Central Washington University
Assessment of Student Learning
Department and Program Report

Please enter the appropriate information concerning your student learning assessment activities for this year.

Academic Year of Report: 2008 – 2009 College: COTS
Department: Computer Science Program: Bachelor of Science

1. What student learning outcomes were assessed this year, and why?

2.1 Overview.
The Computer Science Department has established a regular review process for assessment of student learning. Table 1 below lists the Student Learning outcomes for the Bachelor of Science in Computer Science. Linking of the Student Learning Outcomes to the Department, College and University goals can be found in our Student Learning Assessment Plan at: http://www.cwu.edu/~cs_dept/accred&review.html. As noted in the Plan, our assessment measures generally are reviewed either annually or on a three year rotating basis. The department believes that by continually some aspect of each outcome we can more easily react to both opportunities and concerns as they arise.

Table 1. Student Learning Outcomes for the Bachelors of Science in Computer Science.

Student Learning Outcomes
1. Basic Knowledge: Graduates will demonstrate an understanding of each of the subject areas that define the discipline as well as the interrelationships that exist among them.
2. Critical Thinking Skills: Graduates will demonstrate the ability to utilize appropriate theoretical constructs for problem solving: definitions, and axioms, theorems, proofs, and interpretation of results.
3. Research Skills: Graduates will have the ability to apply basic research methods in computer science.
4. Applied Design Skills: Graduates will have the ability to apply appropriate design constructs: requirements analysis and specification, design, implementation, and testing.
5. Ethics and Society: Graduates will demonstrate knowledge of ethical codes and societal issues associated with the computing field.
6. Technical and Theoretical Background: Graduates will demonstrate knowledge of 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.
7. History of Computing: 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.
8. Graduate Preparation: Graduates will have the necessary background for entry into graduate study.
9. Communication Skills: Graduates will have the ability to communicate effectively.

2. How were they assessed?

A) What methods were used?
B) Who was assessed?
C) When was it assessed?

2.1 Overview

As several of the methods of assessment used correspond to more than one of the student learning outcomes, we have divide the answers here into two tables. In Table 2, we list in column 1, the method used, in column 2, who was assessed, and in column 3 – when the assessment occurred. In Table 3, we correlate the Student Learning outcomes with the methods of assessment used.

Table 2. How the Student Learning Outcomes Were Assessed.

Method Used	Who was Assessed	When the Assessment Occurred
A. Major Field Test	Senior CS Majors	March, June 2009
B. Senior Capstone Courses, CS 480 / 481	Senior CS Majors	Fall 2008 and Winter 2009 when the courses were offered
C. Senior Colloquium, CS 489	Senior CS Majors	March, June 2009
D. Participation in SOURCE Participation in research projects and groups	Majors at all levels Majors at all levels	May 2009 June 2009
E. Survey of students in Fundamentals of Computer Science, CS 112	Entering majors, minors and some non-majors	Dec 2008, March, June 2009
F. Exit Interviews	Senior CS Majors	March, June 2009
G. Employers and Internship Employers Surveys	Majors at all levels	June 2009
H. Graduate School Acceptance	Senior CS Majors	June 2009
I. Individual Course Outcomes	Majors at all levels	September 2008

Table 3. Correlation of Student learning Outcomes to the Methods of Assessment Used.

Student Learning Outcome	Method Used
1. Basic Knowledge	Major Field Test Exit Interviews Individual Course Outcomes
2. Critical Thinking Skills	Major Field Test
3. Research Skills	Senior Colloquium, CS 489 Participation in SOURCE Participation in research projects and groups
4. Applied Design Skills	Senior Capstone Courses, CS 480 / 481 Individual Course Outcomes
5. Ethics and Society	Senior Colloquium, CS 489
6. Technical and Theoretical Background	Senior Capstone Courses, CS 480 / 481 Employers and Internship Employers Exit Interviews Individual Course Outcomes
7. History of Computing	Fundamentals of Computer Science, CS 112
8. Graduate Preparation	Participation in SOURCE Participation in research projects and groups Graduate School Acceptance
9. Communication Skills	Senior Capstone Courses, CS 480 / 481 Senior Colloquium, CS 489

3. What was learned?

3.1 Overview

We divide this section into two sub sections. In the Section 3.2, we present the results for each of the methods of assessment used this year. Where appropriate, we summarize these results in Tables 4 – 9. In section 3.3, Table 10 details how these results compare to the standard of mastery for each of the student learning outcomes as found in our Assessment Plan. Our interpretation of these results can be found with our discussion of how this will affect the program in Section 4.

