Computer Science
MONTANA TECH OF THE UNIVERSITY OF MONTANA

Computer Science Industry Advisory Board Meeting Minutes
September 19, 2014

Industry Members Present:

- Davis Almanza, IAB Member representing Computers Unlimited
- Terry Brandt, IAB Member representing Zoot Enterprises, Inc
- Phillip Curtiss, IAB Member representing SIAFU Technology Group, LLC
- Bill Ivanich, IAB Member representing EchoStar
- Justin Malsam, IAB Member representing Micron
- Koa McCullough, IAB Member representing Oracle
- David Thompson, IAB Member representing SoFi
- Matt Conroy, representing SoFi
- Zachary Wormgoor, IAB Member representing Schweitzer Engineering Laboratories, Inc.

Montana Tech Representatives Present:

- Jeff Braun, C.S. Dept. Chair
- Frank Ackerman, C.S. Faculty
- Celia Schahczenski, C.S. Faculty
- Keith Vertanen, C.S. Faculty
- Tami Windham, C.S. Administrative Associate
- Garrett Brown, C.S. Student
- Scott Fleener, C.S. Student
- Vernon Foley, S.E. Student
- Terra Miller, S.E. Student

Welcome and Introductions

Doug Coe, Dean of the College of Letters, Sciences and Professional Studies welcomed the board members to Montana Tech and thanked the members for the time and efforts they put into the Computer Science program. Dr. Coe informed members that Montana Tech students once again scored very well on the ETS Major Field Test compared to the national average. Dr. Coe informed members that enrollment was up in the Computer Science program. He contributed this success to the leadership and hard work of the department head Jeff Braun.

Introduction of all attending the meeting were made. Jeff Braun, Department Head welcomed the board members to Montana Tech and thanked the members for their input to the department.

Computer Science Department Updates (Jeff Braun)

- Enrollment remains high – record setting enrollment of 2945 students at Montana Tech
    - 72 students in CS/SE for fall 2014, up from 58 in fall 2013.
- Freshmen Engineering Program (FEP) was launched in fall 2014 with 249 students enrolled
    - Software Engineering freshmen are not enrolled in this program
- New Director of Student Success – Carrie Vath
    - Advises all new CLSPS freshmen, including CS/SE freshmen
- Buildings:
    - Natural Resources Laboratory Building
        - Architects are completing design, will be located east of ELC
        - Will free up space in Science and Engineering (SE) Building
            - Possibly move 3D data visualization lab to SE Building
    - Still planning a new dormitory

- National Recognition/Rankings
    - 23rd Best Public School - Money Magazine
    - 12th Baccalaureate Colleges - Washington Monthly
    - 6th Highest Graduate Salaries in nation
    - 19th Colleges with Best Return on Investment
    - Military Friendly School – top 20% of all colleges

Department Updates Outline

- Faculty:
    - Frank Ackerman is back form sabbatical
    - Michele Van Dyne is on sabbatical
- Accreditation
- Curriculum
- Recruiting Efforts and Enrollment
- Research Activity

ABET Accreditation

- ABET Accreditation - 6 year cycle
    - Both CS and SE Programs accredited to 2017
    - Next ABET visit is Fall 2016
    - 2015-16 Academic Year
        - Assessment Committee review - Fall 2015
        - Collect examples of student work (assignments, programs, exams)
        - Create course notebooks
        - Prepare Program Reports
            - CS Program - Computing Accreditation Committee (CAC)
            - SE Program - Engineering Accreditation Committee (EAC)

Curriculum

- Software Verification and Validation course
    - Approved and plan to offer in Spring 2016
- CSCI 443 User Interface course replaced with COMX 338 User Experience and Design
- CSCI 102 Computational Thinking
    - Two sections this fall to nearly 50 students
- CS 2013 Curriculum Guidelines
    - Faculty completed overview spreadsheet provided with the curriculum which motivated some course enhancements

Recruiting Efforts

- CodeMontana started Fall 2013
    - Goal: Increase CS graduates in Montana
    - Introduce high school students to coding and computer science
    - $4000 CodeMontana scholarships offered from MT Tech (see scholarships below)
    - CSCI 191 CodeMontana: Intro to CS course this fall so students can also earn college credit
- Gianforte Family Foundation proposals we are working on this fall to address:
    - More Montana students entering CS
    - More Montana students graduating in CS More CS graduates working in Montana
- Tech's recruiters purchased contact information for more students interested in Computer Science in 2013-14
- Tech Days – One hour mobile application development for high school students that attend one of the Tech Days
- Hour of Code – Presentation made to 11 Butte High Math Classes resulting in more Butte students majoring in CS
    - Plan to repeat in December 2014

- Improving retention and graduation rates
    - Average ~20% graduation rate over last 10 years
    - 25% graduation rate in 2013
    - 42% for 2014 with 8 graduates
    - 39% expected for 2015 with 7 graduates

Scholarships

- Code Montana $4000 scholarship awarded over 2 years
    - Complete 4 CodeHS.com modules
    - 6 students received the scholarship
- R.E.A.L. Scholarship Program - Year 6
    - Earn up to $600 by completing 4 online modules
    - 9 new students completed modules
    - Competitive Programming Challenges
        - Three students earned an additional $200 to $600
    - Currently helps support 16 students ($2800/year)
- Montana Minds Scholarship ($6500) returned for 2013-14.
    - 3 more CS and SE freshmen received
- Enrollment is the highest it have been for over 10 years:

