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# Economics of Grids, Clouds, Systems, and Services


15th International Conference, GECON 2018  
Pisa, Italy, September 18–20, 2018  
Proceedings


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# Preface

This volume constitutes the proceedings of the 15th International Conference on the Economics of Grids, Clouds, Systems, and Services (GECON 2018). GECON is a long-held conference that annually brings together economics and computer science researchers, with the ultimate aim of building a strong multidisciplinary community in the increasingly important areas of future ICT systems and economics.

The strong connection between ICT and economics aspects in current research endeavors reflects the reality of today's world, where technological advancements cause social and economic shifts, and information technology is often provided or controlled by large industrial realities and pervasive social networks. Clouds, mobile and distributed systems are well-established game-changer innovations of this kind. Other emergent ICT paradigms such as microservices and artificial intelligence are obvious examples of this recurring trend. Therefore, a multidisciplinary approach is needed when tackling the complexity of the interdependencies between ICT and economy, as well as the links with other disciplines such as politics or sociology. From another viewpoint, the impact of ICT is becoming so significant compared with other disciplines that, to some extent, the economy itself is transforming into an information and knowledge economy.

In order to better focus on new research directions and their impact and relationship with the main conference, this year's GECON organized three special sessions on selected topics, namely: "IT Service Ecosystems Enabled Through Emerging Digital Technologies," "Machine Learning, Cognitive Systems, and Data Science for System Management," and "Blockchain Technologies and Economics."

GECON 2018 was held during September 18–20, 2018, hosted by the Institute of Information Science and Technologies "A. Faedo" (ISTI) and located on the premises of the research area of the National Research Council of Italy (CNR) in Pisa, Italy. Pisa is a small but very lively city in Tuscany with an ancient history. Most notably, Pisa was one of the Maritime Republics in the Middle Ages, and is known worldwide for the Piazza dei Miracoli and its iconic Leaning Tower. Pisa is also a longtime hub of research excellence and higher education, being home to one of the oldest universities in Italy, as well as of the Scuola Normale Superiore, of the Sant'Anna School of Advanced Studies, and of the largest research area of the CNR.

We received 40 regular submissions for this year's edition. Each submission was assessed by three to five reviewers of the international Program Committee. Of these submissions, 11 were selected as full papers, for an acceptance rate of 27%. Additionally, nine shorter work-in-progress papers were integrated in the volume. Like in previous GECON editions, a combination of full papers and work-in-progress ones fulfills the twofold aim of gathering solid, original work and capturing innovative results. Starting from the presentation schedule and onward, the conference enabled open and informed dialogue between presenters and the audience, encouraging discussions and debates after each talk and providing enough discussion time.

## Keynotes

This year's GECON featured three keynotes on ICT topics that deeply affect the way we use clouds as well as their economics.

The first invited speaker, at the conference opening, was Prof. Antonio Cisternino, University of Pisa. Antonio Cisternino has been a researcher at the Department of Computer Science since 2006. Among the positions he served there, he was the director of the Centre for Calculus of the department and participated in the constitution of the interdepartmental centre for research and services IT Center, of which he has been vice director since 2013. His main research interests include programming languages, meta-programming and domain-specific languages. He contributed to the .NET platform dynamic compilation runtime and the F# programming language. At present, he has turned his attention to clouds and virtualization, Fog Computing, and the Internet of Things. Also very active in technology transfer, Dr. Cisternino oversees the IT Center's collaborations with numerous industrial entities such as Ferrari, Microsoft, Dell, Intel, Acer, AMD and HP.

Prof. Cisternino's keynote "How Does the New Memory Hierarchy Affect the Cloud Model" tackled the issues and changes that recent developments of ITC hardware are bringing to the use and management of computing resources, both from a general viewpoint and specifically to the field of Cloud Computing.

"Cloud Computing, which started as a business model, has become a reference model to organize and use IT resources so that users are shielded by the ever-growing complexity of the ICT infrastructures. As any other model, the cloud one is based on implicit and explicit assumptions about the technology that made it possible. In this talk I present recent technology changes that are affecting the very underlying assumptions that have contributed to define the cloud reference architecture and the way cloud is used. In particular, I focus on the revolution of storage media and the impact on the whole communication infrastructure."

