

# COTS Assessment of Assessment

## September 2007

Department: *Computer Science*

Chair: *Jim Schwing*

Program review year - previous: *2004-2005*

Program review year - next: *2009-2010*

List of department degree programs:

*Bachelor of Science, Computer Science*

Affiliated interdisciplinary programs:

*Bachelor of Science, Computer Engineering Technology*

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## I. Overview of Assessment in Computer Science

### Ia. Programmatic Outcomes

- A. Graduates will have a reasonable level of understanding of each of the subject areas that define the discipline as well as the interrelationships that exist among them: algorithms, architecture, artificial intelligence and robotics, data structures, database and information retrieval, human-computer interaction, operating systems, programming languages, and software engineering.
- B. Graduates will have the ability to utilize appropriate theoretical constructs: definitions, and axioms, theorems, proofs, and interpretation of results.
- C. Graduates will have the ability to utilize appropriate abstractive constructs: hypothesis formation, data collection, modeling and prediction, experimental design, and analysis of results.
- D. Graduates will have the ability to utilize appropriate design constructs: requirements analysis and specification, design, implementation, and testing.
- E. Graduates will be exposed to ethical and societal issues associated with the computing field.
- F. Graduates will be familiar with recent technological and theoretical developments, general professional standards, and have an awareness of their own strengths and limitations as well as those of the discipline itself.
- G. Graduates will be aware of the history of computing, including those major developments and trends - economic, scientific, legal, political, and cultural - that have combined to shape the discipline.
- H. Graduates will be able to appreciate the intellectual depth and abstract issues that will continue to challenge researchers in the future. They should have a strong foundation on which to base lifelong learning and development.
- I. Graduates will have the necessary background for entry into graduate study.
- J. Graduates will have the ability to communicate effectively.

### Ib. Correlating program objectives with specific courses

#### 1. Entering the program.

The department requires that pre-majors complete a collection of six courses with a 2.50 GPA. Specifically, the six courses are: Eng 101 & 102 – English I & II, Math 172 – Calculus I, CS 110 & 111 – Programming Fundamentals I & II, and CS 301 – Data Structures. The purpose is to ensure that students will have the necessary language, mathematics, and problem solving skills to successfully complete the computer science program.

#### 2. Correlating courses with objectives

1. All students participate in the core curriculum. In addition to the CS 110, 111, 301 and Math 172 that are part of the entry requirements, the core curriculum consists of the following courses: CS 112 – Foundations of Computer Science, CS 302 – Advanced Data Structures, CS 311 – Computer Architecture I, CS 312 – Computer Architecture II, CS 325 –

Technical Writing in Computer Science, CS 361 – Principles of Language Design I, CS 362 Principles of Language Design II, CS 420 – Database Management Systems, CS 427 – Analysis of Algorithms, CS 446 – User Interface Design, Math 260 – Sets and Logic, CS 470 – Operating Systems, and Math 330 Discrete Mathematics. The core curriculum is used to help determine the following student outcomes:

- A. Graduates will have a reasonable level of understanding of each of the subject areas that define the discipline as well as the interrelationships that exist among them: algorithms, architecture, artificial intelligence and robotics, data structures, database and information retrieval, human-computer interaction, operating systems, programming languages, and software engineering.
  - B. Graduates will have the ability to utilize appropriate theoretical constructs: definitions, and axioms, theorems, proofs, and interpretation of results.
  - C. Graduates will have the ability to utilize appropriate abstractive constructs: hypothesis formation, data collection, modeling and prediction, experimental design, and analysis of results.
  - F. Graduates will be familiar with recent technological and theoretical developments, general professional standards, and have an awareness of their own strengths and limitations as well as those of the discipline itself.
  - G. Graduates will be aware of the history of computing, including those major developments and trends - economic, scientific, legal, political, and cultural - that have combined to shape the discipline.
  - H. Graduates will be able to appreciate the intellectual depth and abstract issues that will continue to challenge researchers in the future. They should have a strong foundation on which to base lifelong learning and development.
  - J. Graduates will have the ability to communicate effectively.
2. All seniors participate in a two-term capstone sequence of courses, CS 480 and 481. The senior capstone courses are used to help determine the following student outcomes:
- B. Graduates will have the ability to utilize appropriate theoretical constructs: definitions, and axioms, theorems, proofs, and interpretation of results.
  - C. Graduates will have the ability to utilize appropriate abstractive constructs: hypothesis formation, data collection, modeling and prediction, experimental design, and analysis of results.
  - D. Graduates will have the ability to utilize appropriate design constructs: requirements analysis and specification, design, implementation, and testing.
  - H. Graduates will be able to appreciate the intellectual depth and abstract issues that will continue to challenge researchers in the future. They should have a strong foundation on which to base lifelong learning and development.
  - I. Graduates will have the necessary background for entry into graduate study.
  - J. Graduates will have the ability to communicate effectively.

