To:                Christopher Markwood, Provost/Vice Chancellor/Dean of Faculty
                   Martha Einerson, Chair of the Faculty

From:              Program Review and Planning Council
                   Chair, Deb Nordgren

Cc:                Chad Scott, Chair, Mathematics and Computer Science Department
                   Pamela Bustos, PRPC
           George Wright, PRPC
           Mary Pulford, PRPC
           Maureen Salzer, PRPC
           Laura Jacobs, University Archivist

Date:              May 9, 2007

Re:                Report on the Review of the Computer Science Program

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## Introduction

In spring of 2007, the members of the PRPC began their examination of the self-study submitted by the faculty of the Computer Science program. Members of the Council, which is chaired by Deb Nordgren, volunteered to write a review of particular sections of the materials.

Review sections were written by the following members of the Council:

- George Wright reviewed Question One, on purposes of the program and Question Two, on the means it employs to accomplish its goals;
- Maureen Salzer reviewed Question Three, on goal achievement by the program;
- Mary Pulford reviewed Question Four, on the program's ability to continue to accomplish its goals, and
- Deb Nordgren reviewed Question Five, on the program's plans for the next five years, and Question Six, on how the program will continue to improve in quality.
- The editor for the review was Pamela Bustos.

The Council met with  Serguei Bezroukov, Victor Piotrowski and Chad Scott on February 28, 2007.

The review was approved by the PRPC on May 9, 2007.

## 1.  What are the program's purposes?
## 1.1:  the nature of the program and its mission

The Computer Science program at the University of Wisconsin-Superior has among its goals the delivery and continuing development of a curriculum based on national standards. It aims at providing a rigorous, liberal-arts under-graduate degree with a strong emphasis on theoretical computer science, mathematics and software design. Its graduates can expect grounding in the funda-men-tals of the discipline, sufficient flexibility within the program to allow for research in related fields as well as opportunities for graduate study. The formation of values and attitudes conducive to success in later life is also a matter of concern within the program, whose faculty members model behaviors aimed at inculcating in their students a respect for lifelong learning. Individual attention is a hallmark of the program. Each student is required to complete a capstone project as evidence of his or her mastery of the skills and understandings necessary for success in the area of computer science. Development of non-technical skills, such as ability at interpersonal communica-tion, team and management skills, is also a program priority. Non-tradi-tional learning experiences are a hallmark of the program's pedagogical approach, as is student participation in such interactive learning experiences as competitions, workshops and conferences. The faculty encourages students to participate in relevant professional organizations.

## 1.2:  relation to the university mission and its use within the program

The mission of the Computer Science program supports and complements the mission of UW-Superior. In fostering intellectual growth and career preparation within a liberal-arts tradition, the program connects fundamental theories of Mathematics and Computer Science to real-world experiences in our informa-tion-age economy. Its emphasis on critical thinking, analysis and problem-solving combines with instruction on the social embeddedness of computers as well as on important privacy and civil liberties issues. The faculty is dedicated to maintaining high academic standards through individual attention, personal interaction and small class size.

The program maintains a very intensive collaboration with the Lac Courte Oreilles Ojibwa Community College in Hayward, Wisconsin. Dr. Victor Piotrowski was Co-principal Investigator on a $640,000., grant from the NSF, Advanced Technological Education, entitled, "A Tribal College, State University and Industrial Partnership for Building an Information Technology Workforce in Rural America."

Dr. Piotrowski was Principal Investigator on a $387,000., grant from the NSF, Federal Cyber Service, entitled, "Collaborative Research: Wiscon-sin Col-laborat-ing Campuses on Cyber Security." The community college was also one of the partners in the grant program.

## 1.3  responses to state and societal needs

The Web and Internet have obliterated traditional disadvantages associated with life in a geographically remote area such as the Northland. The impetus for growth and economic development that results from the new technologies should not be lost, and it is one of the overriding objectives of the program to fight any evidence of a digital divide that would adversely impact this new opportunity. The program focuses on local students in an effort to insure that they can compete in the global, digital economy. Graduates of the program find positions in local and national businesses and in such federal agencies as the National Security Agency. They make contributions to both the local and global economies and serve as a first line of computer defense under the Cyber Security Corps program.

