Computer Science
MONTANA TECH OF THE UNIVERSITY OF MONTANA

Computer Science Industry Advisory Board Meeting Minutes
September 9, 2015

Industry Members Present:

- Terry Brandt, IAB Member representing Zoot Enterprises, Inc.
- Andrew Ellmaker, IAB Member representing Synesis7
- Bill Ivanich, IAB Member representing EchoStar
- Justin Malsam, IAB Member representing Micron
- David Thompson, IAB Member representing SoFi
- Zachary Wormgoor, IAB Member representing Schweitzer Engineering Laboratories, Inc.

Montana Tech Representatives Present:

- Michele Van Dyne, C.S. Dept. Chair
- Frank Ackerman, C.S. Faculty
- Jeff Braun, C.S. Faculty
- Phillip Curtiss, C.S. Faculty
- Brian Koontz, C.S. Faculty
- Celia Schahczenski, C.S. Faculty
- Tami Windham, C.S. Administrative Associate
- Joshua Lee, S.E. Student
- Mack Sutherland, S.E. Student
- Ross Mitchell, C.S. Student

Welcome and Introductions

Introduction of all attending the meeting were made. Michele Van Dyne, Department Head welcomed the board members to Montana Tech and thanked the members for taking the time to attend the meeting and for their input to the department.

Computer Science Department Updates (Michele Van Dyne)

- Enrollment remains high
- Freshmen Engineering Program (FEP) - 2nd Year
    - Advises all new CLSPS freshmen, including CS/SE freshmen
- Buildings
    - Natural Resources Laboratory Building
        - Construction has started
        - Will free up space in Science and Engineering Building
    - Still planning a new dormitory
- National Recognition/Rankings
    - 12th Baccalaureate Colleges - Washington Monthly
    - 25th Highest Early Career Salaries
    - 19th Colleges with Best Return on Investment

Department Updates Outline

- Faculty:
    - Michele Van Dyne is back from sabbatical
        - Promoted to full professor
        - Demoted to department head
    - Jeff Braun is on sabbatical
        - Promoted to associate professor

        - Celia Schahczenski applying for sabbatical for next year
        - Keith Vertanen left us last spring
        - Phil Curtiss replaces Keith as a Visiting Professor
        - Brian Koontz added as Outreach Coordinator
        - Search has started for 1-2 tenure track faculty
        - 2nd position contingent upon funding
- Curriculum
    - Software Verification and Validation Course
        - Will have first offering Spring 2016
    - CSCI 102 Computational Thinking
        - Being offered to Freshman Engineering Program students
    - Dependent on staffing, we may need to offer some courses every two years (AI, Theory of Computation, Graphics)
        - If we do get the second faculty position funded, this will be a non-issue
    - Data Science is being considered as a program offering

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
        - Create course notebooks
        - Prepare Program Self-Study Reports
            - CS Program - Computing Accreditation Committee (CAC)
            - SE Program - Engineering Accreditation Committee (EAC)

Recruiting Efforts

- CodeMontana started Fall 2013
    - Publicity for need or more CS graduates
    - Introduce high schools students to coding
    - $4000 scholarships offered from MT Tech
    - CSCI 191 CodeMontana: Intro to CS course
- Gianforte Family Foundation Grant:
    - Purpose
        - More Montana students entering CS
        - More students graduation in CS in Montana
        - More CS graduates working in Montana
    - Grant
        - 2 ½ years funding for Outreach Coordination
        - The department is hosting and managing the CodeMontana site

Scholarships

- 20 Code Montana Scholarship $4000 over 2 years
    - Complete 4 modules OR AP score of 4-5
    - ACT Math score of 24 or higher (SAT Math score of 590 or higher).
    - 12 students received the scholarship
        - 6 last year, 6 this year
- R.E.A.L. Scholarship Program - Year 6
    - Earn up to $600 by completing 4 online modules
    - 6 new recipients this year
    - Competitive Programming Challenges
        - One student earned an additional $400

- Currently helps support 15 students ($2500 this year)
- Montana Minds Scholarship ($6500)

Enrollment/Recruiting

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
2015	24	48	72

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
2015	28	8	44

Retention

- Tracking why students leave CS/SE with an brief exit interview
- Exit interviews within department
  - Information on 9 students leaving CS/SE in the past year
    - All 9 changed majors and are still at Tech

Other Activities

- Video display system to show student and faculty projects in Museum Lab
  - This is up and running
- Second display for interactive use
  - Funding has been approved, expected installation, Jan. 2016
- First Robotics Competition
  - Hosting qualifier since Nov. 2013
  - Brian Koontz and Bryce Hill (EE) will be organizing this year
- Grace Hopper Conference
  - Fall 2015 - Booked up, but trying to get students in
- Montana Tech Robotic Mining Club Placed in Top 10
  - 2015 NASA Robotic Mining Competition, Kennedy Space Center
  - Three of these students were CS/SE
    - Josh Lee, Mack Sutherland, Ross Mitchell

Computer Science and Software Engineering Program Assessment (Jeff Braun)

CS Assessment Results: Fall 2014 - Spring 2015

Assessment Process Summary

- ABET Accreditation uses assessment of educational 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 platform for presenting those assessment results and gathering input on any changes we might make based on results

ABET General Criterion 2

Program Educational Objectives 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 in odd years
- Assessment of whether the objectives are being attained is no longer required for Criterion 4 – Continuous Improvement
- Periodic review of educational objectives ensures they remain consistent with the institutional mission, the program's constituents' needs, and ABET's general criteria.

