Program:  **B. S. Computer Science**

Department:  **Computer Science**

Number of students enrolled in the program in Fall 2011:  **404**  
Date:  **January 23, 2012**

Faculty member completing template:  **Mary Jane Lee, Computer Science Assessment Coordinator**

Period of reference in the template:  **2006-07 to present**

1. Please describe your program’s learning-outcomes trajectory since 2006-07: Has there been a transformation of organizational culture regarding the establishment of learning outcomes and the capacity to assess progress toward their achievement? If so, during which academic year would you say the transformation became noticeable? What lies ahead; what is the next likely step in developing a learning-outcomes organizational culture within the program?  
   [Please limit your response to 200 words or less]

The Computer Science accreditation board, ABET/CAC, specifies a number of characteristics that seniors must have at the time of graduation. Originally, the Department adopted these characteristics as its student learning outcomes. There were originally eleven (11) outcomes. In 2008-2009 the Department revised these outcomes, based on input from constituents: faculty, employers, and Industry Advisory Committee. Similar outcomes were combined, some outcomes were broadened by rewording, overlapping outcomes were eliminated, and oral communication and written communication were separated. This process resulted in the current nine (9) learning outcomes.

The Department has developed an outcome assessment plan which is revised and fine-tuned regularly. Rubrics have been developed for direct assessment of oral presentations and written reports. In 2008, performance criteria for assessment of core Computer Science topics were established and subsequently implemented using course-embedded questions on midterms and final exams. The Department has assessed core topics for several cycles incorporating recommendations on “closing the loop” with positive results. The Department has adopted a three-year outcome assessment plan which has enabled the assessment of all learning outcomes over a three-year period.  
(See Appendix A.)

All Department faculty members are engaged in the assessment process through course-based assessment and regular discussions at monthly faculty meetings. Faculty reflection has become an integral part of the process.

2. Please list in prioritized order (or indicate no prioritization regarding) up to four desired learning outcomes (“takeaways” concerning such elements of curriculum as perspectives, specific
content knowledge, skill sets, confidence levels) for students completing the program. For each stated outcome, please provide the reason that it was designated as desired by the faculty associated with the program. [Please limit your response per outcome to 300 words or less]

For each of our nine student learning outcomes (macro level), the Department developed a set of measurable performance criteria (micro level) to assess core topics in upper division core courses. These performance criteria were established in 2008-09 and updated and refined in 2010 and 2011. Our top four outcomes, A through D, are presented below in prioritized order. Associated performance criteria and courses for each learning outcome are also provided.

A. Apply knowledge of mathematics, algorithmic principles, computer theory, and principles of computing systems in the modeling and design of computer-based systems that demonstrate an understanding of tradeoffs involved in design choices.

This outcome forms the foundation of the computing discipline. It represents the mathematical, theoretical, and technical basis of the core knowledge of Computer Science.

The performance criteria for Outcome A are:
A-1. Understand and apply fundamental algorithms. (CSC 130)
A-2. Understand and use appropriately essential data structures. (CSC 130)
A-3. Understand tradeoffs in selection of algorithms and data structures. (CSC 130, CSC 133, CSC 190/191)
A-4. Demonstrate knowledge of abstract machines, languages, and grammars. (CSC 132)
A-5. Understand and use relational data bases. (CSC 134)
A-6. Understand predicate calculus and logic programming. (CSC 136)
A-7. Understand the functional programming paradigm. (CSC 136)
A-8. Understand layers of communication protocol. (CSC 138)
A-9. Understand concurrency and resource management. (CSC 139)

B. Analyze a problem, specify the requirements, design, implement, and evaluate a computer-based system, process, component, or program that satisfies the requirements.

This outcome represents the ability to apply the knowledge given in Outcome A. This reflects the fact that not only is the fundamental knowledge critical, but the ability to apply the theory to solve real world computing problems is essential for success in the computer science profession.

The performance criteria for Outcome B are:
B-1. Demonstrate the ability to design and analyze hardware components, such as, processors and memory devices. (CSC 137)
B-2. Understand modern computer architectures. (CSC 137)
B-3. Demonstrate proficiency in using hardware description languages. (CSC 137)
B-4. Understand Moore finite state diagrams and circuit diagrams. (CSC 137)
B-5. Understand and apply process synchronization principles. (CSC 139)
B-6. Understand concurrency and resource management. (CSC 139)
B-7. Understand paging system. (CSC 139)
B-8. Understand and apply modeling and analysis techniques. (CSC 190/191)
B-9. Understand and apply requirements engineering process. (CSC 190/191)
B-10. Understand and apply design principles. (CSC 131, CSC 190/191)
B-11. Understand and apply appropriate testing techniques. (CSC 190/191)
B-12. Understand and apply project management processes and tools. (CSC 190/191)

C. Function effectively as a member of a team to accomplish a common goal.

Computer Science graduates are expected to work effectively and cooperatively on project teams. Often these teams are interdisciplinary in nature. The ability to work together, deal with alternative viewpoints, address conflicts and resolve differences, and produce quality work at the completion of each project phase is critical in the computing work environment. This is viewed by industry as an essential characteristic of the graduates they hire.

The performance criteria for Outcome C (evaluated in courses CSC 131, and CSC 190/191) are:
C-1. Cooperate and collaborate as a team member.
C-2. Communicate and listen. Keep teammates informed.
C-3. Address conflicts and resolve differences.
C-4. Contribute as a member of the project team.

D. Effective communication.

Technical knowledge, in and of itself, is not sufficient for success as a computer scientist. The graduate must be able to effectively communicate this knowledge, both orally and in writing, to technical as well as non-technical audiences. Again, this is a requirement stressed by industry. (Note that two learning outcomes are combined under the broad category of effective communication.)

The performance criteria for Outcome D (evaluated in courses CSC 131 and CSC 190/191) are:
1) For Oral Communication
D-1. Identify main points clearly and present them concisely.
D-2. Demonstrate good organization.
D-3. Make transitions smooth and logical.
D-4. Attract and hold the interest of the audience.
D-5. Present the material effectively and confidently
D-6. Maintain eye contact.
D-7. Use appropriate vocabulary.
D-8. Use appropriate and accurate technical terms.

2) For Written Communication
3. For undergraduate programs only, in what ways are the set of desired learning outcomes described above aligned with the University’s Baccalaureate Learning Goals? Please be as specific as possible. Please limit your response to 400 words or less.

The relationship between the program four desired learning outcomes and the University’s Baccalaureate Learning Goals (BALG) is reflected in the matrix below. Notably, each BALG is linked with one or more learning outcomes.

<table>
<thead>
<tr>
<th>University Baccalaureate Learning Goals</th>
<th>Outcome A Application of Fundamental Knowledge</th>
<th>Outcome B Computer System Development Cycle</th>
<th>Outcome C Teamwork</th>
<th>Outcome D Effective Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence in Discipline</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of Human Cultures &amp; Physical &amp; Natural Worlds</td>
<td>X</td>
<td></td>
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<tr>
<td>Intellectual &amp; Practical Skills</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Personal &amp; Social Responsibilities</td>
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<tr>
<td>Integrative Learning</td>
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<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Competence in the Discipline:**
Outcome A involves the ability to apply knowledge of mathematics and physics (related fields) to fundamental areas of computer science, such as, algorithmic principles, computer theory, computer architecture, and principles of computing systems. This ability is demonstrated by understanding the tradeoffs required in the effective design of computing systems.

Outcome B involves skills required to apply the fundamental knowledge in Outcome A to the analysis, design, and development of computer-based systems that satisfy specific requirements.

