

INSTITUTE FOR SOFTWARE RESEARCH / UNIVERSITY OF CALIFORNIA, IRVINE

HOT RESEARCH

Bridging the Abstraction Gaps from Architecture to Code

Over the past few years, Prof. **Joshua Garcia** has been working extensively in the areas of mobile security, testing, and analysis; software architecture; and software maintenance and re-engineering. Garcia's



static and dynamic analysis techniques, machine learning, and artificial intelligence to address problems in the area of mobile applications and

research

utilizes

decay of software architecture.

One of his most recent works, led by Negar Ghorbani, a Ph.D. student coadvised by both Garcia and ISR Director Prof. Sam Malek, has examined the effects of architectural inconsistencies that arise among the differences between the *prescriptive architecture* of a software system, i.e., the architecture as intended or designed by the system's architects, and the descriptive architecture, i.e., the architecture as implemented or found in the code-level artifacts of the system. "All software systems have an architecture, even if that architecture is not explicitly documented or resides primarily in the minds of a system's architects," says Garcia.

A particularly exciting aspect of this research is that it has been conducted using actual specifications of the system's architecture by its developers and architects. The ability to obtain such specifications is possible due to the recent

RESEARCH BRIEFS

- Prof. Emerita **Bonnie Nardi** has been bestowed a Lifetime Achievement Award from the European Society for Socially Embedded Technology (EUSSET) for her body of research on activity theory, interaction design, games, social media, and society and technology. She received the prestigious award at the 17th European Conference on Computer-Supported Cooperative Work (ECSCW) in Salzburg, Austria in June.
- Prof. **André van der Hoek** is hosting eight undergraduate Korean students this summer as part of the International Summer Undergraduate Research Fellowship (I-SURF) program. Four students will work with van der Hoek's Ph.D. student **Elahe Paikari** and four will work with his Ph.D. student **Adriana Meza Soria**.
- Prof. **David Redmiles** gave the opening lecture titled "A Range of Methods in CSCW and HCI: examples from research in software engineering" at the First International Summer School in Research Methods for HCI/CSCW, which was held in Rio de Janeiro, Brazil in March.
- Prof. Joshua Garcia was a panelist at the first Student Mentoring Workshop at the International Conference on Software Engineering (ICSE 2019), held in May in Montreal, Canada. The panel was titled "What I wish I knew when I started my Ph.D. in SE."
- The paper titled "Towards Automating Precision Studies of Clone Detectors," which was presented in the Technical Track at ICSE 2019 in May, received an ACM SIGSOFT Distinguished Artifact Award. The paper is authored by alumnus Dr.
 Vaibhav Saini (Microsoft), Ph.D. students Farima Farmahinifarahani, Yadong Lu, and Di Yang, Pedro Martins (Microsoft, Lisbon), alumnus Dr. Hitesh Sajnani (Microsoft), Prof. Pierre Baldi, and Prof. Cristina Lopes.

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emergence of true architectural components that are now available in the Java programming language, one of the most widely used programming languages in the world. Specifically, starting with Java

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9, programs written in Java must contain a module descriptor file that specifies Java *modules*, which is the term used to refer to architectural components. Java modules expose Java packages at compile-time or runtime and even control the extent to which packages of a module may be accessed through reflection, i.e., the ability of a program to inspect or modify itself during runtime. Through five different module directives that control the extent to which a Java module requires internals of other modules or exposes its own internals, a Java program now necessitates the use of this new system called the Java Platform Module System (JPMS). In fact, starting with Java 9, JPMS requires that developers either explicitly specify modules or create a single module that exposes all of its internals.

"After about two decades of research about architecture-based development, a

MESSAGE FROM THE DIRECTOR

We have had many exciting accomplishments and activities at ISR in the past few months that you will read about in this edition of the *ISR Connector*. Notably, ISR organized and sponsored the first **Sou**thern **C**alifornia **So**ftware Engineering **S**ymposium (SuCSES), which was held on June 7. This symposium replaces the ISR Research Forum which was held annually for almost 20 years. SuCSES caters to researchers and practitioners with an interest in software from all over Southern California. This is not



or researchers and practitioners with an interest in software from all over Southern California. This is not our first edition of a regional forum as such. In the 1990s, ISR's predecessor IRUS organized an annual software engineering symposium, which was held jointly with USC in its later years. Since then, both the software industry and academic community in the area have grown significantly, making it even more important to have an event to foster relationships, stimulate collaborative research, and facilitate technology transition.

The first instance of SuCSES was a huge success! We had seven distinguished speakers from a variety of universities in Southern California presenting the latest research results from software architecture and design, to testing and analysis, to games, and more. Attendees came from all over California and even from a few other states. The event benefited from two great industry keynotes, delivered by Hans-Martin Will from SAP and Emerson Murphy-Hill from Google.

