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BOOK OF ABSTRACTS

10th European Symposium on Computational Intelligence and Mathematics

October 7th – 10th, 2018 • Riga, Latvia

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Book of abstracts of ESCIM 2018

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Program of the 10th European Symposium on Computational Intelligence and Mathematics

October 7th - 10th, 2018, Riga, Latvia

SUNDAY 7th	
9:00–10:00	**Open Registration Desk. Hotel Islande**
11:30	**Round table** Seventh International Workshop on Mathematics and Soft Computing
14:00	**Round table** Tenth Györ Symposium on Computational Intelligence

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	Towards Automatic Web Identification of Solutions in Patient Innovation João Nuno Almeida, Salomé Azevedo and Joao Paulo Carvalho
	The Discrete Bacterial Memetic Evolutionary Algorithm for solving the one-commodity Pickup-and-Delivery Traveling Salesman Problem Boldizsár Tüű-Szabó, Péter Földesi and László T. Kóczy
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11:30–12:20	**Keynote Speaker - Gabriella Pasi** Title: Aggregation guided by fuzzy quantifiers in IR and in Social Media Analytics Chairperson: Jesús Medina
12:20–13:30	**Session S2**. Chairperson: László T. Kóczy
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	Applying fuzzy Hough transform for identifying honed microgeometrical surfaces Szilvia Nagy, Brigita Sziová, Levente Solecki, Balázs Sarkadi-Nagy and László T. Kóczy
	Notes on the Rescaled Algorithm for Fuzzy Cognitive Maps Istvan Harmati and László T. Kóczy
