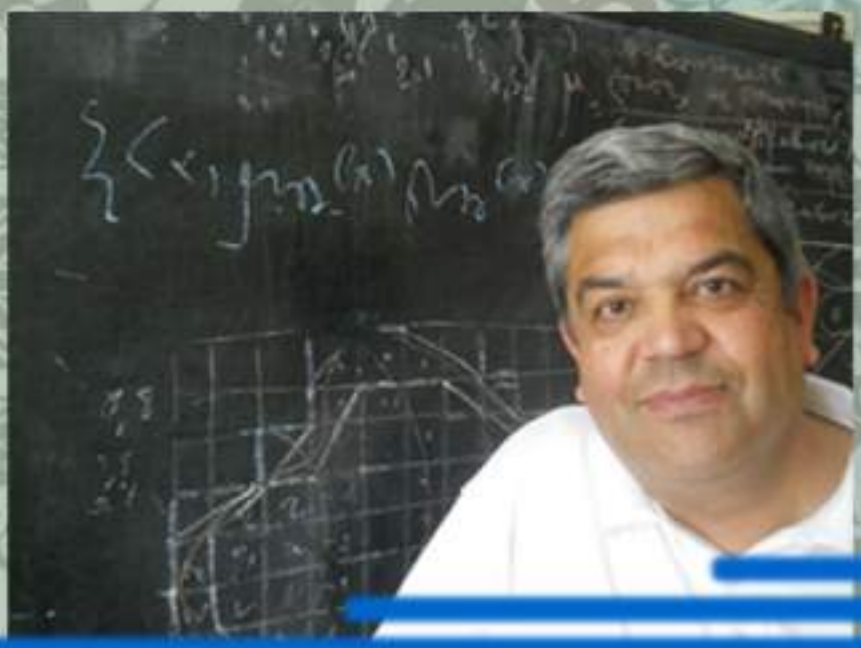
Mathware & Soft Computing

The magazine of the European Society for Fuzzy Logic and Technology

Interview with Prof. Krassimir T. Atanassov
by Eulalia Szmidt

Conference reports

News and calls



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EUSFLAT
EUROPEAN SOCIETY FOR FUZZY LOGIC AND TECHNOLOGY

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Hot Topics

Eusflat Life

World Echoes

Message from the Editor-in-Chief (June 2017)

HUMBERTO BUSTINCE

Here you have the next issue of the Mathware&Soft Computing magazine. As usual, we have put all our effort and illusion in getting an issue as interesting as possible so that all the members of our community (and also those outside from our community who read these pages) can have a good overview of our scientific life.

In this sense, this issue includes a talk between two well known personalities in the fuzzy community: Krassimir Atanassov and Eulalia Szmidt share with us their views, opinions and experiences, providing us with a fascinating view of two lifes devoted to science. I am sure all of us will find extremely valuable this opportunity of reaching the insight of such relevant personalities.

Besides, this issue comes full of news and activities. Let me focus for a while on all these aspects of our work. In my opinion, the rich variety of conferences, publications, Ph.D. Thesis and awards covered in the pages of this issue as well as in those of previous issues reflect better than anything else the intense effort done by all of us for improving, enrichening and renovating our community both with a high quality work and with the permanent inclusion of new, young researchers who are building the future everyday. So I think we should congratulate ourselves, because the pages of this issue are a proof of the fact that our community is full of life.

And regarding this life and the possibilities for the future, do not forget that next September in Warsaw the EUSFLAT conference will be held. I hope as many of us as possible will meet there!

I think now it is time to finish this letter and let you enjoy the contents of the magazine. But, as usual, just one last remark! The magazine is at the end done by all of us for all of us. So, recall that whatever you consider that can be of interest for community, just let us know so that we can publicite it in these pages!

Have a nice read!

Humberto Bustince
Editor-in-chief

Message from the President (June 2017)

GABRIELLA PASI

Dear EUSFLAT members,

in these days the 17th World Congress of the International Fuzzy Systems Association (IFSA) is taking place in Otsu, Japan (June 27th - 30th, jointly with the 9th International Conference on Soft Computing and Intelligent Systems). An important event that that I am very happy to announce and that took place at the IFSA Conference is that Javier Montero has been elected the new President of IFSA. Javier was appointed the President Elect of IFSA during the successful IFSA/EUSFLAT Joint Conference, held in 2015 in Gijón, Spain. I congratulate Javier for this new important role; he will give a great contribution to the Society. Moreover this will be a great opportunity to further strengthen the relations between EUSFLAT and IFSA. I also congratulate Luis Magdalena, who has been elected IFSA Treasurer.

Another important event that will take place next September is the EUSFLAT Conference. The 11th Conference of the European Society for Fuzzy Logic and Technology will take place in Warsaw, Poland, from September 11th to September 15th, under the valuable organization of the Systems Research Institute of the Polish Academy of Sciences (`http://www.eusflat2017.ibspan.waw.pl/`). Several special events and celebrations are planned at the conference, including the conferral of various awards. During the conference the EUSFLAT General Assembly will take place, and a new President and Board will be elected. Time quickly goes on, and soon this EUSFLAT Board will end its term to welcome a new President with a new Board.

I have been very honored and happy to serve as the EUSFLAT President for four years, and to work with the colleagues and friends in the Board, who I warmly thank for sharing with me this nice experience. During the four years of my presidency several events have happened; in this last letter as a President I would just like to remind the most important initiatives that this EUSFLAT Board has promoted. A core issue has been to make young people central in the life of the Society. A first action that has been undertaken to this purpose is to increase the number of Student Grants offered to both the EUSFLAT Conference and to various conferences endorsed or supported by EUSFLAT. Student grants allow PhD students to submit their research articles and to present them to the research community (`http://www.eusflat.org/members_grants.php`). Moreover, the EUSFLAT conference keeps supporting the Best Student Paper award, and the EUSFLAT Best Ph.D. Thesis award (rules for applicants can be found at: `http://www.eusflat.org/awards.php`).

This year, for the first time EUSFLAT defined an agreement with the IEEE International Conference on Fuzzy Systems, which will take place in Naples, on July 10th - 12th (`https://www.fuzzieee2017.org`). The conference will apply a reduced registration fee to EUSFLAT members, while EUSFLAT has offered to the conference some Student Grants. In addition, EUSFLAT has promoted the Italian Fuzzy Pioneers Awards that will be given during the conference. Distinguished Italian scientists who contributed to the initiation and spreading of research on Fuzzy Sets and Fuzzy Logic in Italy will be awarded (many congratulations to Antonio di Nola, Mario Fedrizzi, Giangiacomo Gerla, Salvatore Sessa, and Settimo Termini!)

