Computer Science
MONTANA TECH OF THE UNIVERSITY OF MONTANA

Computer Science Industry Advisory Board Meeting Minutes
March 25, 2005

Board Members Present:

- Rita Spear, Ingenium Data Technics
- Jim Petrick, Zoot Enterprises
- Justin Lerum, EDS
- Craig Spannring, Spraying Systems
- Tom Jinneman, RightNow Technologies

Montana Tech Representatives Present:

- Celia Schahczenski, C.S. Dept. Chair
- Michael Grinder, C.S. Faculty
- Gary Mannix, C.S. Faculty
- Lou Glassy, C.S. Faculty
- Chris Boroni, C.S. Faculty
- Jeff Braun, C.S. Faculty
- Nicole Burns, C.S. Administrative Associate
- Aaron Sande, C.S. Student
- MaeLynn Velin, C.S. Student

I. ABET Outcomes-Based Assessment

Celia Schahczenski gave an overview of the ABET Accreditation process. There are four commissions within ABET. The Computer Science program is accredited through the Computing Accreditation Commission of ABET through 2007-2008, while the Software Engineering program would be accredited through the Engineering Accreditation Commission of ABET. The Computer Science faculty are now working on accrediting the Software Engineering program. ABET gives general criteria for accrediting engineering programs and program criteria for software engineering. For the main part, however, ABET lets the faculty define their own goals for the program and then show ABET that they are achieving these goals. The three main components of ABET accreditation are as follows:

1. Objectives & Outcomes: statements that describe what students are expected to know and are able to do by the time of graduation
2. Assessment: processes that identify, collect, and prepare data to evaluate the achievement of outcomes and educational objectives
3. Evaluation: determines the extent to which outcomes or objectives are being achieved, and results in decisions & actions to improve the program.

II. Welcome

Chancellor Gilmore and Doug Coe, the Dean of the College of Mathematics and Sciences, welcomed the board members to MT Tech and emphasized the importance of their advice to the department. Chancellor Gilmore explained that Tech is in the process of creating a strategic plan for the school. An Industry Advisory Board, primarily made up of department IAB chairs, may be formed to assist with strategic plan. The school has gone through a series of audits from Tech constituents. The majority of constituents believe that Tech is going in the right direction. The school is now going through a "branding" process and will soon have a "tag line." The budget issues look more positive from the legislature this time. Tech would like to build a new Petroleum and Bureau of Mines building. The legislature has slated 9 million for the project, but the project still needs 5 million more. The Computer Science and Software Engineering programs need to bring their enrollment up, but the Chancellor also said that he realizes that it is hard to find top students who can "handle" the curriculum. Dr. Coe applauded the department for all of their hard work on the ABET assessment process.

III. Computer Science Department Update

A. Accreditation: As stated above, the Computer Science program is accredited through 2007-2008, and the Computer Science faculty are now working on accrediting the Software Engineering program. It seems likely that the accreditation of the Software Engineering program will not be in sync with the other engineering programs on campus. The other engineering programs had an accreditation visit this year, and they expect to be accredited for the next six years.

B. Freshman Scholarship: The first freshman scholarship for a Computer Science or Software Engineering major was awarded for the current academic year. The scholarship is $250 per semester for eight semesters, beginning in the fall semester of the freshman year. Unfortunately, the student who accepted the scholarship has changed programs, so he will not receive anymore of the scholarship money. The department will award that money to a new student. The department is in the process of awarding the scholarship to a new incoming freshman. Constituents who donate to MT Tech and the Computer Science Department now have a choice between donating to the department or the scholarship. All money donated to the scholarship will only be used for scholarships.

C. Newsletter: The department has developed a template for both the fall and spring newsletters. The last issue of the newsletter was sent in the spring of 2004. A new issue of the newsletter will be sent in the spring of 2005.