Will talked about the emerging models of software development in industry, particularly how many software decisions that were previously made offline have now moved into the runtime, forcing companies to

embrace what he called "software experimentation." In the age of big data, software development is treated as a data-driven problem as well. In a nutshell, leveraging continuous integration and deployment technologies, companies experimentally add features to a small sample of users, monitor their behavior, and adjust the availability of such features in real-time to optimize the system's objectives. In turn, the evolution of software has turned into a series of "live" experiments, where hypotheses as to the utility of features are tested in controlled settings. The sheer speed and scale of change in this emerging paradigm challenge the conventional models of software engineering and force us to reconceptualize our understanding of software development in the age of big data.

The second keynote by Murphy-Hill focused on software developer diversity and inclusion. Tech companies need to build software that works for a variety of users. Studies involving real developers in industry indicates that doing so requires a diverse set of developers to construct that software. The tech industry, however, has a way to go when it comes to fostering a diverse and inclusive workforce. Murphy-Hill gave an interesting overview of what companies such as Google are doing to promote diversity and inclusion. But there is only so much that can be achieved through isolated efforts at such companies. Many of the challenges facing the industry in terms of improving developer diversity and inclusion stem from the lack of a diverse graduating student population from universities. Fundamentally addressing the diversity and inclusion issues in the tech industry requires a more concerted collaboration between industry and academia.

The first edition of SuCSES gave the audience a lot to contemplate. ISR will continue to hold SuCSES annually going forward. However, to better facilitate industry-university collaboration through internship opportunities for students, it will be moved to an earlier date in winter. I look forward to seeing many of you in the future iterations of this event.

Prof. Sam Malek can be reached at malek@uci.edu.

mainstream programming language finally has an explicit notion of components with rich architectural interfaces, opening up opportunities for architectural research that could not be conducted before, especially from an empirical standpoint," says Garcia.

A variety of inconsistencies arise due to mismatches between prescriptive architectures as specified in a module descriptor file and the actual dependencies implemented in a Java system. For example, a module that exports internals that are not used by other modules in an application increases the attack surface of a module, reducing its security. At the same time, creating spurious dependencies reduces encapsulation and, in turn, maintainability. As another example, a module that requires more internals than it actually uses at runtime increases an application's memory consumption, creating software bloat. Garcia and his team specified eight different types of Java module inconsistencies derived from the five different types of module directives available in JPMS. To detect and repair these inconsistencies, the team created a novel approach called Darcy. To evaluate Darcy, Garcia and his team obtained 38 Java applications. Using Darcy, they found that 74% of the applications had architectural inconsistencies, totaling 124 inconsistencies across 28 Java applications. Through manual inspection, they found that all of the detected inconsistencies were, in fact, correct. To assess the correctness of Darcy repairs, the team verified that Darcy repairs result in programs that can still compile and, for applications with test suites, that the passing rate of the suites is the same both before and after Darcy repairs. Both of these repair assessments showed that Darcy repairs programs in a way that maintains both a program's compilation ability and test passing rates, confirming Darcy's ability to automatically repair architectural inconsistencies.

The team further evaluated Darcy in terms of security, encapsulation, and software bloat. For security, they assessed the extent to which Darcy repairs can reduce the attack surface of modules, finding an average reduction of 60.33% from 25 apps with overexposed modules. In terms of encapsulation, the team found a reduction of undesirable coupling, due to Darcy repairs, ranging from 20.7%-25.3% on average, up to 80.5%. For six applications suffering from software bloat, Darcy repairs result in reductions of memory

repairs result in reductions of memory consumption by 14% on average, with reductions up to 54.7%.

Besides work on inconsistencies among Java modules, Garcia is one of the lead researchers addressing problems involving the decay of software architectures through the construction of a communitywide research infrastructure called the Software Architecture INstrument (SAIN). This infrastructure is funded by the NSF and involves multiple teams across the United States interested in addressing problems of reproducibility, interoperability, and a lack of datasets and benchmarks when conducting software architecture research from the perspective of software



high-level overview of Darcy.

maintenance and empirical software engineering. Collaborators on the project include nearly 50 researchers from industry and academia across the globe.

Recently, and in support of SAIN, Garcia was one of the co-organizers of the 2nd International Workshop on Establishing the Community-Wide Infrastructure for Architecture-Based Software Engineering (ECASE 2019). ECASE workshops explore issues at the intersection of software architecture and empirical software engineering, and identify plausible solutions that jointly move both areas forward. One of ECASE's goals is to support the construction of SAIN. ECASE 2019 was also coorganized with ISR professors Malek and **Nenad Medvidović** of USC. Beyond research focused on software architecture, Garcia continues to study issues involving mobile security. In one project led by Garcia's Ph.D. student Sumaya Almanee, Garcia's team is examining third-party library vulnerabilities in native code, a major attack surface of Android apps that has been largely ignored thus far by the research community but which can, nevertheless, lead to severe security issues, including privilege escalations and memory-oriented vulnerabilities. The team, which includes Prof. Mathias Payer from Ecole polytechnique fédérale de Lausanne (EPFL), has been gathering many versions of the top 600 apps from Google Play and studying the extent to which they contain vulnerable third-party native libraries and how often apps update their usage of such native libraries.

