

Date of publication XXXX-00-0000, date of current version XXXX-00-0000.

Digital Object Identifier 10.1109/ACCESS.2017.2681550

# Multiattribute Evaluation Model Based on the KSP Algorithm for Edge Computing

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This work was supported in part by the Natural Science Foundation of China under Grant 61170254, in part by the Hebei Natural Science Project under Grant F2018201153, and in part by the Hebei Natural Science Foundation Key Program Project under Grant F2019201290.

**ABSTRACT** To solve the problems of single evaluation attributes and highly overlapping trust paths in the current trust model, a multiattribute trust evaluation model based on the K shortest paths (KSP) algorithm is proposed. The model refines the evaluation attributes among nodes and uses the analytic hierarchy process (AHP) to allocate the weights based on users' preferences to meet the special needs of individual users. Also, the model introduces the penalty factor algorithm idea of KSP and proposes a trust path optimization algorithm RKSP based on the A\* algorithm. It can filter highly overlapping trust paths during the formation of recommended trust paths so that the searched trust paths have certain differences. Through comparative experiments, it is proven that the model can reduce the resource overhead of edge devices, improve the accuracy of evaluation, ensure load balancing within the domain, and better align the results of the model recommendation with user needs.

**INDEX TERMS** trust model; multiattribute; trust path; KSP algorithm

## I. INTRODUCTION

The rise of the Internet of Everything and 5G technology leads to new computing models such as fog computing [1], edge computing [2] and mobile edge computing [3]. Edge computing can provide near ground real-time computing and storage functions through smartphones, cameras, wearable devices, smart gateways, etc. It can reduce the pressure of the cloud computing center and network bandwidth, with the advantages of low latency and high energy efficiency [4], [5]. Moreover, it has a good application effect in intelligent car networking, virtual reality, healthcare, smart homes, smart cities, industrial Internet of Things and other scenarios [6]-[8]. However, the characteristics of edge devices, such as openness, dynamics, autonomy, and the lack of stable basic protection measures, result in the lack of necessary trust between devices. As a result, it is difficult for devices to resist unreliable fraud and services, the collaboration between devices is prone to problems, and considerable private data can become exposed [9], [10].

Establishing trust relationships between devices to detect untrusted entities can effectively eliminate malicious and selfish nodes, reduce the risk of independent decision-making, and improve system reliability [11]. Compared with the cloud computing environment, the traditional centralized

security mechanism is no longer suitable for the fully distributed edge computing architecture. The edge layer contains a large number of high-frequency interactive devices, and the number of nodes and trust information is growing exponentially. While edge layer devices are mostly resource-constrained devices, massive trust information easily leads to information overload, causing node overload and early decline [12]-[14]. A trusted and lightweight distributed trust evaluation mechanism is urgently needed. Therefore, the trust model in the edge computing environment has gradually become a research hotspot.

In the face of limited resources and open edge computing, many experts and scholars have adopted different methods for building trust evaluation models for edge computing environments[15]-[18]. In addition to the evaluation model based on subjective logic, Dempster-Shafer evidence theory, Bayesian networks and other trust evaluation models, there are also models based on recommendation node similarity, scoring deviation mixed methods, multiattribute evaluation, and so on. Next, we will discuss the following three aspects:

In terms of improving effectiveness, Deng *et al* [19] proposed a multiobjective optimization and collaboration scheme based on comprehensive trust, which optimized the

# Multiattribute Evaluation

**Holger Schütz, Peter M.  
Wiedemann, Wilfried  
Hennings, Johannes Mertens, Martin  
Clausberg**

## **Multiattribute Evaluation:**

Multiattribute Evaluation Ward Edwards, John Robert Newman, 1982-10 Ward Edwards and J Robert Newman clearly explain Multiattribute Utility Technology MAUT a technique that facilitates decision making by identifying and weighting the objectives of the stakeholders in a specific decision

Multiattribute Evaluation Ward Edwards, 1983

**Economic and Multiattribute Evaluation of Advanced Manufacturing Systems** John R. Canada, William G. Sullivan, 1989 Very Good No Highlights or Markup all pages are intact

*Social Multi-Criteria Evaluation for a Sustainable Economy* Giuseppe Munda, 2007-12-22 The real world is characterized by deep complexity May be a rather unremarkable observation yet it has important implications on the manner policy problems are represented and decision making is framed Is contemporary democracy compatible with science in real world policy making This book gives answers in the affirmative It also asserts that this congruence can have positive implications not only in terms of economic prosperity but also when dealing with the difficult sustainability policy problems of our millennium To address contemporary issues economic science will have to expand its empirical relevance by introducing more and more realistic assumptions to its models One of the most interesting research orientations in recent times in the field of public economics is the explicit attempt to take account of political constraints interest groups and collusion effects One of the main novelties of this book is its establishment of a clear relationship between social and public choice theories on one hand and multiple criteria decision analysis on the other The pioneering research developed by Arrow and Raynaud 1986 has shown that the relationships between multi criteria decision theory and social choice are clear and relevant The main directions of cross fertilization between these research fields are twofold 1 Multi criteria decision theory can be an adequate framework for applied social and public choice 2 Social choice can produce interesting theoretical results for ensuring the axiomatic consistency needed by multi criterion aggregation conventions

