Annual Report

Department of Computer Science
Ammon School of Arts & Sciences
Central Connecticut State University

May 22, 2013
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1: Additional Faculty

According to the Admissions Department, 50 new students have confirmed their intent to enroll in CCSU as computer science majors in Fall of 2013.

2: Support for Computer Science Tutors

3: Laboratory Support

Appendix. Copy of Assessment 2011-2012 Report

Preamble

Section 1. Learning Outcomes

Student Outcome (a): An ability to apply knowledge of computing and mathematics appropriate to the discipline.

Student Outcome (b): An ability to analyze a problem...

Student Outcome (c): An ability to design ... a computer-based system...

Student Outcome (d): An ability to function effectively on teams to accomplish a common goal.

Student Outcome (e): An understanding of professional, ethical, and social responsibilities...

Student Outcome (f): An ability to communicate effectively...

Student Outcome (g): An ability to analyze the impact of computing...

Student Outcome (h): Recognition of the need for ... continuing professional development...

Student Outcome (i): An ability to use current techniques, skills, and tools...

Student Outcome (j): An ability to apply mathematical foundations, algorithmic principles, and computer science theory...

Student Outcome (k): An ability to apply design and development principles...

Section 2B. Methods

Section 3. Analysis

Section 4. Use of Results

Section 5. General Education

Section 6. Assessment Plan
Computer Science Department Mission and Programs

The Computer Science department offers academic programs that develop the student’s knowledge and ability in the broad area of computer sciences. The programs directly support employment and graduate study and follow the curriculum guidelines developed by the leading professional organizations, Association for Computing Machinery (ACM) and Institute of Electrical and Electronics Engineers (IEEE). Graduates easily find professional employment upon graduation and are often successful in gaining admission to top graduate schools.

Degree Programs

- B. S. Computer Science (Honors) – this degree is accredited by the Computing Accreditation Commission of ABET (CAC of ABET).
- B. S. Computer Science (Alternative) – this degree is intended for transfer students and for students who change their major and so do not have the time for all the mathematics and science that the Honors degree requires

Section 1: Past Year Activity

A. Progress in Meeting Annual Goals

The goals for the department were discussed and agreed upon during various department meetings throughout the past several school years.

Goal 1: Continued Accreditation. The immediate goal of the department is to retain accredited by CAC of ABET.

Status: CAC of ABET is recognized by Council for Higher Education Accreditation as the accrediting body for computer science and related disciplines. The CS department first sought accreditation (from CSAB, now a part of ABET) in 1988 but failed to get it in that year. Further efforts resulted in accreditation in 1990, one of the first in New England. Presently, only about 300 computer science programs in the United States have CAC accreditation out of approximately 2000 computer degree programs.

A self-study report is due in July 2013 in support of an on-site visit by program evaluators in October 2013. The report will describe how the program meets CAC criteria and what corrective actions have been taken to correct shortcomings found in the last evaluation from CAC.

Progress: Work on the self-study was done throughout the summer and the school year. Three hours of release time was granted to the principle author of the report for the fall 2012 semester. The self-study report is mostly completed. Some sections should be updated to reflect recent activity. Specifically, changes are needed to show the revised curriculum of the CS-honors program and the revised objectives of the department. Additional assessment material needs to be gathered and incorporated into the document.

The on-site visit is on track. A team leader has been picked by CAC and the rest of the visitation team is being assembled. This team will study the self-study during the months leading up to the visit.

Impediments: Writing some sections of the self-study presents problems. Some of the shortcomings found in the latest CAC report have not been as strongly addressed as CAC would expect. Specifically, the Final Statement of August 2012 identifies three concerns:
Concern 1. (Standard I-6). Without documentation of the linkage between assessment and program changes, there is potential that the program will not be able to fully evaluate the effectiveness of changes.

The department has made some progress on this. Annual assessment reports have abundant assessment data. But the linkage between this data and action is not as strong as ABET (and NEASC) might want.

Concern 2. (Standard III-8). Policies implemented should be monitored to ensure that all full-time faculty members have sufficient time for scholarly activities and professional development.

There has been almost no change in this since the last program evaluation. It is almost certain that CAC will regard this as a continuing problem.

Concern 3. (Standard V-4). Without evidence of the effectiveness of the service agreement [between CS and Information Services] and the use of student workers there is a potential that the support does not fully meet the program’s needs.

There has been no change in this since the last program evaluation. The level of service provided by Information Technology is well below the level expected for a university computer science department. This, in fact, has been a weakness since the 2001 ABET self-study.

Goal 2: Evaluating Curriculum Changes. The Honors degree program was redesigned in 2010. This goal is to assess the effect of these changes.

Status: In 2010 the Honors degree was redesigned to accommodate changes in CAC requirements and to simplify the program. Some bottlenecks were eliminated, some requirements were broadened, and the program was matched with recommended curricula from professional societies. Hopefully this made it easier for students to find courses to satisfy degree requirements and ensured that the curriculum was up to date.

Progress: Direct evaluation of this is difficult, but the overall impression is that students are more reliably finding courses that meet requirements and that the degree program is running smoother than before. Assessment of the program (Goal 3) shows no radical change in learning outcomes. Some continuing problems were addressed by making further small changes to the curriculum in spring 2013. After both sets of changes the curriculum now looks like this:
Curriculum Sheet: Bachelor of Science in Computer Science--Honors

CORE COURSES (24 semester hours):  
CS 151 (3), CS 152 (3), CS 153 (3), CS 253 (3), CS 254 (3),  
CS 354 (3), CS 355 (3), CS 385 (3)  

ADVANCED ELECTIVES (12 semester hours) choice of 12 hours from:  
CS 407 (1-3), CS 410 (3), CS 415 (3), CS 423 (3), CS 425 (3), CS 460 (3),  
CS 462 (3), CS 463 (3), CS 464 (3), CS 465 (3), CS 473 (3), CS 481 (3),  
CS 483 (3), CS 490 (3), CS 491 (3), CS 492 (3), CS 495 (3)  

AUXILIARY ELECTIVES (4 semester hours) selected from the Advanced Electives or from the following:  
CS 290 (1-3), CS 300 (3), CS 301 (3), CS 398 (1-3), CS 498 (3), CS 499 (3)  

MATH/STATISTICS (15 semester hours):  
MATH 152 (4), MATH 218 (4), MATH 221 (4), MATH 226 (3)  

SCIENCE/QUANTITATIVE (15 semester hours): A choice of one of the following sequences (8 hours):  
BIO 121 & BIO 122; CHEM 161 & CHEM 162 & CHEM 200 & CHEM 201;  
ESCI 121 & ESCI 122; PHYS 125 & 126  
Plus an additional 7 credits in science, MATH above MATH 119, or STAT courses (not counting courses already in the Math/Statistics category).  

