

Σ SciM 2019



BOOK OF ABSTRACTS

11th

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Editors:

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María Eugenia Cornejo-Piñero, Juan Carlos Díaz-Moreno, Janusz Kacprzyk,

Eloísa Ramírez-Poussa, Juan Moreno-García, David Lobo, Roberto G. Aragón

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Program of the 11th European Symposium on Computational Intelligence and Mathematics

October 2nd - 5th, 2019, Toledo, Spain

WEDNESDAY 2 nd	
Location: San Pedro Mártir building. Toledo	
8:30	Open Registration Desk
9:30–10:00	Inauguration
10:00–11:00	Keynote Speaker - José Luis Verdegay Chairperson: Jesús Medina Room: El Teatrillo
11:00–11:20	Coffee break
11:20–12:30	Session S1. Chairperson: José Luis Verdegay Room: El Teatrillo
	<i>A new exploitation scheme in the context of bipolar classifiers</i> Guillermo Villarino Martínez, Daniel Gómez, J. Tinguaro Rodríguez and Alberto Fernández
	<i>Dynamic maximal covering location problem with facility types and time dependent availability</i> Cynthia Porras, Jenny Fajardo Calderín, Alejandro Rosete, Raúl Álvarez and David Pelta.
	<i>Implicative linguistic summaries</i> María Eugenia Cornejo and Jesús Medina
12:30–13:30	Session S2. Chairperson: Andreja Tepavčević Room: El Teatrillo
	<i>Some relationships between the notions of f-inclusion and f-contradiction</i> Nicolás Madrid and Manuel Ojeda-Aciego
	<i>Decomposition integrals for interval-valued functions</i> Adam Šeliga
	<i>A Mostert & Shields-type Characterization for Group-like Uninorms</i> Sándor Jenei
13:30–14:40	Lunch
14:40–15:40	Keynote Speaker - Andreja Tepavčević Title: Special lattice valued structures and approximate solutions of linear equations Chairperson: László T. Kóczy Room: El Teatrillo
15:40–16:00	Coffee break

16:00–18:00	Parallel Session S3a. Chairperson: László T. Kóczy Room: El Teatrillo
	<i>Enhanced Comparison of Discrete Memetic Evolutionary Metaheuristics which are able to apply for TSP</i> Gergő Fogarasi, Boldizsár Tüű-Szabó, Péter Földesi and László T. Kóczy
	<i>Syntactic analysis of sentences using deep neural networks</i> David Muñoz-Valero, Luis Rodríguez-Benítez, Luis Jiménez Linares and Juan Moreno García
	<i>Estimating Remaining Time of Business Processes with structural attributes of the traces</i> Ahmad Aburomman, Manuel Lama and Alberto Bugarín
	<i>Convolutional Neural Networks in the Ovarian Cancer Detection</i> Piotr A. Kowalski, Jakub Błoniarz and Łukasz Chmura
	<i>Analyzing the performance of TSP solver methods</i> Boldizsár Tüű-Szabó, Péter Földesi and László T. Kóczy
	<i>Fuzzy Decision Support Methodology for Sustainable Packaging System Design</i> Adrienn Buruzs, Kata Vöröskői, Gergő Fogarasi and László T. Kóczy
16:00–18:00	Parallel Session S3b. Chairperson: Manuel Ojeda-Aciego Room: Sala de prensa
	<i>Relational powerset theories</i> Jiří Močkoř
	<i>On some categories underlying knowledge graphs</i> Ondrej Krídlo, Manuel Ojeda-Aciego, Tim Put and Marek Reformat
	<i>On two categories of many-level fuzzy morphological spaces</i> Alexander Šostak and Ingrida Uljane
	<i>Congruences on lattices and lattice-valued functions</i> Branimir Šešelja and Andreja Tepavčević
	<i>Some Roughness Features of Fuzzy Sets</i> Zoltán Ernő Csajbók
	<i>On some generalizations of the Choquet integral</i> Andrea Stupňanová
19:00	Welcome reception

