COMPLEXIS 2020

5th International Conference on Complexity, Future Information Systems and Risk

Final Program and Book of Abstracts

8 - 9 May, 2020

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COMPLEXIS 2020
Final Program and Book of Abstracts

5th International Conference on Complexity, Future Information Systems and Risk

Online Streaming
May 8 - 9, 2020

Sponsored by
INSTICC - Institute for Systems and Technologies of Information, Control and Communication

In Cooperation with
CCSS - Centre for Complex Systems Studies
NPCS - Netherlands Platform Complex Systems
CCSIPN - Centre of Complex Systems IPN

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Foreword

This book contains the abstracts and final program of the 5th International Conference on Complexity, Future Information Systems and Risk (COMPLEXIS 2020) which was organized and sponsored by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC). This year COMPLEXIS was, exceptionally, held as a web-based event, due to the Covid-19 pandemic, from 8 - 9 May.

This conference was held in cooperation with Centre for Complex Systems Studies, Netherlands Platform Complex Systems, and Centre of Complex Systems IPN.

We hope that these proceedings, which include areas like “Complexity in Informatics and Networking”, “Complexity in Biology and Biomedical Engineering“, “Complexity in Social Sciences”, “Complexity in Risk and Predictive Modeling“ and “Complexity in Edge/Fog/High-Performance Computing” would interest a global audience of engineers, scientists and students involved in the research topics of COMPLEXIS.

We believe the proceedings published demonstrate new and innovative solutions, and highlight challenging technical problems in each field.

COMPLEXIS 2020 received 28 paper submissions from 16 countries. From these, 5 papers were published and presented as full papers.

The conference was complemented with a shared Special Session entitled “Artificial Intelligence for Emerging IoT Systems: Open Challenges and Novel Perspectives - AI4EIoTs” (chaired by Fiammetta Marulli).

The conference also featured 3 keynote lectures delivered by internationally known experts, namely Schahram Dustdar (Vienna University of Technology, Austria), Rajiv Ranjan (Newcastle University, United Kingdom) and Robert Lovas (SZTAKI, Hungary).

These talks contribute to increase the overall quality of the conference and to provide a deeper understanding of the conference interest fields.

The number and high quality of the papers received imposed difficult choices in the reviewing process. Each paper was reviewed by at least, two reviewers. Based on those reviews, papers that adequately balanced quality, originality and relevance to the conference themes were selected.

The proceedings of COMPLEXIS will be submitted for indexation by DBLP, Thomson-Reuters Conference Proceedings Citation Index, EI, SCOPUS, Semantic Scholar and Google Scholar.

A short list of papers presented at the conference will be selected for publication of extended and revised versions in a special issue of one of the following publications: Open Journal of Big Data (OJBD), International Journal of Organizational and Collective Intelligence (IJOCI), Expert Systems and the Elsevier Journal Internet of Things.

All presented papers will be available at the SCITEPRESS digital library.

To recognize the best submissions, awards based on the best combined marks of paper reviews, as assessed by the Program Committee, and the quality of the presentation, as evaluated by the chairs during the conference, were conferred at the closing session of the conference.

As a final point, we would like to express our thanks, first of all, to the authors of the technical papers, whose work and dedication made it possible to create a program that we believe is very exciting and of high technical quality. Next, we would like to thank all the members of the program committee and auxiliary reviewers, who helped us with their expertise and time. We would also like to thank the invited speakers for their invaluable contribution and for sharing their vision in their talks. Finally, we acknowledge the professional support of the COMPLEXIS 2020 team for all organizational processes, especially given the need to introduce online streaming, forum management, direct messaging facilitation and other web-based activities in order to make it possible for COMPLEXIS 2020 authors to present their work and share ideas with colleagues in spite of the logistic difficulties caused by the current pandemic situation.

We wish you all an inspiring conference and we hope to meet you again next year for COMPLEXIS 2021,

details of which will soon be available at http://www.complexis.org/

Reinhold Behringer, Knorr Bremse GmbH, Germany
Victor Chang, Teesside University, United Kingdom

Important Information

Event App
Download the Event App from the Play Store and App Store now, to have mobile access to the technical program and also to get notifications and reminders concerning your favorite sessions.

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The option “My Program” gives you the possibility of creating a selection of the sessions that you plan to attend. This service also allows you to print-to-pdf all papers featured in your selection thus creating a pdf file per conference day.

Online Access to the Proceedings *
In the option “Proceedings and Final Program” you cannot only download the proceedings but also access the digital version of the book of abstracts with the final program.

Digital Access to the Receipt *
By clicking on the option “Delegate Home” and then “Registration Documents” it will enable you to access the final receipt which confirmes the registration payment.

Keynotes Videos
The keynote lectures will also be available on video on the website after the event, as long as the appropriate authorization from the keynote is received, so you will be able to see them again or watch them should you have missed one.

Survey
Every year we conduct a survey to access the participants’ satisfaction with the conference and gather the suggestions. You will receive an e-mail after the event with the detailed information. Your contribution will be carefully analysed and a serious effort to react appropriately will be made.

* Please login to PRIMORIS (www.insticc.org/Primoris), select the role “Delegate” and the correct event.

If you have any doubt, we will be happy to help you at the Welcome Desk.

General Information

Welcome Desk
Friday, May 8 – Open from 10:15 to 17:45
Saturday, May 9 – Open from 09:15 to 19:00

Opening Session
Friday, May 8, at 10:30 in the Plenary room.

Closing Session
Saturday, May 9, at 18:30 in the Plenary room.