Garcia is an Assistant Professor in the Department of Informatics in the Donald Bren School of Information and Computer Sciences (ICS). Prior to being appointed an Assistant Professor, he was an Associate Project Scientist at UCI ISR, working under the supervision of Prof. Malek. Garcia received his Ph.D. in 2014 from the University of Southern California under the advisement of Professor Medvidović.

To find out more about Prof. Garcia, visit his website:

http://jgarcia.ics.uci.edu/

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Example Java modules and their inter-dependencies.

Meet Chancellor's Professor Michael Franz

Chancellor's Professor Dr. **Michael Franz's** research background lies in the area of programming languages and compilers, but from the start of his career, he has been exploring new directions at the edges of the field rather than working solely at the core of a sub-discipline. He



was an early pioneer of the idea of machine independent code and just-in-time compilation. His 1994 dissertation "Code Generation On-The-Fly: A Key to Portable Software" was published two years before the appear-

ance of Java brought the ideas of portable code and just-in-time compilation to widespread attention. His later work on continuous profile-guided optimization still informs ongoing research efforts in industry today.

In the early 2000s, Franz and his student Andreas Gal (Ph.D. 2006) invented a new way of building compilers using "trace trees" (on which a U.S. patent has been awarded that the University of California has donated for the use of the open-source community). Franz realized this invention could have a huge effect on the nascent "Web 2.0" paradigm. When he started applying these ideas to JavaScript compilation, no one was working on lightweight compilers for dynamically typed languages such as JavaScript. Today, every major web browser has a JavaScript compiler built in.

Franz was able to convince the leadership of Mozilla (the nonprofit open-source organization behind the Firefox web browser) of the virtues of this approach. In a joint project between Mozilla and Franz's lab at UCI, they developed the first-ever JavaScript just-in-time compiler ("TraceMonkey") and incorporated it into the Firefox web browser, a substantial risk since the new compilation method had never been used in a "real world" context. The project was an unqualified success, enabling Firefox to retain its relevance for many years even as new competitors such as Google's Chrome emerged. At its peak, several hundred million users were using this software every day. Mozilla subsequently also adopted the "Compartmental Memory Management" technique developed in Franz's laboratory and incorporated it into Firefox. Originally designed to enhance browser security, as a nice side effect it also improves performance.

Hence, in addition to advancing the dis-

RESEARCH BRIEFS

ISR Director Prof. **Sam Malek** and Prof. **Joshua Garcia** gave a talk at Google in Sunnyvale in March titled "Testing and Analysis Techniques for Improving the Quality of Android Apps."

- Research Prof. Emeritus **Walt Scacchi** and Dr. **Thomas A. Alspaugh** have published an article titled "Challenges and Opportunities for Securing Software Ecosystem Architectures" in the May/June 2019 issue of *IEEE Software*.
- Visiting Prof. **Alf Inge Wang**, from the Norwegian University of Science and Technology, has two papers accepted to the European Conference on Games Based Learning, to be held in October in Odense, Denmark. The papers are titled "Jumble vs. Quiz – Evaluation of Two Different Types of Games in Kahoot!" and "Evaluation of Interactive and Gamified Approaches for Teaching ICT Theory – A Study of PowerPoint, Sembly, and Kahoot!"
- Prof. **Oliver Yi Wang**, Rochester Institute of Technology, and Prof. **David Redmiles** co-authored a paper titled "Implicit Gender Biases in Professional Software Development: An Empirical Study," which was accepted to the Software Engineering in Society (SEIS) Track of the 41st ACM/IEEE International Conference on Software Engineering (ICSE), held in Montreal, Canada in May. Prof. Wang presented the paper.

cipline, through his partnership with the open-source community, Franz has also impacted people's everyday lives. His invention sped up the processing of Web 2.0 apps in the browser, such as Gmail, by 700% on average while requiring much less memory than previous methods. This game-changer made it practical to run such web apps on much lower-powered computers than was previously possible – helping bridge the "digital divide" and broadening participation in the digital economy.

More recently, Franz has turned his main research focus to computer security, and has focused on unconventional solutions. He is considered one of the fathers of the field of "Moving Target Cyber-Defenses." At the center of his research in this area has been the idea of using compiler technology to generate a large number of different software binaries, similar to biodiversity in nature.

Prof. Franz received the Diplomingenieur and Doctor of Technical Sciences degrees from ETH Zurich, the Swiss Federal Institute of Technology in Zurich, Switzerland. He joined UCI as an Assistant Professor in 1996. He is now a Full Professor of Computer Science in UCI's Donald Bren School of Information and Computer Sciences and holds a courtesy appointment as a Professor of Electrical Engineering and Computer Science in UCI's Henry Samueli School of Engineering. In 2016, the University awarded him the title of distinction "Chancellor's Professor."