Educational Objectives: CS

- Graduates of the Computer Science program will have:
- 1. adapted, thrived and contributed in an industry setting or completed a graduate program;
- 2. contributed to the continual improvement and competitiveness of their workplace;
- 3. demonstrated an ongoing commitment to professional development.

Educational Objectives: SE

- Graduates of the Software Engineering program will have:
- 1. adapted, thrived and contributed in an industry setting or completed a graduate program;
- 2. contributed to 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.

Educational Objectives: CS & SE

Educational Objectives: Alumni Surveys

		Objective: 1	2	3	
2011					
	Computer Science	89%	100%	56%	n=9
	Software Engineering	86%	50%	75%	n=8
2013					
	Computer Science	75%	100%	100%	n=4
	Software Engineering	80%	80%	100%	n=5
2015					
	Computer Science				n=1
	Software Engineering	100%	75%	75%	n=4

Student Outcomes Assessment

- Student outcomes are those criteria we expect students to meet immediately after 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*

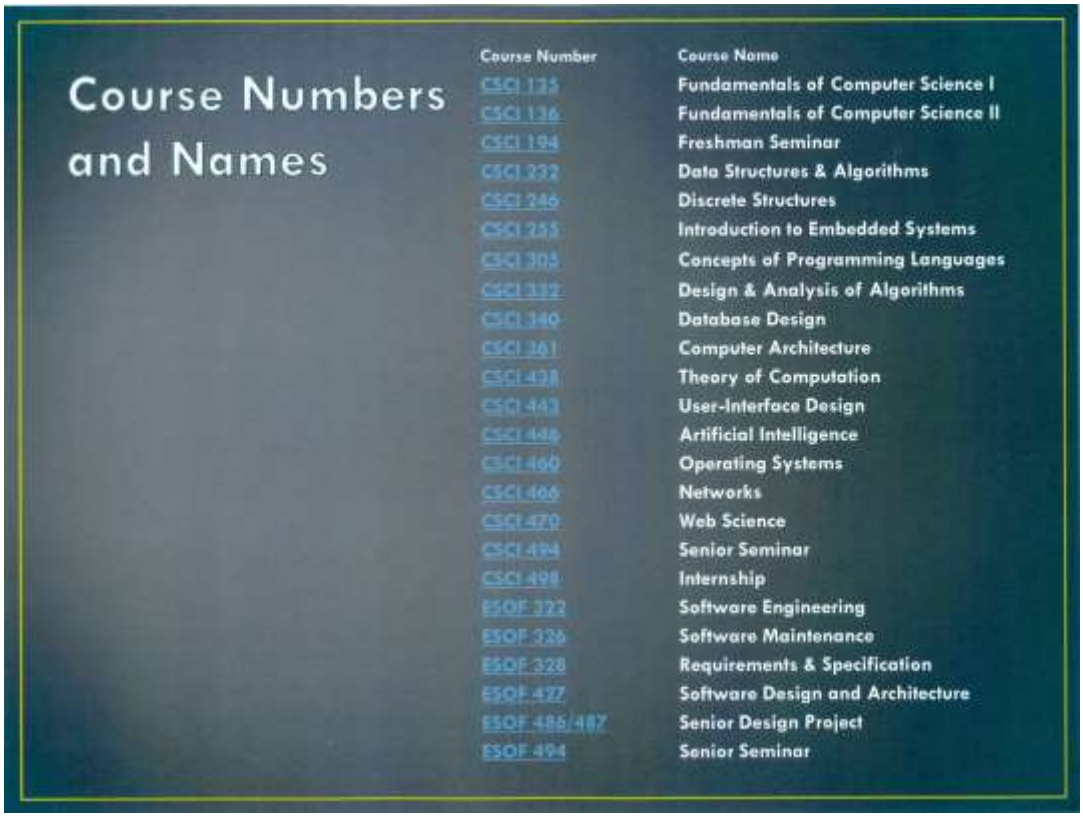
(j) *A knowledge of contemporary issues*

(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 2014 - Spring 2015 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