Enrollment

Total students

	SE	CS	CS+SE	
2001	16	100	116	
2002	18	86	104	
2003	28	69	97	
2004	26	45	71	
2005	20	45	65	
2006	21	36	57	
2007	25	26	51	
2008	21	26	47	
2009	26	27	53	
2010	20	28	48	FESP began
2011	22	26	48	
2012	24	34	58	
2013	27	31	58	
2014	32	39	72	FESP ends

Enrollment

CS+SE	total fr	total grads	%graduate
2001	41		
2002	34		
2003	40	13	
2004	22	7	14
2005	21	7	17
2006	17	10	29
2007	24	11	28
2008	23	5	23
2009	24	4	19
2010	19 (FESP)	4	24
2011	18	2	8
2012	16	4	17
2013	18	6	25
2014	34 (No FESP)	8	42

Retention

- Tracking why students leave CS/SE with an brief exit interview
    - Most students leave because they don't enjoy programming or struggle with it.
    - Some struggle with math courses as well
- School tracks some info:
    - 184 unique students majored in CS/SE for at least one term over the past 5 years (2008-13)
    - 33 graduated from Tech, 22 in CS/SE
        - Other programs these students graduated from:
            - 2 Business and Information Technology (BIT),
            - 3 Network Technology (NT),
            - 1 Professional and Technical Communications (PTC),
            - 1 Petroleum Engineering (PE),
            - 2 General Engineering (GE),
            - 2 Statistics (STATS)
    - 83 Registered in Fall 2013 (58 remain in CS and/or SE, the other 25 switched to other majors at Tech)

- 68 no longer at Tech, 53 had last major of CS/SE
    - 20 of 53 tracked to other schools

Where the 20 students went:

ASHFORD UNIVERSITY ENVIRONMENTAL STUDIES 1
HELENA COLLEGE ASSOCIATE OF SCIENCE-1, COMPUTER TECHNOLOGY-1
LOUISIANA STATE UNIVERSITY AT EUNICE - 1
METROPOLITAN STATE UNIVERSITY OF DENVER - 1
MONTANA STATE UNIVERSITY – BOZEMAN - COMPUTER SCIENCE - 1
MONTANA STATE UNIVERSITY – NORTHERN - 2
MONTANA STATE UNIVERSITY-BILLINGS - 1
RED ROCKS COMMUNITY COLLEGE - 1
SADDLEBACK COLLEGE - 1
UNIVERSITY OF ALASKA – ANCHORAGE- 1
UNIVERSITY OF MONTANA- 6
COMPUTER SCIENCE-1
ELECTRONICS TECHNOLOGY-1
PRE-RESPIRATORY THERAPY TECH-1
PSYCHOLOGY-1
UNIVERSITY OF MONTANA – WESTERN - 2

Other Activities

- Developing video display system to show student and faculty projects in Museum Lab
- Web site - current events
    - Department Facebook page being developed in lieu of a newsletter
- First Robotics Competition for high school teams held in HPER in Dec. 2012 and Nov. 2013
- Grace Hopper Conference for women students – Attempted to register 4 students and 1 faculty member in Fall 2014 but conference filled up too quickly. Will try again in Fall 2015.

Research and Scholarly Activity

- Keith Vertanen received Montana Tech's 2014 Distinguished Researcher Award
- Keith Vertanen presented one paper in 2013-14
    - Coauthored eight publications, two with students
- Keith Vertanen submitted 3 grant proposals
- Michele Van Dyne had 3 publications in 2014
- Celia Schahczenski submitted 2 proposals
- Frank Ackerman - Robotic Undergraduate Research Project (URP) last summer
    - Invited to software engineering presentation in Austria
- Jeff Braun heading up Tech's HPC initiative
    - Coauthored and presented paper at SIG-CSE
- All faculty attended conferences and workshops
- Adjunct Research Faculty positions to increase URP opportunities and grant proposals

IAB Members/Students (Comments/Suggestions/Questions):

- IAB members support the Software Verification and Validation course
- Money should not hinder students, there are plenty of scholarships out there that student should be applying for.
- Student testimonial: "Had I realized the return I would have received on my investment I would have made more of an effort to finance school." "Students should be taught education awareness; the value of getting a college degree compared to not getting a college degree." (Vernon Foley, SE Student)
- Students don't seem to understand what Computer Science is about, have you done any outreach? Have you spoke with other teachers around Butte? *Time is an issue for the department to do visits. Keith did some high school visits in 2012-2013 when he had a course release; he felt the outreach was successful. Celia and Frank did some high*

school visits in 2013-2014. The department received good feedback from students and teachers. Students were surprised that they were good at coding; their teachers were surprised at their skills.