THURSDAY 3rd	
Room: El Teatrillo. San Pedro Mártir building	
9:00–9:50	Keynote Speaker - Juan Moreno-García Title: Generating linguistic descriptions using Linguistic Petri Nets Chairperson: José Luis Verdegay
9:50–11:00	Session S4. Chairperson: Juan Moreno-García
	<i>A fuzzy model to aggregate performance indicators in sports</i> Francisco Romero, Eusebio Angulo, Jesús Serrano-Guerrero and José A. Olivas-Varela
	<i>Formal analysis of solar power and weather data</i> María Eugenia Cornejo, Jesús Medina and Clemente Rubio-Manzano
	<i>Parametric optimisation of line and shape detection algorithms in driving assistance applications</i> Luis Rodríguez-Benítez, Juan Alfredo García-García, Juan Giralt-Muiña, Juan Moreno-García, Luis Jiménez-Linares and Víctor Menéndez

11:00–11:20	Coffee break
11:20–13:30	Session S5. Chairperson: László T. Kóczy
	<i>Combining Symbolic Unfolding and Tuning Techniques for Fuzzy Logic Programs</i> Ginés Moreno and José Antonio Ríaza Valverde
	<i>A weakened notion of congruence to reduce concept lattices</i> Roberto García-Aragón, Jesús Medina and Eloísa Ramírez-Poussa
	<i>Interactive search by means of the minimal generators</i> Pablo Cordero, Manuel Enciso, Ángel Mora, Manuel Ojeda-Aciego and Carlos Rossi
	<i>Knowledge implications in multi-adjoint concept lattices</i> Eloísa Ramírez-Poussa, Jesús Medina and Pablo Navareño
	<i>TinyPaella: A formal tool for FCA context's debugging</i> Gonzalo A. Aranda-Corral, Joaquín Borrego-Díaz, Antonia M. Chávez-González and Juan Galán-Páez
13:30–15:00	Lunch
17:00–20:00	Toledo tour. Cathedral of Toledo
20:00	Gala dinner. Restaurante Museo Alcázar de Toledo

FRIDAY 4 th	
Room: El Teatrillo. San Pedro Mártir building	
10:00–11:00	Keynote Speaker - Joao Carvalho Title: Recommender Systems: Using Fuzzy Fingerprints for “Proper” Recommendations Chairperson: László T. Kóczy
11:00–11:20	Coffee break
11:20–13:30	Session S6. Chairperson: Joao Carvalho
	<i>A new community detection problem based on bipolar fuzzy measures</i> Inmaculada Gutiérrez, Daniel Gómez, Javier Castro and Rosa Espínola
	<i>Novel methods of FCM model reduction</i> Miklós Hatwágner and László T. Kóczy
	<i>Some Implications of Interval Approach to Dimension for Network Complexity</i> Věra Kůrková
	<i>Social indexes segregation based on MEOWA and MOOWA aggregation operators</i> Nuria Martínez, Daniel Gómez, Karina Rojas, Pablo Olaso and Javier Montero
	<i>Combining conceptual graphs and sentiment analysis for fake news detection</i> Walter Rene Cuenca, César González Fernández, Alberto Fernández-Isabel, Isaac Martín De Diego and Alejandro G. Martín
13:40–15:00	Closing Session
19:30–21:00	Night Toledo tour

SATURDAY 5 th	
10:00	Round table Seventh International Workshop on Mathematics and Soft Computing
14:00	Round table Tenth Győr Symposium on Computational Intelligence

Social Events	
WEDNESDAY 2 nd	
19:00	Welcome reception
THURSDAY 3 rd	
17:00–20:00	Toledo tour. Cathedral of Toledo
20:00	Gala dinner. Alcázar of Toledo
FRYDAY 4 th	
13:40–15:00	Closing Session
19:30–21:00	Night Toledo tour
SATURDAY 5 th	
9:00–17:00	Visit to Aranjuez

Keynote speech:

Guidelines to solve Decision Making Problems

José Luis Verdegay

Department of Computer Science and Artificial Intelligence,
University of Granada, Granada, Spain



Abstract: To build Intelligent Systems that act in daily life like people do, it is very important to know in depth the mechanisms that govern the decision processes that human beings follow. The context in which a decision process is developed is a key aspect that needs to be known in depth. In this talk, this aspect will be approached and studied. Accordingly the definition of General Decision Problem will be modified and, by means of some examples, a set of guidelines to solve decision making problems will be proposed.