3.2 Results for each of the Methods Used

A. Major Field Test

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 4 summarizes MFT results for the last five years.

Table 4. Five Years of MFT Results.

	04-05		05-06		06-07*		07-08*		08-09*	
	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Num. Stu.	22		27		24		17		24	
Overall	145.3	45	153.1	75	148.2	55	149.1	60	154	65
Programming	51.1	48	60.0	82	55.0	35	60.7	55	65	70
Systems	31.3	33	40.2	63	39.9	35	37.0	25	41	35
Theory	37.4	71	44.3	92	33.3	40	34.8	45	41	70
GPA – avg.	3.19		3.66		3.25		3.19		3.32	

* new interpretation of scores used – 4CMF

B. Senior Capstone Courses, CS 480 / 481

This year the department had six senior project teams. Five teams used the traditional waterfall model of software development and one team used a research project model of development. In each model students were required to develop six documents and make three presentations. Five teams met the major requirements specified in their original design. One team did not meet all the specified major requirements due to factors beyond their control (sickness of their client did not allow for sufficient contact). Table 5 summarizes these results.

Table 5. Summary of Project Success for Senior Projects, AY 08-09

Model of Project	Met All Requirements	Met Major Requirements	Major Requirements Lacking
Waterfall	2	2	1
Research		1	

All six documents and three presentations were evaluated relative to both content and style rubrics. The following summarizes the students' performance in these critical communication areas. In the content evaluation, one team was evaluated as excellent, three teams were evaluated as exceeding expectations and one team was evaluated as meeting expectations. In the style evaluations, two teams were evaluated as exceeding expectations and three teams were evaluated as meeting expectations. Table 6 summarizes these results.

Table 6. Summary of Writing and Presentation Evaluations for Senior Projects, AY 08-09

	Excellent	Exceeds Expectations	Meets Expectations	Fails Some Expectations	Missing Major Requirements
Content	1	3	2		
Style	2	2	2		

Finally while knowledge of testing software appeared improved based on written exams, the use of testing methods in the projects remained at the short end and was evaluated as minimally acceptable in three projects and below expectations in three projects.

C. Senior Colloquium, CS 489

All graduating seniors are required to participate in the Senior Colloquium. This year 24 students took this class. In addition to taking the Major Field Test, students complete an ethics unit, write a research paper and make a presentation on that research paper. Each of these units are evaluated by both content and style rubrics. Table 7 summarizes these results.

Table 7. Summary of Content and Style Evaluations for Senior Colloquium, Winter & Spring 09

	Excellent	Exceeds Expectations	Meets Expectations	Fails Some Expectations	Missing Major Requirements
Ethics Unit					
Content	2	8	13	1	
Style	1	11	11	1	
Research Paper					
Content		9	14	1	
Style		14	9	1	
Presentation					
Content		16	7	1	
Style		8	15	1	

D. Participation in SOURCE and in research projects and groups

The faculty believes that it is the students in their last two years of study in computer science who generally have the background to be eligible to participate in SOURCE or research projects. This year there were 36 students in last two years of study in computer science. Fifteen different students participated in some form of undergraduate research this year. Table 8 summarizes how these students participated in different aspects of undergraduate research. As an aside, the department had one regular faculty member on sabbatical this year; thus, there were four active regular faculty members in the department this year.

Table 8. Summary of students Participating in Undergraduate Research.

	Number of Students
SOURCE	11
Individual Research	6
Group Research	8
Conference Presentations	4
Publications	3

E. Survey of Students in Fundamentals of Computer Science, CS 112

This survey is a follow-up to the one done last year at the end of a major revamp of this course and its place in the curriculum. We will discus the changes and our perceptions about them in section 5 below. Here we will [resent the result of our survey of students taking CS 112 this year. The class had four basic sections: Alice – a programming language used to introduce animation, careers in computer science, hands-on computers – a look at basic data representation and the development of computer hardware, and Scribbler robots – programming low level interaction with robotic sensors.

Alice: Students enjoyed the introduction to animation. Students valued the introduction to “pairs” programming. Students had an appreciation for the impact of this technique in the development of software.

Careers in computer science: The results here were an improved perception about the opportunities and requirements of a career in computer science. Most of the students reported already leaning towards becoming computer science majors.