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	On the exchange principle in adjoint triples M. Eugenia Cornejo, Jesús Medina and Eloísa Ramírez-Poussa
	Poset valued intuitionistic preference relations Marija Djukic and Andreja Tepavcevic
	Relating Hilbert-Chu Correspondences and Big Toy Models for Quantum Mechanics Ondrej Kridlo and Manuel Ojeda-Aciego
	Attribute selection via Hellwig's algorithm for Atanassov's Intuitionistic Fuzzy Sets Eulalia Szmidt, Janusz Kacprzyk and Paweł Bujnowski
	Extended fuzzy signature based model for qualification of residential buildings Ádám Bukovics, Gergő Fogarasi and László T. Kóczy
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	Triggering Probabilistic Neural Networks with Flower Pollination Algorithm Piotr Kowalski and Konrad Wadas
	Research on Improvement of Information Platform for Local Tourism by Paragraph Vector Takeshi Tsuchiya
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	Modeling enterprise architecture and strategic management from fuzzy decision rules Daniel Alfonso-Robaina, Annette Malleuve, Juan Carlos Díaz, Jesús Medina and Clemente Rubio-Manzano
	Describing Time Series using Fuzzy Piecewise Linear Segments Juan Moreno-García, Antonio Moreno-García, Luis Jiménez-Linares and Luis Rodríguez-Benítez
	A combined fuzzy and statistical approach for the evaluation of management questionnaires László T. Kóczy, Ojaras Purvinis and Dalia Susniene
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Computational Intelligence and Mathematics to Digital Forensic	
COST ACTION DigForASP – CA17124	
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20:00	**Gala dinner**
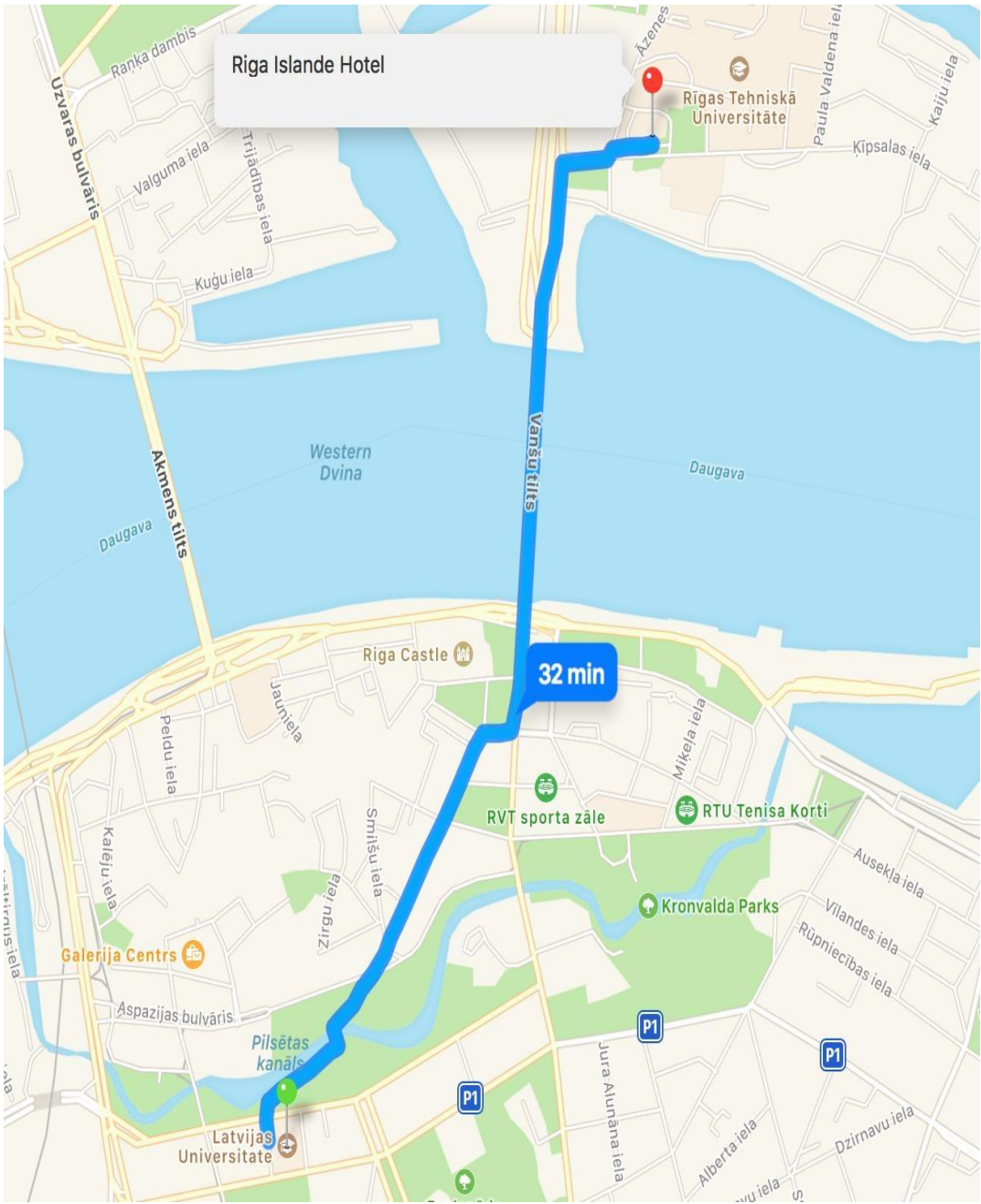
Keynote speech:

Decisions in human centric systems: a crucial role of bipolarity in judgments and intentions

Janusz Kacprzyk

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Abstract: We are concerned general problems of decision making in human centric systems, i.e. those in which a human being, an individual or a group of individuals, is a crucial element in the sense that the human judgments, affects, intentions, preferences, cognitive biases, etc. should be taken into account. This is clearly in line with some crucial modern challenges for science, notably IT/ICT, which − at a general level − boil down to making computers to be "cognitive partners" for the humans, and − on a more operational level − to find tools and techniques to develop and implement the human/society-in-the-loop paradigm which is considered promising.

Since decision making is the key problem as it is omnipresent in virtually all human activities, even if mimicked by/in inanimate systems, we show our analyses in this context. We start with a bried account of difficulties in traditional, formal approaches to decision making based on a strict rationality. We indicate inherent difficulties relate to a crucial role related to inherent characteristics of all human centric problems, i.e. a need to take into account affects, judgments, attitudes, evaluations and intentions of the human being, which are usually imprecise (fuzzy), changeable, subjective, and − which is the main concern here − involve pro and con arguments, i.e. are bipolar. The concept of bipolarity in this context is explained and some logical, optimization, etc. approaches to its formalization and handling are elaborated. A special emphasis is given to models should involve multiple agents (decision makers) who should act collectively, for instance, cooperate or collaborate, but may exhibit different general attitudes, notably ranging from greed to fairness. We show some possible solutions, in particular using non-orthodox multicriteria decision making. We also mention some relations to Wang's cognitive informatics.

Hierarchical fuzzy decision support methodology for dangerous goods packaging design

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Abstract: In the field of logistics packaging (industrial-, or even customer packaging), companies have to take decisions on determining the optimal packaging solutions and expenses. The decisions often involve a choice between one-way (disposable) and reusable (returnable) packaging solutions. Even nowadays, in most cases the decisions are made based on traditions and mainly consider the material and investment costs, but many other aspects are important as well. Traditional (two-valued) logic is not suitable for modeling this problem, so the application of a fuzzy signature approach was considered. In a previous paper a fuzzy signature modeling the packaging decision was suggested, based on logistics expert opinions, in order to support the decision making process of choosing the right packaging system. The aim of this study is to improve the model and apply it for dangerous goods packaging.

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Towards Automatic Web Identification of Solutions in Patient Innovation

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Abstract: Patient Innovation is an online open platform, with a community of over 60.000 users and more than 800 innovative solutions developed by patients and informal caregivers from all over the world. These solutions and/or creators were found by manually searching the Web in four different languages, through a combination of appropriate keywords and using experts to curate the results. In this paper we present a classifier architecture composed by a Word2Vec based SVM and a Fuzzy Fingerprint relevance classifier that is able to obtain a F1-score of 0.98 in the process of automatically identifying Patient Innovation solutions from texts obtained from the web.

Keywords: Patient Innovation, Text classification, SVM, Word2Vec, Fuzzy Fingerprints.

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The Discrete Bacterial Memetic Evolutionary Algorithm for solving the one-commodity Pickup-and-Delivery Traveling Salesman Problem

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Abstract: In this paper we propose a population based memetic algorithm, the Discrete Bacterial Memetic Evolutionary Algorithm for solving the one-commodity Pickup-and-Delivery Traveling Salesman Problem. The algorithm was tested on benchmark instances up to 100 nodes, and the results were compared with the state-of-the art methods in the literature. For all instances the DBMEA found optimal or close-optimal solutions.

Keywords: combinatorial optimization, Pickup and delivery, Metaheuristic.

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Keynote speech:

Aggregation guided by fuzzy quantifiers in IR and in Social Media Analytics

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Abstract: Various processes related to the task of Information Retrieval (IR) can be interpreted as Multi Criteria Decision Making activities. The same applies to some tasks related to the analysis of user generated content in Social Media (like for example the assessement of credibility of online reviews). What is particularly interesting by this interpretation is that depending on the selected aggregation strategy different behaviors can be modelled for the considered process, which can be intuitively captured by guiding the aggregation by fuzzy quantifiers. In this lecture the impact of quantifier guided aggregation (and of aggregation in general) will be shown in both contexts of IR and of the assessment of credibility of user generated content. It will be also shown that quantifier guided aggregation offers an interesting alternative to the application of machine learning techniques (in particular classifiers).

Roughness and Fuzziness

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Abstract: Between roughness and fuzziness, the rough membership function may establish a connection. Rough membership functions can be viewed as a special type of fuzzy membership functions. This paper addresses taking into account possible coincidences between rough membership and fuzzy membership functions regarding not only classical cases but their different extensions as well. Roughness is treated in a general set approximation framework.