**Knowledge of Human Cultures and Physical and Natural Worlds:**
Outcome A requires computer science graduates to have knowledge of mathematics and physics. This is complemented by the knowledge students acquire through the courses they take to satisfy the CSUS general Education requirements.
Intellectual and Practical Skills:
This BALG is addressed by all four desired outcomes. Outcomes A and B cover the intellectual and practical skills of inquiry and analysis, critical thinking, quantitative literacy, and problem solving. Outcome C involves teamwork and Outcome D effective oral and written communication skills. Both the ability to work as a team member and effective communication skills are very significant and practical skills.

Personal and Social Responsibilities:
Outcome B is related to analytic abilities in problem solving which address ethical reasoning and real world challenges. Outcome C teamwork addresses “the ability to work collaboratively with those from diverse cultural backgrounds”, a common work environment in technical disciplines such as computer science.

Integrative Learning:
Interdisciplinary learning and capstone or senior studies are evident in Outcome B which addresses a student’s ability to integrate knowledge and skills acquired throughout their academic program and to apply such skills in the development of a system. The ability to effectively communicate this knowledge, Outcome D, is a critical part of integrative learning.

4. For each desired outcome indicated in item 2 above, please:
   a) Describe the method(s) by which its ongoing pursuit is monitored and measured.
   b) Include a description of the sample of students (e.g., random sample of transfer students declaring the major; graduating seniors) from whom data were/will be collected and the frequency and schedule with which the data in question were/will be collected.
   c) Describe and append a sample (or samples) of the “instrument” (e.g., survey or test), “artifact” (e.g., writing sample and evaluative protocol, performance review sheet), or other device used to assess the status of the learning outcomes desired by the program.
   d) Explain how the program faculty analyzed and evaluated (will analyze and evaluate) the data to reach conclusions about each desired student learning outcome.

[Please limit your response to 200 words or less per learning outcome]

(If the requested data and/or analysis are not yet available for any of the learning outcomes, please explain why and describe the plan by which these will occur. Please limit your response to 500 words or less.)

The desired outcomes are assessed using direct measures. For Outcomes A and B, test-embedded questions in upper division core courses are the primary means of evaluation. For Outcomes C and D, a combination of faculty evaluation of oral presentations and written reports in the senior project is used. Feedback from supervisors on the performance of student interns is used to assess Outcomes B, C, and D. With the exception of internship (internships are not a mandatory part of the program), all
students in a class are evaluated. The focus is on upper division required courses where the student population is almost exclusively computer student majors (with few computer engineering students).

Responses to parts a) through c) for each desired outcome is provided in the table below. The response to Part d) follows.
### Methods, Courses, and Instruments for Assessment of Learning Outcomes A, B, C, and D.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>a) Methods outcome is monitored and measured</th>
<th>b) Courses from which students were assessed</th>
<th>c) Instruments used to gather data</th>
</tr>
</thead>
</table>
| **A. Apply Fundamental Knowledge** | CSC 130, CSC 132, CSC 134, & CSC 136: Course embedded exam questions | 2008-09: CSC 130, CSC 132, CSC 134  
2009-10: CSC 130, CSC 132, CSC 134, CSC 136  
2010-11: CSC 130, CSC 136, CSC 138 | Exam questions graded by Instructor and rated as:  
1 (Below expectations), 2 (Progressing to criteria), 3 (Meets criteria), or 4 (Exceeds criteria). See Appendix B for sample questions. |
| **B. Computer System Development Cycle** | CSC 131, CSC 137, & CSC 139: Course embedded exam questions  
CSC 195/195A: Supervisor evaluations | 2008-09: CSC 137, CSC 139  
2009-10: CSC 131, CSC 137  
Supervisor evaluation. See Appendix C for survey and results for 2009-10. |
| **C. Teamwork** | CSC 191: Student survey; Instructor evaluations  
CSC 195/195A: Supervisor evaluations | 2008-09: CSC 191  
2010-11: CSC 191  
2006-07, 2009-10, 2010-11: CSC 195/195A | Student survey on team work experience. See Appendix D.  
Supervisor evaluations – Same as in Outcome B. |
| **D. Effective Communication** | CSC 131, CSC 190, CSC 191: Evaluation form & rubric for oral & written communication  
CSC 195/195A: Supervisor evaluations | Oral:  
2006-07: CSC 131, CSC 190, CSC 191  
2007-08: CSC 131, 190, CSC 191  
2010-11: CSC 131  
2006-07, 2009-10, 2010-11: CSC 195/195A  
Written:  
2007-08: CSC 191  
2010-11: CSC 190  
2006-07, 2009-10, 2010-11: CSC 195/195A | Oral communication evaluation instrument - See Appendix E.  
Written communication rubric - See Appendix F.  
Supervisor evaluations - Same as in Outcome B. |
Part d) How the faculty analyzed and evaluated data to reach conclusions for the outcome.

To assess a performance criterion, the Department used the following rating method for each student:

1 -- Fails to meet criterion
2 -- Progressing to criteria
3 -- Meets criterion
4 -- Exceeds criterion

A criterion is said to be met if 75% of the students receive a rating of 3 or 4.

Outcome A. Application of Fundamental Knowledge

Test-Embedded Questions
Student answers to test embedded exam questions used to assess learning Outcome A are graded by the course instructors. The instructor then determines a rating scale which converts test scores to a rating of 1, 2, 3, or 4 as defined above. The percentage of ratings of 3 or 4, i.e., percentage of students who satisfy or exceed the criterion for Outcome A, is computed for each question. Criteria with percentages of 75% or higher are considered to be satisfied. Criteria with percentages of 75% or less are considered to be not satisfied. These results are discussed by Department faculty. Steps to improve student learning for performance criteria not satisfied are recommended and implemented prior to a subsequent reassessment.

Outcome B. Computer System Development Cycle

Test-Embedded Questions
Similar to Outcome A.

Supervisor Evaluation
Students who participate in CSC 195 Field Work in Computer Science and CSC 195A Professional Practice (or Coop Experience) are evaluated at the end of every semester by their supervisors. Supervisors rate students’ abilities using the following scale: Outstanding, Above Average, Average, Below Average, Weak, and Did not Observe. Performance criteria cover Outcomes B, C, and D. The percentage of Outstanding, Above Average, and Average ratings for each criterion is computed. Using the standard of 75% or above as an indicator that a criterion is met, the results are analyzed and presented to the faculty. Faculty discussion and reflection follow.

Outcome C. Teamwork

Student Survey
Students at the end CSC 191 Senior Project - Part II complete an anonymous survey on their experience working on their senior project as a member of a team. For each of the 10 questions, there are four possible responses. These responses varied with each question. (See Appendix D.) The senior project instructor and one faculty member analyze student responses for questions related to
the four performance criteria for Outcome C and rate if the criterion is met using the scale of 1 to 4. Percentages of students who meet or exceed criterion are computed.

**Supervisor Evaluation**
Same as for Outcome B.

**Outcome D. Effective Communication**
*Oral and Written Communication Rubric/Evaluation Instrument*

The oral communication evaluation instrument was implemented to assess student presentations in CSC 131 Computer Software Engineering and CSC 190/191 Senior Project – Parts I and II. See Appendix E. (Note: A rubric developed and implemented during prior years was determined by faculty to be burdensome and difficult to complete. The evaluation instrument currently in use evolved as a stream-lined version of the rubric.) All project team members were required to have a speaking part. Department faculty evaluated the presentations in terms of the following criteria:

- organization
- style and delivery
- language and vocabulary
- communication of technical content.

The same 4-point rating system described above was used. Percentages of students who meet or exceed criterion were computed for each performance criterion. A criterion is considered to be satisfied if 75% or more of the students receive a rating of 3 or 4.