PHILOSOPHY (3 semester hours): PHIL 242 (3) or PHIL 245 (3)  

Notes:  
1. The number of core course was expanded by moving some courses out of the category “Advanced Area Courses,” which was eliminated.  
2. The course CS 315 (Game Programming) was added. Additional courses were moved into this category from the eliminated category “Advanced Area Courses.”  
3. The “4 semester hours” continues to be a problem since students end up taking an extra full three hour course to meet this requirement.  
4. MATH 226 (Linear Algebra and Probability for Engineers) replaces the former requirement STAT 315 (Mathematical Statistics I).  
5. The chemistry sequence has been updated to match the current offerings of the chemistry department (April 2013).  
6. The qualifier “above MATH 119” was added.  
7. PHIL 242 added as an option.
Goal 3: Continued Assessment. This goal is to continue assessment of upper level courses and general education courses, and to integrate this data into assessment of the entire program.

Status: The department has set learning outcomes and has been doing assessment of them since well before 2001, as required by ABET. The department has submitted annual assessment reports to the university since first required in 2007.

Progress: The department submitted its assessment report for 2011/12 in September 2012 (included).

Of the eight core courses, seven are regularly assessed (to varying degrees).

Of the four courses that count in general education, three are regularly assessed, although not all instructors of multiple section courses provide data.

Of the ten advanced elective courses that are frequently offered, eight are regularly assessed (to varying degrees).

The degree program has five educational objectives and eleven learning outcomes (using ABET terminology.) These are assessed by compiling the assessment of the individual courses and by an annual major field test given to seniors and by occasional surveys of graduates.

Impediments: Although the assessment of individual courses is strong, assessment of the more encompassing educational objectives of the entire degree program is somewhat weak. It would help if there were a capstone course that included a group or individual project. Such capstones are becoming common in computer science departments and are all but required in other ABET disciplines.

The department does not clearly show how assessment data are used to implement improvements. Faculty often drop a course when it is finished and not reflect on how it could be improved and what actions assessment data support.

Goal 4: Teaching Innovation. The department has been at the forefront of teaching innovation (first use of the Web for course material and first implementation of WebCT within the university). We intend to continue this innovation by using those popular tools and by continued use of web-based teaching material.

Status: As has been true for the past fifteen years most CS faculty make heavy use of the Web for teaching. Most professors put course material on the department’s web site. Most course sections are supported by the current course management system (currently Blackboard/Learn).

Progress: Sphero robots were used in CS 355 (Systems Programming) to make it more interesting and motivating to students. Programming was done with Android phones that control the robots. The course CS 355 was redesigned so that it now teaches portable device programming.

Finch robots were used for several programming assignments in the fall 2012 section of CS 153 (Computer Science III).

Much of the web material developed for CS 151 (Computer Science I) continues to be used in the beginning programming course of the Massively Online Open Courseware (MOOC) of Saylor University.

The department established a Facebook page where students and faculty can socialize and discuss their coursework. This has become enormously popular with current and former students. Especially valuable are comments made by former students who are now in the “real world” and who tell students how useful and relevant their courses are.

Impediments: Moving to Blackboard/Learn was a massive step backwards. For example, two courses (CS 153 and CS 254) essentially lost all the material that had been developed over the past several years. Much of what had been developed (on-line quizzes) is not supported by the current system (although it is
falsely claimed that it does). Almost every aspect of Blackboard/Learn is poorly implemented and greatly impedes courseware development and use.

**Goal 5: Laboratory and Tutoring Support.**

**Status:** For the past three years, with Arts & Sciences support, the department has kept MS 314 open for 40 hours a week and provided tutors for computer science for many of those hours. Tutors have also been available in MS 208 for 20 hours a week. This has proven very popular with both computer science students and with general education students. Both rooms are in almost constant use by students studying and working on projects. We hope to continue this program in the next school year.

**Progress:** As in the past several years, the department provided tutors for general education computer science courses (and some other courses). Maria Sanford 314 was kept open for a minimum of 40 hours a week, essentially 10AM to 6PM with additional hours on some days. Students used the lab to work on homework and programming projects.

Undergraduates Mytu Nguyen and Christopher Tine were available for tutoring for 30 hours a week each. The department had a graduate assistant, Jackie Adams, who provided tutoring in Maria Sanford 208 for 20 hours.

Although the lab is great for tutoring and study, it provides many more functions. It has become a focal point for the undergraduate students. Students benefit from interactions outside of formal classroom discussions. Students now feel they are part of a group and have a sense of belonging to the department and to CCSU. This has positive effects on retention and motivation.

**Impediments:** Funding of this initiative has been year-to-year and somewhat uncertain. This makes planning difficult and makes it difficult to recruit student tutors. Another problem is that new tutors need to be found every year. The best tutors are our best seniors, who (of course) graduate every year. Our one GA was previously a tutor as an undergraduate and is expected to be a GA tutor for two years, which alleviates the problem somewhat.
### Tutoring Hours, academic years 2011/12 and 2012/13

<table>
<thead>
<tr>
<th>Tutor</th>
<th>Fall 2011</th>
<th>Spring 2012</th>
<th>Fall 2012</th>
<th>Spring 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jackie Adams</td>
<td>180</td>
<td>227</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Brian Van Stone</td>
<td>115</td>
<td>100</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>Chris Buck</td>
<td>222</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Mytu Nguyen</td>
<td>--</td>
<td>265</td>
<td>212</td>
<td>187</td>
</tr>
<tr>
<td>Andy Theodoropoulos</td>
<td>192</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Christopher Tine</td>
<td>--</td>
<td>270</td>
<td>209</td>
<td>209</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>709</td>
<td>863</td>
<td>821</td>
<td>696</td>
</tr>
</tbody>
</table>
B. Progress with Strategic Planning

*If applicable, summarize progress with your unit’s strategic plan and any changes in the plan. Please attach a copy of the plan as an appendix.*

The computer science department does not have a formal strategic plan.

C. Administrative Changes

*Summarize any significant changes in budgetary, staffing, and infrastructure conditions in your unit in the past year.*

**Budgetary:** Our budget for 2011/2012 was about the same as past years. Discretionary Personal Services was $7,000; General Administration was $13,000. There was a $500 rescission taken from this. In addition to the above, the A&S Dean’s office covered $4,525 for student tutors and we used $1,265 of CCSU foundation money to cover student travel to a conference.

**Staffing:** As per the departmental meeting of May 1, 2012 Stanislav Kurkovsky will replace Bradley Kjell as department chair starting school year 2013/14. Bradley Kjell was department chair for the school years 2007/08 - 2012/13.

**Infrastructure:** There has been no significant change in the department’s infrastructure.

D. Special Initiatives

*Describe changes in current initiatives, any new initiatives, or initiatives beyond the normal scope of your unit’s activities. Present evidence of their impact or effectiveness.*

**Curriculum Alignment.** In Fall of 2010 the department’s curriculum committee studied the computer science curriculum recommended by the Association for Computing Machinery (ACM) and the IEEE Computer Society. Our curriculum mostly matches the recommendations but lacked regular offerings of web programming which had been taught sporadically in the past. We hired Dr. Chad Williams specifically for this and now offer this course regularly. The course is somewhat hampered by lack of laboratory support.

