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BUILDING ONTOLOGIES WITH BASIC FORMAL ONTOLOGY

ROBERT ARP, BARRY SMITH,
AND ANDREW D. SPEAR

In the era of “big data,” science is increasingly information driven, and the potential for computers to store, manage, and integrate massive amounts of data has given rise to such new disciplinary fields as biomedical informatics.

Applied ontology offers a strategy for the organization of scientific information in computer-readable form, drawing on concepts not only from computer and information science but also from linguistics, logic, and philosophy. This book provides an introduction to the field of applied ontology, that is, of practical relevance to biomedicine, covering theoretical components of ontologies, best practices for ontology design, and examples of biomedical ontologies in use.

After defining an ontology as a representation of the types of entities in a given domain, the book distinguishes between different kinds of ontologies and discusses, and shows how applied

ontology draws on more traditional ideas from metaphysics. It presents the core features of the Basic Formal Ontology (BFO), now used by over one hundred ontology projects around the world, and offers examples of domain ontologies that utilize BFO. The book also describes Web Ontology Language (OWL), a common framework for Semantic Web technologies. Throughout, the book provides concrete recommendations for the design and construction of domain ontologies.

Robert ARP is a researcher and analyst for the U.S. Army at Fort Leavenworth, Kansas, who has worked on ontologies for the U.S. Air Force and the National Institutes of Health. He is the author of *Scenario Visualization: An Evolutionary Account of Creative Problem Solving*. **Barry SMITH** is SUNY Distinguished Professor of Philosophy at the University at Buffalo and Director of the National Center for Ontological Research. **Andrew SPEAR** is Associate Professor of Philosophy at Grand Valley State University in Allendale, Michigan.

“This book addresses the important, 2,000-year-old challenge of how to soundly formalize the content and organization of scientific knowledge. As a user and teacher of ontological methods in medicine and engineering I have for years warned my students that the design of domain ontologies is a black art with no theoretical foundations and few practical principles. Without progress on the problem, I argue, many fields ranging from informatics and computer science to AI and cognitive science will struggle to achieve their enormous potential, or to do so in a way that is convincing or safe. I now have a much more positive story for my students. Arp, Smith, and Spear have combined years of experience and lessons learned in diverse application domains into this treasure trove of guidance and good practice for the ontology builder. In the journey from black art to a truly scientific theory for ontology design, this book is an important milestone.”

—**John Fox**, Department of Engineering Science, University of Oxford; Director, OpenClinical knowledge sharing project

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Building Ontologies with Basic Formal Ontology Robert Arp, Barry Smith, Andrew D. Spear, 2015-07-31 An introduction to the field of applied ontology with examples derived particularly from biomedicine covering theoretical components design practices and practical applications In the era of big data science is increasingly information driven and the potential for computers to store manage and integrate massive amounts of data has given rise to such new disciplinary fields as biomedical informatics Applied ontology offers a strategy for the organization of scientific information in computer tractable form drawing on concepts not only from computer and information science but also from linguistics logic and philosophy This book provides an introduction to the field of applied ontology that is of particular relevance to biomedicine covering theoretical components of ontologies best practices for ontology design and examples of biomedical ontologies in use After defining an ontology as a representation of the types of entities in a given domain the book distinguishes between different kinds of ontologies and taxonomies and shows how applied ontology draws on more traditional ideas from metaphysics It presents the core features of the Basic Formal Ontology BFO now used by over one hundred ontology projects around the world and offers examples of domain ontologies that utilize BFO The book also describes Web Ontology Language OWL a common framework for Semantic Web technologies Throughout the book provides concrete recommendations for the design and construction of domain ontologies

Ontology-Based Development of Industry 4.0 and 5.0 Solutions for Smart Manufacturing and Production János Abonyi, László Nagy, Tamás Ruppert, 2024-01-01 This book presents a comprehensive framework for developing Industry 4.0 and 5.0 solutions through the use of ontology modeling and graph based optimization techniques With effective information management being critical to successful manufacturing processes this book emphasizes the importance of adequate modeling and systematic analysis of interacting elements in the era of smart manufacturing The book provides an extensive overview of semantic technologies and their potential to integrate with existing industrial standards planning and execution systems to provide efficient data processing and analysis It also investigates the design of Industry 5.0 solutions and the need for problem specific descriptions of production processes operator skills and states and sensor monitoring in intelligent spaces The book proposes that ontology based data can efficiently represent enterprise and manufacturing datasets The book is divided into two parts modeling and optimization The semantic modeling part provides an overview of ontologies and knowledge graphs that can be used to create Industry 4.0 and 5.0 applications with two detailed applications presented on a reproducible industrial case study The optimization part of the book focuses on network science based process optimization and presents various detailed applications such as graph based analytics assembly line balancing and community detection The book is based on six key points the need for horizontal and vertical integration in modern industry the potential benefits of integrating semantic technologies into ERP and MES systems the importance of optimization methods in Industry 4.0 and 5.0 concepts the need to process large amounts of data while

ensuring interoperability and re usability factors the potential for digital twin models to model smart factories including big data access and the need to integrate human factors in CPSs and provide adequate methods to facilitate collaboration and support shop floor workers

