

COMPUTING &amp; SOFTWARE SYSTEMS SPRING 2014

# Bits & Bytes

**W****COMPUTING & SOFTWARE SYSTEMS FOCUS ON ASSISTANT PROFESSOR HAZELINE ASUNCION****CONTENTS****VOLUME 19**

1. Computing & Software Systems Focus
2. Letter from the Interim Chair
  - Tid Bits
  - New Staff and Faculty
3. Research Spotlight
  - State of Computing
4. Enrollment
5. Faculty Publications
6. Capstone Highlights
7. Life Outside of the Classroom
8. Applied Computing

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## INTEGRATING DATA PROVENANCE WITH SOFTWARE TRACEABILITY



In Winter 2014, UW Bothell Computing & Software Systems professor Hazeline Asuncion was awarded the CAREER Award by the National Science Foundation (NSF) Faculty Early Career Development (CAREER)

Program for her proposal, "iProvenance: Integrating Data Provenance with Software Traceability". The prestigious award is given to a select few who "exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations".

The honor demonstrates how Dr. Asuncion's research serves not only as a means to advance her field, but also as a bridge to the students she teaches. It provides an opportunity for them to develop methodologies and understand the fundamentals of academic research. With the skills they learn, students can go on to present their findings at conferences across the globe (see pg. 3) and branch into their

own areas of interest. Many integrate faculty research as a part of their capstone project in a culmination of their time in the program.

Dr. Asuncion was able to answer a few questions about her work:

**WHAT IS SOFTWARE TRACEABILITY AND HOW DID YOU BECOME INTERESETED IN IT?**

My research centers around traceability, connecting related information that may be scattered across different files, different locations, and may be owned by different groups of people. Managing related information is a fundamental task in many contexts. Currently, my research activities are in the following domains: software engineering (software traceability) and eScience.

**Software traceability** focuses on connecting related code and documentation produced during software development to facilitate code understandability, maintenance, change impact analysis, assessment of product quality, and access to related documentation. Currently, we are examining how we can use traceability techniques to manage changes made during a software lifecycle. Flexible

**SEE 'FOCUS' ON PAGE 10**

# LETTER FROM THE CHAIR



*Welcome to Spring 2014! This year finds us in Computer and Software Systems (CSS) busy as bees, with more students, faculty, and staff than ever. Our profession is one of the brightest spots in the US economy and an engine for future growth. It also provides unparalleled opportunities for people to build rewarding, creative, and well-paying careers. We view as part of our mission the imperative to use our profession to*

*advance the cause of social justice by supporting students whose family members have little experience with college. We believe that this also helps our profession by bringing in a diversity of experience that can lead to new and better products.*

*This bigger-than-ever newsletter will give you a snapshot of what this means in concrete terms for the CSS community. We have had two major faculty accomplishments, with Munehiro Fukuda being promoted to full Professor and Hazel Asuncion earning a NSF CAREER Award — the premiere recognition of research excellence and promise for faculty. Our “Focus” article introduces Hazel’s research area, and our “Research Spotlight” describes the experiences of student Nathan Duncan in his work with her. We continue to welcome new faculty; in this issue, we introduce Dr. Danielle Lee.*

*We’re expanding capabilities for teaching about the interface between hardware and software with the launch of our new BS degree in Computer Engineering, which will admit its first student class in fall. Enrollment — at both the undergraduate and graduate levels — is not only growing but accelerating and we expect this to continue as we contribute to the School of STEM’s overall growth.*

*As always, our students execute impressive projects as they reach the end of their studies; you can see examples of these projects in our coverage of cooperative education for our BS in Computer Science and Software Engineering and capstone projects for our BA in Applied Computing. Our alumni, of course, go on to do great things; we have a brief Q&A with one of our recent grads, Evelina Arthursson, about her experiences as she joined the community of working professionals.*

*These, and the other articles you’ll find here, are just a sampling of what’s happening in CSS.*

*Cordially,*

*Dr. Michael Stiber  
Professor and Chair*

## Bachelor of Science in Computer Engineering Starting Fall 2014

The BS in Computer Engineering combines education in hardware and software development, with students gaining the background necessary to become broadly-educated professionals who are knowledgeable in both domains, understanding how the domains interact, restrict, or enable interdependent capabilities. Core coursework encompasses the physical and mathematical sciences, object-oriented programming, algorithms, data structures, software engineering, technical communications, circuits and systems, microprocessors, embedded systems, and operating systems. The major also offers the opportunity to build a strong foundation in network design and development, signal processing, mobile computing, sensor systems, semiconductor devices, testing and quality assurance, and project management, among others.

