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BOOK OF ABSTRACTS

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Laszlo Koczy

¹ Szechenyi Istvan University, Győr, Hungary

² Budapest University of Technology and Economics, Budapest, Hungary
koczy@tmit.bme.hu



Abstract: When Zadeh introduced the concept of fuzzy sets where $\mu(x) : X \rightarrow [0, 1]$, soon his that time student Goguen extended the idea to L-fuzzy sets where the unit interval $[0, 1]$ was replaced by arbitrary algebraic lattice in the manner that the membership degrees are defined by $\mu(x) : X \rightarrow L$. In the late 1970s, we introduced a practical extension to fuzzy sets: vector valued Fuzzy (VVF) sets $\mu(x) : X \rightarrow [0, 1]^n$. The n -dimensional unit hypercube may be certainly interpreted as a lattice under the usual partial ordering \leq . This concept was necessary for a certain industrial application, classifying microscopic images of steel alloys.

Much later we proposed a further extension of the idea by allowing the vectorial membership degree components being vectorial themselves, the new concept called Fuzzy Signature (FSig). This way the degree of x belonging to a FSig set is expressed by a nested membership degree vector (with arbitrary depth), or illustrated by a rooted tree graph where each leaf has a membership degree. As in the following various applications (medical diagnosis, built construction evaluation, fuzzy communication of robots, warehouse optimization, etc.) it was necessary to manipulate partly different FSig-s at the same time, the internal nodes of the graphs were attached fuzzy aggregations so partial reduction and transformation of the FSig becomes possible, in order to combine FSig-s of partially different, but essentially similar structure. While many applications were completed and they worked all right, the algebraic structure of FSig-s has never been analysed as far.

The present keynote talk is an attempt to define a series of operations, such as lattice meet and join, and two variations of partial ordering among FSig-s belonging to a certain “family”. Based on these it is possible to define an algebraic lattice over the set of nested vectors (within a family), and so, it will be proved that Fuzzy Signature Sets are a special case of Goguen’s L-fuzzy sets, thus the “new” concept is in fact a possible realisation of an “old” definition and thus it fits in the existing mathematical system of the fuzzy theory.

Model Reduction Method supported by Fuzzy Cognitive Map to Promote Circular Economy

Adrienn Buruzs¹, Miklós F. Hatwágner² and László T. Kóczy³

¹ Department of Environmental Engineering, Széchenyi István University, Győr, Hungary, buruzs@sze.hu

² Department of Information Technology, Széchenyi István University, Győr, Hungary, miklos.hatwagner@sze.hu

³ Department of Information Technology, Széchenyi István University, Győr, Hungary and Department of Telecommunications and Media Informatics, Budapest University of Technology and Economics, Hungary, koczy@sze.hu, koczy@tmit.bme.hu

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

In order to support the realization of circular economy it is essential to evaluate local needs and conditions which help to select the most appropriate system components and resource needs. Each of these activities requires careful planning, however, the model of circular economy offers a comprehensive interdisciplinary framework. The aim of this research was to develop and to introduce a practical methodology for evaluation of local and regional opportunities to promote circular economy.

Keywords: factors, fuzzy cognitive maps, model reduction, circular economy, sustainability.

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Analyzing the Process of Constructing Reducts in Multi-adjoint Concept Lattices

M. Eugenia Cornejo¹, Jesús Medina² and Eloisa Ramírez-Poussa²

¹ Department of Statistic and O. R., University of Cádiz. Spain, mariaeugenia.cornejo@uca.es

² Department of Mathematics, University of Cádiz. Spain, jesus.medina@uca.es, eloisa.ramirez@uca.es

Abstract: Attributes contained in a database usually provide redundant information, hence an essential part in Formal Concept Analysis is getting procedures to remove the unnecessary attributes. In this work, we present some properties related to the attributes that generate irreducible elements of a multi-adjoint concept lattice. These properties are very useful in order to obtain minimal sets of attributes keeping the knowledge of the database.

Keywords: attribute reduction, reduct, multi-adjoint concept lattice.