D. New Networking Lab: The Computer Science Department has gained a room in the Museum building to use as a networking lab that is independent from the campus network. This networking lab will give students a chance to work on a network without disrupting the campus network. The lab is a work in progress, and at the moment, they are working on getting more power supply in the room.

E. Object Pascal as the Introductory Programming Language: Michael Grinder reported that this is the second year of teaching Object Pascal in the Introductory Programming Language class. It seems that it is easier to teach the students programming when they start with simple programs that eventually get more difficult. He is not sure about how students are doing in other classes as a result of the change. Aaron Sande, who is a student tutor in the Museum lab, said that he can tell a difference in the understanding of programming from the students who are in the class now and his level of understanding when he took the class. The IAB members are still concerned about Object Pascal being taught because it is not being used in industry today. After CS 211, the students take CS 254, Object-Oriented Programming, where they learn C++, which is used in later classes.

F. Senior Seminar: This is the first year that the one-credit Senior Seminar has been taught. SE majors must take the course, and CS majors will eventually have to take the course. Each faculty member has given a talk, and now the students are starting to give theirs. The department will give an exit exam to the students enrolled in the Senior Seminar. The exit exam will assess how students are meeting the program outcomes of the department. These exams will only be used as a program outcome assessment tool. Students cannot actually be kept from graduating if they do not pass the test. Jim Petrick suggested that the exit exam be given in the Freshman Seminar to inform the students of the road ahead. Lou suggested that a future agenda item could be what belongs in this exam.

G. Process Across the Curriculum – Testing and Version Control: During last year's IAB meeting, board members discussed the importance of using a sound software development process and of developing systems that are easy to test and maintain. Some classes in the Computer Science and Software Engineering programs have required students to use testing and version control tools. Students in CS452 (Fall 2004) used version control (an open-source system called "subversion") and wrote test plans for all programming assignments. Students in SE295 (an experimental class in GUI construction, Spring 2005) are using the Subversion version control system, and J-Unit for unit testing their Java programs. In CS 211 students are encouraged to develop their programs incrementally (get a small piece working correctly and then move on to the next small piece rather than writing the entire program all at once). To accomplish this, the students write out the requirements of the program and test cases for each requirement. While they are writing the program, they use an automated testing tool, qmtest, to test the program. As they complete the implementation of each requirement, they record their changes into a version control repository so that the instructor can see their development process. This process will be implemented in CS 210 next fall as well. Jim Petrick mentioned that his company uses J-Unit for testing and version control, but sometimes the sales people don't give the developers enough time to do all of the things that should be done. He also mentioned that students need experience in making process-related estimations such as the size of an anticipated system, the expected effort to develop that system, etc.

IV. Industry Update – Project Evaluation at Your Company

IAB members described how they assess what worked or what needs improvement after project delivery.

A. Justin Lerum of EDS explained that development teams document everything that is done throughout the process and then meet after a project is completed. Clients also have input into how they think the project went. On an individual basis, each employee has a personnel and peer review. Employees and supervisors agree on employee goals that he or she needs to meet each year at that time.

B. Jim Petrick said that Zoot also has employees write goals that need to be met each year. The employee's progress is re-evaluated every three months. He said that it is sometimes hard to get personal goals done when completing projects are the priority. When working on a project, Jim constantly assesses his progress on the project and tries not to wait until the end. He also stressed that finger pointing will always happen, but employees need to learn to not take it personally and to keep good communications among all groups involved. Since he has not been at Zoot long enough to see a project to its completion, he does not know what the company will require his team to do at the end, but he hopes that they have a process similar to EDS's.

C. Craig Spannring works for Spraying Systems which is a smaller company that has not set up a project evaluation process yet; however, the company does have a Quality Assurance person. Spraying Systems has half of their personnel in Illinois and the other half is in Montana, so it is hard to get people together to do project assessment.

D. Rita Spear started her new company, Ingenium Data Technics, in November of 2004. She sees the project assessment process as necessary, but as Craig said, smaller companies have a harder time getting the assessment process set up.