An important initiative that has been launched by this Board is the EUSFLAT Summer School in Fuzzy Logic and Applications (SFLA school), which for the first time took place in 2015 in Italy. The School has been conceived as an annual event addressed to PhD students and to young researchers, to the aim of introducing the core aspects and recent developments of Fuzzy Logic and related applications, and to give students the possibility to interact with internationally recognized experts. Moreover, such an initiative is a way to set up collaborations and to increase mobility in our scientific network, by making it alive and dynamic. The second SFLA school took place in Čeladná, Czech Republic on August 14th -19th , 2016, and it was organized by the Institute for Research and Applications of Fuzzy Modeling, University of Ostrava (Czech Republic). On July 17th - 21st, 2017, the third SFLA school will take place in Santiago de Compostela (Spain). The school will consist of several courses centered on core aspects and recent developments of Fuzzy Logic and related applications, including two sessions inside-the-lab. For the first time at SFLA, the best student presentation will be awarded. Many thanks to Jose Maria Alonso for the attention he is devoting to the organization of the school. The link to the Web Site of the School is the following: `https://eventos.citius.usc.es/sfla2017`.

Another new initiative launched by the EUSFLAT board I presided is related to the promotion of EUSFLAT Research Centres, which has been conceived to motivate and support the generation of excellent research centers in the topical areas of EUSFLAT. A EUSFLAT research centre is aimed to "seal" existing or newly generated research centres that are focused on fuzzy logic and on related technologies, and that are strongly engaged in EUSFLAT activities. Detailed information can be found on the EUSFLAT Web site: `http://www.eusflat.org/research_research_centre.php`.

During the last four years two new working groups have been launched: the Working Group on Intuitionistic Fuzzy Sets: Theory, Applications and Related Topics (coordinated by Sotir Sotirov, Vassia Atanassova, Peter Vassilev, Alžbeta Michalíková), and the Working Group on Fuzzy logic-based decision modeling in economics and social sciences (coordinated by Gisella Facchinetti, Mario Fedrizzi, Benedetto

Matarazzo and Aldo Ventre). Moreover two Working Groups have been renewed, by appointing new coordinators: the working group on Soft Computing in Image Processing is now coordinated by Humberto Bustince, Etienne E. Kerre, Javier Montero, and Irina Perfilieva, and the working group on Mathematical Fuzzy Logic is now coordinated by Brunella Gerla and Tommaso Flamini. (`http://www.eusflat.org/research_workinggroups.php`).

As I previously mentioned, several awards have been and will be conferred in these years. In particular, at the forthcoming EUSFLAT conference in Warsaw the EUSFLAT Honorary Membership will be conferred to Janusz Kacprzyk, and two EUSFLAT Scientific Excellence Awards for 2017 will be conferred to Bernadette Bouchon Meunier and Radko Mesiar. Congratulations to our estimated colleagues for this deserved recognition! Also the best PhD thesis Awards for the years 2015 and 2016 will be given in Warsaw: the evaluation committee is working to this aim. I remind that the EUSFLAT 2013 Best PhD Award went to Miguel Ángel Olivares Méndez for his PhD entitled "Soft-Computing Based Visual Control for Unmanned Vehicles", and the EUSFLAT 2014 Best PhD Award went to Tarad Jwaid for his PhD entitled "Semilinear and semiquadratic conjunctive aggregation functions". In addition, I would like to remind that in 2013 the EUSFLAT scientific excellence award was conferred to Petr Hájek and the EUSFLAT Honorary Membership to Irina Perfilieva At the following link you can find further information about the EUSFLAT Awards, including the Best Student paper awards conferred in 2013 and 2015: `http://www.eusflat.org/awards.php`.

Another point that it is worth mentioning is that the EUSFLAT Magazine (Mathware and Soft Computing) has changed its editorial strategy and it is keeping growing during the last years. Many thanks to the whole editorial team for their valuable work!

In closing this letter I would like to warmly thank several people:

1. all the board members: with you and your help this experience has been positive, enriching and invaluable. Thank you!

2. the evaluation committee of the EUSFLAT best PhD Award, composed by the Honorary Members of EUSFLAT: Francesc Esteva, Enric Trillas, Ulrich Bodenhofer, and Irina Perfilieva. Thank you for your continuous support and for guaranteeing a high quality to the selection process.

3. the EUSFLAT Excellence Award Committee, composed by: Ulrich Bodenhofer, Didier Dubois, Francesc Esteva, Luis Magdalena, Javier Montero. Thank you for your excellent support and for your availability.

Last but not least, my warm congratulations and best wishes to the next EUSFLAT President and Board.

I wish all of you and your families a beautiful and restful summer.

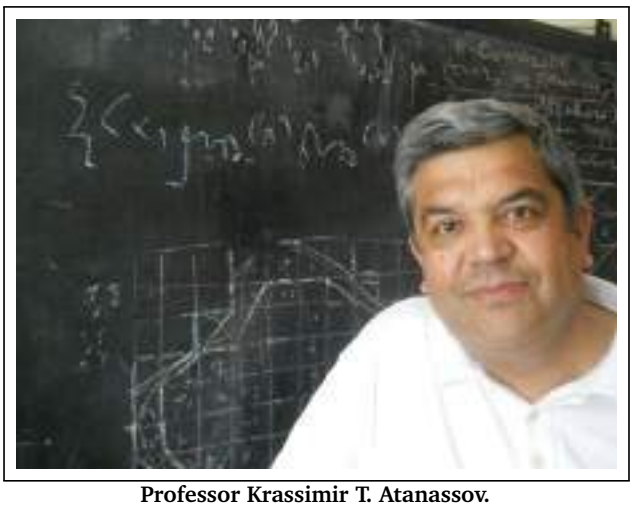
With my warmest regards

Gabriella Pasi
President of EUSFLAT

INTERVIEW

Known and unknown faces of Professor Krassimir T. Atanassov

Eulalia Szmidt



Professor Krassimir T. Atanassov.

EULALIA SZMIDT: I know that your father was an artist, a painter to be more precise. Thus, I guess that the atmosphere at home was artistic rather than scientific. When and how your scientific interests have started?

KRASSIMIR T. ATANASSOV: The atmosphere at home was normal, but in my father's studio, per my mother's words, "total chaos" reigned. And maybe afraid not to "disorder" it, he wouldn't let me in for long. Shortly before he died, he expressed for the first time regret that I hadn't become an artist like him. But the truth is that he never showed me how he was painting, never told me why he had chosen to draw a streak here, or a colour blot there, what he was thinking in the moment of drawing. When I was in school, he would send me to a friend of his to teach me drawing, and I learnt a lot from that man, but obviously not enough to become a painter myself.

Before high school, I also attended piano and music theory lessons, courses in mathematics, physics, chemistry, biology; I trained basketball for a while, and for some four years I was the city chess champion in my age group. I guess I learned quite a lot from these lessons back then, but it?s hard to estimate nowadays how they have helped me in real life afterwards. In high school, my teacher in physics opened my eyes for astronomy, giving me a portable telescope to use, and I regularly made observations, as much as it was possible with an amateur device. Unfortunately, only once I forgot to place the sun filter and looked at the sun, and for many year since then I had to permanently use sunglasses.

