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Software Architecture

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Proceedings

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Preface

The European Conference on Software Architecture (ECSA) is the premier European software architecture conference, providing researchers, practitioners, and educators with a platform to present and discuss the most recent, innovative, and significant findings and experiences in the field of software architecture research and practice.

The special theme for the 16th edition of ECSA 2022 was "Software Architectures and Practices for Emerging Technologies and Applications." We were interested in learning about how software architecture principles and practices are evolving and being applied to address the challenges of emerging technology and applications. This raises questions such as: what are the current research results in developing software architecture principles and practices for systems that include machine learning, quantum computing, blockchain, and other emerging technologies? How is current research dealing with evolving software architecture principles and practices for emerging applications such as collaborative systems, learning systems, autonomous systems, and other emerging applications? What are good examples and case studies of software architecture in the context of emerging technologies and applications? How have software architecture courses changed to accommodate or take advantage of emerging technologies and applications?

Due to the remaining uncertainty concerning COVID-19, this edition of ECSA was held as a hybrid conference during September 19–23, 2022, with the in-person events taking place in the beautiful and historic city of Prague in the Czech Republic. The core technical program included five sessions that blended contributions from the research, industry, and tools & demonstration tracks, plus three keynote talks. Moreover, ECSA 2022 offered a doctoral symposium track with its own keynote. ECSA 2022 also encompassed workshops on diverse topics related to the software architecture discipline, such as architecture erosion and consistency, formal approaches for advanced computing, architecture for automotive systems, and software architecture for machine learning systems.

For the main research track, ECSA 2022 received 47 submissions in the two main categories: full and short research papers. For the first time this year, ECSA followed a double-blind review process. Each paper received three reviews. Based on the recommendations of the Program Committee, we accepted 9 papers as full papers and 6 additional papers as short papers. Hence the acceptance rate for full research papers was 19% for ECSA 2022. The conference attracted papers (co-)authored by researchers, practitioners, and academia from 13 countries (Australia, Austria, Belgium, Chile, Colombia, Denmark, Germany, Italy, Poland, Spain, Sweden, Switzerland, the Netherlands).

The main ECSA program had three keynotes. Patricia Lago from Vrije Universiteit Amsterdam (the Netherlands), leader of the Software and Sustainability (S2) research group in the Computer Science Department, talked about the role of software for sustainability, with special emphasis on software architecture in our highly digitized society. David Garlan from Carnegie Mellon University (USA), recognized as one of the founders

of the field of software architecture, and in particular, formal representation and analysis of architectural designs, talked about humanizing software architecture to better exploit human-system synergies that are required by today's increasingly autonomous, self-adaptive, and AI-driven systems. Finally, as the industrial keynote, Jaroslav Gergic (Czech Republic), Director of Engineering in the Cognitive Intelligence Unit of Cisco Security Business Group, talked about software architecture in the age of cloud computing, highlighting the challenges of scalability and the need for a wider variety of skills to deal with all layers of a cloud-based system in a software-as-a-service company.

We are grateful to the members of the Program Committee for their valuable and timely reviews. Their efforts formed the basis for a high-quality technical program for ECSA 2022. We would like to thank the members of the Organizing Committee for successfully organizing the event with several tracks, as well as the workshop organizers, who made significant contributions to this year's successful event.

We thank our sponsor Springer that funded the best paper award of ECSA 2022 and supported us with publishing the proceedings in the Lecture Notes in Computer Science series. Finally, we thank the authors of all the ECSA 2022 submissions and the attendees of the conference for their participation.

The preparation and organization of ECSA 2022 took place during a special time in our history, an ongoing pandemic that has affected us all over the world. We thank the software architecture community for their support in these times, and for continuing to advance the field of software architecture through their scientific submissions to ECSA.

August 2022

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Abstract of Keynotes

Humanizing Software Architecture

David Garlan

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Abstract. The traditional view of software architecture typically places humans outside the system and in the system's environment. In this talk I argue that there are benefits in shifting this view by bringing humans into an architectural design as first-class entities. The resulting architectural designs can then much better exploit human-system synergies that are required by today's increasingly autonomous, self-adaptive, and AI-driven systems. We will illustrate the ideas by examining case studies in which this approach has been used to provide formal human-system architectural models that attempt to maximize the respective strengths of both humans and systems. We also highlight some of the key challenges and potential directions for research in maturing these ideas.