A new course, CS 415 (Computer Game Development) was added. This subject is fairly common in computer science curricula. This course will motivate students to enlarge their knowledge in an engaging context.

**Revised Educational Objectives.** The industrial advisory board met April 12, 2013 to discuss the state of the department and the department’s educational objectives and student outcomes. After some discussion, the previous four learning outcomes were slightly revised and a new one added (outcome 5). The student outcomes are largely prescribed by ABET and were left unchanged. The current objectives are:

- [EO1 - fundamentals] Graduates will gain a broad understanding of the fundamental theories, concepts, and applications of computer science.
- [EO2 - careers] Graduates will be prepared to apply their understanding in a wide range of careers in computer science and information technology.
• [EO3 - communicate] Graduates will communicate effectively, both orally and in writing.

• [EO4 - life-long learning] Graduates will be prepared for life-long learning and for graduate study in computer science.

• [EO5 - ethics] Graduates will be prepared to act ethically and with social responsibility in their careers.

Database of Graduates. Our 2011 summer intern, Anna Syta, systematically went through the list of our graduates for the last two decades gathering career and graduate school information available on Facebook, Linked-In, and personal web pages. This information was put into a spreadsheet. The data show that the department is meeting these objectives. This data has been sporadically updated throughout the 2012/13 school year. We expect this to be a useful part of the self-study to be prepared for the ABET visit in October of 2013.

Computer Science Club. The Computer Science Club met several times during the school year with Dr. Chad Williams as their faculty sponsor. The club had a resume and interview workshop, a cover letter review session, and worked on programming challenges.

E. Significant Accomplishments

Provide a bulleted list of the most significant accomplishments in your unit this past year (e.g., accreditations, honors, new programs approved, milestones, etc.)


Stan Kurkovsky’s grant continues: “STEM Scholarship Program 2011-2016,” awarded $600,000 for student scholarships.

Stan Kurkovsky is the principal investigator for a NSF grant “Using Mobile Game Development to Improve Student Learning and Satisfaction in Introductory Computer Science Courses,” $133,788, 2010-2012.

Irena Pevac received an AAUP Research Grant 2013-2014: “Improved Version of the Tutor for Time Performance Analysis of Recursive Algorithms that Uses Simpler Visualization Techniques.”

Neli Zlatareva received an AAUP Faculty Research grant 2012-2013.
2. **Department Colloquium.** The department sponsored one colloquium:

Clinton Andrews, “Who Controls Smart Stuff”, 3:00 PM, April 11, 2011 (the fifth annual Brian M. O’Connell Memorial Event).

Dr. Andrews (Rutgers University) discussed who gets to control what parts of our built environment. The event included a musical performance by Melissa Morgan (cello) and the award of the Brian O’Connell Scholarship to Mark Smith, a computer science student.

3. **Publications.**


S. Kurkovsky, “Mobile Game Development: Improving Student Engagement and Motivation in Introductory Computing Courses”. *Computer Science Education*, Taylor and Francis. [Accepted].


Chad Williams presented at *Mobile Computing, Applications and Services Conference*, October 2012.

5. Student Internships.

Our students are in high demand by local employers. Students have found internship positions at Stanley Tools (Chris Gentle), Veeder-Root (Jesse Engle), CASE Partners (Katie Swol), U. Conn. Health Center (Mathias Heck), Cigna (Nick Pryor-Bennett, Charles Cantoni, Mytu Nguyen, and Mark Smith).

Graduates and continuing students have found full-time positions at Cigna (Matt Wood), Hartford (Chris Tine), Travelers (David Durant, Christopher Peshka, Emran Talukder), Charles Computer Services (Patrick Nolan), and Qualitest (Tyler Bouchard).

6. Undergraduate Research.

Undergrads Emran Talukder, Christopher Tine, Mark Smith advised by Stan Kurkovsky received an AAUP student/faculty research grant titled "The Himalaya Sensor Library & Distributed Computing". The Himalaya Sensor Library will allow users to consume and analyze environmental data for many different uses. The sensor system consists of a singleboard microcontroller that can interface with a variety of analog sensors. The data from the microcontroller(s) will be transmitted via HTTP to a web server, where the incoming data will be processed and stored persistently. The Himalaya library will then render graphical plots of the data and apply a system of procedures providing statistical Inference.


Charles Cantoni, Rachel Grabowski (CS majors) presented and published “Solving a Sudoku Puzzle by using a Modified Greedy Graph Coloring Algorithm”. This was selected for inclusion in the Undergraduate Research Competition at the 18th annual conference of the Consortium for Computing Sciences in Colleges, Northeastern Region (CCSCNE), April 12 – 13, 2013, Siena College in Loudonville, NY.
Undergrads Melissa Mulcahy, Daniel Tobin, and David Stanley attended the 4th International IEEE Consumer Electronics Society Games Innovation Conference under the supervision of Stan Kurkovsky as part of his STEM grant.

7. Honor Student. David Durant is the department’s Honors Student for 2012/2013. The presentation was at the University Honors Convocation on May 3, with the presentation done by Irena Pevac. David Durant has accepted a full-time position at Travelers.

8. Scholarship and Service.


Bradley Kjell is a member of the Board of Governors for the Society on the Social Implications of Technology of the IEEE (2012-2014) and attended BoG meetings at Sanford, CT (July 28) and New Brunswick, NJ (March 16) and others by teleconference.

Bradley Kjell served as a grader for the Computer Science Advanced Placement test in Cincinnati OH (June 1-9, 2012). Approximately 200 high school and college computer science teachers graded the free response questions of about 5000 exams.

Stan Kurkovsky and Bradley Kjell were external program evaluators for the computer science degree program and the information technology degree program at Kean University, April 3, 2013.

Zdravko Markov is an Associate Editor, International Journal on Artificial Intelligence Tools (IJAIT), 2004 – present.

Zdravko Markov was a member of the program committee for the 15th International Conference AIMSA 2012, Bulgaria.

Irena Pevac and Chad Williams were on the Excellence in Teaching Honor Roll 2012 at CCSU.

Irena Pevac served in September 2012 as an external evaluator for promotion portfolio of a candidate at Penn State University at Abington at the School of Engineering Design, Technology and Professional Programs.

Neli Zlatareva is a member of the program committee for the 12th IASTED International Conference on Artificial Intelligence and Applications, AIA 2013.

F. Assessment

The assessment report for the 2011/12 school year is attached in the Appendix.
Section 2: Planning for 2013 - 2014

A. Goals

List your goals for the next academic year. Specify any appropriate numerical targets.

**Goal 1: Continued Accreditation.** The immediate goal of the department is to retain accredited by CAC of ABET.

Accreditation of the Computer Science – Honors degree is due for renewal as happens every six years. A self-study is being prepared for this. A program evaluation team will visit the department in October 2013.

**Goal 2: Assessment.** We expect to continue assessment of upper level courses and general education courses and to integrate this data into assessment of the entire program.