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Uncertainty Tolerance and Behavioral Stability

Analysis of Fixed Structure Fuzzy Cognitive Maps

Miklós F. Hatwágner¹ and László T. Kóczy²

¹ Department of Information Technology, Széchenyi István University, Győr, Hungary, miklos.hatwagner@sze.hu

² Department of Information Technology, Széchenyi István University, Győr, Hungary and Department of Telecommunications and Media Informatics, Budapest University of Technology and Economics, Hungary, koczy@sze.hu, koczy@tmit.bme.hu

Abstract: Fuzzy Cognitive Maps (FCMs) are widely applied to describe, model and simulate complex systems. It supports decision making and helps better understand the operation of multicomponent systems. FCMs can be considered as digraphs: the nodes represent the components of the system, while the arcs express the cause-effect relationships among these components. There are two possible main ways of model creation: expert-based and automated methods.

Expert based methods are based on the knowledge, experience and opinions of experts of the investigated field. As a consequence of this approach, the resulting models contain more or less subjective information that may decrease the trustworthiness of the model, even if the final model aggregates the information provided by individual models of several experts.

This phenomenon can be avoided by using automated methods. The drawback of this approach is that these methods require the availability of historical data.

A novel technique is proposed in this paper in order to investigate the effect of slightly modified model parameters (arc weights) on simulation results. The most influencing parameters can be detected this way, and their values can be revised in order to model the studied system in a more accurate way. It proved to be especially useful in practice when the model is created by experts. The paper presents an example as well to demonstrate that the performed modifications can give rise to different kind of model behaviors, different amount of fixed-point attractors.

Keywords: fuzzy cognitive maps, model uncertainty, behavioral stability, multi-objective optimization, Bacterial Evolutionary Algorithm.

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Towards Multi-adjoint Logic Programming with Negations

M. Eugenia Cornejo¹, David Lobo² and Jesús Medina²

¹ Department of Statistics and O. R., University of Cádiz. Spain, mariaeugenia.cornejo@uca.es

² Department of Mathematics, University of Cádiz. Spain, david.lobo@alum.uca.es, jesus.medina@uca.es

Abstract: An initial study on multi-adjoint logic programming with negations is presented in this paper. In particular, the existence of stable models for the mentioned logic programs is guaranteed.

Keywords: Multi-adjoint logic program; negation; stable model.

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Manuel Ojeda-Aciego

Department of Applied Mathematics, University of Málaga
aciego@uma.es



Abstract: Formal Concept Analysis (FCA) has become a very active research topic, both theoretical and practical; its wide applicability justifies the need of a deeper knowledge of its underlying mechanisms, and one important way to obtain this extra knowledge turns out to be via generalization.

Several fuzzy variants of generalized FCA have been introduced and developed both from the theoretical and the practical side. Most of the generalizations focus on including extra features (fuzzy, possibilistic, rough, etc.); however, not much have been published on the suitable general version of certain specific notions, such as the bonds between formal contexts.

One of the motivations for introducing the notion of bond was to provide a tool for studying mappings between formal contexts, somehow mimicking the behavior of Galois connections between their corresponding concept lattices. In this talk we will deal with generalizations of the notion of bond in an L-fuzzy setting.

Comparison of Krill Herd Algorithm and Flower Pollination Algorithm in Clustering Task

Piotr A. Kowalski^{1,2}, Szymon Łukasik^{1,2},
Małgorzata Charytanowicz^{2,3}, Piotr Kulczycki^{1,2}

¹ Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, al. Mickiewicza 30, 30-059 Cracow, Poland, {pkowal, slukasik, mchat, kulczycki}@agh.edu.pl

² Systems Research Institute, Polish Academy of Sciences, ul. Newelska 6, PL-01-447 Warsaw, Poland, {pkowal, slukasik, kulczycki}@ibspan.waw.pl

³ Institute of Mathematics and Computer Science, The John Paul II Catholic University of Lublin, Konstantynów 1 H, 20-708 Lublin, Poland, mchmat@kul.lublin.pl

Abstract: The Krill Herd Algorithm (KHA) and Flower Pollination Algorithm (FPA) are modern heuristic techniques that are applicable for the purposes of deriving best solution within several optimization tasks. This paper is a comparison with regard to quality of result, of utilizing these metaheuristic procedures for the data clustering task when applied to twelve data sets drawn from the UCI Machine Learning Repository. Here, the Celinski-Harabsz Index served to validate the cluster division criteria. Moreover, for broader comparison, the well-known and commonly employed k-means method was applied. Via the Rand Index, the quality of the results were assessed. The notion that KHA and FPA are effectively employed in such work is supported.