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Applying fuzzy Hough transform for identifying honed microgeometrical surfaces

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Abstract: In the measurement of microgeometrical surfaces it is useful if the same location can be found on a surface for two or more different and independent measurements, as in this case not only statistical parameters of the measurements can be compared, but direct differences can be calculated. Honing is a typical surface processing method resulting in pattern consisting of straight valleys crossing at various angles. Honing pattern is of great help to find a special location. The main goal of this article is to find a method that is able to give some characteristic points that can be used for fitting two measured surfaces together.

Hough transform is used in finding straight lines in an image or map, thus it could be used for detemining crossing points of the honed surface. However, classical Hough transform either finds way too many disturbing lines in the case of a typical honed surface or almost none, depending on the parameter selection. To solve this rapid changing in the number of the resulting lines, we introduced fuzzy Hough transform. If a fuzzified version of the weights of the individual points in the Hough transform is used, the inverse of the transform becomes clearer, resulting in a pattern more suitable for finding the same location on two measured versions of a surface.

Keywords: Fuzzy sets, Hough transform, Microgeometrical surface analysis, Pattern analysis

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Notes on the Rescaled Algorithm for Fuzzy Cognitive Maps

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Abstract: Fuzzy Cognitive Maps are network-like decision support tools, where the final conclusion is determined by an iteration process. Although the final conclusion relies on the assumption that the iteration reaches a fixed point, it is not straightforward that the iteration will converge to anywhere, since it can produce limit cycles or chaotic behaviour also. In this paper, we briefly analyse the behaviour of the so-called rescaled algorithm for fuzzy cognitive maps with respect to the existence and uniqueness of fixed points.

Keywords: fuzzy cognitive map, rescaled algorithm, fixed point, stability.

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Introducing Group-like Uninorms - Construction and Characterization

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Abstract: Uninorms play a prominent role both in the theory and applications of Aggregations and of Mathematical Fuzzy Logic. In this paper the class of group-like uninorms is introduced as the subclass of group-like FL_e-algebras, where the underlying universe is order-isomorphic to the open real unit interval. First, two variants of a construction method – called partial-lexicographic product – will be recalled; it constructs a large subclass of group-like FL_e-algebras. Then three specific ways of applying the partial-lexicographic product construction will be introduced. The first one constructs starting from $\mathbb{R}$ and modifying it in some way by $\mathbb{Z}$'s, what we call the basic group-like uninorms, whereas with the last two ones one may extend group-like uninorms by using $\mathbb{Z}$ and basic uninorms to obtain further group-like uninorms. All group-like uninorms obtained this way have finitely many idempotents. On the other hand, we assert that the only way to construct group-like uninorms which have finitely many idempotents is to apply the last two extension methods consecutively, starting from a basic group-like uninorm. In this way a complete characterization for group-like uninorms which possess finitely many idempotents is given. The paper is illustrated with several 3D plots of group-like uninorms.

Keywords: Uninorms· Construction · Characterization.

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On the exchange principle in adjoint triples

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Abstract: Adjoint triples are a general structure composed of operators satisfying weak properties, which are usefully used in important frameworks such as fuzzy logic programming, formal concept analysis and fuzzy relation equations. In this work, we will analyze how the exchange principle law should be defined on adjoint triples and what conditions the conjunctor of an adjoint triple should fulfill in order to guarantee that its corresponding residuated implications satisfy such property.

Keywords: Adjoint triples, exchange principle, residuated implications.

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Poset valued intuitionistic preference relations

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Abstract: It is known that in every finite poset each element can be presented as a join of completely join-irreducible elements. This representation is used here to justify a new notion of poset-valued reciprocal (preference) relations and also the intuitionistic version of this definition. Join-irreducible elements would represent pieces of information representing grade of preference in this framework. It is demonstrated that no restriction on type of a poset is needed for developing the intuitionistic approach, except that the poset should be bounded with the top element T and the bottom element B (T representing the total preference). Some properties are proved and connections with previous definitions are shown. It is demonstrated that the new definition is in a sense more general (and in some aspects more convenient) than previous ones.