We especially hope to use assessment data to improve the curriculum to complete the linkage between assessment and program changes. We also expect to improve the assessment of general education and to use this data to improve those courses.

We intend to keep the database of computer science graduates current and to conduct a survey of graduates. Both of these will be useful in assessing the Educational Objectives of the program.

**Goal 3: Teaching Innovation.** We intend to continue this innovation by using new tools and by continued use of web-based teaching material.

**Goal 4: Laboratory and Tutoring Support.** With Arts & Sciences support the department has kept MS 314 open for 40 hours a week and provided tutors for computer science for many of those hours. We hope to continue this program in the next school year.

B. Collaboration

Identify any plans for collaboration with other units at CCSU, with other CSU institutions, and with individuals and organizations beyond CCSU.

The annual Brian O’Connell event also is a function of the Connecticut Section of the IEEE and is listed in their newsletter and web site.

The computer science department supports the Connecticut Section of the Computer Science Teachers Association and sometimes hosts their meetings.

C. Needs

Provide a list of anticipated or emerging needs in staffing or budget.

**1: Additional Faculty.** To meet the demand of increasing numbers of students new faculty lines must be added.

There are presently too few faculty to offer enough courses to enable timely graduation of students. Most courses for majors in Fall 2013 are enrolled beyond capacity and there is heavy demand for more courses, but too few faculty to cover them. Far too few courses are offered in the computer science option MS Computer Information Technology degree to effectively support this degree.
Nation-wide, computer science enrollments have increased 30% over past years. Some computer science departments report a 50% increase in enrollment. At CCSU, enrollment has been increasing, but the number of faculty lines has not.

<table>
<thead>
<tr>
<th>Fall Enrollment (Head Count, Full and Part Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Computer Science</td>
</tr>
<tr>
<td>74</td>
</tr>
<tr>
<td>Computer Science--Honors</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

According to the Admissions Department 50 new students have confirmed their intent enroll in CCSU as computer science majors in Fall of 2013.

2: Support for Computer Science Tutors. The computer science department’s tutoring program is very successful. It is used by students taking the department’s general education courses, by students in the degree program, and by some other students.

The room where the tutoring is done (Maria Sanford 314) has become a focus of the computer science community. Spontaneous study groups have formed, students drop in to chat with other students, and students working as interns drop in relate their experiences to other students. We also have a graduate assistant who does tutoring and keeps room MS 210 open for quiet study.

A survey of 1000 computer science students conducted by Nanette Veilleux [Simmons College] found that when students have a sense of belonging to a community they do better in courses and are more likely to continue with their studies. This seems to be happening with us.

We would like to continue supporting this program. In the academic year 2012/13 we supported the GA with $6000 and the undergraduate tutors were supported with $9000 of which $4500 was funded by Arts and Sciences.

3: Laboratory Support. The computer science department does not at present have the laboratory capacity and the level of support expected of a university department.

CCSU does not have computer laboratories sufficient for educating students in professional level software development. All students do their work at home on their own computers using an ill-assorted mix of software. This is not usual for a computer science department.
Appendix. Copy of Assessment 2011-2012 Report

Note: This appendix contains the body of the assessment report for 2011/12 but not the 40 page appendix to that report which contains assessment data of individual courses and various other data. The full report is on the OIRA web site.

Preamble

The Computer Science Department prepares students for graduate study and for positions in computer-related professions, including computer systems analysis, software development, internet programming, security, software engineering, and database administration.

The curriculum conforms to the accreditation standards of ABET, the recognized accreditor for college and university programs in computer science and engineering. The degree programs cover the full range of computer sciences and include a foundation in mathematics and science. This background is expected for professional positions and for graduate study in computer science.

The Department offers two degrees:

- **B. S. Computer Science (Honors)** – this degree is accredited by the Computing Accreditation Commission of ABET (CAC of ABET), recognized by the Council on Higher Education Accreditation for computer science accreditation.

- **B. S. Computer Science (Alternate)** – this degree is intended for transfer students and for students who change their major and so do not have the time for all the mathematics and science that the Honors degree requires.

The same computer science courses are used in both programs. Since the programs are similar, assessment data covers both degrees. Most of the assessment instruments are administered to all students together, and partitioning the results into two groups would be difficult. Students frequently shift between the two degrees. The learning outcomes (educational objectives and student outcomes) are the same for both programs.

Section 1. Learning Outcomes

In agreement with ABET’s definitions, program educational objectives describe what graduates are expected to attain within a few years after graduation. Program educational objectives are based on the needs of the program’s constituencies. Objectives are the long-term goals of the degree program. Our objectives are published at http://cs.ccsu.edu/mission.html

The following objectives were discussed and approved by the department and our Industrial Advisory Board on April 24, 2009.

- **Objective 1:** Students will gain a broad understanding of the fundamental theories, concepts, and applications of Computer Science.

- **Objective 2:** Students will be prepared for professional careers in computer science and information technology.

- **Objective 3:** Students will communicate effectively both orally and in writing.
Objective 4: Students will be prepared for life-long learning and for graduate study in computer science.

Student Outcomes describe what students are expected to know and be able to do by the time of graduation, similar to the “Learning Outcomes” of CCSU documents. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program. An outcome is often supported by a learning outcome of a particular course. Following are the student outcomes expected by Criteria for Accrediting Computing Programs (Computer Accreditation Commission, October 29, 2011), www.abet.org.

The program enables students to attain, by the time of graduation:

Student Outcome (a): An ability to apply knowledge of computing and mathematics appropriate to the discipline.

Student Outcome (b): An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.

Student Outcome (c): An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.

Student Outcome (d): An ability to function effectively on teams to accomplish a common goal.

Student Outcome (e): An understanding of professional, ethical, legal, security and social issues and responsibilities.

Student Outcome (f): An ability to communicate effectively with a range of audiences.

Student Outcome (g): An ability to analyze the impact of computing on individuals, organizations, and society.

Student Outcome (h): Recognition of the need for and an ability to engage in continuing professional development.

Student Outcome (i): An ability to use current techniques, skills, and tools necessary for computing practice.

Student Outcome (j): An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

Student Outcome (k): An ability to apply design and development principles in the construction of software systems of varying complexity.
Section 2A. Findings

Student Outcome (a): An ability to apply knowledge of computing and mathematics appropriate to the discipline.

This outcome is supported by nearly all of our courses and is directly measured by the Major Field Test. Assessment reports of individual courses and the Major Field Test show that students are reaching satisfactory levels. See Section 2B.

Informal assessment in the form of comments from employers and the success of our students in graduate school also show that this outcome is being achieved. This informal assessment also shows that students are achieving the other outcomes, as well.

Student Outcome (b): An ability to analyze a problem...

This outcome is supported by nearly all courses, especially the upper level courses that require larger projects and give the student more design flexibility. CS 355 and CS 410 are particularly relevant. CS 355 learning outcomes LO-1 and LO-5 are a direct measure of outcome b. (See Appendix A, section 9). Mostly, students are performing well in this area.

