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It is our great pleasure and honor to welcome everyone to the 31st IEEE/ACM International Conference on Automated Software Engineering (ASE 2016). The ASE conference series is the premier research forum for automated software engineering. Each year it brings together researchers and practitioners from academia and industry to discuss foundations, techniques, and tools for automated analysis, design, implementation, testing, and maintenance of software systems. This booklet contains the program of the conference, which is held between September 3-7, 2016 in Singapore. The first two days of the conference are allocated to workshops, tutorials, and a doctoral symposium, while the last three days were for the presentations of keynotes, technical papers, and tool demo papers.

Entering its fourth decade after its inception, the ASE conference is getting even more relevant today. More and more individuals, businesses, and governments are relying on software systems, ranging from small apps that run on handheld devices to large mission critical systems that run on the cloud. ASE tools and techniques help in the construction and evolution of such systems to improve system reliability and developer productivity.

ASE 2016 is held in the beautiful downtown campus of Singapore Management University. We are excited to bring ASE for the first time to Singapore and the second time to Asia. Singapore is a green island/city-state in Southeast Asia with a population of over 5 million people. It is a global transportation hub and leading IT, commerce, and financial center. Thousands of information and communication (infocomm) companies are located in Singapore, with tens of thousands of people working in this sector.

As a major highlight, ASE 2016 is able to attract 3 internationally renowned keynote speakers:

- Markus Püschel (ETH Zurich): “Program Generation for Performance”
- Wolfram Schulte (Microsoft): “Changing Microsoft's Build: Revolution or Evolution”
For the technical research track, we received 353 paper submissions- a record for the ASE conference series! 20 submissions were desk rejected without review, because they failed to follow the instructions given in the call for papers or were clearly out of scope. The remaining 333 submissions- 284 technical papers, 14 experience papers, and 35 new idea papers were reviewed by the members of the Program Committee and the Expert Review Panel, with each paper receiving, at least, 3 reviews. For the first time, ASE pursued a lightweight double-blind review process. While our initial impression is positive, we are still in the process of analyzing the data we collected. A report on double-blind reviewing is in the process of making. We would like to thank our review process chairs, Yuriy Brun and Claire Le Goues, for their help with the double-blind reviewing process.

We had a very active online discussion phase, with many long and detailed discussions among the members of the Program Committee (PC) and the Expert Review Panel. During a two-day physical PC meeting held at the University of Passau on July 12, 2016, the members of the Program Committee compiled the final selection of papers to be presented at ASE 2016. This careful and thorough review process resulted in the selection of 53 technical research papers, 4 experience papers, and 14 new ideas papers (some of these were recategorized). Our sincere thanks go to members of the Program Committee and the Expert Review Panel, and the authors for their hard work and contributions!

Beside presentations of technical papers, the program of ASE 2016 also includes the presentations and demonstrations of 20 tool papers. These papers were selected from 44 submissions. We thank our tool demonstration chairs Yuanfang Cai and Yang Liu along with tool paper authors to make this track possible!

Furthermore, prior to the conference, 4 workshops will be held on Sept 3-4, 2016 thanks to the hard work of the workshop chairs Leonardo Mariani and Zhenchang Xing as well as the workshop organizers and authors:
• Workshop on Specification, Comprehension, Testing and Debugging of Concurrent Programs.
  Organizers: Zijiang Yang, Ting Liu, and Daniel Xiapu Luo.

• First International Workshop on Software Refactoring.
  Organizers: Ali Ouni, Marouane Kessentini, and Mel Ó Cinnéide.

• Fifth International Workshop on Software Mining.
  Organizers: Ming Li, Xiaoyin Wang, and Lu-cia.

• Workshop on Formal Methods for Analysis of Business System.
  Organizers: Ravindra Naik, Raveendra Kumar Medicherla, and Ansuman Banerjee.

ASE 2016 also offer a wide range of tutorials to conference attendees. The tutorials covered a broad range of topics, such as model checking, product lines, program analysis, testing, search-based software engineering, human computer interaction, and software mining. We thank our tutorial chairs Tien N. Nguyen and Rui Abreu as well as the tutorial lecturers to make ASE 2016 attendees be spoilt for choice.

Furthermore, we would like to thank our doctoral symposium chairs Massimiliano Di Penta and Tien N. Nguyen for organizing the annual ASE doctoral symposium on Sept 4. Many doctoral students will benefit from advice given by a panel of experts and the keynote speaker Andrian Marcus.

Numerous organizing committee members have helped in various ways to make the event a success. We would like to thank Lingxiao Jiang for serving as local arrangement/finance chair; Siau-Cheng Khoo for serving as sponsorship chair; Jun Sun for serving as proceedings chair; Christian Kästner, Shahar Maoz, and Xin Xia for serving as publicity co-chairs; Lingming Zhang and Lucia for serving as social media co-chairs; Jin Song Dong and Steven Miller for serving as members of the local advisory committee; Pavneet Singh Kochhar and Ferdian Thung for serving as webmasters. Additionally, we would also like to thank various members of the administrative team of the School of Information Systems (SIS) and Living Analytics Research Center (LARC), and members of the Software Analytics Research (SOAR) group, who have contributed
much in managing the finance and local arrangements.

Last but not least, we would like to thank our sponsors for providing various kinds of support.

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**Sven Apel and Sarfraz Khurshid, ASE 2016 PC Chairs**
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<th>Affiliation</th>
<th>Location</th>
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<td>Jianmei Guo</td>
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<td>Build Your Own Model Checker with PAT</td>
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<tr>
<td></td>
<td>SMU School of Accountancy, Level 2, Seminar Room 2-4</td>
<td>Workshop on Specification, Comprehension, Testing and Debugging of Concurrent Programs</td>
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<tr>
<td>Pg 22</td>
<td>09:00 – 13:00</td>
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<td>Organizers: Zijiang Yang, Ting Liu, and Daniel Xiapu Luo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PM</th>
<th>Tutorial 2</th>
<th>Tutorial 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pg 32</td>
<td>Product Line Variability</td>
<td>Automated GUI Testing of Android Apps: Challenges, Approaches, Tools, and Best Practices</td>
</tr>
<tr>
<td></td>
<td>SMU School of Accountancy, Level 2, Seminar Room 2-5</td>
<td>SMU School of Accountancy, Level 2, Seminar Room 2-4</td>
</tr>
<tr>
<td></td>
<td>09:00 – 13:00</td>
<td>14:30 – 18:30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FULL DAY</th>
<th>Tutorial 5</th>
<th>Workshop 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pg 39</td>
<td>Search Based Software Engineering: Foundations, Challenges and Recent Advances</td>
<td>Fifth International Workshop on Software Mining</td>
</tr>
<tr>
<td></td>
<td>SMU School of Accountancy, Level 2, Seminar Room 2-5</td>
<td>SMU School of Accountancy, Level 2, Seminar Room 2-3</td>
</tr>
<tr>
<td></td>
<td>14:30 – 18:30</td>
<td>09:30 – 18:00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organizers: Ming Li, Xiaoyin Wang, Lucia</td>
</tr>
</tbody>
</table>
## 4th September 2016, Sunday

### AM

| Tutorial 7 | Testing Stochastic Software | Pg 44 |
| SMU School of Accountancy, Level 2, Seminar Room 2-5 | 09:00 – 13:00 |

| Tutorial 8 | Mining and Modelling Unstructured Data | Pg 46 |
| SMU School of Accountancy, Level 3, Seminar Room 3-1 | 09:00 – 13:00 |

### PM

| Tutorial 3 | Software Analytics: Challenges and Opportunities | Pg 33 |
| SMU School of Accountancy, Level 2, Seminar Room 2-5 | 14:30 – 18:30 |

| Tutorial 9 | Using Docker Containers to Improve Reproducibility in Software Engineering Research | Pg 47 |
| SMU School of Accountancy, Level 3, Seminar Room 3-1 | 14:30 – 18:30 |