Outcome	Fall 2014	Spring 2015	Row Average
CAC a	83%	82%	83%
CAC b	80%	82%	81%
CAC c	80%	78%	79%
CAC d	82%	79%	80%
CAC e	83%	81%	82%
CAC f	85%	84%	84%
CAC g	86%	84%	85%
CAC h	87%	85%	86%
CAC i	87%	83%	85%
CAC j	86%	83%	85%
CAC k	86%	82%	84%
EAC 1	86%	82%	84%
EAC 2	87%	82%	84%
EAC 3	87%	82%	85%
EAC 4	87%	83%	85%
EAC a	87%	83%	85%
EAC b	87%	83%	85%
EAC c	87%	83%	85%
EAC d	87%	84%	85%
EAC e	87%	83%	85%
EAC f	88%	83%	86%
EAC g	88%	84%	86%
EAC h	88%	84%	86%
EAC i	89%	85%	87%
EAC j	89%	85%	87%
EAC k	88%	85%	86%
Column Average	86%	83%	

Fall 2014 – Spring 2015 CS Outcome 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	Row Average
CSCI 135		64%	60%						71%	71%	64%	66%
CSCI 136		70%	76%						82%	82%	70%	76%
CSCI 194						87%		91%				89%
CSCI 232	50%	60%	70%		90%				60%	70%	70%	67%
CSCI 246	80%											80%
CSCI 255	100%		89%						92%		96%	94%
CSCI 305	85%								100%	100%		95%
CSCI 332	60%	60%	40%						40%	40%	40%	46%
CSCI 340			55%	88%	77%	88%	77%	66%	100%		55%	76%
CSCI 361	75%		75%			100%			87%	50%	87%	79%
CSCI 438	80%	100%							80%	100%		90%
CSCI 446	90%	100%	100%		100%		100%	100%		90%		97%
CSCI 460	83%		83%			100%		100%	66%	100%		88%
CSCI 466												
CSCI 470	100%		83%						83%	100%	83%	89%
CSCI 486												
CSCI 494					100%	100%		100%				100%
CSCI 498	100%			100%		100%		100%	100%		100%	100%
ESOF 322	78%	71%	85%		92%	92%	100%		78%		78%	84%
ESOF 326	92%	100%	92%	92%	92%	100%		100%	84%	92%	100%	94%
Column Average	82%	78%	75%	93%	92%	96%	92%	94%	80%	81%	76%	

Fall 2014 – Spring 2015 SE Outcome Assessment Results Details

	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 Average
CSCI 135							64%								64%	64%
CSCI 136							94%								82%	88%
CSCI 194											87%		91%			89%
CSCI 232	70%				50%	80%			70%	90%				90%	60%	72%
CSCI 246		100%			80%											90%
CSCI 255	89%		92%		100%		92%		96%						92%	94%
CSCI 305															100%	100%
CSCI 332	40%				60%				40%						40%	45%
CSCI 340	55%							88%		77%	88%		66%	88%	100%	80%
CSCI 361	87%				75%		75%		75%		100%			100%		85%
CSCI 443																
CSCI 460	100%				100%						100%		100%		100%	100%
CSCI 466																
CSCI 470	83%	100%			100%	83%	83%		83%						83%	88%
CSCI 494										100%	100%		100%	100%		100%
ESOF 322	78%	85%			85%		85%		78%	100%	92%	100%			78%	87%
ESOF 326	92%	92%	92%	92%	92%		92%	92%	92%	92%	100%		100%		84%	92%
ESOF 328	75%	50%			75%				50%		75%				50%	62%
ESOF 427	100%	100%			100%		100%		100%		100%				100%	100%
ESOF 486	100%	100%	100%	100%	100%		100%	100%	100%	100%	100%		100%		100%	100%
ESOF 487	100%	100%	100%	100%	100%		100%	100%	100%	100%	100%		100%		100%	100%
Column Average	82%	91%	96%	97%	86%	81%	88%	95%	80%	94%	94%	100%	94%	94%	82%	

Additional Independent/External Assessments

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

Results of the Educational Testing Service (ETS) Proficiency

2014-2015 Department Summaries of Proficiency

Doctoral/Research I & II,
Master's Comprehensive I & II,
and Liberal Arts I & II Institutions
(124,588 Seniors at 252 four year institutions)

		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
Montana Tech (N = 323)	Proficient	90%	69%	11%	74%	33%	8%	88%	73%	36%
	Marginal	5%	18%	44%	20%	40%	42%	10%	15%	33%
	Not Proficient	5%	13%	45%	6%	27%	50%	2%	12%	32%
Computer Science & Software Engineering (N = 6)	Proficient	100%	67%	17%	67%	17%	0%	100%	100%	67%
	Marginal	0%	33%	67%	33%	50%	50%	0%	0%	33%
	Not Proficient	0%	0%	17%	0%	33%	50%	0%	0%	0%
Marginal (N-schools = 252, N-students = 124,588)		66%	39%	8%	65%	23%	9%	59%	36%	13%
Proficient (N-schools = 252, N-students = 124,588)		19%	18%	19%	25%	35%	27%	21%	23%	18%
Not Proficient (N-schools = 252, N-students = 124,588)		15%	43%	73%	10%	42%	63%	20%	42%	69%