<table>
<thead>
<tr>
<th>Table 1 — Learning Outcomes of CS 355</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>LO-1</td>
</tr>
<tr>
<td>LO-2</td>
</tr>
<tr>
<td>LO-3</td>
</tr>
<tr>
<td>LO-4</td>
</tr>
<tr>
<td>LO-5</td>
</tr>
</tbody>
</table>

The course CS 410 learning outcomes LO-1, LO-2, and LO-5 are a direct measure of student outcome b. (See Appendix A Section 10.) Mostly, students are doing OK. LO-1 is: Be able to ... solve software engineering problems, including the specification, design, implementation ... . Most students take this course as juniors or seniors, and most do at least moderately well in the course.
Table 2 — Learning Outcomes of CS 410

<table>
<thead>
<tr>
<th></th>
<th>Exemplary</th>
<th>Good</th>
<th>Acceptable</th>
<th>Below acceptable</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO-1</td>
<td>9</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>LO-2</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LO-3</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>LO-4</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LO-5</td>
<td>11</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>LO-6</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>LO-7</td>
<td>10</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>LO-8</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>LO-9</td>
<td>8</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

CS 492 outcomes 1-4 also support program learning outcome b. (See Appendix A Section 13.) The following chart shows that most students are doing well in this course.

Table 3 — Learning Outcomes of CS 492

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Exemplary</th>
<th>Good</th>
<th>Acceptable</th>
<th>Below Acceptable</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 1</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Outcome 2</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Outcome 3</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Outcome 4</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The assessment reports of other courses also show achievement in outcome b. (See individual courses assessments in the appendix for details.)

**Student Outcome (c): An ability to design ... a computer-based system....**

Outcome c overlaps with outcome b, and is also supported by nearly all our courses. LO-1 thru LO-5 of CS 355 and LO-1, LO-2, and LO-5 of CS 410 support this, as do the outcomes of CS 492. The above tables one through three show the department’s success in bringing students to this level.

CS 423 concludes with a semester project that requires the student to design, implement and evaluate a computer graphics project. The Table 4 shows that 86% of students are able to do this satisfactorily.
### Table 4 — Student Success with final project in CS 423

<table>
<thead>
<tr>
<th>Semester</th>
<th>Students</th>
<th>Requirements Met</th>
<th>% meeting Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2002</td>
<td>23</td>
<td>22</td>
<td>96%</td>
</tr>
<tr>
<td>Fall 2003</td>
<td>28</td>
<td>24</td>
<td>86%</td>
</tr>
<tr>
<td>Fall 2004</td>
<td>17</td>
<td>13</td>
<td>76%</td>
</tr>
<tr>
<td>Fall 2005</td>
<td>17</td>
<td>15</td>
<td>88%</td>
</tr>
<tr>
<td>Fall 2006</td>
<td>9</td>
<td>7</td>
<td>78%</td>
</tr>
<tr>
<td>total</td>
<td>94</td>
<td>81</td>
<td>86%</td>
</tr>
</tbody>
</table>

**Student Outcome (d):** An ability to function effectively on teams to accomplish a common goal.

Teamwork is practiced in group projects and design meetings in CS 153, CS 410, CS 460, and CS 463. In CS 153 the students work on one big project involving dozens of individual programs which must be integrated into the whole. In CS 410 this is measured directly in LO-4, LO-5 (see table). Skill 2 in CS 495 (Table 5) measures student achievement in a group project.

**Student Outcome (e):** An understanding of professional, ethical, and social responsibilities.

The entire course CS 495 (Legal, Social, Ethical, and Economic Issues in Computing) covers this topic, as do parts of several other courses. Course outcomes 1-4 directly measure various aspects of this. Course outcome 1 (for example) is “… understand some legal, social, ethical, and economical issues related to computers…”.

### Table 5 — Learning Outcomes and Acquired Skills of CS 495

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Exemplary</th>
<th>Good</th>
<th>Acceptable</th>
<th>Below Acceptable</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 1</td>
<td>31</td>
<td>12</td>
<td>9</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Outcome 2</td>
<td>54</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Outcome 3</td>
<td>53</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Outcome 4</td>
<td>56</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skill 1</td>
<td>56</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Skill 1 46 5 3 2 0
Skill 2 50 1 4 0 0
Skill 4 51 2 2 0 1
Skill 5 53 2 1 0 0

**Student Outcome (f):** An ability to communicate effectively.

Written and oral reports are required in several courses and are directly assessed. LO-6 and LO-7 of CS410 (Table 2) measure as student’s to convey technical material through oral presentation and interaction with an audience, and a student’s ability to convey technical material through written reports. Skill 1 of CS 495 is giving an oral presentation; Skill 3 is critical and analytical writing (Table 5). Evidence shows that both of these are being achieved.

**Student Outcome (g):** An ability to analyze the impact of computing ...

This outcome overlaps with outcome e, so, again, our CS 495 mostly covers this topic. Course outcomes 1-4 directly measure various aspects of the topic (Table 5). LO-9 of CS 410 “…evaluate the impact of potential solutions to software engineering problems in a global society” (Table 2) measures this. Students in the CS Honors program are required to take PHIL 245, which also covers aspects of outcomes e and g, but that course is not assessed.

**Student Outcome (h):** Recognition of the need for ... continuing professional development.

Some of our courses claim that they develop this in students, but there are few direct measures. LO-9 of CS 410 (Table 2) measures this in part. The success of our students in finding professional positions and in graduate school acceptance shows that at least some of them expect the need for continued development.

**Student Outcome (i):** An ability to use current techniques, skills, and tools ...

This outcome is assessed by showing that students do their work for outcomes (a), (b) and (c) using current computers and software. Outcomes a, b, and c are concerned with a student’s knowledge and ability with general principles. Outcome (i) is concerned with the specific “technologies” in current practice. For example, knowing how to program is covered by outcome (a). Knowing how to program using a particular language is outcome (i).

All courses that involve programming use one of the top three programming languages as measured by various organizations. ABET requires that students be exposed to several languages and develop proficiency in at least one. Our students use current development environments and tools as provided by the university and use a contemporary desk-top operating system (Windows) as well as an enterprise operating system (Linux).
**Student Outcome (j):** An ability to apply mathematical foundations, algorithmic principles, and computer science theory...

Computer science students are required to take MATH 152 (Calculus I) and MATH 218 (Discrete Math). Honors students take also MATH 221 (Calculus II) and STAT 315 (Math Statistics). Discrete math especially includes the mathematical foundations of this outcome. The success of computer science students in these courses has not been separately assessed.

Algorithmic principles are the subjects of CS 463, which has been offered twice in the past five years. Table 6 shows the average grade on the midterms and finals.

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>Average Test 1</th>
<th>Average Test 2</th>
<th>Average Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2010</td>
<td>21</td>
<td>84%</td>
<td>88%</td>
<td>80%</td>
</tr>
<tr>
<td>Spring 2011</td>
<td>18</td>
<td>85</td>
<td>78%</td>
<td>84%</td>
</tr>
</tbody>
</table>

The results look satisfactory, but not all students take the course. Another assessment of outcome (j) is Indicator 2 of the Major Field Test, “Discrete Structures and Algorithms”. All CS-Honors students are required to take this test. The average score over the past six years in this indicator puts us in the 60th percentile of all students nationwide taking the test.