Ontology Makes Sense Claudio Masolo, Laure Vieu, 2019-04-15 Nicola Guarino is widely recognized as one of the founders of applied ontology His deep interest in the subtlest details of theoretical analysis and his vision of ontology as the Rosetta Stone for semantic interoperability guided the development and understanding of this domain His motivations in research stem from the conviction that all science must be for the benefit of society at large and his motto has always been that ontologies are not just for making information systems interoperable but more importantly for ensuring that systems users understand each other He was among the first to recognize that applied ontology must be an interdisciplinary enterprise if it is to capture the intended meaning of the terms used by an information system This book is a collection of essays written in homage to Nicola Guarino a tribute to his many scientific contributions to the discipline of applied ontology The papers presented here reflect the wide variety of research topics that marked Nicola s impact on the applied ontology community They are grouped according to the five general areas addressed by Nicola in his career what is an ontology knowledge engineering ontologies and language ontological categories and relationships and ontologies and applications Nicola Guarino s work and dedication will undoubtedly continue to influence the applied ontology community and this book will be of interest to the many researchers aiming to establish ontologically sound bases for their research areas

Artificial Intelligence in Patient Counselling Bhupendra G. Prajapati, Meghraj Vivekanand Suryawanshi, Jigna Prajapati, Nemat Ali, 2025-11-08 Artificial Intelligence in Patient Counselling explores the transformative role of artificial intelligence in enhancing patient counseling and education The book delves into how cutting edge AI technology is reshaping the healthcare landscape improving patient experiences and driving better health outcomes It provides a comprehensive overview of the ways AI can address the challenges of personalized and effective patient care Sections cover a wide range of topics including the creation of personalized treatment plans through AI s analysis of patient data the emergence of AI powered virtual health assistants for 24 7 support and the use of predictive analytics to identify early disease progression Additionally it explores AI enhanced medical imaging empathetic AI chatbots ethical considerations and real world case studies that illustrate the tangible benefits of AI in patient counseling and education By offering insights from leading experts it empowers readers to navigate the evolving healthcare landscape with confidence and compassion The book provides essential knowledge and tools for improving patient outcomes and modernizing patient care through AI driven solutions making it a valuable resource for understanding the impact of AI on patient care and education Delves into how AI analyzes patient data including medical histories genetics and lifestyles to create tailored treatment plans Highlights the role of AI driven virtual health assistants and chatbots that provide 24 7 support empathetic conversations and proactive counseling Discusses the ethical implications of using AI in healthcare Presents real world case studies that illustrate the practical

benefits and challenges of AI in patient counseling and education *Evaluating the Brain Disease Model of Addiction* Nick Heather, Matt Field, Antony Moss, Sally Satel, 2022-03-07 This ground breaking book advances the fundamental debate about the nature of addiction As well as presenting the case for seeing addiction as a brain disease it brings together all the most cogent and penetrating critiques of the brain disease model of addiction BDMA and the main grounds for being skeptical of BDMA claims The idea that addiction is a brain disease dominates thinking and practice worldwide However the editors of this book argue that our understanding of addiction is undergoing a revolutionary change from being considered a brain disease to a disorder of voluntary behavior The resolution of this controversy will determine the future of scientific progress in understanding addiction together with necessary advances in treatment prevention and societal responses to addictive disorders This volume brings together the various strands of the contemporary debate about whether or not addiction is best regarded as a brain disease Contributors offer arguments for and against and reasons for uncertainty they also propose novel alternatives to both brain disease and moral models of addiction In addition to reprints of classic articles from the addiction research literature each section contains original chapters written by authorities on their chosen topic The editors have assembled a stellar cast of chapter authors from a wide range of disciplines neuroscience philosophy psychiatry psychology cognitive science sociology and law including some of the most brilliant and influential voices in the field of addiction studies today The result is a landmark volume in the study of addiction which will be essential reading for advanced students and researchers in addiction as well as professionals such as medical practitioners psychiatrists psychologists of all varieties and social workers **Metaphor and Metonymy in the Digital Age** Marianna Bolognesi, Mario Brdar, Kristina