In these courses, students as part of teams develop a piece of software for an external client. Students are responsible for all aspects of the project from the initial requirements writing to the final acceptance test. All faculty are involved in the evaluation of these projects.

3. All seniors participate in a senior colloquium, CS 489. The senior seminar is used to help determine the following student outcomes:
  - E. Graduates will be exposed to ethical and societal issues associated with the computing field.
  - J. Graduates will have the ability to communicate effectively.

Students in this class go through an in-depth study of professional codes of ethics, ethical systems and reasoning and case studies. They also are responsible for preparing a major research paper and making an oral presentation on it. Faculty alternate supervising the seminar.

4. Once a decade, computer professionals from business, industry, and education get together and analyze the needs and trends in computer education. The most recent curriculum review was published with the title Curriculum 2001. The department commenced a total curriculum review in 2000 based on advanced releases of the document. The review was completed with just after Curriculum 2001 was issued and the new curriculum was published for students beginning in the 2002 academic year. The core courses listed in the first bullet in this section cover much of the CS Body of Knowledge defined by Curriculum 2001. The table below represents an analysis of Computer Science Department relative to the Computer Science Body of Knowledge found in Curriculum 2001.

## Ic. Assessment plan

The department specifically considers the results of the following in measuring and assessing the student learning outcomes, reviewing the curriculum and making alterations.

1. All seniors participate in the Major Field Test published by ETS. In addition to an overall score, the test provides scores on three (formerly four) major indicators in undergraduate computer science education.
2. All seniors participate in a two-term capstone sequence of courses. Results of this sequence course form part of the consideration of our assessment of student learning outcomes.
3. All seniors participate in a senior colloquium. Results of this course form part of the consideration of our assessment of student learning outcomes.
4. All seniors participate in exit interviews. Feedback from these interviews form part of the consideration of our assessment of student learning outcomes.
5. The department interviews recent graduates. Results of these interviews form part of the consideration of our assessment of student learning outcomes.
6. Many students participate in undergraduate research, independent studies, cooperative education and internships. The faculty considers the effectiveness of these projects and activities in furthering the goals of the students.

7. All students participate in the core curriculum. Review of these courses and student performance help measure the breath of the program.
8. The faculty conducts an annual peer review of instruction. The primary purpose of this review is two-fold. In addition to reviewing faculty performance, it allows the faculty to take an in-depth look at courses.

As noted above, the department also reviews the program curriculum with respect to the recommendations of current experts in the field of computer science education, the most recent being Curriculum 2001. The annual peer review noted in the last point above ensures that the department will thoroughly review the curriculum every three years.

Participation of all seniors is assured as all measures are tied to specific course requirements (this includes participation in the MFT and exit interviews that are part of the course requirements in the senior colloquium).

## II. Review of June 2006 Assessment Recommendations

In June 2006 during the department's annual curriculum review four curricular recommendations were made. Those recommendations and an analysis of what happened based on those recommendations follow.

1. Senior project courses – CS 480 and 481 – a redesign will be undertaken to increase the breadth of available projects, to provide increased emphasis on the testing component, and to include a different collection of documents for the research oriented projects.