## 1.4  history and context of the program

The university has had a curriculum in Computer Science since 1975; at that time, it offered a minor in the field. In 1981, a Mathematics Major with a Com-puter Science option was offered. In the period 1996-98, the late Prof. John Davis and Dr. Piotrowski developed a proposal for a major in the field. The Academic Affairs Council and the Faculty Senate approved the proposal in 1998, and it was sent to the UW System in 2000, when it was approved at the UW Board of Regents meeting of May, 2005.

## 1.5 additional information

In August of 2006, the Computer Information major was discontinued, and two CIS faculty members were reassigned to the Department of Mathematics and Computer Science. These faculty members are currently offering courses for the old CIS majors. The Computer Science program has taken steps to develop a plan on how to assimilate CIS and/or introduce additional concentrations within Computer Science.

## 2. By what means does the program accomplish its goals?

## 2.1 description of the curriculum

The Computer Science program takes inspiration for its curriculum from the vision of the Joint Task Force for Computing designed by the Association for Computing Machinery (ACM), the Association for Information Systems (AIS) and the Institute of Electrical and Electronics Engineers Computer Society (IEEE-CS). The principles which derive from these sources include:

1) the necessity of a thorough grounding in the unchanging foundations of the discipline, either through training in formal theory rooted in Mathematics or in the professional values of the field;

2) a foundation in the skills and concepts of computer programming, which consists of five layers:

an understanding of the central role of algorithms and data structures;

an understanding of computer hardware;

programming skills which permit the implementation of algorithms and data structures in programming;

design skills required to implement larger structural units that utilize algorithms and data structures;

software engineering principles and technologies that insure that software implementations are robust, reliable and appropriate for their intended audience.

3) understanding of the possibilities and limitations of computer technology, including software, hardware and networking;

4)  understanding of the concept of the lifecycle and its management;

5)  study of advanced computing topics which students to visit and understand the frontiers of the discipline;

6)  identification and acquisition of skill sets that transcend technical skills, including interpersonal skills, team skills and management skills;

7)  exposure to applications and case studies that connect theory and skills learned in the university to real-world situations;

8)  attention to professional, legal and ethical issues that allows students to acquire, develop and demonstrate attitudes appropriate to the profession's ethical stature and status, and

9)  demonstration that each student has acquired the various elements of the undergraduate experience through the production of a capstone experience.

The program currently offers a minor in Computer Science (22 credits), a minor in Computer Science in secondary education (22 credits), a liberal-arts major in Computer Science (36 credits), and a comprehensive major in Computer Science (57 credits).

All minors and majors in Computer Science are required to take the following four core courses:

CSCI 201  Introduction to Programming
CSCI 202  Object-oriented Programming
CSCI 303  Algorithms and Data Structures
CSCI 324  Assembly Language Programming

These courses are offered once a year with some exceptions, for example, CSCI 201, which is offered every semester.  Most upper division courses are offered only once in two years.

## 2.2  curriculum design, planning and evaluation

Program faculty are attentive to the guidelines of professional organizations.  The current curriculum complies with the ACM guidelines of 2001 and will be brought into com-pli-ance with the group's 2007 recommendations, soon to be issued.  Though the pace of change in the discipline is quite high, the key to success is maintaining a sense of balance between more immediately applicable and marketable skills and a comprehensive know-ledge base that will serve as the basis of lifelong learning.

The ACM Task Force defines the competence of the computer scientist as encompassing three abilities:

they design and implement software;

they devise new ways to use computers, and

they develop effective ways of solving computing problems.

## 2.3  links with other curricula

A number of CSCI courses satisfy general education requirements, including CSCI 101, CSCI 170, CSCI 201, CSCI 202 and several others.  The most popular are CSCI 101 and CSCI 201.  CSCI provide introductory computing courses for their own majors, for pre-engineering majors and Mathematics majors.  The Library Science program requires CSCI 101.  The Teachers Education program requires CSCI 170.

## 2.4  human resources

### 2.4.1  faculty and staff qualifications

The Mathematics and Computer Science programs share faculty under the assumption that CS courses are no less rigorous than Mathematics courses.  Many courses are cross-listed between the programs.  Professors Bezrukov and Piotrowski coordinate, advise and teach in the Computer Science program.  Dr. Steven Rosenberg teaches some additional advanced courses.  Some introductory courses are at times taught by ad hoc faculty.  All full-time faculty have the PhD degree in various fields related to Computer Science.

### 2.4.2  role expectations

The program sets out clear criteria for its tenure-track and tenured faculty, including the use of faculty evaluations as markers of teaching and advising effectiveness (50-70%); scholarly activities (10-40%), and professional and public services (15%).  The relative weights given to these different aspects of profes-sional activity, change over an academic's career.  Teaching predominates through-out, with scholarly activities second and service third.