A new exploitation scheme in the context of bipolar classifiers

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Abstract: From the basis of the combination of supervised classification and bipolar knowledge representation, we explore in this proposal a new approach for the exploitation of the bipolar classification scores. The proposed approach is based on fitting a rule-based classifier to determine the decision rule that produces the final class assignments on the basis of the bipolar scores provided by any soft classifier. Therefore, the proposed method can be seen as a generalization of ROC-curve based decision rules, that takes advantage of the extra information introduced through the bipolar knowledge representation. The presented experimental results shows the feasibility of the proposed approach.

Keywords: Supervised classification · Bipolar knowledge representation · Soft information · Decision rule · Aggregation.

Acknowledgement: Supported by FORAID Research Group by means of grant PGC2018-096509-B-I00 of the Government of Spain.

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Dynamic maximal covering location problem with facility types and time dependent availability

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Abstract: Location problems have been highly studied in the field of Logistics. A classic location models is the maximal covering location problem (MCLP), which attempts to locate a limited number of facilities in order to maximize the overall covered demand. The dynamic MCLP (DMCLP) is a well-known generalization where the facilities are located in several periods of time. In this contribution we propose a generalization of the dynamic maximal covering location problem, which also includes different types of facilities with their availability changing over time. We present the model and we show two examples, to illustrate the amount of information that can be considered besides the coverage value attained.

Keywords: Dynamic maximal covering location problem · facility types.

Acknowledgement: D. Pelta acknowledges support of Project TIN2017-86647-P (Spanish Ministry of Economy and Competitiveness, includes FEDER funds from the European Union).

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Implicative linguistic summaries

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Abstract: Linguistic summaries are a useful tool for extracting information of a database. In this paper, we show the usual linguistic summaries with their corresponding protoforms. In addition, we propose the notion of implicative linguistic summary and a method to compute its validity by using fuzzy implications.

Keywords: Linguistic summary · Fuzzy set · Fuzzy implication.

Acknowledgement: Partially supported by the State Research Agency (AEI) and the European Regional Development Fund (ERDF) project TIN2016-76653-P.

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Some relationships between the notions of f -inclusion and f -contradiction

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Abstract: In this paper we analyse the relationships between the notions of f -inclusion and f -weak-contradiction. In particular, we present some theoretical results that relate both notions by means of negation operators (used to define complements of fuzzy sets) and Galois connections.

Keywords: Galois Connections · Inclusion measure · Contradiction measure · Fuzzy sets.

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Decomposition integrals for interval-valued functions

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Abstract: In this contribution we define a new integral for interval-valued functions. This integral is an extension of a decomposition integral for real-valued functions. We present two different extensions of this integral. The first one is based on the integral of Aumann that is an extension of Riemann integral for set-valued functions. The second one is based on endpoint-wise interval operations. Interestingly, both of these at a first sight different approaches lead to the same integral. An illustrative example is added, too.

Keywords: decomposition integrals · interval-valued functions · set integrals.

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A Mostert & Shields-type Characterization for Group-like Uninorms

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Abstract: In this talk a subclass of group-like uninorms is characterized ala Mostert & Shields. Two particular variants of applying the so-called partial-lexicographic product construction will be specified. The first method constructs, starting from \mathbb{R} and modifying it in some way by \mathbb{Z} 's, what we call basic group-like uninorms, whereas with second method one may modify any group-like uninorm by using \mathbb{Z} and a basic group-like uninorm to obtain another group-like uninorm. All group-like uninorms obtained this way have finitely many idempotent elements. On the other hand, we prove that given any group-like uninorm which has finitely many idempotent elements, it can be constructed by consecutive applications of the second construction (finitely many times) using only basic group-like uninorms. So any basic group-like uninorm can be built using the first method, and any group-like uninorm which has finitely many idempotent elements can be built by the second method using only basic group-like uninorms.