### FULL DAY

| Workshop 3 | 1st International Workshop on Software Refactoring | Pg 26 |
| SMU School of Accountancy, Level 2, Seminar Room 2-2 | 09:15 – 18:00 |

- Organizers: Ali Ouni, Marouane Kessentini and Mel Ó Cinnéide

| Workshop 4 | Workshop on Formal Methods for Analysis of Business System | Pg 28 |
| SMU School of Accountancy, Level 2, Seminar Room 2-3 | 08:45 – 16:30 |

- Organizers: Ravindra Naik, Ansuman Banerjee, Raveendra Kumar M

| Doctoral Symposium | Pg 49 |
| SMU School of Accountancy, Level 3, Seminar Room 3-2 | 09:00 – 17:00 |

| Tutorial 6 | Learn to Build Automated Software Analysis Tools with Graph Paradigm and Interactive Visual Framework | Pg 42 |
| SMU School of Accountancy, Level 2, Seminar Room 2-4 | 09:00 – 18:30 |
## 5th September 2016, Monday

### Track 1
(Mochtar Riady Auditorium, Level 5, SMU Administration Building)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00-9:30</td>
<td>Opening (Mochtar Riady Auditorium)</td>
</tr>
<tr>
<td>9:30-10:30</td>
<td>Keynote: Markus Püschel (Mochtar Riady Auditorium)</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td>Break</td>
</tr>
<tr>
<td>11:00-13:00</td>
<td>Test evaluation (Pg 56)</td>
</tr>
<tr>
<td>13:00-14:30</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:30-16:30</td>
<td>Recommendation and automation (Pg 57)</td>
</tr>
<tr>
<td>16:30-17:00</td>
<td>Break</td>
</tr>
<tr>
<td>17:00-18:30</td>
<td>Crowdsourcing (Pg 58)</td>
</tr>
</tbody>
</table>

### Track 2
(Function Room 4.1 & 4.2, Level 4, SMU Administration Building)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00-13:00</td>
<td>Learning (Pg 59)</td>
</tr>
<tr>
<td>13:00-14:30</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:30-16:30</td>
<td>Model-based testing and oracles (Pg 60)</td>
</tr>
</tbody>
</table>

### Tool Demo
(Presentation)
(Function Room 6.1, Level 6, SMU Administration Building)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>16:30-17:00</td>
<td>Break</td>
</tr>
<tr>
<td>17:00-18:30</td>
<td>Testing, validation, and verification (Pg 65)</td>
</tr>
</tbody>
</table>

### Tool Demo
(Presentation)
(Function Room 6.1, Level 6, SMU Administration Building)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:30-21:30</td>
<td>Reception (SMU Li Ka Shing Library)</td>
</tr>
</tbody>
</table>
### Schedule

**6th September 2016, Tuesday**

<table>
<thead>
<tr>
<th>Time</th>
<th>Track 1</th>
<th>Track 2</th>
<th>Tool Demo (Hands on)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( Mochtar Riady Auditorium, Level 5, SMU Administration Building )</td>
<td>( Function Room 4.1 &amp; 4.2, Level 4, SMU Administration Building )</td>
<td>( Foyer Outside Mochtar Riady Auditorium )</td>
</tr>
<tr>
<td>9:30-10:30</td>
<td><strong>Keynote: Wolfram Schulte</strong> (Mochtar Riady Auditorium)</td>
<td></td>
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</tr>
<tr>
<td>10:30-11:00</td>
<td>Break</td>
<td></td>
<td></td>
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<tr>
<td>11:00-13:00</td>
<td>Faults</td>
<td>Program analysis</td>
<td>Mobile and security</td>
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<td></td>
<td></td>
<td></td>
<td>Pg 66</td>
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<td>Pg 69</td>
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<td></td>
<td></td>
<td></td>
<td>Pg 62</td>
</tr>
<tr>
<td>13:00-14:30</td>
<td>Lunch</td>
<td></td>
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</tr>
<tr>
<td>14:30-16:30</td>
<td>Locks and races</td>
<td>Empirical studies and new ideas</td>
<td>Performance, recommendation, and analysis</td>
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<td></td>
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<td>Pg 67</td>
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<td>Pg 70</td>
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<td>Pg 63</td>
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<tr>
<td>16:30-17:00</td>
<td>Break</td>
<td></td>
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<tr>
<td>17:00-18:30</td>
<td>Inference</td>
<td>Interactions, deltas, goals</td>
<td>Testing, validation, and verification</td>
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<td></td>
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<td>Pg 68</td>
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<td>Pg 71</td>
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<td></td>
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<td></td>
<td>Pg 65</td>
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<tr>
<td>19:30-21:30</td>
<td>Dinner @ Carlton Hotel</td>
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<tr>
<td>Time</td>
<td>Track 1</td>
<td>Track 2</td>
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<td></td>
<td>(Mochtar Riady Auditorium, Level 5, SMU Administration Building)</td>
<td>(Function Room 4.1 &amp; 4.2, Level 4, SMU Administration Building)</td>
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</tr>
<tr>
<td>9:30-10:30</td>
<td><strong>Keynote: David Rosenblum</strong> (Mochtar Riady Auditorium)</td>
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<tr>
<td>10:30-11:00</td>
<td>Break</td>
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<tr>
<td>11:00-13:00</td>
<td>Symbolic execution</td>
<td>Design and specs</td>
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<tr>
<td>13:00-14:30</td>
<td>Lunch</td>
<td></td>
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<tr>
<td>14:30-16:30</td>
<td>Test generation</td>
<td>Code comparison and transformation</td>
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<tr>
<td>16:30-17:00</td>
<td>Break</td>
<td></td>
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<tr>
<td>17:00-18:00</td>
<td>Language</td>
<td>Mining and retrieval</td>
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<tr>
<td>18:00-18:30</td>
<td>Closing and Presentation of ASE 2017</td>
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<tr>
<td>Time</td>
<td>Session I</td>
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<tr>
<td>9:00 - 9:05</td>
<td>Opening</td>
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</tbody>
</table>
| 9:05-10:00 | Invited Speech I: Compositional Verification of Concurrent Programs  
Jun Sun  
Singapore University of Technology and Design |
| 10:00-10:30| Paper Presentation                           |
| 10:00-10:30| Paper 1: An algebraic specification language for Organizational Behavior of OOMAS  
Yan Zhang and Lejian Liao |
| 10:00-10:30| Paper 2: A Model for Systematic Monitoring and Debugging of Starvation Bugs in Multicore Software  
Sara Abbaspour Asadollah, Mehrdad Saadatmand, Sigrid Eldh, Daniel Sundmark and Hans Hansson |
| 10:30-11:00| Break                                        |
| 11:00-11:55| Invited Speech II: On the Theory of Parallelizable Architecture  
Yuanfang Cai, Drexel University |
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>11:55-12:40</td>
<td><strong>Paper Presentation</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Paper 3</strong></td>
</tr>
<tr>
<td></td>
<td>A Leader Election Based Deadlock Detection</td>
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<td></td>
<td>Algorithm in Distributed Systems</td>
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<tr>
<td></td>
<td>Wei Lu, Yong Yang, Liqiang Wang, Weiwei Xing</td>
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<tr>
<td></td>
<td>and Xiaoping Che</td>
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<tr>
<td></td>
<td><strong>Paper 4</strong></td>
</tr>
<tr>
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<td>Dynamic Cohesion Measurement for Distributed</td>
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<tr>
<td></td>
<td>System</td>
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<tr>
<td></td>
<td>Wuxia Jin, Ting Liu, Yu Qu, Jianlei Chi, Di</td>
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<td></td>
<td>Cui and Qinghua Zheng</td>
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<tr>
<td></td>
<td><strong>Paper 5</strong></td>
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<td></td>
<td>A Test Case Generation Method without Test</td>
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<td>Oracle Problem</td>
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<td></td>
<td>Zhanwei Hui and Song Huan</td>
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<tr>
<td>12:40-12:45</td>
<td><strong>Closing</strong></td>
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<tr>
<td>Time</td>
<td>Session</td>
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</tr>
<tr>
<td>9:30 - 9:45</td>
<td>Workshop Opening</td>
</tr>
<tr>
<td>9:45 - 10:30</td>
<td>Invited Talk 1</td>
</tr>
<tr>
<td>10:30 - 11:00</td>
<td>Break</td>
</tr>
<tr>
<td>11:00 - 11:25</td>
<td>Session 1: Code Mining</td>
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<td>11:25 - 11:50</td>
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<tr>
<td>11:50 - 12:15</td>
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<tr>
<td>12:35 - 13:00</td>
<td></td>
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<tr>
<td>13:00 - 14:30</td>
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</table>
### Invited Talk 2