Many other courses deal with algorithmic principles. Algorithms are at the core of computer science and assessing outcomes (a), (b), and (c) implicitly measures this one.

**Student Outcome (k):** An ability to apply design and development principles ...

Principles of design and development (independent of implementation) are taught in CS152, CS355, CS410, CS490 and implicitly in several other courses. For CS355 LO-2 through LO-5 measure this outcome (Table 1). For CS410, LO-1 and LO-5 measure this outcome (Table 5). For CS490, LO-7 measures this outcome (see appendix).

**Section 2B. Methods**

**Methods.** Table 1 in the appendix shows the objectives and the assessment methods used to measure them. Some of the methods in that table are discussed in the following.

**Major Field Test.** The Major Field Test in Computer Science from Educational Testing Service measures student achievement in the fundamental concepts of computer science and is a direct measure of our objectives one and two. All BS Computer Science-Honors majors are required to take this in their senior year. Although it is not required of them, some BS Computer Science-Alternate students also take the test.

*ETS Major Field Tests are designed to measure basic knowledge and mastery of concepts and principles expected of senior-level undergraduates completing an academic*
The tests evaluate a student's ability to: analyze and solve problems, understand relationships, and interpret specific material. (http://www.ets.org).

The test has been given to our students since the spring of 2000. The most recent was given in April 2012 to 8 students.

<table>
<thead>
<tr>
<th>Number of students</th>
<th>Total Score</th>
<th>Indicator 1</th>
<th>Indicator 2</th>
<th>Indicator 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>151</td>
<td>52</td>
<td>38</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>56 percentile</td>
<td>32 percentile</td>
<td>62 percentile</td>
<td>54 percentile</td>
</tr>
</tbody>
</table>

The 2012 average total score of 151 is nearly identical to what it has been for the past seven years. This score puts our graduates at the 56th percentile of those students nationwide taking the test. Although, due to changes in the test from year to year, the raw scores are not directly comparable, it seems reasonable to claim that our graduates are consistently close to the national average.

Indicator 1 (Programming) puts this year’s students at the 32nd percentile level, a sizeable decrease from previous years. However, the raw score is about the same previous years.

Indicators 2 and 3 remain roughly in the middle of the range, as they have been for the past seven years. Although the subjects covered by the indicators vary, the results show no systematic weakness in our students. The low score for indicator 3 (Architecture, Operating Systems, Networking, and Database) might be explained by the observation that not many of our students take all four of those courses.

ETS does not provide tables that can be used to evaluate several years of tests grouped together. To get this, weighted averages of the total score and of the three indicators for the years 2006 to 2011 were computed.

<table>
<thead>
<tr>
<th>Number of students</th>
<th>Total Score</th>
<th>Indicator 1</th>
<th>Indicator 2</th>
<th>Indicator 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>153</td>
<td>61</td>
<td>40</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>60 percentile</td>
<td>55 percentile</td>
<td>70 percentile</td>
<td>60 percentile</td>
</tr>
</tbody>
</table>
These averages and their percentile rank confirm that our graduates are about in the middle of computer science graduates in the nation. The following table shows the “Total Score” as a percentile for each year the test has been given.

**ABET Accreditation.** The Computing Accreditation Commission of ABET (CAC of ABET) has accredited the Computer Science (Honors) degree through Sept 2012. ABET is the sole accreditor of engineering and computer science programs in the US. Although not a direct measure of success in achieving our objectives and outcomes, accreditation indicates that the degree program meets the standards for content as determined by CAC’s advisory board of major universities and employers.

**Informal Assessment.** The most satisfying and perhaps the most meaningful measure of our success in achieving our objectives is the success of our students in graduate school placement and in employment. Our graduates have been accepted for graduate study at Yale, Columbia, Carnegie-Mellon, University of Connecticut, University of Maryland, University of Waterloo, and others. Our graduates are employed in many leading Connecticut firms, including Travelers, LIMRA, United Technologies, Northeast Utilities, and others.

Several employers have remarked on how well prepared the students they hired have proven. Several students have had internships at Travelers and LIMRA and have gone on to full-time employment. Travelers is especially pleased with the students from CCSU it has hired (from several departments) and is sponsoring on-campus workshops to encourage students in their careers. Dave Fearon (Management) has been working to maintain this relationship.

**Assessment of Individual Courses.** Some of our courses are individually assessed. Each course has its own learning outcomes which support the learning outcomes and objectives of the department. Individual reports on each of these courses are available separately on the computer science department’s S: drive.

General education courses (which are not part of the degree programs) are assessed: CS 110 (Internet Programming), CS 113 (Introduction to Computers), and CS 207 (Introduction to Computer Graphics).
The following chart shows the assessment status of recently-offered courses which are part of the majors. See section 5 for general education courses.

### Table 9 — Courses and the Outcomes they Support
* Summary of latest report is included in the appendix

<table>
<thead>
<tr>
<th>Course</th>
<th>Assessment Reports</th>
<th>Outcomes Supported</th>
<th>Major Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 151</td>
<td>Spring 2007, Spring 2009, *Spring 2011</td>
<td>a, b, c, i</td>
<td>Considerably improved passing rate suggests that implemented curriculum changes are steps in the right direction. Upon successful completion of CS 151 students are well prepared to take the second course in the sequence, CS 152, and other courses listing CS 151 as a prerequisite.</td>
</tr>
<tr>
<td>CS 152</td>
<td>Spring 2007, *Spring 2011</td>
<td>a, b, c, i, j, k</td>
<td>Most of the learning outcomes of the course are being achieved.</td>
</tr>
<tr>
<td>CS 153</td>
<td>Spring 2007, *Spring 2012</td>
<td>a, b, c, d, i, j</td>
<td>Students need more practice in programming fundamentals.</td>
</tr>
<tr>
<td>CS 210</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 253</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 254</td>
<td>Spring 2007, Spring 2009, *Spring 2011</td>
<td>a, b, c, i, j</td>
<td>The learning outcomes of the course are being achieved, although students need improvement on material covered in the last weeks of the course.</td>
</tr>
<tr>
<td>CS 354</td>
<td>Fall 2009, *Fall 2010</td>
<td>a, b, c, i, j</td>
<td>The learning outcomes of this class are being achieved.</td>
</tr>
<tr>
<td>CS 355</td>
<td>*Fall 2009</td>
<td>a, b, c, i, j, k</td>
<td>Student understanding of Unix I/O and file system needs attention.</td>
</tr>
<tr>
<td>CS 385</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 410</td>
<td>*Spring 2010</td>
<td>a, b, c, d, f, g, h, i, j</td>
<td>Some students have trouble with software design and with teamwork.</td>
</tr>
<tr>
<td>Course</td>
<td>Term</td>
<td>Grade(s)</td>
<td>Comments</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CS 423</td>
<td>Fall 2007</td>
<td>a, b, c, i, j</td>
<td>The course is meeting its objectives. Nothing needs to be changed in the design and presentation of the course.</td>
</tr>
<tr>
<td>CS 460</td>
<td>Spring 2006</td>
<td>a, b, c, d, f</td>
<td>The learning outcomes of the course are being achieved.</td>
</tr>
<tr>
<td>CS 462</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 463</td>
<td>Spring 2006</td>
<td>a, b, c, j</td>
<td>Most of the learning outcomes of the course are being achieved.</td>
</tr>
<tr>
<td>CS 464</td>
<td>Spring 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 465</td>
<td>Spring 2011</td>
<td></td>
<td>(Course has not run in past 5 years.)</td>
</tr>
<tr>
<td>CS 481</td>
<td>Spring 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 490</td>
<td>*Fall 2009</td>
<td>a, b, c, d, e, i, j, k</td>
<td>Some students have inadequate understanding of the layers of network architecture.</td>
</tr>
<tr>
<td>CS 492</td>
<td>Fall 2009</td>
<td>a, b, f, g, h</td>
<td>Most students perform at acceptable levels or above in the course objectives and skills.</td>
</tr>
<tr>
<td>CS 495</td>
<td>Fall 2010</td>
<td>d, e, f, g</td>
<td>Most students perform at acceptable levels or above in the course objectives and skills.</td>
</tr>
</tbody>
</table>