Keywords: Poset, Intuitionistic preference, Join irreducible element.

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Relating Hilbert-Chu Correspondences and Big Toy Models for Quantum Mechanics

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Abstract: In a previous work, we showed that the category $\text{ChuCors}_{\mathcal{H}}$ of Chu correspondences between Hilbert contexts is equivalent to the category of Propositional Systems (the algebraic counterpart of the set of closed subspaces of a Hilbert space); in this paper, we extend the previous relation to the Big Toy Models introduced as a tool to represent quantum systems in terms of Chu spaces.

Keywords: Chu Correspondence; Big Toy Models; Quantum Mechanics.

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Attribute selection via Hellwig's algorithm for Atanassov's Intuitionistic Fuzzy Sets

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Abstract: This paper is a continuation of our previous considerations on attribute selection by Hellwig's method while a data set is expressed via an Atanassov's intuitionistic fuzzy set (A-IFS). The main goal is the dimension reduction for sets of data represented as the A-IFSs. We provide an illustrative example using real SPECT Heart data and analyze in detail the results obtained by Hellwig's algorithm comparing them with other results from literature. Some advances and disadvantages of Hellwig's method are presented.

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Extended fuzzy signature based model for qualification of residential buildings

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Abstract: Residential buildings can be qualified and ranked based on many viewpoints. For the intervening decision-supporting survey of old residential buildings in the course of our former researches we have created a fuzzy signature based model which defines status evaluation and ranking of buildings on the basis of the condition of load-bearing structures and other building structures. We have extended and changed this model in a way so that it should take into account other viewpoints, too, which, in addition to the load bearing viewpoints strongly influence the manner of intervening. Since in addition to the importance of the given structure the relevance of the building structures of residential buildings are determined also by their quantities and other features, in our case it was necessary to determine relative and absolute relevance weights. We use a structure of fuzzy signature with variable aggregations, where the definition of aggregations is made by parameters, and the value of parameters are changing depending on the specific application, which follow the changes of relevance of given subtrees. The developed method is examined on the basis of a database for which we were used status evaluating expert reports relating to real stock of residential buildings.

Keywords: fuzzy signatures, parametric aggregation, residential building, decision support.

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Keynote speech:

Nature-Inspired Optimization of Type-2 Fuzzy Logic Controllers

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Abstract: The design of Type-2 fuzzy logic systems is a complex task and in general achieving an optimal configuration of structure and parameters is time consuming and rarely found in practice. For this reason the use of nature-inspired meta-heuristics offer a good hybrid solution to find near optimal designs of type-2 fuzzy logic systems in real world applications. In particular, type-2 fuzzy control offers a real challenge because the problems in this area require very efficient and accurate solutions; in particular this is the case for robotic applications. In this talk we present a general scheme for optimizing type-2 fuzzy controllers with nature-inspired optimization techniques, like ant colony optimization, the chemical reaction algorithm, bee colony optimization and others.

Design of a fuzzy system for classification of blood pressure load

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Abstract: Nowadays, blood pressure is the most common way to diagnose hypertension, however it is important to observe all the data provided by a 24-hour device, which is why it is important to analyze the blood pressure load, which indicates the daytime blood pressure load (% of diurnal readings $\geq 135/85$ mmHg) and the nocturnal blood pressure load (% of nocturnal readings $\geq 120/70$ mmHg). Different studies have shown the correlation between the blood pressure load and some cardiovascular problems. In this work we analyze the day and night load of 30 patients, which were classified with 100% accuracy by the fuzzy classifier and indicated a high index of people with a pressure load and this indicates that a cardiovascular event could occur at any time for these patients.

Keywords: Fuzzy system, Hypertension, Diagnosis, load blood pressure.