Ultimately, we prove that all group-like uninorms which have finitely many idempotent elements can be constructed by the mentioned two variants of the partial lex-product construction using only \mathbb{R} and \mathbb{Z} . Another interpretation of the same result is that all these uninorms can be built by the second variant of the partial lex-product construction using only basic group-like uninorms, as building blocks. If understood this way then there is a striking similarity between this characterization and the well-known ordinal sum representation of continuous t-norms of Mostert and Shields (see [1]) as ordinal sums of continuous archimedean t-norms: replace 't-norm' by 'uni-norm', 'continuous' by 'group-like with finitely many idempotent elements', 'continuous archimedean t-norm' by 'basic group-like uninorm', and 'ordinal sum construction' by 'the second variant of the partial lex-product construction'. Besides, according to the classification of continuous archimedean t-norms, any continuous archimedean t-norm is order-isomorphic to either the Łukasiewicz t-norm or the Product t-norm, so there are two prototypes. In our setting basic group-like uninorms have \aleph_0 prototypes, one for each natural number.

Keywords: Uninorms · Construction · Characterization.

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*Keynote speech:***Special lattice valued structures and approximate solutions of linear equations****Andreja Tepavčević**

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Abstract: Equations and solution of equations are mostly based on different types of algebraic structures (coefficients and solutions are usually elements of algebras). A common algebraic structure of this type is the structure of real numbers (which is a field). The topic of this talk will be equations and (approximate) solutions of equations in a different framework. The underlying structures are lattice valued algebras and relational systems, which are classical structures equipped with a generalized (lattice valued) equality replacing the classical equality. The theoretical basics originate in universal algebra (weak congruences), in general algebra (algebraic structures, quasigroups), in logic (Boolean and Heyting valued models) and in fuzzy mathematics (fuzzy algebra).

The valuating structure is a complete lattice Ω , and main ingredients of the theory are different types of Ω -algebras, which are classical algebras equipped with an Ω -valued equality replacing the ordinary one. In these new structures identities hold as appropriate lattice-theoretic formulas. Identities hold in such algebra if and only if they hold on all particular cut-factor algebras, i.e., cut subalgebras over cut-equalities. Algebraic structures that will be exploited in the framework of equations are groups, quasigroups, rings, fields, vector spaces and modules.

Applying general results to mentioned algebraic structures, we give answers to existence of approximate solutions of various types of linear equations with respect to a fuzzy equality, and we describe solving procedures. Some potential applications in coding theory and cryptography are proposed.

Enhanced Comparison of Discrete Memetic Evolutionary Metaheuristics which are able to apply for TSP

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Abstract: In our paper we compare discrete memetic evolutionary metaheuristics (and other algorithms) which are applicable (also) for the widely studied and industrially applied (symmetric, Euclidean) NP-hard combinatorial optimization problem called Traveling Salesman Problem (TSP) such as DBMEA (Discrete Bacterial Memetic Evolutionary Algorithm), DMTLBO (Discrete Memetic Teaching-Learning Based Optimization) not to mention DMSSA (Discrete Memetic Squirrel Search Algorithm) algorithms. The comparisons occurred under the same fixed conditions.

Keywords: TSP · DBMEA · DMTLBO · DMSSA.

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Syntactic analysis of sentences using deep neural networks

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Abstract: Deep learning is a very common tool for natural language processing. In this document the use of neural networks is proposed to perform the syntactic analysis of sentences. We have experimented with three different models of artificial neural networks to identify the subject and the predicate of a sentence. A test has also been conducted to determine the type of words that make up the sentence. The obtained results are different for each network tested: the first one obtains inadequate results, the second one reaches 60% success in the detection of the subject and the predicate, and the third achieves 100% in the detection of the subject and the predicate and identifies the type of word in 92% of cases.