E. Tom Jinneman of RightNow Technologies talked about project evaluation from an I.T. operations point of view. He and his department are continually looking at software development metrics and tracking them. Customers also have a lot of input.

V. Enrollment

A. Gary Mannix presented current C.S. and S.E. student enrollment numbers. The total enrollment of both programs went from 115 in the fall of 2001 to 57 in the spring of 2005; the number of graduates went from 14 to 8. Contributing factors to the decline may be that the program is too heavy in math or that the department is getting competition from the Information Technology, Professional & Technical Communication, and Healthcare Informatics programs. Currently, the department uses the following strategies for recruitment:

1. Faculty members call students who have expressed interest in the C.S. programs
2. Applicants are assigned an advisor who keeps in contact with them

Approximately one-third of the freshman class moves to another program after the first semester. In order to help keep students in the C.S. programs, the department has instituted the following changes:

1. Students who are not calculus ready can take Visual Basic so that they can at least get started in the program
2. The C.S. minor has been revamped so that one full year of programming is no longer required. Students now have the choice of taking one the following core requirement sequences:

a.	C.S. 2106	Intro to Computer Science I
	C.S. 2116	Intro to Computer Science II
b.	C.S. 2136	Matlab Programming for Engineers & Scientists
	C.S. 2146	C Programming for Engineers & Scientists
c.	C.S. 2126	Applications Programming
	C.S. 3126	Advanced Applications Programming

3. The C.S. department offers more service courses which is one method of keeping C.S. courses valuable to the school.

B. Lou Glassy then presented information on national trends. There has been about a 25% drop in C.S. enrollment across the country. The reasons for this drop may be contributed to several reasons:

1. During the dot.com age, did people go into C.S. who shouldn’t have?
2. Are industry people becoming more efficient?
3. High school seniors and college freshmen are aware of off-shoring and may feel that there will not be enough jobs here in the U.S.
4. High school seniors don’t know what they want to do with their lives or what actually happens in a C.S. job.
5. Students are not adequately prepared mathematically.

C. Questions, comments, and suggestions about enrollment issues:

1. If the students are not going into C.S. programs, where are they going?
2. Is there a demand for C.S. & S.E. majors in industry?
3. Should the C.S. Department start offering a harder I.T. degree?
4. New employees in industry are assigned a mentor. Maybe freshmen need to be assigned a senior mentor. Both Aaron Sande and Gary Mannix have seen that underclassmen are more willing to talk to upperclassmen than their professors when they have a problem. The idea of students talking to an alumnus when they are starting to think about leaving the program was also mentioned.
5. It was stated that computer science is still a math-based program, so reducing the math requirements should not be an option. Jim Petrick suggested that we replace one or more math classes with problem solving classes.

VI. ABET Outcomes-based Assessment

The entire afternoon was devoted to going through the mission statement, educational objectives, and program outcomes that the faculty has developed for the Software Engineering program. We got a lot of input on how to assess the software engineering program. In addition, we discussed what changes need to be made to the S.E. assessment plan in order to create an assessment plan for the C.S. program. These notes were taken directly on the Software Engineering Assessment Plan document, which are located at the end of these minutes. The notes are underlined.

VII. Wrap-Up

The discussion returned to enrollment issues. IAB members liked the idea of people such as mentors or alumni talking to underclassmen who are struggling or thinking about leaving the program. All IAB members present agreed that C.S. faculty could e-mail them with contact information of the student who is having trouble, and then they would in turn contact the student.

Montana Tech Computer Science Department
Software Engineering Assessment Plan
Work in progress – last updated March 11, 2005

Mission Statement

Our program prepares students to develop quality software systems using proven software engineering methodologies. Our graduates positively influence how computer technology affects the world and carry on our institution's tradition of excellence.(add something about graduates being adaptive, confidence, quick learning, can start working right away , meet industry expectations right out of college)

Educational Objectives:

Objectives are statements that describe the expected accomplishments of graduates during the first three to five years after graduation.