**Sinno Jialin Pan**

### Session 2: Text Mining

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:15 - 15:40</td>
<td>Duplicate Issue Detection for the Android Open Source Project</td>
<td>Kasthuri Jayarajah, Meeralakshmi Radhakrishnan and Camellia Zakaria</td>
</tr>
<tr>
<td>15:40 - 16:05</td>
<td>Mining Testing Questions on Stack Overflow</td>
<td>Pavneet Singh Kochhar</td>
</tr>
<tr>
<td>16:05 - 16:20</td>
<td>Discussion</td>
<td></td>
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<tr>
<td>16:20 - 17:00</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>17:00 - 18:00</td>
<td>Keynote Speech</td>
<td>Andreas Zeller</td>
</tr>
</tbody>
</table>
# 1st International Workshop on Software Refactoring

**SMU School of Accountancy, Level 2, Seminar Room 2-2**

### 9:15-9:30
**Workshop Opening**

### 9:30-10:30
**Keynote Talk**
Danny Dig

### 10:30-11:00
**Break**

### Session 1: Architecture, Detection and Evaluation

<table>
<thead>
<tr>
<th>11:00-11:30</th>
<th>Empirical Evaluation of Code Smells in Open Source Projects: Preliminary Results</th>
<th>Aziz Nanthamornphong and Apatta Chaisutanon</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30-12:00</td>
<td>Refactoring for Software Architecture Smells</td>
<td>Ganesh Samarthyam, Tushar Sharma and Girish Suryanarayana</td>
</tr>
<tr>
<td>12:00-12:30</td>
<td>Graph-Based Approach for Detecting Impure Refactoring from Version Commits</td>
<td>Syogo Tsutsumi, Eunjong Choi, Norihiro Yoshida and Katsuro Inoue</td>
</tr>
<tr>
<td>12:30-13:00</td>
<td>Measuring Refactoring Benefits: A Survey of the Evidence</td>
<td>Mel Ó Cinnéide, Aiko Yamashita and Steve Counsell</td>
</tr>
</tbody>
</table>

### 13:00-14:30
**Lunch**
# 1st International Workshop on Software Refactoring

**SMU School of Accountancy, Level 2, Seminar Room 2-2**

## Invited Talk
**14:30-15:00**

**Invited Talk**

Vittorio Cortellessa

## Session 2: Models and Application

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>15:00-15:30</strong></td>
<td>Refactoring Verification using Model Transformation</td>
<td>Makoto Ichii, Daisuke Shimbara, Yasufumi Suzuki and Hideto Ogawa</td>
</tr>
<tr>
<td><strong>15:30-16:00</strong></td>
<td>Automated Translation among EPSILON Languages for Performance-Driven UML Software Model</td>
<td>Davide Arcelli, Vittorio Cortellessa and Daniele Di Pompeo</td>
</tr>
<tr>
<td><strong>16:00-16:30</strong></td>
<td>Full Application of the Extract Interface Refactoring: Conceptual Structures in the Hands of Master Students</td>
<td>Marianne Huchard</td>
</tr>
</tbody>
</table>

## Break
**16:30-17:00**

**Break**

## Panel Discussion
**17:00-17:45**

**Panel Discussion**

## Workshop Closing
**17:45-18:00**

**Workshop Closing**
## Workshop on Formals Methods for Analysis of Business Systems

**4 Sep. 2016**

**SMU School of Accountancy, Level 2, Seminar Room 2-3**

### Session 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:45-9:00</td>
<td><strong>Welcome and Workshop Objectives</strong></td>
<td>Ravindra Naik and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ansuman Banerjee</td>
</tr>
<tr>
<td>9:00-10:00</td>
<td><strong>Keynote Talk</strong></td>
<td>Thomas Hildebrandt</td>
</tr>
<tr>
<td></td>
<td>Flexible, Adaptable &amp; Compliant Business Systems with Dynamic Condition Response Graphs</td>
<td></td>
</tr>
<tr>
<td>10:00-10:30</td>
<td><strong>Paper 1</strong></td>
<td>Pavan Kumar Chittimalli</td>
</tr>
<tr>
<td></td>
<td>Domain-independent Method of Detecting Inconsistencies in SBVR-based Business Rules</td>
<td>and Kritika Anand</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td><strong>Break</strong></td>
<td></td>
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</tbody>
</table>

### Session 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00-11:45</td>
<td><strong>Invited Talk</strong></td>
<td>Abhik Roychoudhury</td>
</tr>
<tr>
<td></td>
<td>SemFix and Beyond: Semantic techniques for Program Repair</td>
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</tr>
<tr>
<td>11:45-12:15</td>
<td><strong>Paper 2</strong></td>
<td>Dusica Marijan and Maius</td>
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<td></td>
<td>Improving Configurable Software Testing with Statistical Test Selection</td>
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</tr>
<tr>
<td>12:15-13:00</td>
<td><strong>Invited talk</strong></td>
<td>Sebastian Uchitel</td>
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<tr>
<td></td>
<td>Business Process Adaptation using Discrete Event Controller Synthesis</td>
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</tbody>
</table>
### Workshop on Formals Methods for Analysis of Business Systems

**SMU School of Accountancy, Level 2, Seminar Room 2-3**

**Date:** 4 Sep. 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 3</th>
<th>Chair: Raveendra Kumar</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00-14:30</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>14:30-15:15</td>
<td><strong>Invited Talk</strong> &lt;br&gt;Static Analysis to Enable verification and Rransformation of Data-Intensive Business Applications.</td>
<td>K.V. Raghavan</td>
</tr>
<tr>
<td>15:15-16:15</td>
<td><strong>Panel Discussion / Round Table Discussion</strong>&lt;br&gt;Moderator: Ansuman Banerjee</td>
<td>Thomas Hildebrandt, Sebastian Uchitel, K.V. Raghavan, Abhik Roychoudhury and Ravindra Naik</td>
</tr>
<tr>
<td>16:15-16:30</td>
<td><strong>Summarization and Closing</strong></td>
<td>Raveendra Kumar</td>
</tr>
</tbody>
</table>
Title
Build Your Own Model Checker with PAT

Date
Sept 3, Half Day, AM

Abstract
Model checking has established as an effective method for automatic system analysis and verification. It is making its way into many domains and methodologies. Applying model checking techniques to a new domain (which probably has its own dedicated modeling language) is, however, far from trivial. Translation-based approach works by translating domain specific languages into input languages of a model checker. Because the model checker is not designed for the domain (or equivalently, the language), translation-based approach is often ad hoc. Ideally, it is desirable to have an optimized model checker for each application domain. Implementing one with reasonable efficiency, however, requires years of dedicated efforts.

In this tutorial, we will briefly survey a variety of model checking techniques. Then we will show how to develop a model checker for a language combining real-time and probabilistic features using the PAT (Process Analysis Toolkit) step-by-step, and show that it could take as short as a few weeks to develop your own model checker with reasonable efficiency. The PAT system is designed to facilitate development of customized model checkers. It has an extensible and modularized architecture to support new languages (and their operational semantics), new state reduction or abstraction techniques, new model checking algorithms, etc. Since its introduction 5 years ago, PAT has attracted more than 3500 registered users (from 800+ organisations in 60 countries) and has been applied to develop model checkers for 20 different languages.

