Program Assessment Report

Bachelor of Science in Computer Science

2005-2006

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November 2006
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I. Assessment of Program Outcomes

A. Program Outcomes Summary

All computer science graduates shall demonstrate
1. An ability to apply knowledge of math, science and computing.
2. An ability to design and implement programs as well as to analyze and interpret code and data.
3. An ability to design a system, component, or process to meet desired needs.
4. An ability to function on multi-disciplinary teams.
5. An ability to identify, formulate and solve computing problems.
6. An understanding of professional and ethical responsibilities.
7. An ability to communicate effectively.
8. The broad education necessary to understand the impact of computing solutions in a global and societal context.
9. A recognition of the need for, and an ability to engage in, life-long learning.
10. A knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern computing tools necessary for computing practice.

B. Core Course Alignment / Program Outcomes Matrix

Table 1: Core Course x Program Outcomes Matrix.

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>CSCI 111 / EECE 135</td>
<td></td>
</tr>
<tr>
<td>Programming and Algorithms I</td>
<td></td>
</tr>
<tr>
<td>CSCI 112</td>
<td></td>
</tr>
<tr>
<td>Programming and Algorithms II</td>
<td></td>
</tr>
<tr>
<td>CSCI 221 / EECE 221</td>
<td></td>
</tr>
<tr>
<td>Assembly Language Programming</td>
<td></td>
</tr>
<tr>
<td>CSCI 301</td>
<td></td>
</tr>
<tr>
<td>Computer's Impact on Society</td>
<td></td>
</tr>
<tr>
<td>CSCI 305 / EECE 335</td>
<td></td>
</tr>
<tr>
<td>Project Requirements, Design, Testing</td>
<td></td>
</tr>
<tr>
<td>CSCI 311</td>
<td></td>
</tr>
<tr>
<td>Algorithms and Data Structures</td>
<td></td>
</tr>
<tr>
<td>CSCI 315</td>
<td></td>
</tr>
<tr>
<td>Programming Languages</td>
<td></td>
</tr>
<tr>
<td>CSCI 320</td>
<td></td>
</tr>
<tr>
<td>Computer Architecture</td>
<td></td>
</tr>
<tr>
<td>CSCI 330</td>
<td></td>
</tr>
<tr>
<td>Software Engineering</td>
<td></td>
</tr>
<tr>
<td>CSCI 340</td>
<td></td>
</tr>
<tr>
<td>Operating Systems Programming</td>
<td></td>
</tr>
<tr>
<td>CSCI 490</td>
<td></td>
</tr>
<tr>
<td>Directed Programming Experience</td>
<td></td>
</tr>
<tr>
<td>CSCI 550</td>
<td></td>
</tr>
<tr>
<td>Theory of Computing</td>
<td></td>
</tr>
</tbody>
</table>

Key: Introduced  Practiced  Assessed
C. Timeline

To facilitate collection of assessment data, the department identified three subsets for program outcome assessment. These subsets are listed in Table 2.

Table 2: Grouping of Program Outcomes into Subsets.

<table>
<thead>
<tr>
<th>Subset</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. An ability to apply knowledge of math, science, and computing.</td>
</tr>
<tr>
<td></td>
<td>2. An ability to design and implement programs as well as to analyze and interpret code and data.</td>
</tr>
<tr>
<td></td>
<td>3. An ability to design a system, component, or process to meet desired needs.</td>
</tr>
<tr>
<td>2</td>
<td>4. An ability to function on multi-disciplinary teams.</td>
</tr>
<tr>
<td></td>
<td>5. An ability to identify, formulate, and solve computing problems.</td>
</tr>
<tr>
<td></td>
<td>6. An understanding of professional and ethical responsibilities.</td>
</tr>
<tr>
<td></td>
<td>7. An ability to communicate effectively.</td>
</tr>
<tr>
<td>3</td>
<td>8. The broad education necessary to understand the impact of computing solutions in a global and societal context.</td>
</tr>
<tr>
<td></td>
<td>9. A recognition of the need for, and an ability to engage in, life-long learning.</td>
</tr>
<tr>
<td></td>
<td>10. A knowledge of contemporary issues.</td>
</tr>
<tr>
<td></td>
<td>11. An ability to use the techniques, skills, and modern computing tools necessary for computing practice.</td>
</tr>
</tbody>
</table>

A rotational assessment timeline for data collection, assessment and evaluation is shown in Table 3. This timeline was developed to maximize the efficiency of the assessment data collection. The guiding principle in the department’s assessment data collection is that data does not need to be collected from every student/graduate every year on every outcome to provide valuable information for program improvement. The timeline given in Table 3 is reviewed annually to determine its appropriateness for the information that the assessment yields.

Table 3: Rotational Assessment Timeline.

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Subset 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subset 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subset 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above rotational assessment timeline will be administered in conjunction with the College of ECC Academic Year Assessment Cycle given in Table 8 on page 30 of the Appendix.
D. Embedded Assessment Measures

Table 4: Embedded Assessment Measures.¹

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Course</th>
<th>Embedded Assessment Measures &amp; Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSCI 221</td>
<td>Students must demonstrate their ability to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• utilize different number systems, specifically binary, hexadecimal, and decimal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• apply the rules for arithmetic in each number system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• perform conversions between number systems and encoding/decoding for representation in the memory of a computer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• represent, manipulate, and convert, numeric quantities of different types in the memory of a computer, specifically unsigned integers, signed integers, and floating point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To pass, a student must receive a grade of at least 80% on a subset of questions from Midterm #1, which primarily covers the above topics.</td>
</tr>
<tr>
<td></td>
<td>CSCI 320</td>
<td>Students must demonstrate understanding of boolean algebra, truth tables, logic gates, combinational and sequential circuits, Karnaugh maps, binary and hexadecimal notation, unsigned and signed binary number representations, fundamental ALU design, and performance metrics and evaluation. Evaluation is based on results of at least one quiz and at least one exam.</td>
</tr>
<tr>
<td>2</td>
<td>CSCI 311</td>
<td>Students must demonstrate understanding of discrete structures and algorithms, which are foundational material in computer science. Students must also demonstrate fluency in a programming language, along with the ability to connect fundamental programming concepts, basic data structures, and algorithmic processes. Evaluation is based on results of the final exam and the final programming assignment.</td>
</tr>
<tr>
<td>3</td>
<td>CSCI 320</td>
<td>CSCI 340</td>
</tr>
<tr>
<td>4</td>
<td>CSCI 305</td>
<td>CSCI 330</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Research – Collaborative research and formulations of project concepts and plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Presentation – A team-based presentation that describes the project concept and plan. Students are graded both on the overall presentation, and on their individual contributions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Documents – Three collaboratively generated documents: concept, requirements, and design. Participation – The instructor's evaluation of each individual student's successful and constructive participation in the group activities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Students must receive a grade of at least 75% on team participation and team contribution evaluations.</td>
</tr>
<tr>
<td></td>
<td>CSCI 311</td>
<td>CSCI 340</td>
</tr>
</tbody>
</table>

¹ Some textual descriptions are based on ACM SIGCSE’s *Computing Curricula 2001*, http://www.sigcse.org/cc2001/.
² CSCI 320 used for data gathering for Program Outcome #1 in Spring 2006 only.
³ Cross-listed with EECE 335, so information and assessment results are from the Department of EECE Program Assessment Report.
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Course</th>
<th>Embedded Assessment Measures &amp; Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating systems (externals) and their design and implementation (internals). Evaluation is based on a project design grade of at least 70 out of 100 averaged over all projects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CSCI 301</td>
<td>Students must recognize basic cultural, social, legal, and ethical issues inherent in the discipline of computing. Hence, students must demonstrate fundamental understanding of their individual roles in the direction of the evolving field of computing, as well as appreciate the philosophical questions, technical problems, and aesthetic values that play an important part in the development of the discipline. Evaluation is based on the students' final grades, which combines performance measures from term papers, book reports, class participation, and the exams.</td>
</tr>
<tr>
<td>7</td>
<td>CSCI 330</td>
<td><strong>CSCI 330</strong>: Students must demonstrate the ability to apply theory, knowledge, and practice for effectively and efficiently building software systems that satisfy the requirements of users and customers. Students must establish a level of professionalism, quality, timeliness, and cost-effectiveness as expected in producing a quality software system. Evaluation is based on term group projects (documents and presentation grade). <strong>CSCI 490</strong>: Since this is a capstone course, students must exhibit the ability to synthesize and apply concepts learned from core courses in the development of their senior project. Evaluation is based on students' presentation of their work and their summary report.</td>
</tr>
<tr>
<td>8</td>
<td>CSCI 301</td>
<td>Students must recognize basic cultural, social, legal, and ethical issues inherent in the discipline of computing. Hence, students must demonstrate fundamental ability to ask serious questions about the social impact of computing and to evaluate proposed answers to those questions (e.g. the skill to anticipate the impact of introducing a given product into a given environment, based on potential impact upon individuals, groups, and institutions). Evaluation is based on the students' final grades, which combines performance measures from term papers, book reports, class participation, and the exams.</td>
</tr>
<tr>
<td>9</td>
<td>CSCI 490</td>
<td><strong>CSCI 490</strong>: Since this is a capstone course, students must exhibit the ability to synthesize and apply concepts learned from core courses in the development of their senior project. Evaluation is based on students' attendance at scheduled peer presentations.</td>
</tr>
<tr>
<td>10</td>
<td>CSCI 301</td>
<td>Students must demonstrate fundamental comprehension of basic cultural, social, legal, and ethical issues inherent in the discipline of computing. In particular, students need to understand issues pertaining to risks and liabilities of computer-based systems, intellectual property, privacy and civil liberties, computer crime, and others. Evaluation is based on the students' final grades, which combines performance measures from term papers, book reports, class participation, and the exams.</td>
</tr>
<tr>
<td>11</td>
<td>CSCI 330</td>
<td><strong>CSCI 330</strong>: Students must demonstrate the ability to apply theory, knowledge, and practice for effectively and efficiently building software systems that satisfy the requirements of users and customers. Students must establish a level of professionalism, quality, timeliness, and cost-effectiveness as expected in producing a quality software system. Evaluation is based on term group project (overall grade). <strong>CSCI 490</strong>: Since this is a capstone course, students must exhibit the ability to synthesize and apply concepts learned from core courses in the development of their senior project. Evaluation is based on their senior project grade.</td>
</tr>
</tbody>
</table>
E. Other Direct Measures

Every semester since Spring 2002, the department has been using the Educational Testing Services’ Major Field Test (MFT) in Computer Science as a direct measure to supplement embedded assessment measures from required courses in the program. The MFT is a standardized test that provides assessment information (based on national, comparative data) in the form of score statistics and assessment indicators.