- Do the visits need to be done by a professor? *Absolutely not. We did a pilot where one of our graduates would visit his own high school last year; however he never made it to the high school for a visit.*

Welcome

Chancellor Don Blackketter welcomed the board members to Montana Tech and emphasized the importance of their advice to the department. Dr. Blackketter indicated that the recent recognition received by MT Tech is a tribute to the faculty and staff`s hard work. Chancellor Blackketter stressed the importance of recruiting students that want to go to Tech, placing the student correctly when they enter, enrolling them in the courses that will make them successful and then graduate them. He informed members that they are attacking renovation needs around campus, using state funds, making the campus looked loved. Dr. Blackketter expressed the importance of a good appearance, not only for the students but for the faculty and staff as well. Chancellor Blackketter conveyed his appreciation to the board members for their time, support and feedback to the Computer Science program.

Computer Science and Software Engineering Program Assessment (prepared by Michele Van Dyne)

CS Assessment Results: Fall 2013 - Spring 2014

- ABET Accreditation uses assessment of program objectives and student outcomes as part of their process of evaluating computing programs
- We gather assessment data on objectives and outcomes and report this to the assessment committee annually
- The assessment committee is comprised of members of industry (our IAB), a recent alumnus, a student, and the faculty
- This annual meeting is the venue for presenting those assessment results and gathering input on any changes we might have based on the results

Program Objective Assessment

- Program objectives are those criteria we expect our graduates to meet after being in the workplace for a period of time
- Alumni who graduated 4-5 years ago are surveyed to measure program objectives
- Survey administered every two years, and was reported last year, so we will not be reporting assessment results on that today

Student Outcome Assessment

- Student outcomes are those criteria we expect students to meet immediately upon completing coursework within the CS and SE programs
- Each course has course outcomes, and these are mapped to more general student outcomes
    - These more general student outcomes are one part of how our programs are evaluated by the ABET accreditation teams
- Outcomes between the two programs are similar but do have differences

Student Outcomes: CAC

(a) *An ability to apply knowledge of computing and mathematics appropriate to the discipline*
(b) *An ability to analyze a problem, and identify and define the computing requirements appropriate to its solutions*
(c) *An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs*
(d) *An ability to function effectively on teams to accomplish a common goal*
(e) *An understanding of professional, ethical, legal, security and social issues and responsibilities*
(f) *An ability to communicate effectively with a range of audiences*
(g) *An ability to analyze the local and global impact of computing on individuals, organizations and society*
(h) *Recognition of the need for and an ability to engage in continuing professional development*

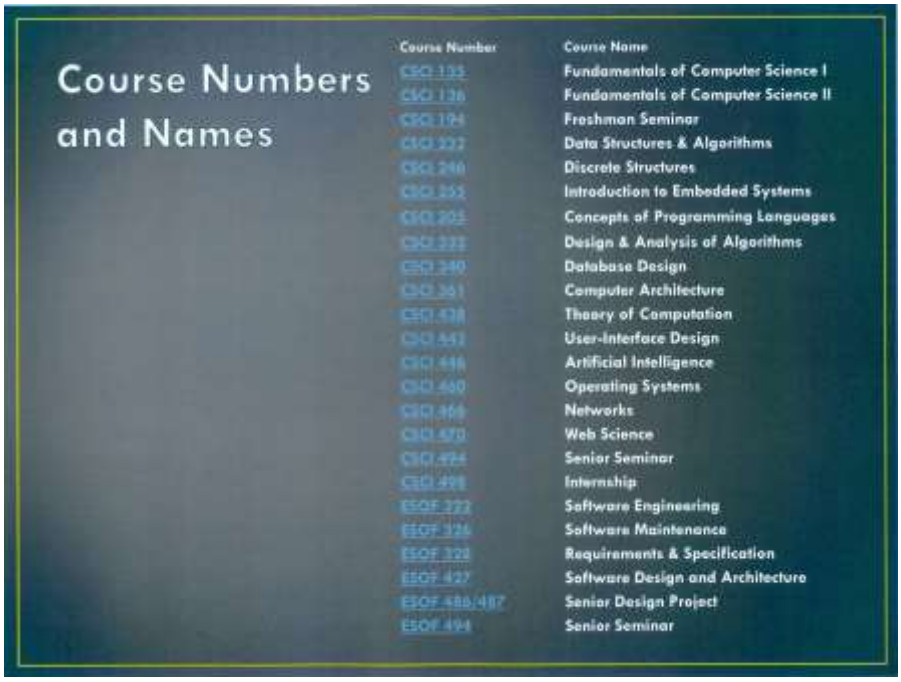
(i) *An ability to use current techniques, skills and tools necessary for computing practices*
(j) *An ability to apply mathematical foundations, algorithmic principles and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices*
(k) *An ability to apply design and development principles in the construction of software systems of varying complexity*

Student Outcomes: EAC

(a) *An ability to apply knowledge of mathematics, science and engineering*
(b) *An ability to design and conduct experiments, as well as to analyze and interpret data*
(c) *An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability*
(d) *An ability to function on multidisciplinary teams*
(e) *An ability to identify, formulate and solve engineering problems*
(f) *An understanding of professional and ethical responsibility*
(g) *An ability to communicate effectively*
(h) *The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context*
(i) *A recognition of the need for and an ability to engage in life-long learning*
(j) *A knowledge of contemporary issues*
(k) *An ability to use the techniques, skills and modern engineering tools necessary for engineering practice*
The program must demonstrate that graduates have: (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; and (SEC-4) the ability to manage the development of software systems.