Presenters' Biographies

Jin-Song Dong
Jin-Song Dong is an Associate Professor at School of Computing, National University of Singapore. Jin-Song Dong received Bachelor (1st hon) and PhD degrees in Computing from University of Queensland in 1992 and 1996. From 1995 to 1998, he was research scientist at CSIRO in Australia. Since 1998 he has been a faculty member in the School of Computing at the National University of
Jun Sun is an Assistant Professor at Singapore University of Technology and Design. Jun received Bachelor and PhD degrees in computing science from National University of Singapore (NUS) in 2002 and 2006. In 2007, he received the prestigious LEE KUAN YEW postdoctoral fellowship in School of Computing of NUS. Since 2010, he joined Singapore University of Technology and Design (SUTD) as an Assistant Professor. He was a visiting scholar at MIT from 2011-2012. Jun's research interests include software engineering, formal methods, software engineering, program analysis and cyber-security. He is the co-founder of the PAT model checker. To this date, he has more than 140 publications.

More information is available at http://people.sutd.edu.sg/~sunjun/.

Jin Song

Jin Song is on the editorial board of ACM Transaction on Software Engineering and Methodology and Formal Aspects of Computing. He is on the steering committee of APSEC, FME & ICFEM and has been general/program chair for a number of international conferences, including 19th FM 2014 in Singapore. Jin Song has been a Visiting Fellow (2006) at Oxford University and a Visiting Professor (since 2009) at National Institute of Informatics of Japan. Outside of work, he plays competitive tennis and coaches top ranked junior players in Singapore (including his own 3 kids). He also developed Markov Decision Process (MDP) models for tennis strategy analysis in PAT.

More information is available at https://www.comp.nus.edu.sg/~dongjs/.


Yang Liu

Yang Liu is an Assistant Professor at Nanyang Technological University, Singapore. Yang graduated in 2005 with a Bachelor of Computing in the National University of Singapore (NUS). In 2010, he obtained his PhD and started his post doctoral work in NUS, MIT and SUTD. In 2011, Yang is awarded the Temasek Research Fellowship at NUS to be the Principal Investigator in the area of Cyber Security. In 2012 fall, he joined Nanyang Technological University as a Nanyang Assistant Professor. Yang specializes in software verification, security and software engineering. His research has bridged the gap between the theory and practical usage of formal methods and program analysis to evaluate the design and implementation of software for high assurance and security. His work led to the development of a state-of-the-art model checker PAT.

More information is available at http://www.ntu.edu.sg/home/yangliu/.

Title
Product Line Variability

Date
Sept 3, Half Day, AM

Abstract
In this tutorial, the participants will learn the difference between software variability and product line variability. They will learn and apply the key concepts of product line variability modelling. Besides the integrated modelling of product line variability information, the participants will learn how to define variability in an separate model. They will know the key benefits of defining and communicating about product line variability in an orthogonal model. In addition, they will learn the core concepts of modelling product line variability illustrated using examples. Moreover, they will know the difference of an application variability model and the product line (domain) variability model. Running examples will illustrate the concepts taught.
Presenter's Biography

Klaus Pohl

Klaus Pohl is the director of paluno, the Ruhr Institute for Software Technology, and holds a full professorship for software systems engineering at the University of Duisburg-Essen. He received his Ph.D. and his habilitation in computer science from RWTH Aachen. He is involved in various technology transfer as well as major research projects focusing on different aspects of product line engineering. Klaus Pohl is (co-)author of over 250 refereed publications and served as program chair for conferences such as the IEEE Intl. Conference on Software Engineering (ICSE 2013), Intl. Requirements Engineering Conference (RE '02), the Experience Reports Track of the 27th ICSE in 2005, the German Software Engineering Conference (SE 2005), the 9th Intl. Software Product Line Conference (SPLC Europe 2005) and the 18th Intl. Conference on Advanced Information Systems Engineering (CAiSE 2006), and he is a member of the organizing committee of VaMoS (the international workshop on Variability Modeling of Software-intensive Systems).

More information is available at https://sse.uni-due.de/team/leitung/prof-dr-klaus-pohl/.

Title
Software Analytics: Challenges and Opportunities

Date
Sept 4, Half Day, PM

Abstract
Nowadays, software development projects produce a large number of software artifacts including source code, execution traces, end-user feedback, as well as informal documentation such as developers' discussions, change logs, Stack-Overflow, and code reviews. Such data embeds rich and significant knowledge about software projects, their quality and services, as well as the dynamics of software development. Most often, this data is not organized, stored, and presented in a way that is immedi-
ately useful to software developers and project managers to support their decisions. To help developers and managers understand their projects, how they evolve, as well as support them during their decision-making process, software analytics - use of analysis, data, and systematic reasoning for making decisions - has become an emerging field of modern data analysis. While results obtained from analytics-based solutions suggested so far are promising, there are still several challenges associated with the adoption of software analytics into software development processes, as well as the development and integration of analytics tools in practical settings.

We therefore propose a tutorial on software analytics. The tutorial will start with an introduction of software analytics. Next, we will discuss the main challenges and opportunities associated with software analytics based on the examples from our own research. These examples will cover a range of topics leveraging software analytics. The topics include mobile apps quality, code review process and its quality, analytics for bug report management, as well as the use of analytics to solve scheduling problems in the cloud.

Presenters' Biographies

**Latifa Guerrouj**

Latifa Guerrouj is an Assistant Professor at the Department of Software Engineering and Information Technologies of École de Technologie Supérieure, Montréal, Canada. She hold a Ph.D. from the Department of Computer Science and Software Engineering (DGIGL) of Polytechnique de Montréal (2013) and engineering degree with honours in Computer Science (2008). Latifa’s research interests span several software engineering areas, including empirical software engineering, software analytics, data mining, and mining software repositories.

More information is available at [http://latifaguerrouj.ca/](http://latifaguerrouj.ca/).
Olga Baysal

Olga Baysal is an Assistant Professor at the School of Computer Science, Carleton University, Ottawa, Canada. She received a Ph.D. (2014) in Computer Science from the University of Waterloo, Canada. Her research interests span a wide range of software engineering areas, including empirical software engineering, mining software repositories, software analytics, software maintenance and evolution, and human aspects of software engineering. Much of Olga's work focuses on understanding how software engineers create, use and maintain software systems.

More information is available at http://olgabaysal.com/.

Foutse Khomh

Foutse Khomh is an Assistant Professor at the École Polytechnique de Montréal, where he leads the SWAT Lab on software analytics and cloud engineering research. Prior to this position he was a Research Fellow at Queen's University (Canada), working with the Software Reengineering Research Group and the NSERC/RIM Industrial Research Chair in Software Engineering of Ultra Large Scale Systems. He received his Ph.D. in Software Engineering from the University of Montreal in 2010. His main research interest is in the field of empirical software engineering, with an emphasis on developing techniques and tools to improve software quality. He co-founded the International Workshop on Release Engineering and was one of the editors of the first special issue on Release Engineering in the IEEE Software magazine.

More information is available at http://www.khomh.net/.
Automated GUI Testing of Android Apps: Challenges, Approaches, Tools, and Best Practices

Sept 3, Half Day, PM

Xin Xia

Xin Xia received his PhD degree from the College of Computer Science and Technology, Zhejiang University, China in 2014. He is currently a research assistant professor in the college of computer science and technology at Zhejiang University. He has published in many major international conferences and journals in software engineering, including TSE, ASE, ISSTA, EMSE, ICSME, TR, ASEJ, SANER, ICPC, MSR, ESEM, and ISSRE. His research interests include software analytic, empirical study, and mining software repository.


