS4480, and CS4960.

D. Curriculum and Instruction

1. *Describe the program’s effectiveness in offering the instructional program in Turlock, Stockton, and/or other off‐campus sites, and via distance education.*

Our program is offered primarily via our Turlock campus. One notable exception is CS4000: Personal Computing, a General Education F1 course, which was changed in Spring 2009 to a primarily on-line course. We believe we need to update and revise our General Education offerings, particularly at the upper division level, to align them with upcoming changes to the CSU Stanislaus General Education Goals and Outcomes. This will be a project for the coming years.

At this point, the only fully on-line course we offer is CS4000. A variety of faculty include hybrid elements in their courses. This has primarily occurred in upper division courses. We are planning to explore both fully on-line and more hybrid course offerings in the future.

1. *Describe issues, as appropriate related to program delivery, such as the scheduling of courses in order to meet student program needs and for program completion, and library and technological support.*

Our program experiences difficulty scheduling appropriate courses and course sections to allow students to progress smoothly towards graduation. More students are expressing interest in majoring in CS by registering for the core lower division prerequisites to the major, filling waitlists. We do not want to turn the students away from a major with strong job growth, but finding faculty and funds to teach extra course sections is difficult. In our region we do not have a broad pool of potential adjunct faculty to support advanced coursework.

Our current strategy is generally as follows:

1. CS1500 -- offered in multiple sections every semester. This also provides for other programs that require an introductory programming course, such as mathematics and chemistry.
2. CS2500 – has been offered in one section each semester. We are currently expanding that to offer two sections, due to increased demand.
3. CS2700 – has been offered in one section in Fall semesters. We will be expanding this to offer two sections per year, due to increased demand.
4. MATH2300 (Discrete Structures) – has been offered in one section each Spring.
5. CS3100 – has been offered in one section each semester.
6. CS3740, CS3750, CS4100 – has been offered in one section per year. We anticipate the need for an additional section each year.
7. Theory and Practice courses – have been offering at least one Theory and at least one Practice course each semester, but this has, at times, been difficult to accomplish.
8. Elective courses – typically have been offered on a two year cycle, which constrains the range of courses available to students.

In recent years we have been experiencing significant growth in our majors and minors, and are experiencing growing pains. Unfortunately there are quantum effects associated with the growth, for example we might have enough students for one and a half sections of a core course in a particular semester, but not quite enough for two sections.

1. *Describe the effectiveness of the program in improving students’ writing skills through the curriculum and/or writing proficiency courses*.

The computer science department is strongly committed to improving student writing skills in general and in our discipline. All of our courses emphasize problem solving skills and logical thought that contribute to clear, concise, well-organized writing.

In our programming courses (CS 1500, CS 2500, and CS 3100) students learn to write programs in one or more formal computer languages and to clearly document their code in concise and appropriate English.

In our upper-division courses students practice a wide range of technical writing, such as specification and requirements documents (CS 4800) and project reports (CS3200, CS4250, CS 4300 and CS 4480).

In addition, all majors are required to take our WP course and the Senior Seminar. Both of these courses have substantial writing components focused on clearly communicating technical material to a computer literate audience.

In our Senior Seminar (CS 4960) students write a paper on a faculty-approved current topic in computer science and give a 40-minute public presentation. The paper and the talk are peer-reviewed, which gives students the opportunity to receive a broader range of feedback than the instructor alone can provide and to develop and practice critical writing assessment skills.

In our WP course, Programming Languages (CS 4100), students write a long research paper (project) on some aspect of computers and language. The project is peer-reviewed and receives developmental feedback from the instructor. Students write four or five other essays on various aspects of programming languages.

1. *Describe the effectiveness of student advising and mentoring and involvement with student majors.*

We have mandatory advising. We require students to meet with a faculty member each semester before registering for the next semester’s courses. Department faculty are participating in college-wide programs, like the Central Valley Math and Science Alliance and the LS-AMP, that provide information about the changing situation with regard to transferring from community colleges and provide opportunities for advising individual students.