Hands-on computers: Students reported a better appreciation for the development of hardware and in how computers are put together. Generally students reported an improved comprehension of data representation, though a minority of students reported still being confused on this topic.

Scribbler robots: Though generally well received a number of students reported frustration with the somewhat uneven performance of the Scribbler sensors.

F. Exit Interviews

All graduating seniors participate in an exit interview. Topics covered include the efficacy of the core curriculum, the impact, breadth, and depth of the focus area electives, the perceived state-of-the-art of our labs (including research and instructional labs – both hardware and software), the faculty, the staff and any other concerns. The following represents the highlights of senior exit interviews conducted in AY 07-08.

Core courses are effective and generally meet the perceived needs of the students. Students would like to see more emphasis on multiple database engines in the database class. As an aside, none of the graduating seniors took the revised database class this year. Students would like to see 300 and 400 level core courses offered more that once a year.

Focus area elective courses generally provide sufficient breadth and depth for the interests of the students. Students would like to see more emphasis on parallel and distributed environments – particularly multi-threading due to the proliferation of multi-core processors.

Labs continue to house state-of-the-art equipment and software. Students are aware that the department with the help of the university replaces one lab each year allowing students to have access to the latest in computing technology.

Faculty were perceived as knowledgeable and helpful.

Staff were perceived as friendly and helpful. The descriptor “awesome” came up frequently.

G. Employers and Internship Employers

Internship employers are surveyed at the end of any term that they employ a computer science intern. Employers of computer science graduates are survey more informally. The results of this feedback has been uniformly positive. Students are considered prepared for the work place with an understanding of basic professional interactions.

H. Graduate School Acceptance

Table 9 summarizes the graduate school success of students graduating in AY 08-09.

Table 9. Graduate School Success, AY 08-09

	Number of Students
Number Applied	4
Number Accepted	3
Number Pending	1
Number Rejected	

I. Individual Course Review

Annually, the Computer Science faculty conduct a thorough review of one class (or perhaps a pair of sequenced classes) for each faculty member. Each faculty member is asked to prepare a complete portfolio for the class (or classes). Different classes are to be presented each year until the department has reviewed the entire curriculum. The purpose is two-fold. The first purpose is to review the current professional instructional development of each faculty member. The second purpose (which has impact here) is to provide a tool for our curriculum review. Portfolios include the following information: textbook, syllabus, objective, notes, slides, other materials including web-based, programming projects, exams, samples of student work and SEOIs.

This year, the faculty met in retreat in September and reviewed the following courses, CS 110/111, 112, 420, 474, 480/481. Of these, all but CS 420 met their learning outcomes. It was felt that 420 – Database Management Systems fell short in several areas with the major one being that it did not demonstrate knowledge of state-of-the-art systems. This was due in large part to stale material in the course.

3.3 How Assessment Results Correlate to the Student Learning Outcomes.

Standards of mastery are described in the Computer Science Student Learning Outcomes Assessment Plan.

Table 10. Correlating Results with Standards of Mastery for Student Learning Outcomes.

Student Learning Outcome	Standard of Mastery	AY 07-08 Results
1. Basic Knowledge	Major Field Test > 50th percentile overall and in content areas	Overall, Programming and Theory > 50th percentile System < 50th percentile but improved from AY 07-08,
	Exit Interviews – student self-reported strengths and weaknesses of the program	Focus area electives, labs, faculty, and staff were all listed as strengths. One concern raised in core courses: database breadth.
	Individual Course Outcomes	110/111 and 112 address basic skills and were evaluated as meeting individual course outcomes.
2. Critical Thinking Skills	Major Field Test > 50th percentile overall and in content areas	Overall, Programming and Theory > 50th percentile System < 50th percentile but improved from AY 07-08,
3. Research Skills	Senior Colloquium, CS 489 All graduates will produce a successful research paper	23 of 24 students produced acceptable papers or better, 1 student papers was rated minimally acceptable.
	Participation in SOURCE Participation in research projects and groups > 25% student participation > 2 students per faculty	15 of 36 eligible students participated in some form of undergraduate research 3.75 students per active full-time faculty member
4. Applied Design Skills	Senior Capstone Courses, CS 480 / 481 > 75% successful projects	5 of 6 teams met the major requirements of their project; yet, testing still lags.