Franz has graduated 28 Ph.D. students as primary advisor to date. He serves on the editorial boards of three journals, including *IEEE Transactions on Dependable and Secure Computing*, which is the top archival journal in the field of computer security. Franz has been awarded five United States Patents and has published more than 150 peer-reviewed scientific articles.

Prof. Franz is a Fellow of both the ACM and IEEE. He is a recipient of a Fulbright Scholarship, the NSF CAREER Award, the IEEE Computer Society's Technical Achievement Award, the UCI Applied Innovation Innovator of the Year Award, and the Humboldt Research Award.

To learn more, visit Prof. Franz's website: www.michaelfranz.com.

Contact Prof. Franz at franz@uci.edu.



NEW! Southern California Software Engineering Symposium (SuCSES)

ISR launched a new event on June 7: the Southern California Software Engineering Symposium (SuCSES). The goal of this event is to bring together researchers, leaders in industry, and technical practitioners to Southern California to discuss trends in the field of software engineering, showcase current research, formulate visions on strategic future research and technological directions, and build community.

SuCSES 2019 featured two engaging keynote speakers. The event opened with Dr. Hans-Martin Will, Head of SAP's new Innovation Center in Newport Beach, whose talk was titled "When Everything is an Experiment – Software Engineering in the Age of Big Data and Artificial Intelligence." To conclude the program,



Keynote Speaker Dr. Emerson Murphy-Hill, Google.

Dr. Emerson Murphy-Hill, Staff Research Scientist at Google, spoke on the topic of "Software Developer Diversity and Inclusion."

With an eye towards building community, the program included talks by faculty from five regional universities in addition to UCI. The speakers were: ISR alumnus Prof. **Yongjie Zheng**, CSU San Marcos; Prof. William Griswold, UC San Diego; Prof. Tevfik Bultan, UC Santa Barbara; Prof. Manu Sridharan, UC Riverside; ISR Prof. **Nenad Medvidović**, USC; and ISR Profs. **Iftekhar Ahmed** and **Cristina Lopes** from UCI.

A poster and demo session held at lunch featured over 20 projects by students and faculty from UCI, UC Santa Barbara, UC San Diego, UC Riverside and USC. This was a great opportunity for attendees to interact one-on-one with researchers from UCI and regional universities and learn



ISR STUDENT NEWS

Reyhaneh Jabbarvand (S. Malek, advisor) presented her paper titled



"Search-Based Energy Testing of Android" in the Technical Track of ICSE 2019 held in Montreal, Canada in May. The paper is co-authored by Ph.D. student Jun-Wei Lin

and her advisor Prof. **Sam Malek**. The paper has been selected to be featured in the Practitioners Digest column for *IEEE Software*. Jabbarvand also served on the artifact evaluation committee for ICSE 2019, and received a SIGSOFT CAPS travel award to attend.

Kaj Dreef (J. Jones, advisor) is intern-



ing this summer at Sony - PlayStation Now in Aliso Viejo, CA. He will assist the Hardware & Systems Engineering team in the development of PlayStation

Now server technology and Content Delivery Network technology.

Adriana Meza Soria (A. van der Hoek, advisor) presented her poster titled "Collecting Design Knowledge



through Voice Notes" at the 12th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE) held at ICSE 2019,

in Montreal, Canada in May. The poster is co-authored by her advisor Prof. **André van der Hoek**.

ISR STUDENT NEWS



Yang Feng (J. Jones, advisor) served as Proceedings

> Chair for the 14th IEEE/ACM International Conference on Global Software Engineering (ICGSE 2019), which was colocated with ICSE 2019 in

Montreal, Canada in May.

Elahe Paikari's (A. van der Hoek, advisor) paper titled "A Chatbot for Conflict Detection and Resolution" was presented at the 1st International Workshop on Bots



in Software Engineering (BotSE), held in May in Montreal, Canada at ICSE. The paper is co-authored by: JaeEun Choi of Kyung Hee University; SeonKyu Kim

of Kookmin University; Sooyoung Baek of Hanyang University; MyeongSoo Kim, SeungEon Lee, ChaeYeon Han, and YoungJae Kim of Kookmin University; KaHye Ahn of Sogang University; Chan Cheong of Dankook University; and Paikari's advisor Prof. **André van der Hoek**.

David Kutas (A. van der Hoek, advisor), is interning this summer



at NextGen Healthcare Information Systems in Irvine, CA. He is working on a project connected to the new cloudbased data aggregation platform called

Health Data Hub.



Alumni congregate at SuCSES with ISR Director Emeritus Prof. Richard Taylor. Left to right: Dr. Kristina Nasr, Google; Dr. Leyna Cotran, Lyft; Dr. Owen O'Malley, Cloudera; Kari Nies, UCI ISR; Dr. Eric Dashofy, The Aerospace Corp.; Prof. Nenad Medvidović, USC; Prof. Taylor; Prof. Youngjie Zheng, CSUSM; Dr. Hiroko Wilensky, Boeing; Debra Brodbeck, UCI ISR; and ISR DIrector Sam Malek.

about projects firsthand.