**Participatory Evaluation for Special Education and Rehabilitation** Darrell R. Lewis, David R. Johnson, David L. Braddock, 2000 Lewis and Johnson lay out a clear nine step method for identifying and weighting the importance of disparate goals and outcomes These consensus building evaluation techniques are well suited for administrators in the field of disabilities

**Judgment and Decision Making** Terry Connolly, Hal R. Arkes, Kenneth R. Hammond, 2000 This work examines issues such as medical diagnosis weather forecasting labour negotiations risk public policy business strategy eyewitnesses and jury decisions This is a revision of Arkes and Hammond's 1986 collection of papers on judgment and decision making Updated and extended the focus of this volume is interdisciplinary and applied

**Comparative Risk Assessment** Holger Schütz, Peter M. Wiedemann, Wilfried Hennings, Johannes Mertens, Martin Clauberg, 2006-08-21 Providing a catalogue of suggested solutions for different categories of issues this book offers a balanced overview and methodological examples for the practical implementation of the CRA It considers CRA in the USA Europe and Germany using case studies to analyze and exemplify the decision making processes and challenges involved The

authors then go on to look at the practical lessons learned from these case studies together with an in depth discussion of the underlying scientific hypotheses Sound scientific knowledge for everyone who makes decisions whether government ministers regulators or company directors      Evaluation of Fire Safety D. Rasbash,G. Ramachandran,B. Kandola,J. Watts,M. Law,2004-04-21 Fire safety is a major concern in many industries particularly as there have been significant increases in recent years in the quantities of hazardous materials in process storage or transport Plants are becoming larger and are often situated in or close to densely populated areas and the hazards are continually highlighted with incidents such as the fires and explosions at the Piper Alpha oil and gas platform and the Enschede firework factory As a result greater attention than ever before is now being given to the evaluation and control of these hazards In a comprehensive treatment of the subject unavailable elsewhere this book describes in detail the applications of hazard and risk analysis to fire safety going on to develop and apply quantification methods It also gives an explanation in quantitative terms of improvements in fire safety in association with the costs that are expended in their achievement Furthermore a quantitative approach is applied to major fire and explosion disasters to demonstrate crucial faults and events Featuring Full international coverage and a review of several major fires and explosion disasters Presentation of the properties and science of fire including the latest research Detailed coverage of the performance of fire safety measures This is an essential book for practitioners in fire safety engineering loss prevention professionals technical personnel in insurance companies as well as academics involved in fire science and postgraduate students This book is also a useful reference for fire safety officers building designers engineers in the process industries safety practitioners and risk assessment consultants      **Evaluation of demonstrated and emerging technologies for the treatment of contaminated land and groundwater (phase III) 2000 special sessiondecision support tools.** ,2001      **Studying Judgement** Nigel Harvey,2001 The papers in this Special Issue are derived from presentations at the 17th Conference on Subjective Probability Utility and Decision Making      **Benefits Assessment** J.D. Bentkover,V.T. Covello,J.L. Mumpower,2012-12-06 In recent years there has been substantial interest in benefits assessment methods especially as these methods are used to assess health safety and environmental issues At least part of this interest can be traced to Executive Order 12291 issued by President Ronald Reagan in 1981 This Executive Order requires Federal agencies to perform benefits assessments of pro posed major regulations and prohibits them from taking regulatory action unless potential benefits exceed potential costs to society Heightened interest in benefits assessment methods has in tum given rise to greater recognition of the inherent difficulties in performing such assess ments For example many benefits that are intuitively felt to be most important are also among the most difficult to measure It can be difficult to identify the full range of both benefits and costs The choice of an appro priate discount rate for comparing benefits and costs over time is proble matic Even when benefits are quantifiable in principle and agreement can be reached on their valuation required d ata may not be available Thus considerable uncertainty is built into most benefit estimates even when they are

based on the best available data In light of the complexities and difficulties associated with the performance of a benefits assessment this book reviews the current state of theoretical and methodological knowledge in the field The review is extensive in that it covers over fifty years of research theoretical development and practice **Multiple Attribute**