	Applied Design Skills (cont.)	All teams produce minimally acceptable documents based on content	All teams produced acceptable documents based on content.
		Individual Course Outcomes	420, 474 and 480/481 were reviewed in this category. 474 and 480/481 were evaluated as meeting course outcomes. 420 was evaluated as not meeting all course outcomes.
5.	Ethics and Society	Senior Colloquium, CS 489 All students successfully complete the ethics unit.	All students but one student completed successfully the ethics unit.
6.	Technical and Theoretical Background	Senior Capstone Courses, CS 480 / 481 All teams produce professionally acceptable documents based on style.	All teams produced acceptable documents based on style.
		Employers and Internship Employers Surveys – no negative responses from surveys	Students perceived as prepared and professional.
		Exit Interviews – student self-reported strengths and weaknesses of the program	Focus area electives, labs, faculty, and staff were all listed as strengths. One concern raised in core courses: database breadth.
		Individual Course Outcomes	420, 474 and 480/481 were reviewed in this category. 474 and 480/481 were evaluated as meeting course outcomes. 420 was evaluated as not meeting all course outcomes.
7.	History of Computing	Fundamentals of Computer Science, CS 112 – student self-reported strengths and weaknesses of the class	The history component woven into Alice, Hands-on computing and the Scribbler robots was effective.
8.	Graduate Preparation	Participation in SOURCE Participation in research projects and groups > 25% student participation > 2 students per faculty	15 of 36 eligible students participated in some form of undergraduate research 3.75 students per active full-time faculty member
		Graduate School Acceptance	4 students applied for graduate school. At this time three have been accepted and one has applications pending.

9. Communication Skills	Senior Capstone Courses, CS 480 / 481 All teams produce professionally acceptable documents based on style. All teams make three professionally acceptable presentations.	All teams produced acceptable documents based on style. All teams made acceptable presentations based on style.
	Senior Colloquium, CS 489 All graduates will write an acceptable research paper and make an acceptable presentation.	23 of 24 students produced acceptable papers, one student papers was minimally acceptable. 23 of 24 students made an acceptable presentation, one student presentation was minimally acceptable.

4. **What will the department or program do as a result of that information?**

In Table 11 below we analyze the results presented in Section 3 above and where appropriate recommend action items to help address the issues raised.

Table 11. Analysis of Results and Action Items.

Student Learning Outcome	Assessment and Curricular Changes
1. Basic Knowledge	Generally this student learning outcome has been met, there are however two concerns. a) While all categories of the MFT showed improvement this year, it is time to address shortcomings in the Systems area. The systems area breaks down into four sub areas: Architecture (CS 311/312), Operating Systems (CS 470), Networking (CS 450), Database (CS 420). Action items: The faculty felt that we would approach modifying these courses in stages. CS 420 was run with a redesign for AY 08-09 based on last year's assessment. CS 311/312 should be redesigned for AY 09-10 and CS 450 should undergo redesign for AY 10-11. b) Students noted a continuing concern in the Exit Interviews that they are currently being exposed to just one database management system. These graduating seniors were not however in the CS 420 class redesigned for AY 08-09. Feedback from the revised class indicated that students were pleased with the changes. Action item: continue to monitor the revised CS 420 class. c) Students noted a concern in the Exit Interviews that they would like to see 300 and 400 level core courses offered more that once a year. Unfortunately, enrollment in Computer Science courses will not support more frequent offering of these courses. No Action item.
2. Critical Thinking Skills	Generally this student learning outcome has been met, there is however one concern. Performance in the MFT in the area of System, while improving, is not to the mastery level. We believe that this is a critical component in critical thinking for a computer scientist. Curricular changes here will correspond to the changes listed in 1a) above.

3.	Research Skills	Based on the results of the current assessment the faculty believe that this concern has been met. No curricular changes are planed here.
4.	Applied Design Skills	Based on the results of the current assessment the faculty believe that this concern has been generally met. However as noted in the description of testing in the senior project sequence, this aspect does not receive the necessary development when it comes to actual application. Action item: in the fall faculty retreat, review other courses where testing can be made a larger component and more naturally incorporated in projects.
5.	Ethics and Society	Based on the results of the current assessment the faculty believe that this concern has been met. No curricular changes are planed here.
6.	Technical and Theoretical Background	Generally this student learning outcome has been met, there are however one concerns. Concerns were raised in exit interviews about database breadth of experience. Curricular changes here correspond to the changes listed in 1a) and 1b) above.
7.	History of Computing	Based on the results of the current assessment the faculty believe that this concern has been met. No curricular changes are planed here.
8.	Graduate Preparation	Based on the results of the current assessment the faculty believe that this concern has been met. No curricular changes are planed here.
9.	Communication Skills	Based on the results of the current assessment the faculty believe that this concern has been met. No curricular changes are planed here.

