BCT4MAS

Blockchain Technology for Multi-Agent Systems

1.   Workshop title and acronym if available

1st International Workshop on Blockchain Technology for Multi-Agent Systems (BC4MAS)

2.   Topic Description

Multi-agent systems (MAS) are composed of loosely coupled entities (agents) interconnected and organized in a network. Every agent has the ability to *solve problems* and *attain its goals* by interacting with each other through *collaboration*, *negotiation*, and *competition* patterns. MAS are increasingly dealing with sensitive data. Therefore, enforcing the notion of reputation, ensuring trust and reliability, is essential for modern MAS.

Blockchain (BCT) is a P2P distributed ledger technology providing shared, immutable, transparent, and updatable (append-only) registers of given values characterizing a given network (e.g., all the actions intercurred among the participants and information about the participants themselves).

However, employing the BCT ``as-is'' and by itself in dynamic and quickly evolving scenarios can represent an unlucky choice. The reasons span from fundamental properties of BCT, to application/domain specific constraints. Reaching consensus in distributed multi-stakeholder networks with possible unaligned interests can be considerably complex or unsustainable.

Therefore, if properly managed, combining BCT and MAS can represent a win-win solution:

(i) the adoption and adaption of BCT can help to overcome trust and reliability limitations broadly known in MAS literature, enabling secure, autonomous, flexible and even profitable solutions.

(ii) MAS can contribute with its features to address limitations of BCT.

3.   A draft call for papers

Human beings are increasingly connected through uncountable interlinked electronic devices that perform ubiquitous computing. As a consequence, scientific research is pushing towards the design and development of autonomous and collaborative systems and devices that interact and compete with each other, often emulating humankind dynamics.

Multi-Agent Systems (MAS) are widely used for the development of intelligent distributed systems, including cases that deal with highly sensitive data, such as ambient assisted living, healthcare, and energy trading. An agent can be rationalized as an autonomous entity observing its surrounding environment through a perception layer, and possibly interacting with it, as well as with other agents. These intelligent agents are also able to perform distributed reasoning exploiting their knowledge base. It can be extended and updated, thus renewing their plans to achieve the desired goals. In MAS, a solution to given problem to be solved is delivered through autonomous actions and interactions between many agents rather than by any single "smart" agent. Hence, MAS are generally composed of loosely coupled agents interconnected and organized in a network, each of them having the ability to solve problems and attain its goals by interacting with each other through collaboration, negotiation, and competition patterns.

Recently, BCT has been proposed as a peer-to-peer distributed ledger technology that can provide a shared, immutable, and transparent history of all the events intercurred among all the participants in a given network. Currently, MAS require trusted mediators storing the transactions among the agents. These mediators can be replaced with a distributed ledger technology: BCT properties can ensure that no corruption of topics or moderators would impact on the reliability of the network.

For example, systems handling societal information and dealing with hundreds/thousands of nodes to manage sensitive information can benefit from the combination of MAS and BCT. Such systems need the crucial feature guaranteed by MAS, as much the traceability and immutability ensured by the BCT.

This workshop aims at offering a common ground to researchers from diverse areas to share experiences about possible outcomes of combining MAS and BCT.

In particular, the submitted papers should address how MAS and BCT can be used together in one or more of the following (scientific and applied) topics:

<u>Theoretical track:</u>
- Main properties of blockchain technology
- Self-aware and smart contracts
- Reputation management
- Decision-making for policy
- Secure identity assurance
- Security and privacy management
- Trust and data integrity
- Procurement
- Conflict resolution in business collaboration
- Task allocation, coordination, and supervision
- Agreement technologies and artificial institutions
- Big data management in highly distributed environments
- Anonymization of distributed data

<u>Applied track</u>
- Distributed energy grids
- Collaborative governance
- Distributed Autonomous Organisations (DAO)
- Distributed artificial intelligence
- Swarm robotics
- Coordination models in Internet-of-Things (IoT)
- E-commerce and demand-supply relationships
- Software life-cycle management
- E-government
- Sharing economy

The accepted papers will be published in the Springer proceedings Lecture Notes in Artificial Intelligence (LNAI). Participants are therefore invited to submit papers up to 16 pages in length, addressing the topics of the workshop. Papers must be edited using the LNCS format (applying the [LNCS proceedings template](#)) and have to be submitted electronically as PDF files via the EasyChair submission page.

We encourage papers describing motivations, assumptions, requirements, strengths, limitations and open challenges of combination of BCT and MAS in reconciling systems to realize more trustworthy distributed platforms and applications.