## NEW STAFF AND FACULTY



### Dr. Danielle Lee

Danielle Lee joined us this fall as an Assistant Professor.

She received an M.S. degree in Telecommunication and Network Management from Sangmyung

University and Syracuse University in 1998 and 2001, respectively. She received her Ph.D. in Information Science at the University of Pittsburgh in 2013. Before pursuing her doctoral degree, she worked for Samsung SDS Inc., as a software engineer.

Dr. Lee’s research interests have an interdisciplinary focus on knowledge management and social media. Her past research revealed an in-depth understanding of knowledge-sharing patterns on various social media applications. She also developed personalized recommendations using social networks, highlighting the potential for new types of social recommendations expandable to more diverse social networks. Her current research focuses on information personalization technologies for social media and the nature of socially constructed metadata.

### EDITORS

**Ellis Zhuang**  
**Michael Stiber**

Program Assistant  
Chair

### CSS STAFF

**Megan Jewell**  
**Josh Larios**  
**Janet McDaniel**  
**Tina Wong**  
**Stacey Doran**

Graduate Advisor  
Advanced Systems Engineer  
Program & Internship Coordinator  
Undergraduate Advisor  
Admissions Advisor

### SPECIAL THANKS

Nathan Duncan    Evelina Arthursson    Hazeline Asuncion

# NATHAN DUNCAN AT

# SEKE BOSTON

Working on the FACTS project has been a good learning experience. It has been challenging to look at other people's code, understand their thought processes, and then make adjustments to change the appearance of the program. The experience of working within a team, meeting deadlines, completing challenging tasks, and then presenting the work is something that I probably couldn't have experienced outside of the research environment. I feel that I have learned so much more throughout this process than what I could learn by taking a class that just covers the basics on a particular topic.

Presenting at the UW Bothell Research Symposium was a good way for me to talk about the project to the general public and other students who aren't familiar with traceability. I also had to explain what traceability means within software development. This gave me an opportunity to talk about the project in ways that were less technical and present more of a high level overview.

At the SEKE 2013 Conference in Boston, I presented in front of software engineers from all over the world. This was the first time I had ever presented outside of the school environment and it was an amazing experience. I was nervous but it was a chance for me to do something I had never done before. It was especially interesting to sit at the dinner table with people of many other countries, such as Germany, Sweden, Norway, Spain, and Japan. Also, the presentation of other people's research was very enlightening and gave me an idea of what they were all currently working on.

## Research Spotlight

CSS Student Nathan Duncan has been working with Assistant Professor Hazeline Asuncion on her traceability research as a member of FACTS PT (Flexible Artifact Change and Traceability Support for Project Team) which:

- Uses change entries to gather scattered project information.
- Includes a set of tools which extract, trace, aggregate and visualize change entries and other metrics.
- Has been evaluated in a real-world setting

As a member of the Traceability team, Nathan has presented the FACTS project at the University of Washington Bothell Symposium as well as the SEKE conference in Boston.

After his presentation, Nathan talks about his experiences.

## CSS STATE OF COMPUTING

On November 15, 2013 guests from across Washington came together for the annual State of Computing Education Summit. Computer science advisors and instructors from Washington State colleges converged to discuss the landscape of computer science and how two and four year programs can work together to polish and prepare students for their careers in one of the most dynamic fields. This year boasted the greatest diversity of schools and the largest group assembled.

A key focus of the summit is to help ease the transition for students coming into the CSS program from outside the University of Washington Bothell. CSS admissions advisor Stacey Doran provided insight and gave each school statistics on their students and how successful they are once accepted. Though it may be hard to believe, students can jump right into the CSS

## EDUCATION SUMMIT

program even though each school is unique and many use different coding languages. Students can adapt to change and use the fundamental tools they pick up to help them see the similarities in perceived differences.