Secretariat Contacts
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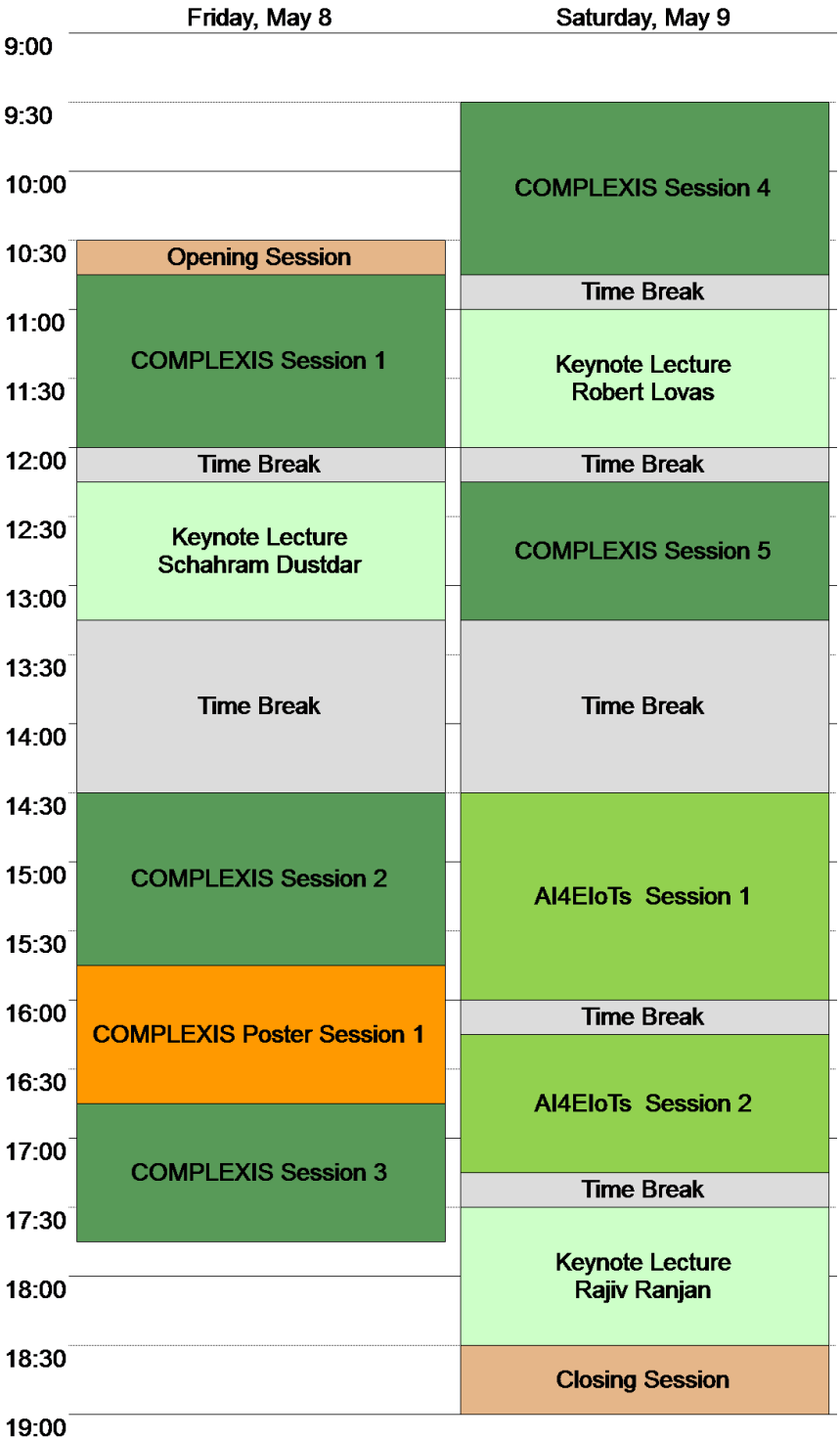
Program Layout



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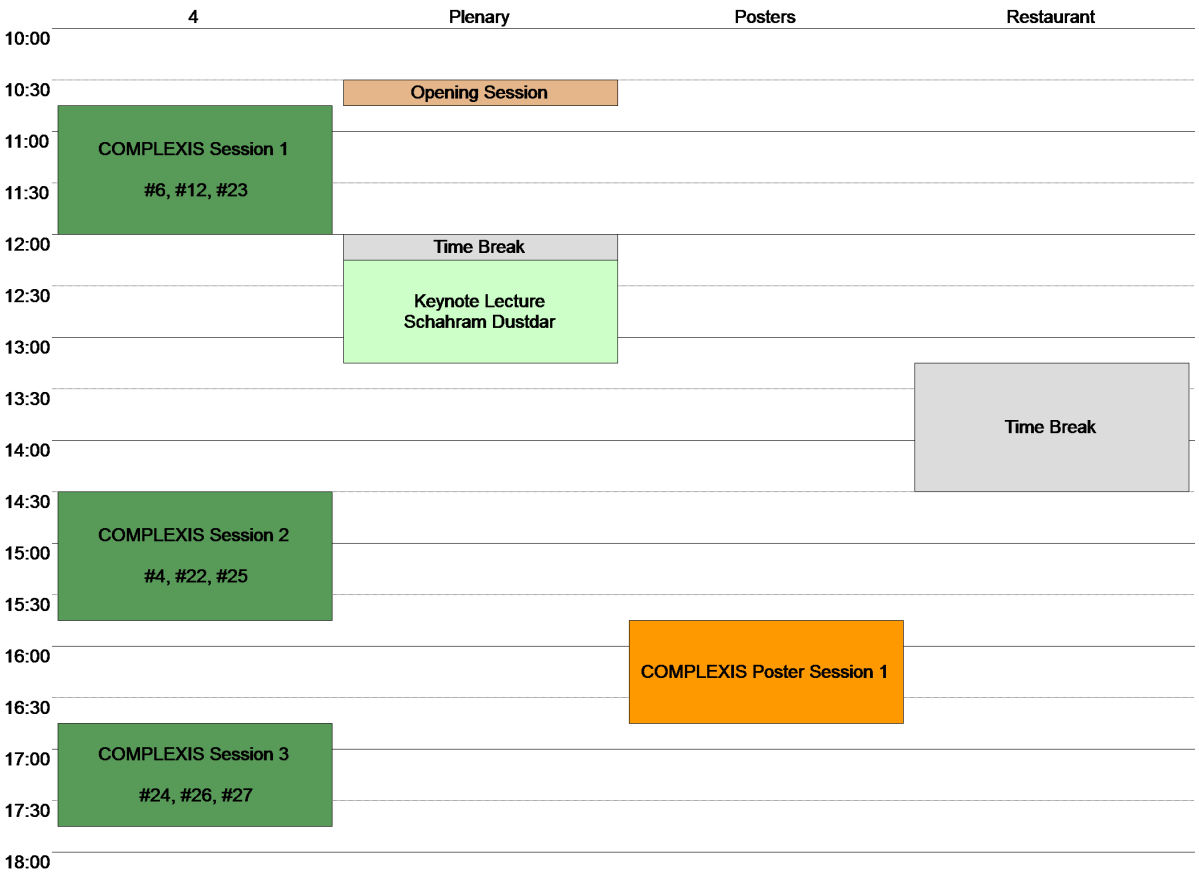

