

**MEMORANDUM**

**To: Linda Beath**  
**Associate Vice President for Undergraduate Studies**

**Meghan Miller**  
**Dean, College of the Sciences**

**From: Jim Schwing** \_\_\_\_\_  
**Chair, Computer Science**

**Date: October 27, 2006**

**RE: Computer Science Program Review Follow-up**

**Please find attached a summary of activities conducted in the Computer Science Department related to the program review conducted in February 2005.**

# **Activities Responding to the Computer Science Program Review**

## **Overview**

In February 2005, the Computer Science Department participated in a program review, specifically the Bachelor of Science in Computer Science. The purpose of this report is to document the steps taken by the Department, the College of the Sciences and the University in response to the suggestions outlined in the reviewer's recommendations. In an effort to set a context for our continuing program development and assessment, the report will begin with discussing departmental activities that correspond to comments by the reviewer found in the middle of his evaluation in the section titled "Major Areas of Review." In particular, the report will focus on activities and results related to program and curriculum planning and assessment. Next the report will turn to the beginning section of the reviewer's evaluation and report on responses to the "Four Immediate Needs." Finally, the report will consider in turn each of the 13 "Other Department Needs and Suggestions" listed by the reviewer at the end of his evaluation.

## **Continuing Program Development and Assessment**

In this section, we begin with a listing of the programmatic outcomes and then note how outcomes are correlated with courses and other measures. We then present eight measures that the department uses in assessment, summarize how the curriculum has changed and finally detail how those changes were identified through each of the eight measures.

### **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.

## Correlating program objectives with specific courses and other measures

### 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.

### Courses and other measures

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. As a side note, the core courses listed in (1) above in this section cover much of the CS Body of Knowledge defined by Curriculum 2001. A table analyzing Computer Science core courses relative to the CS Body of Knowledge found in Curriculum 2001 appeared in our self-study and has not changed.

## 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 entire 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).

## Assessment results, notes about how curriculum has been modified

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

### Changes

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.
2. A networking focus area will be developed for our students by combining CS theory courses with IT application courses.
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.
4. The faculty will investigate building a follow on course to Math 260 and 330.

### Positives

1. The material of CS 470 was found directly applicable many work situations.
2. Increased lab space and equipment and travel funds have been used to good purpose by our undergraduate students.

## Notes about how curriculum has been modified

What follows is a description the major assessment factor in making our decision. Of course, few if any of these assessment results are affected by just one of the factors.

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.

	01-02		02-03		03-04		04-05		05-06	
	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
<b>Num. Stu.</b>	36		31		28		22		27	
<b>Overall</b>	143.5	39	152.2	71	151.6	71	145.3	45	153.1	75
<b>Programming</b>	43.6	25	53.4	71	54.2	63	51.1	48	60.0	82
<b>Comp. Org.</b>	26.9	37	33.0	77	38.2	91	31.3	71	40.2	92
<b>Theory</b>	35.0	28	43.6	63	43.7	63	37.4	33	44.3	63
<b>GPA – avg.</b>	3.22		3.39		3.18		3.19		3.66	

The annual review of the MFT results reveals reasonably consistent results with a general upward trend. The department did not initialize curriculum changes based upon these results.

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.

At this year's annual review of the capstone courses, two concerns were raised. First, the breadth of projects seemed to be narrowing, and second, there seemed to be a continuing problem designing technical documents to be produced by teams working on more research oriented projects. It was decided that Ed Gellenbeck would take on a redesign of the courses to address these concerns.

A third change will also be made in these courses that arose due to assessment number five below.

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

A 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.

Two strong recommendations arose during this year's exit interviews. First an interest in some of the more practical aspects of networking and a growing interest in security. As part of investigating expanded opportunities for our students, we noted a growing practical program in both networking and security in ITAM. Grant Eastman and Jim Schwing met with Dave Rawlinson from ITAM and talked about a sequence of courses that could meet both the theoretical and practical needs of students in both programs. This included the possibility of sharing lab space and the mechanics of making that happen. The upshot is that a specialty area was developed for our students and Grant will design a theoretical course in network security that would complement the practical IT courses.

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

Interviews with recent graduates this year lead to one major kudos and one recommendation for change. The Kudos was received for the material in our CS 470 Operating systems course along with its applicability in the job market.

The recommendation for change was relative to our senior project course. More and more of our graduates are being hires as software testers. It was pointed out that currently this tends to be a minor portion of the project. As mentioned above Ed Gellenbeck will make this a third point to consider in redesigning the course.

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 that the already strong participation in undergraduate research is on the rise. There were more active research groups and presentations at SOURCE, and regional and national conferences. The department has succeeded in building an additional research lab to support Ed Gellenbeck's new project and swapping research space to support distributed database activities and increase space for the Imaging Lab. The department will continue to provide funds for research equipment and travel to conferences.

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. Boris Kovalerchuk and Razvan Andonie have decided to take up the task of seeing if it is possible to design a course that takes up after the 330 course that might still provide tools in a timely fashion.

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.

Virtually, all the reviews described above were finalized during the annual review of instruction.

## **Reponses to "Four Immediate Needs"**

### *1. Air-conditioning in Hebel Hall*

In a meeting with Dean Miller of the College of the Sciences and Bill Vertrees, AVP for Facilities Planning, Bill indicated that he believed that funding for the air conditioning project would be approved by the legislature for this biennium. Since that funding would be available in July 2007 at the earliest, the estimate was that the air conditioning project could be completed by the summer of 2008.

### *2. Multimedia presentation equipment for labs and classrooms*

As of October 2006, all classrooms that Computer Science uses for instruction will have new multimedia presentation equipment installed since the program review. This includes HB 106, 112, 116, and 121.