Another key aspect of the discussions is what students are learning while in the program, and what jobs they are getting after they graduate. With this information, other schools can understand what direction their students are going, and how to best ready them for the job market. That being said, CSS students go on to work in a wide variety of positions and in companies both large and small, so there is no one right answer.

SEE SUMMIT ON PAGE 11

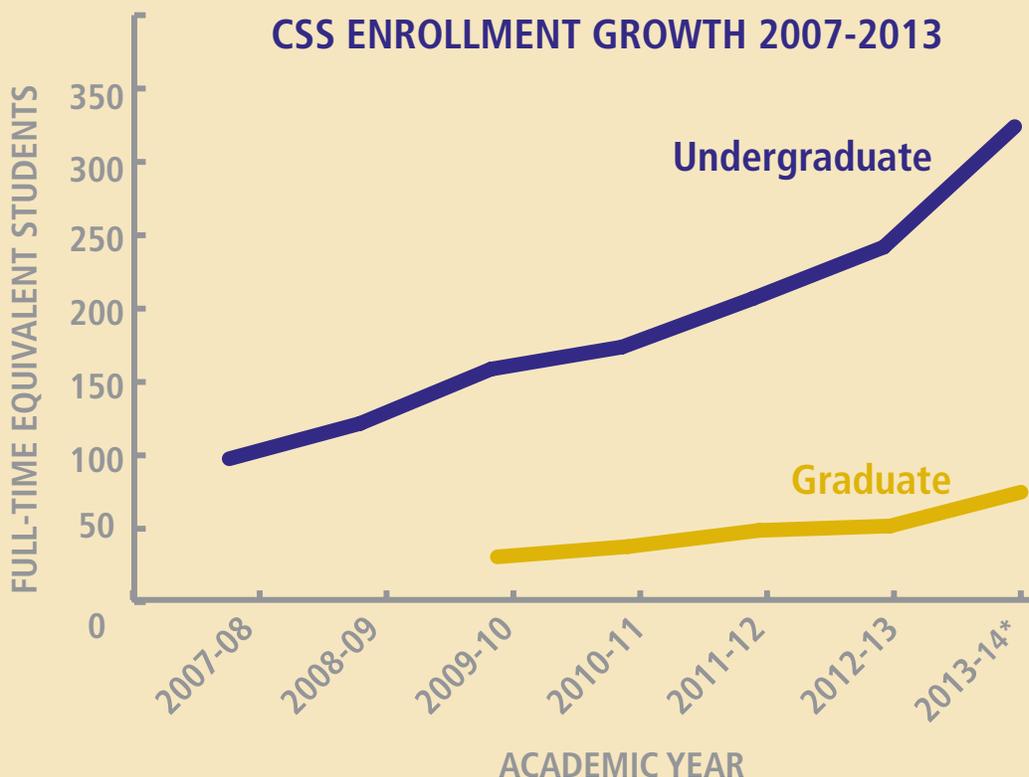
# ENROLLMENT

Enrollment growth in CSS courses at UW Bothell continues its torrid pace. The graph shows that undergraduate enrollment (purple) has more than tripled in six years, while graduate enrollment (gold) has more than tripled in four years. Both have taken big jumps this fall, for different reasons:

- The Washington legislature allocated additional funding this year to increase enrollment in engineering and computer science at state higher education institutions. This was an amazingly fortunate occurrence, as we've been seeing a big increase in application numbers. We were able to act immediately to increase the size of our undergraduate class this fall. Despite admitting more students, we still needed to tighten competitive requirements, as demand for computing degrees continues to outstrip the number of seats in our programs.
- This fall saw the start of our new MS in Cyber Security Engineering degree; the new cohort of students added substantially to our graduate enrollment.

The net result for CSS operations has been an increase of almost 50% in number of courses to be taught this year compared to last. To accommodate this growth, we hired four new faculty who started this fall and we will use the new legislative funding to hire at least four more faculty during this academic year. That means that the number of CSS faculty will almost double over two years — an incredible growth rate that will propel us into position as the second largest computing program in the Pacific Northwest.

