Editorial Preface

Special Issue on Data-Driven Self-Regulating Systems

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The emergence of pervasive and ubiquitous technologies has resulted in unprecedented opportunities to reason about the complexity of our society based on magnitudes of data. Embedded ICT technologies mandate the functionality and operations of several techno-socio-economic systems such as smart grids, food supply networks, traffic systems, etc. It is estimated that over 50 billion connected smart devices will be online by the year 2020. Moreover, complex networks provide invaluable insights about the complexity of social interactions and how these interactions influence the sustainability of several ICT-enabled techno-socio-economic systems. These observations show that regulating online the complex systems of our nowadays digital society is a grand challenge. Regulation concerns managing trade-offs such as the alignment of technical requirements, e.g. robustness, fault-tolerance, safety, and security, with social or environmental requirements, for instance, fairness in the utilization of energy resources. The scale of nowadays data cannot tackle the challenge by itself as data may convey ungrounded correlations and biased predictions. Smart, autonomic, and self-regulating mechanisms are required for filtering data streams in real-time and transform them to valuable information based on which intelligent adaptive decisions can be made in a decentralized fashion.

This special issue consists of one new and three extended papers from the 2nd International Workshop on Data-driven Self-regulating Systems (DSS 2016) hosted by the 10th International Conference on Self-adaptive and Self-Organizing Systems (SASO 2016). The papers cover recent advances in different aspects of data-driven self-regulating systems. Smart grid, sustainable consumption, health, and earthquake detection are some of the applications covered.

The paper "Predicting Room-Level Occupancy using Smart-meter Data" by Nambi et al. introduces a data-driven approach to self-regulate residential energy demand by predicting the occupancy of rooms via the energy usage of the devices in the house. The proposed approach does not require infrastructure such as cameras, RFID tags, Bluetooth beacons or Wi-Fi-based localization and relies exclusively on household-level smart meter demand measurements. The operational state of the devices can be detected as well as the devices that actually indicate occupancy, for instance, the use of TV vs. the on/off states of the refrigerator that do not explicitly indicate occupancy. The authors evaluate several classification algorithms that use multilabel classifiers and association rules to predict room-level occupancy. The influence of the smart meter sampling rate on accuracy and privacy is studied.

The paper "A Multinomial Logistic Regression Approach for Arrhythmia Detection" by Behadada et al. contributes a method based on multi-class logistic regression for the automated prediction of cardiac arrhythmia as an indicator of serious vascular diseases. The method can be used in expert support tools to facilitate and justify diagnoses. The classification process is demonstrated by an accuracy of 93.13%

The paper "Incremental Distributed Learning with JavaScript Agents for Earthquake and Disaster Monitoring" by Bosse illustrates the JAM multi-agent platform for seismic data analysis and earthquake recognition. JAM is based on mobile JavaScript code that can be modified on the runtime by the agents.

An incremental distributed machine learning algorithm implements the earthquake prediction that is provided by the platform as a service, with a clear separation between algorithms and model data. Incremental learning eliminates high storage requirements of historic data. Evaluation is performed on a large-scale seismic measuring network with real-world historic earthquake data. Results show high accuracy values compared to non-incremental algorithms.

The final paper "Sustainable Consumerism via Context-Aware Shopping" by Klinglmayr et al. illustrates the ASSET self-regulatory approach that envisions a more sustainable consumption and shopping behavior by citizens. The paper discusses the technical concept of the proposed platform that includes a database system with product data, a smart phone app that performs personalized product ratings and a product localization technology in supermarkets with which two ambitious field tests are designed. The paper illustrates evidence about the cost-effectiveness of the localization strategy via extensive testbed measurements. It also discusses the potential of the ASSET platform to enable collective awareness, harness network effects and eventually contribute to sustainable self-regulatory consumption.

In conclusion, the papers presented in this special issue demonstrate the significant potential of automated self-regulatory practices in real-world applications. I would like to heartily thank the authors and the reviewers of the papers as well as the technical program committee and the organizers of the DSS 2016 workshop. Special thanks to the editor-in-chief Prof. Dr. Nik Bessis for his encouragement, support, and guidance in the preparation process of this special issue.

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