At the same meeting mentioned in the prior point, Bill indicated that he would work with Doug Ryder and David Kaufman to bring multimedia presentation equipment into the instructional computing lab HB 203.

### 3. *Space*

#### a. *Faculty/Student Research Labs*

This fall the Department completed moving and revamping three student faculty research labs and one student project lab. The CWU Imaging lab was moved to a larger space in HB 208. This lab is used to support the research done by Dr. Kovalerchuk and his students. A new distributing computing research lab was developed in the space vacated by the Imaging Lab, HB 205. This lab is used to support the research done by Drs. Andonie and Schwing and their students. A research lab dedicated to Accessibility computing was built in HB 204A. This lab is used to support the research of Dr. Gellenbeck and his students. Computing equipment was upgraded for each of these labs. Finally, the Linux and Networking Lab in HB 207 had its equipment upgraded this summer. Dr. Eastman and his students conduct projects in this lab.

On an additional note, the Computer Science Department Systems Engineer, Fred Stanly has been able to flexibly respond to Senior Project needs. For example this year Fred will put together systems for three project teams that special server access. These teams will be housed in HB 204A, HB 205 and HB 214A.

#### b. *Students*

With the consolidation of Academic Services in Hertz Hall, the Writing Center moved out of the former Library space in Hebel. This space was then reassigned to Computer Science. With the help of Doug Ryder and Carmen Rahm, the department has built an excellent project and study area for Computer Science students. Approximately half the room is dedicated to space for computer workstations with the other half of the room holding work tables and whiteboards. This has proved to be a popular venue for students to work on projects and form study groups.

#### c. *Adjunct Office Space*

At this point the department has two adjunct faculty sharing one office. We do not agree with the reviewer that changing this room assignment is an immediate need.

### 4. *Master's Degree in CS*

The Department has just completed an NOI which is being reviewed for submission to the HECB.

## **Responses to “Other Department Needs and Suggestions”**

#### 1. *New faculty need more support for grant writing.*

The department has a policy of assigning a mentor to new faculty. One of many purposes for this mentor is to help the new faculty with grant writing. Consider the example of the most recent hire. Razvan Andonie was assigned Boris Kovalerchuk as a mentor. Among other things, Boris has been outstandingly successful in securing external funding. In addition,

Drs. Andonie and Kovalerchuk work in related fields. This has proved to be a compatible assignment. Though no grants have been awarded to this point, Dr. Andonie has submitted several strong proposals.

2. *Lab equipment replacement planning.*

The Department has been successful working with ITS on computing labs. Through funding from the Department and ITS, new equipment has been placed into instructional labs HB 203, 209 and 218 and upgraded equipment has been brought into HB 204C.

It is important to note here that ITS has been successful in designing and implementing a policy to assure that all computing lab equipment rolls over in a less than four year timeframe. Further, ITS has been an advocate for adding and improving other IT infrastructure such as the installation of wireless on campus.

3. *Adjuncts need one-year contracts.*

This policy is no longer under the sole control of the Department and the University. With the advent of a faculty union and a collective bargaining agreement since the program review, such policies are now negotiated between the administration and the union. At this point, CS adjuncts are still on a term by term contract.

4. *PC upgrade for the Computer Science Department secretary.*

The computing equipment for the Computer Science secretary has been upgraded.

5. *Plan for release-time that corresponding to overloads generated by capstone and independent study courses.*

This policy is no longer under the sole control of the Department and the University. With the advent of a faculty union and a collective bargaining agreement since the program review, such policies are now negotiated between the administration and the union. The department chair now works with faculty members to plan an annual workload assignment that meets the instructional needs of the department including capstone and independent study while accounting for all other aspects of faculty members' professional activities.

6. *Use junior and senior female CS majors as role models to promote retention of women in CS*

Due to this recommendation, the chair has been asking senior female computer science majors to mentor newly declared female majors.

7. *A major facelift for rooms and furniture in Hebel Hall*

While not a major facelift, Bill Vertrees has indicated that he will look to replace carpeting in the Computer Science offices this year.

8. *Problems with scheduling CS courses (conflicts)*

The chair as schedule designer is cognoscente of this problem. Every effort is made to avoid such conflicts. On the other hand, given the number of courses that need to be scheduled and the number of periods available for scheduling, it is impossible to avoid all conflicts. When such conflicts do arise, the chair works with any students affected to revamp their graduation plan to avoid lengthening time to graduation. During the tenure of the current chair (eight years) no student graduations have been extended by such a conflict.

9. *Problems with scheduling Math courses (conflicts)*

The chair consults with the Mathematics department prior to the generation of each term's schedule. Every effort is made to avoid scheduling conflicts. Nonetheless, such conflicts cannot be totally avoided. The comments of the previous answer relative to working with student graduation plans apply here as well.

10. *Students are unaware of available resources*

The reviewers note relative to adding information on the Department's Academic Alliance Agreement with Microsoft has been added to the department web page. Also, the chair holds a welcome for all Computer Science students in September each year. The Academic Alliance, Scholarship and other similar programs are described there.

11. *Brookline and university housing have poor internet service*

It is our understanding that Housing continues to improve IT facilities for students.

12. *Inform students how SEOIs are used*

As noted in point ten above, the chair holds a welcome for all Computer Science students in September each year. The importance and use of the SEOI is described there. Though quite a bit later, the students are reminded of the use of SEOIs in the Department at their exit interviews.

13. *Students would like to see stronger ties to industry*

Last year the department, through meetings of the student chapter of the ACM, brought in several industry representatives to describe job and internship opportunities. This program is continuing this year.