Despot, 2019-08-06 This book describes methods risks and challenges involved in the construction of metaphor and metonymy digital repositories The first part of this volume showcases established and new projects around the world in which metaphors and metonymies are harvested and classified The second part provides a series of cognitive linguistic studies focused on highlighting and discussing theoretical and methodological risks and challenges involved in building these digital resources The volume is a result of an interdisciplinary collaboration between cognitive linguists psychologists and computational scientists supporting an overarching idea that metaphor and metonymy play a central role in human cognition and that they are deeply entrenched in recurring patterns of bodily experience Throughout the volume a variety of methods are proposed to collect and analyze both conceptual metaphors and metonymies and their linguistic and visual expressions

Frontiers of Artificial Intelligence, Ethics, and Multidisciplinary Applications Mina Farmanbar, Maria Tzamtzi, Ajit Kumar Verma, Antorweep Chakravorty, 2024-02-24 This groundbreaking proceedings volume explores the integration of Artificial Intelligence AI across key domains healthcare finance education robotics industrial and other engineering applications unveiling its transformative potential and practical implications With a multidisciplinary lens it transcends technical aspects fostering a comprehensive understanding while bridging theory and practice Approaching the subject

matter with depth the book combines theoretical foundations with real world case studies empowering researchers professionals and enthusiasts with the knowledge and tools to effectively harness AI Encompassing diverse AI topics machine learning natural language processing computer vision data analytics and supervisory control the volume showcases state of the art techniques propelling AI advancements Structured into four parts Part 1 Artificial Intelligence AI explores evolving deep neural networks reinforcement learning and explainable AI providing a deep dive into the technical foundations of AI advancements Part 2 Robotics and Control Systems delves into the integration of AI in robotics and automatic control addressing supervisory control automated robotic movement coordination anomaly detection dynamic programming and fault tolerance offering insights into the evolving landscape of intelligent automation Part 3 AI and Society examines the societal impact of AI through chapters on ethical considerations economic growth environmental engagements and hazard management providing a holistic perspective on AI s role in shaping society Part 4 PhD Symposium presents the future of AI through cutting edge research covering legal and ethical dimensions privacy considerations and computationally efficient solutions offering a glimpse into the next generation of AI advancements Catering to a diverse audience from industry leaders to students the volume consolidates the expertise of renowned professionals serving as a comprehensive resource for navigating the ever evolving AI landscape An essential reference for those staying at the forefront of AI developments

Challenges of Trustable AI and Added-Value on Health Patrick Weber, Ferdinand Dhombres, Cyril Grouin, Jan-David Liebe, Sylvia Pelayo, Andrea Pinna, 2022-08-15 Artificial Intelligence AI in healthcare promises to improve the accuracy of diagnosis and screening support clinical care and assist in various public health interventions such as disease surveillance outbreak response and health system management But the increasing importance of AI in healthcare means that trustworthy AI is vital to achieve the beneficial impacts on health anticipated by both health professionals and patients This book presents the proceedings of the 32nd Medical Informatics Europe Conference MIE2022 organized by the European Federation for Medical Informatics EFMI and held from 27-30 May 2022 in Nice France The theme of the conference was Challenges of Trustable AI and Added Value on Health Over 400 submissions were received from 43 countries and were reviewed in a thorough process by at least three reviewers before being assessed by an SPC co chair with papers requiring major revision undergoing further review Included here are 147 full papers acceptance rate 54% 23 short papers and 79 posters from the conference Topics covered include the usual sub domains of biomedical informatics decision support and clinical information systems clinical research informatics knowledge management and representation consumer health informatics natural language processing public health informatics and privacy ethical and societal aspects but also innovative approaches to the collection such as organization and analysis of data and knowledge related to health and wellbeing as well as theoretical and applied contributions to AI methods and algorithms Providing an overview of the latest developments in medical informatics the book will be of interest to all those involved in the development and provision of healthcare today Philosophy and

Finance: Ten Open Questions Emiliano Ippoliti, Melissa Vergara-Fernández, Fabrizio Zennaro, 2025-09-26 This volume presents ten thought provoking essays exploring issues in the philosophy of finance that are crucial for the economy and society They also show the mutual relations and benefits between finance and philosophy These issues include the link between financial systems and climate change the ontologies of finance that are essential for market design the role and effect of AI in the financial systems the nature and prospects of money and their digital version methodological problems in the use of models and mathematics in the financial world and critical discussions of some of the main theories on financial systems like the efficient market hypothesis As this volume covers a wide array of topics whilst still forming a coherent whole it is of interest to philosophers of finance philosophers of science epistemologists and philosophers of economics as well as to scientists and practitioners interested in the debates over methodological ontological epistemological as well as ethical issues in finance