In 1970, after the end of 9th grade, I attended a summer mathematical school in my hometown Bourgas, on the Black Sea coast. Having listened to a lecture on Sperner's Lemma, on my way home I began thinking of a way to generalize it. It so happened, that it took me twenty years to prove my generalization. After Prof. Erdős' recommendation, it was published in Studia Scientiarum Mathematicarum Hungarica in 1996. An idea that had occurred to me so spontaneously, determined my life forever.

In my next year in school I had to write an essay on Homer's Iliad. The theme I developed was something like the following: Aphrodite, Hera, and Athena asked Paris to choose one of them as the most worthy of the golden apple. Another goddess, Themis, overheard the conversation and intervened. According to her, each of them four might have claims on the apple. However, "should Athena give her wisdom, Hera give her power, Aphrodite give her beauty, and I give my precision, we would create a new goddess, and name her Mathematica. She would be the one to deserve the golden apple". My teacher's patience had, no doubt, been challenged, but he was a fine person with a good sense of humour...

A photocopy of the first original IFS paper in Bulgarian in 1983.

E.S.: I had the pleasure to meet you for the first time in Sofia during one of the first conferences on a generalization of fuzzy sets, i.e., intuitionistic fuzzy sets (IFSs). How did you arrive at the idea, what was your inspiration, how has the area been developing.

K.T.A.: For me, 1982 started happily. In January my daughter was born, and in June I was notified that my first two papers on e-nets, which back then were the first existing extension of Petri nets, were highly evaluated and the objects discussed there had stronger modeling capacity compared to e-nets, which is why R. Grutzner had named them "generalized e-nets". This stimulated me to define a new extension of the Petri nets that would contain as particular cases the rest extensions of Petri nets which I knew of back then, as well as those that would later appear in the works of other researchers. For this reason, this new extension was

named “generalized net”. In it, tokens enter the net with initial characteristics, move from place to place, getting (and storing) subsequent characteristics, while their direction of movements depends on the truth value in a matrix of predicates.

The end of that year was not so happy though, as I suffered gouty arthritis giving me pains in the fingers and knees for a long period of time. One day, I met in the street one of the prominent Bulgarian philosophers, Acad. Azarya Polikarov, who also had problems with gout, and who kindly supplied me in early 1983 with a cure from France. During the next more severe gout crisis that year, equipped with the cure and the Russian translation of A. Kaufmann’s book “Introduction à la Théorie des Sous-Ensembles Flous” (the first book on fuzzy sets that appeared in Bulgarian bookstores), I entered the hospital. I should note here that while I was a student, one of my respected teachers claimed with conviction that fuzzy sets were nonsense. I started reading this book in the hospital, and as a “mathematical game” I started altering the definition of the fuzzy sets and the operations over them, adding a second component to them: the degree of non-membership. At the end of my hospital stay, two interesting things happened, which to a certain degree determined the further events. I don’t remember any more which happened first, but this is what happened.

The physician who administered my treatment, Dr. Joseph Sorsich, asked me to process his observations of 22 patients, using the least squares method. I told him that his data are too little for obtaining valid results, but as I didn’t want to sadden him that he wouldn’t have a paper for some medical conference, I offered him to describe the diagnostic process of gout arthritis, using generalized nets. The paper we prepared together got a warm welcome, and in the next years 800 similar generalized nets models in various areas of medicine decision making appeared. Unfortunately, after Dr. Sorsich’s death, I couldn’t find another enthusiastic erudite in the area to work with in order to complete the work related to the generalized net modes of different organs and systems in the human body.

The second interesting event during my hospital stay was related to the idea to define about the new kind of sets some new groups of operators, analogues to the existing “necessity” and “possibility”. To my utter surprise, I noticed that using these new operators, these sets lose their sense for the case of fuzzy sets, while it fosters meaningful results for the case of the new sets I had defined. Therefore, when I left the hospital, I immediately visited George Gargov, who was an Assistant Professor of mine in the Faculty of Mathematics and Mechanics at the Sofia University. Getting familiar with my notes, he offered me to call the new sets *intuitionistic fuzzy sets*, because their meaning relates with Brower’s concept of intuitionism in the way that the Law of Excluded Middle was not valid for them. And, yes, in the case of the new sets, the elements have both a degree of membership, and a degree of non-membership, where the latter does not necessarily complement the formed one to 1, but may be smaller. This gives rise to the third degree of uncertainty that complements the sum of the two degrees of membership and non-membership to 1. Thus, in 1989, I learnt that this idea was also offered by the Russian mathematician A. Narinyani, and I immediately noted this fact in the next paper I prepared for publication. It was then again that I discovered the paper by G. Takeuti and S. Titani which introduced under the same name another kind of sets with a different definition. At the beginning of this century, a discussion arose about which of the two kinds of sets shall be given the name *intuitionistic fuzzy sets*. As I noted in my paper from 2005, the sets defined by me had been originally defined a year and a half before those of G. Takeuti and S. Titani, and as of the date of their publication, 6 other papers of mine had been published already. Hence, at least in the moral aspect, I find it justified to defend the priority of the objects that I had defined, over the name *intuitionistic fuzzy sets*.

E.S.: This question was to be on your, as I was thinking, second field of interest, namely Generalized Nets (GNs), but I see that both concepts were born almost the same time. Were you working on them in parallel or had you to concentrate officially (in work) on one of them? Had you combined Generalized Nets with intuitionistic fuzzy sets?

K.T.A.: Having completed my university studies, I started to work as a programmer in the Institute of Physics at the Bulgarian Academy of Sciences. On the very first day, my director told me that he was preparing a habilitation thesis and he wanted to have a PhD student under his supervision. He directed me to the area of pattern recognition, but a year later he changed his thematic scope, and thus changed mine as well ? to design of printed circuit boards. I had to start learning and developing algorithms and programs for printed circuit board projecting. By this moment, as I said, the ideas about generalized nets and intuitionistic fuzzy sets had occurred to me, almost simultaneously. I soon realized that two vast unknown territories stay there in front of me, alluring me with their obscurity and this stimulated me to delve in both of them. In the beginning, I was most actively engaged in GNs; between the years 1984 and 1990, only in the series of the journal AMSE Press, published by Prof. G. Mesnard in France, I published more than 100 papers, as well as many other papers in journals and conference communications. Of course, I soon saw the opportunity to combine the two concepts. In 1985, I published in AMSE a paper that defined the concept of intuitionistic fuzzy generalized net, which included as a very partial case the fuzzy Petri net that was introduced by C. Looney three years later.

It cost me a lot of trouble, but I managed to win the right to prepare my dissertation on the topic of generalized nets.