SuCSES 2019 attracted nearly 140 attendees from 19 companies, and 17 regional, national, and international universities. Alumni turned out in abundance, as is the tradition for ISR's annual event. Attendees commented enthusiastically on the wide range of participation from local universities, the timeliness and strength of the research addressed in the faculty talks and the posters/demos, and the value added by the industry keynote talks.

Alumna Dr. Kristina Nasr (Ph.D. 2010, D. Richardson, advisor), Software Engineer, Google, reflected on the event: "I absolutely loved attending SuCSES at UCI, and it's something I plan on attending in the future. It was interesting to hear the presentations about software engineering, particularly about reviewing software and testing software. Being in industry and developing software with the tools we have at hand, we don't really get exposed to new research like this. It was also wonderful to chat with the professors I met as a student in the Informatics Department and with friends who were there at the same time."

Read more about the event in the Message from the Director on page 2.

For additional information, visit the 2019 SuCSES website:

http://isr.uci.edu/isr-events/symposium/2019

Videos of the talks are available on the SuCSES website and the ISRUCI YouTube channel.

Contribute to the Richard N. Taylor Graduate Award in Software Engineering

The UCI Donald Bren School of Information and Computer Sciences (ICS) established the Richard N. Taylor Graduate Award in Software Engineering in Fall 2018. This is the first award in ICS specifically dedicated to software engineering. It honors the legacy of ISR Founding Director Prof. Emeritus **Richard N. Taylor**.

Would you like to support graduate students in software engineering? Or show your support for the Richard. N. Taylor Graduate Award?

Your tax-deductible donation can be made online at: https://bit.ly/2VsX6se

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Questions? Contact:

ISR Assistant Director **Debra Brodbeck**, brodbeck@uci.edu ICS/Eng. Assistant Dean for Development **Ed Hand**, elhand@uci.edu Informatics Dept. Chair Prof. **André van der Hoek**, andre@ics.uci.edu



CPRI-ISR IoT Security and Privacy Conference

ISR was pleased to co-sponsor, with UCI's Cybersecurity Policy and Research Institute (CPRI), a one-day event on the topic of Internet of Things (IoT) Security and Privacy. The event was held on May 14 in Donald Bren Hall at UCI.

The event featured:

■ a keynote talk by Prof. Kevin Fu from the University of Michigan on the topic of "The Physics of Sensor Cybersecurity;"

presentations by CPRI Executive Director Bryan Cunningham and ISR Director Sam Malek, as well as faculty and graduate students from UCI Health, the Henry Samueli School of Engineering, and the Donald Bren School of ICS;

■ a panel on IoT Privacy Regulation with panelists from CPRI, UCI Law, the Henry Samueli School of Engineering, and the Donald Bren School of ICS; and

a research showcase with posters and



Research Showcase: graduate students present their projects to attendees.



demonstrations by UCI graduate students.

Topics addressed by the presentations included: mitigating cyber threats over the next decade; mobile application security; how to get IoT devices to 'think straight'; automated security analysis of emerging smart transportation systems; and a noninvasive side channel attack against DNA synthesis machines.

Nearly 100 people attended from a broad range of commercial software development companies, defense contractors, national and regional government agencies, law firms, financial advisement companies, consulting agencies, regional universities and high schools, in addition to numerous UCI schools and campus institutions.

"The dynamic environment and high quality of the content made for an excellent collaborative opportunity," said alumnus Dr. Jose Romero-Mariona (Ph.D. 2010, D. Richardson, advisor), Cyber Science and Technology Branch Head, Naval Information Warfare Center-Pacific. "I valued being able to learn from leading faculty in cybersecurity while engaging with the bright students during the poster session. As a research scientist in cybersecurity and IoT, we need more events like these. CPRI and ISR at UCI are doing it right!"

Videos of the talks and the panel are available on the ISR YouTube channel:

https://www.youtube.com/user/ISRUCI

For more information, visit:

https://cpri.uci.edu/iot-security-privacyconference-2019/

ISR STUDENT NEWS

Negar Ghorbani's (J. Garcia and S. Malek, advisors) paper titled



"Detection and Repair of Architectural Inconsistencies in Java" was presented in the Technical Track at ICSE 2019, which was held in Montreal, Canada in May.

The paper is co-authored by her advisors Prof. Joshua Garcia and Prof. Sam Malek. The tool developed in this project, Darcy, received two artifact badges during the ICSE artifact evaluation: Reusable and Available.

Maruf Zaber (C. Lopes, advisor)



is interning this summer at Google in Sunnyvale, CA. Zaber is working with a team in Google Cloud. His supervisor is James Nam.