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 2012-15)	Mean*	2012		2013		2014		2015	
		Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Total Score	147.2	164	95%	169	99%	164	95%	169	99%
Programming & SE	47%	61%	89%	65%	95%	64%	93%	63%	92%
Discrete Structures and Algorithms	39%	54%	94%	60%	98%	58%	98%	55%	95%
Systems (Architecture, OS, DB, Networking	38%	57%	98%	60%	99%	49%	90%	72%	99%
#students	7530	7		5		10		6	

*Mean is based on 214 institutions

Welcome

Chancellor Don Blackketter welcomed the board members to Montana Tech and emphasized the importance of their advice to the department. Dr. Blackketter informed the members that retention is up which he accredits to students being placed into the right course and the hard work of Tech's faculty. He continued with an overview of projects that are going on around the campus, e.g., the new research building, a new dormitory, collaborative learning space, auxiliary gym, and an energy conservation project on the CBB building. Chancellor Blackketter emphasized that MT Tech's finances are in a solid position. Dr. Blackketter informed members that a "Faculty Excellence Endowment" in the amount of 1 million dollars was donated by one individual. He touched base on the scholarships that have been paid out by the foundation, and stressed that the structure should be changed to work towards incoming freshman. At the present 85% of scholarship support was paid to non-freshman. Once again Chancellor Blackketter conveyed his appreciation to the board members for their time, support and feedback to the Computer Science program.

CS Outreach at Montana Tech (Brian Koontz)

Funding for Outreach Efforts

- GFF funds outreach efforts
- Goals:
    - Seek out students who might not know about CS/SE opportunities at Tech
    - Promote Tech's excellent graduate placement record
    - Provide opportunities to underrepresented populations
- Our Audience
    - 42,070 public high school students
    - 11,067 private/homeschooled students
    - 171 public high schools
    - Approx. 17% minority, 50% female
    - Many of our students come from rural communities with no formal CS programs

Excellent Graduate Placement History

- Destinations for some of our recent graduates:
    - Computers Unlimited
    - Amazon
    - Echostar
    - Yahoo
    - Google
    - Micron
    - Townpump

Outreach Efforts

- CodeMontana/CodeHS
- Dual enrollment
- HS visits
- Scholarships
- Student-focused presentations

CodeMontana/CodeHS

- CodeMontana now hosted and maintained at Tech

CodeMontana

- Non-credit enrollment is free for Montana students
- Two courses: Karel (intro) and advanced programming concepts (JS)
- Students completing the courses are eligible for $4000 scholarship at Tech

Dual Enrollment

- Dual enrollment (college credit) is possible through Tech's Jump Start
- Students receive credit that can be applied to the CS degree program
- Students pay the cost of the credit course (currently)
- High schools in Bozeman and Great Falls are offering their own programs via CodeMontana

HS Visits

- About 10 high school visits planned for each semester
- 10-15 min. presentations about CS/SE opportunities at Tech, promoting CodeMontana
- Hands-on projects using Arduinos

Scholarships

- $4000 CodeMontana scholarship
    - Complete the two CodeMontana courses
    - Score > 24 on the ACT
- $1200 REAl scholarship (separate from CodeMontana)

Student-focused Presentations

- Exploring opportunities to connect in other ways:
    - Girls for a Change conference (Bozeman)
    - GEMS (Girls Excelling in Math and Science, Tech)

Work in Progress

- Big state, traveling salesman problem!
- Identifying other underrepresented groups
- More exposure of Tech CS/SE programs through direct contact (posters, brochures, swag, etc.)
- Other ideas welcome!

Welcome

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 support they give to the Computer Science program. Dr. Coe informed members that the CS department is in the process of hiring two tenure track positions, one of which is contingent on funding. Dean Coe expressed to the members that he is very optimistic that both positions will be funded. Dr. Coe touched base on the new data visualization and collaborative learning space that will be available for student use in the near future. He expressed his appreciation to the board members for their input and feedback to the Computer Science program.

Industry Update - IAB Members

Andrew Ellmaker, Synesis7

- **Industry Trends:** Synesis7 is stuck between the legacy world and leading edge technology because of their clients. Synesis7 is transitioning to Microsoft Edge for Windows 10 for smartphones and tablets. We are busy migrating applications that no longer work and are currently making smartphones and tablets touch enabled.

- **Update on big data/data analysis:** Big data/data analysis is the company's expertise, moving away from relational databases. We are developing more efficient tools to get better results from all of the data and converting the data to the final product.

- **Security:** No development; is always kept in mind.

- **Cloud computing:** Synesis7 employs a lot of remote workers**;** we develop and host our own solutions.

Justin Malsam, Micron

- **Industry Trends:** We are constantly improving the performance of our solutions to help bring new, innovative products to markets. Micron works with large amounts of data. We are looking for people that can analyze data quickly, can adapt quickly, and have the ability to drive and pull things together to get the product out quicker.

- **Update on big data/data analysis**: Micron gathers a massive amount of data. Tool used to analyze data Tableau.

- **Security:** When security issues with cloud computing pop up, Micron has vendors step in with solutions.