We expect to continue growing, though maybe a bit more slowly, over the next few years as we build collaborations with other UW Bothell academic programs. This has already borne fruit with our new BA in Interactive Media Design (joint with the UW Bothell School of Interdisciplinary Arts and Sciences), BS in Computer Engineering (joint with UW Bothell EE), and undergraduate degree option in Information Assurance and Cybersecurity (joint with the UW Seattle iSchool and UW Tacoma CSS).



# FACULTY PUBLICATIONS

## HAZEL ASUNCION

Alsbaugh, T., Asuncion, H., Scacchi, W., The Challenge of Heterogeneously Licensed Systems in Open Architecture, Software Ecosystem, Palgrave-MacMillan, 2013.

Asuncion, H., Automated Data Provenance Capture in Spreadsheets, with Case Studies. Future Generation Computer Systems, 2013.

Asuncion, H., Shonle, M., Porter, R., Potts, K., Duncan, N., Matthies Jr., W.J., Using Change Entries to Collect Software Project Information, The 25th International Conference on Software Engineering and Knowledge Engineering (SEKE), June 2013.

Davis, D., Asuncion, H., Abdulla, G., Carr, C., "Towards Recovering Provenance with Experiment Explorer", Fifth International Conference on Information, Process, and Knowledge Management (eKnow), Feb 2013.

## GRANTS

National Science Foundation (ACI), "CAREER: iProvenance: Integrating Data Provenance with Software Traceability", 2014-2019.

National Science Foundation (CCF), "SHF: Small: Collaborative Research: Tracing and Reasoning about Changing Artifacts", 2012-2015.

National Science Foundation (CCF), "SHF: Small: Collaborative Research: Tracing and Reasoning about Changing Artifacts", Research Experiences for Undergraduates (REU) Supplement, 2013.

## MUNEHIRO FUKUDA

Yuta Aoki, Tadao Oishi, Masaki Bandai, Munehiro Fukuda, Takashi Watanabe, "Load Balancing of Multi-Sink Sensor Networks with Asymmetric Topology and Traffic Patterns," Transaction of The Institute of the Electronics, Information and Communication Engineers, accepted on June 24, 2013, in press.

Timothy Chuang, Munehiro Fukuda, A Parallel Multi-Agent Spatial Simulation Environment for Cluster Systems, In Proc. of the 16th IEEE International Conference on Computational Science and Engineering - CSE 2013, pages 143-150, Sydney, Australia, December 3-5, 2013

Somu Jabayalan, Munehiro Fukuda, Field-Based Job Dispatch and Migration, In Proc. of 2013 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing - PACRIM'13, pages 52-57, Victoria, BC, Canada, August 27-29, 2013

Masashi Sakurada, Munehiro Fukuda, An RSSI-based Error Correction Applied to Estimated Sensor Locations, In Proc. of 2013 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing - PACRIM'13, pages 58-63, Victoria, BC, Canada, August 27-29, 2013

## WOORYOUNG KIM

W. Kim, Martin Diko and Keith Rawson, Network Motif Detection: Algorithms, Parallel and Cloud Computing, and Related Tools, Bioinformatics and Computational Biology of Tsinghua Science and Technology Journal, Volume 18, issue 5, 2013.

## DANIELLE LEE

Lee, D. H. & Brusilovsky, P. (In Press) Recommending Talks at Research Conferences Using Users' Social Networks, International Journal of Cooperative Information Systems

## CLARK OLSON

David C. Hunn and Clark F. Olson, Evaluation of Monte Carlo Subspace Clustering with OpenSubspace, Proceedings of the International Conference on Data Mining (DMIN13), 2013.

## DAVID SOCHA

D. Socha, J. Tenenberg, Navigating Constraints: The Design Work of Professional Software Developers. ACM SIGCHI Conference on Human Factors in Computing Systems (CHI 2013), Paris, France, April 2013.

D. Socha, J. Tenenberg, Sketching Software in the Wild. 35th International Conference on Software Engineering (ICSE 2013), San Francisco, USA, May 2013.

## MICHAEL STIBER

Kawasaki, F. and M. Stiber, "Stimulation effects on cortical culture development", International Conference on Cognitive Neurodynamics, Sigtuna, Sweden, June 23-27, 2013.

## KELVIN SUNG

J. Pavleas, J. Chang, K. Sung, and R. Zhu, Learn 2D Game Development with C#, APress, December 2013. ISBN-13: 978-1430266044.