Keywords: Natural Language Processing · Deep Learning · LSTM · seq2seq.

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Estimating Remaining Time of Business Processes with structural attributes of the traces

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Abstract: In this paper, we deal with one of the challenges in process mining enhancement: prediction of remaining times in a business process, which is a critical task for many organisations. Our approach consists of i) defining a number of attributes on the business logs that capture structural information from the traces, ii) extending the well-known annotated transition system model to annotate its states with the attributes values and iii) applying linear regression for predicting the remaining time of the process for each state using the attributes values. Experiments with ten well-known real-life datasets show that our approach outperforms the baseline model defined in [7] in the three metrics considered.

Keywords: Business Process Management · Remaining Time estimation · Business intelligence.

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Convolutional Neural Networks in the Ovarian Cancer Detection

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Abstract: The main goal of the work is to create an artificial neural network capable of recognizing tumor cell groups in histopathological slides. Here, the Convolution Neural Network was used in the course of research on the detection of areas that include ovarian cancer cells. Theoretical and practical investigations included the issues of both preparing data for learning and selecting the appropriate architecture of the artificial neural network. The obtained results show that neural networks can be used as a competitive method for designating areas in which pathological cells of cancer origin are present. An additional goal of the work is to obtain superior results without losing the quality of the input image as one of the major limitations to this is the memory and computing capabilities of the computer on which the tests are carried out.

Keywords: Artificial Intelligence · Neural Network · Deep Learning · Convolutional Neural Network · Image analysis · Histopathological analysis · Ovarian Cancer.

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Analyzing the performance of TSP solver methods

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Abstract: In this paper we analyze the efficiency of three TSP solver methods: the best-performing exact Concorde algorithm, the state-of-the-art inexact Helsgaun's Lin-Kernighan heuristic and our Discrete Bacterial Memetic Evolutionary Algorithm (DBMEA). In our analysis the run time predictability was also taken into account, not only the tour quality and the run time properties. Three models (polynomial, exponential, square-root exponential) were fitted to the mean run times of VLSI (Very-large-scale integration) instances up to 20000 nodes. The DBMEA produces the highest (close to 1) R²-values for each model. The Concorde algorithm shows very low run time predictability.

Keywords: Traveling Salesman Problem · Concorde · Lin-Kernighan · DBMEA.

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Fuzzy Decision Support Methodology for Sustainable Packaging System Design

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Abstract: The aim of the present paper is to develop an integrated method that provide assistance to decision makers during packaging system planning, design, operation and evaluation from an environmental perspective.

The role of the packaging system is to provide a cover for the handling and communication functions surrounding the product. Single-use and reusable packaging are known based on the time it participates in the goods trade. The purpose of the authors is to develop an evaluation model for the selection of packaging systems from an environmental and sustainability point of view in the supply chain.

Keywords: packaging · model · environmental aspects · decision-making.

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Relational powerset theories

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Abstract: For general powerset theories in categories, relational powerset theories in these categories are introduced. These structures are defined as categories whose objects are the original powerset objects with relational structures defined on these objects. This construction generalizes classical relations or fuzzy relations in sets, and it enables to define these relational structures on more general powerset objects, based on lattice-valued fuzzy structures.

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On some categories underlying knowledge graphs

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Abstract: This paper proposes a method to provide a categorical structure for RDF-based data representing descriptions of entities. This is the first step towards our aim to further develop the underlying categorical structure so that we can eventually provide an internal logic which enables us to focus on analysis of properties of entities.

Keywords: RDF · Formal Concept Analysis · Category theory.