Graduates of the Software Engineering program will have:

1. adapted, thrived and contributed in an industry setting or completed a graduate program;
2. improved software quality and the state of the art by promoting the adoption of best practices and supporting those best practices that are already being used;
3. demonstrated an ongoing commitment to professional development.

Assessment:

Faculty will contact, via phone or face-to-face discussions, at least 50% of the alumni four years after graduation. In addition to a general discussion faculty will ask:

- What has been your job history for the last four years?
- Have your responsibilities increased over the last four years?
- Did your coursework help you adapt initially to your new job?
- Has the problem solving that you learned in school helped you through your job?
- Have you been able to contribute to improving the quality of your company's software products?
- Are you a member of any professional societies?
- Do you have any problems with our contacting your employer? If you are the only recent employee (hired in the last five years) from our Computer Science Department we probably will not be contacting him/her.

If the alumnus went to graduate school ask:

- Have you completed a graduate program? In what field? If you didn't finish the degree, why?
- Did your undergraduate coursework prepare you adequately for graduate school?
- Did you need to take additional courses to address deficiencies and if so, what courses?
- Are you a member of any professional societies?
- Have you published any papers or attended any professional conferences since you started graduate school?

Interviewing employers
We keep track of where graduates of the program have been hired, and we attempt to contact those employers that have hired two or more of our graduates in the past five years. (We will need to get permission to contact employers through the appropriate channels on a per employer basis.)

Questions to IAB members:

- What are your policies on speaking to academic people concerning the preparation of new hires from that school? (We will insert the actual questions to employers here.)

Evaluation:
Every two years have a committee of the CS faculty, members of the IAB, (add “a recent graduate (4-5 years out),” here) and a current student look over the results determine how well we are meeting our objectives and recommend changes to the program as well as to the assessment process. Lou Glassy suggested the agenda item for a future meeting: “What should an SE graduate be able to do right out of college?” Rita responded with “Cut quality code, on time, within budget, and be able to think logically.”

Program Outcomes

Outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. An exercise was performed during the meeting where people voted for the 6 outcomes that they thought were the most important, and then they were able to indicate any outcomes they would like to see removed. The votes are recorded below.

At the time of graduation, all Software Engineering students will have demonstrated the ability to:

SE1 ~~Make sensible moral and ethical decisions~~ (change to “Understand professional and ethical responsibilities”) (received 5 votes)

SE2 Be able to (add “effectively”) work with clients (add “and co-workers”), have tact and see things from other perspectives (received 6 votes)

SE3 Be able to identify and evaluate technical alternatives (received 5 votes)

SE4 Be able to identify and evaluate non-technical alternatives (received 2 votes)

SE5 Apply oral and written skills effectively (received 7 votes)

SE6 ~~Be aware of the state of the art and best practices in Software Engineering~~ (change to “Use the techniques and tools of modern software engineering practices”) (received 1 vote)

SE7 Able to work effectively in multidisciplinary teams (received 2 votes)

SE8 ~~Be committed to professional growth and development~~ (change to “Understand the need for professional development and historical perspective”) (received 3 votes and 1 removal request)

SE9 Be able to learn new technologies ~~on their own~~ (change to “independently”) (received 6 votes)

SE10 See a multistage project/task through to completion (received 6 votes)

SE11 See the essence of the problem and design a solution (received 6 votes)

SE12 Staying current with respect to societal issues relating to computer technology (received 0 votes)

SE13 Be able to apply quantitative methods to software development (received 0 votes)

SE14 Be able to apply skills gained in math, science, engineering, and business (received 0 votes)

SE15 Be technically proficient and able to perform all phases of software development (received 9 votes)

SE16 Be able to work effectively in a non-IT application domain (received 0 votes)

SE17 ~~Be able to observe, use, reflect on and~~ refine software development and business processes (received 1 vote)

At the end of this document is the correspondence between these program outcomes and the courses in the S.E. curriculum that address these outcomes.