### 2.4.3  professional development opportunities

The program faculty complains of inadequate Supplies and Expenses [S&E] funding.  Some opportunities for professional development have been funded by extramural funding brought in

by program faculty members.

### 2.4.4  recruitment, development and retention of junior faculty

The inability to offer competitive salaries to in-coming faculty has caused considerable difficulty since the death of Prof. John Davis in academic year 2001-02.  A candidate chosen from the bottom of the list proved incompetent, and he was not retained.

### 2.4.5  faculty and staff evaluation procedures

All instructors are evaluated in every class each semester.

### 2.4.6  recruitment and retention of women and minorities

Special emphasis is placed upon the recruitment of women and minorities.  Measures include sending position announcements directly to the "Minorities Bank" provided by Human Resources.

### 2.5  financial resources

### 2.5.1  internal funding

Internal funding for the Department of Mathematics and Computer Science included:

| | |
|---|---|
| unclassified salaries | 388,605.00 |
| program assistant | 12,191.00 |
| support services | 5,697.00 |

The S&E budget was $5,697, supplemented by $5000., due to the transfer of the two CIS faculty members.

### 2.5.2  external funding

Dr. Victor Piotrowski has received NSF funding continuously over the last six years.  The faculty signaled a discrepancy between other programs' liability to indirect costs and its own.

### 2.6  physical resources

Location of the Computer Science program in Sundquist Hall makes its proper operation very difficult, given the building's inadequate power supply, leaking roof, lack of space, excessive building heat during the summer months, etc.

PRPC recommends that all departments that endure the conditions of Sundquist receive some facilities improvments that would acknowledge the substandard working condition in Sundquist in comparison with other campus buildings such as Holden Fine Arts, Erlanson, Old Main and Barstow. While the proposed academic building is often mentioned as a potential cure for this inequity in working environments, its appearance on campus and the beginning of its use are far in the future and thus irrelevant to the current situation. The administration should discontinue using the "new" building as an excuse for maintaining substandard working conditions for faculty and staff housed in Sundquist.

## Question 3: Is the program accomplishing its goals?

3. Is the program accomplishing its goals?

As the self-study indicates, the Computer Science program has a steadily if slowly growing number of majors. Its number of graduates is also strong in comparison with number of majors. As opportunities within the field continue to grow, the program can expect to remain in demand. It is especially noteworthy that UWS's Computer Science program graduated nearly as many students in 2004-05 as the much larger UW La Crosse and UW Green Bay while keeping pace with both UW Parkside and UW Oshkosh.

The program itself is carefully and artfully designed, considering the large array of courses and the small number of faculty. The self-study points out that advisement beginning in the freshman year is crucial to timely graduation; the faculty take great care to plan students' coursework to insure that requirements are met, and they should be commended for their commitment to advisement.

The Computer Science curriculum is dynamic, rigorous, and varied. The faculty should be commended on their efforts to maintain a state-of-the-art curriculum that meets or exceeds the national requirements of accredited programs. The faculty is well aware of the need to prepare students for the information-age economy, and in the self-study they acknowledge the importance of "actively fighting a potential digital divide" in our remote region.

In terms of resources, the most important question at this time is an appropriate level of S&E allocation.

In addition, the Computer Science lab requires a separate budget line that will enable the faculty members to maintain its state-of-the-art condition permanently.
As for faculty resources, the unfilled position should be filled as soon as possible. In terms of the ad hoc appointments, the department's stated desire to make one of these positions a continuing

rather than one-year position should be honored.

In terms of the university mission, Computer Science is positioned well to enter into interdisciplinary arrangements with other programs and departments because its Liberal Arts major provides space for more courses in other fields and for minors in other fields than the comprehensive major does. The program will likely see more majors in the liberal arts area and intends to welcome them.

Students perform well on measures of their knowledge and performance, which include independent projects, formal presentations, optional internships, and required Capstone Projects. In these areas in particular, the close relationships formed between faculty and students beginning in the first year are developed and the program's high expectations are fulfilled.

The Computer Science faculty members produce top-notch scholarship at an impressive rate and are to be commended for the extent of their participation in research and scholarship opportunities with an international network of colleagues, most of which involve travel that is severely under funded.