Authors can provide short (up to 8 pages) and full papers (8 to 16 pages) about theoretical contributions, early/advanced prototypes, demo, tools, novel and improved techniques, and general survey papers.

Accepted papers, presented at the workshop by one of the authors, will be published in the LNAI Post-Proceedings of BC4MAS (with an ISBN). The acceptance of the submitted papers will depend on their quality, relevance, and originality.

3. Important Dates

Deadline for Submission: 9 September 2018
Notification of Acceptance: 1 October 2018
Camera-ready: 12 October 2018
Workshop day: 3 December 2018

4. Organizers:

Dr. Davide Calvaresi
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Bio: Dr. Davide Calvaresi is currently a Postdoctoral researcher at the *University of Applied Sciences and Arts Western Switzerland* (since March 2018). He obtained his Ph.D. in *Emerging Digital Technologies* curriculum: *Embedded Systems* at the *Scuola Superiore Sant'Anna* (2014 - 2018). Dr. Calvaresi joined the AISLAB research group (directed by Prof Michael Schumacher) at the University of Applied Science Western Switzerland (HES-SO) in October 2016 to carry out daring new research in Real-Time Multi-Agent Systems (RT-MAS) and its possible applications in eHealth and safety-critical scenarios.
He obtained his Master's in Information and Automation Engineering at Università Politecnica delle Marche in 2014. In his final year, he spent six months at the University of Toronto working with Prof Eric Yu and Arnon Sturm on his master thesis, which was about modeling the Ambient Assisted Living (AAL) domain with the Goal-Oriented Requirement Engineering Technique and the i-star modeling language. Throughout his Ph.D. process, Davide became a reviewer for several journals (ACM Transactions on Cyber-Physical Systems, IEEE Transactions on Industrial Informatics, Autonomous Agents and Multiagent Systems, and Artificial Intelligence in Medicine) and conferences (ICAART 2017, EPIA 2017, A2HC 2017, SAC 2016, RTSS-CPS 2016, AIH 2018).
He also has been Program Chair of the:
- 1st International Workshop on Real-Time compliant Multi-Agent Systems (RTcMAS 2018),
- 1st International Workshop on Blockchain for Multi-Agent Systems (BCT4MAS 2018)
 and a member of the Program Committee of A2HC 2017 and AIH 2018.

Moreover, Dr. Calvaresi has received the following honors: Best Paper Award (A2HC@AAMAS 2017), Best Social and Environmental ICT Idea Award (GSVC 2016), Winner of Automotive and Service Category (Lee Kuan Yew Global Competition 2017), High-Tech Award (Lions Club International 2016), Changemakers for a Connected Society (EGO Ericsson 2015), and Best Business and High-Tech Ideas (StartCup Tuscany 2015).
Furthermore, he is co-founder and member of the scientific committee of Polo Tecnico Tecnologico in Ascoli Piceno, Italy (PTT-consortium), that aims at realizing joint research laboratories between university and industry; and co-founder of the startup Wriggle Solutions s.l.r.s pursuing the main project "SMARTTyre" (which addresses the safety on the road) recording the patent IT102015000079497.
Currently, his research areas cover Real-Time Multi-Agent System, Blockchain for Multi-Agent Systems, and Assistive/Telerehabilitation applications.
Dr. Calvaresi has 26 accepted papers, 99 citations, and h-index 6 (source: Google Scholar date: 15/05/2018)

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Bio: Alevtina is a Research Assistant belonging to the Applied Intelligent Systems Lab (AISLab) at the HES-SO Valais working under the supervision of Prof Dr M. Schumacher. Moreover, she is an external PhD candidate at École Polytechnique Fédérale de Lausanne (EPFL) in Distributed Information Systems Laboratory, co-advised by Prof Dr K. Aberer. Her PhD thesis focuses on building systems and protocols for privacy-preserving data exchange and aggregation, with an application to the healthcare domain. In 2016 Alevtina spent 3 months in Stony Brook University, NY, US, working on the application of BCT to support healthcare data management applications. Her research interests are BCT, eHealth, MAS, Privacy, and

Distributed Systems. Alevtina has been awarded with the Best Paper Award for the paper on application of BCT technology in healthcare for the Swiss eHealth Summit 2017. She received a Doctoral Fellowship from the EDIC program at EPFL in Switzerland (2012-2013) and Russian Government Prize Fellowship (2011-2012). Alevtina served as a program committee member for the Workshop on Data Management and Analytics for Medicine and Healthcare (DMAH), which took place in conjunction with the Conference on Very Large Databases (VLDB 2017) and she will also be PC in the upcoming edition of DMAH. In addition, she has served as a reviewer for the IEEE journal Transactions on Information Forensics & Security, for the conferences CLOSER 2014, ICAART 2015, ICTH 2016, and Netmob 2017, and for the workshop on Artificial Intelligence for Diabetes (AID)@ECAI 2016.