Assessment:

Assessment exams (e):
Give exams at the beginning of the courses CS 2546 (to assess the freshman year), CS 3326 (to assess up to the sophomore year), CS 4526 (to assess the up to junior year), and in SE 4940 at the end of the senior year (to assess the entire program). The first three tests will be 50 minutes long and will be given in the second class period. The exit exam will be two hours long and given as the final for SE 4940. Students will not be given grades for these exams. The exams will primarily be multiple choice.

(In order to motivate students to take the exam, add the following: “The results of these exams will be publicly available. These exams will not be linked to individual students. By making the results of these exams openly available, we show our commitment to improving our program.”

Instructors for each course will generate a pool of questions for the assessment exams. Each year the assessment exams will be made by randomly picking questions from the question pool for that year’s exam.

The first exam will be made up of an equal percentage of the questions from the courses being assessed. The second exam will be weighted with 80% from second year material and 20% from first year material. The third exam will be weighted with 70% from third year material, 20% from the second year material and 10% from the first year material. The final exit exam will be weighted 40/30/20/10 across the four years.

There will be two sections for the SE5 written and oral assessments: a section of common criteria used for assessment and a section of assignment specific criteria used for grading. The specific criteria are written by the instructor and does not appear on the standardized forms on the web.

Written evaluations (W):
Evaluate all papers with a standard form (*SE5 written assessment form)*. These evaluations will be used to assess all written assignments. A limited number of writing assignments will be targeted to appear in the final evaluation portfolio. The specific topics and courses for these assignments are given in the table below.

Course	**Topic**
S.E. 1000	• Working resume • Fictional cover letter • Career paper
C.S. 2656	• Information stewardship and computer technology • Portfolio of work for a database application
C.S. 3406	Internals of an existing operating system
S.E. 3250	• Usefulness of ethical codes • Process models • Software system requirements presented to outside clients
S.E. 3260W	• Software development and/or software metrics

For an assignment that appears in the evaluation portfolio, all *writing evaluations* will be provided and the best, average and worse of the graded assignments will be identified and the graded paper will be included.

(add “Oral”) Presentation evaluation (o):
Presentations will be assessed, using the *SE5 oral assessment form*, in the same way that written assignments are except that the evaluation portfolio will not include actual transcripts of the presentations. (Add “Targeted assignments include:”)

Course	**Topic**
C.S. 2656	Database application presentation to outside clients
C.S. 3406	Internals of an existing operating system
S.E. 3250	• Usefulness of ethical codes • Process models
S.E. 3260W	• Software development and/or software metrics • Software system requirements presented to outside clients
C.S. 4406	Difference between various architectures

Additional presentations will come from include internships and senior design projects.

Reflection papers (R):

To evaluate SE2, SE7, SE9, SE10 and SE16 we will do the following things for course:
CS 2656, SE 3250, SE 3260W, SE 4920. In these courses the students will complete a multi-stage project for outside clients.

Reflection paper written by the students to answer the following questions:
How did we work as a team? (SE2)

How did we work with the clients? (SE7)
What things could we do better next time?
What is the process that I have to use to quickly get up to speed in the application domain of the clients? (SE16)
What new technologies did you need to learn to accomplish this project? (SE9)
What techniques did you use to learn the new technology that you used in the project? (SE9)

Project evaluation complete by the clients to determine the following:
How satisfied are you with the finished product? How well did the finished product meet you needs? (SE10)
Did the students appear to be effective as a team? (SE7)
Were the students responsive to your needs? (SE2)

How do we evaluate SE8 & SE9? (Suggestions included: give the students something that they haven't used before like a writing an easy program in a certain language or give them an unfinished program in a different language and have them finish it)
The courses that address life-long learning are CS/SE 4940, CS/SE 1000.
We still don't know what to do for this. Let's discuss how to assess SE8 at the IAB meeting.