The written communication rubric (See Appendix F) was designed to evaluate student writing in terms of the following:

- composition and completeness (organizational structure, syntax, paragraph structure)
- presentation of technical content (problem statement, design requirements, design process, data, results, conclusion).

Department faculty evaluated student reports. The 4-point rating system was again used. Percentages of students who meet or exceed criterion were computed for each performance criterion.

**Supervisor Evaluation**
Same as for Outcome B.

5. Regarding each outcome and method discussed in items 2 and 4 above, please provide examples of how findings from the learning outcomes process have been utilized to address decisions to revise or maintain elements of the curriculum (including decisions to alter the program’s desired outcomes). If such decision-making has not yet occurred, please describe the plan by which it will occur. **[Please limit your response to 200 words or less per item]**
Student learning outcomes are connected to the curriculum by linking them with performance criteria associated with course outcomes in core courses. Once learning outcomes (macro level) were finalized by the Department, a concerted effort was made to identify performance criteria (micro or course level). This effort transpired over several years, 2008-2011, with each iteration resulting in a clearer and more refined set of criteria based on the experiences in implementing some of the criteria. Performance criteria were updated on 1/21/10, 3/16/10, and 5/3/11.

Over this period of time, the Department was able to “close the loop” and correct deficiencies in Outcomes A, B, and D. Student performance in Outcome C Effective team member was considered to be satisfactory. 2010 results were consistent with those of 2008.

Outcome A. Application of Fundamental Knowledge

In 2008-09, the assessment of Outcome A produced mixed results. Three out of five criteria were satisfied while deficiencies were observed in two criteria, A-2 Understand fundamental algorithms (55% satisfied criterion) and A-4 Understand finite state machines (70% satisfied criterion). Since this was the first time the Department assessed core topics, the faculty recognized that there were some problems with the process. For example, the performance criteria were not in place when exam questions were developed, the level of difficulty of the questions was not standardized, and there was significant variation in the grading process, even among faculty grading the same question. To address these concerns, the Department decided that, first, a complete set of criteria must be specified for each outcome. Second, the exam question selected for evaluation must cover a performance criterion for the course. And last, instead of having faculty members not teaching the course serve as evaluators, the evaluator should be the course instructor. Outcome A was assessed again the following year.

In 2009-10, re-assessment of A-2 and A-4 indicated substantial improvement in satisfying these criteria. See Appendix B for questions used to re-assess Outcome A and results obtained. In this cycle, performance criterion, Understand fundamental algorithms, was relabeled from A-2 to A-1. For criterion A-1, the percentage of students who satisfied the criterion increased from 55% to 87%. For criterion A-4, finite state machines and grammars were combined with an aggregate assessment result of 85%. Thus, the Department was able to correct deficiencies in satisfying A-1 and A-4 criteria. Criteria A-5 and A-6 were also satisfied. However, deficiencies now appeared in criteria A-2 Understanding essential data structures and A-7 Understanding functional programming paradigms. It was recommended that the instructors for CSC 130 and CSC 136 develop instructional materials to assist students in understanding these topics and that these two criteria be reassessed the following year.

In Fall 2010, the instructor for CSC 130 provided more in-class examples of various data structures and their applications. In the re-assessment of criterion A-2, students were asked to answer four related questions rather just one question as was done in 2009-10. The percentages significantly increased from 41% to 88%. Similar results were observed for criterion A-7 with similar changes
implemented in CSC 136. Percentages increased from 56% to 77%. Thus, the Department was able to “close the loop” by making changes in lectures which resulted in satisfying all the performance criteria assessed for Outcome A. Instructors for CSC 130 and CSC 136 were asked to continue to provide students with examples and their applications.

Outcome B. Computer System Development Cycle

At the end of each semester, students in CSC 195/195A are evaluated by their supervisors. The results for 2006-2007 indicated that 100% of the 39 students satisfied Outcome B with 22 out of 39 students rated as outstanding. Comparable results were obtained in 2009-2010 and 2010-2011. See Appendix C for the supervisor evaluation form and compiled results for 2009-2010.

In 2008-09, four performance criteria, B-1, B-4, B-6, and B-7, were assessed using test-embedded questions in CSC 137 and CSC 139. Percentages of students meeting criterion exceeded 75% for all assessed criteria except for B-1 Understands cache memory and the number of misses. As mentioned above in Outcome A, because the process of selecting questions was of concern to faculty, the Department decided to reassess B-1 the following year using a different exam question. In 2009-10, criterion B-1 was re-assessed in CSC 137. A new performance criterion B-10 was assessed in CSC 131. Again, test-embedded questions were used. (See Appendix A for test–embedded questions used and results.) The percentages of students meeting criteria were 92% and 87% for B-1 and B-10, respectively. All performance criteria assessed for Outcome B are satisfied.

Outcome C. Effective Team Member

In 2006-07, students in CSC 195/195A were evaluated in terms of their ability to function as effective team members. The results for 2006-2007 indicated that 100% of the 41 students satisfied Outcome C with 20 students rated as outstanding. See Appendix C for comparable results for 2009-2010. For 2010-2011, 100% of the 10 students were again rated as effective members of a team with 6 considered outstanding.

At the end of Spring 2009 and Spring 2011, each CSC 191 student completed an anonymous survey on their experiences as a member of a project team for two semesters. The survey elicited feedback on how each team member felt about their team and how effectively members functioned as a team. Each team was then asked to review, reflect, and analyze the results of the survey and write a report reflecting on the individual and aggregate results of the seven teams. Individual student data and team reports were reviewed by the CSC 191 instructor and another faculty member. Both the 2009 and 2011 results for each performance criterion were consistent with each other and with what senior project instructors have observed through the years. The first percentages are the results for 2009; the second for 2011.
C-1. Cooperate and collaborate. (84%, 97%)
C-2. Communicate with each other; keep members informed (75%, 80%)
C-3. Address conflicts and resolve differences (56%, 60%)
C-4. Share equally in the workload (88%, 77%)

All performance criteria for outcome C were satisfied except C-3. The low percentage in C-3 was addressed by adding several lectures in CSC 190/191 devoted to how to address conflicts and resolve differences. In this context, the class is given several scenarios and alternative solutions are proposed and discussed. In the case of an actual conflict arising within a team, members are asked to attempt to resolve the issue(s) as a team before requesting instructor assistance and/or intervention. However, given that most students have little or no experience working in a group environment for an extended period of time, students are not expected to satisfy C-3 criterion by the completion of senior project. The Department considers performance at 50% or higher to satisfy the criterion.

Thus, Outcome C is considered to be satisfied.

Outcome D. Effective Oral and Written Communication

Oral Presentation

In 2006-07, the Department used an evaluation form to evaluate student presentations in CSC 131, CSC 190, and CSC 191. About 20 students were evaluated in each class. Results indicate that six out of 8 performance criteria were satisfied. D-4 Attract and hold interest of audience and D-6 Maintain eye contact were the criteria not satisfied. It was recommended that a lecture on effective oral presentation techniques be included in both CSC 131 and CSC 190/191.

In Fall 2007, a rubric was developed and was the instrument used to evaluate oral presentations in CSC 131, 190, and 191. Although aggregate percentage scores in the four major categories (organization, delivery, language and vocabulary, communication of technical content) exceeded the 75% minimum, some improvement could be made in the subcategories of D-2 Organization and D-6 Maintain eye contact in CSC 131 and CSC 190. No deficiencies were cited in CSC 191 for Spring 2008.