**Decision Making** Gwo-Hsiung Tzeng, Jih-Jeng Huang, 2011-06-22 Decision makers are often faced with several conflicting alternatives How do they evaluate trade offs when there are more than three criteria To help people make optimal decisions scholars in the discipline of multiple criteria decision making MCDM continue to develop new methods for structuring preferences and determining the correct relative weights for criteria A compilation of modern decision making techniques Multiple Attribute Decision Making Methods and Applications focuses on the fuzzy set approach to multiple attribute decision making MADM Drawing on their experience the authors bring together current methods and real life applications of MADM techniques for decision analysis They also propose a novel hybrid MADM model that combines DEMATEL and analytic network process ANP with VIKOR procedures The first part of the book focuses on the theory of each method and includes examples that can be calculated without a computer providing a complete understanding of the procedures Methods include the analytic hierarchy process AHP ANP simple additive weighting method ELECTRE PROMETHEE the gray relational model fuzzy integral technique rough sets and the structural model Integrating theory and practice the second part of the book illustrates how methods can be used to solve real world MADM problems Applications covered in the book include AHP to select planning and design services for a construction project TOPSIS and VIKOR to evaluate the best alternative fuel vehicles for urban areas ELECTRE to solve network design problems in urban transportation planning PROMETEE to set priorities for the development of new energy systems from solar thermal to hydrogen energy Fuzzy integrals to evaluate enterprise intranet web sites Rough sets to make decisions in insurance marketing Helping readers understand how to apply MADM techniques to their decision making this book is suitable for undergraduate and graduate students as well as practitioners *Neutrosophic AHP Multi Criteria Decision Making Method Applied on the Selection of Learning*

*Management System* Nouran M. Radwan, M. Badr Senousy, Alaa El Din M. Riad , Learning management systems LMSs are used today to assist in the designing delivery and management of learning resources for learners There are hundreds of LMS available in the marketplace Selecting the most suitable LMS that meets specific requirements is a problem of decision making Many studies in learning management system selection are implemented under complete information while in the real world many uncertainty aspects do exist *Theory and Practice in Policy Analysis* M. Granger Morgan, 2017-10-12

Many books instruct readers on how to use the tools of policy analysis This book is different Its primary focus is on helping readers to look critically at the strengths limitations and the underlying assumptions analysts make when they use standard tools or problem framings Using examples many of which involve issues in science and technology the book exposes readers to some of the critical issues of taste professional responsibility ethics and values that are associated with policy analysis and

research Topics covered include policy problems formulated in terms of utility maximization such as benefit cost decision and multi attribute analysis issues in the valuation of intangibles uncertainty in policy analysis selected topics in risk analysis and communication limitations and alternatives to the paradigm of utility maximization issues in behavioral decision theory issues related to organizations and multiple agents and selected topics in policy advice and policy analysis for government

Decision Making Ray Crozier, Rob Ranyard, Ola Svenson, 2002-09-11 This book offers an exciting new collection of recent research on the actual processes that humans use when making decisions in their everyday lives and in business situations The contributors use cognitive psychological techniques to break down the constituent processes and set them in their social context The contributors are from many different countries and draw upon a wide range of techniques making this book a valuable resource to cognitive psychologists in applied settings economists and managers

**Multicriteria Decision Analysis in Geographic Information Science** Jacek Malczewski, Claus Rinner, 2015-02-02 This book is intended for the GIS Science and Decision Science communities It is primarily targeted at postgraduate students and practitioners in GIS and urban regional and environmental planning as well as applied decision analysis It is also suitable for those studying and working with spatial decision support systems The main objectives of this book are to effectively integrate Multicriteria Decision Analysis MCDA into Geographic Information Science GIScience to provide a comprehensive account of theories methods technologies and tools for tackling spatial decision problems and to demonstrate how the GIS MCDA approaches can be used in a wide range of planning and management situations

Contributions To Information Integration Theory Norman H. Anderson, 2014-01-02 The theory of information integration provides a unified general approach to the three disciplines of cognitive social and developmental psychology Each of these volumes illustrates how the concepts and methods of this experimentally grounded theory may be productively applied to core problems in one of these three disciplines

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Engineering for Business Colin O. Benjamin, 2009-05-16

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*Advanced Operations Management for Complex Systems Analysis* Jingzheng Ren, 2020-04-21 This book focuses on operations management methods for analysing complex systems from a system engineering perspective It presents various advanced multi criteria decision analysis methods for investigating factors that influence complex systems In turn it shows how to improve systems performance including their competitiveness safety and sustainability The book also draws on examples of typical virtual systems such as tourism aviation maintenance and waste to wealth systems to illustrate the operations management methods discussed Cases from day to day life are used to elicit heuristic questions on the operations management methods presented in each chapter The book will help researchers operations managers and engineers alike to understand the latest advances in operations management methods for analysing complex systems from the standpoint of system engineering

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