emergenCITY Workshop “Software and Resilience”

June 14, 2021

Description

“Software systems play a fundamental role in resilient IT infrastructure. Distributed applications analyze and process events from various sources to extract relevant patterns (e.g., emergency conditions, traffic congestion, infrastructural failures) based on processing units spread across different computing nodes to form a network.
In the context of disaster management and emergency reaction, such systems must provide a high level of resilience and service guarantees. The “Software and Resilience” workshop identifies the latest challenges in distributed resilient software systems and outlines new methods to address these issues based on the key resilience principles.”

Program

Speaker	Affiliation	Time Zone	Schedule (CET)
Schahram Dustdar	TU Wien	CET	10:00-10:45
Tina Comes	TU Delft	CET	11:00-11:45
Martin Kleppmann	University of Cambridge	GMT(CET-1)	12:00-12:45
Gul Agha	University of Illinois at Urbana–Champaign	CT(CET-7)	15:00-15:45
Sasa Misailovic	University of Illinois at Urbana–Champaign	CT(CET-7)	16:00-16:45

Website: www.emergencity.de/ecweek21
Location (Zoom): www.emergencity.de/s/ecweek21_workshop

Abstracts and Biographies

10:00 - 10:45	**Speaker:** Schahram Dustdar, TU Wien
	Title: Distributed Systems - The Next Level
	Abstract: As humans, things, software and AI continue to become the entangled fabric of distributed systems, systems engineers and researchers are facing novel challenges. In this talk, we analyze the role of Edge, Cloud, and Human-based Computing as well as AI in the co-evolution of distributed systems for the new decade. We identify challenges and discuss a roadmap that these new distributed systems have to address. We take a closer look at how a cyber-physical fabric will be complemented by AI operationalization to enable seamless end-to-end distributed systems.
	Bio: Schahram Dustdar is Full Professor of Computer Science heading the Research Division of Distributed Systems at the TU Wien, Austria. He holds several honorary positions: University of California (USC) Los Angeles; Monash University in Melbourne, Shanghai University, Macquarie University in Sydney, and University of Groningen (RuG), The Netherlands (2004-2010). From Dec 2016 until Jan 2017 he was a Visiting Professor at the University of Sevilla, Spain and from January until June 2017 he was a Visiting Professor at UC Berkeley, USA. From 1999 - 2007 he worked as the co-founder and chief scientist of Caramba Labs Software AG in Vienna (acquired by Engineering NetWorld AG), a venture capital co-funded software company focused on software for collaborative processes in teams. Caramba Labs was nominated for several (international and national) awards: World Technology Award in the category of Software (2001); Top-Startup companies in Austria (Cap Gemini Ernst & Young) (2002); MERCUR Innovation award of the Austrian Chamber of Commerece (2002). He is founding co-Editor-in-Chief of the new ACM Transactions on Internet of Things (ACM TIoT) as well as Editor-in-Chief of Computing (Springer). He is an Associate Editor of IEEE Transactions on Services Computing, IEEE Transactions on Cloud Computing, ACM Transactions on the Web, and ACM Transactions on Internet Technology, as well as on the editorial board of IEEE Internet Computing and IEEE Computer. Dustdar is recipient of the ACM Distinguished Scientist award (2009), the IBM Faculty Award (2012), an elected member of the Academia Europaea: The Academy of Europe, where he is chairman of the Informatics Section, as well as an IEEE Fellow (2016).
11:00 - 11:45	**Speaker:** Tina Comes, TU Delft
	Title: From Smart to Resilient Cities
	Abstract: Resilience, as the capacity to quickly recover from crises, adapt and grow, has rapidly risen to the top of the agenda sustainable development. As the world is

	still combatting the COVID-19 pandemic, and with billions of dollars' worth of resilience investments being mobilized globally, resilience will continue to rise as a priority. Especially cities are facing unprecedented environmental, social and technological challenges that are unprecedented in scale, scope, and complexity. Information and data have been recognized as vital to improve resilience especially in the face of adverse events, and with the turn to digitalization and increasingly smart cities, new opportunities for better planning and decision-making arise. Yet, major challenges remain in rapidly identifying and analysing different data sources and develop from there meaningful and actionable information. Through several case studies, I will outline key resilience principles, highlight how data and information can be used to improve disaster response and longer-term adaptation. Further, I will highlight the possible dilemmas arising given the different time frames of decision-making and discuss requirements for responsible design, and outline directions for future research.
	Bio: Dr. Tina Comes is Delft Technology Fellow and Associate Professor in the Department of Engineering Systems and Services at the TU Delft, Netherlands, and Full Professor in Decision-Making & Digitalisation at the University of Maastricht. Dr. Comes is a Visiting Professor at the Université Dauphine, France, and a member of the Norwegian Academy for Technological Sciences. She serves as the Scientific Director of the 4TU.Centre for Resilience Engineering, as Principle Investigator on Climate Resilience for AMS, as Director of the TPM Resilience Lab, and she leads the Disaster Resilience theme for the Delft Global Initiative. She is advising the European Commission as the Chair of the SAPEA Working Group on the Future of Strategic Crisis Management in Europe. Since her PhD on distributed decisions from the Karlsruhe Institute of Technology (Germany), Dr. Comes' research focuses on decision-making and information technology for resilience and disaster management. Solidly rooted in this direction, she conducts research on using information and smart technology for better decisions and coordination in complex, volatile and uncertain environments. Grounded in this orientation, she has conducted research with stakeholders and decision-makers in private companies, public authorities and international organizations. This perspective on decision making, resilience and humanitarian response is reflected in more than 100 publications.
12:00 - 12:45	**Speaker:** Martin Kleppmann, University of Cambridge
	Title: Local-first software: Collaborating without depending on servers
	Abstract: Cloud-hosted software services and web apps have become crucial machinery for the functioning of companies, governments, and society, making it easier to communicate, collaborate, and coordinate our actions. However, this type of software depends on a server infrastructure that processes requests from clients and stores the data in a central database. The datacenter where these servers are hosted is often far away from the clients that depend on it. If the clients can't reach the servers, cloud software stops working. In a disaster scenario, we cannot assume that every device has a working internet connection