Farima Farmahinifarahani's (C. Lopes, advisor) paper titled "On precision of code clone detection tools" was presented at the



26th IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER), held in Hangzhou, China in February. The paper

is co-authored by alumnus Dr. Vaibhav Saini (Microsoft), Ph.D. student Di Yang, alumnus Dr. Hitesh Sajnani (Microsoft), and Farmahinifarahani's advisor Prof. Cristina Lopes.

NTT Software Innovation Center Collaborates with Prof. André van der Hoek on Recovering Undocumented Knowledge

A common problem in both open source and closed source software development is the checking in of code changes that are not linked to any issues in the issue tracker. Especially when an issue does exist that actually describes the needed change in functionality, such missing links represent knowledge that should be captured but is not. NTT is no stranger to this problem and recognizes the importance of addressing it.

For the past year, Dr. Shinobu Saito from the NTT Software Innovation Center has been working with Prof. André van der Hoek and his team to do exactly that. Key to the project has been Taneisha Kaur Arora, an undergraduate majoring in both Software Engineering and Data Science, who worked together with van der Hoek's graduate student Adriana Meza **Soria** to develop a tool suite to perform experiments on an open source data set exhibiting the problem. Using her outstanding knowledge of machine learning, information retrieval, and statistics, Arora experimented with a range of different approaches, slowly but steadily making progress in more robustly recovering the links. In their most recent experiments, the team achieved a success rate above 80% with several refinements still to be made. Naturally, a next step is applying the approach to an NTT data set, which Dr. Saito and his colleagues at NTT SIC in

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Japan are now preparing.

"It has been tremendously rewarding collaborating with Dr. Saito for the past few years," van der Hoek says. "The ability to work on problems that are directly relevant to the real world is of great value, and brings to our students a challenge they not only embrace, but also can turn into their next job!" Arora, indeed, is off to Google this summer for an internship that in no small measure emerged because of her experience working on this problem with NTT.

This fruitful collaboration with Dr. Saito, a Distinguished Research Engineer, Software Engineering at NTT SIC, grew out of Saito's time spent at ISR as a visiting researcher from July 2016 – June 2018.

For more information, contact Prof. van der Hoek at andre@ics.uci.edu.



Dr. Shinobu Saito, Prof. Andre van der Hoek, undergraduate researcher Taneisha Kaur Arora, Ph.D. student Adriana Meza Soria, and Project Manager Mr. Daisuke Hamuro of NTT SIC.

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ICS Hall of Fame Inductees (left to right) Justin Erenkrantz, Jim Berney, Gerald Bortis, and Erin Bradner, with ICS Dean Marios Papaefthymiou (center).

Four Alumni Inducted into ICS Hall of Fame – All with Ties to ISR

On February 8, the Donald Bren School of ICS inducted four alumni into the ICS Hall of Fame. ICS Dean **Marios Papaefthymiou** presented the awards to the alumni at the Engineering, ICS, and Physical Sciences Hall of Fame Celebration which was held at the Tustin Hangar in Tustin, CA.

Jim Berney received his B.S. from ICS in 1989, and was hired as a programmer analyst for the Software group's Arcadia Research Project which was run by faculty members Prof. Richard Taylor and Prof. Debra Richardson, among others. Berney went on to a tremendously successful career: he is an Academy Award® nominated freelance visual effects supervisor and is currently working on Disney's production of Jungle Cruise. Other recent works include visual effect supervising for Warner Brothers' Aquaman and the *Minecraft* movie, as well as Legendary's Pacific Rim 2. Berney was selected on behalf of the ICS inductees to speak to the audience at the induction ceremony. In his heartfelt and inspiring speech, Berney called attention to the professors who taught him software engineering and AI, noted that although he is in an artistic field he relies on the software engineering skills he learned at UCI, and emphasized that ICS prepared him for the challenges that he would meet in his career.

Dr. **Gerald Bortis** received his Ph.D. in 2016, with Informatics Chair Prof. **André van der Hoek** as his advisor. Bortis is now Vice President of Software Development at NextGen Healthcare, a leading provider of healthcare technology solutions. Bortis started his career as a software engineer with Mirth in 2005 where he was one of the founders of Mirth Connect, an open source data integration engine. While at Mirth, Bortis helped grow the development team and was instrumental in the acquisition of Mirth in 2013 by Quality Systems, Inc., now NextGen Healthcare.

Dr. **Erin Bradner** earned her Ph.D. from ICS in 2001 under the advisement of Prof. **Gloria Mark**. Bradner is a Director and Research Scientist at Autodesk Inc. in San Francisco. She helped found the Generative Design initiative at Autodesk, and now manages Autodesk's Robotics Lab. Bradner has led hundreds of research projects over the course of her career – a common thread across them being that her research helps amplify human creativity through intelligent and intuitive technology.

Dr. Justin Erenkrantz rounds out the list of esteemed inductees. He received his Ph.D. in 2009, with ISR Founding Director Prof. Richard Taylor as his advisor. Erenkrantz is currently SVP of Software Engineering at Major League Baseball where his teams are responsible for delivering the core technology that supports the game. Prior to joining MLB in 2017, Erenkrantz was at Bloomberg LP as Head of Compute Architecture in the Office of the CTO. Erenkrantz is a member and past president of The Apache Software Foundation and a long-time contributor to several well-known open source projects such as the Apache HTTP Server and Subversion.