MFT results from Spring 2006 was a mean score of 149.33, a median score of 150, the lowest was 130 and the highest was 170. Figure 1 illustrates the score statistics trend from 2002 through 2006.

Figure 1: MFT in Computer Science, Scores Statistics Trend

The MFT in Computer Science also provides assessment information categorized into Assessment Indicators (AIs; numbers in parenthesis indicate approximate percentage of questions in that category):
- AI-1: Programming Fundamentals (34%)
- AI-2: Computer Organization, Architecture, and Operating Systems (30%)
- AI-3: Algorithms, Theory, and Computational Mathematics (36%)

MFT mean percent scores from Spring 2006 was 56 (60) for AI-1, 36 (60) for AI-2, and 43 (40) for AI-3 (numbers in parentheses indicate percent at or below the mean percent score, based on comparative data). Figure 2 illustrates the assessment indicators trend from 2002 through 2006.

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4 Educational Testing Services Major Field Test (MFT), www.ets.org/hea/mft/
The department also uses the MFT Assessment Indicators to determine appropriate topical coverage in and student preparation from core courses. Table 5 provides the MFT AI and CSCI core courses matrix.

Table 5: MFT Assessment Indicators x Core Course Matrix.

<table>
<thead>
<tr>
<th>Assessment Indicator (AI)</th>
<th>Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>111</td>
</tr>
<tr>
<td>AI-1: Programming Fundamentals</td>
<td></td>
</tr>
<tr>
<td>AI-2: Computer Organization, Architecture, and Operating Systems</td>
<td></td>
</tr>
<tr>
<td>AI-3: Algorithms, Theory, and Computational Mathematics</td>
<td></td>
</tr>
</tbody>
</table>

The correlation between the MFT AI’s and the department’s program outcomes can be derived from Table 1 and Table 5. Interestingly, all three AI’s cover the same outcomes: program outcome #1 (An ability to apply knowledge of math, science, and computing), #2 (An ability to design and implement programs as well as to analyze and interpret code and data), #3 (An ability to design a system, component, or process to meet desired needs), #5 (An ability to identify, formulate, and solve computing problems), and #11 (An ability to use the techniques, skills, and modern computing tools necessary for computing practice).
F. Indirect Measures

1. Senior Exit Survey

College of ECC Senior Exit Surveys were administered in December 2005, and again in May 2006 to graduating seniors. Of the 225 surveys administered for the College, 31 were from CSCI majors, 12 were CIS majors, and 1 was an APCG major.

Table 6 and on page 28 in the Appendix summarizes the results from questions in the ECC Senior Exit Survey that pertain to educational satisfaction. Unfortunately, it seems that students are not satisfied with the quality of teaching of faculty in the department. It also seems that students are not satisfied with the quality of courses in the department. These two items received the lowest mean scores of all the educational satisfaction questions.

Table 7 on page 29 in the Appendix summarizes the results from questions in the ECC Senior Exit Survey that pertain to program outcomes.

2. Alumni Survey

Alumni surveys were not administered during this assessment cycle. The department is looking into the possibility of having Alumni Surveys available online.

3. Advisory Board Survey/Feedback

An Industry Advisory Board (IAB) meeting is scheduled for December 2006. IAB feedback from the meeting will be reported in the next assessment cycle.
G. Analysis and Interpretation of Results

On a scale of 1 (lowest) through 5 (highest), the faculty has arbitrarily chosen a rating of 3.8 or above as the desired success rate for all embedded (in-class), direct (MFT), and indirect (senior survey) program outcome assessments. To transform embedded measures from the typical 0-100% scale used by faculty to the appropriate 1-5 scale, the following transformation is used:

\[ 1 + 4 \times \frac{p}{n} \]

where \( p \) is the number of students successfully achieving the measure, and \( n \) is the total number of students from which the measure was taken.

1. An ability to apply knowledge of math, science and computing.

a) Embedded assessment data was collected from CSCI 320 in Spring 2006 (see Table 4 on page 7). Using department rubrics (see Table 9 on page 31 of the Appendix), the results are 4.2 (80.0%) for Quiz #4 and 3.8 (70%) for the Midterm, both of which are at least equal to the department’s expected value – so there is no reason for concern. After this semester, CSCI 221 will be used for embedded assessment for this program outcome.

b) Direct measurement data from MFT AI trends shown in Figure 2 on page 10 indicates an overall downward trend on all three AI’s, indicating a need for faculty to emphasize application of knowledge of math, science, and computing across the curriculum in general and in upper division courses in particular. This outcome will be monitored closely in future assessments.

c) College of ECC Senior Exit Survey Question #31 (Apply knowledge to solve problems) received a mean score of 3.91 (see Table 7 on page 29 in the Appendix) for this assessment cycle. Although this score is above the department target of 3.8, the committee is keeping watch of the apparent downward trend on the mean score for this question, as illustrated in Figure 3.

![Figure 3: Senior Exit Survey Trends for Program Outcome #1.](image)

5 The expected rating of 3.8 is based on a 70% expected success rate, translating to \( 1 + 4(0.70) = 3.8 \) in a 1-5 scale.
2. An ability to design and implement programs as well as to analyze and interpret code and data.

a) Embedded assessment data was not collected from CSCI 311 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from this course this Fall 2006.

b) Direct measurement data from MFT AI trends shown in Figure 2 on page 10 indicates an overall downward trend on all three AI’s, indicating a need for faculty to instill the skill to design and implement programs as well as to analyze and interpret code and data across the curriculum in general and in upper division courses in particular. This outcome will be monitored closely in future assessments.

c) College of ECC Senior Exit Survey Question #32 (Design and conduct experiments) and Question #33 (Analyze and interpret experimental data) received a mean score of 3.91 and 3.87, respectively (see Table 7 on page 29 in the Appendix), for this assessment cycle. These scores are above the department target of 3.8 and are also exhibiting an upward trend, as illustrated in Figure 4.

![Figure 4: Senior Exit Survey Trends for Program Outcome #2.](image-url)
3. An ability to design a system, component, or process to meet desired needs.

a) Embedded assessment data was not collected from CSCI 320 or CSCI 340 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from at least one of these courses this Fall 2006.

b) Direct measurement data from MFT AI trends shown in Figure 2 on page 10 indicates an overall downward trend on all three AI’s, indicating a need for faculty to instill the skill to design a system, component, or process to meet desired needs across the curriculum in general and in upper division courses in particular. This outcome will be monitored closely in future assessments.

c) College of ECC Senior Exit Survey Question #34 (Design component or system to meet needs) received a mean score of 3.94 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 5.

Figure 5: Senior Exit Survey Trends for Program Outcome #3.
4. An ability to function on multi-disciplinary teams.

a) Embedded assessment data was collected from EECE 335 (CSCI 305) last Fall 2004 and Spring 2005 with success rates of 91.4% and 94.2%, respectively. These scores translate to 4.66 and 4.77, respectively, in a 1-5 scale. Embedded assessment data was also collected this Fall 2006 semester with a success rate of 96.6% (4.86 in a 1-5 scale). Assessment data is scheduled to be collected from at least one of EECE 335 (CSCI 305) and CSCI 330 in Spring and/or Fall 2007.

b) None of the MFT Assessment Indicators directly assess this program outcome.

c) College of ECC Senior Exit Survey Question #35 (Function on multidisciplinary team) received a mean score of 3.88 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 6.

![Figure 6: Senior Exit Survey Trends for Program Outcome #4.](image-url)
5. An ability to identify, formulate and solve computing problems.

a) Embedded assessment data was not collected from CSCI 311 or CSCI 340 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from at least one of these courses in Spring and/or Fall 2007.

b) Direct measurement data from MFT AI trends shown in Figure 2 on page 10 indicates an overall downward trend on all three AI’s, indicating a need for faculty to instill the skill to identify, formulate and solve computing problems across the curriculum in general and in upper division courses in particular. This outcome will be monitored closely in future assessments.

c) College of ECC Senior Exit Survey Question #36 (Identify, formulate, solve technical problems) received a mean score of 3.91 (see Table 7 on page 29 in the Appendix) for this assessment cycle. Although this score is above the department target of 3.8, the committee is keeping watch of this gradual, upward trend on the mean score for this question, as illustrated in Figure 7. There was a slight recovery from the downward trend between Spring 2002 to Academic Year 2003-2004, the department wants to improve this trend further.

![Figure 7: Senior Exit Survey Trends for Program Outcome #5.](image-url)
6. **An understanding of professional and ethical responsibilities.**

   a) Embedded assessment data was not collected from CSCI 301 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from this course in Spring and/or Fall 2007.

   b) None of the MFT Assessment Indicators directly assess this program outcome.

   c) College of ECC Senior Exit Survey Question #39 (Understand professional, ethical responsibilities) received a mean score of 3.72 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is below the department target of 3.8, and there has been a downward trend on the mean score for this question since Academic Year 2003-2004, as illustrated in Figure 8.

![Figure 8: Senior Exit Survey Trends for Program Outcome #6.](image_url)
7. **An ability to communicate effectively.**

   a) Embedded assessment data was not collected from CSCI 330 or CSCI 490 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from at least one of these courses in Spring and/or Fall 2007.

   b) None of the MFT Assessment Indicators directly assess this program outcome.

   c) College of ECC Senior Exit Survey Question #37 (Communicate technical matters in writing) and Question #38 (Communicate technical matters orally) received a mean score of 3.88 and 3.81, respectively (see Table 7 on page 29 in the Appendix), for this assessment cycle. These scores are above the department target of 3.8 and are also exhibiting an upward trend, as illustrated in Figure 9.