- The curriculum must provide both breadth and depth across the range of engineering and computer science topics implied by the title and objectives of the program.

Course Numbers and Names:



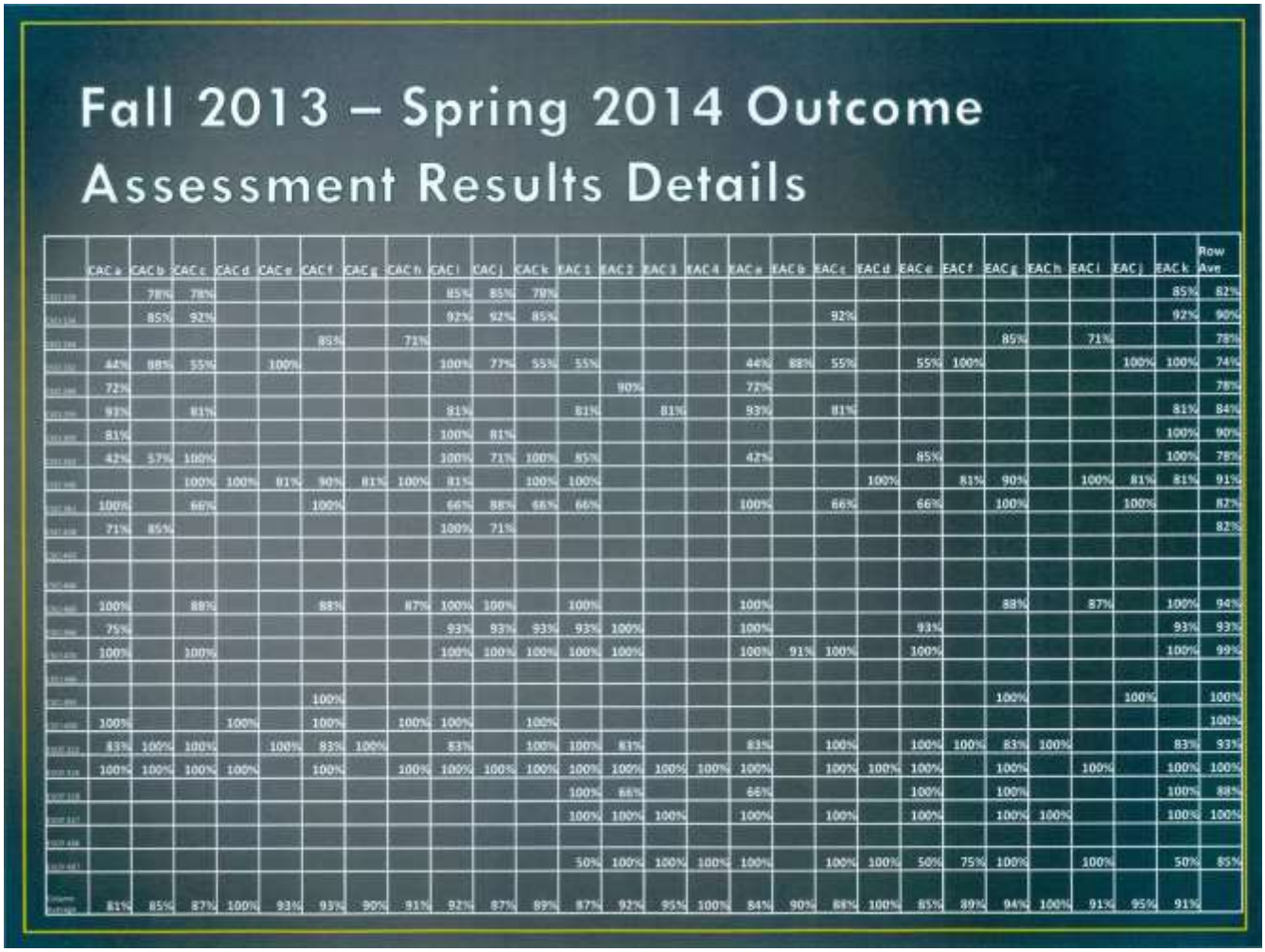
Fall 2013 - Spring 2014 Outcome

Assessment Results

- Our expectation is that 75% of students will meet each outcome at a level of 70% or above
- The percentages in this table are the percent of students meeting that outcome
- None of our outcomes fell below 75% across all courses
- NOTE: This is the first year we are using a student written program to report those results
- AbOut has been in development over the past few years, and is reaching a level of utility now

Outcome	Fall 2013	Spring 2014	Row Average
CAC a	78%	89%	83%
CAC b	81%	86%	84%
CAC c	81%	89%	85%
CAC d	82%	90%	86%
CAC e	84%	90%	87%
CAC f	85%	91%	88%
CAC g	85%	91%	88%
CAC h	85%	91%	88%
CAC i	87%	91%	89%
CAC j	86%	91%	89%
CAC k	86%	92%	89%
EAC 1	86%	91%	89%
EAC 2	87%	91%	89%
EAC 3	87%	91%	89%
EAC 4	87%	92%	89%
EAC a	86%	91%	89%
EAC b	86%	91%	89%
EAC c	86%	91%	89%
EAC d	86%	92%	89%
EAC e	86%	91%	89%
EAC f	87%	91%	89%
EAC g	87%	91%	89%
EAC h	87%	91%	89%
EAC i	87%	91%	89%
EAC j	87%	92%	89%
EAC k	87%	91%	89%
Column Average	85%	91%	