Faculty members are engaged in on-going undergraduate research efforts. In addition to on-going individual research efforts by faculty, in recent years we successfully applied for and were awarded two grants from the *Army High Performance Computing Research Center* with an emphasis on recruiting and retaining minority students. Funded by these grants, students were able to attend nation-wide conferences and work on research projects.

5. *Describe the program’s role in providing service courses to other majors and the general education program.*

The CS department offers CS2000 (Effective Computing, GE Area E), CS4000 (Personal Computing, GE Area F1) and CS 3500 (Human Centered Design, GE Area F1) in service to the General Education program. In addition, some concentrations in other science majors require CS 1500 (Computer Programming I) for their majors. We are looking at developing both lower and upper division scientific computing courses, which would be offered to support other programs in our college. At the lower division, these courses would probably focus on providing discipline-based problem solving and computer programming skills. At the upper division level, these courses would probably be General Education courses.

**E. Faculty**

1. *Describe and evaluate faculty expertise for covering the breadth of the program’s curriculum. Summarize and evaluate institutional research data regarding faculty and their deployment ‐‐ sufficiency of full and part‐time faculty, released time, and reimbursed time from grants/contracts, anticipated retirements, and other faculty issues important to the program.*

At this point, we have five tenured / tenure-track faculty in the Department: Dr. Tom Carter, Dr. Melanie Martin, Dr. John Sarraille, Dr. Robert Silverman, and Dr. Megan Thomas. We hope to hire an additional faculty member to accommodate the observed increase in student demand.

We consider faculty expertise to be reasonable to cover the breadth of our program. Our general principle for faculty in the department is that we expect every faculty member to be capable of being effective at teaching every core course in the major (with some preparatory lead time), and to be able to teach a reasonable range of elective/depth courses. Our experience has been that the elective courses taught by individual faculty members have varied over the years as their interests have developed and changed.

Typically in recent years our combined faculty have had approximately one full-time equivalent (FTEF) of release and assigned time, if not more. This has included local and grant-funded RSCA and administrative and other service responsibilities, such as faculty union activities and program direction. In addition, Dr. Martin teaches courses for the Mathematics Department and Dr. Carter teaches courses for the Cognitive Studies and Honors programs.

1. *Describe how faculty members are engaged and supported in scholarship, research, and/or creative activity. Describe program support for and involvement in faculty development, especially new and non‐tenured faculty.*

Our faculty are reasonably active in scholarship, research, and creative activities. Of course, given the teaching responsibilities within the CSU, we are not able to devote the time and effort to these areas as we might wish or might otherwise be able. Individual faculty are described briefly below.

Dr. Carter continues his work on developing a web-published lecture-notes series including Information Theory, Nonlinear Systems and Chaos, Theory of Computation, and an Introduction to Quantum Computation. He is also developing a suite of pedagogical computer simulation examples and tools. As appropriate, he uses these in his classes. He has also uses these with graduate students and postdocs in the NSF sponsored Santa Fe Institute Complex Systems Summer School. Dr. Carter has been developing information-theory and graph theoretic approaches to analysis of data sets and network systems. In recent years, with grant support from the Army High Performance Computing Research Center, a group of faculty, including faculty from Geography, have been developing an undergraduate research program focusing on analysis of large data sets.

Dr. Martin took on an administrative role as the Program Director and Campus Coordinator of the CSU Stanislaus Lewis Stokes Alliance for Minority Participation (LSAMP) program in Fall 2011. She is also a member of the Strategic Committee of the Central Valley Math and Science Alliance (CVMSA) and is serving as a CVMSA mentor for the 2012-2013 academic year. She participated in two years of a grant-funded interdisciplinary undergraduate research program,  “Exploring Large Data Sets,” funded by the Army High Performance Computing Research Center (see Dr. Thomas’ more detailed description). She continues working on her dissertation research, studying the trustworthiness of medical information for consumers on the World Wide Web and has been able to hire students to implement a demo with support from Naraghi and RSCA grants. In addition, she continues to work in the area of team communication with colleagues at other universities. Dr. Martin teaches in both the Computer Science and Mathematics departments. She is exploring ways to update and improve Statistics (Math 1600) and Programming Languages (WP – CS 4100), as well as developing an introductory programming course for the sciences and a senior-level computer science elective in Data Mining.