- **Cloud computing:** Database structure in cloud

Terry Brandt, Zoot Enterprises, Inc.

- **Industry Trends:** Zoot provides software to the largest and most innovative financial companies.
  We continually examine current and anticipated market conditions and review possible solutions so that we can have the most up-to-date information available to our clients. Due to many of the users being from the younger generation adding gamification to applications makes it fun to work.

- **Update on big data/data analysis:** Huge relational databases. We keep clients separate and data separate.

- **Security:** We use a cloud service so we are big on security. We get audited all the time. Emphasize security in our applications.

- **Cloud computing:** Cloud network. All critical data are encrypted, only authorized users have access to data in it's entirely.

Zachary Wormgoor, Schweitzer Energy Labs (SEL)

- **Industry Trends:** SEL values software design, software architecture, software engineering principals, maintainability, consistency with code and specifications.

- **Update on big data/data analysis:** Venturing into big data using SCADA (supervisory control and data acquisition). SEL has been concerned what happens with in a substation network, we are now trying to look at the bigger picture. SEL now has multiple substations reading real time data and how we make use of that data. SEL has a UI design and are looking for user interface skills.

- **Security:** New requirements for utilities are coming into effect, not just cyber security but security in all aspects. SEL can help companies that do not understand security. Utilities feel it is easier for them to pay the fines than to satisfy these new requirements. This is something SEL can help companies with. Some web applications for good security design; OWASP (open web application security project), Microsoft SEL.

- **Cloud: N/A**

David Thompson, SoFi, Software Finance

- **Industry Trends:** Our employees drive software development. Company uses Tableau , Forklift, Cassandra, Scala, Console, Node.JS, Ember.js, are presently moving into JavaScript Trainworks and JavaScript Back-ends. Everything is behind firewalls; web services are being written that way.

- **Update on big data/data analysis**: Company does not consider themselves big data only at a terabyte of data**.** Company does a lot of data analysis; this comes from production data marrying with marketing data. He emphasized that it is hard to find good data warehouse people**.**

- **Security:** I will be teaching how to build web security into applications

- **Cloud:** We are completely in the cloud using Docker hosting.

Bill Ivanich, EchoStar

- **Industry Trends:** EchoStar is a global provider satellite operations, video, and engineering services. We continue to design and engineer new satellites for our customers. Television is at an inflection point. New technologies and businesses are rapidly evolving and reshaping how we watch TV. We are Move Networks, makers of Sling TV, an OTT (over-the-top) TV service that delivers live programming, as well as video on demand, over the Internet. With the changing of trends our company is not only looking for people with data analysis background but statistics as well.

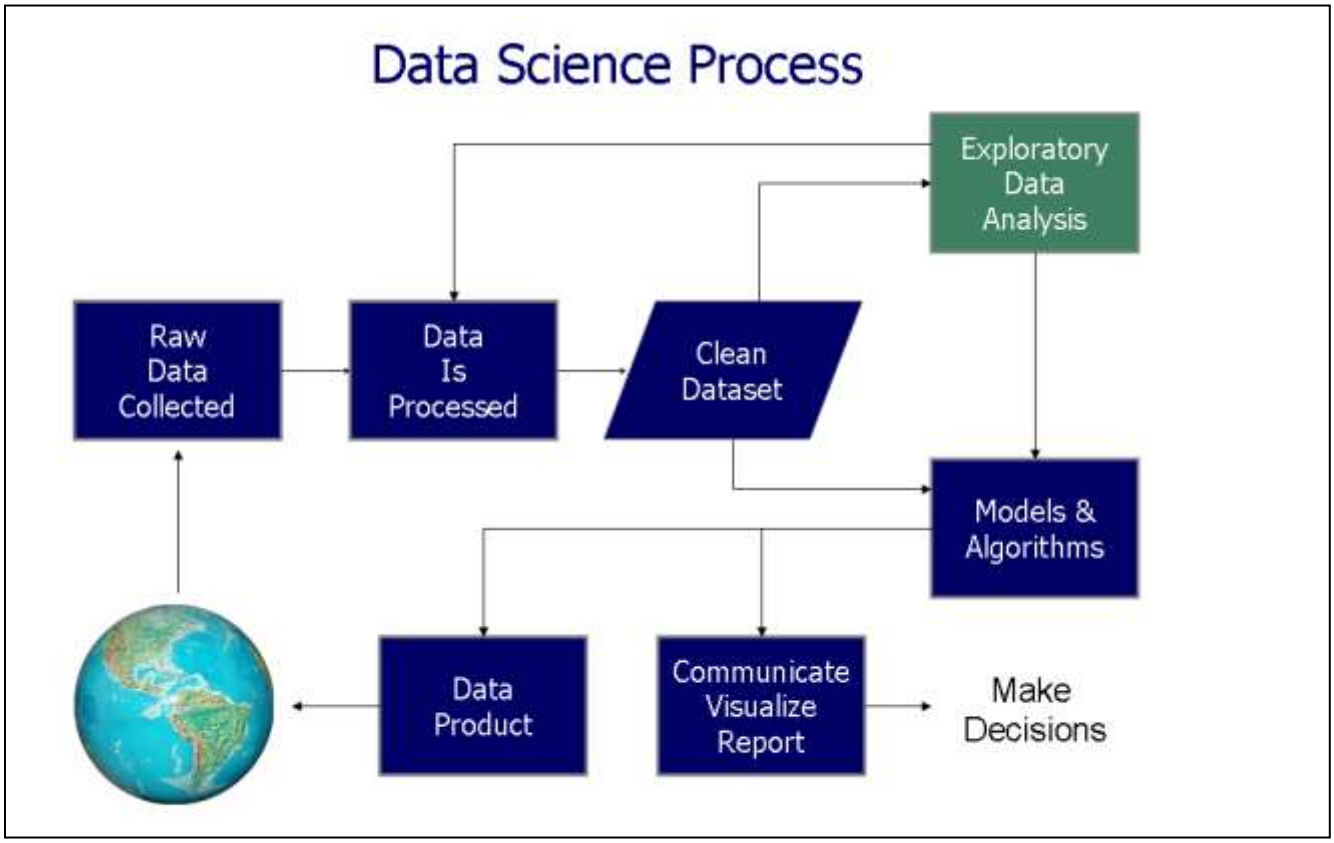
- **Update on big data/data analysis:** EchoStar is connecting the World in new and exciting ways. When working with DVRS and recording events the commercials are no longer irrelevant data, we can identify that commercial and target that commercial in real time.