Assessment Results Details



	CAC a	CAC b	CAC c	CAC d	CAC e	CAC f	CAC g	CAC h	CAC i	CAC j	CAC k	EAC 1	EAC 2	EAC 3	EAC 4	EAC a	EAC b	EAC c	EAC d	EAC e	EAC f	EAC g	EAC h	EAC i	EAC j	EAC k	Row Ave
		78%	78%						85%	85%	78%															85%	82%
		85%	92%						92%	92%	85%							92%								92%	90%
						83%		71%														85%		71%			78%
	44%	88%	55%		100%				100%	77%	55%	55%				44%	88%	55%		55%	100%				100%	100%	74%
	72%												90%			72%											78%
	93%		81%						81%			81%		81%		93%		81%								81%	84%
	81%								100%	81%																100%	90%
	42%	57%	100%						100%	71%	100%	85%				42%				85%						100%	78%
			100%	100%	81%	90%	81%	100%	81%		100%	100%							100%		81%	90%		100%	81%	81%	91%
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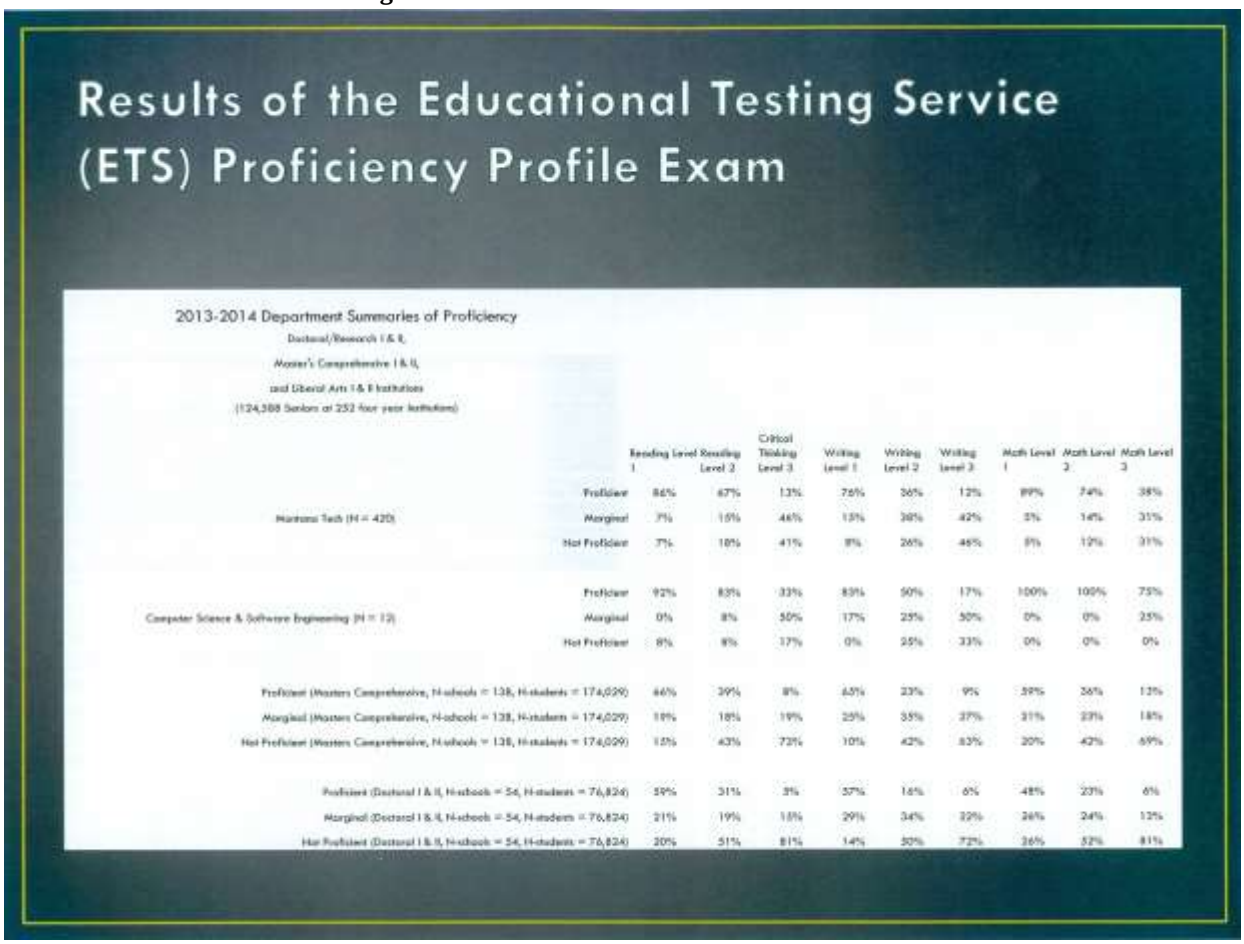
												50%	100%	100%	100%	100%		100%	100%	50%	75%	100%		100%		50%	85%
	81%	85%	87%	100%	93%	93%	90%	91%	92%	87%	89%	87%	92%	95%	100%	84%	90%	88%	100%	85%	89%	94%	100%	91%	95%	91%	