Opening Session	COMPLEXIS
10:30 - 10:45	Room Plenary

Session 1A	COMPLEXIS
10:45 - 12:00	Room 4
Complex Networks	

Paper #6

Credibility-based Model for News Spreading on Online Social Networks

Vincenza Carchiolo[1], Alessandro Longheu[2], Michele Malgeri[2], Giuseppe Mangioni[2] and Marialaura Previti[2]

[1] *DMI, University of Catania, Italy*

[2] *DIEEI, University of Catania, Italy*

Keywords: Credibility, Trust, Social Network, Information Diffusion.

Abstract: Trustworthiness in Online Social Networks has become essential to discriminate the goodness of both different information as well as the users it originates. Here a model for news spreading in directed online social networks (OSNs) that takes into account trustworthiness-related issues is introduced. In particular we add a credibility network on top of the acquaintance network naturally present in OSNs to model the changing of each node's opinion about his/her neighbors every time a piece of news comes from them over the OSN. We examine three different scenarios of news spreading over OSNs and propose a model suitable for each scenario, evaluating its applicability using a real world weighted directed network.

Paper #12

Evolution of Physics Sub-fields

Murali Enduri[1], I. Reddy[2] and Shivakumar Jolad[3]

[1] *SRM University-AP, Andhra Pradesh 522502, India*

[2] *Indian Institute of Technology Bhilai, Chhattisgarh 492015, India*

[3] *FLAME University, Pune, Maharashtra 412115, India*

Keywords: PACS Codes, Sub-fields, Physics.

Abstract: We study the evolution and relationships between sub-fields of Physics using the large data set of articles published in the various physical review journals from 1985-2010. Each article is assigned to some PACS codes by their authors which represent specific sub-fields of Physics. We construct a weighted network with nodes as PACS codes and there is a link between two PACS codes if there is an article assigned to both these codes. The weight of a link represents the number of articles in which both PACS codes appears. We study the time evolution of PACS network at various hierarchy levels of PACS codes. We observe that sub-fields Physics of elementary particles and fields, Nuclear Physics and Condensed matter physics have stronger connections inside the field compared to connections to other sub-fields. We also observe that both condensed matter physics sub-fields are strongly related compared to any other pair of sub-fields.

Paper #23

Introduction to DiNA: An Extendable Web-application for Directed Network Analysis

Máté Széll, Miklós Becsei and Gergely Kocsis

University of Debrecen, Faculty of Informatics, Department of Informatics Systems and Network, Kassai Str. 26, Debrecen, Hungary

Keywords: Directed Graph, Network Topology, Web Interface.

Abstract: A new web-application is presented that can be used to easily express basic properties of directed graphs and run some rather complex algorithms on them. The application builds up from two distinct parts. i.) It contains a core package written in plain Java representing the graph and implementing the algorithms and ii.) it has a web user interface with which it become easy to call methods of the core package. Both the core package and the web-interface were developed in a modular way making it easy to add new algorithms or even to run pre-implemented algorithms of already well-known graph analyzer tools. At the current state of the work we are implementing new algorithms and extending the features of the web user interface. The application is available at http://dina.inf.unideb.hu/.

Time Break 1	COMPLEXIS
12:00 - 12:15	Room Plenary

Keynote Lecture	COMPLEXIS
12:15 - 13:15	Room Plenary

Edge Intelligence - The Co-evolution of Humans, IoT, and AI

Schahram Dustdar

Vienna University of Technology, Austria

Abstract: Edge AI and Human Augmentation are two major technology trends, driven by recent advancements in edge computing, IoT, and AI accelerators. As humans, things and AI continue to grow closer together, systems engineers and researchers are faced with new and unique challenges. In this talk, we analyse the role of Edge computing and AI in the cyber-human evolution and identify challenges that Edge computing systems will consequently be faced with. We take a closer look at how a cyber-physical fabric will be complemented by AI operationalisation to enable seamless end-to-end Edge intelligence systems.

Time Break	COMPLEXIS
13:15 - 14:30	Room Restaurant

Session 2A **COMPLEXIS**
14:30 - 15:45 **Room 4**
Discovery and Prediction

Paper #4

Product Lifecycle De-trending for Sales Forecasting

Albert Lechner and Steve Gunn

School of Electronics and Computer Science, University of Southampton, U.K.

Keywords: Time Series Prediction, Forecasting, De-trending, ARIMA.

Abstract: This work introduces a new way to improve the sales forecasting accuracy of time series models using product's life cycle information. Most time series forecasts utilize historic data for forecasting because there is no data available for the future. The proposed approach should change this process and utilize product life cycle specific data to obtain future information including product life cycle changes. Therefore a decision tree regression was used to predict the shape parameters of the bass curve, which reflects a product's life cycle over time. This curve is used in a consecutive step to de-trend the time series to exclude the underlying trend created through the age of a product. The sales forecasts accuracy was increased for all 11 years of a luxury car manufacturer, comparing the newly developed product life cycle de-trending approach to a common de-trending by differencing approach in a seasonal autoregressive integrated moving average framework.

Paper #25

Effective Piecewise CNN with Attention Mechanism for Distant Supervision on Relation Extraction Task

Yuming Li[1], Pin Ni[1], Gangmin Li[2] and Victor Chang[3]

[1] *University of Liverpool, U.K.*

[2] *Xi'an Jiaotong-Liverpool University, China*

[3] *Teesside University, U.K.*

Keywords: Relation Extraction, Distant Supervision, Piecewise Convolutional Neural Networks, Attention, Convolutional Neural Networks.