![Figure 9: Senior Exit Survey Trends for Program Outcome #7.](image-url)
8. The broad education necessary to understand the impact of computing solutions in a global and societal context.

a) Embedded assessment data was not collected from CSCI 301 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from this course in Spring and/or Fall 2008.

b) None of the MFT Assessment Indicators directly assess this program outcome.

c) College of ECC Senior Exit Survey Question #40 (Understand contemporary issues facing society) received a mean score of 3.84 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 10.

![Figure 10: Senior Exit Survey Trends for Program Outcomes #8 and #10.](image-url)
9. A recognition of the need for, and an ability to engage in, life-long learning.

a) Embedded assessment data was not collected from CSCI 490 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from this course in Spring and/or Fall 2008.

b) None of the MFT Assessment Indicators directly assess this program outcome.

c) College of ECC Senior Exit Survey Question #43 (Continue learning) received a mean score of 4.09 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 11.

![Figure 11: Senior Exit Survey Trends for Program Outcome #9.](image-url)
10. A knowledge of contemporary issues.

a) Embedded assessment data was not collected from CSCI 301 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from this course in Spring and/or Fall 2008.

b) None of the MFT Assessment Indicators directly assess this program outcome.

c) College of ECC Senior Exit Survey Question #40 (Understand contemporary issues facing society) received a mean score of 3.84 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 10 on page 19.
11. An ability to use the techniques, skills, and modern computing tools necessary for computing practice.

a) Embedded assessment data was not collected from CSCI 330 or CSCI 490 in Spring 2006 for this outcome. Assessment data is scheduled to be collected from these courses in Spring and/or Fall 2008.

b) Direct measurement data from MFT AI trends shown in Figure 2 on page 10 indicates an overall downward trend on all three AI’s, indicating a need for faculty to instill the skill to use the techniques, skills, and modern computing tools necessary for computing practice across the curriculum in general and in upper division courses in particular. This outcome will be monitored closely in future assessments.

c) College of ECC Senior Exit Survey Question #31 (Apply knowledge to solve problems) received a mean score of 3.88 (see Table 7 on page 29 in the Appendix) for this assessment cycle. This score is above the department target of 3.8 and is also exhibiting an upward trend, as illustrated in Figure 12.

![Figure 12: Senior Exit Survey Trends for Program Outcome #11.](image-url)
H. Proposed Actions from Outcomes

The faculty is concerned about the downward trend exhibited in all three MFT Assessment Indicators. In particular, there was a significantly noticeable decline in ratings for AI-2, *Computer Organization, Architecture, and Operating Systems*, and for AI-3, *Algorithms, Theory, and Computational Mathematics* (see Figure 2 on page 10) during this assessment cycle. The faculty speculate a correlation between these recent MFT scores and the educational satisfaction trend exhibited in Table 6 on page 28 in the Appendix. It seems possible that students did not have the right “attitude” about the MFT when they took it. Hence, the faculty will focus on improving faculty–student relations in the strong hope to improve educational satisfaction and potentially the MFT scores.

Additionally, there is only one indirect assessment measure that fell below the department expected rating of 3.8 – this was for Program Outcome #6, an understanding of professional and ethical responsibilities. The department will monitor course content and coverage in CSCI 301, *Computer's Impact on Society.*
I. Proposed Revision of Measures, Metrics, or Outcomes

Based on “proposed changes” listed on page 15 of ABET’s Computing Accreditation Criteria 2006-2007, the assessment committee proposes to modify the program outcomes to read:

All computer science graduates shall demonstrate
1. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
2. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
3. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
4. An ability to function effectively on teams to accomplish a common goal.
5. An understanding of professional, ethical, and social responsibilities.
6. An ability to communicate effectively.
7. An ability to analyze the impact of computing on individuals, organizations, and society, including ethical, legal, security, and global policy issues.
8. Recognition of the need for and an ability to engage in continuing professional development.
9. An ability to use current techniques, skills, and tools necessary for computing practice.

The Assessment Committee noted that it seems the previous ABET program outcome #5 (An ability to identify, formulate and solve computing problems) was eliminated because it is covered by program outcome #2 (An ability to design and implement programs as well as to analyze and interpret code and data) and program outcome #3 (An ability to design a system, component, or process to meet desired needs). Further, it seems the previous ABET program outcome #10 (A knowledge of contemporary issues) was eliminated because it is covered by program outcome #8 (The broad education necessary to understand the impact of computing solutions in a global and societal context).

In preparation for the next assessment cycle, the Assessment Committee noted that the Educational Testing Service (ETS) recently changed the Assessment Indicators (AI) for the MFT in Computer Science. From Spring 2002, MFT in Computer Science Form 3XMFM used the following AI’s:

1. Programming Fundamentals (34%)
2. Computer Organization, Architecture, and Operating Systems (30%)
3. Algorithms, Theory, and Computational Mathematics (36%)

Effective January 2006, the ETS is using Form 4CMF with the following AI’s:

1. Programming (35%)
2. Discrete Structures (40%)
3. Systems – Architecture, Operating Systems, Networking, and Databases (25%)

The numbers in parentheses indicate the approximate percentage of questions in each category.

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7 The College of ECC should consider modifying the Senior Exit Survey to match ABET’s proposed nine program outcomes.
II. Assessment of Program Educational Objectives

A. Program Educational Objectives Summary

The objectives of the Computer Science program are that:
1. All students will be able to analyze and solve computing problems, or problems in related areas, and continually upgrade their knowledge and skills.
2. All students will be effective oral and written communicators and be able to function effectively as members of multi-disciplinary teams.
3. All students will have an appreciation for the individual, society, and human heritage and they will be aware of the impact of their work on society and the environment.
4. Those graduates who pursue careers as computing professionals will have the skills to use and design new and innovative systems that meet society's needs.
5. Those graduates who pursue advanced degrees will have the skills to succeed in graduate programs in computing and related fields.

B. Alumni Survey Methodology and Results

Alumni surveys were not administered during this assessment cycle. The department is looking into the possibility of having Alumni Surveys available online.

C. Employer Survey Methodology and Results

The department currently does not administer employer surveys.

D. Advisory Board Feedback

An Industry Advisory Board (IAB) meeting is scheduled for December 2006. IAB feedback from the meeting will be reported in the next assessment cycle.

E. Accreditation Evaluation Feedback


F. Program Improvement Resulting from Feedback

Not applicable.

G. Proposed Revisions to Program Objectives

None.
III. Program Accreditation

A. Summary of Accreditation Feedback

1. Objectives and Assessments

   a) Accreditation Feedback. Concern: *(Standard I-5)* 8 “The program demonstrated an ability to identify improvements based on assessment activities, but their formal process definition of their periodic assessment process is new. A stronger connection between the periodic assessment process and the identification of program activities needs to be established.”

   b) Corrective Actions. The department's Assessment Committee reviewed the faculty-approved assessment activities and made some adjustments to improve the connection between the periodic assessment process and the identification of program activities. The department's modified process is presented on pages 5 through 7 of this document.

   c) Results. Overall, the faculty seems supportive of the procedural adjustments made to the assessment activities of this department.

2. Student Support

   a) Accreditation Feedback. Concern: *(Standard II-5)* 9 “Students feel that advising is not well coordinated and that some faculty members are not familiar enough with the curriculum requirements.”

   b) Corrective Actions. Since the last Program Assessment Report, the department has assigned another faculty member as Undergraduate Advising Coordinator for the program. The prior faculty advisor was also the program coordinator for a separate program offered by the department.

   c) Results. The concern remains and will be of interest for the next assessment cycle.

3. Faculty

   a) Accreditation Feedback. Concern: *(Standard III-1)* 10 “The enrollment trend should be monitored and any significant growth in student demand must be matched with adequate and appropriate faculty resources.”

   b) Corrective Actions. The department addressed the difference between the number of undergraduate majors in the department and the number of undergraduate majors in the program, which reflects the fact that the department has other undergraduate programs including a relatively new one in Applied Computer Graphics (APCG). The department is in the process of separating the APCG program. The department is also evaluating the General, Systems, and Math/Science options of its Computer Science program, as well as its graduate program.

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8 The results of the program’s periodic assessments must be used to help identify opportunities for program improvement.
9 There must be established standards and procedures to ensure that graduates meet the requirements of the program.
10 There must be enough full-time faculty members with primary commitment to the program to provide continuity and stability.
c) Results. The concern remains and will be of interest for the next assessment cycle.

4. Curriculum
   a) Accreditation Feedback. Concern: None.
   b) Corrective Actions. Not applicable.

5. Laboratories and Computing Facilities
   a) Accreditation Feedback. Concern: (Standard V-5)11 “Except during scheduled classes, instructional assistance in the laboratories is minimally available.”
   b) Corrective Actions. The department is striving to improve and maintain positive faculty-student relations with its student organizations. The department's student organizations are extremely active in providing free tutoring services to all majors. So, although instructional assistance in the laboratories is still minimal, majors are made aware of the availability of these tutoring services from two separate offices – one on each floor where laboratories under the jurisdiction of the department reside.
   c) Results. The concern remains and will be of interest for the next assessment cycle.

6. Institutional Support and Financial Resources
   a) Accreditation Feedback. Concern: None.
   b) Corrective Actions. Not applicable.

7. Institutional Facilities
   a) Accreditation Feedback. Concern: None.
   b) Corrective Actions. Not applicable.

B. Summary of Actions Taken to Address Issues

The department continues its efforts in addressing accreditation feedback/concerns and in monitoring results of any corrective actions that directly impact the stability, overall quality, or future accreditation of the program.

11 Instructional assistance must be provided for the laboratories and computing facilities.
### A. Assessment Data Summaries

The following is from Table 4.4 on page 9 of the *College of ECC Assessment Report, Senior Exit Survey Results: Academic Year 2005-2006*.