Title
Automated GUI Testing of Android Apps: Challenges, Approaches, Tools, and Best Practices

Date
Sept 3, Half Day, PM

Abstract
The last decade has seen tremendous proliferation of mobile computing in our society. Billions of users have access to millions of mobile applications that can be installed directly on their mobile devices and electrical appliances such as TV settop boxes. Factors such as new monetization/revenue models, programming models, and distribution infrastructures contribute to an "attractive" movement that captivates new and traditional developers, as well as a crowd of other professionals that explore, design, and implement mobile apps. Also, the need for "enterprise apps" that support startups or serve as a new frontend for traditional companies is pushing software-related professionals to embrace the mobile technologies [35]. However, the nature of the economy (devices, apps, markets) imposes new challenges on how mobile apps are envisioned, designed, implemented, tested, released, and maintained? for instance, mobile developers and testers face the following critical challenges: (i) continuous pressure from the market for frequent releases, (ii) platform fragmentation at device and OS levels, and (iii) rapid platform/library evolution and API instability.
In order to deal with the aforementioned challenges, continuous testing of mobile apps on a large set of device configurations and under different contextual events (e.g., WiFi connectivity) is a "must have" in the development process to ensure quality. However, this must be enabled within the constraints of tight release schedules and limited developer and hardware resources. Additionally, both practitioners and researchers must contend with mobile specific challenges during the execution and testing of mobile apps including: the event driven nature of mobile apps, gesture-based interactions, interfaces with sensors, and the possibility of multiple contextual states (e.g., WiFi /GPS on/off).

This tutorial aims at providing the ASE community with up to date information on the state of the art and state of the practice regarding mobile app testing. Specifically, it will address the challenges, approaches, tools, and best practices for GUI testing of Android apps. The tutorial content will help participants understand the main challenges behind mobile testing, and will provide them with useful and actionable information concerning the pros and cons of the approaches and tools available for mobile app GUI testing. Additionally, it will provide with guidelines for designing their own infrastructure for mobile app testing. The content of this tutorial is based on the knowledge and experience gathered during the last four years of academic research and industrial collaborations of the members of SEMERU group from the College of William and Mary.

Presenters' Biographies

Mario Linares-Vasquez

Mario Linares-Vasquez has recently received his Ph.D. from the College of William and Mary, advised by Dr. Denys Poshyvanyk, and he has joined Universidad de los Andes (Colombia), as a tenure track Assistant Professor. His research interests include evolution and maintenance of mobile apps, automated GUI testing, and application of data mining and machine learning techniques to support software engineering tasks. The topic of his dissertation focused on supporting evolution and maintenance of Android apps, by relying on novel combinations of dynamic analysis, mining software repositories,
Kevin Moran

Kevin Moran is currently a Ph.D student in the Computer Science Department at the College of William and Mary. He is a member of the SEMERU research group and advised by Dr. Denys Poshyvanyk. His main research interest involves facilitating the processes of Software Engineering, Maintenance, and Evolution with a focus on mobile platforms. He graduated with a M.S. degree from William & Mary in August of 2015 and his thesis focused on improving bug reporting for mobile apps through novel applications of program analysis techniques. He has published in several top peerreviewed software engineering venues including: ICSE, ESEC/FSE, ICST, and MSR. He was recently recognized as the second overall winner among graduate students in the ACM Student Research competition at ESEC/FSE’15. Moran has served as an external reviewer for ICSE, ICSME, FSE, APSEC, and SCAM.


Denys Poshyvanyk

Denys Poshyvanyk is an Associate Professor in the Computer Science Department at the College of William and Mary where he leads SEMERU research group. He received his Ph.D. from Wayne State University, where he was advised by Dr. Andrian Marcus. His current research is in the area of software engineering, evolution and maintenance, program comprehension, reverse engineering,
A growing trend has begun in recent years to move software engineering problems from human-based search to machine-based search that balances a number of constraints to achieve optimal or near-optimal solutions. As a result, human effort is moving up the abstraction chain to focus on guiding the automated search, rather than performing the search itself. This emerging software engineering paradigm is known as Search Based Software Engineering (SBSE). It uses search based optimization techniques, mainly those from the evolutionary computation literature to automate the search for optimal or near-optimal solutions to software engineering problems. The SBSE approach can and has been applied to many problems in software engineering that span the spectrum of activities from requirements to maintenance and reengineering. Already, success has been achieved in requirements, refactoring, project planning, testing, maintenance and reverse engineering. However, several challenges have to be addressed to mainly tackle the growing complexity of software systems nowadays in terms of number of objectives, constraints and inputs/outputs. Most of software engineering problems are multi- and many-objective by nature to find a trade-off between several competing goals. In addition, several software engineering solutions lack robustness due to the dynamic environments of software systems (e.g., requirements changes over time). Furthermore, it is essential to under-
stand the points at which human oversight, intervention, resumption-of-control and
decision making should impinge on automation. Human programmers might reject
changes made by any automated programming technique. If they feel that they have
little understanding or control, there will be a natural reluctance to trust the auto-
mated tool. Thus, we have to consider different levels of automation when adapting
search algorithms to software engineering problems.

In this tutorial, we will give, first, an overview about SBSE then we will focus on
some case studies that we proposed, along with our research groups and industri-
al partners, addressing the above challenges, including: many-objective software
re-modularization, bi-level defects detection and interactive dynamic multi-objective
optimization for software refactoring. Finally, we will discuss possible new research
directions in SBSE.

Presenters' Biographies

Marouane Kessentini

Marouane Kessentini is an Assistant Professor in the Department
of Computer and Information Science at the University of Michigan
Dearborn. He is the founder of the Search-Based Software En-
gineering (SBSE) research lab. He has several collaborations with
different industrial companies on the use computational search,
machine learning and evolutionary algorithms to address several
software engineering problems such as software quality, software
testing, software migration, software evolution, etc. He received
his Phd from University of Montreal in 2012 and a Presidential BSc
Award from the President of Tunisia in 2007. He received many
grants from both industry and federal agencies and published
around 75 papers in search-based software engineering journals
and conferences, including 3 best paper awards. He has served as
program committee member in several major conferences (GECCO,
MODELS, ICMT, SSBSE, etc.), an editorial board member of several
journals (SQJ, ASE, IST, TEVC and EMSE), and an organization mem-
ber of many conferences and workshops. He was also the co-chair
of the SBSE track at the GECCO2014 and GECCO2015 conferences and he is now the general chair of the 8th IEEE Search Based Software Engineering Symposium (SSBSE2016).

He is also the founder of the North American Symposium on Search Based Software Engineering, funded by the National Science Foundation (NSF), and a guest editor of the first Special Issue on Search Based Software Engineering at the IEEE Transactions on Evolutionary Computation Journal (2016). He is an invited speaker in the 2016 IEEE World Congress on Computational Intelligence (Vancouver, Canada) to give a tutorial around SBSE.

More information is available at http://www-personal.umd.umich.edu/~marouane/.

Ali Ouni

Ali Ouni is a Research Assistant Professor in the department of Computer Science at Osaka University. He is a member of the software engineering laboratory (SEL). He received his Ph.D. degree in computer science from the University of Montreal in 2014. For his exceptional Ph.D. research productivity, he was awarded the Excellence Award from the University of Montreal. He has served as a visiting researcher at Missouri University of Science and Technology, and University of Michigan, in 2013 and 2014 respectively. His research interests are in software engineering including software maintenance and evolution, refactoring of software systems, software quality, service-oriented computing, and the application of artificial intelligence techniques to software engineering. He served as a program committee member and reviewer in several journals and conferences. He is a member of the IEEE and the IEEE Computer Society.

More information is available at https://sites.google.com/site/ouniaali/.
Learn to Build Automated Software Analysis Tools with Graph Paradigm and Interactive Visual Framework

Suresh Kothari (Suraj)

Suresh Kothari (Suraj) is the Richardson Professor of Electrical and Computer Engineering (ECE) at Iowa State University (ISU) and the founder of EnSoft. He has served as a PI for the DARPA Automated Program Analysis for Cybersecurity (APAC) program, and a Co-PI for the DARPA Software Enabled Control (SEC) program. Currently he is
Ben Holland

Ben Holland is a research scientist at ISU working on DARPA projects. He has extensive experience of writing program analyzers to detect novel and sophisticated malware in Android applications. He has served on the ISU team as a key analyst for DARPA's APAC program. He has given talks at Derbycon 4.0 in Louisville, Kentucky and at DARPA's headquarters in Arlington, Virginia. His past work experience has been in mission assurance at MITRE, government systems at Rockwell Collins, and systems engineering at Wabtec Railway Electronics. He holds a master's degree in Computer Engineering and Information Assurance, a B.S. in Computer Engineering, and a B.S. in Computer Science. Currently he serves on the ISU team for DARPA's STAC program.