## CAROL ZANDER

Can first-year students program yet?: a study revisited. McCartney, R., Boustedt, J., Eckerdal, A., Sanders, K., computing education research (ICER '13). ACM, New York, NY, USA, p91-98.

A Broader Threshold: Including Skills as well as Concepts in Computing Education, Thomas, L., Boustedt, J., Eckerdal, A., McCartney, R., Moström, J. E., Sanders, K., and Zander, C., Threshold Concepts: from personal practice to communities of practice, book chapter, Proceedings of the National Academy's Sixth Annual Conference and the Fourth Biennial Threshold Concepts Conference, ISBN number 978-1-906642-58-7, 2013.

# CAPSTONE



## WESTON WINN CONCUR Technologies

Through the course of the capstone, Weston worked on Concur's mobile application for the iPhone and iPad. Specific responsibilities included familiarity and proficiency using Xcode and Objective C, particularly in the iPhone Operating System (iOS) environment. As he became proficient with these technologies, he implemented bug fixes on production code. He learned Jira software for testing purposes.



## PAUL BUNN BRAIN GRID

Paul's goal was to provide a framework for Computational Neuroscientists to use to rapidly develop high- performance simulations. The core development project is nearing completion and the research team would like to release it to the scientific community as an open source project. Before this can happen the software needs to be documented and verified against various neural network models. The team would also like to develop visualization tools for the simulator prior to release.



## PAUL SURRETTE Faculty Research

Paul completed his capstone requirement with CSS Professor Hazel Asuncion.

Researchers working with data use specialized tools to help them keep track of any and all changes they make to various data sets. When dealing with large amounts of data, it can be difficult for researchers to remember the reasons for specific changes or analyses they made in the past.



Spring 2013 Capstone student presenters

# HIGHLIGHTS



**EVELINA ARTHURSSON**  
Amazon.com

Nina's capstone required her to refactor an existing body of legacy code, S3 Tools. She replaced outdated encryption techniques with new encryption compatible with Amazon's data warehouse service, Redshift. After suggesting the upgrade of the remaining tools, the whole package became uniform, maintainable, readable, and concise. Part of the project also required her to coordinate with two other teams who used the tools to upload their data to S3.



**MICHAEL MOSEICHUCK**  
Logos Bible Software

While Michael completed the capstone requirement at Logos Bible Software, he worked on upgrading First Run Wizard for Proclaim Presentation Software. During the capstone he learned to use the Windows Presentation Foundation and C#. He refactored existing code and wrote new code to improve logic and make the code's purpose clearer for his team members. He worked closely with designers on specs and made updates to improve the user experience. He had the responsibility of testing every feature and complete the new wizard to be ready for a new release.



**TAMER SWELLUM**  
Glu Mobile

At Glu Mobile, Tamer worked as a quality assurance engineer intern. His project involved the start-to-end video game development lifecycle in a practical environment. He received hands-on developing test tools and worked on current game code. He transitioned his academic knowledge and experienced how Agile development and SCRUM work in an actual work environment.



Summer 2013 Capstone student presenters

# LIFE OUTSIDE OF THE CLASSROOM

## Student Spotlight

Evelina Arthursson is a recent CSS grad and has taken her knowledge and skills to the next level. After completing her internship at Amazon, she was immediately offered a software developer position. As an alum, Evelina has maintained strong ties to the UW Bothell community. Her blog, titled "Life Outside of the Classroom," aims to show what transitioning from a student to a professional looks like in the computer science field.

Evelina was kind enough to answer some questions about her experiences.

### WHAT FIRST INTERESTED YOU IN COMPUTER SCIENCE?

I didn't get interested in computer science until I graduated high school. I had always been interested in technology and solving challenging problems, but it wasn't until I took a class in community college that I realized that a computing-related degree was a good match for me. If it wasn't for a few friends bringing attention to a programming class being offered at the time, I'm not sure if I would be where I am today.

Once I started delving into the subject, I couldn't stop. Up until that point, I had interests in several professions, but software development was the first that I could actually picture myself doing in the near future. It was a really great feeling.