Because faculty considered the rubric too detailed and cumbersome to be completed during a 10-minute presentation, the rubric was revised in 2010-11 to facilitate ease of use. See Appendix E. The rating scale was reduced from 4 to 3 (1 - Meets or exceed criterion, 2 – Minimally meets criterion, 3 – Below expectations. A criterion was said to be met if at least 75% of the students receive a rating of 1 or 2.) The results of assessing 10 teams of 3-4 students each in CSC 131 indicated that the percentages exceeded the 75% minimum for all criteria.

The results of supervisor evaluations of student oral presentations for 2010-2011 indicate that 100% (9 out of 9) satisfy the criterion. See Appendix C for comparable results for 2009-2010.
Written Presentation

In 2006-07, supervisors evaluated their student interns in CSC 195/195A. All 40 students were evaluated as satisfying the criterion for effective writing. For 2009-2010, 23 out of 24 were rated as satisfying this criterion. (See Appendix C.) For 2010-2011, comparable positive results were also achieved.

In 2007-08, a rubric was developed to assess student writing. (See Appendix F.) Four 2-page writing samples on CSC 191 students’ reflections on teamwork were evaluated. The following criteria were satisfied.

- Description of problem statement
- Report summary and conclusion
- Structure (organization and transition)
- Paragraph structure

Technical aspects, not present in the paper, were not assessed. One criterion – syntax and sentence structure – was not satisfied.

In 2010-11, to evaluate student writing skills, the faculty selected Software Requirements Specifications (SRS) reports submitted by CSC 190 students. Four SRS reports were reviewed and six faculty members served as evaluators. Each faculty evaluated two reports resulting in three evaluations per report. The rubric was modified to fit the document evaluated. Criteria D-9 to D-13 were assessed. Results indicated that all five criteria were satisfied with percentages ranging from 91% to 100%. The criterion of correct syntax and sentence structure was now satisfied.

Thus, Outcome D is satisfied.

In summary, it can be concluded that learning outcomes A, B, C, and D are satisfied by our student.

Reviewers are referred to the Department’s annual assessments reports from 2006-2007 to 2010-2011 for detailed assessment information.

6. Has the program systematically sought data from alumni to measure the longer-term effects of accomplishment of the program’s learning outcomes? If so, please describe the approach to this information-gathering and the ways in which the information will be applied to the program’s curriculum. If such activity has not yet occurred, please describe the plan by which it will occur.

[Please limit your response to 300 words or less]

In ABET terminology, program objectives describe the characteristics of alumni three to six years after graduation. The Department has regularly surveyed alumni to assess how well these objectives are
met. The seven (7) program educational objectives have been derived from numerous discussions with and input from our alumni, annual onsite visits with area and regional employers, and our Industry Advisory Council. The most recent industry survey to update our program objectives was conducted in 2010-11. Our program objectives will be refined this year as a result of this survey. The mapping of our learning outcomes to our program objectives is provided in Appendix G.

The most recent alumni survey to assess our program objectives was conducted in Spring 2010. The Department updated a list of standard survey questions and utilized an online tool called Student Voice (http://www.studentvoice.com/app/Views/Home/Default.aspx). All 7 program objectives were assessed. Alumni who participated in this anonymous survey received their B.S. degrees between 3 to 6 years ago. There were 25 respondents. Results of this survey provide strong evidence of accomplishment of our program objectives. A high percentage of alumni (77% - 100%) view the Department’s program objectives as extremely/very/moderately important to their professional careers. And a high percentage of alumni (77% - 100%) rate their Sacramento State education as having prepared them extremely/very/moderately well to achieve these objectives.

7. Does the program pursue learning outcomes identified by an accrediting or other professional discipline-related organization as important? Does the set of outcomes pursued by your program exceed those identified as important by your accrediting or other professional discipline-related organization? [Please limit your response to 300 words or less]

The B.S. degree program in Computer Science at Sacramento State has been continuously accredited by the Computing Accreditation Commission (CAC) of ABET since programs in the computing sciences were first accredited in 1986. The Department views program accreditation as vital to the viability and success of our B.S. degree program. As mentioned in part 1 of this report, our original set of student learning outcomes were based on the desired ABET/CAC characteristics of a baccalaureate computer science student. These learning outcomes were refined in 2008 to incorporate input from faculty and area employers.

8. Finally, what additional information would you like to share with the Senate Committee on Instructional Program Priorities regarding the program’s desired learning outcomes and assessment of their accomplishment?

[Please limit your response to 200 words or less]

The Department has recently received nationally competitive grants and recognitions. In 2007 the Department of Homeland Security and the National Security Agency designated the Department as a Center of Academic Excellence in Information Assurance and Security Education. This national level designation recognizes the Computer Science faculty’s achievements in research and in curriculum development for both undergraduate and graduate programs in response to the discipline needs in information assurance and security. In September 2010, the Department received about $1.2 million funding from NSF for a Scholarship for Service Program to educate and train in the next four years 15
undergraduate and graduate students to become information assurance and security professionals mainly for Federal and State governments. This NSF grant also provides the Department with funding support for faculty development. In January 2011, the Department also received $740K funding from NSF for a three-year project on game design to mentor K-12 educationally disadvantaged students in computer science and math. These two most recently received nationally competitive NSF grants again recognize the Computer Science faculty’s achievements in scholarly contributions and curriculum development. In addition, other grants were also awarded for funded research projects.
### Appendix A. BS in Computer Science 3-Year Learning Outcome Assessment Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>Outcomes Assessed</th>
<th>Courses</th>
<th>Data Collected</th>
<th>Continuous Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-2012</td>
<td><em>(a) Application of fundamental knowledge</em></td>
<td>Outcome (a) assessed in selected core courses: CSC 130, 133, 134, 135, 138, 139, and 190/191</td>
<td>Course embedded exam questions, assignments, projects as appropriate.</td>
<td>Review of evaluation procedures for assessment of all outcomes (a) to (i).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outcome (b) assessed in selected core courses: CSC 131, 137, 139, and 190/191</td>
<td></td>
<td>Review of learning outcomes and performance criteria. Refine if necessary.</td>
</tr>
<tr>
<td>2012-2013</td>
<td><em>(b) Computer system development cycle</em></td>
<td>Outcome (c) assessed in selected core courses: CSC 131, 133, and 190/191</td>
<td>Supervisor evaluations</td>
<td>Analyze assessment of outcomes (a) &amp; (b).</td>
</tr>
<tr>
<td></td>
<td><em>(c) Application of software development principles</em></td>
<td>Outcome (d) assessed in selected core courses: CSC 133, 134, 135, and 137</td>
<td></td>
<td>Implement faculty recommended improvements based on assessment of outcomes (e) to (i).</td>
</tr>
<tr>
<td></td>
<td><em>(d) Skills and techniques for computing practice</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013-2014</td>
<td><em>(e) Team work</em></td>
<td>CSC 131, and 190/191</td>
<td>Instructor evaluation and student self-assessment and reflection</td>
<td>Analyze assessment of outcomes (e) to (i).</td>
</tr>
<tr>
<td></td>
<td><em>(f) Professional and ethical Issues and responsibilities</em></td>
<td>CSC 138, 190/191, 194, 195/195A, PHIL 103</td>
<td>Student surveys</td>
<td>Implement faculty recommended improvements based on assessment of outcomes (c) &amp; (d).</td>
</tr>
<tr>
<td></td>
<td><em>(g) Written communication</em></td>
<td>CSC 190/191</td>
<td>Written reports Supervisor evaluations</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>(h) Oral Communication</em></td>
<td>CSC 131, 190/191</td>
<td>Oral presentations</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>(i) Life-long learning</em></td>
<td>CSC 194, 195/195 A, 199, Industry visits</td>
<td>Reports, Supervisor evaluations Graduating senior surveys</td>
<td></td>
</tr>
</tbody>
</table>