Abstract: Relation Extraction is an important sub-task in the field of information extraction. Its goal is to identify entities from text and extract semantic relationships between entities. However, the current Relationship Extraction task based on deep learning methods generally have practical problems such as insufficient amount of manually labeled data, so training under weak supervision has become a big challenge. Distant Supervision is a novel idea that can automatically annotate a large number of unlabeled data based on a small amount of labeled data. Based on this idea, this paper proposes a method combining the Piecewise Convolutional Neural Networks and Attention mechanism for automatically annotating the data of Relation Extraction task. The experiments proved that the proposed method achieved the highest precision is 76.24% on NYT-FB (New York Times - Freebase) dataset (top 100 relation categories). The results show that the proposed method performed better than CNN-based models in most cases.

Paper #22

Altered Functional Complexity Associated with Structural Features in Schizophrenic Brain: A Resting-state fMRI Study

Yi-Ju Lee[1,2], Su-Yun Huang[3], Shih-Jen Tsai[2,4,5] and Albert Yang[1,2,5,6]

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[2] *Laboratory of Precision Psychiatry, National Yang-Ming University, Taipei, Taiwan*

[3] *Institute of Statistical Science, Academia Sinica, Taipei, Taiwan*

[4] *Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan*

[5] *Institute of Brain Science, National Yang-Ming University, Taipei, Taiwan*

[6] *Division of Interdisciplinary Medicine and Biotechnology, Beth Israel Deaconess Medical Center, Boston, MA, U.S.A.*

Keywords: Power Law Scaling, 1/f Signal, Resting-state fMRI, Schizophrenia, Neuroscience.

Abstract: Power law scaling is a well-defined physical concept in complexity science that has been used to quantified the dynamic signals across temporal scales. In this research, we aim to investigate the power law scaling of resting-state fMRI signal in schizophrenic and healthy brain and to examine the potential structural properties that may correlate to the altered functional complexity. Brain imaging data of 200 schizophrenia patients and 200 age and sex-matched healthy Han Chinese was retrieved from Taiwan Aging and Mental Illness cohort. Power law scaling was extracted by Pwelch function. In schizophrenia, six brain regions with abnormal complexity were correlated to the regional structural network of grey matter volume (hub at right superior frontal gyrus) and white matter volume at right superior cerebellar peduncle and splenium of the corpus callosum. Moreover, the identified power law scaling was correlated with clinical symptom severity. Our findings suggest that a loss of scale-free brain signal dynamics affecting by brain morphometries proposed the reduced complex brain activity as one of the neurobiological mechanisms in schizophrenia. This research supports "the loss of brain complexity hypothesis" and "the dysconnectivity hypothesis of schizophrenia.", laying potential impact in psychiatry.

Poster Session 1 **COMPLEXIS**
15:45 - 16:45 **Room Posters**

Paper #3

Modal Mu-calculus Extension with Description of Autonomy and Its Algebraic Structure

Susumu Yamasaki and Mariko Sasakura

Department of Computer Science, Okayama University, Tsushima-Naka, Okayama, Japan

Keywords: Modal Logic, Fixed Point, Abstract State Machinery, Human Computer Interaction, Application to Autonomy.

Abstract: This paper deals with complex abstract state machinery, clearly represented by modal logic with fixed point operator. The logic is well known as modal mu-calculus, which is extended to the version involving human computer interaction as well as involving awareness, communication and behavioral predicates of propositional variables as in autonomy systems. The extended version contains complexity for human machine interaction, whose meaning is represented by Heyting algebra but not by Boolean algebra. In the sense of Heyting algebra, human computer

interaction of complexity can be described such that related predicates of communication and behavior may be simplified. Then the extended version can be applied to some process by means of awareness to an expertise, communication and behavior processes, and repetitions represented with fixed point operator (that is, mu-operator). This version is also concerned with model theory caused by postfix modal operator, where composition and alternation of modal operators may be organized into an algebraic structure.

Paper #8

Theoretical Basis of Language System with State Constraints

Susumu Yamasaki

HCI Group, Department of Computer Science, Okayama University, Tsushima-Naka, Okayama, Japan

Keywords: Programming Language, Algebraic Expression, State Constraint System.

Abstract: This paper presents theoretical basis of a language system whose program is described as algebraic expressions and implemented as abstract state machine. The behaviors of the described expressions may be captured (with their models) as causing sequences for state transitions, where composition and alternation for state transitions are mechanized in algebraic structure. Monitoring facilities to the language system may be described with state concepts, as well. With respect to intuitionistic logic and logical program containing negatives, Heyting algebra expressions are taken rather than already established nonmonotonic reasoning programs with negations, where 3-valued domain may be of use for the undefined to be allowable such that positives and negatives may be consistently evaluated, instead of rigid 2-valued settlements. We may have a standard form of Heyting algebra expressions in accordance to logical and AI programming, where the expressions are constrained with states. The states may be regarded as environmental conditions or objects as in object-oriented programming. As regards 3-valued models of given expressions, monotonic mapping cannot be in general associated with, but some ways are presented to approximate fixed points of a mapping for the given expression. Then the formal description of programs may be given with reference to state transitions, which is thought of as proposing a language system structure.

Paper #14

FLOPTICS: A Novel Automated Gating Technique for Flow Cytometry Data

Wiwat Sriphum, Gary Wills and Nicolas Green

School of Electronics and Computer Science, University of Southampton, Southampton, U.K.

Keywords: Flow Cytometry, Automated Gating, Density-based Clustering, Optics Clustering.

Abstract: Flow cytometry (FCM) involves the use of optical and fluorescence measurements of the characteristics of individual biological cells, typically in blood samples. It is a widely used standard method of analysing blood samples for the purpose of identifying and quantifying the different types of cells in the sample, the result of which are used in medical diagnoses. The multidimensional dataset obtained from FCM is large and complex, so it is difficult and time-consuming to analyse manually. The main process of differentiation and therefore labelling of the populations in the data which represent types of cells is referred to as Gating: gating is the first step of FCM data analysis and highly subjective. Significant amounts of research have focussed on reducing this subjectivity, however a faster standard gating technique is still needed. Existing automated gating techniques are time-consuming or need many user-defined parameters which affect the differentiation to different clustering results. This paper presents and discusses FLOPTICS: a novel automated gating technique that is a combination of density-based and grid-based clustering algorithms. FLOPTICS has an ability to classify cells on FCM data faster and with fewer user-defined parameters than many state-of-the-art techniques, such as FlowGrid, FlowPeaks, and FLOCK.