**Table 6: Educational Satisfaction Trends for Computer Science.**

<table>
<thead>
<tr>
<th>Educational Satisfaction Questions</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spr 02</td>
</tr>
<tr>
<td>Scale: 1=Very Dissatisfied; 5=Very Satisfied</td>
<td>N=19</td>
</tr>
<tr>
<td>Q15. Quality of teaching of faculty in department</td>
<td>3.32</td>
</tr>
<tr>
<td>Q16. Quality of teaching by other faculty.</td>
<td>3.89</td>
</tr>
<tr>
<td>Q17. Access to faculty in your department.</td>
<td>3.79</td>
</tr>
<tr>
<td>Q18. Availability of courses in your department.</td>
<td>2.53</td>
</tr>
<tr>
<td>Q19. Quality of courses in your department.</td>
<td>3.42</td>
</tr>
<tr>
<td>Q20. Access to lab facilities and equipment.</td>
<td>3.11</td>
</tr>
<tr>
<td>Q21. Quality of laboratories and equipment.</td>
<td>3.21</td>
</tr>
<tr>
<td>Q22. Access to computer facilities.</td>
<td>3.21</td>
</tr>
<tr>
<td>Q23. Quality of computer facilities.</td>
<td>3.42</td>
</tr>
<tr>
<td>Q24. Academic advising from your major adviser.</td>
<td>4.05</td>
</tr>
<tr>
<td>Q25. Academic advising from the Advising Office.</td>
<td>3.37</td>
</tr>
<tr>
<td>Q26. Career advice from faculty in your department.</td>
<td>3.32</td>
</tr>
<tr>
<td>Q27. Availability of GE courses.</td>
<td>4.00</td>
</tr>
<tr>
<td>Q28. Quality of GE courses.</td>
<td>3.63</td>
</tr>
<tr>
<td>Q29. Overall quality of your education.</td>
<td>3.58</td>
</tr>
<tr>
<td>Q30. Overall experience at Chico State.</td>
<td>3.89</td>
</tr>
</tbody>
</table>
The following is from Table 5.4 on page 18 of the *College of ECC Assessment Report, Senior Exit Survey Results: Academic Year 2005-2006*.

**Table 7: Program Outcomes Trends for Computer Science.**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Program Outcomes Questions</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Spr 02 N=19</td>
</tr>
<tr>
<td>1</td>
<td>Q31. Apply knowledge to solve problems.</td>
<td>3.95</td>
</tr>
<tr>
<td>2</td>
<td>Q32. Design and conduct experiments.</td>
<td>3.84</td>
</tr>
<tr>
<td>2</td>
<td>Q33. Analyze and interpret experimental data.</td>
<td>3.81</td>
</tr>
<tr>
<td>3</td>
<td>Q34. Design component or system to meet needs.</td>
<td>4.00</td>
</tr>
<tr>
<td>4</td>
<td>Q35. Function on multidisciplinary team.</td>
<td>3.84</td>
</tr>
<tr>
<td>5</td>
<td>Q36. Identify, formulate, solve technical problems.</td>
<td>4.26</td>
</tr>
<tr>
<td>7</td>
<td>Q37. Communicate technical matters in writing.</td>
<td>3.84</td>
</tr>
<tr>
<td>7</td>
<td>Q38. Communicate technical matters orally.</td>
<td>3.95</td>
</tr>
<tr>
<td>6</td>
<td>Q39. Understand professional, ethical responsibilities.</td>
<td>4.05</td>
</tr>
<tr>
<td>8, 10</td>
<td>Q40. Understand contemporary issues facing society.</td>
<td>3.53</td>
</tr>
<tr>
<td>11</td>
<td>Q41. Use modern tools and technology.</td>
<td>4.11</td>
</tr>
<tr>
<td></td>
<td>Q42. Enter the workplace.</td>
<td>4.00</td>
</tr>
<tr>
<td>9</td>
<td>Q43. Continue learning.</td>
<td>4.21</td>
</tr>
</tbody>
</table>
Table 8: College of ECC Academic Year Assessment Cycle.

**Academic Year Assessment Cycle**

The following are grouped logically by semesters and breaks but have overlapping timelines.

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Weeks Before</td>
<td></td>
<td>Faculty submit course syllabi to Dept. Chairs for assessment review</td>
</tr>
<tr>
<td>Classes Begin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Week Before</td>
<td></td>
<td>Department Chairs approve syllabi, return to faculty with</td>
</tr>
<tr>
<td>Classes Begin</td>
<td></td>
<td>assessment deliverables identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Faculty administer Senior Exit Surveys prior to end of semester</td>
</tr>
<tr>
<td>Winter Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Semester</td>
<td></td>
<td>Faculty submit assessment materials to Dept. Chair and/or department</td>
</tr>
<tr>
<td>Grading Due Date</td>
<td></td>
<td>Assessment Committee.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dept. Chair and/or Assessment Committee reviews pertinent outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assessment results</td>
</tr>
<tr>
<td>1 Week Before</td>
<td></td>
<td>Dept. Chair and/or Assessment Committee present</td>
</tr>
<tr>
<td>Classes Begin</td>
<td></td>
<td>assessment results to faculty, set actions if needed.*</td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Weeks Before</td>
<td></td>
<td>Faculty submit course syllabi to Dept. Chairs for assessment review</td>
</tr>
<tr>
<td>Classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Week Before</td>
<td></td>
<td>Department Chairs approve syllabi, return to faculty with</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td>assessment deliverables identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Faculty administer Senior Exit Surveys prior to end of semester</td>
</tr>
<tr>
<td>Summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Semester</td>
<td></td>
<td>Faculty submit assessment materials to Dept. Chair and/or department</td>
</tr>
<tr>
<td>Grading Due Date</td>
<td></td>
<td>Assessment Committee.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dept. Chair and/or Assessment Committee reviews pertinent outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assessment results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dept. Chair and/or Assessment Committee conducts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alumni and Employer surveys</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior Exit Survey Results Analyzed - Results to Chairs</td>
</tr>
<tr>
<td>1 Week Before</td>
<td></td>
<td>Dept. Chair and/or Assessment Committee presents</td>
</tr>
<tr>
<td>Classes Begin</td>
<td></td>
<td>assessment results to faculty, set actions as needed.*</td>
</tr>
<tr>
<td>October</td>
<td></td>
<td>Annual Assessment Report from Dept. Chairs to Dean's Office summarizing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assessment results, actions.*</td>
</tr>
</tbody>
</table>

* Department assessment results are to be shared, analyzed, and reflected with appropriate constituent groups including advisory boards or student groups at regularly scheduled meetings.
### B. Measurement Standards (Rubrics)

#### Table 9: CSCI Program Outcomes x ABET Scoring Rubric Matrix

<table>
<thead>
<tr>
<th>CSCI Program Outcome X ABET Scoring Rubric</th>
<th>Level 5 Performance characterized by ...</th>
<th>Level 3 Performance characterized by ...</th>
<th>Level 1 Performance characterized by ...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CSCI Program Outcome 1:</strong> An ability to apply knowledge of math, science, and computing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Combines mathematical and/or scientific principles to formulate algorithms  
- Applies the appropriate mathematical concepts to solve computing problems  
- Shows appropriate interpretation of mathematical and scientific terms  
- Translates academic theory into computing applications and accepts limitations of mathematical models of physical reality  
- Performs/executes calculations, conversions, transformations correctly  
  - by hand  
  - in software implementations  
- Correctly analyzes data sets using statistical concepts |  
- Chooses a mathematical model or scientific principle that applies to a problem, but has trouble in algorithm development  
- Shows nearly complete understanding of applications of mathematical concepts in problem-solving  
- Most mathematical and scientific terms are interpreted correctly  
- Some gaps in understanding the application of theory to the problem and expects theory to predict reality  
- Minor errors in calculations, conversions, transformations  
  - by hand  
  - in software implementations |  
- Does not understand the connection between mathematical models and/or scientific principles and algorithm development  
- Does not understand the application of mathematical concepts in solving computing problems  
- Mathematical and scientific terms are interpreted incorrectly or not at all  
- Does not appear to grasp the connection between theory and the problem  
- Calculations, conversions, transformations not performed or performed incorrectly  
  - by hand  
  - in software implementations  
- No application of statistics to analysis of data |
| **CSCI Program Outcome 2:** An ability to design and implement programs as well as to analyze and interpret code and data |  
- Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information  
- Can relate theoretical concepts to practical problem solving  
- Can predict and defend problem outcomes  
- Uses appropriate resources to locate information needed to solve problems  
- Takes new information and effectively integrates it with previous knowledge  
- Demonstrates understanding of how various pieces of the problem relate to each other and the whole  
- Formulates strategies for solving problems |  
- Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated  
- Connects theoretical concepts to practical problem-solving when prompted  
- Occasionally predicts and defends problem outcomes  
- Uses limited resources to solve problems  
- Must be assisted in integrating previous knowledge and new information  
- Is missing some of the pieces of the whole problem |  
- Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems  
- Does not see the connection between theory and practical problem solving  
- Is unable to predict or defend problem outcomes  
- Uses no resources to solve problems  
- Has no concept of how previous knowledge and new information relate  
- Does not realize when major components of the problem are missing  
- Has no coherent strategies for problem solving |
<table>
<thead>
<tr>
<th>CSCI Program Outcome X</th>
<th>Level 5</th>
<th>Level 3</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABET Scoring Rubric</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Level 5 Performance characterized by ... | Level 3 Performance characterized by ... | Level 1 Performance characterized by ...
| • Answers/Solutions are correct and properly labeled/commented | • Has some strategies for problem-solving, but does not apply them consistently | solving |
| • Answers/Solutions are correct and checked in other ways when they can be; interpretations are appropriate and make sense | • Answers/Solutions are nearly correct, but properly labeled/commented (within reasonable and logical range of the correct answer—it’s in the "ballpark") | • Answers/Solutions are incorrect and not checked for its reasonableness |
| • Can select appropriate programming language/environment and corresponding implementation tools to develop and maintain software | • Needs some guidance in selecting appropriate programming language/environment and corresponding implementation tools to develop and maintain software | • No attempt at checking obviously incorrect answers/solutions -- no commentary provided |
| • Is able to master use of the latest programming tools and integrated development environments | • Is tentative in the mastery of the latest programming tools and integrated development environments | |
| • Seeks information for projects/studies from multiple sources | • Seeks information for projects/studies from a few sources - mainly from the textbook or the instructor | |
| • Develops sound design and implementation strategies, including a plan of attack, decomposition of solution into subtasks, and development of a timetable | • Uses design and implementation strategies with guidance | |
| • Capable of suggesting new approaches and improves on what has been done before | • Follows previous examples competently | |
| • Develops several potential solutions and finds optimum | • Can develop and compare multiple solutions to a problem, but does not usually arrive at the best result; conducts optimization but neglects one or two key aspects | |
| • Understands how areas interrelate and demonstrates ability to integrate prior knowledge into a new problem | • Can use prior knowledge to design code segments competently when guided to do so | |
| • Thinks holistically: sees the whole as well as the parts | • Does not think holistically: does not see the integration of the pieces clearly | |
| • No design strategy; haphazard approach | • No design strategy; haphazard approach | |
| • Cannot design algorithms or individual code segments without significant amounts of help | • Cannot design algorithms or individual code segments without significant amounts of help | |
| • Only focuses on one solution to a problem; no optimization attempted | • Only focuses on one solution to a problem; no optimization attempted | |
| • Unable to relate prior knowledge to the design problem | • Unable to relate prior knowledge to the design problem | |
| • Has no concept of the process as a sum of its parts | • Has no concept of the process as a sum of its parts | |
| • No use of software tools and computing resources | • No use of software tools and computing resources | |
| • Design is done incompletely without the proper algorithms and without documentation or references | • Design is done incompletely without the proper algorithms and without documentation or references | |