I wrote it for a year and a half, and after defense I had to choose between development of application software for a microcomputer operation system (the new thematic of my director's habilitation ? the third one he never wrote), or leave the Institute. I chose to leave. Three months later I joined the Artificial Intelligence Laboratory at the Institute of Microprocessor Technology. During the job interview, I was asked what programming languages I have command of, I answered: consider them none. I got the job in competition with an applicant who claimed to work with more than twenty. I also got the liberty to work on the areas that absorbed me, and my colleagues also got interested in GNs and IFSs, which stimulated me to work actively in both fields. A series of extensions of IFSs appeared, like Interval Valued IFSs, IFS oved Different Universes, Temporal IFS, as well as various aspects of the theory of GNs ? algebraic, logic, topologic, functional. Apart from the GN models in the area of medicine that I mentioned, together with colleagues of mine from my new institute, we prepared a series of papers describing GN models of the functioning and the results of the work of an arbitrary expert system. It turned out that there can be constructed a GN that is universal for the class of all expert systems. At a conference in my Institute in 1991, I formulated the idea that would be my priority: to describe all areas of the Artificial Intelligence with the uniform mathematical language and apparatus, that of the generalized nets. This would allow for more detailed models of real processes. For 26 years already, I have been working on this idea.

E.S.: Most people from our area know about your works concerning IFSs and GNs. But you are also, or maybe I should say, mainly interested in the theory of numbers. You are a mathematician who not only studied mathematics but also publishes strictly mathematical papers and books. Tell me please how did you arrive at this area, or maybe it was your first interest.

K.T.A.: When I was a student, I wasn't among the excellent students, but I opted to attend much more than the obligatory lecture courses. I started taking notes of the more interesting ideas that occurred to me while listening to lectures or while preparing for exams. In my third year, I encountered a problem related to partially symmetric functions. I found a solution and reported it in front of the Faculty's seminar on discrete mathematics. The moderator of the seminar praised me, but none of the listeners ever tipped me that I might publish this result, and I also had no clue about how to do so. Several years later we were travelling together with my wife and two friends of ours in what is arguably the most picturesque Bulgarian mountain, the Rhodopes. On our way, we passed through Plovdiv and I visited the Russian bookshop and bought several scientific books there. While the rest of the group went for a supper after the tiring excursion that day, I decided to go to bed with one of the books, published in that same year, 1981. I was shocked to discover there the solution of that problem over partially symmetric functions. Then, in the silence of the night, I realized that if I am to actively do mathematics, first I need to learn who has published what in all the areas of mathematics I am interested in. Back in Sofia, I started putting my idea into effect. For about a year, I made a thorough, systematic research of all volumes of the *Russian Referativny Zhurnal Matematika*, the *American Mathematical Reviews* and the *German Zentralblatt für Mathematik* which were available in our libraries. I was annotating them for myself, taking more than 7000 notes, which I still keep today, and I subscribed for the *Referativny Zhurnal*, the only one of the three we could subscribe for from Bulgaria back in those days. I discovered that many of my ideas from the time I was a student had actually been well known, and moreover, often formulated in a much more general form. I noticed that some statements that I had checked for $n = 1$ and $n = 2$, and was planning to check for larger values of n, were actually not true at all. But I also encountered a series of interesting new ideas.

In 1983, conversing with colleagues from my first Institute (of Physics), when asked if I can give an example for parallel behaviour in mathematics, I had the idea about two Fibonacci sequences having their members swapping. Afterwards, I realized that I had actually given a completely inaccurate answer to the question asked, but the idea about the two Fibonacci sequences seemed interesting to me. Luckily, the Institute?s library was subscribed for the *The Fibonacci Quarterly journal*, and I immediately started out examining all its issues but I didn't find any similar idea. This was my impetus to write a paper on this topic, and after its positive referee report, I was inspired to write a whole series of papers, describing different new extensions of the Fibonacci sequence. It was first my wife, and 15 years later - my daughter, who got involved in my work in this direction.

Krassimir Atanassov and Januscz Kacprzyk.

It was again in this moment of time that I encountered a problem on arithmetic functions, formulated by A. Mullin. For a whole month, I was going to bed and waking up with the thought about this problem until I found a solution that was published in the *Bulletin of Number Theory and Related Topics*. For me, this first paper was the cue for more than 50 other papers of mine in the area, written and published by now. Following an idea of Prof. Aldo Peretti, then editor of the Bulletin and of Prof. Anthony Shannon, in 1995, we started publishing the journal *Notes on Number Theory and Discrete Mathematics*. The same year, together with Prof. Humberto Bustince and Prof. Janusz Kacprzyk, we also started publishing the journal *Notes on Intuitionistic Fuzzy Sets*.

E.S.: When did you meet Prof. Zadeh for the first time? Did the meeting influence your research?

K.T.A.: I met Professor Zadeh for the first time in Vila-Real,

Portugal, in 2001. He impressed me first of all with his vitality - he was exactly 80 years old and talked for 3 hours nonstop. Besides, he formulated a bunch of interesting problems, and at the end of his lecture he showed slides with articles by Gödel and Kleene, in which they criticized the fuzzy sets. Only then I figured out the negative opinion some Bulgarian logicians had for the fuzzy sets. It took me 10 years to fully comprehend what I had heard back then and once again to convince myself that even luminaries can be wrong. I think these two world-famous logicians were concerned that with the evaluations of propositions belonging to the $[0, 1]$ interval, they could potentially be irrational numbers. In my book "On Intuitionistic Fuzzy Sets (Springer, Berlin, 2012)" I have shown that if degrees of truth and falsity are constructive objects (e.g., rational numbers), the operations and operators defined over the IFS will retain their constructiveness.

Krassimir T. Atanassov and Lofti A. Zadeh.

My second encounter with Professor Zadeh was two years later in Zittau, in 2003. In 2004, the second IEEE Conference on Intelligent Systems was to be organized in Varna. So I invited Professor Zadeh to participate in it, and he said he had to check out his commitments. He took out his notebook, browsed through it, and at one point he exclaimed, "Oh, that's for 2005," and took out the one for 2004. How many 82-year-olds are working in the perspective for at least two years ahead! From my next meetings with Professor Zadeh, I also keep exciting memories.

E.S.: Tell us please about the meetings with other foreign colleagues.

K.T.A.: My first contact with foreign colleagues was in 1988 when I received a letter with papers by Professor Toader Buhaescu. I was first visited by the Spanish Professor Humberto Bustince, then holding a PhD degree. During his next visit in 1994, we decided to stat publishing the international journal "Notes on Intuitionistic Fuzzy Sets". Together with him and Prof. Janusz Kacprzyk we have been publishing this journal for already 23 years. This same year, 1994, I met for the first time Janusz as well, at a conference organized in Sofia. As of the next year, we had already had a running collaboration between our institutes, meeting every year at least twice, in Warsaw and Sofia, where we organize international conferences on IFSs and generalized nets. In Poland I have many friends, two of whom - Eulalia Szmidt and Maciej Krawczak have defended their Doctor of Science degrees defended in Bulgaria, respectively by IFSs and GNs. A few years later, they were followed by Panagiotis Chountas from the UK.