The Computer Science faculty members attend to issues of diversity and gender in their hiring and student recruitment processes, though numbers of women and minorities in their program remain very low. One effort to recruit minority students involves Lac Courte Oreilles Community College. At the faculty level, women and minority finalists have been recruited, but offers to women candidates have been rejected on the basis of salary and teaching load.
More attention is needed in this area.

## 4. Can the program continue to accomplish its goals?

It seems apparent from both the submitted documents as well as the meeting between PRPC and the Computer Science Program, that CS is committed to accomplishing its goals despite some serious financial hurdles. CS's dollars from its allocated S&E fund does not cover the cost of lab/classroom equipment and maintenance. With the number of CS majors increasing at a steady rate, their S&E funding needs to be appropriate to the needed lab/classroom expense. Another serious problem is the lack of sufficient funds for the CS faculty to fully cover their cost to conferences for paper presentations.

Another issue which should be addressed is the unequal treatment of outside grant money. CS has to give more of its grant money back to the university than other departments. There seems to be no justification given for this policy.

## 5. What new purposes is the department to address in the next five years?

The addition of two faculty from the former Computer Information Systems major presents an opportunity for the program to develop a modern, interdisciplinary major in emerging fields such as Geographical Information Systems, E-Commerce, and Information Assurance incorporating courses from Legal Studies or Mass Communications. An exploratory committee has been formed to investigate the possibilities.

The Program and Math Department are interested in being a part of a campus-wide technology literacy effort which may be incorporated into the General Education program.

## Question 6:
## How will the department continue to improve in quality?

The CS Program will continue to implement the Association for Computing Machinery (ACM) standards even though the program is not formally accredited by the ACM. These national standards will be a part of the high quality the CS Program offers its students and the benchmark for the curriculum and teaching staff. The CS Program has anecdotal reports on the quality of the graduates from the Program; three of their outstanding students have been accepted to extremely competitive graduate program in Information Assurance at University of Tulsa: one student has finished the program and works for the Air Force Computer Emergency Team; another student has finished the program and works for the National Security Agency; a recent UW-Superior graduate has been accepted and started the program last Fall. The program is very competitive and "Tulsa receives on average 1,000 applications per year and accepts 30" [from Interview with Dr. Shenoi in IEEE Software, January/February 2005 p.99]. However, there is no formal assessment of the students or the Program to determine how the standards are met.

The new academic building, which will replace Sundquist, will provide state-of-the art labs to attract students as well as improve their performance.

The CS program expects to be an integral part of the UW-Superior liberal arts mission.

### Recognition

1. Enrollment objectives for 04-05 were met in 05-06.

2. The CS program has comparable enrollment/graduates to other state programs.

3. This program has an active faculty who are successful as grant recipients and active researchers.

4. Even though the CS program is not accredited it still seeks to meet ACM curricula standards.

5. The CS program has a history of high quality of graduates with great placements.

6. The program contributes to the campus through various course offerings and to the liberal arts mission.

7. The CS program is moving forward with the development of a modern, interdisciplinary major with CIS.

## Recommendations

1. PRPC recommends that all S&E allocations on campus are equitably distributed rather than remaining as disparate and inequitable as they are currently.

   2. PRPC recommends that CS receive a separate budget line for their lab. PRPC also recommends that the CS Program work with the Provost to determine if a fee should be charged for its courses to cover the cost of maintain the computer labs. CS should consider having a line item in their budget for technological upgrades as well as make an appeal to the Technology Committee for technology replacements/upgrades for the computer science classrooms and faculty computers.

3. As for faculty resources, the unfilled position should be filled as soon as possible. In terms of the ad hoc appointments, the department's stated desire to make one of these positions a continuing rather than one-year position should be honored.

4. PRPC recommends the development of a formal assessment of the program and graduates of the program. This would be coordinated with the campus institutional researcher.

5. CS should aggressively develop a plan to seek out funding from the foundation, faculty development grants, and more S&E funds to cover the costs of its faculty to attend conferences. Faculty should not have to pay out of pocket for expenses that are related to the University's expectations for scholarship and research.

6. CS, along with its department chair, should petition the Provost and the governance units to investigate why the CS program pays a higher % of its outside grant money to the university for overhead compared to other programs on this campus. Overhead expenses taken from grant dollars, should be standardized across academic

departments.

7.  PRPC recommends the Program move forward in planning and implementing the integration of the CIS faculty.

8.  PRPC recommends working with the Vice Chancellor for Enrollment Management to develop a marketing plan to attract and retain more women and minority students into the Program.