More information is available at https://ben-holland.com/.
Abstract
Despite 40 years of research in automated test data generation, testing programs with nondeterministic behaviour remains a major challenge. Traditional testing techniques are designed for programs that always produce the same output for any given set of inputs. Increasingly however, researchers and industry practitioners are interested in developing software that has stochastic behaviour. Examples include machine learning, Search-Based Software Engineering, metaheuristic optimisation and Monte-Carlo simulations. These approaches are used to comprehensively explore the range of potential outcomes and can identify novel solutions to complex problems. Yet, they also create additional challenges for software testing, since we often cannot say for certain whether any one particular output is correct. Failures in stochastic software could lead to losses in time, money, reputation, injury and even death. However, existing techniques are unable to cope with uncertainty in the correctness of the outputs. How then can we test such stochastic software?

This tutorial introduces a statistical approach towards testing stochastic software. Instead of checking the software outputs one at a time for each test, the output distributions are investigated over multiple executions. This is important since, even though the outputs observed so far may appear to be correct, the next execution could potentially produce an unexpected result (for exactly the same inputs). Statistical tests will therefore be presented (based on frequentist, likelihood and Bayesian statistics) to estimate how likely it is that the software contains a fault. Some stochastic programs are particularly difficult to test because their behaviour depends non-linearly on a large number of variables. In these cases, faults may exist in the software for a long time before they are noticed and it is difficult to know whether a fault has been fixed. This tutorial therefore includes search-based techniques for finding input values that make discrepancies more apparent in the outputs. This, in combination with metaheuristics and pseudo-oracles provides a comprehensive solution for test-
Matthew Patrick is a Wellcome Trust Junior Interdisciplinary Fellow in the Department of Plant Sciences at the University of Cambridge, holds a Research Associateship at Corpus Christi College, Cambridge and is a Fellow of the Cambridge Philosophical Society. He is currently researching new techniques to address specific challenges involved with testing scientific software (stochasticity, big data and mathematical assumptions). Dr Patrick is also interested in combining software engineering and statistical analysis more broadly, with particular expertise in biologically-inspired techniques such as evolutionary algorithms and mutation testing. Prior to joining the University of Cambridge, he worked in the Agronomic Information Services group at Syngenta Crop Protection AG in Basel, Switzerland and in 2013 he obtained a PhD in Computer Science from the University of York, UK for research into mutation testing.

More information is available at http://www.plantsci.cam.ac.uk/directory/patrick-matthew.

Guoxin Su

Guoxin Su is a Senior Research Fellow in the Department of Computer Science, School of Computing at the National University of Singapore (NUS). He is interested in developing novel methods of probabilistic model checking and improving its applicability (e.g., efficiency and flexibility) to a variety of real-world problem areas, including adaptive software, runtime monitoring, networking and cybersecurity. He has published a number of papers in the premier...
Artifacts containing natural language, like Q&A websites (e.g., Stack Overflow), tutorials, and development emails, are essential to support software development. They have become a popular subject for software engineering research. The analysis of such artifacts is particularly challenging because of their heterogeneity: These resources consist of natural language interleaved with fragments of multiple programming and markup languages. Our tutorial is aimed at overcoming the challenge, by first discussing the state of the art of methodologies to analyze unstructured data, and their current limitations and challenges. Then, it focuses on our efforts towards a systematic approach to model contents of such artifacts. This in turn enables novel holistic analyses that fully exploit their intrinsic heterogeneous nature. We describe the theoretical foundations of our StORMeD framework, how it can be used to extract a full-fledged model of a development artifacts, and how it can be leveraged to construct various types of analyses, such as summarization.

Luca Ponzanelli

Luca Ponzanelli is a PhD student at the Università della Svizzera italiana (USI) since September 2012. He is working in the REVEAL research group under the supervision of Prof. Dr. Michele Lanza. He received his Msc from USI in 2012, and his BSc from the University of Milano-Bicocca in 2010.

More information is available at http://www.inf.usi.ch/phd/ponzanelli/
Andrea Mocci

Andrea Mocci is a postdoctoral researcher at Università della Svizzera italiana (USI), working in the REVEAL research group headed by Prof. Michele Lanza. His interest include analysis of development artifacts, developer behavior, and software components. He obtained his PhD in 2011 under the supervision of Prof. Carlo Ghezzi, and he has been a postdoctoral fellow at MIT in 2012 with Prof. Daniel Jackson.

More information is available at http://www.inf.usi.ch/postdoc/mocci/

Michele Lanza

Michele Lanza is a full professor at the faculty of informatics of Università della Svizzera italiana, where he founded the REVEAL research group in 2004. He co-authored over 150 journal and conference papers and the book Object-Oriented Metrics in Practice. His activities span various international software engineering research communities. He has served on the program committees of ICSE, FSE, ICSME, ICPC, and MSR. He has given tutorials and technical briefings at ICSE 2006, OOPSLA 2007, ICSE 2008, and ICSE 2011.

More information is available at http://www.inf.usi.ch/faculty/lanza/.

Title
Using Docker Containers to Improve Reproducibility in Software Engineering Research

Date
Sept 4, Half Day, PM

Abstract
The ability to replicate and reproduce scientific results has become an increasingly important topic for many academic disciplines. In computer science and, more specifically, software engineering, contributions of scientific work rely on developed
algorithms, tools and prototypes, quantitative evaluations, and other computational analyses. Published code and data come with many undocumented, dependencies, and configurations that are internal knowledge and make reproducibility hard to achieve. This tutorial presents how Docker containers can overcome these issues and aid the reproducibility of research artifacts in software engineering and discusses their applications in the field.

Presenters' Biographies

Jurgen Cito

Jurgen Cito is a Ph.D. candidate at the University of Zurich, Switzerland. In his research, he investigates the intersection between software engineering and cloud computing. In the summer of 2015, he was a research intern at the IBM T.J. Watson Research Center in New York, where he worked on cloud analytics based on Docker containers. That year he also won the local Docker Hackathon in New York City with the project docker-record. More recently, he has been a mentor at various Docker events and meetups.

More information is available at http://www.ifi.uzh.ch/seal/people/cito.html

Harald C. Gall

Harald C. Gall is a professor of software engineering in the Department of Informatics at the University of Zurich, Switzerland. His research interests include software engineering, focusing on software evolution, software quality analysis, software architecture, reengineering, collaborative software engineering, and service centric software systems. He was the program chair of the European Software Engineering Conference and the ACM SIGSOFT ESEC-FSE in 2005 and the program co-chair of ICSE 2011.

More information is available at http://www.ifi.uzh.ch/seal/people/gall.html.
# Doctoral Symposium

## Keynote:
The good, the bad, and the ugly when pursuing a PhD
Andrian Marcus (University of Texas at Dallas, USA)

## Session 1: Software Analytics

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<td>Developer Targeted Analytics: Supporting Software Development Decisions with Runtime</td>
<td>Jürgen Cito</td>
<td>University of Zurich, Switzerland</td>
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<td>API Recommendation System for Software Development</td>
<td>Ferdian Thung</td>
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<td>Factoring Requirement Dependencies in Software Requirement Selection using Graphs and Integer Programming</td>
<td>Davoud Mougouei</td>
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## Session 2: Testing & Analysis

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<td>Automated Testing and Notification of Mobile App Privacy Leak-Cause Behaviours</td>
<td>Joo Keng Joseph Chan</td>
<td>Singapore Management University, Singapore</td>
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<td>Towards Efficient and Effective Automatic Program Repair</td>
<td>Le Dinh Xuan Bach</td>
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<td>Statistical Analysis of Large Sets of Models</td>
<td>Önder Babur</td>
<td>Eindhoven University of Technology, Netherlands</td>
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It has become extraordinarily difficult to write software that performs close to optimally on complex modern microarchitectures. Particularly plagued are domains that require complex mathematical computations such as multimedia processing, communication, control, graphics, and machine learning. In these domains, performance-critical components are usually written in C (with possible extensions) and often even in assembly, carefully "tuned" to the platform's architecture and microarchitecture. The result is usually long, rather unreadable code that needs to be re-written or re-tuned with every platform upgrade. On the other hand, the performance penalty for relying on straightforward, non-tuned, "more elegant" implementations can be often a factor of 10, 100, or even more.