Krassimir Atanassov, his student, Maciej Krawczak, Peter Vassilev, Eulalia Szmidt, Belo Riecan, Panagiotis Chountas, Sławomir Zadrożny.

Also in 1994, my guest for the first time was Professor Anthony (Tony) Shannon from Australia, with whom we started to publish the International Journal "Notes on Number Theory and Discrete Mathematics". For 20 years, Tony was visiting me on an annual basis and over the years we have written more than 15 joint books. After these first meetings, and especially since I myself started attending conferences (albeit not very actively), the number of colleagues I have met and became friends with, has been constantly growing. I have collaborated on various articles with people from more than 15 different countries.

E.S.: You have been publishing a lot. Which are your main works (in one area, or maybe in all the areas of your interests).

K.T.A.: In 1990, Prof. G. Mesnard motivated me to write a book on GNs. In was published in 1991 by *World Scientific*. The next year, I wrote a continuation and then started a book on IFS. George Gargov had just returned from a sabbatical year in the United States and told me about a colleague of his who planned his yearly research in such a way that between January and October he was writing papers, and in the last two months of the year compiled them in a book. This idea appealed to me a lot, and I tried it on the next year, but I realized it was not as good as it seemed: you write, and write, and write, and then you get fed up and lose enthusiasm for some time, and then you have to force yourself into writing again... Then I decided that if one writes two books at a time, when one gets stuck and fed up with one of them, one can always opt to switch to the other. But 20 years ago, I changed this scheme again. Since then, I started working on three books at a time, and whenever I get tired with one of them, I have the freedom to switch to whichever of the other two appeals to me more in that moment. Every year, I have at least one new book published, but there are also books that I have been working on for quite a lot of time. For instance, in early 2017, Springer released my book on *Intuitionistic Fuzzy Logic* that I had been working on since 2000. And I still have an unpublished manuscript of a book on number theory that I have been working on

since 1995. In the meanwhile, I published four other books in this area, two of which (in an American publishing house) solving 60 problems, formulated by F. Smarandache, one on Fibonacci sequences (in World Scientific) and two years ago in a Polish publishing house ? on a modifications of Pascal triangle. Together with other coauthors, I published a series of seven volumes in which we described GN-models describing the functioning and the results of the work of: expert systems, different machine learning algorithms, Ant Colony Optimization, neural networks, genetic algorithms, and as books outside of this series ? pattern recognition, speech recognition and decision making procedures. Some colleagues of mine accuse me of graphomania, and I do my very best to prove them right :-). The truth is that I still have numerous and quite interesting things that can be done on the areas of mathematics that I find intriguing. After that Russian book I read during the trip in the Rhodopes, there have been other occasions when I have seen other authors implementing ideas that have occurred to me as well. For 30 years already, I have been attributing one operation over IFS to the Romanian mathematician Toader Buhaescu although all of his results can be found in my own notes from the first 1-2 years since the introduction of IFSs. That is why whenever a new idea occurs to me, I try to publish it quickly. And in each paper or book I am reading, I am always looking for the interesting ideas, and while reading, I am constantly asking myself how that idea can be generalized, and what follows from its generalization.

E.S.: Are young people in Bulgaria willing to do science and what are your methods working with them?

K.T.A.: Up to now, I have 31 successfully defended PhD students, and 8 who are currently preparing their dissertation theses. One of my ex-students has already become a full professor, 10 are associate professors, and 5-6 others will soon apply for associate professors. Reading academic lectures in Bulgaria is not a road to wealth, but I am doing it only to find motivated students to work on my ideas. In the end of the first lecture course that I read almost 30 years ago, I offered the students to write a paper instead of being examined in the usual way. I helped the authors of the best works to publish their papers alone, without my participation. Since then, this is the main form of examination in my courses, despite that I have had two of my courses discontinued with the claim that I am examining in an "unpedagogical" manner. Moreover, I offer the authors of the best papers to start their master theses under my supervision, and those who excel in that, to become my PhD students. More than half of my PhD students have started this way. Having PhD students who are willing to do science is pleasure. Unfortunately, their number decreases with each year, but I still keep contacts with most of my students and we keep collaborating over time.

E.S.: You have already mentioned astronomy among your interests. During my first visits in Bulgaria you were telling what was going on above in the sky. Do you still have time to use your telescope?

K.T.A.: As I said, my interest in astronomy started in high school. As a student, I was writing programs for some of the leading Bulgarian astronomers. In the 1970s, in Bulgaria there was practically no market even for small amateur telescopes. And it was pure luck that my father could buy such a telescope from private persons. With this telescope I took part in solar and lunar eclipse observations, and meteor showers observations. Alas, for the last 20 years, my telescope has been gathering dust in a closet...

Krassimir Atanassov and his students.

E.S.: History is another interest of yours. I was amazed when you were talking in details about one of our Polish kings. Later I got accustomed that you are like a perfect guide in the museums we were visiting after the conferences in Bulgaria. How did your history interests started?

K.T.A.: In the first four years at school we had one teacher in all subjects. He himself was studying history part-time. So, when we started studying history in our third year, he would tell us about our country's history in much more detail than what was written in the textbook. In the first days of the schoolyear our teacher examined me in front of the rest of the class, I don't remember any more in which subject. Since I was the tallest boy in the class, many of my schoolmates made fun of me. After the exam, while I was walking back to my desk, the teacher also jested about my size. My first thought was to leave the room, but I was afraid. I didn't share my bitterness with anyone at home, but I made up my mind to take revenge. My father had bought the most complete book on Bulgarian history back then, which was just released in the bookstores at that moment. I started reading it diligently, and during the next history lesson, after he told us as usual more details than those presented in the textbook, I stood up and added even more facts to those he had just mentioned. That puzzled him. The next lesson this happened again, and the third time, after he had finished examining some of my classmates, he challenged me to present the new lesson to the whole class instead of him. I did it. He never examined me again until then end of the year, and I continued to study our Bulgarian history more diligently than anyone else, as I did in the next years as well, finding it very interesting. And by this day, I still read with pleasure historic books and memoirs. Years ago I used to know by heart the years of birth and death of more than 500 mathematicians and more than 1000 other notable persons, but I have started forgetting them, as I am growing old...

We can see among others: Vassia Atanassova, Janusz Kacprzyk, Eva Sotirova, Sotir Sotirov, Maciej Krawczak, Patricia Melin, Oscar Castillo, Krassimir Atanassov.

E.S.: You propose visiting very interesting places in Bulgaria at the end of the conferences you organize. I know that you like this form of resting with your family, too. Did you start this sort of activity with your parents or later?