Paper #18

Knowledge as a Complex Phenomenon

Rafal Maciag

Institute of Information Studies, Jagiellonian University, Lojasiewicza 4, 30-348 Krakow, Poland

Keywords: Knowledge, Discourse, Dynamical Space, Discursive Space, Complexity.

Abstract: The paper presents the construction of the discursive space, which is a representation of knowledge. It is a multidimensional dynamic space crossed by discourses running along their specific trajectories. These discourses remain in the relationship of supervenience with reality, which is interpreted as a world of facts (state of affairs). Discourses inherit the complexity of the world, and because they are the articulation/retention of knowledge, this knowledge also inherits this property. Discursive space is, therefore, a model of knowledge of a complex nature.

Session 3A **COMPLEXIS**
16:45 - 17:45 **Room 4**
Complexity in Social Sciences

Paper #24

Complexity as a Paradigm for Social Sciences and Linguistics: Theoretical Basis and Perspectives

Gemma Bel-Enguix[1], Ángels Massip-Bonet[2] and Gerardo Sierra[1]

[1] *Instituto de Ingeniería, Universidad Nacional Autónoma de Mexico, Ciudad de Mexico, Mexico*

[2] *Departament de Llengua i Literatura Catalanes, Universitat de Barcelona, Barcelona, Catalunya, Spain*

Keywords: Complexity, Complex Systems, Scientific Paradigm, Quantitative and Qualitative Methods, Natural Language as a CAS.

Abstract: This article discusses the relevance and significance of the use of complexity as a scientific paradigm in social and human sciences, focusing on linguistics. For this, a review of the concept of paradigm is made, and its evolution in the last decades. In this framework, the controversy between quantitative and qualitative methods and their validity in the twentieth century is discussed. In this dichotomy, we claim that the theory of complexity is prepared to assume the use of the so-called Mixed Methods Research (MMR). The paper develops the impact of Complex Systems (CS) and Complex Adaptive systems (CAS) in science, as well as the epistemological and methodological implications this entails. Moreover, natural language is defined as a CAS. In general, the article defends the adoption of this paradigm in linguistics, both in

synchronous and diachronic research, providing some examples of these new lines of study. In spite of the still emerging nature of some formulations, we envision a deep theoretical breakthrough in linguistics thanks to this interdisciplinary perspective.

Paper #26

It Means More If It Sounds Good: Yet Another Hypotheses Concerning the Evolution of Polysemous Words

Ivan Yamshchikov[1], Cyrille Saha[1], Igor Samenko[2] and Jürgen Jost[1]

[1] *Max Planck Institute for Mathematics in the Sciences, Inselstrasse 22, Leipzig, Germany*

[2] *Institute of Computational Technologies SB RAS, Russia*

Keywords: Evolution of Language, Semantic Structures, Polysemy.

Abstract: This position paper looks into the formation of language and shows ties between structural properties of the words in the English language and their polysemy. Using Ollivier-Ricci curvature over a large graph of synonyms to estimate polysemy it shows empirically that the words that arguably are easier to pronounce also tend to have multiple meanings.

Paper #27

Text Classification for Monolingual Political Manifestos with Words Out of Vocabulary

Arsenii Rasov[1], Ilya Obabkov[1], Eckehard Olbrich[2] and Ivan Yamshchikov[2]

[1] *Ural Federal University, Mira Street, 19, Yekaterinburg, Russia*

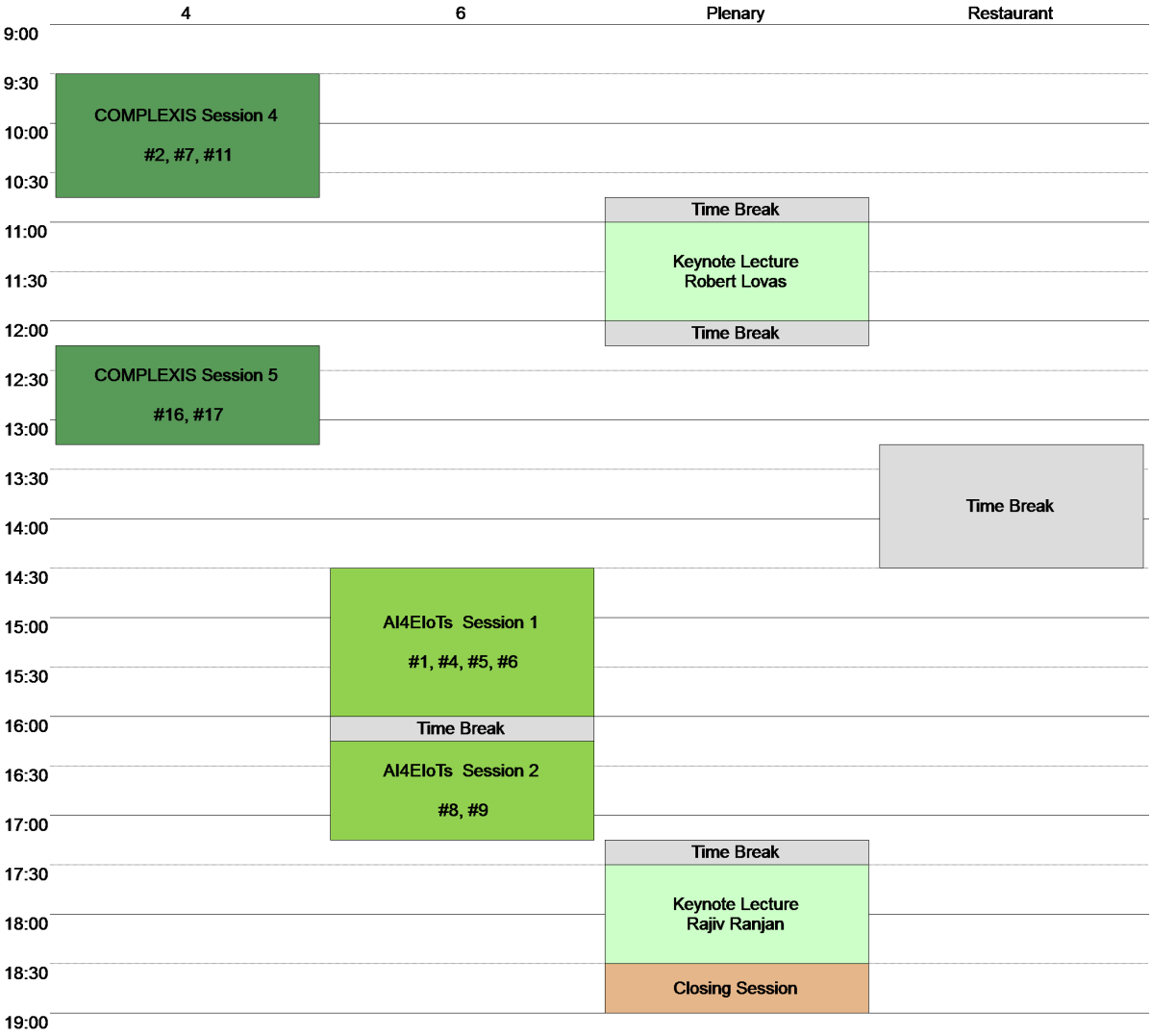
[2] *Max Planck Institute for Mathematics in the Sciences, Inselstrasse 22, Leipzig, Germany*

