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6th International Workshop, WILF 2005
Crema, Italy, September 2005
Revised Selected Papers

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Preface

This volume contains the proceedings of the 6th International Workshop on Soft Computing and Applications (WILF 2005), which took place in Crema, Italy, on September 15–17, 2005, continuing an established tradition of biannual meetings among researchers and developers from both academia and industry to report on the latest scientific and theoretical advances, to discuss and debate major issues, and to demonstrate state-of-the-art systems.

This edition of the workshop included two special sessions, sort of subworkshops, focusing on the application of soft computing techniques (or computational intelligence) to image processing (SCIP) and bioinformatics (CIBB).

WILF began life in Naples in 1995. Subsequent editions of this event took place in 1997 in Bari, in 1999 in Genoa, in 2001 in Milan, and in 2003 back in Naples.

Soft computing, also known as computational intelligence, differs from conventional (hard) computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth, and approximation. The guiding principle of soft computing is to exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness, and low solution cost. The main components of soft computing are fuzzy logic, neural computing, and evolutionary computation.

A rigorous peer-review selection process was applied to the 86 submitted papers. The Program Committee was carefully selected for their knowledge and expertise, and, as far as possible, papers were matched with the reviewer's particular interests and special expertise. The results of this process are seen here in the high quality of papers published within this volume.

Of the 50 published papers, 23 have an Italian provenance; the next strongest representation is from Korea, with 9 papers; all remaining papers are European, with the exception of 3 from the USA, 1 from Algeria and 1 from Iran. This distribution confirms the vocation of WILF to establish itself as a truly international event.

The success of this conference is to be credited to the contribution of many people. In the first place, we would like to thank the members of the Program Committee for their commitment to the task of providing high-quality reviews. We would also like to thank the Information Technology Department of the University of Milan, which hosted the workshop on its premises.

December 2005

Isabelle Bloch
Alfredo Petrosino
Andrea G.B. Tettamanzi

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A Bipolar Possibilistic Representation of Knowledge and Preferences and Its Applications

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Abstract. When representing knowledge, it may be fruitful to distinguish between negative and positive information in the following sense. There are pieces of information ruling out what is known as impossible on the one hand, and pieces of evidence pointing out things that are guaranteed to be possible. But what is not impossible is not necessarily guaranteed to be possible. This applies as well to the modelling of the preferences of an agent when some potential choices are rejected since they are rather unacceptable, while others are indeed really satisfactory if they are available, leaving room for alternatives to which the agent is indifferent. The combination of negative information is basically conjunctive (as done classically in logic), while it is disjunctive in the case of positive information, which is cumulative by nature. This second type of information has been largely neglected by the logical tradition. Both types may be pervaded with uncertainty when modelling knowledge, or may be a matter of degree when handling preferences. The presentation will first describe how the two types of information can be accommodated in the framework of possibility theory. The existence of the two types of information can shed new light on the revision of a knowledge / preference base when receiving new information. It is also highly relevant when reasoning with (fuzzy) if-then rules, or for improving the expressivity of flexible queries.

1 Introduction

Generally speaking, bipolarity refers to the existence of positive and negative information. There are at least three different types of bipolarity. The simplest one, which may be termed *symmetric univariate bipolarity*, takes place when the negative and the positive parts are the exact images of each other. It is the situation in classical logic where negation is involutive. Graded versions of this type of bipolarity are provided in uncertainty modelling by probabilities (since $P(A) = 1 - P(\neg A)$), and in multiple criteria decision making, by bipolar univariate scales having a central element (e. g., the scale [0,1], where 1 (resp. 0) stands for fully satisfactory (resp. not satisfactory at all), and 1/2 models indifference). A second type of bipolarity, termed *dual bivariate*, refers to the use of two separate scales still pertaining to the same information, with generally a duality relation putting the scales in correspondence. An example of it is the representation of uncertainty by dual belief and plausibility functions in Shafer evidence theory, or dual necessity and possibility measures in possibility theory. A third type of *bipolarity*, called "*heterogeneous*", which is

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addressed in this paper, takes place when dealing with two different kinds of information in parallel. For instance, incomplete information describing a subset of elements is naturally expressed in a bipolar way. On the one hand, we know that some elements of the referential do not belong to this subset: this is negative information and on the other hand, we know that some other elements belong to this subset: this is positive information. This applies to knowledge or preference representations.

Negative knowledge is usually given by pieces of generic knowledge, integrity constraints, laws, necessary conditions, which state what is impossible, forbidden. Observed cases, examples of solutions, sufficient conditions are positive pieces of information. Beware that positive knowledge may not just mirror what is not impossible. Indeed what is not impossible, not forbidden, does not coincide with what is explicitly possible or permitted. So, a situation that is not impossible (i.e., possible) is not necessarily guaranteed possible (i.e., positive) if it is not explicitly permitted, observed or given as an example. The bipolar view applies to preference representation as well if we have to identify positive desires among what is not more or less rejected. More precisely, negative preferences express solutions, which are rejected or unacceptable, while positive preferences express solutions that are desired, pursued. Bipolarity is supported by recent works on cognitive psychology showing that there are indeed two independent types of information, processed separately in the mind [7]. Indeed, positive and negative information require different representation models and reasoning techniques.

Bipolarity may also be present in other domains. For instance, learning processes bridge the gap between positive and negative information: situations that are often observed are eventually considered as normal and those never observed are considered as impossible. In inconsistency handling problems, argumentation frameworks compute arguments in favor and arguments against formulas. A conflict on a formula is then solved by evaluating the acceptability of arguments in favor of this formula with respect to arguments against this formula. Then, an argument may be accepted, rejected or in abeyance i.e., neither accepted nor rejected [2]. Multiple criteria decision-making can be addressed by evaluating the weight of criteria in favor of a decision and criteria against it.

Possibility theory is a suitable framework for modelling and reasoning about bipolar information. Then negative information and positive information are represented by two separate possibility distributions yielding possibility and guaranteed possibility measures respectively; see, e. g. [9, 13]. This paper provides an introduction on representation and reasoning about bipolar information in this framework. The next section first recalls the semantic representation of bipolar information, and then presents a more compact representation in terms of logical expressions. It also briefly discusses the fusion and the revision of bipolar information. Section 3 discusses bipolarity in the representation of if-then rules. Section 4 briefly discusses the handling of bipolar preferences in flexible querying.

2 Representation of Bipolar Information in Possibility Theory

Bipolar information is represented in possibility theory by *two* separate possibility distributions, denoted by δ and π, representing respectively positive and negative