K.T.A.: As I already mentioned, I was born in Burgas, on the Black Sea coast, where there are no mountains. I became a tourist only after I started studying in Sofia University. Unfortunately, after I started suffering gout arthritis, I practically stopped climbing mountains, although we have many mountains in Bulgaria, and I used to enjoy them...

E.S.: I know that you like driving a car. You told me you rested when driving. Which was your longest car trip? I guess it was a trip connected with one of the conferences, and probably with visiting lots of places on the way.

C.M.: Definitely, for me driving is pleasure, one of those pleasures which replaced my joy of mountaineering. It has happened hundred times when I start driving tired or annoyed, and 50-60 km later I am already fresh and relaxed. Several times I have made one-day trips of more than 1000 km around the country, and for the last 10-12 years I have been travelling with members from my team by car to Poland for the annual workshops on intuitionistic fuzzy sets and generalized nets, organized by Janusz Kacprzyk. These trips to Poland take two days, with the nights spent in Banská Bystrica, Slovakia, and the first leg of the trip from Sofia usually takes 1000 - 1100 km, depending on the chosen route and on the places along it where I skillfully manage to get us lost :-).

E.S.: At the end I would like to ask about something I was told by your students. Is it true that you are reading books when walking to work?

K.T.A.: It is true, it is my habit for years to walk the street reading a book. And the reason for this is quite weird. In 1970s I was doing my military service in Sofia and then studied mathematics in Sofia University. So my parents purchased an apartment in Sofia, in the apartment building of the Union of Artists, where all my neighbours were my father's acquaintances. However, I'm very bad in memorizing faces and names and nowadays, almost 40 years of living in this building, I still know about 30% of the people by face, and about 30% of them by name, where these two sets do not obligatory coincide.

But just a week after I started living in the building, some of my father's colleagues started complaining how haughty I was for not greeting them. It was then when I started taking a book with me and reading while walking the streets. Thus the neighbours whom I am passing by, and failing to greet, do not get so angry. Unfortunately, the problems of not recognizing acquaintances is a problem I can not handle, and not once or twice in my life it has made me look funny and sometimes even stupid. On the other hand, I'm already so used to reading on the streets that when I do not have a book to read while walking, I feel uncomfortable ? like I'm wasting my time. All the more that I have so many books to read.

Since early May 1983, I started writing a diary. My enquiry with my diary shows that for these 34 years, I have read a bit more than 5700 books, while my home library contains more than 12 000 books. I plan to read the rest by my 100th anniversary.

CONFERENCE REPORT

FuzzyMAD 2016

Once again, FuzyMAD seminar held at Complutense University of Madrid, with the declared aim of serving those researchers within Madrid region interested on fuzzy sets and soft computing as an opportunity to meet and explore joint adventures. The 9th edition of FuzzyMAD was organized by the FORaid group at Complutense University, in collaboration with the CASI-CAM-CM network, which is participated by four Universities of Madrid: Autonomous University of Madrid, Carlos III University, Technical University of Madrid, and Complutense University.

FuzzyMAD 2016 seminar started at 8:45 and finished at16:00, with the participation of a 62 researchers in total. In the first section of the seminar, three invited speakers gave talks mainly oriented to Ph.D. students: Daniel Hernández-Lobato gave a talk on "Optimization in Automatic Learning", Joaquín Miguez gave a talk on "Stochastic filtering and approximation algorithms", and Javier Yáñez gave a talk on "Support Vector machines". In the second section of the workshop, some Ph.D. students made a short presentation about their Ph.D. projects (Pablo Flores, Adán Rodríguez, Rubén González, Fabián Castiblanco, César Guevara, Adolfo Urrutia, Miguel Martín, José Luis González Sánchez and Carely Guada). In the open discussion, senior researchers made helpful suggestions about their research. And in the third section of the seminar we had the traditional buffet lunch around the posters each group had prepared about their activities. In this way, we could discuss about possible future collaborations and next joint projects.

FuzzyMAD 2016 was possible thanks to the support of the Government of Spain (grant TIN2015-66471-P), the Community of Madrid (grant S2013/ICCE-2845), the Institute for Interdisciplinary Mathematics (IMI), and the passionate dedication of Pablo Flores, Daniel Gómez, Carely Guada, Javier León, Javier Martín, J. Tinguaro Rodríguez, Karina Rojas, Begoña Vitoriano and Javier Yáñez.

Something special will be prepared for the next 10^{th} FuzzyMAD edition in 2018!

Javier Montero,

Javier Montero
Complutense University of Madrid
Spain

NEWS

Enric Trillas: Master, Scientist, and Humanist - Honorary Doctor from the University of Santiago de Compostela

Senén Barro, Alberto Bugarín, and Alejandro Sobrino

On June 17, 2016 Professor Enric Trillas received the honorary doctorate from the University of Santiago de Compostela, Spain (USC), that has recently published a book featuring the speeches delivered during the ceremony. The application, which was submitted by the authors of the present review, was enthusiastically supported by our university centers and departments. The title of the speech in praise of Professor Trillas was the same of the chapter that the three of us wrote as part of a tribute book dedicated to him in his 75th birthday - the same words we have once again chosen to be the title of this review, as we believe they accurately describe our beloved professor.

In his speech, Juan Viaño, mathematician and Rector of the USC, stated that Professor Trillas deserved the honorary doctorate not only because of his remarkable scientific work, but also because of his personal qualities. He earned such recognition thanks to his exceptional scientific career: not only he created multidisciplinary research teams that accomplished extraordinary achievements, but also he promoted science from his important position as President of CSIC (SpainâĂŹs National Center for Scientific Research). By awarding him with the honorary doctorate, the USC recognized Professor Trillas as a valuable person and professional.

Only those who have made extraordinary contributions to the USC and whose career has significantly promoted the development of a specific field of knowledge are bestowed with such recognition. Having the ability and the will to keep devoting one's work to the university in the future is also valued. Enric Trillas was discovered by the USC fifty years ago, in 1967, when he presented one of his papers at a mathematics annual meeting, which took place at the USC. In 1985, Alejandro Sobrino and Juan Vázquez, now Philosophy Professors at the USC, asked him to be SobrinoâĂŹs PhD director. Trillas accepted immediately. This was the first step that led to Trillas' fruitful collaborations with Professor Sobrino and his Department of Logic and Philosophy of Science, with the Department of Electronics and Computer Science, and the Research Center in IT (CiTIUS), where Senén Barro and Alberto Bugarín develop their activity. In these thirty years of close collaboration with our university, Professor Trillas shared with us the best of his personal and professional qualities. As a visiting professor, he trained and guided emergent researchers, delivered seminars and conferences, delimited research lines, and contributed to numerous scientific research and divulgation projects. Trillas was also one of the pioneers that increased the importance of the USC's international role - our university hosted renowned conferences dedicated to science, such as the 26th IEEE International Symposium on Multiple-Valued Logic (1996).