	through which it can communicate with a remote cloud service. Instead, devices that are physically close to each other can use local radio links such as mesh networks to communicate. However, most collaboration software today is built on top of the assumption that there is one central database, and all communication is routed through it. This assumption is no longer true when we allow nearby devices to communicate directly, without going via any server. This talk will introduce our research on algorithms for collaboration software that works via any type of network, without assuming any servers. We call this type of software "local-first", since it prioritises local networks and local storage over cloud computing resources. We will also discuss Automerge, an open source library of Conflict-free Replicated Data Types (CRDTs) that can be used to create local-first software.
	Bio: Dr. Martin Kleppmann is a researcher at the University of Cambridge, and author of the acclaimed book “Designing Data-Intensive Applications” (O'Reilly Media, 2017). He works on distributed systems and security, in particular collaboration software and CRDTs. Previously he was a software engineer and entrepreneur, co-founding and selling two startups, and working on large-scale data infrastructure at LinkedIn.
15:00 - 15:45	**Speaker:** Gul Agha, University of Illinois at Urbana–Champaign
	Title: Building Smart Structures with Decentralized Control and Predictive Monitoring
	Abstract: Resilience in software requires decentralization and cooperation among autonomous systems. Such systems must sense and actuate locally while cooperating to ensure globally efficient outcomes. The talk will discuss advances in IoT which can facilitate smart physical infrastructure. It will then discuss the opportunities and challenges in developing software systems which rely on edge devices with limited processing, storage, and energy. I will briefly describe several new methods we have worked on which are promising for scalability. These include predictive decentralized monitoring, statistical model checking, Euclidean model checking, and energy complexity analysis. will conclude with conjectures about how new programming languages and tools may facilitate transition to resilience by incorporating these methods.
	Bio: Dr. Gul Agha is Professor Emeritus and Research Professor of Computer Science at the University of Illinois at Urbana-Champaign and CEO of Embedor Technologies. Dr. Agha is a Fellow of the ACM and of the IEEE. He served as Editor-in-Chief of IEEE Concurrency and of ACM Computing Surveys. Dr. Agha is best known for his formalization of the Actor Model. Actor languages have been used to develop scalable applications such as Twitter, LinkedIn, and Facebook Chat. Other contributions include work on Concolic Testing, a method incorporated in industrial software testing tools such as KLEE, Microsoft SAGE,

	and S2E; Euclidean model checking for reasoning about the evolution of probability distributions and for synthesizing controllers; Statistical Model Checking for reasoning about probabilistic properties; the application of computational learning to program verification; methods for automated decentralized, predictive runtime verification; and algorithms and applications of wireless sensor networks(WSNs). Dr. Agha co-founded Embedor Technologies which is applying WSNs to continuously monitor the structural health of bridges, buildings, and railroads.
16:00 - 16:45	**Speaker:** Sasa Misailovic, University of Illinois at Urbana–Champaign
	Title: Accuracy-aware Programming Systems for Edge
	Abstract: Tradeoffs between accuracy, performance and energy exist in many resource-intensive applications pervasive in machine learning and robotics. Manually optimizing these tradeoffs with flexible accuracy or precision requirements is extremely difficult. I will present our work on programming systems (including languages, compilers, and runtime systems) for accuracy aware optimization of programs. A particular focus of the talk will be on ApproxTuner, a novel automatic framework for accuracy-aware optimization of tensor-based applications that requires only high-level end-to-end quality specifications. ApproxTuner implements and manages approximations in algorithms, system software, and hardware. The key contribution in ApproxTuner is a novel three-phase approach to approximation-tuning that consists of development-time, install-time, and run-time phases. Our approach decouples tuning of hardware-independent and hardware-specific approximations, thus providing retargetability across devices. In the talk, I will highlight applications in autonomous systems and agricultural robotics that can leverage our optimizations. We published ApproxTuner recently at PPoPP 2021.
	Bio: Sasa Misailovic is an Assistant Professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign since August 2016. He obtained PhD from MIT in 2015. His research interests include programming languages, compilers, and computing systems, with an emphasis on improving performance, energy efficiency, and resilience in the face of software errors and approximation opportunities.

emergenCITY

The LOEWE center emergenCITY, established in **2020**, combines the extensive research in Hesse on resilient and crisis-proof infrastructures in digital cities.
emergenCITY is an interdisciplinary and multi-site collaboration led by **Technische Universität Darmstadt, Universität Kassel, and Philipps-Universität Marburg**. Twenty-three professors from the fields of computer science, electrical engineering and information technology, mechanical engineering, social sciences and history, architecture, economics, and law conduct research in four interlinked program areas: City and Society, Information, Communication, and Cyber-Physical Systems.
Also, the **Federal Office of Civil Protection and Disaster Assistance (BBK), the City of Darmstadt, the German Aerospace Center (DLR)**, and more than 40 other partners from industry and science are involved in the center.

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Exzellente Forschung für Hessens Zukunft

Contact:

Prof. Dr.-Ing. Matthias Hollick
Scientific Coordinator

Anne Hofmeister
Manager

manager@emergencity.de
www.emergencity.de
Hochschulstraße 1 | 64289 Darmstadt | +49 6151 16-25482