Metadata and Semantic Research Michalis Sfakakis, Emmanouel Garoufallou, Matthew Damigos, Athena Salaba, Christos Papatheodorou, 2025-02-25 This book constitutes the refereed post proceedings of the 18th Research Conference on Metadata and Semantic Research MTSR 2024 held in Athens Greece during November 19 22 2024 The 23 full papers and 6 short papers included in this book were carefully reviewed and selected from 59 submissions These papers were organized in the following sections track on metadata linked data semantics and ontologies general session track on open repositories research information systems track on digital libraries information retrieval big linked social track on cultural collections track on european and national projects and 8th dOAbLE papers for libraries archives museums track on agriculture food track on digital humanities and digital curation

Enterprise Interoperability: Smart Services and Business Impact of Enterprise Interoperability Martin Zelm, Frank-Walter Jaekel, Guy Doumeingts, Martin Wollschlaeger, 2018-10-25 The ability of future industry to create interactive flexible and always on connections between design manufacturing and supply is an ongoing challenge affecting competitiveness efficiency and resourcing The goal of enterprise interoperability EI research is therefore to address the effectiveness of solutions that will successfully prepare organizations for the advent and uptake of new technologies This volume outlines results and practical concepts from recent and ongoing European research studies in EI and examines the results of research and discussions cultivated at the I ESA 2018 conference Smart services and business impact of enterprise interoperability The conference designed to encourage collaboration between academic inquiry and real world industry applications addressed a number of advanced multidisciplinary topics including Industry 4 0 Big Data the Internet of Things Cloud computing ontology artificial intelligence virtual reality and enterprise modelling for future smart manufacturing Readers will find this book to be a source of invaluable knowledge for enterprise architects in a range of industries and organizations

Formal Ontology in Information Systems Nicola Guarino, 1998 Research on ontology is becoming increasingly widespread in the computer science community While this term has been rather confined to the philosophical sphere in the past it is now gaining a

specific role in areas such as Artificial Intelligence Computational Linguistics and Databases Its importance has been recognized in fields as diverse as knowledge engineering knowledge representation qualitative modeling language engineering database design information integration object oriented analysis information retrieval and extraction knowledge management and organization agent based systems design Current applications areas are disparate including enterprise integration natural language translation medicine mechanical engineering electronic commerce geographic information systems legal information systems and biological information systems Various workshops addressing the engineering aspects of ontology have been held in the recent years However ontology by its very nature ought to be a unifying discipline Insights in this field have potential impact on the whole area of information systems taking this term in its broadest sense as testified by the interest recently shown by international standards organizations In order to provide a solid general foundation for this work it is therefore important to focus on the common scientific principles and open problems arising from current tools methodologies and applications of ontology

Rationality and irrationality Barry Smith, 2001 [IEEE Advances in Digital Libraries 2000, May 22-24, 2000, Washington, D.C.](#) ,2000 Annotation Papers from a May 2000 conference address topics including agent technology collaborative research digital library testbed systems document models economic issues and human computer interactions Other subjects are intellectual property and security knowledge representation meta information publishing semantic and systems interoperability and telecommunications and networking Some specific topics include using regular tree automata as XML schemas morphing towards interoperable catalogues and clustering and identifying temporal trends in document databases Lacks a subject index The editor is affiliated with Tilburg University Annotation copyrighted by Book News Inc Portland OR [Proceedings](#) ,2000 **WISE 2002** ,2002 Collects the 31 papers presented at the three workshops held during the December 2002 conference The workshops address web and wireless geographical information systems data semantics in web information systems and mining for enhanced web search Topics of the papers include a context sensitive p

Legal Knowledge Based Systems H. Prakken, 1994 [Journal of Information Science](#) ,2002 Principles practice [Encyclopedia of Networked and Virtual Organizations](#) Goran Putnik, Maria Manuela Cunha, 2008 This book documents the most relevant contributions to the introduction of networked dynamic agile and virtual organizational models definitions taxonomies opportunities and reference models and architectures It creates a repository of the main developments regarding the virtual organization compiling definitions characteristics comparisons advantages practices enabling technologies and best practices Provided by publisher

AAAI 99 American Association for Artificial Intelligence, 1999 AAAI proceedings describe innovative concepts techniques perspectives and observations that present promising research directions in artificial intelligence The annual AAAI National Conference and Innovative Applications of Artificial Intelligence Conference provide a forum for information exchange and interaction among researchers from all disciplines of AI Contributions include theoretical experimental and empirical results The technical papers published in this

proceedings were selected by a rigorous double blind review process The National Conference papers cover a myriad of topics including agents artificial intelligence and the world wide web cognitive systems constraint satisfaction problems knowledge acquisition knowledge representation learning model based reasoning natural language and information retrieval planning robotics satisfiability scheduling search tractable reasoning and vision The Innovative Applications Conference papers feature deployed and emerging applications These papers will be of special benefit to AI applications developers In addition abstracts from the Invited talks Intelligent Systems Demonstrations Robotic Competition and Exhibition SIGART AAI Doctoral Consortium and Student programs are also included in this proceedings

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