Biography

David Garlan is a Professor of Computer Science and Associate Dean in the School of Computer Science at Carnegie Mellon University. His research interests include software architecture, self-adaptive and autonomous systems, formal methods, and cyber-physical systems. He is recognized as one of the founders of the field of software architecture, and in particular, formal representation and analysis of architectural designs. He has received a Stevens Award Citation for "fundamental contributions to the development and understanding of software architecture as a discipline in software engineering," an Outstanding Research award from ACM SIGSOFT for "significant and lasting software engineering research contributions through the development and promotion of software architecture," an Allen Newell Award for Research Excellence, an IEEE TCSE Distinguished Education Award, and a Nancy Mead Award for Excellence in Software Engineering Education. He is a Fellow of the IEEE and ACM.

Software Architectures in the Age of Cloud Computing

Jaroslav Gergic

Cognitive Intelligence Unit, Cisco, Czech Republic

Abstract. The age of cloud computing presents the software architects with a unique set of opportunities as well as a unique set of challenges. Designing, building, and operating applications at cloud scale has changed the very nature of software architecture discipline to accommodate a much larger set of objectives and skills. Prior to the cloud era, software architecture was primarily about fulfilling functional requirements while maintaining code modularity and meeting a narrow set of non-functional requirements, such as performance. The cloud-era architect needs to accommodate not only functional requirements and customer-defined throughput and performance requirements, but also a large set of non-functional requirements related to cyber security, compliance, and most notably also the financial/cost characteristics, which at cloud scale can make or break a software-as-a-service company. The whole discipline of software architecture just became not only wider to accommodate all the above aspects, but also deeper as cloud-scale architecture spans all layers of software all the way down to operating system kernel tuning and in the case of private cloud also requires hardware know-how and hardware assembly design closely aligned with high-level application workload requirements to achieve reasonable performance and economics at cloud scale.

Biography

Jaroslav Gergic is Software as a Service R&D executive with a strong R&D background and years of professional services experience. His focus is on innovation and operational excellence and best practices in project and knowledge management. He has 3+ years of general management practice as a country managing director of a company with 150+ employees. Currently he leads the Cognitive Intelligence unit of Cisco Security Business Group as a Director of Engineering while living in the confluence of cybersecurity, machine learning, and cloud computing. Prior to joining Cisco, Jaroslav led R&D and Operations at GoodData and in a more distant past held various positions at Ariba and IBM Research. Besides his full-time job, Jaroslav is actively engaging in local startup communities as a mentor.

Software Sustainability: What it Means for Software Architects and Why Should We Care

Patricia Lago

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Abstract. The need for sustainability is crucial for all aspects of society, as framed by the Sustainable Development Goals (SDGs) of the United Nations, and increasingly prioritized by Governments and Global Organizations. Thanks to digital transformation, most organizations in all sectors are facing incredible challenges to embrace sustainability as related to their software portfolios. Similarly, they struggle in identifying the opportunities that software sustainability can bring. This talk introduces the role of software for sustainability and related research, with special emphasis on software architecture (and architecture design decision making) in our highly digitalized society. Given the pervasive presence of software-intensive systems that are multi-stakeholder and that bring incredible complexities, understanding and managing software architecture design decision making has never been as important as it is nowadays. Examples from collaboration with various industries, sectors, and societal groups are used to illustrate the main takeaways.

Biography

Patricia Lago is a professor at Vrije Universiteit Amsterdam, the Netherlands, where she leads the Software and Sustainability (S2) research group in the Computer Science Department. Her passion in research is to create software engineering knowledge that makes software better, smarter, and more sustainable. Her research focuses on software architecture, software quality assessment, and software sustainability.

She is the initiator of the VU Computer Science Master Track in Software Engineering and Green IT, the director of the Master Information Sciences, and a co-founder of the Green Lab, a place where researchers, students, and companies collaborate to measure the energy footprint of software solutions and the impact on software quality. She has a PhD in Control and Computer Engineering from Politecnico di Torino and a Master in Computer Science from the University of Pisa, both in Italy. She has been awarded an honorary doctorate degree by the Norwegian University of Science and Technology (NTNU).

She is program committee member and reviewer of the major international conferences and journals in her fields of interest; a member of the Steering Committees of IEEE ICSA, ECSA; and currently the Steering Committee Chair of the ICT4S

conference series. She is also in the management team of IPN (ICT-research Platform Netherlands). She has published over 200 articles in all major scientific conferences and journals of her field. She is a senior member of ACM and IEEE. More info at: www.patricialago.nl.

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