* Selected as desired outcomes.
Appendix B. Sample Test-Embedded Questions for Assessment of Outcomes A and B

I. 2009-2010 Assessment of Core Topics

### Results for Outcome A

<table>
<thead>
<tr>
<th>Outcome A Performance Criterion</th>
<th>Performance Criterion Description</th>
<th>Course</th>
<th>Embedded Test Question</th>
<th>Ratio (%) of Students Meeting or Exceeding Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-1</td>
<td>Understand and apply fundamental algorithms</td>
<td>130</td>
<td>130 a-1</td>
<td>47/54 (87%)</td>
</tr>
<tr>
<td>a-2</td>
<td>Understand and use appropriately essential data structures</td>
<td>130</td>
<td>130 a-2</td>
<td>22/54 (41%)</td>
</tr>
<tr>
<td>a-4</td>
<td>Demonstrate knowledge of abstract machines, languages, and grammars</td>
<td>132</td>
<td>132 a-4</td>
<td>11/13 (85%)</td>
</tr>
<tr>
<td>a-5</td>
<td>Understand and use relational databases</td>
<td>134</td>
<td>134 a-5</td>
<td>23/29 (80%)</td>
</tr>
<tr>
<td>a-6</td>
<td>Understand predicate calculus and logic programming</td>
<td>136</td>
<td>136 a-6</td>
<td>20/27 (74%)</td>
</tr>
<tr>
<td>a-7</td>
<td>Understand functional programming paradigm</td>
<td>136</td>
<td>136 a-7</td>
<td>15/27 (56%)</td>
</tr>
</tbody>
</table>

Average: 70.5%

### Results for Outcome B

<table>
<thead>
<tr>
<th>Outcome B Performance Criterion</th>
<th>Performance Criterion</th>
<th>Course</th>
<th>Embedded Test Question</th>
<th>Ratio (%) of Students Meeting or Exceeding Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>b-3</td>
<td>Understand and apply design principles.</td>
<td>131</td>
<td>131 b-3</td>
<td>27/31 (87%)</td>
</tr>
<tr>
<td>b-6</td>
<td>Demonstrate the ability to design and analyze hardware components, such as, processors and memory devices.</td>
<td>137</td>
<td>137 b-6</td>
<td>24/26 (92%)</td>
</tr>
</tbody>
</table>

Average: 90%
Test-Equated Questions for Outcome A

130 a-1

1. Use the hash function \( h(key) = key \mod 11 \) and the following sequence of keys to create hash tables: 4, 9, 2, 20, 10, 15, 31, 13
   a. Use coalesced chaining with a cellular size of 4.
   b. Use generalized linear rehashing with a step size of 3.
   c. Use quadratic rehashing.
   d. Use double hashing and \( h_2(key) - key \mod 9 + 1 \).

130 a-2

1. Comparing linked lists and arrays, linked lists are better suited for
   a. Searching an element
   b. Inserting and deleting elements
   c. Both of the above operations
   d. None of the above operations

2. Which of these operations have a constant average case time?
   a. Search an AVL tree
   b. Search an unsorted array
   c. Search a sorted array
   d. Search a hash table

3. Which of these operations has the smallest worst case time?
   a. Search a fully threaded binary search tree
   b. Search a hash table
   c. Search an AVL tree
   d. Search a B/B+ tree

4. Which of these data structures is best for implementing a priority queue?
   a. Binary heaps
   b. AVL trees
   c. B/B+ trees
   d. Graphs

5. Suppose that you are to list elements of a binary search tree in ascending order. Which of these traversals would you use?
   a. Preorder traversal
   b. Inorder traversal
   c. Postorder traversal
   d. Level-order traversal

132 a-4
1. Using the algorithm discussed in class, convert the NFA below to a regular expression, processing states in the following order: 3, 2, 1, 4. You must show all the steps and make sure you indicate clearly what each step is intended to do.

![NFA Diagram]

2. Let L be any regular language over \{a, b\}. Consider the language:
   \[ L_1 = \{ u \mid u \in L \text{ and } u \text{ has exactly one } a \} \]
   Using the closure property of regular languages show that \( L_1 \) is regular.

3. Use the pumping lemma to prove that the language \( L = \{ a^n b^l a^k \mid n = l + k \} \) is not regular. Make sure that you include all the necessary details including why the resulting string is not in \( L \).

4. Given the following context-free grammar
   \[
   \begin{align*}
   S & \rightarrow ASB \mid \lambda \\
   A & \rightarrow aAS \mid a \\
   B & \rightarrow SbS \mid A \mid bb
   \end{align*}
   \]
   Convert it to Chomsky Normal Form. Note: indicate clearly all the steps involved, even if this particular grammar does not require any change for those steps. Explain what you are doing!

5. Use the following list of words (nouns are presented as singular, verbs in their infinitive form) find the best match for each blank (not all words are necessarily applicable, some may apply multiple times):
   - accept, always, context-free, context-sensitive, denote, deterministic, element, eliminate,
   - expect, family, generate, language, never, new, non-deterministic, old, operation, proper,
   - recognize, regular, represent, set, sometimes, string, subset, superset
   a. \( L = \{ a^n b^n c^n \mid n > 0 \} \) is a __________ language. (1)
   b. Given a non-deterministic finite state automaton, there __________ exists an equivalent deterministic finite automaton.
   c. The intersection of two context-free languages is ______________ context-free.
   d. A __________ of ______ is closed under a(n) __________.
   e. A language is a set of ______________.
   f. \( L = \{ a^n b^n \mid n > 0 \} \) is a __________ language.
   g. A context-free language is __________ accepted by a deterministic push-down automaton.
   h. A regular language is ______________ context-free.
   i. A context-free language is __________ regular.
   j. A finite language is ______________ regular.
   k. Context free languages are a __________ __________ of context-sensitive languages (2 words).
   l. \( L = \{ a^n b^m \mid n, m > 0 \} \) is a ______________ language.
m. The union of two context-free languages is ______________ context-free.

6. Construct a PDA which recognizes the following language:
   \[ L = \{ a^n c^m \mid 0 < n \leq m \}. \]
   a. Explain in plain English how your PDA works.
   b. Give the corresponding PDA including the transition function, input and stack alphabets, and set of final states.

7. Construct a PDA which recognizes the following language:
   \[ L = \{ a^n v \mid v \in \{ a, b \}^n, |v| = 2n, n > 0 \}. \]
   a. Explain in plain English how your PDA works.
   b. Give the corresponding PDA including the transition function, input and stack alphabets, and set of final states.

8. Assume you are to construct a Turing Machine which accepts the language
   \[ L = \{ 0^n 1^{2n} \mid n > 0 \}. \]
   Give a description, in words, of your approach in designing the machine.

9. Construct a Turing Machine which accepts the language
   \[ L = \{ w \mid w \in \{ a, b \}^* \text{ & w does not contain the string } abb \}. \]
   a. Give a description, in words, of your approach in designing the machine.
   b. Give the transition function of your machine.

134 a-5

Map the following ER design into a relational model.

136 a-6

1. Consider the following set of Prolog rules for reverse:
   \[
   \begin{align*}
   (1) & \quad \text{reverse}( X, Z ) :- \quad \text{rev} ( X, [ ], Z ). \\
   (2) & \quad \text{rev} ( [ ], Y, Y ). \\
   (3) & \quad \text{rev} ( [ A \mid X ], Y, Z ) :- \quad \text{rev} ( X \mid [ A \mid Y ], Z ).
   \end{align*}
   \]
   Trace the order of execution for the following query: reverse( [ 9, 2 ], W ).
   Present your trace as a tree, using the numbers above to indicate the rules called. For each call, indicate the appropriate subgoal that is attempting to be proven. Indicate where an answer is found.
1. **Note:** you may not use if statements nested within either if or cond statements, nor cond statements within either if or cond statements.