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On two categories of many-level fuzzy morphological spaces

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Abstract: We introduce many-level versions of the basic concepts of mathematical morphology, i.e. erosion and dilation, thus allowing to consider them not as a result, but as a process. We introduce two alternative many-level kinds of fuzzy morphological spaces. Fuzzy morphological spaces and reasonably defined continuous transformations of such spaces lead us to two categories, the study of which is initiated in the paper.

Keywords: Many-level fuzzy relation · many-level fuzzy relational erosion and dilation · many-level fuzzy morphological spaces.

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Congruences on lattices and lattice-valued functions

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Abstract: For a complete lattice L and an L -valued function μ on a domain X , the cuts of μ determine a residuated map f from L to the power set of X ordered dually to inclusion. We describe a class of complete lattices for which the kernel of f is a complete congruence on L . Conversely, every complete congruence on a complete lattice L is uniquely determined by a suitable L -valued function μ on an arbitrary domain, as the kernel of a residuated map which sends every element $p \in L$ into the corresponding cut μ_p . As an application, using residuated maps we get a representation of finite lattices by meet-irreducible elements.

Keywords: L -valued functions · residuated maps · closure operators · cuts.

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Some Roughness Features of Fuzzy Sets

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Abstract: Studying rough calculus was initiated by Z. Pawlak. In this paper, a few of roughness features of fuzzy sets will be investigated looking at the fuzzy membership functions from the point of view of rough continuity and rough approximation of real functions. In the paper, these subfields of rough calculus accurately follow Pawlak's ideas.

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On some generalizations of the Choquet integral

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Abstract: Choquet integral, in particular its discrete form, became one of the most important aggregation functions considered in any branch dealing with multicriterion decision support. There are several equivalent formulas for the discrete Choquet integral, thus opening several ways for its generalizations. We discuss some of such generalizations and add some illustrative examples.

Keywords: Choquet integral · copula · Möbius transform · OMA operator · OWA operator.

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Keynote speech:

Generating linguistic descriptions using Linguistic Petri Nets

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Abstract: The generation of linguistic descriptions from raw data is a current line of research. These kinds of descriptions are used, for instance, in virtual assistants such as Alexa, Google Home or SIRI. The generation of linguistic descriptions of data that has been acquired by all kind of sensors, technologies and observations over a time period differs from classical techniques based on segmentation, forecasting and, pattern recognition and extraction. The use of Fuzzy Logic and Petri Nets to generate linguistic descriptions from raw data is an interesting possibility. On one side, the relevance of fuzzy sets, protoforms and computation with words to generate linguistic descriptions has been proved. On the other hand, Petri Nets (PNs) can detect events and manage the input flow, thus providing the necessary tools to synchronize and coordinate the system to describe. In this talk, a new method to generate linguistic descriptions with an operation similar to PNs is presented. The presented approach maintains the operation of PNs, while adding the necessary mechanism to generate linguistic descriptions. The different linguistics elements are added to the places and transitions of the PNs, thereby maintaining the operation of the PNs. This extension is called linguistic Linguistic Petri Nets (LPNs). It is a language to generate linguistic descriptions of systems. Some examples using datasets from real applications will be presented during the talk.

A fuzzy model to aggregate performance indicators in sports

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Abstract: There is currently a growing interest in evaluating the performance of individual sports teams. These measurement frameworks are based on the opinion of various experts who do not always agree with the importance of the selected indicators. In this work, it is proposed to use methods of treatment of subjectivity and ambiguity based on fuzzy logic to obtain a selection of correctly assessed indicators. As a preliminary case of study, it has been decided to study handball players due to the scarcity of literature on the subject.

Keywords: Aggregation Operators · Linguistic Model · Player Performance Evaluation.

Acknowledgement: This work has been partially supported by the Spanish Government under grant MERINET: TIN2016-76843-C4-2-R (AEI/FEDER, UE).