Also on the first day of the conference, the second invited speaker was Alessia Bardi, a researcher at Networked Multimedia Information Systems (NeMIS) Laboratory of CNR-ISTI. After getting her PhD in Information Engineering in 2016, Dr. Bardi has been involved in several EU-funded projects addressing the realization and operation of aggregative data infrastructures for various research communities. She is currently participating in projects supporting Open Access and Open Science, in particular OpenAIRE and OpenUP. Her research interests include service-oriented architectures, data and metadata interoperability, and data infrastructures for e-science and scholarly communication.

Dr. Bardi's keynote speech was about "Open Science as-a-Service for Repositories and Research Communities." A long abstract of her talk is included as the first contribution in this volume.

"Open Science is a set of practices of science mandating for accessibility and availability for re-use and re-distribution of research activities and products. Implementing Open Science principles aims at enabling responsible, reproducible, and transparently assessable research. Beside the need for a behavioral change in interested stakeholders, as of today the scholarly communication ecosystem lacks tools and open research community practices. To fill this gap and support a smooth transition toward Open Science, the OpenAIRE initiative is offering novel services for research communities and content providers."

The third invited speaker was Prof. Antonio Brogi. Antonio Brogi has been a full professor at the Department of Computer Science, University of Pisa (Italy) since 2004. He was previously there as associate professor and assistant professor, and later served as Dean of the Bachelor's and Master's Degree Programs in Computer Science. He leads the Service-Oriented, Cloud and Fog Computing research group (SOCC). His research interests include service-oriented and cloud-based computing, coordination and adaptation of software elements, formal methods and design of programming languages. He has published over 150 research papers and is member of the editorial board of several journals in the field, as well as member of the steering committees of conference series like CIBSE, ESOC, and FOCLASA. The keynote from Prof. Brogi, on the second day of the conference, was entitled "Microservices Everywhere?"

"In this talk we critically discuss the main characteristics of microservices and the potentially huge advantages offered by their adoption for managing enterprise applications. We also show how a simple formalization of the main properties of microservices can be exploited to drive the refactoring of existing applications."

## Special Topic Sessions

### *IT Service Ecosystems Enabled Through Emerging Digital Technologies*

Chair: Somayeh Khaghghi, Amsterdam University, The Netherlands.

New business ecosystems have become possible thanks to digital platforms such as cloud computing, Internet of Things, and wearable technologies. Digital businesses in these ecosystems continuously monetize, manage, and measure information as an asset for having a competitive advantage in the market. This special session focuses on new ways of integrating people, resources, processes, and technologies, impacting on the management of systems and resources, on the analysis and modeling of value creation, and on the sustainability of technologies.

### *Machine Learning, Cognitive Systems and Data Science for System Management*

Chair: Aurilla Aurelie Arntzen, University of South-Eastern, Norway.

It is well recognized in this interconnected world that businesses, government, and people depend on reliable technical infrastructures for all aspects of daily operations such as retail distribution, public and private transportation, and even social interaction. There are many reasons why failures occur in digital infrastructures and information systems, including human errors and malicious behavior. Today, the emerging trend is to use techniques from data science, Machine Learning, and Artificial Intelligence in order to automate management tasks, thus increasing system reliability and management efficiency.

*Blockchain Technologies and Economics*

Chairs: Paolo Mori, CNR-IIT, Italy and Stefano Bistarelli, University of Perugia, Italy.

The blockchain technology is raising increasing expectations, with many promising applications being proposed in several fields that go far beyond the crypto-currency use case that popularized the technology. This special session focuses on theory and applications of blockchain systems and services, as well as their impact on the viability of new economic models and issues on essential properties of the affected systems, including the legal, privacy, and security aspects.

**Acknowledgments**

We would like to thank first all the authors who submitted their work for evaluation. The community is what makes the conference possible. We would also like to wholeheartedly thank the reviewers and all Program Committee members for completing their reviews on time and providing insightful and valuable feedback to the authors. We wish to thank the invited speakers, for bringing new viewpoints and inputs to the GECON community, as well as the special session chairs, for their additional work and contribution to the conference. Furthermore, we would like to thank Alfred Hofmann and the whole team at Springer for their support in publishing the proceedings of GECON 2018. The collaboration with Springer was, as in the past, efficient and effective. Finally, we wish to acknowledge the support of the HPC Laboratory at ISTI-CNR and thank the ISTI-CNR administration team. Last but not least, we wish to acknowledge Asti Incentives & Congressi Srl, whose team supported the conference organization and handled most of the logistics.

October 2018

Massimo Coppola  
Emanuele Carlini  
Daniele D'Agostino  
Jörn Altmann  
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