### WHAT INTERESTED YOU IN THE CSS PROGRAM AT UW BOTHELL?

I've lived in Washington State practically my entire life, and have always been a bit of a home-body, so the idea of moving out of state wasn't very appealing to me. However, I was very fortunate that I was already living in one of the most technologically dense regions of the country, and in such close proximity to two of the University of Washington campuses.

I think my preference for UW Bothell was established very early on, during my first or second programming class. My professors often emphasized the differences in curriculum between UW Seattle and UW Bothell. UW Seattle was always portrayed as having a more theoretical approach, while Bothell gave you a more hands-on experience. As someone

who learns more by doing, this was a big deciding factor. Not to mention, UW Bothell offered smaller class sizes that added to the benefit of a hands-on approach.

### AS A TRANSFER STUDENT, DID YOU FIND THE TRANSITION DIFFICULT?

The transition in itself wasn't that bad. I had already been taking college-level courses and had a general idea of what to expect. I think the difficulty was in taking the step from introductory courses to intermediate ones. That first quarter was probably the most challenging for me, but once I got through those first few "weed-out" classes, I was much more confident in my abilities.

### WHAT CLASS GAVE YOU THE MOST TROUBLE AND WHY? HOW DID YOU OVERCOME THOSE STRUGGLES?

I'd have to say that it probably was that very first programming course, CSS 342. It was challenging to be thrown into a new environment where, not only did I need to learn a new programming language, but I also needed to implement brand new concepts in that new language. Adding to that difficulty, half of that class focused on discrete mathematics (which I didn't find myself being overly skilled in).

In order to overcome the challenge I simply had to compensate for it. I made friends who helped me better understand the new concepts we were learning, and I studied. Studied a lot. I think I made it worse for myself because I was so determined to not only pass the class, but pass it with the highest grade I could possibly get. I think my free time was non-existent for much of that quarter, especially towards the end... but there was lots of celebration when that quarter was over!

### DID YOUR INTEREST IN COMPUTER SCIENCE EVER WAVER?

I have never had any serious wavering of interest. That first quarter I often wondered if I was going to be able to learn all these concepts and be able to apply them in real-world settings. As my confidence rose throughout my time at UW Bothell, many of those thoughts started to diminish. Although the following classes became more advanced,

those wavering feelings came less and less. On occasion I will often wonder where I would be if I chose a different major, but I'm very pleased where I ended up!

## **YOUR INTERNSHIP WAS AT AMAZON, WHAT SPECIFICALLY INTERESTED YOU IN THAT COMPANY?**

I honestly didn't know a lot about Amazon when I first applied for them, aside from that they were a successful tech company that had a retail website and some web services. I knew in my mind that I wanted to start out my career at one of the "big" tech companies if I could, as the experience would prove invaluable for my early career. I had also heard good things about the overall software developer experience at Amazon.

## **WHAT WAS THE PROCESS LIKE TO GET AN INTERNSHIP THERE?**

I started out simply applying for an Amazon internship on HuskyJobs. I had spent quite a bit of time on my resume to ensure that a recruiter could easily determine my background within 10-15 seconds. While I waited for a response from that application, I attended several career fairs and ran into another Amazon recruiter at one of them. Since I had not gotten a response yet on my HuskyJobs application, I took the opportunity to speak to the recruiter one-on-one and presented her with my resume with an expressed interest in an internship.

Whether it was from my HuskyJobs application, or my conversation with the recruiter, I ended up receiving an email shortly afterwards requesting that I schedule a phone interview. I made sure to ready myself for the interviewing process, even buying a whiteboard to practicing free-hand coding. Several weeks later I had my first phone interview, and it seemed to go well. A few days later I got another email saying they wanted a follow-up phone interview with a different interviewer. I was fortunate to have gotten such friendly interviewers, as I was given an internship offer shortly after!

## **DID YOU FACE ANY CHALLENGES DURING YOUR TIME THERE?**

Most assuredly. The transition from an academic lifestyle to a full-time software developer position, while also still being enrolled in several credits, was very challenging by itself. Add on top of that the fact that interns are treated exactly the same as an SDE I (Software Developer Engineer), albeit employed in a smaller time frame. There was no hand-holding and no concretely defined tasks laid out for me, as I was expected to be the main driver of what I came away with from the internship.