Prof. Dr. Michael Schumacher
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Bio: Michael Schumacher is a Professor in the Institute of Information Systems at the University of Applied Sciences and Arts Western Switzerland (HES-SO Valais Wallis) since 2007. In 2016 he was appointed UAS Ordinary Professor. Previously, he held positions at the Swiss Federal Institute of Technology Lausanne (EPFL) as Senior Researcher, and at the Robotics Institute in Carnegie Mellon University in Pittsburgh (USA) as a visiting researcher. He also worked in project management in an international Swiss foundation committed in social investment. He holds a PhD and an MSc in computer science and biology from the University of Fribourg in Switzerland. In 2009, he founded the Applied Intelligent Systems Lab (AISLab), which concentrates on multiagent systems and artificial intelligence applied to healthcare. His research has focused on personal health systems for chronic disease monitoring (Diabetes type 1 and 2, COPD, etc.), on interoperability issues for eHealth systems, on electronic healthcare records, on medical expert systems, on decision support tools for general practitioners, on pseudonymization techniques for clinical research databases, chatbot supported programs for smoking cessation campaigns, etc. Recently his research team started investigating the usage of BCT in healthcare. Since 2014, he is coordinating the Health Technology Innovation Center (HTIC) of HES-SO Valais Wallis, which is running R&D for sustainable health technology solutions, with a team of interdisciplinary researchers. From 2008 to 2016, he was member of the commission "Architecture and Standards" of the Swiss eHealth strategy. In 2016, he joined the Executive Board of the Swiss Personalized Health Network (SPHN). In 2012, the startup company Fairtrace was founded as a result of a research project lead by AISLab. Prof Schumacher was involved in the organization of the Workshop on Agents Applied in Health Care (A2HC), which was held in AAMAS 2017 and AAMAS 2015. Furthermore, he co-organized the 25th ACM Symposium on Applied Computing (SAC'2010) in Crans-Montana (Switzerland).

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Bio: Prof Dr Kuldar Taveter is a Full Professor and Head of the Lab of Socio-Technical Systems at the Department of Software Science of Tallinn University of Technology. Jointly with Professor Leon Sterling from Swinburne University of Technology, Australia, he has developed a novel methodology and research direction called agent-oriented modelling, which is described in their monograph by MIT Press. Agent-oriented modelling facilitates an agile design of distributed socio-technical systems. Prof Taveter led the TTU team in the FP7 project "Modelling crisis management for improved action and preparedness" (CRISMA, 2012-2015), where agent-based simulations were used for decision support by serious gaming in crisis management. He currently leads the TTU team in the Horizon 2020 project "Observation capacity mapping in the context of Atmospheric and Climate change monitoring" (GAIA-CLIM). In 2005-2008 he was a research fellow at the University of Melbourne, Australia, where he was working in agent-oriented software engineering. In 1997-2005 Kuldar was employed as a research scientist and project leader at the

Technical Research Centre of Finland (VTT). His main research areas at VTT were agent-based business process automation and ontologies. In 2011 he spent 8 months as a Fulbright Scholar at the University of South Carolina, USA, doing research work in agent-based crowdsourcing systems. In 2010-2014 Prof Kuldar Taveter belonged to the Management Committee of the COST Action "Agreement Technologies". The Action aimed at coordinating national efforts on a new paradigm for next-generation distributed systems, where autonomous software agents negotiate with one another in order to come to mutually acceptable agreements. Prof Kuldar Taveter currently belongs to the Management Committee of the COST Action "From Sharing to Caring: Examining Socio-Technical Aspects of the Collaborative Economy", where BCT is a prominent technology considered for storing transactions occurring within sharing economy. He has 89 publications and 682 citations by Google Scholar.

5. List of program committee members, including their affiliations

(Waiting for the confirmation by all the members)

Alexander Norta, Tallinn University of Technology, Estonia
Sascha Ossowski, University Rey Juan Carlos, Spain
Andrea Omicini, Alma Mater Studiorum-Università di Bologna, Italy
René Schumann, University of Applied Sciences and Arts Western Switzerland
Jean-Paul Calbimonte, University of Applied Sciences and Arts Western Switzerland
Stéphane Galland, Université de Technologie de Belfort-Montbéliard
Rik Eshuis, Eindhoven University of Technology, the Netherlands
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Nicola Falcionelli, Università Politecnica delle Marche, Italy
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