Congratulations to all four 2019 ICS Hall of Fame inductees!

Alumni News



Leyna Cotran (Ph.D. 2013, advisor R. Taylor), is now a Systems Engineer at Lyft Level 5 in Palo Alto, CA.

Rosalva Gallardo Valencia (Ph.D. 2012, advisor S. Sim), now a Cloud Program Manager at Google in



Mountain View, CA, was interviewed by Univision in conjunction with her advocacy of the Technolochicas project to inspire young Latinas to pursue careers in

Technology. Watch it at: https:// bit.ly/2Jm3MAG

Wayne Lutters (Ph.D. 2001, advisor



M. Ackerman) is now an Associate Professor at the College of Information Studies (iSchool) at the University of Maryland.

Jie Ren (Ph.D. 2006, advisor R.



Taylor), a Senior Staff Software Engineer at Google, is now working at YouTube headquarters in San Bruno, CA.

ISR STUDENT NEWS

Fatema Akbar (G. Mark, advisor) presented her paper titled "Email Makes You Sweat: Examining Email Interruptions and Stress Using Thermal Imaging" at the Conference on Human Factors in Computing Systems (CHI 2019),



which was held in Glasgow, Scotland in May. The paper is coauthored by Ayse Elvan Bayraktaroglu, Pradeep Buddharaju, Dennis Rodrigo Da Cunha

Silva, Ge Gao, Ph.D. student **Ted Grover**, Ricardo Gutierrez-Osuna, Nathan Cooper Jones, Akbar's advisor Prof. **Gloria Mark**, Ioannis Pavlidis, Kevin Storer, Zelun Wang, Amanveer Wesley, and Shaila Zaman.

Ted Grover (G. Mark, advisor) presented his *Computer Supported Cooperative Work (CSCW)* journal-first paper titled "Moral



and Affective Differences in U.S. Immigration Policy Debate on Twitter" at the 17th European Conference on Computer Supported Cooperative

Work (ECSCW) held in June in Salzburg, Austria. The paper is coauthored by Elvan Bayraktaroglu of Istanbul Technical University, his advisor Prof. **Gloria Mark**, and Ph.D. student **Eugenia Ha Rim Rho**. Grover also presented the paper titled "Detecting Potential Warning Behaviors of Ideological Radicalization in an Alt-Right Subreddit" at the AAAI International Conference on Web and Social Media (ICWSM), held in Munich, Germany in June. The paper is co-authored by Prof. Mark.

Congratulations Graduates!

Join us in wishing our recent graduates well as they move on to new jobs around the country. Three cheers to one and all!



Hosub Lee (Ph.D., advisor A. Kobsa) has joined Samsung Research America in Irvine, CA as a Staff Software Engineer. He is working on building ML-based systems that provide Samsung Smart TV users with a personalized TV-viewing experience.

Yao Li (Ph.D., advisor A. Kobsa) is joining the University of Central Florida as an Assistant Professor in the Department of Informatics.





Wen Shen (Ph.D., advisor C. Lopes) is on the job market.



Ph.D. candidate Yang Feng (J. Jones, advisor), Prof. James A. Jones, Ph.D. graduate Wen Shen (C. Lopes, advisor), Prof. Cristina Lopes, Ph.D. candidate Di Yang (C. Lopes, advisor), Informatics Dept. Chair Prof. André van der Hoek, ISR Director Prof. Sam Malek, Alumnus Dr. Alireza Sadeghi (Ph.D. 2017, S. Malek, advisor), and Ph.D. candidate Reyhaneh Jabbarvand (S. Malek, advisor).



Front: David Redmiles, Iftekhar Ahmed, Anita Sarma, Mariam Guizani, and Yi Wang. Middle: Yang Yue, Elahe Paikari, Tayana Conte, Yang Feng, Adriana Meza Soria, and Andrew Truelove. Back: David Kutas, Igor Steinmacher, Zhendong Wang, and Marco Gerosa.

Workshop on Exploring the Unexplored in Social Software Development Platforms

Professors **David Redmiles** and **Iftekhar Ahmed** co-organized a workshop held Friday afternoon, May 17, and all day Saturday, May 18, on current research surrounding social software development platforms. Readers will be familiar with the well-known examples of such platforms, which include GitHub and StackOverflow. These platforms allow communities of software developers to lead and join together on projects, as well as answer questions supporting software and technology use. GitHub, for instance, has become the new vehicle for hosting much of the open source software development happening today.