(JS working here) Dr. Sarraille has been working with a team in developing a Japanese electronic dictionary. This effort has resulted in a number of conference presentations with publication in proceedings. He maintains and updates software to estimate fractal dimensions. The software has been used by researchers from around the world in a variety of fields, ranging from Mayan settlements to vertebral bone structure. John has also continued his development of curricular materials for various courses he teaches.

(RS working here) Dr. Silverman’s scholarly activity consists of several efforts. He has updated Software Engineering course and used the updated syllabus to teach the course in 2003/2004. He has developed a new course on electronic commerce (E-commerce). E-commerce is an important area in industry and is expected to be a growing field in the future as many companies are building business presence on the net. He is also developing a book proposal on E-commerce and searching for a publisher for the book.

Dr. Thomas has been working on innovation and improvement in our computer science education pedagogy and our local course offerings. Of particular note are the course in Human Centered Design, a course about a topic taught, at most universities, only to upper division CS majors, but offered here to General Education students as well. (This course led to a journal publication.) New in Spring 2013 will be a course, about creating apps for Apple smart phones and tablets, that employs innovative pedagogical techniques. (Apple iPhones have only been available since mid-2007.) Dr. Thomas has also, with Drs Carter and Martin of CS and Dr. Hauselt of Geography, received two year-long grants from the Army High Performance Research Center to fund development of an undergraduate research program for multidisciplinary “big data” research and improved retention of minority students in our STEM major. (This program also led to a journal publication and several awards for student research presentations.)

We consider CSU in general, and campus in particular, support for RSCA to be inadequate. This is especially true considering the very high teaching load we have in the CSU. This issue is not specific to Computer Science, but is true generally across all faculty. This was brought home to us during searches for new faculty members. We found that our pool was limited by the disparity between the CSU required teaching load and the expected load at other campuses to which applicants were applying.

**F. Implementation Plan**

***Preliminary Implementation Plan***

*As a result of the self-study, the department chair develops a preliminary implementation plan that reflects the view of the program faculty. This preliminary implementation plan is discussed with the Provost, Dean, and Vice Provost during the academic program review meeting. The implementation plan includes (but is not limited to) the following elements:*

1. *Key recommendations of the program faculty resulting from the self‐study.*

We will continue to try to align our major requirements with the curriculum standards set by nationwide organizations like ABET and the Joint ACM/IEEE Computing Curricula Task Force.

The department will continue to explore offering a BA degree program. With support and encouragement from Dean Kamali we will look at the possibility of developing a BA in Information Technology with significant on-line components. We are still in the fact-finding stage, including reviewing example programs from other universities. A major concern for this project is the level of faculty and staff support that would be required for such a significant undertaking.

The department will also explore offering our BS degree with concentrations in cross-disciplinary areas like computational biology, or multimedia. Similarly, we will explore offering more focused computational minors to students majoring in other disciplines.

1. *Anticipated student profile in terms of number and type of students over the next seven years.*

We expect on-going, moderate growth in both majors and minors. Like most computer science departments nationwide, the ratio of male to female students in our major is not where we would like it to be, though we have a relatively high number of minority students compared to other universities.

1. *Action steps to be taken in order to achieve each of the recommendations and student enrollments over the next seven years.*

See above.

Also, we would like to review and update our General Education course offerings.

We would like to increase the frequency with which we offer core courses.

We would like to explore enhanced interaction with the local technical and business community.

*4. Types of human, fiscal, and physical resources needed to implement recommendations.*

At least one additional faculty member will be needed to accommodate growth in student interest. At least one more faculty member beyond that would be needed if we were to offer a BA in Information Technology. It is also likely that between one and three senior faculty members will retire within the next seven years. We will need to replace any retired faculty.

We continue to need ongoing funding for replacement and maintenance of computing hardware to support our current program, and will need increased funding if we want to expand our program offerings or create new programs.