Actions: Dr. Gellenbeck began a redesign of the course last year which included the extreme programming model in addition to the standard waterfall model and also included more emphasis on testing. In addition, the course continued to allow two basic types of projects are attempted by student teams, basic applications and research investigations. This year a separate set of documents were designed for student teams participating in research investigation projects. In addition since Dr. Gellenbeck offered students two alternate development models for student teams to use in their projects (the standard waterfall model and extreme programming), a third set of documents tailored to the work produced by students using the extreme programming model was developed.

Analysis: Last year project teams participated in all three models mentioned above: standard waterfall, extreme programming, and research investigation. Student project teams make three formal presentations and prepare four to five documents describing their progress. Faculty viewed and discussed project artifacts from all teams. The following conclusions were reached.

- The testing component showed some improvement. Efforts need to be continued here.
- The new document sets provided a better, more typical vehicle for students participating in the different project models.

2. A networking focus area will be developed for our students by combining CS theory courses with IT application courses.

Actions: Dr. Schwing and Dr. Rawlinson from ITAM have worked to identify appropriate courses in both departments to be taken by students working on a networking/security focus area. Drs. Schwing and Eastman incorporated this information into their quarterly advising.

Analysis: Several students have chosen this new focus area. They have reported positive responses to this track in advising sessions and are making good progress toward graduation.

3. A new course will be developed in network security to complement courses offered in IT and provide expanded resources and opportunities to our students.

Actions: Drs. Schwing and Eastman worked with Drs. Braunstein and Rawlinson in ITAM to identify proper course content for security courses to be taught by CS and IT. Using these discussions, Dr. Eastman then implemented a computer security course for the department.

Analysis: Given the short time frame within which the course was introduced there was a small enrollment the first term. Nonetheless, the course was well received and will continue to be offered.

4. The faculty will investigate building a follow-on course to Math 260 and 330.

Action: An initial plan to have Drs. Andonie and Kovalerchuk design and co-teach such a course had to be abandoned when other teaching priorities arose.

Analysis: This continues to be a concern. The department will attempt to address this in the redesign of some of our earlier courses such as CS 112 discussed below.

### III. June 2007 Assessment Recommendations and Notes about Recommendation Decisions

Over the last year the department noted several concerns and several positives in assessing the program curriculum. I will begin by summarizing the changes and follow that with a quick list of the positives.

#### IIIa. Curricular Recommendations

1. Senior project courses – CS 480 and 481 – as noted in the June 2006 recommendations above, we will continue to emphasize testing as an important component of the courses.

2. Redesign CS 101 the computer literacy course to reflect the fact that the Office 2007 suite of applications will be installed on university systems this fall – a major change in the interface and capabilities of the Office programs.
3. Redesign CS 112, Foundations of Computer Science, with the major purpose of attracting more majors to the discipline while still covering the basic material. Further as noted in the analysis of June 2006 Recommendation 4 above, the department will attempt to address some of the mathematical shortcomings in this redesign. Further, if this course is successful in connecting with new majors, it is our intent to use this as the starting point for designing a new computer science track.
4. Pay particular attention to the material conveyed in CS 427, Analysis of Algorithms, the major computational theory course taught as part of the curriculum.

### IIIb. Notes about Recommendation Decisions

In what follows, I will describe what I feel is the major assessment factor from our assessment plan that was used in making our decision. Of course, few if any of these assessment results are affected by just one of the factors. In what follows each of the numbered sections corresponds to the numbers of the assessment plan found above in Section Ic.

1. All seniors participate in the Major Field Test published by ETS. In addition to an overall score, the test provides scores on three major indicators in undergraduate computer science education.

Currently, approximately 150 computer science departments across the country use this test as part of their assessment process. The faculty have reviewed the list of institutions participating in the computer science MFT and feel it provides a fair cross section of computer science programs, many from what are considered peer-institutions.

Table. Average MFT scores for students in the Central Computer Science Program along with the national percentile ranking of these averages.