CSCI Program Outcome 3:
An ability to design a system, component, or process to meet desired needs

• Develops sound design and implementation strategies, including a plan of attack, decomposition of solution into subtasks, and development of a timetable
• Capable of suggesting new approaches and improves on what has been done before
• Develops several potential solutions and finds optimum
• Understands how areas interrelate and demonstrates ability to integrate prior knowledge into a new problem
• Thinks holistically: sees the whole as well as the parts
• Uses design and implementation strategies with guidance
• Follows previous examples competently
• Can develop and compare multiple solutions to a problem, but does not usually arrive at the best result; conducts optimization but neglects one or two key aspects
• Can use prior knowledge to design code segments competently when guided to do so
• Does not think holistically: does not see the integration of the pieces clearly
• Minimal or incorrect use of software tools and computing resources
• No design strategy; haphazard approach
• Cannot design algorithms or individual code segments without significant amounts of help
• Only focuses on one solution to a problem; no optimization attempted
• Unable to relate prior knowledge to the design problem
• Has no concept of the process as a sum of its parts
• No use of software tools and computing resources
• Design is done incompletely without the proper algorithms and without documentation or references
# CSCI Program Outcome X

## ABET Scoring Rubric

<table>
<thead>
<tr>
<th>Level 5</th>
<th>Performance characterized by ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses software tools and computing resources effectively</td>
<td></td>
</tr>
<tr>
<td>Supports design procedure with documentation and references</td>
<td></td>
</tr>
<tr>
<td>Develops a solution that includes execution time, resource requirement, and other realistic constraints</td>
<td></td>
</tr>
<tr>
<td>Applies computing and/or scientific principles correctly to design practical algorithms</td>
<td></td>
</tr>
<tr>
<td>Recognizes practical significance of problem solutions and/or program outputs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 3</th>
<th>Performance characterized by ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completes design, but algorithms and implementations are not documented or referenced</td>
<td></td>
</tr>
<tr>
<td>Includes only minor or cursory consideration of execution time, resource requirement, and other realistic constraints</td>
<td></td>
</tr>
<tr>
<td>Applies computing and/or scientific principles incompletely or incorrectly to design a practical algorithm</td>
<td></td>
</tr>
<tr>
<td>Gives an answer or produces output, but does not check its practicality</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Performance characterized by ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>No consideration execution time, resource requirement, and other realistic constraints</td>
<td></td>
</tr>
<tr>
<td>No application of computing and/or scientific principles</td>
<td></td>
</tr>
<tr>
<td>Software design is incomplete, no answer is given</td>
<td></td>
</tr>
</tbody>
</table>

---

# CSCI Program Outcome 4:
An ability to function on multi-disciplinary teams

<table>
<thead>
<tr>
<th>CSCI Program Outcome 4: An ability to function on multi-disciplinary teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routinely present at group/team meetings or work sessions</td>
</tr>
<tr>
<td>Contributes a fair share to the project workload</td>
</tr>
<tr>
<td>Is prepared for group/team meetings with clearly formulated ideas</td>
</tr>
<tr>
<td>Cooperates with others (outside of the discipline)</td>
</tr>
<tr>
<td>Shares credit for success with others and accountability for team results</td>
</tr>
<tr>
<td>Shares information with others and provides assistance to others</td>
</tr>
<tr>
<td>Demonstrates the ability to assume a designated role in the group</td>
</tr>
<tr>
<td>Values alternative perspectives and encourages participation among all team members</td>
</tr>
<tr>
<td>Remains non-judgmental when disagreeing with others; seeks conflict resolution; does not &quot;point fingers&quot; or blame others when things go wrong</td>
</tr>
<tr>
<td>Is a courteous and collegial group member</td>
</tr>
<tr>
<td>Has knowledge of technical skills, issues</td>
</tr>
</tbody>
</table>

| Absent occasionally, but does not inconvenience group/team |
| Sometimes depends on others to complete the work; contributes less than fair share |
| Prepares somewhat for group meetings, but ideas are not clearly formulated |
| Occasionally works as a loner or interacts to a minor extent with extra-disciplinary team members |
| Makes subtle references to other’s poor performance or sometimes does not identify contributions of other team members |
| Sometimes keeps information to himself/herself; not very willing to share |
| Takes charge when not in the position to lead |
| Persuades others to adopt only his/her ideas or grudgingly accepts the ideas of others |
| Sometimes criticizes ideas of other team members or blames others for errors |
| Is not always considerate or courteous |