Additional Independent/External Assessments

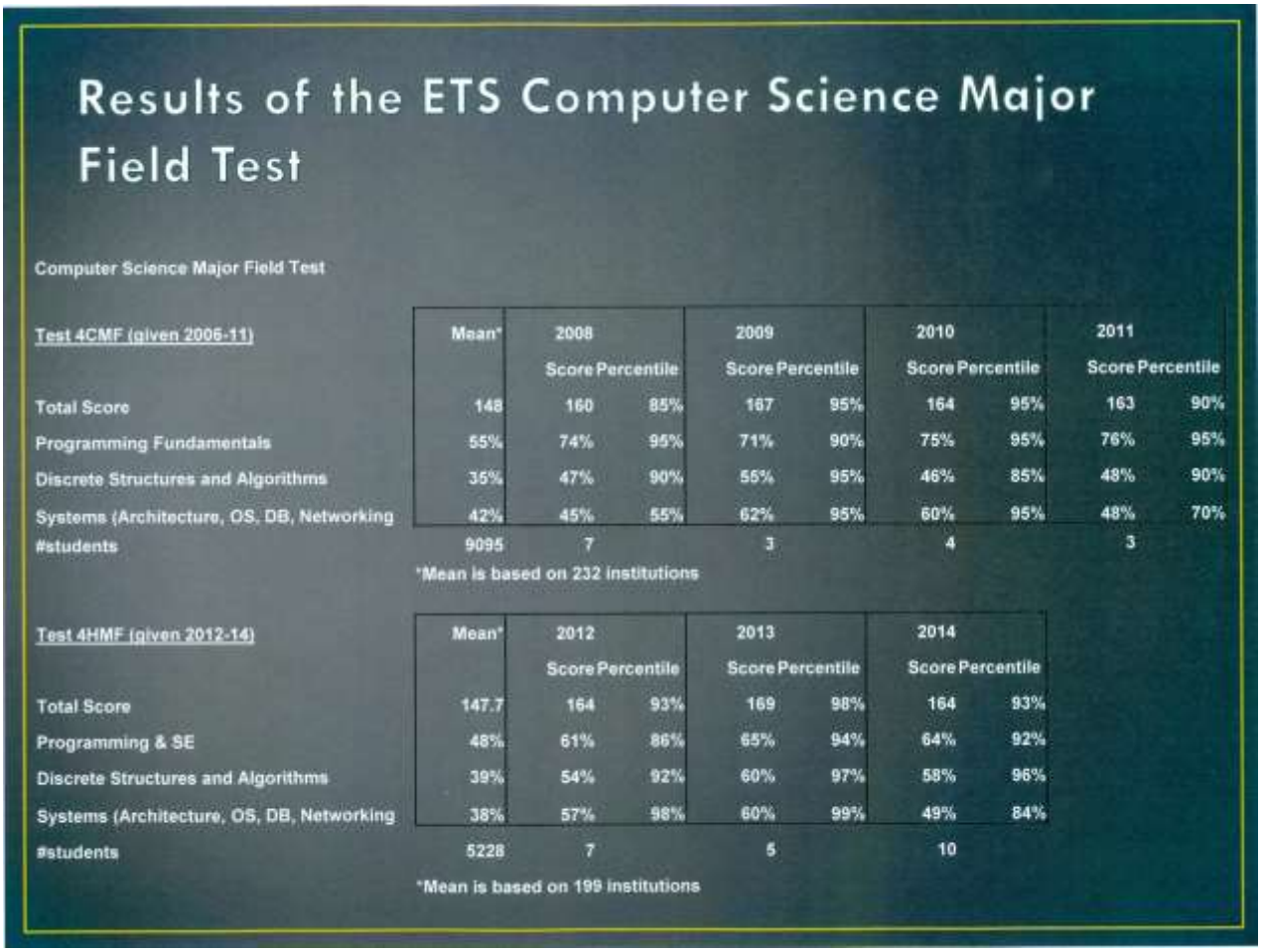
- Educational Testing Service (ETS) Proficiency Profile Exam
- ETS Computer Science Major Field Test