As these platforms have evolved and grown in popularity, more kinds of participants are attracted. Seasoned developers may comprise a core of elite develop-

ISR Technical Reports Available Online

ISR technical reports present information resulting from student and faculty research carried out under the auspices of the Institute. They showcase early results not available in print elsewhere. ISR technical reports are available in PDF on the ISR website. Recent reports include:

"Architectural Decay Prediction from Evolutionary History of Software" Joshua Garcia, Ehsan Kouroshfar, and Sam Malek UCI-ISR-18-7, November 2018

"Towards Ubiquitous Privacy Decision Support: Machine Prediction of Privacy Decisions in IoT" Hosub Lee, Alfred Kobsa UCI-ISR-18-6, October 2018

"A History of Software Engineering in ICS at UC Irvine" Richard N. Taylor UCI-ISR-18-5, October 2018

All ISR technical reports are available at: isr.uci.edu/publications/

ISR STUDENT NEWS

Yang Yue (D. Redmiles, advisor) presented his poster titled "Collaboration in Global Software Development: An Investigation on Research Trends and Evolution" at



the Int'l Conf. on Global Software Engineering (ICGSE), colocated with ICSE in May in Montreal, Canada. The poster is coauthored by Prof. **Iftekhar**

Ahmed, Prof. **Yi Wang** (RIT), and Yue's advisor Prof. **David Redmiles**.

Rui Hao (J. Jones, host) a second-year Ph.D. student visiting from Nanjing Univ., China, presented her paper



titled "CTRAS: Crowdsourced Test Report Aggregation and Summarization" in the Technical Track of the Int'l Conf. on Software Engineering (ICSE 2019),

held in Montreal, Canada in May. The paper is co-authored by Ph.D. student **Yang Feng**, Prof. **James Jones**, and Yuying Li and Prof. Zhenyu Chen of Nanjing Univ.

Di Yang (C. Lopes, advisor) is co-author on the paper titled "Analyzing and Supporting



Adaptation of Online Code Examples," presented in the Technical Track at ICSE 2019, in Montreal, Canada in May. The paper is authored by Tianyi Zhang (UCLA), Yang,

her advisor Prof. **Cristina Lopes**, and Prof. Miryung Kim (UCLA).

ers, but projects attract new developers with a range of interests and experiences. Thus, we see hints at challenges emerging around these platforms. How do newcomers find projects matching their skills and interests? How do learners get accepted to projects? How do long-running projects attract the right kinds of participants to sustain their lifecycle? How do the interfaces



to these platforms encourage or discourage participation, especially among people of different genders or even personalities?

ISR faculty from four institu-

tions along with several of their graduate students participated in the workshop: from UCI, Redmiles, Ahmed, and Prof. **André van der Hoek**; from Oregon State University, Prof. **Anita Sarma**; from Rochester Institute of Technology, Prof. **Oliver Yi Wang**; and from Northern Arizona University, Prof. **Marco Gerosa** and Prof. **Igor Steinmacher**. Also attending was visiting faculty member Prof. **Tayana Conte** from the University of Amazonas, Manaus.

Redmiles presented new research around the behavior of top contributors and ways their roles shift over time. He also reviewed past research on the differences between men and women developers contributing to projects, as well as work on developing trust, cohesion, and positive feelings in group projects. Ahmed explored topics of expert developers, including their behaviors and their effects on software quality. Wang explained the difficulties in parsing language used amongst developers, including in commit messages. He also explained how differences in culture, individuals, and even local, project-oriented norms can confound the interpretation of intentions and emotions. Sarma challenged the attendees to think about what research methods work in this arena of social software development platforms and how user interfaces

ISR EVENT SCHEDULE

Mark your calendars!

Friday, January 24, 2020 2nd Southern California Software Engineering Symposium (SuCSES)

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affect participation by different gender groups. Conte discussed research methods, turning the focus to both positive and negative experiences (as opposed to the more common focus on the easy to learn) as well as a theoretical approach based on communication (semiotic engineering). Steinmacher and Gerosa reviewed their research on the social challenges to



participating in GitHub projects and showed positive results from a portal they have developed to help newcomers succeed in making their first

newcomers

contribution. van der Hoek examined the role of tools in supporting software development, particularly how chatbots might help.

There was a great deal of discussion around all of these topics and the questions enumerated above. Plans were made to collaborate more specifically on white papers, proposals, research articles, and future workshops.

"I had been talking with colleagues for a

SPECIAL THANKS

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long time about having this workshop," said Prof. Redmiles. "We were all working on very close, but generally complementary aspects of research around open source software including expert developers, gender diversity, and education, among other aspects. It was a great opportunity to brainstorm on these topics and to have the input of our graduate students."

Ahmed reflected on the event: "Organizing this workshop with David was a new and exciting experience for me. The workshop facilitated focused discussions leading to collaborations, which as an Assistant Professor is invaluable to me."

The workshop was funded by an "Inspiration Award" from the Dean's Office, Donald Bren School of Information and Computer Sciences (ICS).

For more information, contact Prof. David Redmiles at redmiles@ics.uci.edu and Prof. Iftekhar Ahmed at iftekha@uci.edu.