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Formal analysis of solar power and weather data

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Abstract: Nowadays, the use of renewable energy is a priority for governments around the world since it gives rise to energy saving and environmental sustainability. In the case of photovoltaic systems, it is fundamental, to know how much energy can be generated and how much energy is needed in order to maintain a suitable balance between supply and demand. In this paper, a formal analysis of solar power and weather data is performed in order to study how the energy generated by solar panels depends on sunny days and weather conditions. In particular, a software architecture is proposed which is formed by three modules. The first and second ones allow us to transform open data files to formal contexts. In the third module, two important processes are performed: i) a characterization of the states of the sky and ii) an analysis of the wheather conditions under which the energy production is optimal.

Keywords: Formal Concept Analysis · Renewable Energy · Fuzzy Sets.

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Parametric optimisation of line and shape detection algorithms in driving assistance applications

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Abstract: This work focuses on the detection of the road in real time through a camera sited in an embedded device. Once obtained every individual frame from the camera, a sequence of algorithms and filters are applied to obtain lane marks for the identification of the road. To be robust to changes in the position of the camera or the kind of road, we propose a local search technique to find the optimal configuration for the parameters needed as input by the low level vision algorithms that allow the detection of borders and shapes needed to find lane marks. Our experimentation demonstrates how this technique finds the optimal configuration in videos with very different characteristics and captured from cameras sited in several positions in the car.

Keywords: Driving assistance · Lane Detection · Parametric optimisation · Local Search.

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Combining Symbolic Unfolding and Tuning Techniques for Fuzzy Logic Programs

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Abstract: During the last years we have developed advanced tools for unfolding and tuning fuzzy logic programs devoted to gain efficiency and aiding to select the more appropriate fuzzy connectives for being used in programs rules, respectively. This paper analyzes the synergies between both techniques in order to achieve a unified, reinforced methodology.

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A weakened notion of congruence to reduce concept lattices

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Abstract: This paper addresses the problem of attribute and size reduction of concept lattices in formal concept analysis. The reduction of the number of attributes in a formal context produces a partition on the set of concepts of the concept lattice. In this work, we introduce a weaker notion of congruence relation, called weak-congruence. This less restrictive kind of congruence guarantees that each subset of the partition forms a closed algebraic substructure, aggregating as few concepts as possible and preserving the main information.

Keywords: formal concept analysis · size reduction · attribute reduction · congruence.

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Interactive search by using minimal generators

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Abstract: If-then rules are frequently used as basic elements for knowledge representation in several areas. In Formal Concept Analysis, these rules are the so-called *implications* and can be used to find minimal generators in a symbolic way by using logic. The computation of all minimal generators is exponential. Here, we provide a novel lazy algorithm with polynomial delay in which minimal generators are used as forks in a map to guide an interactive search.

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Knowledge implications in multi-adjoint concept lattices

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Abstract: In this paper, an alternative definition of implication between attributes in formal concept analysis, within the fuzzy environment of the multi-adjoint concept lattices, is presented. This novel definition establishes a relationship between crisp subsets of attributes, according to the information that these subsets provide. One of the main interests of this new definition is its potential application in the detection of unnecessary data as well as in tasks related to attribute reduction.

Keywords: knowledge implication · formal concept analysis · attribute reduction · multi-adjoint concept lattice.

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TinyPaella: A formal tool for FCA context's debugging

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Abstract: Nowadays, one of the great factors found in AI, or more specifically, is the proper management of knowledge bases by non experts. A desirable objective would be that any person could manage knowledge bases, in a safe way, and with an accessible interface. For this purpose we present TinyPaella[1]. A graphical tool that transforms knowledge bases (formal FCA contexts, in this case) into spatial representations (by means of RCC theory) so that user can modify and adapt it to its mental model, only through actions of “drag&drop” and “resizing”. All operations are formally validated that the result generated is the desired one.

Keywords: FCA · RCC · Visual interfaces · Logical sound.