Keywords: Electoral Programs, Text Corpus, Classification of Political Texts.

Abstract: In this position paper, we implement an automatic coding algorithm for electoral programs from the Manifesto Project Database. We propose a new approach that works with new words that are out of the training vocabulary, replacing them with the words from training vocabulary that are the closest neighbors in the space of word embeddings. A set of simulations demonstrates that the proposed algorithm shows classification accuracy comparable to the state-of-the-art benchmarks for monolingual multi-label classification. The agreement levels for the algorithm is comparable with manual labeling. The results for a broad set of model hyperparam-eters are compared to each other.

Saturday Sessions: May 9

Saturday Sessions: May 9 Program Layout



Session 4A	COMPLEXIS
09:30 - 10:45	Room 4
Risk Analysis and Management	

Paper #2

An Interest Rate Decision Method for Risk-averse Portfolio Optimization using Loan

Kiyoharu Tagawa

School of Science and Engineering, Kindai University, 3-4-1 Kowakae, Higashi-Osaka, 577-8502, Japan

Keywords: Risk Analysis and Management, Mathematical Model of Loan, Portfolio Optimization.

Abstract: Portfolio optimization using loan is formulated as a chance constrained problem in which the borrowing money from loan can be invested in risk assets. The chance constrained problem is proven to a convex optimization problem. The low interest rate of loan benefits borrowers. On the other hand, the high interest rate of loan doesn't benefits lenders because such a loan is not often used. For deciding a proper interest rate of loan that benefits both borrowers and lenders, a new method is proposed. Experimental results show that the loan is used completely to improve the efficient frontier if the interest rate is decided by the proposed method.

Paper #11

Return on Cybersecurity Investment in Operational Technology Systems: Quantifying the Value That Cybersecurity Technologies Provide after Integration

Roger Hallman[1,2], Maxine Major[2], Jose Romero-Mariona[2], Richard Phipps[2], Esperanza Romero[2] and John Miguel[2]

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Keywords: Cybersecurity Investment, Acquisition, Decision Support, Return on Cybersecurity Investment.

Abstract: Appropriate cybersecurity investment is a challenge faced by both private and public organizations. This challenge includes understanding the actual vulnerabilities of an organization's networked systems, as well as the cost of a successful cyber attack on those systems. On top of this, an organization's cybersecurity acquisition workforce must be able to discern reality from the marketing hype that is produced by cybersecurity sales forces. This paper builds upon earlier work which developed a cybersecurity acquisition decision support mechanism (Romero-Mariona. et al., 2016). In particular, cybersecurity technology evaluation results are extended to assist organizations to define a Return on Cybersecurity Investment. This new capability is instantiated within the context of networked critical infrastructure and industrial control systems.

Paper #7

Systemic Security Risks in the Telecommunications Sector: An Approach for Security and Integrity of Networks and Services

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Keywords: Information Security, Systemic Risk, Telecommunications, Regulatory Framework, Regtech.

Abstract: A strong emphasis is placed today on the security of Information Systems (IS) and on the management of information security risks. This tendency can be seen in numerous emerging regulations imposing a risk-based approach for IS security on entire economic sectors. However, a major drawback of the methods currently used is that risks are assessed individually by each organization for its own activities, and that no link is established between the risk management results of interacting organizations. In this paper, we propose an approach to deal with systemic risks, i.e. risks propagated from one organization to another due to dependencies between them. This approach is an extension of an existing framework used from 2015 by a European national regulator in the telecommunications sector.

Time Break 2	COMPLEXIS
10:45 - 11:00	Room Plenary

Keynote Lecture	COMPLEXIS
11:00 - 12:00	Room Plenary

Reference Architectures for Cloud-based Platforms: Convergence vs. Diversification

Robert Lovas

SZTAKI, Hungary

Abstract: We are the witnesses of new emerging trends in computing platforms; software-container based approaches, GPGPU-enabled AI solutions, and more-and-more sophisticated cloud services are available for Big Data, IoT and other categories of widespread applications. Software containers play crucial roles to make complex functionalities available on a diverse set of platforms; there is a clear sign of convergence in this field. Some complex services can be also reused with little effort in multiple sectors as well, e.g. IoT back-ends for Connected Cars and precision agriculture. However, the IT experts still face several problems when they attempt to create, efficiently manage, scale out or orchestrate such set of building blocks in various, diverse IT environments in order to improve their non-functional features (including reduced vendor-locking or higher service reliability). 3rd party solutions from the cloud providers, and state-of-the-art open source tools for on-premise/public/hybrid deployments might be taken into considerations leveraging on the approach of new generation of reference architectures (blueprints) to enable high-level convergence. The invited talk gives an overview of the latest results in this field covering the achievements of some EU projects (H2020 COLA, CloudiFacturing, NEANIAS and EOSC-hub), and national initiatives (e.g. Agrodat.hu and HRDA) that address such challenging topics.