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Triggering Probabilistic Neural Networks with Flower Pollination Algorithm

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Abstract: The Flower Pollination Algorithm (FPA) is a modern heuristic technique that is applicable for the purposes of deriving best solution within several optimization tasks. This paper is a example of utilizing this metaheuristic procedure for the Probabilistic Neural Network (PNN) learning process. In this paper, for the purpose of classification, this sort of Neural Network is applied to data sets drawn from the UCI Machine Learning Repository. Moreover, we concentrate upon investigating the inertial parameters of FPA, as well as the overfitting aspect.

Keywords: Probabilistic Neural Network, Learning Process, Flower Pollination Algorithm, Optimization, Metaheuristic.

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Research on Improvement of Information Platform for Local Tourism by Paragraph Vector

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Abstract: In this paper, we discuss and propose the analysis and search method of various information on tourism in the Suwa area of Nagano Prefecture on the Internet. These pieces of information include not only long sentences such as web pages and blogs, but also a lot of content of SNS composed of short sentences of about several words. Therefore, by the conventional search method, based on the occurrence probability of words in sentences, sufficient accuracy cannot be expected for the search of SNS information composed of several words. In this research, we examined a method using Paragraph Vector for expressing relationships of words included in sentences. By doing this, we aim to acquire the same level of search performance even for SNS content composed of several words.

Keywords: tourism information, SNS, Paragraph Vector.

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Generating Preference Relation Matrices from Utility Vectors Using Łukasiewicz Transitivity

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Abstract: Decision support or recommender systems often require to transform utility values to preference values. U2PA is an additively transitive transformation, and U2PM is a multiplicatively transitive transformation. In this paper we consider Łukasiewicz transitivity, derive a new transformation called U2PL, and examine its mathematical properties. A comparison of U2PL with U2PA and U2PM shows that U2PL possesses interesting mathematical properties. In particular, U2PM is the only of these three transformations that is max–min transitive.

Keywords: preference relations, utility theory, Łukasiewicz transitivity.

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Optimization under fuzzy max-t-norm relation constraints

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Abstract: Fuzzy relation equations and inequalities play an important role in many tools of fuzzy modelling and have been extensively studied. In many practical applications they are used as constraints in optimization. Algorithms for specific objective functions have been proposed by many authors. In this paper we introduce a method to convert a system of fuzzy relation constraints with max-t-norm composition to a linear constraint system by adding integer variables. A numerical example is provided to illustrate the proposed method.

Keywords: Optimization under fuzzy relation constraints, Fuzzy relation constraints, Max-t-norm constraints.

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Modeling enterprise architecture and strategic management from fuzzy decision rules

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Abstract: This paper analyses the main variables (causes and effect) related to the Enterprise Architecture in order to obtain an instrument to assess the context of the Enterprise Architecture and the multifactorial elements impregnated with uncertainty that affect it. The knowledge given by the experts is translated into dependence rules, which have also been analyzed from a fuzzy point of view using the fuzzy relation equation theory.

Keywords: Decision making, Formal analysis of rules, Enterprise Architecture, Fuzzy relation equations, Fuzzy logic.

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Describing Time Series using Fuzzy Piecewise Linear Segments

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Abstract: It is very common to use time series in a large number of areas, and it is necessary to obtain as much detailed information as possible from these series. There are different possibilities for displaying this information, for example, in the form of a graphical representation. However, the need to represent information using natural language, that is to say, by means of a linguistic description, is becoming more and more frequent. This paper presents a technique for obtaining linguistic descriptions from time series using a representation called Fuzzy Piecewise Linear Segments. It is shown how to obtain the information of a modelled series using this representation and the necessary steps to generate the description using templates. Finally, some examples of its use are shown.

Keywords: Linguistic Description, Time Series, Fuzzy Piecewise Linear Segments, Fuzzy Logic.

