INTELLIGENT DECISION SUPPORT

Handbook of Applications and Advances of the Rough Sets Theory

Edited by

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PREFACE

Making decisions under uncertainty and imprecision is one of the most challenging problems of our age, which for a long time have been tackled by philosophers, logicians and others. Recently AI researchers have given new momentum and flavor to this area.

Expert systems, decision support systems, machine learning, inductive reasoning, pattern recognition, are areas where decision making under uncertainty is of primary importance.

There are known several mathematical models of uncertainty (e.g. fuzzy sets, theory of evidence), however, there is widely shared view that the problem is far from being fully understood.

The concept of a rough set has been proposed as a new mathematical tool to deal with uncertain and imprecise data, and it seems to be of significant importance to AI and cognitive sciences both from theoretical and practical points of view.

A special attention should be paid to the decision support systems, basic topic of this book – where the rough sets approach offers a new insight and efficient algorithms.

The rough sets philosophy means a specific view on representation, analysis and manipulation of knowledge as well as a new approach to uncertainty and imprecision.

Knowledge is understood here as an ability to classify objects (states, events, processes etc.), i.e. we assume that knowledge is identified with a family of various classification patterns. Objects being in the same class are *indiscernible* by means of knowledge provided by the classification and form elementary building blocks (*granules, atoms*) which are employed to define all basic concepts used in the rough sets philosophy.

In particular, the granularity of knowledge causes that some notions cannot be expressed precisely within available knowledge and can be defined vaguely only. This leads to the so called "boundary–line" view on imprecision, due to Frege who writes (cf. Frege (1903)):

The concept must have a sharp boundary. To the concept without a sharp boundary there would correspond an area that had not a sharp boundary–line all around.

In the rough sets theory each imprecise concept is replaced by a pair of precise concepts alled its *lower* and *upper approximation*; the lower approximation of a concept consists f all objects which *surely* belong to the concept whereas the upper approximation of the oncept consists of all objects which *possibly* belong to the concept in question. Difference etween the lower and the upper approximation is a *boundary region* of the concept, and consists of all objects which cannot be classified with certainty to the concept or its omplement. These approximations are fundamental tools of reasoning about knowledge.

For algorithmic reasons, i.e. in order to provide easy processing and manipulation of nowledge, suitable representation of knowledge is needed. To this end the tabular form, nown as an *information system, attribute–value system* or *knowledge representation system* is used. Attributes in the information system represent various classification patterns. In his way knowledge can be replaced by data and knowledge processing can be replaced by ata manipulation. In particular, concepts (subsets of objects) can now be defined (exactly r approximately) in terms of attribute–values, and a variety of other concepts needed or reasoning about knowledge can by expressed in attribute–value terms. Mostly, we are nterested in discovering various relations between attributes, like exact or approximate ependency of attributes (cause–effect relations), redundancy of attributes and significance f attributes, and in generation of decision rules from data.

The rough sets philosophy turned out to be a very effective, new tool with many successl real–life applications to its credit. It is worthwhile to stress that no auxiliary assumptions bout data, like probability or membership function values, are needed, which is its great dvantage.

The rough set concept has an overlap with other ideas developed to deal with uncertainty nd imprecision, in particular with fuzzy sets (cf. Dubois and Prade (1990)), evidence heory (cf. Skowron and Grzymala–Busse (1992)), statistics (cf. Krusińska, Słowiński and tefanowski (1992)) albeit it can be viewed in its own rights.

The book edited by Prof. Roman Słowiński shows a wide spectrum of applications of he rough set concept, giving the reader the flavor of, and the insight in, the methodology f the newly developed discipline.

Although the book emphasizes applications, comparison to other related methods and rther developments receive due attention. In this sense, the book can be seen as a conuation of the book on theoretical foundations of rough sets (cf. Pawlak (1991)).

I am sure that the reader will benefit from studying the book by gaining a new tool to lve his or her problems as well as a new exciting area of research.

Zdzisław PAWLAK
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References

Dubois, D. and Prade, H. (1990). Rough Fuzzy Sets and Fuzzy Rough Sets. *International Journal of General Systems* **17**, pp.191-209

Frege, G., (1903). Grundgesetze der Arithmetik, 2. In Geach and Black (Eds.), *Selections from the Philosophical Writings of Gotlob Frege*, Blackwell, Oxford, 1970.

Krusińska, E., Słowiński, R. and Stefanowski, J. (1992). Discriminant Versus Rough Sets Approach to Vague Data Analysis. *Journal of Applied Stochastic Models and Data Analysis* **8**, (to appear).

Pawlak, Z. (1991). *Rough Sets. Theoretical Aspects of Reasoning about Data.* Kluwer Academic Publishers, Dordrecht/Boston/London.

Skowron, A. and Grzymala-Busse, J. (1992). From Rough Set Theory to Evidence Theory. In M. Fedrizzi, J. Kacprzyk and R.R. Yager (Eds.), *Advancess in Dempster-Shafer Theory*, Wiley, New York (to appear).