Now, this kind of environment I was thrust into was both exhilarating and terrifying. For the first time I was being tasked to solve a problem that had no requirements neatly laid out. I had to learn not only how to develop software by Amazon standards, but also learn how to wear the multiple hats required getting that software from idea to deployment. While it was definitely very tough, I feel like it really gave me a chance to show off what I could do, and ultimately led me to getting a full-time offer.

## **DID WHAT YOU LEARN IN CSS HELP YOU AT AMAZON?**

Of course. What I learned while in the CSS program laid a foundation of knowledge and skills that was able to use during my time at Amazon. While I learned quite a lot over the internship, I didn't succeed by my wits alone. My experience was not necessarily a by-the-book type of software development experience, but I was able to take aspects from what I had learned in all my classes and apply them to my projects.

After graduating, you accepted a position at Amazon, why? I actually accepted my full-time job offer from Amazon before I graduated. Before my internship, I had been planning on trying to apply at other companies and see if they would be a good match for me. Towards the end of my internship, however, I realized that Amazon would be able to provide for me all that I wanted in my early career (and Amazon is a good place to be working in during this period of rapid growth!). Once I received the offer, I did not immediately accept. After some consideration though, I came to the conclusion that Amazon would be a very good employer for the start of my career.

## **WOULD YOU RECOMMEND AMAZON TO EVERYONE, OR WOULD CERTAIN STUDENTS NOT BE ABLE TO THRIVE IN THAT ENVIRONMENT?**

Amazon provides a very different sort of environment from what is considered the "standard." You aren't just a developer at Amazon; you are responsible for virtually all of the stages of your code's lifecycle. From design, to implementation, to testing, to deployment, to maintenance, etc. you are expected to take ownership. These responsibilities would require students to be more than just skilled coders, and the responsibility can be intimidating. For that reason, I believe that not all students would thrive. However, those who join Amazon will be exposed to principles and practices that will help them truly grow as a developer and a professional.

## FOCUS CONTINUED

Artifact Change and Traceability Support (FACTS) Project investigates how related changes can be explicitly connected in order to support future maintenance activities \*1 <<see footnote below>>. We have devised a technique to extract changes from past project iterations and provide Project Managers insights into development activities, code quality, and areas of improvement. We are also examining how data mining algorithms and machine learning techniques can assist in identifying related files.

**eScience** is a growing field in which scientific research relies on computational resources to collect data, run experiments, and perform scientific analyses. In this new paradigm of scientific research, it is challenging to determine the source of data and the transformations that have been applied to data. Being able to trace the origin of the data and its connections to the eventual results, referred to as data provenance, is crucial in supporting the repeatability of analyses or experiments. Automated support for provenance is indispensable to scientists and researchers.

Data Provenance in Spreadsheets is a project which supports automated provenance within spreadsheets, a popularly used tool among researchers in different fields. The results of this project has been welcomed by researchers in the fields of atmospheric research (e.g., Jaffe Atmospheric Research Group at UW Bothell) and fisheries (e.g., Western Fisheries Research Center at the U.S. Geological Survey, Seattle, WA).

The Experiment Explorer (EE) project is concerned with increasing the accessibility of experiment and provenance data to the entire research team. Experiment Explorer is a lightweight and efficient approach that takes advantage of metadata to retrieve and visualize relevant experiment-related files that are heterogeneously represented (e.g., spreadsheets, image files). More recently, we devised a technique for recovering provenance for analyses or experiments that were performed in the past. This project is in collaboration with Dr. Ghaleb Abdulla at the Lawrence Livermore National Laboratory (LLNL).

### DO YOU COLLABORATE WITH ANY OTHER FACULTY? ANYONE OUTSIDE THE UW?

Yes, I collaborate with various researchers, both on and off-campus. On campus, I have collaborated with faculty members, including Dr. Dan Jaffe, Dr. Munehiro Fukuda, Dr. Eric Salathe, Dr. Kelvin Sung, Dr. David Socha, Dr. Jason Pace, Dr. Mabel Ezeonwu (Nursing), Dr. Robin Angotti, and others.