Constituents

CS department faculty
Members of the IAB
Students
Employers of our interns

Program Outcome Course Matrix

The following table shows the correspondence between the program outcomes and the courses in the Software Engineering curriculum. The first column indicates the assessment method using the following key:

e	annual or exit exam (This will be given at the beginning of sophomore, junior, and senior years, and then the exit exam at the end of the senior year.)
o	SE5 oral assessment
w	SE5 written assessment
?	unknown
r	reflection paper

The fourth column gives a correspondence between our outcomes and ABET outcomes. A list of ABET outcomes is given at the end of this document.

The X's and C's given in the matrix are interpreted as follows:

X	covered
C	contributes indirectly

The X’s and C’s given in the matrix are interpreted as follows:

Assessment Method	Number	Program Outcome	ABET/SEC	SE100	SE325	SE326	SE328	SE330	SE427	SE492	SE494	CS210	CS211	CS215	CS254	CS265	CS316	CS331	CS332	CS335	CS340	CS440	CS452	Spec. Elect
e	SE1	Make sensible moral and ethical decisions	f	X	X		X						X			X		X						
r	SE2	Be able to work with clients, have tact and see things from other perspectives	c		X	X		X		X														
e	SE3	Be able to identify and evaluate technical alternatives		X	X				X	X					X	X		X	X	X	X	X	X	
e	SE4	Be able to identify and evaluate non-technical alternatives	h	X	X	X		X	X	X														
ow	SE5	Apply oral and written skills effectively	g	X	X	X	X	X	X	X	X										X	X		
e	SE6	Be aware of the state of the art and best practices in Software Engineering	k		X	X	X	X	X	X	X	X	X	X	X	X		X	X				X	
r	SE7	Able to work effectively in multidisciplinary teams	d		X	X		X		X						C								
?	SE8	Be committed to professional growth and development	i	X							X									H	H	H		
r	SE9	Be able to learn new technologies on their own	i		X			X		X						X				X			X	
r	SE10	See a multistage project/task through to completion			X	X	X	X		X						X								
e	SE11	See the essence of the problem and design a solution	e		X		X		X	X		X			X	X		X	X	C				
e	SE12	Staying current with respect to societal issues relating to computer technology	j	X		X		X			X					X								
e	SE13	Be able to apply quantitative methods to software development	b/2		X	X	X			X													X	
e	SE14	Be able to apply skills gained in math, science, engineering, and business	a				X			X	X					X	X	X	X			X		
e	SE15	Be technically proficient and able to perform all phases of software development	1		X	X	C	X	C	X		X	X	X	X			X	X		X		X	

r	SE16	Be able to work effectively in a non-IT application domain	3		X	X				X														X
e	SE17	Be able to observe, use, reflect on and refine software development and business processes			X	X	X			X													X	

Correspondence Between Our Program Outcomes and ABET Outcomes

The following table lists ABET General Criteria 3. (These are the ABET "(a) through (k)" criteria.)

identifier	description
ABET-a	an ability to apply knowledge of mathematics, science and engineering
ABET-b	an ability to design and conduct experiments, as well as to analyze and interpret data
ABET-c	an ability to design a system, component, or process to meet desired needs
ABET-d	an ability to function on multi-disciplinary teams
ABET-e	an ability to identify, formulate and solve engineering problems
ABET-f	an understanding of professional and ethical responsibility
ABET-g	an ability to communicate effectively
ABET-h	the broad education necessary to understand the impact of engineering solutions in a global and societal context
ABET-i	a recognition of the need for, and an ability to engage in life-long learning
ABET-j	a knowledge of contemporary issues
ABET-k	an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

These are the ABET Program Criteria that apply specifically to SE degree programs.

identifier	description
SEC-1	the ability to analyze, design, verify, validate, implement, apply, and maintain software systems
SEC-2	the ability to appropriately apply discrete mathematics, probability and statistics, and relevant topics in computer science and supporting disciplines to complex software systems
SEC-3	the ability to work in one or more significant application domains