Record Nr. UNINA9910632469303321

Autore Kreinovich Vladik

Titolo From intervals to -?: towards a general description of validated

uncertainty / / Vladik Kreinovich, Gracaliz Pereira Dimuro, Antonio

Carlos da Rocha Costa

Pubbl/distr/stampa Cham, Switzerland:,: Springer,, [2023]

©2023

ISBN 3-031-20569-3

Descrizione fisica 1 online resource (125 pages)

Collana Studies in computational intelligence; ; Volume 1041

Disciplina 006.3

Soggetti Computational intelligence

Uncertainty (Information theory)

Lingua di pubblicazione Inglese

Formato Materiale a stampa

Livello bibliografico Monografia

Nota di bibliografia Includes bibliographical references.

Nota di contenuto Intro -- Preface -- Contents -- 1 Motivation and Outline -- 1.1 Why

Computers? -- 1.2 Why Interval Computations? -- 1.3 Why Go Beyond Intervals? -- 1.4 Outline -- References -- 2 A General Description of Measuring Devices: Plan -- 3 A General Description of Measuring Devices: First Step-Finite Set of Possible Outcomes -- 3.1 Every Measuring Device Has Finitely Many Possible Outcomes -- 3.2 Not All Marks on a Scale Can Be Physically Possible -- 3.3 We Need a Theory --3.4 We Need a Theory that Also Described a Measuring Device -- 3.5 We Want a Theory that Is "Full" in Some Natural Sense -- 3.6 A Seemingly Natural Definition of a Full Theory is Not Always Adequate --3.7 What Exactly Is a Theory? -- 3.8 What Kind of Statements Are We Allowing? -- 3.9 What Exactly Is a Full Theory -- 3.10 The Existence of a Full Theory Makes the Set of All Physically ... -- 3.11 Conclusion: Algorithmically Listable Set of Physically Possible Outcomes -- 3.12 Example 1: Interval Uncertainty -- 3.13 Example 2: Counting -- 3.14 Example 3: "Yes"-"No" Measurements -- 3.15 Example 3a: Repeated ``Yes"-``No" Measurements -- 3.16 Example 4: A Combination of Several Independent Measuring Instruments --References -- 4 A General Description of Measuring Devices: Second

Step-Pairs of Compatible Outcomes -- 4.1 How Do We Describe Uncertainty: Main Idea -- 4.2 Comment on Quantum Measurements --

4.3 Some Pairs of Outcomes Are Compatible (Close), Some Are Not -- 4.4 The Existence of a Full Theory Makes the Set of All Compatible Pairs of Outcomes Algorithmically Listable -- 4.5 Conclusion: Algorithmically Listable Set of Compatible Pairs of Outcomes -- 4.6 Description in Terms of Existing Mathematical Structures -- 4.7 Example 1: Interval Uncertainty -- 4.8 Example 2: Counting -- 4.9 Example 3: ``Yes"-``No" Measurements.

4.10 Example 3a: Repeated "Yes"-"No" Measurements -- 4.11 Example 4: A Combination of Several Independent Measuring Instruments -- 4.12 Computational Complexity of the Graph Representation of a Measuring Device: General Case -- 4.13 Computational Complexity of the Graph Representation of a Measuring Device: Case of the Simplest Interval Uncertainty -- 4.14 Computational Complexity of the Graph Representation of a Measuring Device: General Case of Interval Uncertainty -- 4.15 Computational Complexity of the Graph Representation of a Measuring Device: Lower Bound for the Case of the General Interval Uncertainty -- 4.16 Computational complexity of the Graph Representation of a Measuring Device: Case of Multi-D Uncertainty -- 4.17 Computational Complexity of the Graph Representation of a Measuring Device: General Case of Localized Uncertainty -- References -- 5 A General Description of Measuring Devices: Third Step-Subsets of Compatible Outcomes -- 5.1 From Pairs to Subsets -- 5.2 Is Information About Compatible Pairs Sufficient? --5.3 Information About Compatible Pairs Is Sufficient For Intervals --5.4 Information About Compatible Pairs is Not Sufficient in the General Case -- 5.5 The Existence of a Full Theory Makes the Family of All Compatible ... -- 5.6 Conclusion: Algorithmically Listable Family of Compatible Sets of Outcomes -- 5.7 Description in Terms of Existing Mathematical Structures: Simplicial Complexes -- 5.8 Resulting Geometric Representation of a Measuring Device -- 5.9 Towards Description in Terms of Existing Mathematical Structures: Domains --5.10 How to Reformulate the Above Description of a Measuring Device in Terms of Domains? -- 5.11 Example 1: Interval Uncertainty -- 5.12 Example 2: Counting -- 5.13 Example 3: "Yes"-"No" Measurements -- 5.14 Example 4: A Combination of Several Independent Measuring Instruments.