	02-03		03-04		04-05		05-06		06-07	
	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
<b>Num. Stu.</b>	31		28		22		27		24	
<b>Overall</b>	152.2	71	151.6	71	145.3	45	153.1	75	148.2	54
<b>Programming</b>	53.4	71	54.2	63	51.1	48	60.0	82	55.0	65
<b>Comp. Org.</b>	33.0	77	38.2	91	31.3	71	40.2	92	39.9	92
<b>Theory</b>	43.6	63	43.7	63	37.4	33	44.3	63	33.3	23
<b>GPA – avg.</b>	3.39		3.18		3.19		3.66		3.25	

The annual review of the MFT results reveals somewhat of a downturn. This was particularly true in the Theory related area where students received the lowest results over the last five years. Prior to that, results were fairly consistent, so the results were somewhat surprising. The faculty did not

believe that this required any particular curricular revision. On the other hand, we did feel it was appropriate to pay special attention to the CS 427 course this year. This resulted in Recommendation 4 above.

2. All seniors participate in a two-term capstone sequence of courses. Results of this sequence course form part of the consideration of our assessment of student learning outcomes.

The basic analysis of this year's annual review of the capstone courses is detailed above in Section IIIa, number 1. The new document sets provided a better, more typical vehicle for students participating in the different project models. The first bullet in that analysis noted the testing component showed some improvement, but that efforts need to be continued here. This is reflected in Recommendation 1 above.

3. All seniors participate in a senior colloquium. Results of this course form part of the consideration of our assessment of student learning outcomes.

No change from June 2006. The annual review of the results of the senior colloquium demonstrates that students are demonstrating practical knowledge of ethics. Also, via this class and the senior project class, students are demonstrating adequate written and oral communications skills.

4. All seniors participate in exit interviews. Feedback from these interviews form part of the consideration of our assessment of student learning outcomes.

There were no major issues raised during the senior exit interviews this year.

5. The department interviews recent graduates. Results of these interviews form part of the consideration of our assessment of student learning outcomes.

We continue to hear that many of our grads will begin their careers as software testers and as such we have moved in the proper direction in adding emphasis to the senior project course sequence. This adds to our consideration of Recommendation 4.

6. Many students participate in undergraduate research, independent studies, cooperative education and internships. The faculty considers the effectiveness of these projects and activities in furthering the goals of the students.

The faculty was pleased to note the continuing strong participation in undergraduate research. There continue to be five active research groups with numerous presentations at SOURCE, and regional and national conferences. The department continues to provide funds for research equipment and travel to conferences. The review of this material lead to no new curricular recommendations.

7. All students participate in the core curriculum. Review of these courses and student performance help measure the breath of the program.

The faculty are still concerned with the mathematical preparation of the students. We noted that the Math department did not appear to be in a position to add a course to the 260, 330 sequence that we once talked about. As it appears that we will not have faculty resources to teach a separate course any time soon, we will look into the alternative of integrating some of this material earlier into the curriculum – perhaps with the redesign of CS 112, Foundations of Computer Science. This leads to the second half of Recommendation 3.

8. The faculty conducts an annual peer review of instruction. The primary purpose of this review is two-fold. In addition to reviewing faculty performance, it allows the faculty to take an in-depth look at courses.

During our annual review of instruction, two major issues arose.

First, Microsoft has released a new version of the Office Suite of programs that has a significantly new interface. This directly impacts the computer literacy course, CS 101. It was decided that Dr. Schwing would work with the CS 101 adjunct instructors to implement new material for this course. This leads directly to Recommendation 2.

Second, we discussed a national problem that is affecting the computer science program locally. Enrollments have not picked up since the “dot com” bust of several years ago. This is surprising given the fact that job opportunities have bounced back significantly. As this is a national problem some scattered attempts are being made to develop new computer science tracks that do not follow the standard mathematical development common for several decades. Some success has been noted along this line from large schools to small liberal arts colleges. The faculty decided that an appropriate starting point would be our CS 112, Foundations of Computer Science course. The intent is to make modifications in CS 112 next year and evaluate the results. Our intent would be, if this is successful, to grow this into a new track in the computer science degree program. This leads directly to the first half of Recommendation 3.