Keywords: clustering, krill herd algorithm, flower pollination algorithm, biologically inspired algorithm, optimization, metaheuristic.

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On the Lower Limit of Possibilistic Correlation Coefficient for Identical Marginal Possibility Distributions

István Á. Harmati¹ and Robert Fullér^{2,3}

¹ Department of Mathematics and Computational Sciences, Széchenyi István University, Győr, Hungary, harmati@sze.hu

² Department of Informatics, Széchenyi István University, Győr, Hungary

³ Institute of Applied Mathematics, John von Neumann Faculty of Informatics, Óbuda University, Budapest, Hungary, robert.fuller@nik.uni-obuda.hu

Abstract: In their recent paper Fullér et al. [1] defined a new measure of interactivity between fuzzy numbers, the so-called f -weighted possibilistic correlation coefficient, which can be determined from the joint possibility distribution. They also left two open questions related to the lower limit of the f -weighted possibilistic correlation coefficient of marginal possibility distribution with the same membership function. In this paper we answer the more general version of the questions, for a large class of fuzzy and quasi fuzzy numbers.

Keywords: possibility theory, possibility distribution, correlation coefficient, possibilistic correlation, fuzzy numbers, quasi fuzzy numbers

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Manipulating Positive and Negative Attributes in Implications

P. Cordero, M. Enciso, A. Mora, and J. M. Rodríguez-Jiménez

University of Málaga, Andalucía Tech, Spain

e-mail: {pcordero, enciso}@uma.es, {amora, jmrodriguez}@ctima.uma.es

Abstract: In several areas such as artificial intelligence, data mining, database theory, formal concept analysis, etc. the implications represent relationships between set of attributes. Usually, they only specify the presence of the attribute (positive) but not their absence (negative). In this work, we propose how to manipulate positive and negative attributes by means of rules, in a logic-style, for inferring new knowledge. A new logic for the treatment of implications with positive and negative attributes is introduced as the first step for the subsequent design of automated methods.

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Attribute Reduction in Fuzzy Formal Concept Analysis from Rough Set Theory

M. José Benítez¹, Jesús Medina¹ and Dominik Ślęzak^{2,3}

¹ Department of Mathematics, University of Cádiz. Spain, {mariajose.benitez, jesus.medina}@uca.es

² Institute of Mathematics, University of Warsaw. Poland, slezak@mimuw.edu.pl

³ Infobright Inc., Canada / Poland, slezak@infobright.com

Abstract: Reducing the number of attributes by preventing the occurrence of incompatibilities and eliminating existing noise in the original data is an important goal in different frameworks as Rough Set Theory (RST) and Formal Concept Analysis (FCA). We have recently presented a novel reduction method in RST based on bireducts using similarity relations. This paper applies this method in the FCA framework from an illustrative example.

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On the n -ary Generalization of Dual Bonds

Ondrej Krídlo¹ and Manuel Ojeda-Aciego²

¹ University of Pavol Jozef Šafárik, Košice, Slovakia

² Universidad de Málaga. Departamento de Matemática Aplicada. Spain

Abstract. We propose the generalization of the notion bond between two formal contexts to the case of n formal contexts. The first properties of the n -ary bonds are given, together with a method for building n -ary bonds. This construction enables to formalize some inference rules within the research topic of building a sequent calculus for formal contexts.

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Toward the Use of the Contraposition Law in Multi-adjoint Lattices

Nicolás Madrid

Department of Applied Mathematics, University of Málaga, Spain
nicolas.madrid@uma.es

Abstract: This paper deals with the issue of combining involutive negations and the contraposition law. Specifically, instead of considering the negation $x \rightarrow 0$, we consider arbitrary involutive negations and we define a multi-adjoint lattice where we can apply the contraposition law by incorporating to the original implication a set of new implications.

Keywords: multiadjoint lattices, involutive negation, contraposition law, residuated pairs, adjoint triple.