In summary we have five action items.

1) Redesign CS 311/312, 420, and 450 in stages. CS 420 was run with a redesign for AY 08-09 based on last year's assessment. CS 311/312 should be redesigned for AY 09-10 and CS 450 should undergo redesign for AY 10-11.
2) Continue to monitor the revisions in the CS 420 class.
3) During the fall faculty retreat, review other courses where testing (particularly in the programming and data structures sequences) can be made a larger component and more naturally incorporated in projects.
4) As the general education program is currently being redefined, CS 112s submission as a general education course has been delayed until next year.
5) Continue the development of a CS Advisory Board.

5. **What did the department or program do in response to last year's assessment information?**

The department adopted the following action issues for curricular change recommendations last year, AY 07-08.

1.1 Though the Theory category results of the MFT showed some improvement this year, they results are still not to the level of mastery indicated in our plan.

1.2 Performance in the MFT in the area of Theory, while improving, is not to the mastery level. We believe that this is a critical component in critical thinking for a computer scientist. Curricular changes here will correspond to the changes listed in 1.1.

Action: These changes were implemented for the CS 427 class and our new faculty member will continue to develop changes for CS 427 next year.

Analysis: The MFT result for the Theory component have continued to improve and now exceed out standard for mastery. While this action item is essentially met, we need to continue to review this annually.

2.1 Students noted a concern in the Exit Interviews that they are currently being exposed to just one database management system. The faculty believes that although this single system has all the components of general database systems, exposing students to new database engines is important. With that in mind the database course will incorporate additional database engines next year.

2.2 Concerns were raised in exit interviews about database breadth of experience.

Action: This concern had come up before and this year taught a redesigned the CS 420. In an end-of-the-term survey of the students seemed to appreciate the new class. Next year most of these students will take the MFT. CS 420 should be part of our annual review next fall.

Analysis: The department believes progress has been made on this action item.

3. Students noted a concern in the Exit Interviews that they believe they do not have sufficient background in testing. This is also a concern that arose in the faculty evaluation of CS 480/481 projects. While we will continue to provide more information on testing and testing software in CS 480, the faculty believes that we need to restructure our curriculum so that testing becomes an important component prior to the CS 480 class. The faculty will conduct a full curriculum review will take place next year so that these and other concerns can be addressed.

   Action: Added material on testing was placed in the CS 480/481 material

   Analysis: As noted above, while knowledge of testing software appeared improved based on written exams, the use of testing methods in the projects remained minimal and was evaluated as minimally acceptable in three projects and below expectations in three projects. So theoretical knowledge has improved while is practical application remains limited. This continues as Action Item 3 for next year.

4. The results of the survey of students in CS 112 shows that although the changes in the course were effective and well received by the students, most of the students were already intended computer science majors. One reason for the changes to this class was an attempt to attract more students to the major. We believe that this class needs wider exposure. We intend to propose this class as a general education class in an effort to attract more students.

   Action: Surveys in the class continue to enforce this idea. General Education is currently in a state of flux – changes will be finalized next AY. At that time, the department intends to submit CS 112 as a GE course.

   Analysis: This remains an action item for next year.

5. It is the intent of the faculty to as part of the curriculum review to consider changes to our program that might attract more students to the major. As part of the discussion among the faculty, it was decided that it would be important to make business and industry feedback about our program design a major contribution to this effort. Thus we will be creating an Employer Advisory Board.

   Action: We currently have invited three individuals to join our advisory board – representing Micorsoft, Boeing, and PNNL. Two have accepted their invitations – one is still under consideration.

   Analysis: The department has made acceptable progress on this action item. It remains active for next year.

6. Full curriculum review.

Action: This has proven difficult to carry out with one faculty member on sabbatical and another faculty member a temporary one-year replacement (the department only has three other full-time faculty).

Analysis: Next year a different faculty member will be on sabbatical and we will have a new full-time hire filling the open position. While it is an appropriate time for a full curriculum review to occur, we believe that it will not be possible to attempt this until AY 10-11.

6. **Questions or suggestions concerning Assessment of Student Learning at Central Washington University:**