   Define a Scheme function `count-zero` (you may abbreviate it to `cz` if you wish) that takes a list of numbers as a parameter and computes the number of zeros in that list.

2. Write a function `addAll` (you may abbreviate it to `aa`) that takes a list of integer as input and returns the sum of the integers in the list. For example, `(addAll '(2 3 4))` returns 9.

3. Write a Scheme implementation that is tail-recursive. You will get partial credit if you produce a function that is not tail-recursive. You may assume that the sum for an empty list is 0.

4. What will the following return?
   
   ```scheme
   (define (y s lis)
     (cond
      (null? lis) '( )
      (equal? s (car lis)) lis)
      (else (y s (cdr lis)))))
   ```

5. Write a Scheme function `common` (you may abbreviate to `com`) that takes two lists of atoms as arguments and returns a list of atoms that are common to both lists. Hint: you may want to use an auxiliary function `member (a, L)` which returns true if atom a is a member of the list of atom L (you need to define member.).

6. Write a high-order Scheme function `does-it-end-with` (you may abbreviate it to `d` if you wish) that takes a predicate function f and a non-empty list L as arguments and returns true if the last element of L satisfies f.

**Test-Embedded Questions for Outcome B**

131 b-3

In the Waterfall model, what are the fundamental development activities?

137 b-6

Design a 128 x 16 memory unit using 32 x 16 memory modules. The modules are designed using 32 x 4 memory chips. Do not show the internal of the memory chip. Label all signals.
II. 2010-2011 Assessment of Core Topics - Closing the Loop

Test-Embedded Questions for Outcome A

130 a-2

1. What is the fundamental difference between a queue and a stack?
2. Given the following binary search tree, list the sequence of nodes visited according to the following:
   a. Breadth first traversal
   b. Depth first pre-order traversal
   c. Depth first post-order traversal

Results:

At least 79% of the 29 students met or exceeded criterion for the questions (100%, 83%, 90%, and 79%). Criterion a-2 is satisfied.

136 a-7

1. Implement the following in Scheme: (Midterm)
   a. A function “repeat-n” with two arguments a positive integer “n” and an atom “a” and returns a list with the atom repeated n time. Hence (repeat-n 3 ‘a) will evaluate to (a a a).
   b. A predicate “every?” that takes two arguments: a predicate p and a list L, and returns true if all the elements of the list satisfy the predicate, false otherwise. For example (every? even? (2 4 8 20 56)) would evaluate to true and (every? even? (2 11 4 7)) would evaluate to false.
   c. A function to compute the length of an arbitrary list.
   d. A tail recursive version of the function written in c.
   e. A high order function “mult_n” which takes a number n as a parameter and returns a function. The returned function has one input parameter which is a number x and returns x multiplied by n. For example ((mult_n 5) 3) will return 15 and ((mult_n -7) 4) will return -28.

2. Show what result the evaluation of the following Scheme expression give: (Final)
   a. (cdr ‘((a b) (() c d) e (f)))
   b. (cdr (cdr (cdr ‘((a b) (() c d) e (f)))))
   c. (cons (quote (F)) (quote (quote (A B)))) Hint: tricky
   d. (atom? (quote A))

3. Write a high-order Scheme function does-it-end-with (you may abbreviate it to d if you wish) that takes a predicate function f and a non-empty list L as arguments and returns true if the last element of L satisfies f. (Final)

4. Draw the graphical representation of the following Scheme lists. (Midterm)
   a. (1 (2 3) (4))
b. \(( (a\ b\ (c\ d))\ f\ (g\ h))\)

5. What will the following return? (Final)

\[
\text{(define (y s lis )}
\text{(cond}
\text{\}
\text{null? lis)'() )}
\text{( (equal? s ( car lis)) lis)}
\text{( else ( y s ( cdr lis)) ) )\text{'( a b) '( a (b c d) ( a b) c d e))}
\]

Results:

Students were tested in both the midterm and the final exam. This provided a broader spectrum of question to evaluate student performance. The results were: 90%, 90%, 58%, 63%, and 84% and the average score was 77%. An overall score of 60% is considered meeting the requirement in this class. Hence, only was score was slightly below the passing score. Increasing the coverage of the materials in class and using several questions on two exams to assess produced greater understanding as reflected in their performance.
Appendix C. Supervisor Evaluation of Interns

COMPILATION OF SUPERVISOR EVALUATIONS OF STUDENT INTERNSHIPS
CSC 195/195A
Semester: Fall 2009
N = 13

<table>
<thead>
<tr>
<th>Ability to develop a computerized solution to a real life problem using appropriate tools:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ability to function as a team member:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>5</td>
<td></td>
<td></td>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>Effective oral communication:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>4</td>
<td>6</td>
<td>3</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Effective written communication:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appropriate use of presentation tools:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>3</td>
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<td></td>
<td></td>
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<td>4</td>
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</table>

<table>
<thead>
<tr>
<th>Awareness of ethical and societal concerns:</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Additional Comments:
- Manraj definitely has the ability to develop a computerized solution and has demonstrated this on a variety of projects in the division. He is currently working on the development of a web reporting tool for a recently adopted regulation. This tool is still in works and once developed will be used by facilities statewide.
- James is an outstanding member of the team. His methodical approach to problem solving has been an asset and he has proven himself to be a can-do employee who requires no follow-up and always provides a solution that meets or exceeds my expectations. His tool and scripts are a benefit to the entire facility and he was integral to us getting Disney’s A Christmas Carol out the door.
- Nithin has really done an excellent job. Any task we give him, he attacks and willingly gets done. The rest of the team really enjoys having him around.
## Compilation of Supervisor Evaluations of Student Internships

### CSC 195/195A

**Semester:** Spring 2010  
**N:** 14

### Ability to develop a computerized solution to a real life problem using appropriate tools:

<table>
<thead>
<tr>
<th></th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
<th>Did Not Observe</th>
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<tbody>
<tr>
<td>rating</td>
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<td>7</td>
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### Ability to function as a team member:

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<th>Average</th>
<th>Below Average</th>
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<tr>
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### Effective oral communication:

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<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
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<tbody>
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### Effective written communication:

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<th>Average</th>
<th>Below Average</th>
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<td>7</td>
<td>2</td>
<td>1</td>
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</table>

### Appropriate use of presentation tools:

<table>
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<tr>
<th></th>
<th>Outstanding</th>
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<th>Average</th>
<th>Below Average</th>
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<td>4</td>
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### Awareness of ethical and societal concerns:

<table>
<thead>
<tr>
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<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Weak</th>
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<tbody>
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<td>5</td>
<td>2</td>
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</table>

### Additional Comments:

- It has been a pleasure having Jeremy as an Intern at HP Networking!
- It has been a pleasure having Sean as one of our HP Networking Interns.
- Excellent addition to staff: fearless, follows through, interested in learning, understands deadlines, able to apply business context to use of technology; quick study. We want to keep him and grow him to be a permanent member of the staff.
- Matt is an outstanding employee who has frequently used his skills gained in classes at CSUS for the benefit of SAFE and its members.
- Tariq is a remarkably capable and reliable team leader and colleague who delivers time-critical results in a uniquely stress and outcome-driven environment. He has absolutely NO shortcomings whatsoever, either as a manager or technician. But that I or any of my staff were as capable or conversant in ANY second language as Tariq is in English!!! He has my wholehearted and enthusiastic recommendation, admiration and support.
Appendix D. CSC 191 Survey on Teamwork

TEAM NAME: ____________________ MEMBER NAME: ____________________

Spring 2011 SENIOR PROJECT SURVEY ON TEAM WORK

Answers will NOT effect your grade OR the team’s grade. A summary of responses will be distributed to the class; NO names will be used and the Team Name will not be used. This survey is intended to help you and your team analyze (and think about) how your team is working and also to help the senior project faculty better understand how the teams are working.