<p>| Is absent from group/team meetings or work sessions &gt;50% of the time |
| Does not contribute to group work at all or submits own work as the group's |
| Routinely fails to prepare for meetings |
| Does work on his/her own; does not value team work |
| Claims work of group as own or frequently blames others |
| Hides in the background; only participates if strongly encouraged |
| Does not willingly assume team roles |
| Does not consider the ideas of others |
| Is openly critical of the performance of others |
| Is discourteous to other group members |
| Has no knowledge of disciplines outside of computer science |</p>
<table>
<thead>
<tr>
<th>CSCI Program Outcome X</th>
<th>Level 5 Performance characterized by ...</th>
<th>Level 3 Performance characterized by ...</th>
<th>Level 1 Performance characterized by ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>and approaches germane to disciplines outside of computer science</td>
<td>towards team members • Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members</td>
<td>Unable to use existing algorithmic specifications to come up with a viable software design. • Unaware of how computing, scientific, and mathematical techniques are used for developing alternative designs. • Does not understand the importance of having alternative design schemes for a single project. • Is unable to defend the software design team's algorithmic alternatives.</td>
<td></td>
</tr>
<tr>
<td><strong>CSCI Program Outcome 5:</strong> An ability to identify, formulate and solve computing problems</td>
<td>• Fully capable of conceiving or contriving detailed algorithmic specifications into operational software products that can be justified in terms of (time and space) efficiency, flexibility, use and other factors. • Fully capable of integrating computing, science, and mathematical principles to resolve all the constraints involved in the design process. • Complete ability to produce a reasonable number of software design and/or algorithmic alternatives knowing the pros and cons and advantages and disadvantages of each alternative. Completely confident about defending the various alternative designs.</td>
<td>• Has ideas about transforming algorithmic specifications into operational software products including the justification of each alternative for efficiency, flexibility, use and other factors. • Aware of how computing, scientific, and mathematical principles should be used in developing alternative designs. • Aware of the advantages and disadvantages of each alternative design and/or algorithm and may be able to defend these various alternatives.</td>
<td></td>
</tr>
<tr>
<td><strong>CSCI Program Outcome 6:</strong> An understanding of professional and ethical responsibilities</td>
<td>• Student understands and abides by the ACM Code of Ethics and the CSUC Students' Code of Conduct • Participates in class discussions and exercises on ethics and professionalism • Demonstrates ethical behavior among peers and faculty • Takes personal responsibility for his/her actions • Is punctual, professional, and collegial; attends classes regularly • Evaluates and judges a situation in practice or as a case study, using facts and a professional code of ethics</td>
<td>• Student is aware of the existence of the ACM Code of Ethics and other bases for ethical behavior • Does not take the discussion of ethics seriously but is willing to accept its existence • Does not model ethical behavior among peers and faculty • Doesn't recognize the need to take personal responsibility for his/her actions • Sometimes exhibits unprofessional behavior; is sometimes absent from class without reason • Evaluates and judges a situation in practice or as a case study using a biased approach</td>
<td>• Student is not aware of any codes for ethical behavior • Does not participate in or contribute to discussions of ethics; does not accept the need for professional ethics • Student has been caught cheating or plagiarizing the work of others • Blames others for own issues and problems • Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty • Evaluates and judges a situation in practice or as a case study using a biased approach.</td>
</tr>
<tr>
<td>CSCI Program Outcome X</td>
<td>Level 5 Performance characterized by ...</td>
<td>Level 3 Performance characterized by ...</td>
<td>Level 1 Performance characterized by ...</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>ABET Scoring Rubric</td>
<td>• Uses personal value system to support actions, but understands the role of professional ethical standards for corporate decisions</td>
<td>practice or as a case study using personal understanding of the situation, possibly applying a personal value system</td>
<td>• Uses personal value system to support actions to the exclusion of all other ethical standards</td>
</tr>
<tr>
<td>CSCI Program Outcome 7a: An ability to communicate effectively (written)</td>
<td>• Articulates ideas clearly and concisely</td>
<td>• Articulates ideas, but writing is somewhat disjointed, superfluous or difficult to follow</td>
<td>• Text rambles, points made are only understood with repeated reading, and key points are not organized</td>
</tr>
<tr>
<td></td>
<td>• Organizes written materials in a logical sequence to enhance the reader's comprehension (paragraphs, subheading, etc.)</td>
<td>• Material are generally organized well, but paragraphs combine multiple thoughts or sections and sub-sections are not identified clearly</td>
<td>• Little or no structure or organization; no subheadings or proper paragraph structure used</td>
</tr>
<tr>
<td></td>
<td>• Uses graphs, tables, and diagrams to support points and to explain, interpret, and assess information</td>
<td>• Uses graphs, tables, and diagrams, but only in a few instances are they applied to support, explain or interpret information</td>
<td>• Graphs, tables or diagrams are used, but no reference is made to them</td>
</tr>
<tr>
<td></td>
<td>• Written work is presented neatly and professionally</td>
<td>• Work is not neatly presented throughout</td>
<td>• Work is not presented neatly</td>
</tr>
<tr>
<td></td>
<td>• Grammar and spelling are correct</td>
<td>• One or two spelling/grammar errors per page</td>
<td>• Spelling/grammar errors present throughout more than 1/3 of the paper</td>
</tr>
<tr>
<td></td>
<td>• Figures and/or tables are all in proper format</td>
<td>• Figures and/or table are present but are flawed – axes mislabeled, no data points, etc.</td>
<td>• No figures or graphics are used at all</td>
</tr>
<tr>
<td></td>
<td>• Uses good professional writing style</td>
<td>• Style is informal or inappropriate, jargon is used, improper voice, tense…</td>
<td>• The writing style is inappropriate for the audience and for the assignment</td>
</tr>
<tr>
<td></td>
<td>• Conforms to the prescribed style guide or format (if any)</td>
<td>• The prescribed style guide or format is only followed in some portions of the paper/write-up</td>
<td>• The prescribed style guide or format is not followed</td>
</tr>
<tr>
<td>CSCI Program Outcome 7b: An ability to communicate effectively (oral)</td>
<td>• Plans and delivers an oral presentation effectively; well organized</td>
<td>• Presents key elements of an oral presentation adequately</td>
<td>• Talk is poorly organized, e.g. no clear introduction or summary of talk is presented</td>
</tr>
<tr>
<td></td>
<td>• Presentation has enough detail appropriate and technical content for the time constraint and the audience</td>
<td>• Presentation contains excessive or insufficient detail for time allowed or level of audience</td>
<td>• Presentation is inappropriately short or excessively long; omits key results during presentation</td>
</tr>
<tr>
<td></td>
<td>• Presents well mechanically – Makes eye contact – Can be easily heard</td>
<td>• Has some minor difficulties with the mechanical aspects of the presentation – Eye contact is sporadic</td>
<td>• Major difficulties with the mechanical aspects of the presentation</td>
</tr>
<tr>
<td>CSCI Program Outcome X</td>
<td>Level 5</td>
<td>Level 3</td>
<td>Level 1</td>
</tr>
<tr>
<td>------------------------</td>
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<td>---------</td>
</tr>
<tr>
<td>ABET Scoring Rubric</td>
<td>Performance characterized by ...</td>
<td>Performance characterized by ...</td>
<td>Performance characterized by ...</td>
</tr>
<tr>
<td>– Speaks comfortably with minimal prompts (notecards)</td>
<td>– Occasionally difficult to hear or understand speaking</td>
<td>– No eye contact</td>
<td></td>
</tr>
<tr>
<td>– Does not block screen</td>
<td>– Overuses prompts or does not use prompts enough—occasionally stumbles or loses place; appears to have memorized presentation</td>
<td>– Difficult to hear or understand speaking</td>
<td></td>
</tr>
<tr>
<td>– No distracting nervous habits</td>
<td>– Occasionally blocks screen</td>
<td>– Reads from prepared script</td>
<td></td>
</tr>
<tr>
<td>• Uses proper American English</td>
<td>– Some nervous habits (um, ah, clicking pointer, etc.)</td>
<td>– Blocks the screen</td>
<td></td>
</tr>
<tr>
<td>• Uses visual aides effectively</td>
<td>• Occasionally uses an inappropriate style of English – too conversational</td>
<td>– Distracting nervous habits (um, ah, clicking pointer, etc.)</td>
<td></td>
</tr>
<tr>
<td>• Professional appearance</td>
<td>• Visual aides have minor errors or are not always clearly visible</td>
<td>• Uses poor English</td>
<td></td>
</tr>
<tr>
<td>• Listens carefully and responds to questions appropriately; is able to explain and interpret results for various audiences and purposes</td>
<td>• Appearance is too casual for the circumstances</td>
<td>• Multiple slides are unclear or incomprehensible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sometimes misunderstands questions, does not respond appropriately to the audience, or has some trouble answering questions</td>
<td>• Does not listen carefully to questions, does not provide an appropriate answer, or is unable to answer questions about presentation material</td>
<td></td>
</tr>
</tbody>
</table>

| CSCI Program Outcome 8: The broad education necessary to understand the impact of computing solutions in a global and societal context | • Is familiar with the current trends in the computing discipline | • Is aware of current events in society |
| | • Respects the historical aspects of “classic” (standard) algorithms and their impacts | • Is aware of historical aspects of “classic” (standard) algorithms, but is not influenced by them |
| | • Reads and is familiar with the content of periodicals that are relevant to understanding the global and societal impact of computing | • Is aware of the existence of technical periodicals—would know where to look to find them |
| | • Has a personal perspective on the impact and significance of computing in today’s world | • Is interested in computing because of what the discipline offers him/her personally |
| | • Demonstrates ability to learn independently | • Requires detailed or step-by-step instructions to complete a task |
| | • Goes beyond what is required in completing an assignment and brings information from outside sources into | • Requires guidance as to expected outcome of task or project |
| | • Sometimes is able to avoid repeating the same mistakes | • Completes only what is required |
| | | | • Is unaware of current events |

<p>| CSCI Program Outcome 9: A recognition of the need for, and an ability to engage in, life-long learning | • Requires detailed or step-by-step instructions to complete a task |
| | • Demonstrates ability to learn independently | • Requires guidance as to expected outcome of task or project |
| | • Goes beyond what is required in completing an assignment and brings information from outside sources into | • Completes only what is required |
| | • Sometimes is able to avoid repeating the same mistakes | • Is unable to recognize own shortcomings |</p>
<table>
<thead>
<tr>
<th>CSCI Program Outcome X</th>
<th>Level 5</th>
<th>Level 3</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABET Scoring Rubric</td>
<td>Performance characterized by...</td>
<td>Performance characterized by...</td>
<td>Performance characterized by...</td>
</tr>
<tr>
<td>assignments</td>
<td>• Learns from mistakes and practices continuous improvement</td>
<td>• Does not always take responsibility for own learning</td>
<td>• Assumes that all learning takes place within the confines of the class</td>
</tr>
<tr>
<td></td>
<td>• Demonstrates capability to think for one's self</td>
<td>• Seldom brings information from outside sources to assignments</td>
<td>• Shows little or no interest in outside learning resources</td>
</tr>
<tr>
<td></td>
<td>• Demonstrates responsibility for creating one's own learning opportunities</td>
<td>• Has some trouble using materials and concepts that are in a different format from that taught in class</td>
<td>• Cannot use materials outside of what is explained in class</td>
</tr>
<tr>
<td></td>
<td>• Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class (e.g. different nomenclature, understand equation from different textbook)</td>
<td>• Occasionally participates in the activities of local professional and technical societies</td>
<td>• Does not show any interest in professional and/or technical societies</td>
</tr>
<tr>
<td></td>
<td>• Participates and takes a leadership role in professional and technical societies available to the student body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSCI Program Outcome 10: A knowledge of contemporary issues</td>
<td>• Has knowledge of current events in the computing discipline and in society</td>
<td>• Has some knowledge of current events</td>
<td>• Has no clue about issues and events in the world</td>
</tr>
<tr>
<td></td>
<td>• Has a good perspective on the current job market</td>
<td>• Has a somewhat narrow perspective on the current job market</td>
<td>• Hopes that a job will fall into his/her lab</td>
</tr>
<tr>
<td></td>
<td>• Able to discuss in-depth major political issues at national, state and local levels</td>
<td>• Able to comment on major political issues, but is not familiar enough with them to defend a position on them</td>
<td>• Unable to comment on political solutions or is unaware of world and local happenings</td>
</tr>
<tr>
<td></td>
<td>– Can summarize essence of several issues; take and defend a position on them</td>
<td>– Can summarize the facts of the issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Is able to evaluate political solutions, or scenarios using a series of different measures - e.g., economic, quality of life; number of individuals affected; political ramifications; etc.</td>
<td>– Can only comment on possible alternative political solutions, or scenarios using a few different measures - e.g., economic, quality of life; number of individuals affected; political ramifications; etc.</td>
<td></td>
</tr>
<tr>
<td>CSCI Program Outcome 11: An ability to use the techniques, skills, and modern computing tools</td>
<td>• Uses computer-based and other resources effectively in assignments/projects</td>
<td>• Uses computer-based and other resources adequately in assignments/projects</td>
<td>• Does not use computer-based and other resources in assignments/projects</td>
</tr>
<tr>
<td></td>
<td>• Seeks information on problems from multiple resources</td>
<td>• Seeks information on problems from some resources</td>
<td>• Does not seek additional information on problems from any resource</td>
</tr>
<tr>
<td></td>
<td>• Is able to interpret and understand</td>
<td>• Is able to interpret and understand</td>
<td>• Is unable to interpret and understand</td>
</tr>
<tr>
<td>CSCI Program Outcome X ABET Scoring Rubric</td>
<td>Level 5 Performance characterized by ...</td>
<td>Level 3 Performance characterized by ...</td>
<td>Level 1 Performance characterized by ...</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>necessary for computing practice fields.</td>
<td>information from a variety of resources</td>
<td>information from a selection of resources</td>
<td>information from any resource</td>
</tr>
<tr>
<td></td>
<td>• Maintains current, state-of-the-art abilities in computing</td>
<td>• Maintains adequate abilities in computing</td>
<td>• Does not maintain currency in computing</td>
</tr>
<tr>
<td></td>
<td>• Is able to learn and implement process simulation software</td>
<td>• Is able to somewhat learn and implement process simulation software</td>
<td>• Is unable to learn and implement process simulation software</td>
</tr>
<tr>
<td></td>
<td>• Understands the organization and use of the library</td>
<td>• Somewhat understands the organization and use of the library</td>
<td>• Does not understand the organization and use of the library</td>
</tr>
</tbody>
</table>
C. Survey Instruments

1. Educational Testing Services Major Field Test (MFT) in Computer Science

MAJOR FIELD TESTS

College and universities use the Major Field Tests to measure student academic achievement and growth and to assess the educational outcomes of their major programs. In addition, academic departments use the Major Field Tests to evaluate their curricula and to measure the progress of their students. The tests also provide students with an assessment of their own level of achievement within a field of study compared to that of students in their program and to national comparative data.