Professor Trillas, USC's Rector Juan Viaño, and Senén Barro, godfather of the ceremony

In his speech, Professor Trillas asserted that theoretical fuzzy logic is undergoing a crisis. A symptom of this,

he said, is the excessive amount of mathematical, descriptive research works that have led to a kind of “theology of fuzzy logic”. The number of publications approaching fuzzy logic has, indeed, increased exponentially in the last decades. However, this has not translated into a corresponding amount of publications and solutions proposing applications that are actually useful. Even though we acknowledge that the value of scientific publications goes beyond the possibility of applying what they propose to solve actual problems, we believe that mathematical proposals should stop being published only because they are, let’s say, academically showy. If the market is used as a criterion for the development and commercialization of applications, rigor in the selection processes should be required when evaluating theoretical and methodological proposals âĂŞa requirement that, as happens in others fields of knowledge, is not always fulfilled in the academic scientific scene.

Enric likes to cite the much quoted words by Theodore von Kármán’s: “Scientists discover the world that exists; engineers create the world that never was.” It is maybe due to his itch for exploring the world of applied science that Professor Trillas devotes part of his work to creating AI systems - that are able to understand and adequately process vague instructions. Professor Trillas exploited his abilities and outstanding background in mathematics to make contributions to the fields of computing and AI in particular - a field that can only benefit from mathematics, and where the discipline can only grow. For his remarkable contributions to this increasingly fertile branch of computer science, along with his long-standing career at our university (which is now his home, too), Professor Trillas deserved to be awarded with the honorary doctorate from the University of Santiago de Compostela.

NEWS

Professor Janusz Kacprzyk awarded Honorary Doctorate by the Lappeenranta University of Technology

LUT, Finland

Professor Janusz Kacprzyk has been awarded one of the 14 honorary doctorates of the Lappeeranta University of Techonology, the highest honour bestowed by a universty. Professor Janusz Kacprzyk is a world-class expert in fuzzy sets and soft computing.

In the LUT strategy, his expertise relates to sustainability in especially water consumption and waste, and decision-making and big data in digitalisation.

Kacprzyk holds a number of international scientific positions of trust, and he is also an active visiting professor in many countries. He is editor-in-chief of several scientific journals and has won various international science awards.

NEWS

Honorary Doctorate for Bernard De Baets at the University of Turku in Finland

Turku, Finland

On May 26, 2017, Bernard De Baets was awarded the title of Honorary Doctor at the University of Turku, Finland. The honorific was given in recognition of his internationally distinguished scientific research on computational intelligence and of the long-term machine learning research collaboration with the Department of Future Technologies of the University of Turku.

Bernard De Baets (Belgium) is a Full Professor of Applied Mathematics at Ghent University, where he is leading both the research unit KERMIT and the Department of Mathematical Modelling, Statistics and Bioinformatics, Faculty of Bioscience Engineering.

De Baets received the M.Sc. degree in mathematics, the Postgraduate degree in knowledge technology, and the Ph.D. degree in mathematics, all summa cum laude from Ghent University, in 1988, 1991, and 1995, respectively. He is the author of more than 400 publications in international peer-reviewed journals, 60 book chapters, and more than 300 contributions to proceedings of international conferences. Since 2007, he is a Co-Editor-in-Chief of Fuzzy Sets and Systems and a member of the editorial board of several other journals. Dr. De Baets was elected Fellow of the International Fuzzy Systems Association in 2011, and has been nominated for the 2012 Ghent University Prometheus Award for research. He was the recipient of several best paper awards. He has delivered more than 200 lectures at national and international conferences, at foreign universities and various research institutes and has acted as (co)supervisorof 55 Ph.D. students.

NEWS

“Medalla de Andalucía” for Francisco Herrera for his scientific career

Seville, Spain

On February 28, 2017, Francisco Herrera was awarded with *Medalla de Andalucía* (Medal of AndalucÃ⬡a) at the *Maestranza Theatre* in Seville for his scientific career.

Francisco Herrera (Jódar, Jaén) is a full professor in the Department of Computer Science and Artificial Intelligence at the University of Granada and he is the head of the research group “Soft computing and Intelligent Information Systems”.

Herrera received his M.Sc. in Mathematics in 1988 and Ph.D. in Mathematics in 1991, from the University of Granada. He has been the supervisor of 38 Ph.D. students and has published more than 300 journal papers. He is co-author of the books “Genetic Fuzzy Systems” (World Scientific, 2001) and “Data Preprocessing in Data Mining” (Springer, 2015), “The 2-tuple Linguistic Model. Computing with Words in Decision Making” (Springer, 2015), and “Multilabel Classification. Problem analysis, metrics and techniques” (Springer, 2016). He currently acts as an editorial member of a dozen of journals and as Editor in Chief of the international journals “Information Fusion” (Elsevier) and “Progress in Artificial Intelligence” (Springer). His current research interests include: soft computing (including fuzzy modeling and evolutionary algorithms), information fusion, decision making, bibliometrics, biometrics, data preprocessing, data science and big data.

NEWS

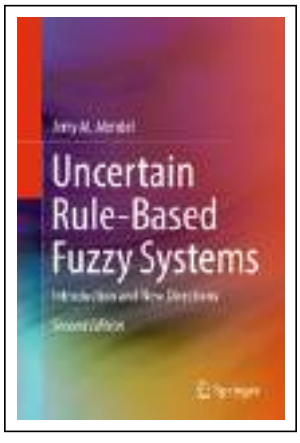
Alejandro Ramos awarded with the SCIE-BBVA Foundation Research Prize

Dr. Alejandro Ramos Soto, currently a postdoctoral researcher at the Intelligent Systems Group of the Research Center in Information Technology of the University of Santiago de Compostela (CiTIUS), was awarded with one of the National Prizes for Young Researchers in Computer Science, which was awarded by the Spanish Computer Science Scientific Society and the BBVA Foundation. The award committee recognized his contributions in the field of Soft Computing, which include the research made in his PhD on the application of fuzzy sets in data-to-text systems (described in the article in page 16 of this magazine issue). This research led to the GALiWeather system, as well as several technology transfer activities, and to proposing and leading an active collaboration between the natural language generation and the fuzzy logic disciplines.

NEWS

New book "Uncertain Rule-Based Fuzzy Systems Introduction and New Directios, 2nd Edition"

Prof. Jerry M. Mendel



The second edition of this textbook provides a fully updated approach to fuzzy sets and systems that can model uncertainty - i.e., "type-2" fuzzy sets and systems. The author demonstrates how to overcome the limitations of classical fuzzy sets and systems, enabling a wide range of applications from time-series forecasting to knowledge mining to control. In this new edition, a bottom-up approach is presented that begins by introducing classical (type-1) fuzzy sets and systems, and then explains how they can be modified to handle uncertainty. The author covers fuzzy rule-based systems - from type-1 to interval type-2 to general type-2 - in one volume. For hands-on experience, the book provides information on accessing MatLab and Java software to complement the content. The book features a full suite of classroom material.