Time Break 3	COMPLEXIS
12:00 - 12:15	Room Plenary

Session 5A **COMPLEXIS**
12:15 - 13:15 **Room 4**
Simulation and Modeling

Paper #16

Ad Hoc Communication Topology Switching during Disasters from Altruistic to Individualistic and Back

Indushree Banerjee, Martijn Warnier and Frances Brazier
Faculty of Technology Policy and Management, Systems Engineering and Simulations, Delft University of Technology, Delft, The Netherlands

Keywords: Ad Hoc Communication Networks, Disaster Management, Topology Switching, Autonomous Computing.

Abstract: Disaster communication has made immense progress in the last thirty years. At present, disaster research focuses on bottom-up approaches such as civilian inclusion in disaster response. With the advent of smartphones, citizen-based emergency communication has become possible. Present ad hoc communication technologies typically form a fully connected mesh network, which connects all phones that are within each other's transmission range. This facilitates low-latency direct communication between citizens, but it quickly drains the battery of phones. Alternative ad hoc communication networks form an adaptive energy-efficient network topology, that is most draining to batteries of phones that have a higher charge, while low-energy phones are spared from relaying messages, thereby preserving battery and thus maintaining their connection with the rescue communication network. Both of these approaches have their own advantages. Which one is best for communication needs depends on the context. This position paper discusses the possibility of a decision model as an approach to automatically switch between the two alternative ad hoc communication networks. This ensures that citizens in disasters can make use of the optimal communication system at all times.

Paper #17

Spatial Characteristics of Communication in Urban Vehicular System

Antal Ilyés, Tomaj Kovács, Gréta Tisza and Imre Varga
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Keywords: Traffic, VANET, Information Spreading, ABM, Radius of Gyration, Bounding Box.

Abstract: We propose a model of information spreading based on urban traffic, where smart vehicles can carry data of sensor measurements and share them by short-range wireless communication. The spreading of information can be quite fast and widespread without central control within this ad hoc network. In this position paper, we want to characterize some spatial aspects of the spreading process. We planned to analyze the radius of gyration and the bounding box of the 2D positions of informed agents and communication events. First simulation results show a crossover in the time evolution of the system.

Time Break **COMPLEXIS**
13:15 - 14:30 **Room Restaurant**

Special Session - Session 1 **AI4EIoTs**
14:30 - 16:00 **Room 6**
Artificial Intelligence for Emerging IoT Systems: Open Challenges and Novel Perspectives

Paper #1

A Reinforcement Learning and IoT based System to Assist Patients with Disabilities

Muddasar Naeem[1], Antonio Coronato[2], Giovanni Paragliola[2] and Giuseppe De Pietro[2]
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Keywords: Artificial Intelligence, Disability, Healthcare, IoT, Pill Reminder, Reinforcement Learning.

Abstract: One of the important aspect of clinical process is to complete treatment according to given plan. The successful completion of this task is more challenging when a person have some physical or mental disability and requires resources and man power for personalized treatment and care. We can mitigate this problem by an intelligent guidance and monitoring system who can assist elderly persons and patients in their treatment schedule. Reinforcement learning and IoT systems have received considerable credit of significant contribution in healthcare over last few years, could be suitable choice for said objective. We propose a pill reminder system using Bayesian reinforcement learning assisted with IoT devices to help people (having mental and/or physical disability) in their treatment plan. The proposed intelligent system is able to successfully communicate with the person through a suitable audio, visual and textual message. The proposed pill-reminder system has been demonstrated for a specific treatment plan of a hypertension patient.

Paper #5

Image-based Malware Family Detection: An Assessment between Feature Extraction and Classification Techniques

Giacomo Iadarola[1], Fabio Martinelli[1], Francesco Mercaldo[1,2] and Antonella Santone[2]
[1] *Institute for Informatics and Telematics, National Research Council of Italy (CNR), Pisa, Italy*
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Keywords: Machine Learning, Mobile Security, Android, Malware Classification, Image Texture Analysis.

Abstract: The increasing number of malware in mobile environment follows the continuous growth of the app stores, which required constant research in new malware detection approaches, considering also the weaknesses of signature-based anti-malware software. Fortunately, most of the malware are composed of well-known pieces of code, thus can be grouped into families sharing the same malicious behaviour. One interesting approach, which makes use of Image Classification techniques, proposes to convert the malware binaries to images, extract feature vectors and classifying them with supervised machine learning models. Realizing that researchers usually evaluate their solutions on private datasets, it is difficult to establish whether a model can be generalized on another dataset, making it difficult to compare the performance of the various models. This paper presents a comparison between different combination of feature vector extraction methods and machine learning models. The methodology aimed

to evaluate feature extractors and supervised machine learning algorithms, and it was tested on more than 20 thousand images of malware, grouped into 10 different malware families. The best classifier, a combination of GIST descriptors and Random Forest classifiers, achieved an accuracy of 0.97 on average.

Paper #4

Early Warning System for Landslide Risk and SHM by Means of Reinforced Optic Fiber in Lifetime Strain Analysis

Renato Zona, Martina De Cristofaro, Luca Esposito, Paolo Ferla, Simone Palladino, Elena Totaro, Lucio Olivares and Vincenzo Minutolo

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Keywords: Early Warnings, Big Data, BODTA, Soil Movement, Sensors Network, Internet of Things, Strain, Displacement, Structure Health Monitoring.

Abstract: Nowadays Sensors Networks (SN) are intensively used for environment monitoring and structural health monitoring. Sensors Network can be greatly useful for data collection in hazard sites or sites of cultural heritage. For the latter is meant structure with historical value as masonry ancient construction, while the first one has to be intended as landslide risk zone. Collecting data in terms of strain and displacements is particularly crucial when anticipating the risks of disasters. When integrated into the Internet of Things and a Big Data database, the SN offers an innovative way to have a health state of the monitored site. The paper describes a prototype of a land-sliding risk early warning system hosted that consists of an optical fiber sensor, called S.T.R.A.I.N, that collects values of deformations in soils or structures in time continuous analysis. This offers an online database readable in remote control from a server or a smartphone. The developed prototype collects and displays strain values, soil movement and structure displacements.

Paper #6

A WSN Energy-aware Approach for Air Pollution Monitoring in Waste Treatment Facility Site: A Case Study for Landfill Monitoring Odour

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Keywords: WSN, Sensor, Energy, Monitoring, Landfill, Odour, LoRaWAN.