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On Pseudo-fixed Points of the Intuitionistic Fuzzy Quantifiers and Operators

Keynote speech

Krassimir Atanassov



- ¹ Department of Bioinformatics and Mathematical Modelling, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 105, Sofia-1113, Bulgaria, krat@bas.bg
- ² Prof. Asen Zlatarov University, Bourgas-8000, Bulgaria

Abstract: In this paper, the pseudo-fixed points of the intuitionistic fuzzy quantifiers and operators from modal and level types, are described.

The first research in the area of intuitionistic fuzzy logics started 30 years ago. Sequentially, intuitionistic fuzzy propositional calculus, intuitionistic fuzzy predicate logic, intuitionistic fuzzy modal logic and intuitionistic fuzzy temporal logic were introduced and developed.

In intuitionistic fuzzy predicate logic, firstly, intuitionistic fuzzy quantifiers that are analogous of the standard logic quantifiers were defined, and after this a series of their extensions arose. In intuitionistic fuzzy modal logic, firstly, intuitionistic fuzzy modal operators that are analogues of standard modal logic operators “necessity” and “possibility” were introduced and after this, a series of their extensions and modifications were defined. Level operators, that are intuitionistic fuzzy analogues of the standard fuzzy set operators, were introduced, too. Here, the pseudo-fixed points of all these operators will be described

Keywords: intuitionistic fuzzy operator, intuitionistic fuzzy quantifier, pseudo-fixed point.

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On a New Ordering between Intuitionistic Fuzzy Pairs

Peter Vassilev and Todor Stoyanov

Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences,
Acad. G. Bonchev Str., Bl. 105, Sofia-1113, Bulgaria, peter.vassilev@gmail.com

Abstract: In this paper we investigate orderings between intuitionistic fuzzy pairs and find some relationships between them. Our purpose is to establish a meaningful automated way to determine an object which best fits a given object, when this specific object is compared to all others and the result of this comparison is in the form of intuitionistic fuzzy pairs. Our idea is to obtain a way of comparison which may be used to identify potentially similar structures, texts, geometric patterns, which can later be processed by other methods to verify or discard this initial hypothesis.

Keywords: Intuitionistic fuzzy pairs, similarity, orderings.

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Generalized Net for Coordination and Synchronization of Human and Computer-based Expert Type Decision Support Activities in a Multiagent Setting

Eulalia Szmidt¹, Evdokia Sotirova², Janusz Kacprzyk¹
and Krassimir Atanassov^{2,3}

¹ Systems Research Institute, Polish Academy of Sciences, ul. Newelska 6, 01-447 Warsaw, Poland, {szmidt,kacprzyk}@ibspan.waw.pl

² “Prof. Asen Zlatarov” University, Prof. J. Jakimov Str. 1, Bourgas-8010, Bulgaria, esotirova@btu.bg

³ Dept. of Bioinformatics and Mathematical Modelling, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, 105 Acad. G. Bonchev Str., 1113 Sofia, Bulgaria, krat@bas.bg

Abstract: The processes of decision making by experts and by decision making tools are described by a Generalized Net (GN). It is shown that the GN-model can organize, coordinate and synchronize the work of the experts and/or decision making tools with aim to obtain the best results of their activity.

Keywords: decision making tool, expert system, generalized net, multiagent system.

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Enriching Prolog Systems by Means of Interval-valued Fuzzy Sets

Clemente Rubio-Manzano and Martin Pereira-Fariña

¹ Department of Information Systems, University of the Bío-Bío, Chile, clrubio@ubiobio.cl

² Centro Singular de Investigación en Tecnoloxías da Información (CiTIUS), Universidade de Santiago de Compostela, Spain, martin.pereira@usc.es

Abstract. In this paper we analyze the benefits of incorporating interval-valued fuzzy sets into Prolog systems. A syntax, semantics and implementation for this extension is presented and formalized. The main application of our approach is to show that fuzzy logic programming frameworks can work together with lexical resources and ontologies in order to improve their capabilities for knowledge representation and reasoning.

Keywords. interval-valued fuzzy sets, approximate reasoning, lexical knowledge resources, fuzzy logic programming, fuzzy Prolog.

