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Collaborative Technologies and Data Science in Smart City Applications

J.UCS Special Issue

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Socio-technical systems aim to ease collaboration among people mediated by technology. This mediation role is especially important in the case of collaboration applied in virtual spaces using large amount of heterogeneous data for learning or working. Mobile systems based on Ambient Intelligence (AmI) could enhance the possibilities available for designers and practitioners. However, a number of complexities must be resolved before such systems are really appreciated by the stakeholders. Among these difficulties are the challenges posed by collaborative human-computer interaction and high network capacity overcoming small-size screens and network interruptions, appropriate user awareness, security and privacy issues, eventually providing satisfactory user experience.

Smart City Applications (SCA) and Smart Environments (SmE) together with Internet of Things (IoT) and reliable Cloud Computing Technologies supporting mobile users in all areas of daily life must guarantee performance, data integrity, privacy, network security, and accuracy in the outcome of algorithms. To fulfill these requirements, a modern Verification and Validation Assessment (VVA) including appropriate user interaction and recommending services based on adaptive criteria is essential. Validation can be achieved via special metrics that help to compute a degree of model similarity or to compare reconstructed objects and their behavior with their real-world instances.

Huge amounts of heterogeneous input and output data and high system complexity require new visual and collaborative analytics to interpret the results. Reliable visual analytics is preceded by an assessment of (meta-) data and code quality, methods to propagate and bound uncertainty and validation efforts with formal rigor. Collaborative outcome analytics done by various stakeholders with multiple expertise deals with system evaluation, effective data mining, problem solving, and concerted follow-up actions. Advanced data and visual analytics for sense making in big data environments mainly rely on quality assessment, awareness of data provenance and characteristics as well as safety, security and privacy issues.

Recently, two research networks crossed their paths at an exploratory bi-lateral Workshop in Armenia on Sept. 12-15, 2018, entitled "Collaborative Technologies and Data Science in Smart City Applications". This workshop has attracted 21 paper submissions which deal with the challenges mentioned above. The studies are in specialized areas and show novel solutions. Especially interesting are approaches based on existing theories suitably applied. The authors of the best papers of the conference were invited to submit significantly extended, improved versions of their contributions to be considered for a journal special issue of J.UCS. Furthermore, there was a J.UCS open call so that any author could also submit papers on the highlighted subject. A total of 9 papers were submitted–including invited and submitted after the open call–and were rigorously reviewed in two rounds by three qualified reviewers each and 8 papers passed this procedure to be presented in this issue.

The first paper "Towards Secure and Efficient 'white-box' Encryption" was authored by Gurgen Khachatrian and Sergey Abrahamyan. The main contribution of the paper is the white-box encryption based on SAFER+ block cipher algorithm. It is shown that this SAFER+ WB is secure against BGE attack and against so called reverse engineering attack. Implementation speed and memory requirements are also presented.

The second paper "A New Information-Theoretical Distance Measure for Evaluating Community Detection Algorithms" by Mariam Haroutunian and Karen Mkhitaryan first reviews several information-theoretic measures and indicates those–the normalized variation of information (NVI) and the normalized information distance (NID)–effective in applying for evaluation tasks of different community detection algorithms. Then it suggests a new measure, which they called modified chi-square divergence. Its metric and normalization properties are analyzed. Moreover, experimentally, it was shown that the proposed measure outperforms NVI and NID with less bias to the number of communities in the network.

The third paper "Secrecy over Communication Networks: A Game of Competition and Cooperation" submitted by Yanling Chen, O. Ozan Koyluoglu, and A. J. Han Vinck studies the discrete memoryless multiple access channel with two transmitters in the presence of eavesdropper. Various secrecy scenarios are discussed from the competitive or cooperative transmission strategies point of view. Inner and outer bounds on the secrecy capacity regions in the case of degraded eavesdropper are derived. It is noticed that these bounds have different permissible sets of input distributions and are not tight.

The fourth paper "On Machine Learning Approaches for Automated Log Management" by Ashot N. Harutyunyan, Arnak V. Poghosyan, Naira M. Grigoryan, Narek A. Hovhannisyan, and Nicholas Kushmerick addresses several problems in automated log management of distributed cloud computing applications and their machine learning solutions. In particular, several approaches and algorithms are proposed as well as validated to be effective The authors argue that the presented method may have great benefit for data scientist in theory and practice.

The fifth paper “Planning of Urban Public Transportation Networks in a Smart City” authored by Jonathan Frez, Nelson Baloian, Jose A. Pino, Gustavo Zurita, and Franco Basso continues current work on efficiently planning public transport in a metropolitan area. It presents a method to use existing crowdsourced data and cloud services as well as information about location of facilities and user behavior to support transportation network modeling, planning, and decision making. Additionally, the auhors show that the presented method enables a realistic forecast about current and expected traffic.

The sixth paper “The Role of Verification and Validation Techniques within Visual Analytics” by Benjamin Weyers, Ekaterina Auer, and Wolfram Luther describes existing verification and validation assessment methods in general and extends them to a broad user-centered system modeling and simulation approach, which relies on visual analytics subjected to a specialized evaluation methodology. They argue that the latter can contribute to the overall V&V procedure. Two use cases illustrate the potential of the introduced framework for reliable visual analytics.

The seventh paper “Identifying Groupware Requirements in People-Driven Mobile Collaborative Processes” contributed by Valeria Herskovic, Sergio F. Ochoa, and José A. Pino is concerned with requirements engineering for groupware development. For this purpose, the paper formalizes the workflow that coordinates the activities performed by the developers. It introduces and discusses a visual notation to represent user interaction scenarios through models. The resulting models can be automatically processed to identify potentially required groupware services.

Finally, in the paper “A Model for Resource Management in Smart Cities based on Crowdsourcing and Gamification” by Rodrigo Orrego and Jorge Barbosa refers to the problem of resource management for smart cities combining crowdsourcing with gamification and proposing a model called CORE-MM. The model is shortly described as well as a system implementation and scenarios get highlighted. In terms of an evaluation, results from a survey of ten users are presented.

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