5.15 Computational Complexity of the Simplicial Complex Representation ... -- 5.16 Computational Complexity of the Simplicial Complex Representation of a Measuring Device: Case of Interval Uncertainty -- 5.17 Computational Complexity of the Simplicial Complex Representation of a Measuring Device: Case of Multi-D Uncertainty -- 5.18 Computational Complexity of the Simplicial Complex Representation of a Measuring Device: General Case of Localized Uncertainty -- References -- 6 A General Description of Measuring Devices: Fourth Step-Conditional Statements About Possible Outcomes -- 6.1 Subsets of Compatible Outcomes Do Not Always Give A Complete Description of a Measuring Device -- 6.2 What We Do We Need to Add to the Subsets Description to Capture the Missing Information About a Measuring Device? -- 6.3 The Existence of a Full Theory Makes the Set of All True Conditional Statements Algorithmically Listable: An Argument -- 6.4 Family of Conditional Statements: Natural Properties -- 6.5 Conclusion: Algorithmically Listable Family of Conditional Statements -- 6.6 Description in Terms of Existing Mathematical Structures: Deduction Relation -- 6.7 Description in Terms of Existing Mathematical Structures: Domains --6.8 Example 1: Interval Uncertainty -- 6.9 Example 2: Counting -- 6.10 Example 3: "Yes"-"No" Measurements -- 6.11 Example 4: A Combination of Several Independent Measuring Instruments -- 6.12

Computational Complexity of the Domain Representation of a Measuring Device: A General Case -- 6.13 Computational Complexity of the Domain Representation of a Measuring Device: Case of Interval Uncertainty -- 6.14 Computational Complexity of the Simplicial Complex Representation of a Measuring Device: Case of Convex Multi-D Uncertainty.

6.15 Computational Complexity of the Domain Representation of a Measuring Device: General Case of Localized Uncertainty -- References -- 7 A General Description of Measuring Devices: Fifth Step-Disjunctive Conditional Statements About the Possible Outcomes -- 7.1 Addition of Conditional Statements Does Not Always Lead to a Complete Description of a Measuring Device -- 7.2 What We Do We Need to Add to the Conditional Statements Description to Capture the Missing Information About a Measuring Device? -- 7.3 The Existence of a Full Theory Makes the Set of All True Disjunctive Conditional Statements Algorithmically Listable -- 7.4 Family of True Disjunctive Conditional Statements: Natural Properties -- 7.5 Conclusion: Algorithmically Listable Family of Disjunctive Conditional Statements -- 7.6 Description in Terms of Existing Mathematical Structures: Sequent Calculus -- 7.7 Description in Terms of Existing Mathematical Structures: Boolean Vectors -- 7.8 Example -- 7.9 Description in Terms of Existing Mathematical Structures: Boolean Algebra -- 7.10 Example -- 7.11 Description in Terms of Existing Mathematical Structures: Domains -- 7.12 Example -- 7.13 Is This a Final Description of Validated Uncertainty? -- 7.14 Example 1: Interval Uncertainty -- 7.15 Example 2: Counting -- 7.16 Example 3: "Yes"-"No" Measurements -- 7.17 Example 4: A Combination of Several Independent Measuring Instruments -- 7.18 Computational Complexity of the Boolean Representation of a Measuring Device: A General Case -- 7.19 Computational Complexity of the Boolean Representation of a Measuring Device: Case of Interval Uncertainty -- 7.20 Computational Complexity of the Boolean Representation of a Measuring Device: Case of Convex Multi-D Uncertainty -- 7.21 Computational Complexity of the Domain Representation of a Measuring Device: General Case of Localized Uncertainty.

References -- 8 A General Description of Measuring Devices: Summary -- 8.1 Summary -- 8.2 Measuring Device: A Final Description -- 9 Physical Quantities: A General Description -- 9.1 General Idea -- 9.2 From the General Idea to a Formal Description -- 9.3 Set of Possible Outcomes: The Notion of a Projection -- 9.4 Pairs of Compatible Outcomes: The Notion of a Projection -- 9.5 Subsets of Compatible Outcomes: The Notion of a Projection -- 9.6 Definition Reformulated in Domain Terms -- 9.7 General Domains and Boolean Vectors: The Notion of a Projection -- 9.8 The Family of All Measuring Devices Measuring A Given ... -- 9.9 Physical Quantity as a Projective Limit of Measuring Devices -- 9.10 Example -- 9.11 Within This Definition, The Fact that Every Outcome ... -- 9.12 Different Sequences of Measurement Results May Correspond to the Same Value of the Measured Quantity -- 9.13 Case of Graphs -- 9.14 Within This Definition, The Fact that siml Describes Exactly Compatible Pairs Is Now a Theorem -- 9.15 Case of Simplicial Complexes -- 9.16 Within This Definition, The Fact that calSI Describes Exactly Compatible Subsets Is Now A Theorem -- 9.17 Cases of Conditional Statements and Boolean Vectors -- 9.18 Examples: A Brief Introduction -- 9.18.1 Example 1: Interval Uncertainty Leads to Real Numbers -- 9.19 Conclusion -- 9.20 Example 2: Counting Leads to Natural Numbers -- 9.21 Example 3: "Yes"-"No" Measurements Lead to Truth Values -- 9.22 Example 4: A Combination of Several Independent Physical Quantities --

References -- 10 Properties of Physical Quantities -- 10.1 A Useful Auxiliary Result: We Can Always Restrict Ourselves to a Sequence of Measuring Devices -- 10.1.1 From the Physical Viewpoint, It is Important to Consider the Most General Families of Measuring Devices. 10.1.2 From the Purely Mathematical Viewpoint (of Proving Results), it is Desirable to Consider the Simpler Case of Sequences.