Results of the Educational Testing Service



		Reading Level 1	Reading Level 2	Critical Thinking Level 3	Writing Level 1	Writing Level 2	Writing Level 3	Math Level 1	Math Level 2	Math Level 3
	Proficient	86%	67%	13%	76%	36%	12%	89%	74%	38%
Montana Tech (N = 420)	Marginal	7%	15%	46%	15%	38%	42%	5%	14%	31%
	Not Proficient	7%	18%	41%	8%	26%	46%	8%	12%	31%
	Proficient	92%	83%	33%	83%	50%	17%	100%	100%	75%
Computer Science & Software Engineering (N = 12)	Marginal	0%	8%	50%	17%	25%	50%	0%	0%	25%
	Not Proficient	8%	8%	17%	0%	25%	33%	0%	0%	0%
Proficient (Masters Comprehensive, N-schools = 138, N-students = 174,029)		66%	39%	8%	65%	23%	9%	59%	36%	13%
Marginal (Masters Comprehensive, N-schools = 138, N-students = 174,029)		19%	18%	19%	25%	35%	27%	21%	23%	18%
Not Proficient (Masters Comprehensive, N-schools = 138, N-students = 174,029)		15%	43%	73%	10%	42%	63%	20%	42%	69%
Proficient (Doctoral I & II, N-schools = 54, N-students = 76,824)		59%	31%	3%	57%	16%	6%	48%	23%	6%
Marginal (Doctoral I & II, N-schools = 54, N-students = 76,824)		21%	19%	15%	29%	34%	22%	26%	24%	13%
Not Proficient (Doctoral I & II, N-schools = 54, N-students = 76,824)		20%	51%	81%	14%	50%	72%	26%	52%	81%

Results of the ETS Computer Science Major Field Test



Results of the ETS Computer Science Major Field Test

Computer Science Major Field Test

Test 4CMF (given 2006-11)	Mean*	2008		2009		2010		2011	
		Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Total Score	148	160	85%	167	95%	164	95%	163	90%
Programming Fundamentals	55%	74%	95%	71%	90%	75%	95%	76%	95%
Discrete Structures and Algorithms	35%	47%	90%	55%	95%	46%	85%	48%	90%
Systems (Architecture, OS, DB, Networking	42%	45%	55%	62%	95%	60%	95%	48%	70%
#students	9095	7		3		4		3	

*Mean is based on 232 institutions

Test 4HMF (given 2012-14)	Mean*	2012		2013		2014	
		Score	Percentile	Score	Percentile	Score	Percentile
Total Score	147.7	164	93%	169	98%	164	93%
Programming & SE	48%	61%	86%	65%	94%	64%	92%
Discrete Structures and Algorithms	39%	54%	92%	60%	97%	58%	96%
Systems (Architecture, OS, DB, Networking	38%	57%	98%	60%	99%	49%	84%
#students	5228	7		5		10	

*Mean is based on 199 institutions

Industry Update - IAB Members

Justin Malsam, Micron

- **Industry Trends:** Microsoft Shop (still use Visual Basic, but more C# now), SAP Shop for process modeling**,** Working with Big Data (collecting data from time order placed through shipping), want developers with real DB experience and OO with C#

- **Software development tools used and recommendations:**
  Visual Basic, C++, C#, SQL, Oracle, Microsoft WPF, ClearQuest, Database experience, MS SharePoint

- **Website/blog - N/A**

Terry Brandt, Zoot Enterprises, Inc.

- **Industry Trends:** Big Data, Enterprise Mobility, Linux Servers
    - Enterprise mobility – seamless on all devices, keep in mind while developing, "digit natives" (people born after 1986) expect this
    - Gamification of device and design – user leaves feeling good, wants to come back
    - Bring user experience into design early – getting users involved earlier in design process

- **Software development tools used and recommendations:**
  Linux shop, desktops are Windows but everything is with VM, C, C++, Java, Python, HTML5, JavaScript, Eclipse, CVS (Concurrent Versions System) in the past, Subversion (used CVS but Subversion works much better), Hudson, Jira bug tracking, iMessage, WebEx, Logstash, Axure, Balsamiq, Oracle relational databases

- **Website/blog**: Nextgov.com

Phillip Curtiss, SIAFU Technology Group, LLC

- **Industry Trends:** Big Data (how to process that data, what you process it on), cloud computing, and complex problems (meaning lots of multi-disciplinary things coming together). Project work, building frameworks to work together using virtual computers.

- **Software development tools used and recommendations:**
  Microsoft Shop with VMs for each environment, Visual Studio, Eclipse, C, C++, Linux, VxWords, Google Apps (for communication), Skype, WebEx, Basecamp for project management (repository to share documents)

- **Website/blog:** Slashdot

Zachary Wormgoor, Schweitzer Energy Labs (SEL)

- **Industry Trends:** IMS Test Environment**,** Rapid Prototyping

- **Software development tools used and recommendations:**
  Moving from Delphi to C#, WinForms with some WPF, Silverlight to HTML5, Enterprise Architect, NUnit, OpenCover, NeSt, IMS Test, ClearCase version control but moving to Git, ClearQuest bug tracking, Code Collaborator for code review ("nice to work with"), WebEx, NoSQL for Big Data, Doors for requirements management but looking into Atlassin tools, bringing usability into the process earlier

- **Website/blog:** Stack Overflow

KOA McCullough, Oracle

- **Industry Trends:** Big Data, Mobile Cloud Services

- **Software development tools used and recommendations:**
  C, C Sharp, PHP, Python, recommends Launchpad (bug tracking, version control), Git

- **Website/blog:** PlanetMySQL

David Thompson, SoFi, Software Finance

- **Industry Trends: Amazon Web Services (**AWS) Servers for cloud computing

- **Software development tools used and recommendations:**
  Logstash Kibana, New Relic, Eclipse, Atlassian, Jira, HipChat, API Framework, Scala, Node.JS, Bitbucket, Chef and Puppet tools in Ruby, Docker for a virtual machine