Test Length
The tests are two-hour multiple-choice tests. The addition of optional, locally developed questions may require a longer testing period.

Test Administration
Departments or schools choose when and where to give the tests; however, the tests are normally administered during the senior year when students have completed the majority of courses in the major. Many institutions administer the tests as part of the requirements of a capstone course.

National Comparative Data
A Comparative Data Guide, published each year, contains tables of scale scores and percentiles for individual student scores, departmental mean scores, and any subscores or group assessment indicators that the tests may report. The tables of data are drawn from senior-level test takers at a large number of diverse institutions. More than 500 colleges and universities employ one or more of the Major Field Tests for student achievement and curriculum evaluation each year.

Scores
Major Field Test score reports are sent directly to the office within an institution that purchases them, such as a department chairperson, dean, or director of testing. Results of the tests are reported for the entire group of test takers, as well as for individual students. Overall student scores are reported on a scale of 120–200; subscores (which many of the tests include) are reported on a scale of 20–100. Another score reported for most of the tests is based on group-level achievement in subfields of the discipline. These "assessment indicators" report the average percent of a subset of test questions answered correctly by all students tested. On Major Field Tests, only correct answers are scored, so students are not penalized for omissions or guesses.

COMPUTER SCIENCE
COMPUTER SCIENCE (3XMF)

(Current form introduced in Spring 2002)

The Major Field Test in Computer Science consists of 60 multiple choice questions, some of which are grouped in sets and based on such materials as diagrams, graphs, and program fragments. The test is divided into four subareas with content distribution as follows:

I. Programming Fundamentals (26 percent)
   A. Fundamental programming constructs and data structures (8 percent)
      1. Conditional and iterative control structures
      2. Basic data structures (primitive, arrays, records, pointers)
      3. Expression evaluation and statement execution
   B. Problem-solving, algorithms, and recursion (6 percent)
      1. Problems-solving strategies (top-down, functional decomposition)
      2. Properties of algorithms
      3. Recursive procedures (towers of Hanoi, generating permutations, divide and conquer)
   C. Abstract data types (7 percent)
      1. Abstract programming interfaces and encapsulation
      2. Specific ADT structures (stacks, queues, symbol tables, graphs)
   D. Object-oriented programming (5 percent)
      1. Object-oriented design
      2. Classes, subclasses, and inheritance
      3. Polymorphism

II. Software Engineering (13 percent)
   A. Software development life cycle (10 percent)
      1. Software processes and metrics
      2. Requirements and specifications
      3. Design and implementation
      4. Verification and validation
   B. Software tools and development methodologies (3 percent)
      1. Development, modeling, testing, and project management tools
      2. Team management, project planning, and project engineering

III. Computer Organization, Architecture and Operating Systems (23 percent)
   A. Logic design and data representation (4 percent)
      1. Logic gates and expressions, address
      2. Number representation (floating-point, signed, and two's-complement)
   B. Assembly level organization (3 percent)
      1. Assembly/machine language programming
      2. Instruction formats and addressing modes
C. Processes, memories, and communication (4 percent)
   1. CPU organization and implementation
   2. Memory organization and operation
   3. I/O control methods, bus, and switch

D. Operating Systems (8 percent)
   1. Scheduling and dispatch
   2. Virtual memory and device management
   3. Security and protection

E. Concurrency and communication (4 percent)
   1. Communication and synchronization
   2. Networking and distributed systems

IV. Algorithms, Theory and Computational Mathematics (27 percent)

   A. Fundamental algorithmic strategies and algorithms (5 percent)
      1. Algorithmic strategies (greedy, divide and conquer, backtrack)
      2. Basic algorithms (searching, sorting, BST, graph algorithms)

   B. Analysis, complexity, and correctness of algorithms (7 percent)
      1. Asymptotic analysis of upper and average space and time complexity bounds
      2. Using recurrence relations to analyze recursive algorithms
      3. Using formal specifications and assertions

   C. Automata and language theory (7 percent)
      1. Models of computation (finite automata, pushdown automata, Turing machines)
      2. Formal languages (regular languages, context-free languages)
      3. Modern computer language principles (types, encapsulation, etc.)

   D. Discrete structures (9 percent)
      1. Mathematical logic
      2. Elementary combinatorics, including graph theory and counting arguments
      3. Elementary discrete mathematics, including number theory, discrete probability, and recurrence relations

V. Special Topics (11 percent)

   A. Intelligent systems (3-4 percent)
      1. Search and optimization methods
      2. Knowledge representation and reasoning

   B. Information management (3-4 percent)
      1. Database systems
      2. Data modeling and relational model

   C. Human-computer interaction (2 percent)

   D. Net-centric computing (2 percent)
Scores on the Computer Science Test are reported as follows:

Total Score
Reported for each student and summarized for the group.

Assessment Indicators
Reported for the group* only.
- Programming Fundamentals (16)
- Computer Organization, Architecture and Operating Systems (14)
- Algorithms, Theory and Computational Mathematics (17)

Numbers in parentheses are approximate number of questions in each category.

* A minimum of five students is required for Assessment Indicators to be reported.
COMPUTER SCIENCE (ICMF)

(Current form introduced in January 2006)

The Major Field Test in Computer Science consists of 66 multiple choice questions, some of which are grouped in sets and based on such materials as diagrams, graphs, and program fragments. The outline below shows the content areas covered on the test and the approximate distribution of questions among content areas.

V. Software engineering (3-9 percent)
   A. Software requirements, specifications, design, validation, and management

VI. Information management (3-8 percent)
   A. Database systems
   B. Data modeling

VII. Other (3-8 percent)
   A. Human computer interaction
   B. Graphics
   C. Intelligent systems
   D. Social and professional issues
   E. Web computing

MFT Computer Science Pseudocode Statement

Scores on the Computer Science Test are reported as follows:

Total Score
Reported for each student and summarized for the group.

Assessment Indicators
Reported for the group* only.
- Programming (22)
- Discrete Structures and Algorithms (25)
- Systems (Architecture, Operating Systems, Networking, Database) (16)

Numbers in parentheses are approximate number of questions in each category.

* A minimum of five students is required for Assessment Indicators to be reported.
MFT Computer Science Pseudocode Statement

We currently do not use any specific programming languages in questions on the MFT Computer Science Exam. Instead, we use a simple pseudocode that we believe will be easily understood by any computer science student. See the examples below.

Example 1. Class declaration and object instantiation

```plaintext
class StudentInfo
    int studentID
    string name
end class StudentInfo

StudentInfo x ← new StudentInfo()
x.studentID ← 1234 //the value 1234 is assigned to x.studentID
x.name ← "John"
print ( x.studentID )
print ( x.name )
```

Example 2. The following procedure swaps the values of two parameters.

```plaintext
swap ( pass-by-reference int x, pass-by-reference int y )
    int temp ← x
    x ← y
    y ← temp
end swap
```

Example 3. SelectionSort

Preconditions: A is an array of integers.
The length of array A is n.
The index of array A starts at 0.

```plaintext
int[] selectionSort ( pass-by-reference int[] A, int n )
    int min
    int j
    int i ← 0
    while ( i ≤ n - 1 )
        min ← i
        j ← i + 1
        while ( j ≤ n - 1 )
                min ← j
            end if
            j ← j + 1
        end while
        if ( min ≠ i )
            swap ( A[min], A[i] )
        end if
        i ← i + 1
    end while
return A //returns the sorted array
end selectionSort
```
Major Field Test in Computer Science
Sample Questions

The following questions illustrate the range of the test in terms of the abilities measured, the
disciplines covered, and the difficulty of the questions posed. They should not, however, be
considered representative of the entire scope of the test in either content or difficulty. An answer
key follows the questions.

1. If D is the accepting state of the nondeterministic finite automaton above, which of the
   following does the automaton accept?
   (A) 001
   (B) 1101
   (C) 01100
   (D) 000110
   (E) 100100

2. If a node in the binary search tree above is to be located by binary tree search, what is the
   expected number of comparisons required to locate one of the items (nodes) in the tree chosen
   at random?
   (A) 1.75
   (B) 2
   (C) 2.75
   (D) 3
   (E) 3.25
Questions 3 and 4 are based on the following information.

If the variables are suitably initialized, and if \( i \) remains within appropriate bounds, then the following code implements the stack operations \( \text{Push} \) and \( \text{Pop} \) when the stack is represented as an array \( V[1..N] \) with an index variable \( i \).

\[
\text{Push:} \quad \text{begin} \quad V[i] := x \quad ; \quad i := i + 1 \quad ; \quad \text{end}
\]

\[
\text{Pop:} \quad \text{begin} \quad i := i - 1 \quad ; \quad x := V[i] \quad ; \quad \text{end}
\]

3. Which of the following gives the correct initialization for this stack implementation?

(A) \( i := 0 \)
(B) \( i := 1 \)
(C) \( i := N - 1 \)
(D) \( i := N \)
(E) \( i := N/2 \)

4. If it is assumed that suitable changes in the initialization code were also made, which of the following changes to \( \text{Push} \) and \( \text{Pop} \) would yield a correct implementation of stacks?