- **Security:** If a student doesn't know about security that's not going to make or break our decision to bring them on.

- **Cloud computing:** We have not got into a lot of cloud computing.

Data Science - Proposed Program Offering (Celia Schahczenski)

- Data Science Process



Data Science (Wikipedia)

- Extraction of knowledge from large volumes of data - structured or unstructured
- Continuation of the field data mining and predictive analytics, also known as knowledge discovery and data mining (KDD)
- Methods that scale to Big Data are of particular interest but the field is not restricted to Big Data
- Uses machine learning

Data Science at Montana Tech

- Proposed Concentration from the Statistics Department
- Needs to be approved by Board of Regents
- On Tech's "wish list" to become a B.S. degree

Proposed Statistics, Data Science, B.C.

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Fall Semester	Spring Semester
FRESHMAN YEAR	
Calculus I (M 171)	Calculus II (Math 172)
Computational Thinking (CSCI 102)	Fundamentals of CS II (CSCI 136)
Fundamentals of CS (CSCI 135)	Science Elective
Intro to Technical Writing (Writ 135)	Into to Public Speaking (Comx 111)
Humanities Elective	Humanities Elective
15 credits	15 credits
SOPHOMORE YEAR	
Data Structures (CSCI 232)	Design and Analysis of Algo (CSCI 332)
Discrete Structures (CSCI 246)	Database Design (CSCI 340)
Multivariable Calculus (M 273) - 4 credits	Intro to Differential Equations (M 274)
Methods of Proof (M 242)	Methods of Proof II (M 323)
Matrices & Linear Algebra (M 333)	Statisticals for Scientists & Engineers (Stat 332)
16 credits	15 credits
JUNIOR YEAR	
Data Mining (CSCI 347)	Bayesian Inference (Stat 4xxx)
Software Engineering (ESOF 322)	Regression & Model Building (Stat 432)
Advanced Calculus I (M 435W)	Advanced Calculus II (M 436W)
Probability Theory (Stat 421)	Mathematical Statistics (Stat 422)
Prin of Micro and Macro Economics (ECN 203)	Science Elective w/ lab
15 credits	16 credits
SENIOR YEAR	
Artificial Intelligence (CSCI 446)	Capstone (Stat or CSCI) - 4 credits
Data Visualization (CSCI 444)	Statistical Computing & Exploratory Data Analysis (Stat 435)
Experiment Design (M 441)	Statistical Learning & Data Science II (Stat 4xx)
Statistical Learning & Data Science (Stat 4xx)	General Elective
General Elective	
15 credits	15 credits

New Courses

- Data Mining (CSCI 347)
- Data Visualization (CSCI 444)
- Bayesian Inference (Stat 4xxx)
- Statistical learning & Data Science (Stat 4xxx)
- Statistical learning & Data Science II (Stat 4xxx)

Data Mining (CSCI 347)

- Course already exists and taken mostly by Health Care Informatics student
- Pre-requisites:
  - semester of programming (Visual Basic)
  - DB course (MS Access)
- Create a new course for HCI students
- Increase pre-requisites so can cover more material

Data Visualization (CSCI 444)

- Formulation of 3-D empirical models
- Translation of 3-D models into graphical displays
- Time sequences and pseudo-animation
- Interactive versus presentation techniques
- Special techniques for video, CD and other media

Statistical Learning and Data Science (STAT 4xx)