**Alumni Survey.** In the most recent survey (Spring 2007) responses came primarily from recent graduates working in large corporations and small software development companies involving insurance, computer imaging, aerospace, medical, and financial applications. Echoing the previous surveys, respondents mentioned the need for courses in database, security, and web programming. A new theme was the frustration of students when upper level courses were cancelled due to low enrollments.

**Industrial Advisory Board.** The Computer Science Department has created an advisory board comprising representatives from local industry, other educational institutions, and alumni. The Advisory Board is composed of a cross-section of experts from the local industry and academia served by the department. The purpose of the Advisory Board is to assess the educational program of the Computer Science Department, to bring in fresh ideas from outside, and to make recommendations to the department. The latest meeting of the Board was April 24, 2009. The Board discussed the objectives and outcomes of the department. The minutes of the meeting are available on the department’s S: drive.

**Passing Rates.** Passing rates for some courses has been gathered for Spring 2008 through Spring 2011. See the appendix.
Section 3. Analysis

Students (and the public) expect a computer science program to support our outcomes (a) through (c) and (i), the goals that relate to the technical abilities of graduates. The data show that this is being accomplished. The Major Field Test data show that our students graduate with basic competence in computer science and programming skills. This is also supported by the other assessment methods.

Our students do well in the first two indicators of the Major Field Test. Those indicators are for fundamental material covered in our introductory and intermediate courses. The test shows that our seniors are weak in Indicator 3: Architecture, Operating Systems, Networking, and Database. These topics are covered in junior/senior level courses (400 level). Of course, those courses build on the fundamental material and, in effect, review and reinforce that material. So it is not surprising that students do better in the fundamentals than in advanced topics. Also, when the test is given students are only partway through spring courses which cover these advanced topics.

Still, the gap in performance is a concern, and points to a need to do further assessment with courses that cover the material.

The “softer” outcomes are harder to measure and evaluate. Outcome (d) is that students will function effectively on teams. Our Industrial Advisory Board and interviews with employers and coop students have indicated that this outcome may need greater emphasis. A capstone course has been proposed for this purpose, but not yet implemented.

Outcome (e) relates to professional, ethical, and social responsibilities. Outcome (f) requires that students communicate effectively. Outcome (g) requires that students gain the ability to analyze the impact of computing on society. These three outcomes have been mostly supported by one course, PHIL 245, which is required of all Computer Science (Honors) students. Direct assessment of these outcomes has not been attempted other than in the coursework in that course.

Outcome (h) is that students realize their need to engage in continuing professional development. This has not been directly assessed.

The passing rates for courses (see appendix) show no major problems. The average passing rate for the introductory course, CS 151, is 70%. This is somewhat low, but is in line with the passing rate for the equivalent course in most other US computer science departments (approximately 50%). Our students do about as expected on the Advanced Placement Pre-test given at the end of CS 151, which demonstrates that the level of the course is appropriate for college work.

Section 4. Use of Results

The principal improvements over the past several years have been the introduction of new courses and offering some courses more frequently. However, these improvements have been frustrated by low enrollments that have forced the cancellation of some of these courses. Changes have been made in the prerequisite structure to ensure that students are adequately prepared. In response to ETS data and ABET standards, we have increased the emphasis on theory, analysis, and design.

How assessment results have been used in the previous year(s) to make curricular or programmatic adjustments:

a. We greatly increased the number of hours that tutors are available to computer science students and have kept a computer lab open for them to work specifically on assignments from our courses. This addresses several issues revealed by assessment reports and instructor impressions.
b. Students in CS 210 are poor writers and often misspell words. The same is shown in assessment of CS 495. Both courses now put more emphasis on writing skills.

c. Assessment of CS 210, CS 385, and CS 407 show that students often have difficulty expressing what they know orally. Oral presentations have been added to all these courses (our student outcome f).

d. Assessment of CS 151, CS 153 and CS 253 shows that students often have difficulty in understanding code that has been presented to them. They are not skilled in stepping through code to figure out what it is doing. More emphasis on this has been added to these courses.

e. Students in CS 152 have trouble with polymorphism and inheritance. Another lecture on each subject has been added. A text on recursion will be revised and will be required for the course.

f. The (possible) decline in scores in programming methodology in the ETS and in the comprehensive ANSI C examination in CS 153 prompted more on-line material to support instruction in this area and more attention paid to making interesting programming assignments.

g. A weakness in CS 495 is in building logical arguments. The course has been updated to include weekly assignments in correctly constructing logical arguments.

h. The decline in ETS scores is also addressed in the meetings of the Computer Club. These now include a weekly programming challenge, which adds interest and social motivation to programming. A feeling of belonging to a department and major is an important factor in student retention and satisfaction in computer science.

i. Assessment results for CS 495 showed that while students understood the theoretical aspects of computer ethics they had difficulty applying them in practice. To address this weakness, the CS 495 syllabus was revised to further stress application of the theoretical concepts. Revisions included adding weekly assignments that require applying the concepts covered to current real scenarios.

j. Some sections of CS 113 were taught using Alice, a programming language specifically aimed at beginning programmers. This was in response to the fairly large number of students whose performance was “below acceptable” in programming in the CS 113 assessment.

k. The curriculum for the Computer Science (Honors) degree was revised in September of 2010. Essentially, the degree requirements were simplified and some courses were eliminated.