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*Keynote speech:***Recommender Systems: Using Fuzzy Fingerprints for “Proper” Recommendations****João Paulo Carvalho**

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Abstract: Most Recommender Systems rely exclusively on ratings and are known as Memory-based Collaborative Filtering systems. This is the currently dominant approach outside of academia due to the low implementation effort and service maintenance, when compared with more complex Model-based approaches. Traditional Memory-based systems have as their main goal to predict ratings, using similarity metrics to determine similarities between the users' (or items) rating patterns. In this talk, we propose item and user-based Fuzzy Collaborative Filtering approaches that do not rely on rating prediction, instead leveraging on Fuzzy Fingerprints to create a novel similarity based recommendation approach. Fuzzy Fingerprints provide a concise and compact representation of users allowing the reduction of the dimensionality usually associated with user-based collaborative filtering.

A new community detection problem based on bipolar fuzzy measures

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Abstract: In social network research, one of the most important analysis is community detection. Fuzzy uncertainty appears clearly when modeling real situations by means of networks. Nevertheless, most of the algorithms used to detect communities in graphs represent them as something crisp. Due to its speed and efficiency, Louvain algorithm is one of the most popular methods used to find clusters in crisp networks. In this study, we propose a modification of it, based on the incorporation of a bipolar fuzzy measure defined over the nodes of the network. Our proposal is based on the use of the Shapley value, which is considered to measure the importance of each node.

Keywords: Bipolar Fuzzy Clustering · Networks · Community Detection · Bipolar Fuzzy Graph.

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Novel methods of FCM model reduction

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Abstract: Fuzzy Cognitive Maps are widely applied to support decision making tasks. It is often hard for experts to create the model of a system that provides the required accuracy but simple enough to easily use in practice. In general, it is better to create complex models first, because they can be computationally reduced later until they preserve the required accuracy but become simple enough.

Two novel Fuzzy Cognitive Map reduction methods based on K-Means and Fuzzy C-Means clustering are suggested in order to generate simplified models that hopefully mimic the behavior of the original model better than the already existing methods. After the quick overview of the existing techniques found in literature, a simple and a complex model of a real-life problem are reduced to varying degrees with the suggested new methods and with an existing one. The first results of the comparison are published in this paper, too.

Keywords: Fuzzy Cognitive Maps · Model reduction · Clustering.

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Some Implications of Interval Approach to Dimension for Network Complexity

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Abstract: An interval approach to the concept of dimension is presented. Implications of exponentially growing quasiorthogonal dimension for estimates of network complexity are analyzed. Bounds on correlations of computational tasks represented by high-dimensional vectors are derived. Network complexity is analyzed from the point of view of the concentration of measure phenomenon.

Keywords: Quasiorthogonal dimension · sparsity of feedforward networks · high-dimensional geometry · concentration of measure · covering numbers.

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Social indexes segregation based on MEOWA and MOOWA aggregation operators

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Abstract: Indexes are very used in social sciences. The construction of an index involves aggregating information about variables that sometimes cannot be ranked, being OWA operators the most appropriate alternative. The associated weights of OWA operators can be defined in different ways. In this paper we propose to use MOOWA aggregation operators (maximizing ordinal dispersion instead of entropy) for the construction of indexes where no ranking amongst their variables is possible.

Keywords: OWA operators · Ordinal Dispersion · Social Indexes.

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Combining conceptual graphs and sentiment analysis for fake news detection

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Abstract: Misinformation has always existed in our society. In these days, the emergence of technological development and the appearance of social networks, pseudo-newspapers and blogs, has aggravated this problem by facilitating the rapid spread of fake news. This fact eases the use of misinformation as a vector of attack on huge communities, which may even compromise the security of a country. This leads to the development of systems that detect the appearance of this type of news and mitigate their influence. This article presents a first prototype of a knowledge-based system for the detection of fake news using reliable information sources. This framework makes use of text mining and sentiment analysis techniques to build conceptual graphs that represent the extracted knowledge. It can be estimated if a text provides misinformation combining similarity matrices gathered from them. Preliminary experiments confirm the potential of the proposal.

Keywords: Fake news · Combination of information · Text mining · Sentiment analysis · Graph-based systems.

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