Please check the response that is closest to your opinion and/or feelings about the question:

1. How would you – in general - describe the team’s level of cooperation and the collaboration amongst its members?
   - Minimal – usually we each do our own thing.
   - Average – we think we are operating at the level that is required.
   - Above average
   - Way above average – exceptional. Members have gone beyond just the required technical reviews – at time we have worked in pairs and/or contributed in the review each other’s work

2. How well have team members worked together – in general – towards producing quality work in completion of each project phases (e.g. design, coding, documentation, etc.)?
   - Not much. We have not really talked about this.
   - We have talked about “quality” but I don’t feel we really know what specifically we should do.
   - Most of us have revised our work because of quality concerns.
   - Specific issues relating to quality are identified for most of the major work we do.

3. To what extent has the team talked about how to improve the team’s effectiveness – in general and/or in relation to specific work (this could include meetings, collaborative and/or individual work, etc.)?
   - I can’t say that we have talked very much about this
   - We did talk about this a few times but never had much follow through
   - We do talk about this quite a lot and occasionally have made some changes
   - We have made this a regular part of our meetings with the results being mostly positive

4. To what extent have members been kept informed about various aspects of the project’s work (this could include decisions, meetings, work assignments, requests from sponsor, faculty adviser and/or seminar adviser, contact with team members, etc.)?
   - Communication has always been full, open and spontaneous – nothing held back.
   - There have been some lapses, but most of the time communication has always been full, open and spontaneous.
   - Lapses occur, not all the time, but they are somewhat common.
   - Communication has consistently been a big problem especially effecting critical aspects of the team’s work.
5. Assuming that you have had thoughts and unexpressed feelings and opinions about the project and the effectiveness of the team, how have your felt about expressing these feelings and opinions?

- I felt completely free to express my feelings and opinions.
- Most of the time I felt free to express my feelings and opinions
- It depends on the situation - so at times I was reluctant to express my feelings and opinions
- My feeling was that we should just do the work and not bring up these kinds of issues – so I never felt free to express my feelings and opinions

6. How does the team deal with alternative viewpoints presented by team members?

- Alternative viewpoints are never raised
- Most are disregarded or ignored
- A lot are listened to
- Most are given thought and consideration

7. How does the team – in general - deal with conflict and difference as well as violations of team “rules”?

- Avoids discussion of the conflict and the differences
- Recognizes the conflict and the differences but moves quickly on to other topics
- Faces the conflict and the differences but does not manage it well
- Faces the conflict and the differences openly and resolves the differences

8. To what extent do you feel that you are perceived by the other team members as an equal contributor and participant in the project?

- Mostly as the major contributor and participant in the project.
- Mostly as an equal contributor and participant in the project.
- Sometimes, but mostly as a “part-time” contributor and participant in the project.
- Completely on the outside, not an equal contributor and participant in the project

9. How would you rate team “spirit”?

- Poor. There doesn’t seem to be much point in treating the project differently than other class assignments.
- It varies based upon the individual team member’s engagement.
- Sort of OK. We seem to get along really well and conversation doesn’t seem to be a problem.
- Great. The team enthusiastic and seem to care a lot about the project, the learning and producing a quality product for our sponsor

10. At the moment, do you feel that you could work effectively with your team on another project?

- Not really
- Maybe, but only with some – not all – of my current team members
- Yes, if I had to
- An enthusiastic, Yes

Adapted from *Using Student Teams in the Classroom*,
Ruth Federman Stein and Sandra Hurd,
Hypothetical. The Senior Project “Company” is concerned about the level and extent of teamwork exhibited by each of its development teams. The anonymous survey was intended to get feedback as to how team members feel about their team and how effectively members function as a team.

Each team is being asked to review and analyze the results of the anonymous survey (below). Based upon your team’s assessment of this data, prepare a report in which you comment on the aggregate results of all seven teams as well as each team individually. Where potential problems are indicated (large or small), recommend what actions might the “Company” take to improve teamwork. Note. The intent is not to identify individual responses or respondents, but to look at the general impression represented by the total responses and each team’s responses. Submit report next week.
<table>
<thead>
<tr>
<th>TEAM Members</th>
<th>Q1</th>
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<td>Average</td>
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<td>3.37</td>
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<td>0.88</td>
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1s  1  2  2  0  1  0  2  1  1  2
2s  10 4  7  6  6  1  10 6  3  2
3s  10 12 16 7  7  9  4  15 12 13
4s  9  12 5  17  16 20 14  8  14 13

1s  3%  7%  7%  0%  3%  0%  7%  3%  3%  7%
2s  13% 13% 23% 20% 20% 3% 33% 20% 10% 7%
3s  33% 40% 53% 23% 23% 30% 13% 50% 40% 43%
4s  30% 40% 17% 57% 53% 67% 47% 27% 47% 43%

NOTE: Questions 1, 2, 3, 6, 7, 9, 10: Score of 4 is most positive
Questions: 4, 5, 8: Score of 1 is most positive
ANONYMOUS SURVEY SCORING

1. How would you – in general - describe the team’s level of cooperation and the collaboration amongst its members?
   1. Minimal – usually we each do our own thing.
   2. Average – we think we are operating at the level that is required.
   3. Above average
   4. Way above average – exceptional. Members have gone beyond just the required technical reviews – at time we have worked in pairs and/or contributed in the review each other’s work

2. How well have team members worked together – in general – towards producing quality work in completion of each project phases (e.g. design, coding, documentation, etc.)?
   1. Not much. We have not really talked about this.
   2. We have talked about “quality” but I don’t feel we really know what specifically we should do.
   3. Most of us have revised our work because of quality concerns.
   4. Specific issues relating to quality are identified for most of the major work we do.

3. To what extent has the team talked about how to improve the team’s effectiveness – in general and/or in relation to specific work (this could include meetings, collaborative and/or individual work, etc.)?
   1. I can’t say that we have talked very much about this
   2. We did talk about this a few times but never had much follow through
   3. We do talk about this quite a lot and occasionally have made some changes
   4. We have made this a regular part of our meetings with the results being mostly positive

4. To what extent have members been kept informed about various aspects of the project’s work (this could include decisions, meetings, work assignments, requests from sponsor, faculty adviser and/or seminar adviser, contact with team members, etc.)?
   1. Communication has consistently been a big problem especially effecting critical aspects of the team’s work.
   2. Lapses occur, not all the time, but they are somewhat common.
   3. There have been some lapses, but most of the time communication has always been full, open and spontaneous.
   4. Communication has always been full, open and spontaneous – nothing held back.

5. Assuming that you have had thoughts and unexpressed feelings and opinions about the project and the effectiveness of the team, how have you felt about expressing these feelings and opinions?
   1. My feeling was that we should just do the work and not bring up these kinds of issues – so I never felt free to express my feelings and opinions
   2. It depends on the situation - so at times I was reluctant to express my feelings and opinions
   3. Most of the time I felt free to express my feelings and opinions
   4. I felt completely free to express my feelings and opinions.

