

Article

Investigations of Symmetrical Incomplete Information Spreading in the Evidential Reasoning Algorithm and the Evidential Reasoning Rule via Partial Derivative Analysis

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Abstract: Incomplete information causes great uncertainty in decision making. It is a critical task to understand how incomplete information spreads symmetrically in order to make comprehensive and balanced decisions. A better understanding of the spreading of incomplete information can also be used for accurately locating limited resources to reduce incomplete information in the input for the final purpose of reducing incomplete information in the result. In this study, the way in which incomplete information spreads is studied via the evidential reasoning (ER) algorithm and the evidential reasoning rule (the ER rule), which are known for their transparent analytical procedures. Specifically, the partial derivative analysis is conducted using the steps of ER and the ER rule for calculating the contributions made by the beliefs, weights, and reliability to the incomplete information in the result. The major theoretical contribution of this study is the calculation of the contribution of the input to the incomplete information in the output based on partial derivative analysis. A numerical case is studied to demonstrate the proposed derivative analysis, the contribution calculation, and the consequential results.

Keywords: symmetrical incomplete information; information spreading; evidential reasoning algorithm; evidential reasoning rule; partial derivative analysis



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1. Introduction

Incomplete information brings uncertainty to traditional decision making, which however, is almost unavoidable under many conditions [1,2]. There are many causes for incomplete information, e.g., degraded sensors [3], inaccurate recording and transferring of data [4], or human knowledge ignorance [5]. Generally existent incomplete information produces challenges in complex systems modeling.

Many traditional machine learning approaches, e.g., the neural network (NN), the support vector machine (SVM), etc., are effective in complex systems modeling, yet they cannot effectively handle incomplete information [1,6,7]. There are several methods for handling incomplete information [8]. When there is a large quantity of data, the data with incomplete information would be deleted or omitted from the later modeling procedure. Alternatively, incomplete information could be imputed using prior information or according to statistical data. Furthermore, the imputed information could be used either in a single value or as a distribution to provide a holistic picture of the problem, if required. Recently, machine learning approaches have been used for inferring the missing information, leading to superior performance. However, those endeavors are all indirect means, i.e., the missing information is either deleted or filled in, becoming complete information which traditional machine learning approaches can handle.

Therefore, the presence of incomplete information remains a challenge in decision-making, leading to the requirement of eliminating or at least reducing it. [9]. For example, there may be ambiguity regarding a patient's assessment of pain, or the X-rays or CT scans may be blurred [10,11], all of which are sources of incomplete information in the input.

Reasoning With Incomplete Information

Dov M. Gabbay, John Woods



Reasoning With Incomplete Information:

Reasoning with Incomplete Information David W. Etherington, 1988 **Intellectics and Computational Logic**

Steffen Hölldobler, 2013-04-18 Intellectics seeks to understand the functions structure and operation of the human intellect and to test artificial systems to see the extent to which they can substitute or complement such functions The word itself was introduced in the early 1980s by Wolfgang Bibel to describe the united fields of artificial intelligence and cognitive science The book collects papers by distinguished researchers colleagues and former students of Bibel s all of whom have worked together with him and who present their work to him here to mark his 60th birthday The papers discuss significant issues in intellectics and computational logic ranging across automated deduction logic programming the logic based approach to intellectics cognitive robotics knowledge representation and reasoning Each paper contains new previously unpublished reviewed results The collection is a state of the art account of the current capabilities and limitations of a computational logic based approach to intellectics Readership Researchers who are convinced that the intelligent behaviour of machines should be based on a rigid formal treatment of knowledge representation and reasoning The Automation of Reasoning with

Incomplete Information Torsten Schaub, 1997 Reasoning with incomplete information constitutes a major challenge for any intelligent system In fact we expect such systems not to become paralyzed by missing information but rather to arrive at plausible results by bridging the gaps in the information available A versatile way of reasoning in the absence of information is to reason by default This book aims at providing formal and practical means for automating reasoning with incomplete information by starting from the approach taken by the framework of default logic For this endeavor a bridge is spanned between formal semantics over systems for default reasoning to efficient implementation **COMADEM 89 International**

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COMADEM COMADEM 88 proved to be a great success and had a truly international flavour reflected this growing interest in the new field