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NEWS

Ph.D. Thesis defended by Alejandro Ramos

CiTIUS, Universidade de Santiago de Compostela - Santiago de Compostela, Spain

Alejandro Roamos defended his Ph.D. Thesis entitled "Application of fuzzy sets in data-to-text systems".

The research focus of the Ph.D. Thesis was the application of fuzzy set techniques in systems that generate texts from non-linguistic data, commonly known as data-to-text (D2T) systems. This is motivated by the non-existent presence of fuzzy set-based techniques in D2T, despite the capabilities fuzzy sets provide to model the imprecision in human language.

The Thesis provided a thorough state of the art review of D2T and those techniques that, in the fuzzy community, are closer to natural language generation, namely fuzzy linguistic summarization and description of data (LDD) [1]. Secondly, it described the application of some fuzzy-set based techniques in an actual D2T system [2]. Based on this experience, an experience-based model for linguistic summarization of data aimed at D2T [3] was presented. Also, potential challenges and opportunities that arise from integrating fuzzy sets into D2T were discussed [4]. Finally, a system that introduces the D2T paradigm into the learning analytics field [5] was designed and implemented.

The study of the state of the art [1] involves considering two related fields, namely fuzzy sets and their application in fuzzy linguistic summarization, and natural language generation, mostly focused on D2T. A global description is provided of both paradigms that includes their basic building blocks and architectures, as well as actual applications and use cases. Some of the problems that both fields have, and some preliminary convergence points are discussed. This review is an useful tool for researchers from both fuzzy and D2T communities that are interested in any of the individual paradigms or their potential convergence.

The Thesis describes the GALiWeather system [2], a textual weather forecast generator that produces customized short-term weather forecasts in Galicia (NW Spain). To extract the relevant information from the forecast data, fuzzy temporal labels are used to model a temporal division of the short-term, and type-I fuzzy quantified statements are utilized to obtain a linguistic summary of the cloud coverage variable. The system was developed in collaboration with the Galician weather agency (MeteoGalicia). After thorough evaluation, GALiWeather was deployed for public service in May 2015. Since then, it has produced more than 350,000 forecast texts and the short-term forecast section in MeteoGaliciaâĂŹs website has received more than 13,500,000 visits. GALiWeather is the first D2T system in actual service that includes fuzzy sets, as one of the different techniques used for performing content determination.

Based on the literature in LDD, and previous experience in the development of D2T systems, the Thesis describes an experience-based model for building LDD solutions [3]. The elements in the model aim to consider the richness and complexity that real LDD processes are endowed with and their actual role in data-to-text natural language generation (D2T-NLG) systems. This model considers how real-life concepts should be considered in an LDD process, including the application context, the entities which are the objects of description, and the actors which produce the descriptions.

Finally, in this research the implications of using fuzzy content in D2T systems were also addressed [4]. Illustrative use cases are presented for describing how using content that has a truth degree associated can influence the different stages that compose a D2T system, by increasing flexibility when organizing, lexicalizing and aggregating linguistic terms and expressions. A final discussion regarding additional topics like the importance of knowledge acquisition tasks in LDD for D2T purposes is also included.

As an additional contribution, the D2T service SLAR [5], which generates on-demand textual reports about the activity developed by students within the SoftLearn e-earning environment is described. SLAR aims to complement to the learning analytics dashboard, and provides textual feedback about the participation of the students in several activities, including blogs, bookmarks, files or twitter-like comments, among others. SLAR was tested on real data from 72 students, and evaluated by an expert pedagogue.

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NEWS

Ph.D. Thesis defended by Raúl Pérez Fernández

CiTIUS, Universidade de Santiago de Compostela - Santiago de Compostela, Spain

Raúl Pérez Fernández defended his Ph.D. Thesis entitled "Monotonicity-based consensus states for the monometric rationalisation of ranking rules with application in decision making" on 12th May. His supervisors are Susana Montes, Irene Díaz and Bernard De Baets.

From social to mathematical sciences, passing by computer, economical and biological sciences, collective decision making is a problem setting that has been addressed systematically by the research community, covering a varied spectrum of scientific disciplines. When a decision between several candidates concerns a large number of people, it is desirable to choose the option that best benefits the group as a whole. This well-being of the entire group is usually referred to as social welfare. As this social welfare is hardly measurable, a voting procedure is commonly invoked to determine the best option to be taken. This best option may either be a single candidate, a set of candidates or a ranking (with ties) of the different candidates. In this dissertation, we mainly focus on the search for the best option of the latter type.

The choice of this best ranking of the candidates is a difficult problem in itself, let aside the fact that the voting procedure may easily be manipulated by the strategic votes of some dishonest voters. In general, there is no absolute truth and we can say that no method is truly best. In fact, as Arrow stated in his well-known impossibility theorem, among all methods based on the search for the best ranking of the candidates, only dictatorship satisfies the following two natural properties at the same time: 1) If a candidate is preferred to another candidate by all the voters, then it should be preferred to this other candidate in the best ranking. 2) The relative position of two candidates in the best ranking should not depend on the other candidates.

The consequences of Arrow's impossibility theorem are despairing. Even worse, it is known that all prominent methods may yield different winners given the same set of votes. One then wonders if the best ranking is just the truly best in case all the power of decision is given to an individual. Should we forget about democracy and surrender to an all powerful leader? No, we just need to accept that a truly best candidate might not exist, that the only truth is that we may need to compromise. The notion of consensus turns then out to be a crucial concept that leads to the study of conditions under which the existence of a truly best candidate can be assured. In this dissertation, we analyse different types of consensus (states) and we search for consensus in order to identify the best ranking of the candidates. All these notions of consensus are centred on the property of monotonicity, which is a common desired property in mathematical modelling exercises.

The property of monotonicity is an old acquaintance for scholars of social choice theory that can easily be traced back to the early 1970s. This concept of monotonicity is different from the one considered throughout this dissertation. Monotonicity, understood in this classical sense, means that a candidate remains being the winning candidate in case he/she is raised on some of the voters' rankings. Although the consequences of the absence of this property may seem paradoxical, several existing methods do not fulfil monotonicity. Indeed, social choice theory is a field full of paradoxes. Among all the existing paradoxes of voting, the one pointed out by Condorcet has managed to become known as 'the' voting paradox. This relevant paradox states that the transitivity of the voters' rankings does not imply the transitivity of the majority rule (a candidate is said to defeat another candidate by simple majority if the number of voters who prefer the first candidate to the second candidate is greater than the number of voters who prefer the second candidate to the first candidate). However, this majority rule disregards a considerable part of the information provided by the voters. The transitivity of the voters' rankings is surprisingly ignored. Monotonicity, now understood in the sense of this dissertation, will be again proved to be a key property for social choice, this time by helping to avoid the inconvenient voting paradox.