6. How does the team deal with alternative viewpoints presented by team members?
   1. Alternative viewpoints are never raised
   2. Most are disregarded or ignored
   3. A lot are listened to
   4. Most are given thought and consideration

7. How does the team – in general - deal with conflict and difference as well as violations of team “rules”?
   1. Avoids discussion of the conflict and the differences
   2. Recognizes the conflict and the differences but moves quickly on to other topics
   3. Faces the conflict and the differences but does not manage it well
4. Faces the conflict and the differences openly and resolves the differences
8. To what extent do you feel that you are perceived by the other team members as an equal contributor and participant in the project?
   1. Completely on the outside, not an equal contributor and participant in the project
   2. Sometimes, but mostly as a “part-time” contributor and participant in the project.
   3. Mostly as an equal contributor and participant in the project.
   4. Mostly as the major contributor and participant in the project.
9. How would you rate team “spirit”?
   1. Poor. There doesn’t seem to be much point in treating the project differently than other class assignments.
   2. It varies based upon the individual team member’s engagement.
   3. Sort of OK. We seem to get along really well and conversation doesn’t seem to be a problem.
   4. Great. The team enthusiastic and seem to care a lot about the project, the learning and producing a quality product for our sponsor
10. At the moment, do you feel that you could work effectively with your team on another project?
    1. Not really
    2. Maybe, but only with some –not all – of my current team members
    3. Yes, if I had to
    4. An enthusiastic, Yes
# Appendix E. Oral Communication Instrument

**Computer Science**

<table>
<thead>
<tr>
<th>Course</th>
<th>Instructor</th>
<th>Date</th>
</tr>
</thead>
</table>

**Semester/Yr**

**Evaluator:**  
- Faculty
- Instructor
- Student
- Alumni
- Industry

**Team Name:**

**Student Names:**
(a) __________  (b) __________  (c) __________  (d) __________  (e) __________

**Group Ratings (Team as a Whole) - Check Appropriate Column**

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>1 – Meets or Exceeds Criteria</th>
<th>2 – Minimally Meets Criteria</th>
<th>3 – Below Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizes content logically and sequentially.</td>
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<tr>
<td>Main points are clearly identified and concisely presented.</td>
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<tr>
<td>Transitions are logical and smooth.</td>
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<tr>
<td>Introduction, body, and conclusion are clearly delineated.</td>
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<tr>
<td>Provides a clear summary of project.</td>
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**Individual Ratings – Write 1, 2, or 3**

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<tr>
<th>STYLE and DELIVERY</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
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</thead>
<tbody>
<tr>
<td>Attracts and holds interest of audience.</td>
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<td>Speaks clearly, distinctly, and with sufficient volume.</td>
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<td>Presents material effectively with confidence and enthusiasm.</td>
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<td>Maintains eye contact throughout presentation.</td>
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</table>
## Individual Ratings - Write 1, 2, or 3

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<tr>
<th>LANGUAGE and VOCABULARY</th>
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<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
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<tbody>
<tr>
<td>Appropriate use of vocabulary. Accurate use of technical terms and phrases.</td>
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<td>Consistently follows rules of standard English.</td>
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## Group Ratings (Team as a Whole) – Check Appropriate Column

<table>
<thead>
<tr>
<th>COMMUNICATION OF TECHNICAL CONTENT</th>
<th>1 - Meets or Exceeds Criteria</th>
<th>2 – Minimally Meets Criteria</th>
<th>3 – Below Expectations</th>
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<tbody>
<tr>
<td>Presents ideas &amp; arguments persuasively, logically, and clearly.</td>
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<td>Techniques used are clearly stated and presented.</td>
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<td>Demonstrates a thorough knowledge of problem area.</td>
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<td>Uses appropriate visual aids that are clear, readable and aid in better understanding of the project.</td>
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<td>Answers all questions clearly and to the point.</td>
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## Appendix F. Written Communication Rubric

**Computer Science Department**  
**Written Communication Rubric**  
**2010-2011**

Table 1. Evaluation of composition and completeness  

<table>
<thead>
<tr>
<th>Criteria</th>
<th>4 Exceeds Criteria</th>
<th>3 Meets Criteria</th>
<th>2 Progressing to Criteria</th>
<th>1 Below Expectations</th>
<th>NA</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td>The report is well organized, and maintains a consistent style. Transitions are logical and smooth.</td>
<td>Report is organized with a reasonable flow of ideas. Most transitions are logical and smooth.</td>
<td>Report is somewhat organized. Transitions are not always logical and smooth.</td>
<td>Report is not organized. Little sense of wholeness and completeness. Poor transitions.</td>
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<tr>
<td>Syntax, sentence structure and conventions of standard English</td>
<td>Words are chosen with care in consideration of fine differences in meaning. Very few errors in syntax, spelling, and/or grammar.</td>
<td>Sentence structure usually conveys the intended meaning. In general, there are few errors in syntax, spelling, and/or grammar.</td>
<td>Sentence structure sometimes conveys confusing meanings, but the intent can still be discerned from the context. A number of errors in syntax, spelling, and/or grammar.</td>
<td>Sentence structure conveys misleading meanings. Many errors in syntax, spelling, and/or grammar.</td>
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<tr>
<td><strong>Paragraph Structure</strong></td>
<td>Paragraphs are on topic and understandable. Stylistic variations show command of language.</td>
<td>Most paragraphs are on topic and understandable with some errors. Although there may be some loss of focus, paragraphs are reasonably written.</td>
<td>Some paragraphs indicate good structure, but often, paragraphs do not show unifying thought and logic. Sentences within paragraphs seem to be related.</td>
<td>Paragraphs are confusing, with unclear topic and meaning.</td>
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</table>
Table 2. Presentation of technical content. This is an evaluation of writing skills as used to convey technical content, not an evaluation of the perceived difficulty of the project. Consider whether the student has effectively communicated the attributes of the project. If any of the following aspects does not apply, then mark NA.

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<thead>
<tr>
<th>Criteria</th>
<th>4 Exceeds Criteria</th>
<th>3 Meets Criteria</th>
<th>2 Progressing to Criteria</th>
<th>1 Below Expectations</th>
<th>NA</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td><strong>Problem Statement</strong></td>
<td>Objective, nature of challenges and value of the project are clearly established.</td>
<td>Objective, nature of challenges and value of the project are adequately stated.</td>
<td>Some significant aspects of the objective, nature of challenges and value of the project are missing.</td>
<td>Significant aspects of the objective, nature of challenges and value of the project are missing.</td>
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<tr>
<td><strong>Design Requirements</strong></td>
<td>Specifications are complete. Appropriate design constraints have been identified.</td>
<td>Specifications are fairly complete. Most design constraints have been identified.</td>
<td>Some specifications are missing. Some design constraints are not identified.</td>
<td>Requirements are not specified. Design constraints are not identified.</td>
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</table>

**Problem Statement.** This section evaluates the problem statement. A problem statement describes the purpose of the work (i.e., the need being addressed) as well as how the project results will accomplish that purpose.

**Design Requirements.** This section includes specifications of functional and/or non-functional requirements.
Appendix G. Mapping of Learning Outcomes to Program Objectives

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<th>Program Objectives</th>
<th>Learning Outcomes</th>
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**Program Objectives** (Defined by ABET as characteristics of graduates 3-6 years after graduation.)

Graduates of the program will

1. Demonstrate proficiency in the design, development, maintenance, and support of computing systems.
2. Be an effective and contributing member of project teams.
3. Engage in the pursuit of professional development opportunities and/or pursue graduate studies.
4. Assume a leadership role in their chosen career and profession.
5. Write effectively.
6. Have effective oral communication skills.
7. Abide by the ethical standards of the profession and understand the ethical, social, and global implications of their professional activities.
Learning Outcomes (Abbreviated Descriptions)

(a) Application of fundamental knowledge

(b) Computer system development cycle
(c) Application of software development principles
(d) Skills and techniques for computing practice
(e) Team work

(f) Professional and ethical issues and responsibilities
(g) Written communication
(h) Oral communication
(i) Life-long learning

* Desired Outcomes