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Multi-adjoint Frameworks, towards a More Flexible Formal World

Keynote lecture

Jesús Medina

Department of Mathematics
University of Cádiz, Spain
jesus.medina@uca.es



Abstract. Multi-adjoint logic programming [10–12], multi-adjoint fuzzy rough sets [1], multiadjoint concept lattices [6–9], multi-adjoint fuzzy relation equations [2–5], etc. These are different frameworks in which the common factor is the multi-adjoint philosophy. This is based on the consideration of an general algebraic structure, called multi-adjoint lattices or algebras, in which the adjoint triples are the underline operators, and the possibility of considering different adjoint triples at the same time.

These operators are defined on general posets or lattices, depend on the specific considered framework, and they do not need to be commutative and/or associative. These general properties together with the consideration of several adjoint triples provides an extra level of flexibility in the framework in which this structure is considered.

This work will present the multi-adjoint algebras, introduce diverse examples, analyze the main features and properties in the main frameworks in which they have been considered and show the first demo of a software which involves different of these frameworks.

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Characterizing the Join Irreducible Elements of Multi-adjointed Object-oriented Fuzzy Concept Lattices

Jesús Medina and Eloísa Ramírez-Poussa

Department of Mathematics, University of Cádiz, Spain
{jesus.medina, eloisa.ramirez}@uca.es

Abstract: This paper introduces a first relation between multi-adjoint formal and object-oriented concept lattices, which is focused on a characterization of the irreducible elements of a multi-adjoint object-oriented concept lattice by the one given in the multi-adjoint concept lattice framework.

Keywords: formal concept analysis, multi-adjoint object-oriented concept lattice, irreducible element

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Minimal Solutions of Finite Fuzzy Relation Equations on Linear Carriers by Cubes

Jesus Medina and Juan Carlos Díaz-Moreno

Department of Mathematics. University of Cadiz, Spain.
{jesus.medina, juancarlos.diaz}@uca.es

Abstract: Fuzzy relation equations, introduced by E. Sanchez in the seventies [11], is an important tool for managing and modeling uncertain or imprecise datasets, which has useful applied to, e.g. approximate reasoning, time series forecast, decision making, fuzzy control, etc. Different results and properties have been studied from its introduction [1, 3, 5].

One of the most important task in this area is the computation of the minimal solutions of a solvable fuzzy relation equation [2, 4, 10, 12, 13, 15–17]. However, restrictive frameworks have been considered in order to solve this important challenge.

The study of characterizations and mechanisms in order to compute the solution set and the minimal solutions, when they exist, is one of our main goals in the last years. See, for example, the recent papers [7, 6, 9].

This paper is a continuation of our last contribution [9] focuses on presenting a new procedure in order to obtain the minimal solutions of this fuzzy relation equation.

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The Existence of Generalized Inverses of Fuzzy Matrices

Miroslav Ćirić and Jelena Ignjatović

University of Niš, Faculty of Sciences and Mathematics, Višegradska 33, 18000 Niš, Serbia
miroslav.ciric@pmf.edu.rs, jelena.ignjatovic@pmf.edu.rs

Abstract: In this paper we show that all fuzzy matrices with entries in a complete residuated lattice possess the greatest generalized inverses of certain types, and we determine criteria for the existence of the greatest generalized inverses of other types. Moreover, we provide an iterative method for computing these greatest generalized inverses, which terminates in a finite number of steps, for example, for all fuzzy matrices with entries in a complete Heyting algebra.

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The IMBPC HVAC System: A Complete MBPC Solution for Existing HVAC Systems

Keynote speech

António E. Ruano

Centre for Intelligent Systems, LAETA
Instituto Superior Técnico and Universidade do Algarve, Portugal
aruano@ualg.pt



Abstract: According to recent studies, energy consumption of buildings (residential and non-residential) represents approximately 40% of total world energy consumption, half of this energy consumed by HVAC systems operation. It is therefore of fundamental importance to control efficiently the existing HVAC systems, in order to decrease energy usage and to increase compliance with the European Directives on the energy performance of buildings and energy efficiency.

Model Based Predictive Control (MBPC) is perhaps the most proposed technique for HVAC control, since it offers an enormous potential for energy savings. This talk will introduce the Intelligent MBPC (IMBPC) HVAC system, a complete solution to enable MBPC of existing HVAC installations in a building. The IMBPC HVAC minimizes the economic cost needed to maintain controlled rooms in thermal comfort during the periods of occupation. The hardware and software components of the IMBPC system are described, with a focus on the MBPC algorithm employed, and the design of Computational Intelligence predictive models.