Abstract: The gaseous emissions derived from industrial plants are generally subject to a strictly program of monitoring, both continuous or one-spot, in order to comply with the limits imposed by the permitting license. Nowadays the problem of odour emission, and the consequently nuisance generated to the nearest receptors, has acquired importance so that is frequently asked a specific implementation of the air pollution monitoring program. In this paper we studied the case study of a generic landfill for the implementation of the odour monitoring system and time-specific use of air pollution control technology. The off-site monitoring is based on the deployment of electronic nose as part of a specifically built WSN system. The nodes outside the landfill boundary do not act as a continuously monitoring stations but as sensors activated when specific conditions, inside and outside the landfill, are achieved. The WSN is then organized on an energy-aware approach so to prolong the lifetime of the entire system, with significant cost-benefit advancement, and produce a monitoring-structure that can answer to specific input like threshold overshooting.

Time Break 4 **COMPLEXIS**
16:00 - 16:15 **Room 6**

Special Session - Session 2 **AI4EIoTs**
16:15 - 17:15 **Room 6**
Artificial Intelligence for Emerging IoT Systems: Open Challenges and Novel Perspectives

Paper #8

Privacy Regulations Challenges on Data-centric and IoT Systems: A Case Study for Smart Vehicles

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Keywords: Internet of Things, Data Centric System, Internet of Vehicles, GDPR, Data Privacy, Data Security, Cyber-physical Systems, Blockchain.

Abstract: Internet of Things (IoTs) services and data-centric systems allow smart and efficient information exchanging. Anyway, even if existing IoTs and cyber security architectures are enforcing, they are still vulnerable to security issues, as unauthorized access, data breaches, intrusions. They can't provide yet sufficiently robust and secure solutions to be applied in a straightforward way, both for ensuring privacy preservation and trustworthiness of transmitted data, evenly preventing from its fraudulent and unauthorized usage. Such data potentially include critical information about persons' privacy (locations, visited places, behaviors, goods, anagraphic data and health conditions). So, novel approaches for IoTs and data-centric security are needed. In this work, we address IoTs systems security problem focusing on the privacy preserving issue. Indeed, after the European Union introduced the General Data Protection Regulation (GDPR), privacy data protection is a mandatory requirement for systems producing and managing sensible users' data. Starting from a case study for the Internet of Vehicles (IoVs), we performed a pilot study and DPIA assessment to analyze possible mitigation strategies for improving the compliance of IoTs based systems to GDPR requirements. Our preliminary results evidenced that the introduction of blockchains in IoTs systems architectures can improve significantly the compliance to privacy regulations.

Paper #9

Machine Learning Approaches for Diabetes Classification: Perspectives to Artificial Intelligence Methods Updating

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[2] *Dep. di Matematica e Fisica, Università Della Campania "L. Vanvitelli", Caserta, Italy*

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Keywords: Diabetes Classification, Diabetes Management, Machine Learning, Artificial Intelligence, Big Data Analytics.

Abstract: In recent years the application of Machine Learning (ML) and Artificial Intelligence (AI) techniques in healthcare helped clinicians to improve the management of chronic patients. Diabetes is among the most common chronic illness in the world for which often is still challenging do an early detection and a correct classification of type of diabetes to an individual. In fact it often depends on the circumstances present at the time of diagnosis, and many diabetic individuals do not easily fit into a single class. The aim is this paper is the application of ML techniques in order to classify the occurrence of different mellitus diabetes on the base of clinical data obtained from diabetic patients during the daily hospitals activities.

Time Break 5	**COMPLEXIS**
17:15 - 17:30	**Room Plenary**

Keynote Lecture	**COMPLEXIS**
17:30 - 18:30	**Room Plenary**

New Horizons in IoT Workflows Provisioning in Edge and Cloud Datacentres for Fast Data Analytics: The Osmotic Computing Approach

Rajiv Ranjan

Newcastle University, U.K.

Abstract: Supporting Internet of Things (IoT) workflow enactment/execution on a combination of computational resources at the network edge and at a datacentre remains a challenge. Increasing volumes of data being generated through smart phones, IoT (Internet of Things) devices (which can vary significantly in scope and capability), need to be processed in a timely manner. Current practice involves using edge nodes (e.g. sensors or other low-capacity devices) as a means to acquire/collect data (i.e. as an "observation" mechanism). Subsequently, this data is transmitted to a datacentre/cloud for analysis/insight. Increasingly, the limitation with the use of a large-scale, centralised datacentre is being realised (such as speed of response for latency-sensitive applications), with the emergence of a number of paradigms to address this concern – such as fog computing, edge computing, Cloud-of-Things, etc. All of these propose the use of dedicated servers (with varying capacity and capability) within micro/nano datacentres at the network edge, to overcome latency constraints associated with moving data to a central facility, and (lack of use of) increasing computational capability within edge devices. These paradigms also closely align with work in content distribution networks (e.g. from Akamai CDNs), which attempt to place data servers within one (or a small number of) hop of end users (currently 85% of users are supported in this way, with >175K Akamai servers) A key objective of this keynote talk is to understand how such emerging paradigms can be used to enable cloud systems (supported through large scale computational facilities) to be "stretched" to the network edge, to enable data-driven IoT workflows to be enacted efficiently over such combined infrastructure. We propose the combined use of (varying) capability at the network edge (referred to as an "Edge Datacentre" (EDC)) with capability within a Cloud Datacentre (CDC). Collectively, IoT devices and edge resources, like gateways (Raspberry Pi 3), software-defined network systems (Huawei CloudEngine 6800) and smart phones equipped with sensors, constitute a new set of computing resources – and as potential components of an EDC. The keynote talk will have the following outline: 1.Overview of the research challenges involved with composing and orchestrating complex IoT workflows in cloud-edge continuum infrastructure 2.Discuss two case studies in healthcare and smart cities domain to understand how data-driven workflows can be applied to create/compose next-generation IoT applications. 3.Discuss our experience with running United Kingdom's largest IoT infrastructure, namely, the Urban Observatory (http://www.urbanobservatory.ac.uk/)

Closing Session	**COMPLEXIS**
18:30 - 19:00	**Room Plenary**

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