- **Website/blog:** N/A

Bill Ivanich, EchoStar

- **Industry Trends:** In house development

- **Software development tools used and recommendations:**
  Linux shop (SlickEdit, Eclipse, VI), C#, C++, ClearCase ("expensive but works well"), Mantis for change control (but Bill's group uses Bugzilla), XML, Godzilla, QT for building user interfaces, MS IM and Outlook, SharePoint

- **Website/blog:** Agile Fusion

Davis Almanza, Computers Unlimited

- **Industry Trends:** AWS Cloud Computing, Agile and kanban

- **Software development tools used and recommendations:**
  C#, Java, Eclipse, Jira, JUnit, Chef & Puppet (tools in Ruby), IM Software, HIT Chat, Atlassian, Bitbucket, CoffeeScript, SharePoint for documentation

- **Website/blog:** LinkedIn, Redhat.com

Big Data-IAB Members, Keith Vertanen

- Curriculum suggestions to prepare students for working with big data
  - Key Challenges: Analysis, capture, search, sharing, storage, transfer, security, privacy
  - How to store and monitor big data on production servers
  - Taking a problem and break it down to a smaller problem; find tools that can actually do this
  - Teach Map Reduce – students learn how to break down data problems
  - Teach why we are doing big data
  - Teach what are we going to do with big data
  - Teach different types of data storage
  - Micron using Hadoop to look at data associated
  - Offer - *Introduction to Big Data Class – junior level course*

Software Engineering Program - (Celia Schahczenski)

- Should Software Engineering join the new Freshman Engineering Program?
  - SE Mission
    "Our program prepares students to develop quality software systems using proven software engineering methodologies. Our graduates positively influence how software products affect society and carry on our institution's tradition of excellence. Our graduates have excellent skills, a "can do" attitude and meet industry expectations right out of college."
  - Description of SE Program
    "Software Engineering focuses on how to design & build software products that reliably deliver valuable services year after year. You will take many of the same courses as you would in computer science, but you

will take additional courses that teach you about topics like software requirements, software design, & software testing. You will also learn about working with people (communication, management, working with non-technical customers), methodologies for developing software, & how to measure and analyze a software system."

- Description of CS Program

  "Computer Science covers the core concepts and technologies involved with how to get a computer system to perform a desired function. Learning to program a computer is an essential part of such a task. Computer programming is used in almost all of our computer science courses & most of our software engineering courses. As a computer science major you will learn details about how computers & networks work, but with an emphasis on how software & programming languages work. You will also learn about the theory behind how & why computers and software work."

- Curriculum Differences

	SE	CS
Program	128 credits	120 credits
CS Dept. Courses	User interface Design •Requirements & Specifications •Software Architecture •Software Verification and Validation	•Theory of Computation •Artificial Intelligence

- Differences - other courses

	SE	CS
Other Courses	•Engineering Economics	•Numerical Computing •Linear Algebra
Science	14-15 credits, physics sequence (11 credits) & chemistry, biology or geology w/ a lab.	11-12 credits, must include a lab sequence. Can be physics, chemistry, biology or geology
Project	Senior Design – 6 credits	Internship – 4 credits

- Freshmen engineering curriculum:
  - New this year
  - Introduces students to all engineering disciplines before choosing and engineering major
  - SE freshmen are not participating
  - SE freshmen are not participating
  - Program:http://www.mtech.edu/academics/mines/fep/curriculum/fep-worksheet.pdf

- Discussion
    - Do you find value in the current SE program? What?
    - How can we make it more valuable?
    - Software engineering tools we should be using?
    - Standardized or flexible project?
    - Join the freshmen engineering program?
    - Others?

IAB Members/Students (Comments/Suggestions/Questions):

- Are the students exposed to only engineering topics? *First semester Excel, CAD/CAM, small design project and open houses with each engineering program. Second semester the students have exposure to three different disciplines in two week modules and the student can choose the modules. Students will also have a 6-week Matlab module.*
- Just because Software Engineering has engineering as a title does not be mean we are engineers. There is a big fundamental difference. Software engineering is closer to computer science than engineering
- Software engineering is significantly different than engineering
- There are not many SE graduates out there
- Software engineering is not something we look for on a resume, but the experience is valuable, not just coding but the complete design
- There is not much difference in the two (Computer Science and Software Engineering); I would not put them in two different jobs and I would not pay software engineers anymore
- Things you are missing from the CS degree you are not going to get on the job. You are never going to get Theory of Computation or Numerical Computing; both are pretty useful things to have
- Software engineering is valuable in industry
- Senior projects at some other universities are industry projects:
    - Some start project with company for two weeks at end of summer and then work on for full year
    - Companies have to be committed to project and allocate time over the year
- An open source project could be used for senior or maintenance projects
- Eliminate a science course from the software engineering curriculum to make room to add Theory of Computation to the SE curriculum
- Theory of Computation should be part of the software engineering curriculum
- Eliminate some of the physics courses from the software engineering curriculum
- Proposals for funding: You-Tube video you can share on website (do a video of interns/graduates working at companies)

Meeting adjourned.

Respectfully submitted,

Tami Windham