The overall problem is one of productivity, maintainability, and quality (namely performance), i.e., software engineering. However, even though a large set of sophisticated software engineering theory and tools exist, it appears that to date this community has not focused much on mathematical computations nor performance in the detailed, close-to-optimal sense above. The reason for the latter may be that performance, unlike various aspects of correctness, is not syntactic in nature (and in reality is often even unpredictable and, well, messy).

The aim of this talk is to draw attention to the performance/productivity problem for mathematical applications and to make the case for a more interdisciplinary attack.
As a set of thoughts in this direction we offer some of the lessons we have learned in the last decade in our own research on Spiral (www.spiral.net), a program generation framework for numerical kernels. Key techniques used in Spiral include staged declarative domain-specific languages to express algorithm knowledge and algorithm transformations, the use of platform-cognizant rewriting systems for parallelism and locality optimizations, and the use of search and machine learning techniques to navigate possible spaces of choices. Experimental results show that the code generated by Spiral competes with, and sometimes outperforms, the best available human-written code. Spiral has been used to generate part of Intel’s commercial libraries IPP and MKL.

Brief Biography

Markus Püschel is a Professor and currently Department Head of Computer Science at ETH Zurich, Switzerland. Before, he was a Professor of Electrical and Computer Engineering at Carnegie Mellon University, where he still has an adjunct status. He received his Diploma (M.Sc.) in Mathematics and his Doctorate (Ph.D.) in Computer Science, in 1995 and 1998, respectively, both from the University of Karlsruhe, Germany. Together with his collaborators, he co-founded Spiralgen in 2009. One of his main research interests is the automatic generation of highest performance code for mathematical functionality using an approach and ideas developed in Spiral (www.spiral.net).

For more information please visit http://people.inf.ethz.ch/markusp/.
Tens of thousands of Microsoft engineers build and test hundreds of software products several times a day. It is essential that this continuous integration scales, guarantees short feedback cycles, and functions reliably with minimal human intervention. During the past three years TSE’s charter has been to shorten this cycle time. We went after this goal in two ways: Evolution via CloudBuild and Revolution via Concord. CloudBuild is a build service infrastructure, now being used by all major product groups in Microsoft, like Azure, Bing, Office, SQL except for Windows. CloudBuild addresses all aspects of a continuous integration workflow, like builds, test and code analysis, but also drops, package and symbol creation and storage. CloudBuild supports multiple build languages as long as they fulfill a coarse grained IO based contract. CloudBuild uses content based caching to run build-related tasks only when needed. Lastly, it builds on many machines in parallel. The speed ups of build and testing range from 1.2x to 10x. CloudBuild aims to rapidly onboard teams and hence has to support non-deterministic build tools and specification languages that under-declare dependencies. CloudBuild, being a reliable build service in the presence of unreliable components, currently achieves service availability better than 99%.

Windows went a different path. Their past build exhaust was so massive that building Windows in the cloud and bringing the build results back for testing on corp.-net. was considered infeasible. So they decided to move to a new build language, codename Concord. By construction, Concord guarantees reliable builds, no over-build, and allows for efficient distribution. Adopting Concord has led to immense performance improvements, we have seen up to 100X speedup for Windows builds.
But the path has been long and rocky, since it not only requires a substantial rewrite of existing build logic, but also all related developer and build lab processes have to change. Whether evolution or revolution is the right path forward -- the verdict is still out.

**Brief Biography**

Wolfram Schulte is a director of engineering in Microsoft’s Developer Division, Redmond, USA, where he founded in 2012 the Tools for Software Engineers (TSE) team. TSE's mission is to improve Microsoft's engineering velocity, more specifically minimize the cycle time of the inner loop from code review, via build, code-analysis and test, to deployment. TSE does so by building developer services using Cloud technologies. TSE tools and services are meanwhile used by more than thirty-five thousand developers within Microsoft. Before Wolfram ventured into product groups, Wolfram lead the Research in Software Engineering (RiSE) group, at Microsoft Research, Redmond, USA. While at RiSE, Wolfram co-authored papers and build prototypes for many tools that Microsoft ships, including Linq, CodeContracts, Task Parallel Library, IntelliTest, and SpecExplorer. Wolfram also co-developed the experimental program verifiers Spec# and VCC. Wolfram was awarded the 2016 Harlan D. Mills award for "... advances in software verification". Before joining MSR in 1999, Wolfram worked at the University of Ulm (1993-1999, habilitation), at sd&m, a German software company (1992-1993), and at the Technical University Berlin (1987-1992, PhD).

For more information please visit [https://www.microsoft.com/en-us/research/people/schulte/](https://www.microsoft.com/en-us/research/people/schulte/)
The Power of Probabilistic Thinking

David S. Rosenblum

Abstract

Traditionally, software engineering has dealt in absolutes. For instance, we talk about a system being "correct" or "incorrect", with the shades of grey in between occasionally acknowledged but rarely dealt with explicitly. And we typically employ logical, algebraic, relational and other representations and techniques that help us reason about software in such absolute terms. There of course have been notable exceptions to this, such as the use of statistical techniques in testing and debugging. But by and large, both researchers and practitioners have favored the relative comfort of an absolutist viewpoint in all aspects of development. In this talk, I will argue the benefits of taking a more thoroughly probabilistic approach in software engineering. Software engineering is rife with stochastic phenomena, and the vast majority of software systems operate in an environment of uncertain, random behavior, which suits an explicit probabilistic characterization. Furthermore, this uncertainty is becoming ever more pronounced in new software systems and platforms, such as the Internet of Things and autonomous vehicles, with their frequent imprecise outputs and heavy reliance on machine learning. To illustrate more deeply some of the considerations involved in taking a probabilistic approach, I will talk about some recent research I have been doing in probabilistic verification.

Brief Biography

David S. Rosenblum is Provost's Chair Professor of Computer Science at the National University of Singapore (NUS). He holds a Ph.D. from Stanford University and joined NUS in April 2011 after holding positions as Member of the Technical Staff at AT&T Bell Laboratories (Murray Hill); Associate Professor at the University of California, Irvine; Principal Architect and Chief Technology Officer of PreCache (a technology startup
funded by Sony Music); and Professor of Software Systems at University College London. David's research interests span many problems in software engineering, distributed systems and ubiquitous computing, and his current research focuses on probabilistic verification, uncertainty in software testing, and infrastructure support for the Internet-of-Things. David is a Fellow of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE). He serves as Editor-in-Chief of the ACM Transactions on Software Engineering and Methodology (ACM TOSEM), and he was previously Chair of the ACM Special Interest Group in Software Engineering (ACM SIGSOFT). He has received two "test-of-time" awards for his research papers, including the ICSE 2002 Most Influential Paper Award for his ICSE 1992 paper on assertion checking, and the first ACM SIGSOFT Impact Paper Award in 2008 for his ESEC/FSE 1997 on Internet-scale event observation and notification (co-authored with Alexander L. Wolf).