The installation of IMBPC HVAC solution in a University building by a commercial company is described, and the results obtained in terms of economical savings and thermal comfort obtained are compared with standard, temperature regulated control.

Wavelet Analysis and Structural Entropy Based Intelligent Classification Method for Combustion Engine Cylinder Surfaces

Szilvia Nagy¹ and Levente Solecki¹

Széchenyi István University, H-9026 Győr, Hungary
{nagysz, solecki}@sze.hu

Abstract: Structural entropy is a good candidate for characterizing roughness of surfaces as it is sensitive not only to the general shape of the surface, but also to the rate of the high and low surface points. Wavelet analysis of the surface can separate the larger-scale behavior from the fine details, and together with the structural entropy it can define a behavior profile for the surface which is typically slightly different for new and for worn tribological surfaces. An intelligent fuzzy classification scheme is introduced to characterize surfaces according to both their degree of wear and method of the surface measurement.

Keywords: Rényi entropy, wavelet analysis, surface classification, fuzzy classification

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Improving Twitter Gender Classification Using Multiple Classifiers

Marco Vicente^{1,2}, Fernando Batista^{1,2}, and Joao P. Carvalho^{1,3}

¹ L2F–Spoken Language Systems Laboratory, INESC-ID Lisboa

² Instituto Universitário de Lisboa (ISCTE-IUL), Lisboa, Portugal

³ Instituto Superior Técnico, Universidade de Lisboa, Portugal
m.vicente.pt@gmail.com, {fernando.batista, joao.carvalho}@inesc-id.pt

Abstract: The user profile information is important for many studies, but essential information, such as gender and age, is not provided when creating a Twitter account. However, clues about the user profile, such as the age and gender, behaviors, and preferences, can be extracted from other content provided by the user. The main focus of this paper is to infer the gender of the user from unstructured information, including the username, screen name, description and picture, or by the user generated content. Our experiments use an English labelled dataset containing 6.5M tweets from 65K users, and a Portuguese labelled dataset containing 5.8M tweets from 58K users. We use supervised approaches, considering four groups of features extracted from different sources: user name and screen name, user description, content of the tweets, and profile picture. A final classifier that combines the prediction of each one of the four previous partial classifiers achieves 93.2% accuracy for English and 96.9% accuracy for Portuguese data.

Keywords: Gender classification, Twitter users, Gender database, Text Mining

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Exploiting Dynamics in Social Recommender Systems

Gergely Pósfai, Gábor Magyar, and László T. Kóczy

Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, 1111, Muegyetem rkp. 3, Budapest, Hungary, {posfai, magyar, koczy}@tmit.bme.hu
<https://www.tmit.bme.hu>

Abstract: In this paper we investigate the possibilities of improving social recommender systems through the exploitation of dynamic, temporal features. Dynamic effects are evaluated by empirically analyzing a variety of time-aware extensions of an existing information diffusion based fuzzy social recommender system method, called IDF-Social. We apply fuzzy subsets to model ratings and predictions in the recommendation process, where dynamic features influence the users' fuzzy membership values. Based on our rigorous experiments, we found that social recommender systems can benefit from incorporating dynamic features.

Keywords: dynamic fuzzy recommender systems, social network, information diffusion.

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Generalized Aggregation Functions and Quality Indicators in Overall Telecommunication Network Models: Some Open Issues

Stoyan Poryazov and Emiliya Saranova

¹ Bulgarian Academy of Science, Institute of Mathematics and Informatics, Sofia, Bulgaria
{stoyan,emiliya}@cc.bas.bg

² University of Telecommunication and Post, Sofia, Bulgaria
emilia.saranova@gmail.com

Abstract: In the present paper, an overall telecommunication system normalized performance model, which includes users, terminals and network equipment, has been considered. Two new overall network performance indicators have been proposed, expressed analytically and demonstrated numerically. The graphic presentations, as well as other considerations, show the necessity of a new aggregation function definition, have been presented accordingly. The results received are useful for Quality of Service prediction as a base for future Quality of Experience prognostication, using aggregation functions

Keywords: overall telecommunication system, performance model, user model, quality of service, aggregation function

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