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An Introduction to Default Logic Philippe Besnard,2013-04-17 This book is written for those who are interested in a formalization of human reasoning especially in order to build intelligent computer systems Thus it is mainly designed for the Artificial Intelligence community both students and researchers although it can be useful for people working in related fields like cognitive psychology The major theme is not Artificial Intelligence applications although these are discussed throughout in sketch form Rather the book places a heavy emphasis on the formal development of default logic results and problems Default logic provides a formalism for an important part of human reasoning Default logic is specifically concerned with common sense reasoning which has recently been recognized in the Artificial Intelligence literature to be of fundamental importance for knowledge representation Previously formalized reasoning systems failed in real world environments though succeeding with an acceptable ratio in well defined environments This situation enabled empirical explorations and the design of systems without theoretical justification In particular they could not be compared since there was no basis to judge their respective merits Default logic turned out to be very fruitful by proving the correctness of some of them We hope that this book will initiate other successful developments in default logic

The Many Valued and Nonmonotonic Turn in Logic Dov M. Gabbay,John Woods,2007-08-13 The present volume of the Handbook of the History of Logic brings together two of the most important developments in 20th century non classical logic These are many

valuedness and non monotonicity On the one approach in deference to vagueness temporal or quantum indeterminacy or reference failure sentences that are classically non bivalent are allowed as inputs and outputs to consequence relations Many valued dialethic fuzzy and quantum logics are among other things principled attempts to regulate the flow through of sentences that are neither true nor false On the second or non monotonic approach constraints are placed on inputs and sometimes on outputs of a classical consequence relation with a view to producing a notion of consequence that serves in a more realistic way the requirements of real life inference Many valued logics produce an interesting problem Non bivalent inputs produce classically valid consequence statements for any choice of outputs A major task of many valued logics of all stripes is to fashion an appropriately non classical relation of consequence The chief preoccupation of non monotonic and default logicians is how to constrain inputs and outputs of the consequence relation In what is called left non monotonicity it is forbidden to add new sentences to the inputs of true consequence statements The restriction takes notice of the fact that new information will sometimes override an antecedently and reasonably derived consequence In what is called right non monotonicity limitations are imposed on outputs of the consequence relation Most notably perhaps is the requirement that the rule of or introduction not be given free sway on outputs Also prominent is the effort of paraconsistent logicians both preservationist and dialethic to limit the outputs of inconsistent inputs which in classical contexts are wholly unconstrained In some instances our two themes coincide Dialethic logics are a case in point Dialethic logics allow certain selected sentences to have as a third truth value the classical values of truth and falsity together So such logics also admit classically inconsistent inputs A central task is to construct a right non monotonic consequence relation that allows for these many valued and inconsistent inputs The Many Valued and Non Monotonic Turn in Logic is an indispensable research tool for anyone interested in the development of logic including researchers graduate and senior undergraduate students in logic history of logic mathematics history of mathematics computer science AI linguistics cognitive science argumentation theory and the history of ideas Detailed and comprehensive chapters covering the entire range of modal logic Contains the latest scholarly discoveries and interpretative insights that answers many questions in the field of logic Logic Programming Philippe Codognet, 2001-11-14 This book constitutes the refereed proceedings of the 17th International Conference on Logic Programming ICLP 2001 held in Paphos Cyprus in November December 2001 The 23 revised full papers presented were carefully reviewed and selected from 64 submissions All current aspects of logic programming and computational logics are addressed *Mathematical Foundations of Computer Science 1996* Wojciech Penczek, Andrzej Szalas, 1996-08-07 This book constitutes the refereed proceedings of the 21st International Symposium on Mathematical Foundations of Computer Science MFCS 96 held in Crakow Poland in September 1996 The volume presents 35 revised full papers selected from a total of 95 submissions together with 8 invited papers and 2 abstracts of invited talks The papers included cover issues from the whole area of theoretical computer science with a certain emphasis on mathematical and logical foundations The 10 invited

presentations are of particular value **ECAI 2014** T. Schaub,G. Friedrich,B. O'Sullivan,2014-08 The role of artificial intelligence AI applications in fields as diverse as medicine economics linguistics logical analysis and industry continues to grow in scope and importance AI has become integral to the effective functioning of much of the technical infrastructure we all now take for granted as part of our daily lives This book presents the papers from the 21st biennial European Conference on Artificial Intelligence ECAI 2014 held in Prague Czech Republic in August 2014 The ECAI conference remains Europe s principal opportunity for researchers and practitioners of Artificial Intelligence to gather and to discuss the latest trends and challenges in all subfields of AI as well as to demonstrate innovative applications and uses of advanced AI technology Included here are the 158 long papers and 94 short papers selected for presentation at the conference Many of the papers cover the fields of knowledge representation reasoning and logic as well as agent based and multi agent systems machine learning and data mining The proceedings of PAIS 2014 and the PAIS System Demonstrations are also included in this volume which will be of interest to all those wishing to keep abreast of the latest developments in the field of AI

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