Assessment data show that only small changes were needed. Computational theory is a continuing problem (our student outcome j) but already is covered in the curriculum. The department considered changing the curriculum to force students to take the relevant courses, but we decided that such a drastic change was not justified by the data.

l. The department curriculum committee reviewed the recommended curricula of the Association for Computing Machinery and the IEEE Computer Society and found that nearly all recommended curricular areas are covered by our courses. The ETS Major Field Test shows that our students graduate with a broad understanding in core computer science.
There is, however, weak coverage in computational theory, embedded programming, and web programming. The department conducted a search for a tenure track professor during this school year and made web programming one of the required qualifications of candidates. We successfully hired Chad Williams, who has a background in this area.

m. The low passing rate for CS 151 seems to be partly due to students who expect it to be an easy general education course and (unwisely) take it to avoid mathematics. To address this, we changed the prerequisite for CS 151 from MATH 119 (pre-calculus) to MATH 152 (calculus I). This ensures that students have the appropriate level of preparation for the course and meshes well with the math prerequisites of higher courses. The assessment data for CS 151 show that this has partially ameliorated this problem.

n. Various assessment results point to the need for increased emphasis on database. Our database course (CS 460) has been modernized and is offered frequently.

o. We installed the program LANschool to increase interaction and student interest in classrooms that have computers. Mostly this helps in general education classes, CS 113 and CS 110.

Section 5. General Education

Six of our courses are used to fulfill Skill Area II of General Education: CS 110, CS 113, CS 151, CS 207, CS 213, and CS 214. Of these, only CS 151 counts toward a degree in Computer Science.

Learning Outcomes: The relevant objectives and outcomes of General Education that apply to Skill Area II (approved by the General Education Subcommittee and approved at the December 3, 2008) are:

QS: To strengthen quantitative skills
   QS1. Apply mathematical and statistical techniques as a means of analysis within a variety of disciplines
   QS2. Assess the strengths and weaknesses of these techniques of analysis.

IFC. To develop information fluency and computer literacy. Relevant outcomes include the ability to:
   IFC1. Locate, evaluate, and effectively use information from a variety of sources;
   IFC2. Use computers for research, analysis, and expression;
   IFC3. Analyze the effects of information technology on society.

Findings:
The following chart shows general education courses and their assessment status. Assessment reports for these courses are available separately on the computer science department’s S: drive and some are excerpted in the appendix.
<table>
<thead>
<tr>
<th>Course</th>
<th>Assessment Reports</th>
<th>Supported Outcomes</th>
<th>Major Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 110</td>
<td>Fall 2009*</td>
<td>QS 1, IFC 1, IFC 2</td>
<td>Of 86 students, 70 (81%) performed at or above acceptable levels.</td>
</tr>
<tr>
<td>CS 113</td>
<td>Fall 2009, Spring 2010, Fall 2010, Fall 2011*</td>
<td>QS 1, IFC 1, IFC 2</td>
<td>Of 104 students, 91 (87%) performed at or above acceptable levels.</td>
</tr>
<tr>
<td>CS 115</td>
<td>----</td>
<td>IFC 1, IFC 2, IFC 3</td>
<td></td>
</tr>
<tr>
<td>CS 151</td>
<td>Spring 2007, Spring 2009, Spring 2011*</td>
<td>QS 1, QS 2, ABET a, b, c, i, j, k</td>
<td>Considerably improved passing rate suggests that implemented curriculum changes worked as intended. Upon successful completion of CS 151 students are well prepared to take the second course in the sequence, CS 152, and other courses listing CS 151 as a prerequisite.</td>
</tr>
<tr>
<td>CS 207</td>
<td>Spring 2010*</td>
<td>QS 1, IFC 2</td>
<td>Of 45 students, 37 (82%) performed at or above acceptable levels.</td>
</tr>
<tr>
<td>CS 213</td>
<td>----</td>
<td>QS 1, QS 2, IFC 1, IFC 2</td>
<td></td>
</tr>
<tr>
<td>CS 214</td>
<td>----</td>
<td>QS 1, QS 2, IFC 1, IFC 2</td>
<td>Course has run only once (but has been offered five times).</td>
</tr>
</tbody>
</table>

* Summary of latest report is included in appendix
Analysis:

The general education courses seem to be mostly working, but a fair number of students fall below the acceptable level (see Assessment of CS 110 in the appendix, for example). Although assessment does not show this directly, the impression of instructors is that students are poorly motivated. Students who take general education computer science often “hate math”, which means they hate goals QS 1 and QS2.

Use of Results:

The department has addressed the problem of poor student interest and motivation by adding LAN School to some classrooms, by providing tutors specific to our courses, and experimenting with Alice.

LAN School. To increase interaction and (hopefully) student interest, the Computer Science Dept. bought and installed LAN School, a software product which supports interactive quizzes (software “clickers”). This product is now provided by the university in selected classrooms. It also enables instructors to look at each student’s computer screen from the instructor’s workstation. This makes answering student questions easier, and cuts down on distractions (students not using the computer for classwork.)

CS Tutors. The CS department has worked to keep open a computer lab (MS 313) during the day so that they can do work and get help that is specific to their courses. There are three CS undergraduate students working as tutors specifically for these classes. In some years the department has a graduate assistant who also works on this. This policy was started in 2010. (We occasionally had tutors in previous years, but the program was considerably expanded in that year.)

Alice. The software environment Alice is purpose built to provide an interesting interactive programming environment for beginning students. It is commonly used in grade schools and high schools. One of our full-time instructors went to a workshop on how to teach with Alice and used it in four sections of CS 113. Unfortunately, we don’t have any direct measure that the experiment was successful, but anecdotal evidence is that it worked. We may do more with this.

Assessment Plan:

Although data has been gathered, no new report and analysis has been done for CS 113. We hope to gather more data and to update the assessment report.

Section 6. Assessment Plan

1. Plans to use the results to make curricular or programmatic adjustments:
   a. The data show that the two degree programs are mostly on track. We will watch this, but there is no pressing need for immediate changes.
   b. We need to find a place in the curriculum for more learning involving outcome (h), continuing professional development.
   c. The low passing rate of students in some core courses is a problem. This has been partially addressed (see section 4) but requires continued study. The department’s passing rate is considerably better than the national average for these courses.
   d. The department’s curriculum committee will consider making adjustments to the curriculum for the Computer Science Alternate degree.
e. The problems in CS 113 may be because most of the programs for the course involve at least rudimentary math, but there is no prerequisite for the course. We intend to consider this issue and possibly add a prerequisite of MATH 101.

2. Plans to adjust, expand, or redirect assessment activities over the coming year.
   a. The Major Field Test will be given in the spring, as in past years. A new version of the test is expected, which might make it difficult to compare results with past years.
   b. This year, all sections of CS 113 will administer a common final with questions specifically addressing assessment. Trend data will be collected. Learning outcomes for CS 213 and CS 214 will be developed.
   c. We need more assessment of outcome (h) continuing professional development. This will be added to whatever course increases its coverage of this topic.
   d. Classroom observation of all classes will resume in fall 2012. Although this in itself is not assessment, it is likely to reveal places where changes can be made to improve student outcomes.
   e. A database of CS department graduates and their job placements has been developed. Work on this will continue and it will be used for an alumni survey.