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A combined fuzzy and statistical approach for the evaluation of management questionnaires

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Abstract: A set of answers to questions to employees of various companies in Lithuania may refer to various positive and negative aspects of the attitudes of employees. These are called Organizational Citizenship Behavior (positive) and Counterproductive Work Behavior (negative). The components in the answers may be grouped by ex-pert knowledge, and by statistical analysis and, according to these approaches, based on expert domain knowledge by management specialists, fuzzy signature structures describing the mutual effects of single elements in the questionnaire may be created. There are some slight differences between the two results, that indicate that expert knowledge is sometimes not objective. An additional step applying hy-brid Generalised Reduced Gradient algorithm and Genetic Evolutionary Algorithm for heuristic optimization of the aggregation parameters in the Fuzzy Signatures re-veals a final model according to the responses. These latter results raise some new questions, including the idea of the use of undeterministic graphs, thus resulting in Fuzzy Fuzzy Signatures. The method could be applied to other similar multicomponent vague data pools.

Keywords: Fuzzy signature, OCB, least squares method.

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Keynote speech:

On many-level fuzzy rough approximation systems

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Abstract: One of possible approaches to the interpretation of Pawlak's rough sets is the following. Assume we have a plane filled up with pixels, and there is a domain D in this plane. We are looking at the plane from some distance. Then we may know exactly that a pixel, say p, is in the domain D. Let $l(D)$ be the set of all pixels contained in D for sure. Further, for some pixels, we assume that possibly they are inside D. The set of all such pixels we denote by $u(D)$. Obviously, $l(D)$ and $u(D)$ can be viewed as the lower and the upper Pawlak's rough approximations of the domain D.

But now imagine that we can change the distance from which the observation of the domain D is made. Then we can expect that the lower and the upper rough approximations of the domain D can vary depending on the distance from which the observation is made. Thus the lower and the upper rough approximations of the doman D become *functions $l_d(D)$ and $u_d(D)$ of the parameter d (the distance of observation)*.

In this and other similar situations there appears the necessity to extend the technique of rough approximation of sets to the case when this approximation is fulfilled on different levels. And the transition of approximation from one level to the other should be done in a smooth, coordinated way.

To manage with this and other similar cases, in crisp as well as in fuzzy cases, one can apply many-level lower and upper fuzzy rough approximation operators. It is just the main goal of our talk to introduce the concept of a many-level fuzzy rough approximation system and to expound the basic properties of such systems. We also consider many-valued fuzzy rough approximation spaces on the base of such systems. Some examples illustrating applications of such systems will be given. Besides, we will present a (graded) topological interpretation of many-level fuzzy rough approximation spaces.

Main results presented in this talk are obtained in collaboration with my colleagues Ingrīda Uļjane and Aleksandrs Eļkins.

F-transforms for the definition of contextual fuzzy partitions

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Abstract: Fuzzy partitions are defined in many different ways but usually, by
taking into account aspects of the whole universe. In this paper, we present a
method to define fuzzy partitions for elements in the universe holding certain
fuzzy attribute. Specifically, we show how to define those fuzzy partitions by
means of F-transforms.

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Fuzzy metric approach to aggregation of risk levels

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Abstract: In this paper we propose a special construction of a general aggregation operator. The construction allows to aggregate fuzzy sets taking into account the distance between elements of the universe. We consider the case when fuzzy sets to be aggregated represent the risk level evaluation by several experts. We describe how the proposed construction could be applied for risk level assessment in the case when a strong fuzzy metric is used to characterize the similarity of objects under evaluation.

Keywords: Aggregation operator, Fuzzy metric, Risk level assessment.

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On the measure of many-level fuzzy rough approximation for L-fuzzy sets

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Abstract: We introduce a many-level version of L-fuzzy rough approximation operators and define measures of approximation obtained by such operators. In a certain sense, theses measures characterize the quality of the resulting approximation. We study properties of such measures and give a topological interpretation of the obtained results.

Keywords: Many-level fuzzy rough approximation system, measure of approximation, fuzzy relation, integral complete lattice monoid.

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Bireducts and FCA

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Abstract: In this paper we apply the philosophy of Rough Set Theory to reduce formal context in the environment of Formal Concept Analysis. Specifically, we propose a reduction mechanism based on the consideration of bireducts and we also study several properties of the reduced contexts.

Keywords: formal concept analysis, rough set theory, bireduct, size reduction.

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