Outside the UW, I have collaborated with researchers at UC Irvine, Lawrence Livermore National Laboratory, and University of Massachusetts Amherst

### HOW ARE STUDENTS A PART OF YOUR RESEARCH AND HOW WOULD AN INTERESTED STUDENT GET INVOLVED?

These research projects have provided both undergraduate and graduate students exposure to the fields of software traceability and data provenance. For undergraduates, their research tasks include tool development, performing literature search for publications, running evaluations, and writing portions of submitted papers. For graduate students, students identify a challenging problem within our research areas of software traceability and data provenance. They then survey the field and devise techniques to solve their problem. Graduate students have the opportunity to lead their research projects, write research papers, and work with undergraduates who can assist in the project.

Students who have contributed significantly to accepted papers may have the opportunity to present their work at a workshop or conference. This is the case with Nathan Duncan (see Nathan's work on page 3).

Former undergraduate student, Delmar Davis, who is now a Master's Student, also had an opportunity to conduct user studies at LLNL and to present our research results at the USENIX Workshop on the Theory and Practice of Provenance (TaPP) 2012 (see CSS newsletter Winter 2012).

\*1 This material is based upon work supported by the National Science Foundation under Grant No. CCF-1218266.



# APPLIED COMPUTING

Computing & Software Systems is not only for those interested in computer science exclusively. Some students want to pursue an education in computer science, but use their acquired knowledge in an outside field. The CSS Bachelor of Arts in Applied Computing is a multidisciplinary major that focuses on the application of computing systems within the context of a specific discipline or field of study. Students are encouraged to think broadly about the impact of computing and computing systems on our society.

In their CSS coursework, students concentrate from an application perspective on software engineering, project management, communications, knowledge of hardware and operating systems, and programming. This common core of classes creates a solid foundation of knowledge in programming and software engineering. Students combine their CSS coursework with studies in a non-computing subject that is of interest to them. This subject area, called a Minor Elective, can take the form of either an established minor at the University of Washington or an approved concentration of courses that covers a complex subject matter.

Here are just a few examples of what Applied Computing students are planning for the future:

<p><b>DEREK LANE</b> Second Major in Business Administration with Management Information Systems emphasis. I intend to use my Applied Computing and Business Administration degrees to design and build Logistics Management Information Systems (LMIS) for aid and relief groups working in austere environments.</p>	<p><b>MILA GOLOVAN</b> I am majoring in Applied Computing with a concentration in Business. When I graduate, I will pursue a career as either a Project Manager, Technical Writer, or Business Analyst.</p>	<p><b>AMHA GEBREMESKEL</b> Minoring in Biology and I am planning on doing research/gathering information and also developing software in a health sector.</p>
<p><b>WILSON LUU</b> Minor/Concentration - User Experience Design. Intend to pursue either a career in user experience design or a position as a visual designer with an emphasis on user interface/user experience development.</p>	<p><b>JEFFREY ASMUS</b> My minor is human rights and in my future I want to develop tools that make the human right movement stronger.</p>	<p><b>ELANOR WORT</b> I am majoring in applied computing and minoring in business at the University of Washington Bothell. I am not sure where I plan on working after graduation but I would like to work as a bridge for communication between programmers and business professionals in the area.</p>

## SUMMIT CONTINUED

The highlight, and new addition this year, was a student panel comprised of undergraduate and graduate students who had come to UW Bothell from other schools. Each presented their particular background and how they transitioned from one school to the other. They answered questions about what helped them prepare for change and what reflection might be required for future progress.

One student noted how they were interested in computer science but never saw it as a career for them. When speaking with their advisor they discovered the CSS Bachelor of Arts

in Applied Computing degree, a multidisciplinary major that focuses on the application of computing systems within a specific field of study. The student loved the idea of being able to translate what they learned in the classroom into real world applications outside of the computer science field.

The field of computer science is always changing and, hopefully, always growing. The State of Computing Education Summit hopes to respond to that change and evolve with the industry to produce students who are going to succeed.



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# Help Support Our Mission!

Whether it's \$5 or \$500, every gift helps keep the Computing & Software Systems program a unique and rewarding experience for our students and an important resource for computing education in this region.

Support from our alumni and friends enables us to grow our activities even in these tough economic times.

Become part of our mission by donating today. Direct your giving to CSS by visiting [www.uwb.edu/css](http://www.uwb.edu/css) and clicking on the 'Make a Gift' link.

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