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### Track 1: Locks and Races

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<td>Greedy Combinatorial Test Case Generation using Unsatisfiable Cores</td>
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<td>Matthias Höschele and Andreas Zeller (Saarland University, Germany)</td>
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<td><strong>Phrase-Based Extraction of User Opinions in Mobile App Reviews</strong> (Short)</td>
<td>Phong Minh Vu, Tam The Nguyen, Hung Viet Pham, and Tung Thanh Nguyen (Utah State University, USA)</td>
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<tr>
<td>Title</td>
<td>Authors</td>
<td>Institution(s)</td>
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<td>Identifying Domain Elements from Textual Specifications</td>
<td>Jitendra Singh Thakur and Atul Gupta</td>
<td>(IIITDM Jabalpur, India)</td>
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<td>Continuous Detection of Design Flaws in Evolving Object-Oriented Programs using Incremental Multi-pattern Matching</td>
<td>Sven Peldszus, Géza Kulcsár, Malte Lochau, and Sandro Schulze</td>
<td>(University of Koblenz-Landau, Germany; TU Darmstadt, Germany; TU Hamburg, Germany)</td>
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<td>Efficient Detection of Inconsistencies in a Multi-developer Engineering Environment</td>
<td>Andreas Demuth, Markus Riedl-Ehrenleitner, and Alexander Egyed</td>
<td>(JKU Linz, Austria)</td>
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<td>How Good Are the Specs? A Study of the Bug-Finding Effectiveness of Existing Java API Specifications</td>
<td>Owolabi Legunsen, Wajih Ul Hassan, Xinyue Xu, Grigore Roşu, and Darko Marinov</td>
<td>(University of Illinois at Urbana-Champaign, USA)</td>
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<td><strong>Track 2:</strong> Code Comparison and Transformation</td>
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<td><strong>Move-Optimized Source Code Tree Differencing</strong></td>
<td>Georg Dotzler and Michael Philippsen</td>
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<td>(University of Erlangen-Nuremberg, Germany)</td>
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<td><strong>Migrating Cascading Style Sheets to Preprocessors by Introducing Mixins</strong></td>
<td>Davood Mazinanian and Nikolaos Tsantalis</td>
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<td>(Concordia University, Canada)</td>
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<td><strong>Automatic Runtime Recovery via Error Handler Synthesis</strong></td>
<td>Tianxiao Gu, Chengnian Sun, Xiaoqing Ma, Jian Lu, and Zhendong Su</td>
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<td>(Nanjing University, China; University of California at Davis, USA)</td>
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<td><strong>Mining Revision Histories to Detect Cross-Language Clones without Intermediates</strong> (Short)</td>
<td>Xiao Cheng, Zhiming Peng, Lingxiao Jiang, Hao Zhong, Haibo Yu, and Jianjun Zhao</td>
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<td>(Shanghai Jiao Tong University, China; Singapore Management University, Singapore; Kyushu University, Japan)</td>
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<td><strong>Battery-Aware Transformations in Mobile Applications</strong> (Short)</td>
<td>Jürgen Cito, Julia Rubin, Phillip Stanley-Marbell, and Martin Rinard</td>
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<td>(University of Zurich, Switzerland; Massachusetts Institute of Technology, USA)</td>
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Track 2: Mining and Retrieval

7th September, Wednesday
17:00 - 18:00
Function Room 4.1, 4.2, Level 4, SMU Administration Building

Practical Guidelines for Change Recommendation using Association Rule Mining
Leon Moonen, Stefano Di Alesio, David Binkley, and Thomas Rolfsnes
(Simula Research Laboratory, Norway; Loyola University Maryland, USA)

Learning a Dual-Language Vector Space for Domain-Specific Cross-Lingual Question Retrieval
Guibin Chen, Chunyang Chen, Zhenchang Xing, and Bowen Xu
(Nanyang Technological University, Singapore; Zhejiang University, China)
The conference will be held within the Singapore Management University (SMU) campus. Purpose-built over 4.5 hectares of prime Singapore land, SMU's campus is the first of its kind - designed, integrated and constructed in the heart of a fully developed cityscape.

Surrounded by museums, theatres, educational institutions, art galleries, cafes, restaurants and a range of retail outlets, planning and development of the SMU campus involved a broad spectrum of professional, community, civic and public groups who together were intent are on creating a unique city campus directed towards the challenges of the new millennium, and yet connected to the historical origins of this important district.

The campus comprises six buildings - the six schools, the Li Ka Shing Library and the Administration Building. The buildings between Bras Basah and Stamford Roads are fronted by trees, with the park landscape of the Campus Green right in the centre, and have glazed facades shaded by a veil of plants growing at each storey.

The campus has porous structures that engage the surroundings with open courtyards and free-flowing walkways and allow for an easy and natural integration with activities of the city. The campus design and structure reflect and support the character of SMU's curriculum and its style of teaching.

The SMU campus offers an open environment in the heart of Singapore, with the ground floor of the buildings and the underground Concourse freely accessible to the public. It also has many street-level linkages and the Bras Basah MRT station directly beneath SMU's University Square.
Location

Workshops, Tutorials & Doctoral Symposium
SMU School of Accountancy

Seminar Room 2-2, 2-3, 2-4, 2-5  Level 2
Seminar Room 3-1, 3-2  Level 3

School of Accountancy - 2nd Floor
School of Accountancy - 3rd Floor

**Main Conference**
SMU Administration Building

- Function Room 4.1, 4.2 **Level 4**
- Function Room 6.1 **Level 6**
- Mochtar Riady Auditorium **Level 5**

**Discussion Area**
Nicole’s Cafe
Level 3, SMU Administration Building

Please proceed to request for a drink coupon at the registration counter. Drink coupons are available upon request, on a while stock last basis.
Social Events

**Reception**
5 September 2016, Monday
19:30 – 21:30

**Li Ka Shing Library, Level 5**
**Singapore Management University**
70 Stamford Road
Singapore 178901

**Banquet Dinner**
6 September 2016, Tuesday
19:30 – 22:00
*Cocktail Reception starts at 18:40*

**Carlton Hotel**
**Empress Ballroom 4 & 5, Level 2**
76 Bras Basah Rd
Singapore 189558

**Night Safari**
7 September 2016, Wednesday
19:30 - Midnight
80 Mandai Lake Road
Singapore 729826

**Meeting Point**
SMU Administration Building,
Level 1 Lobby Area
*Please gather at the meeting point at 19:15*
Travel to Conference Venue

MRT (train) stations near to SMU:
- Bras Basah Station, Circle line
- City Hall Station, East-West line
- Dhoby Ghaut Station, North-South line

Bus services near to SMU:
- Victoria Street
  - Bus stop number: 04151
  - Bus services: 130, 133, 145, 197, 851, 960
- SMU, Stamford Road
  - Bus stop number: 04121
  - Bus services: 7, 14, 16, 36, 77, 106, 111, 124, 128, 131, 147, 14E, 162, 166, 167, 171, 174, 175, 190, 502, 700, 857, NR7, 162M, 174E, 502A, 502B, 700A

NTUC Income Centre,
Bras Basah Road
- Bus stop number: 04179
SMU Guest WiFi Login (Self Registration)

1. Locate and connect to the SSID “SMU_Visitor”.

2. Launch an Internet Browser and browse your desired link.
   
   *For example*
   *http://www.google.com*

3. You will be re-directed to the SMU Guest WiFi Login page.
   
   Select “Click Here” for new guest account creation.
4
Please fill in your name, phone number (*omit +65 for Singapore phone number*) and email address.

Checked the “Confirm” checkbox to accept the terms of use and proceed to Register.

5
Upon successful registration, below screen is shown, displaying the registered information with the expiry date.

You will receive an SMS on the Username and Password for the Guest WiFi login.

6
Proceed to log in.
Enter the username and password given in the SMS.

Checked the “Terms” checkbox to accept the terms of use and proceed to log in.
**eduroam Login**

<table>
<thead>
<tr>
<th>WiFi Network</th>
<th>eduroam (Case sensitive)</th>
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<tbody>
<tr>
<td>Username</td>
<td>UserName@DomainName (e.g. <a href="mailto:xxxx@smu.edu.sg">xxxx@smu.edu.sg</a>)</td>
</tr>
<tr>
<td>Authentication</td>
<td>WPA-2 Enterprise</td>
</tr>
<tr>
<td>Data Encryption</td>
<td>AES</td>
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<tr>
<td>EAP Type</td>
<td>PEAP (EAP-MSCHAP-V2)</td>
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