I. Replacing the code for \( \text{Push} \) with that for \( \text{Pop} \) and vice versa
II. Making \( \text{Push} \) decrement \( i \) and \( \text{Pop} \) increment \( i \)
III. Reversing the order of the statements in both \( \text{Push} \) and \( \text{Pop} \)

(A) I only
(B) II only
(C) III only
(D) I and II only
(E) II and III only

5. In a computer with a cache memory interposed between the processor and the primary memory, the cache is \( k \)-way set-associative (for some fixed \( k \)); i.e., each location in primary memory "maps to" (can be cached in) any of \( k \) locations in the cache. Let there be \( P \) locations in primary memory and \( C \) locations in the cache.

On the average, how many different locations in primary memory map to a particular location in the cache if \( k = 2 \)?

(A) 1
(B) 2
(C) \( P / k \)
(D) \( 2P / C \)
(E) \( P \)
6. Which of the following regular expressions generate(s) no string with two consecutive 1's?
(Note that ε denotes the empty string.)

I. \((1 + ε)(01 + 0)^*\)
II. \((01 + 10)^*\)
III. \((0 + 1)^*(0 + ε)\)

(A) I only
(B) II only
(C) III only
(D) I and II only
(E) II and III only

7. Which of the following C++ expressions does NOT always correctly compute the mathematical average of the integer variables a, b, c, and d?

(A) \(\text{float} \ ((a + b + c + d) / 4.0)\)
(B) \(\text{float} \ ((a + b + c + d)) / 4\)
(C) \((a + b + c + d) / 4\)
(D) \(\text{float} \ ((a + b + c + d)) / 4.0\)
(E) \((a + \text{float} \ (b) + c + d) / 4\)

8. Consider the following recursive function.

```c
int Fun ( int n )
{
    if ( n == 4 )
        return 2;
    else
        return 2 * Fun ( n + 1 );
}
```

What is the value returned by the function call `Fun (2)`?

(A) 2
(B) 4
(C) 6
(D) 16
(E) 24
9. If \( A \) is an array with \( n \) elements and procedure \( \text{Swap} \) exchanges its arguments, then the following code segment sorts \( A \) in descending order.

\[
\text{for } ( \text{int } j = 0; j < n - 1; j++ ) \\
\text{for } ( \text{int } k = 0; k < n - j - 1; k++ ) \\
\text{if } ( A[k] < A[k + 1] ) \\
\text{Swap} (A[k], A[k + 1]);
\]

How many calls to \( \text{Swap} \) are made if initially, \( A[i] = i \), for \( i = 0, 1, 2, \ldots, n - 1 \)?

(A) \( n - 1 \)  
(B) \( n \)  
(C) \( n(n - 1)/2 \)  
(D) \( (n - 1)(n - 2) \)  
(E) \( n(n - 1) \)

10. Which of the following statements about static RAM (SRAM) and/or dynamic RAM (DRAM) is true?

(A) SRAM is implemented using transistors and capacitors that must be periodically refreshed.  
(B) DRAM has a faster access time than SRAM.  
(C) DRAM is less expensive than SRAM.  
(D) SRAM is capable of operating at speeds closely approximating processors.  
(E) DRAM is capable of operating at speeds closely approximating processors.

11. Suppose that \( S_1, S_2, \ldots, S_n \) is a set of \( N \) fixed-length strings ordered alphabetically so that \( S_1 < \ldots < S_n \). If these strings are held, in order, in an array of \( N \) elements, then the time required to find the location of \( S_{i+1} \), given the location of \( S_i \), 1 \( \leq i < N \) is:

(A) \( 1 \)  
(B) \( \log_2 N \)  
(C) \( N \)  
(D) \( N \log_2 N \)  
(E) \( N^2 \)

12. Suppose that \( V \) is a vector with indices from \( a \) to \( b \) and that each element of \( V \) occupies two words. If the elements of \( V \) are stored in consecutive words of memory and \( a \) \( \text{V}[a] \) is the address of word 1 of \( V[a] \), then the address of word 1 of \( V[i] \), where \( a \leq i \leq b \), is:

(A) \( (a \text{V}[a] - a) + i \)  
(B) \( 2(a \text{V}[a] - a) + 2i \)  
(C) \( (a \text{V}[a] - 2a) + 2i \)  
(D) \( (a \text{V}[a] - 2a) + i \)  
(E) \( (a \text{V}[a] - a) + 2i \)
13. If $A$, $B$, and $C$ are Boolean variables, and if $\land$ and $\lor$ denote Boolean "and" and "or," respectively, which of the following is (are) true?

I. $A \land (B \lor C) = (A \land B) \lor (A \land C)$
II. $A \lor (B \land C) = (A \lor B) \land (A \lor C)$
III. $(B \lor A) \lor C = C \lor (A \land B)$

(A) I only  
(B) II only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III

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**Answer Key**


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2. College of ECC Graduating Senior Survey

Graduating Senior Survey
College of Engineering, Computer Science, and Construction Management
CSU, Chico

Dear Graduating Senior,

The College of ECC has developed the enclosed survey to give you a forum for letting us know what you think of your experience at CSU, Chico, and to help us continually improve the curriculum and services we offer. We care a great deal about the programs and your feedback is essential to helping us provide the highest quality education we can deliver. Thank you in advance for your time and attention to this survey.

We hope the years you have spent with us have enriched your life and provided you with the foundation for a successful career. Please stay in touch!

With best wishes, The College of ECC Faculty

1. Major
   - APOG
   - CE
   - CME
   - CSCI
   - CM
   - CS
   - EE
   - ECE
   - MGT

2. Graduation date
   - Semester
     - Spring
     - Summer
     - Fall
   - Year
     - 200

3. Did you come to Chico State as a...
   - First-time freshman
   - Transfer

4. How many semesters did you attend Chico State?
   - 1-3
   - 4-6
   - 7-9
   - 10-12
   - 13+

5. What is your overall GPA?
   - Below 2.25
   - 2.25 - 2.49
   - 2.50 - 2.74
   - 2.75 - 2.99
   - 3.00 - 3.24
   - 3.25 - 3.50
   - 3.51 - 3.74
   - 3.75 - 4.00

6. If you had an internship, co-op, or job related to your major while in school, how valuable was the experience?
   - Did not have internship, co-op, or job
   - Very valuable
   - Valuable
   - Somewhat valuable
   - Not valuable

7. If you were involved in any student/professional society, activities, or clubs, how valuable was the experience?
   - Was not involved in societies, activities, or clubs
   - Very valuable
   - Valuable
   - Somewhat valuable
   - Not valuable.

8. Immediately after graduating are you planning to...
   - Attend graduate school
     - Yes
     - No
   - Begin working
     - Yes
     - No

   If you are NOT planning to work full-time, or if you have not begun looking for a job, please skip to Question 9.

9. How many job offers have you received?
   - None
   - One
   - Two
   - Three
   - Four+

10. Do you currently have a job offer that you are likely to accept?
    - Yes
    - No

    If 'Yes,' please provide:
    - Company name
    - Your job title
    - Starting annual salary
      - Less than $30K
      - $30-40K
      - $41-50K
      - $51-60K
      - $61-70K
      - $71K or more

11. If you interviewed through the campus Career Planning & Placement Office, how helpful was it?
    - Did not interview through campus office
    - Very helpful
    - Helpful
    - Somewhat helpful
    - Not helpful

12. If you found a job that you are likely to accept, how did you find it?
    - Campus Career Planning & Placement Office
    - Faculty/department referral
    - Online posting
    - Mailed resume
    - Personal connections
    - Other:

13. Did you take a comprehensive exam (FE, CMgt, MFT or other) for your discipline?
    - No, did not take
    - Yes, and passed
    - Yes, and did not pass
    - Yes, and waiting for results

14. If you took a comprehensive exam, did you also attend a review course to prepare you for the exam?
    - Yes
    - No

    If 'Yes,' how valuable was the course?
    - Very valuable
    - Valuable
    - Somewhat valuable
    - Not valuable
### Educational Satisfaction Questions

At Chico State, how satisfied were you with the...  

<table>
<thead>
<tr>
<th></th>
<th>Very Dissatisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Quality of teaching by faculty in your department</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Quality of teaching by other faculty</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Access to faculty in your department</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Availability of courses in your department</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Quality of courses in your department</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Access to laboratory facilities and equipment</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Quality of laboratories and equipment</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Access to computer facilities</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Quality of computer facilities</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Academic advising from your major advisor</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Academic advising from the University Advising Office</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Career information from your department</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Availability of General Education courses</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Quality of General Education courses</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>The overall quality of your education</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Your overall experience at Chico State</td>
<td></td>
</tr>
</tbody>
</table>

### Program Outcomes Questions

Based on your educational experience here at Chico State how well prepared are you to...  

<table>
<thead>
<tr>
<th></th>
<th>Very Unprepared</th>
<th>Very Well Prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Apply knowledge of math, science, engineering, or technology to solve problems</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Design and conduct experiments</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Analyze and interpret experimental data</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Design a component or system to meet desired needs</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Function on a multidisciplinary team</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Identify, formulate, and solve technical problems</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Communicate technical matters in writing</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Communicate technical matters orally</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Understand and apply professional and ethical principles</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Understand contemporary issues facing society</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Use modern tools and technology</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Enter the workplace</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Continue learning</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>I would recommend my major program at CSU, Chico to others.</td>
<td></td>
</tr>
</tbody>
</table>

### Supplemental Questions

Please locate the supplemental questions on the sheet provided. Enter your responses to the right.


Thank you for completing the survey, and please stay in touch with us!