Introduces:

- Statistical learning
- Model accuracy
- Simple and multiple linear regression
- Classification
- Logistic regression
- Discriminant analysis
- Bayes' Theorem for classification
- Resampling methods

Uses R statistical package

Bayesian Statistical Inference (STAT 4xx)

Covers:

- Probability
- Subjective probability
- The Law of Total Probability
- Bayes Theorem
- Prior and posterior distributions
- Risk functions
- Bayesian estimation
- Credible intervals
- Bayesian hypothesis testing
- Empirical Bayesian methods
- Gibbs sampler

Data Science at UM

- Big Data Analytics Certificate (12 credits includes project)
- Network and Information Security (Cybersecurity) Professional Certificate (16 credits)

Big Data at UM

Introduction to Data Analytics (BMIS 326)	Introduction to Real-Time Analytics: (BMIS) 465 / (CSCI) 491	Data Visualization (CSCI 444)
Cybersecurity Management: (BMIS 391)	Data Analytics Project: (M) 467	Big Data Mining (CSCI 464)
Marketing Analytics: (BMKT 440)	Big Data Project: (BMIS) 482	Machine Learning (CSCI 447)
Telling the Story with Big Data: (BMKT 491, sec02)	Introduction to Cybersecurity: (CSCI) 491	Pattern Recognition (CSCI 448)
Advanced Marketing Analytics: (BMKT 491, sec 03)	Data Science Theory and Practice: (CSCI) 491 and eDiscovery Law and Practice: (LAW) 591	Applied Parallel Computing Techniques (CSCI 480)

Data Science at MSU

- Machine Learning: Soft Computing (CSCI 447)
- Computational Biology(CSCI 451)
- Machine Learning (CSCI 547)
- Reasoning Under Uncertainty (CSCI 548)
- Data Mining (CSCI 550)
- Engineering Data Analysis (IME 350)

Validation & Verification - Industry Partners (Frank Ackerman)

ESOF 411 Software V&V (Pre-requisite Courses)

- Intro to Software Engineering
- Software maintenance
- Requirements & Specifications
- Software Design and Architecture

Existing Skillset

- Appreciation of process
- Project planning
- Module Development (inc. unit testing)
- Inspection

Course Concentration

- Configuration management
- System testing
- Ideal: Be the V&V team for a project Bozeman

Potential Research Projects - Industry Partners (Phil Curtiss)

Department Research Initiatives

Opportunity	Lead Industry Partner
• Mobile Broadband for Rural MT (MUS MREDI) (Submitted)	• MTECH Electrical Engineering (Decision 9/13-14)
• Simulation & Suicide Prevention (SAMSHA, Dept. VA) (Whitepaper)	• NCHCI/BSB Suicide Task Force (Task Force Meets 9/20)
• Multimodal After Action Review (AFRL BAA) (Submitted)	• AFRL, Wyle Labs, NCHCI (Decision by 11/1)
• Wavelet-based Image Analysis (NASA EPSCor) (In Process)	• Virtual Astronomical Observatory (Closes 10/16)
• Behavioral-Driven NetSecurity (Microsoft Research) (In Process)	• Hoplite Industries, Microsoft (Open Call – Anticipate by 11/15)

Mobile Broadband for Rural MT (Summary of Project)

- Problem to Be Solved:
  - Provide extremely remote geographic areas of Montana with high-speed mobile broadband in a "hot-spot" model utilizing 5G-derived low-band frequencies (<700Mhz) by developing an "exception model" to current FCC licensing of these frequencies that are allocated, but not in use.
- Project Objectives:
  - Identify Remote Geographic Areas
  - Document Frequency Allocation and Utilization
  - Develop Exception Model -> Experimental Licenses
  - Develop 5G-derived low-band transceivers

Mobile Broadband for Rural MT (Anticipated Project Impacts)

- Economic Benefits:
  - Software Platform Tool, tied to the project's time-series repository, driven by econometric models of "characteristic localities" statistically fit using cluster-based statistical analysis - demonstrating economic utility by realizing project objectives.
- Department Benefits:
  - Funding Three (3) Undergraduate Students
  - Development of Software Platform Tool
  - Compute and Storage hardware for Department
  - Leverage HPC and Visualization Environment

Simulation & Suicide Prevention (Summary of Project)

- Problem to Be Solved:
  - Leverage simulation technologies (SW/HW) to provide three (3) simulation environments for the education of at risk behaviors, the skills sustainment training of these behaviors, and the amelioration of these behaviors in identified individuals.
- Project Objectives:
  - Leverage Life-Form Simulation Technology (VTMAK)
  - Desktop Environment for CBT
  - Dome/Cylinder Environment for Training
  - Dome/Cylinder Environment for "Safe Harbor"

Simulation & Suicide Prevention (Anticipated Project Impacts)

- Socioeconomic Benefits:

    - Reduce number of suicide attempts by educating front-line individuals to better recognize signs and symptoms of at risk behaviors and provide a therapeutic "safe harbor" environment for individuals so identified.
- Department Benefits:
    - Fund undergraduates and faculty for development
    - Provide additional compute and viz environments
    - Interdisciplinary work to development computational models of behavior
    - Use CS/SE to improve outcomes for at risk population

Multimodal After Action Review (Summary of Project)

- Problem to Be Solved:
    - Complex simulation training environments lack the required fidelity in the after action review and assessment process required to reinforce learning and provide remediation training as a result of performance during simulation training.
- Project Objectives:
    - Leverage AAR from the Sports World (StudioCode)
    - Leverage NCHCI Execution Framework (USAF)
    - Automate Coding through Event Processing
    - Automate Coding through Learning Mgt. Systems

Multimodal After Action Review (Anticipated Project Impacts)

- Economic Benefits:
    - Provide a capability presently not found in multimodal (simulation) training environments that is widely applicable to many different problem domains and environments.
- Department Benefits:
    - Fund undergraduates and faculty for development
    - Interdisciplinary work to development computational models of learning and assessment
    - Develop a structured approach toward training assessment and measured outcomes

Wavelet-based Image Analysis (Summary of Project)

- Problem to Be Solved:
    - NASA Grand Challenge problem to improve Earth based astronomic observation through cost-effective STEM solutions - difficult to fund additional Hubble Telescopes
- Project Objectives:
    - Understand effective and efficient ways to perform image decomposition and reconstitution
    - Develop a distributed "Virtual Telescope" model
    - Integrate with Large VAO Image Repositories
    - Cost effectively develop a SAS model for Image Analysis and Manipulation for VAO Repos

Wavelet-based Image Analysis (Anticipated Project Impacts)

- Economic Benefits:
    - Demonstrate the feasibility of solving image analysis and manipulation techniques lending toward the creation of additional spectral information through the composition of existing imagery and their metadata, suggesting a solution to enhancing Earth-based astronomical observation.
- Department Benefits:
    - Fund undergraduates and faculty for development
    - Significant work in the areas of image analysis
    - Leverage HPC and visualization capabilities
    - Follow-on applications of work to land cover dynamics, precision agriculture, etc.

Behavioral-Driven Network Security (Summary of Project)

- Problem to Be Solved:

    - Securing the border of networks through static rule-based approaches is insufficient in the mobile, BYOD, decentralized data world in which we live. Protection should occur at "network boundaries" and through behavioral analysis instead of static rules.
- Project Objectives:
    - Access to the world's largest real-time threat databased via Hoplite partner
    - Develop analytical model for uncovering relationships amid the threat database
    - Develop a platform to provide preemptive warning of threat vectors based on model
      Develop metrics of success for analytical platform

Behavioral-Driven Network Security (Anticipated Project Impacts)

- Economic Benefits:
    - Provide a services oriented approach to actionable threat data intelligence for integration into network security systems to augment rule-based approaches.
- Department Benefits:
    - Fund undergraduates and faculty for development
    - Significant work in the areas of large scale data analysis, predictive analytics, and network security
    - Develop modeling techniques such as AMM
    - Leverage HPC and Viz capabilities for model execution

Discussion and Wrap-up

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

- Is security important?
- Would it be beneficial to offer a security class?
- If you offer a security class what would you take out of your current curriculum?
    - Consensus of IAB members*; it is not necessary to have a separate course for security. Incorporate security into present courses.*
- Should the CS program keep the current "Educational Objectives"?
    - Consensus of IAB members; *CS program should keep the current "Educational Objectives".*
- Do you feel the Data Science degree will be attractive to your company?
    - Andrew Ellmaker - *Yes*
    - Zack Wormgoor - *Yes*
    - David Thompson - *Yes (if the course covers the terminology to know how to transfer data to the data warehouse).*
    - Justin Malsam - I *will need to do research on the data science field*.
    - Terry Brandt - *Our clients may use this type of person but we are not.*
- If the Data Science degree is offered do you feel it will affect the CS and SE program?
    - *The student interested in the Data Science degree would be a different person than the student interested in the CS or SE degree. This degree would give students more options of what they really want to do.*
- New job prediction article list data science as a top job.
- Target for the Data Science degree may be people already employed in industry.
- Market the Data Science degree so high school students will understand what it is.
- Adding additional business courses to the Data Science degree; i.e., Google Analytics, Marketing, or Economics could be beneficial.
- Recruiting suggestion:
    - Chromebook (allows kids to do programing)
    - Advertise what is available after hours for students to do (robotic clubs)
    - Industry people may be willing to volunteer to assist with robotics.
    - Google-web-toolkit used with high school students
    - Advertise job placement and ETS scores

    - Add Alumni quotes (what MT Tech has meant to me) to website, Facebook, Tweet
    - Scholarships available to freshman
    - Note that TAs do not teach classes
    - Goals and values of the program
    - Faculty/student ratio
- Senior Design projects can be done by video conference with industry from other states.

Meeting adjourned.

Respectfully submitted,

Tami Windham