

## Preface

The successful creation and implementation of effective machine learning is critical to an organization's success and productivity. Current machine learning within organizations and the technological advancements have revolutionized information science, robotics, forecasting and modeling, and a wide variety of technologies. From artificial intelligence and adaptive technology to data warehousing and mining, this ever-advancing field of machine learning is critical to the success of modern businesses, academic communities, and consumers.

The constantly changing landscape of machine learning makes it challenging for experts and practitioners to stay informed of the field's most up-to-date research. That is why Information Science Reference is pleased to offer this four-volume reference collection that will empower students, researchers, and academicians with a strong understanding of critical issues within machine learning by providing both broad and detailed perspectives on cutting-edge theories and developments. This reference is designed to act as a single reference source on conceptual, methodological, technical, and managerial issues, as well as provide insight into emerging trends and future opportunities within the discipline.

*Machine Learning: Concepts, Methodologies, Tools and Applications* is organized into eight distinct sections that provide comprehensive coverage of important topics. The sections are: (1) Fundamental Concepts and Theories, (2) Development and Design Methodologies, (3) Tools and Technologies, (4) Utilization and Application, (5) Organizational and Social Implications, (6) Managerial Impact, (7) Critical Issues, and (8) Emerging Trends. The following paragraphs provide a summary of what to expect from this invaluable reference tool.

Section 1, **Fundamental Concepts and Theories**, serves as a foundation for this extensive reference tool by addressing crucial theories essential to the understanding of machine learning. Introducing the book is *A Comparison of Human and Computer Information Processing* by Brian Whitworth and Hokyoung Ryu. This chapter lays the fundamental groundwork for differences and similarities in the processing power of the human mind and computer systems. From there, section one continues through fundamentals of machine learning, with chapters such as *Machine Learning Through Data Mining* by Diego Liberati, detailing the impact of data mining in machine learning and its various applications. As the section continues, outlining more of the basic applications and concepts in machine learning, topics covered include data mining, knowledge translation, geometric computing, spatial data fusion, and many more. In all, section 1 is a great collection of research towards the fundamental concepts of machine learning and the theories supporting its applications. This section makes a fantastic resource for those interested in surveying some of the basics in the field.

Section 2, **Development and Design Methodologies**, presents in-depth coverage of the conceptual design and architecture of machine learning, focusing on aspects including learning modeling, information hiding, security methods, rule engines, semantic annotation, and much more. The section starts

with an introductory chapter, *Machine Learning as a Commonsense Reasoning Process*, by Xenia Naidenova. This chapter describes the machine processes of discovering/acquiring knowledge, and using it effectively. The section continues through a wide variety of descriptions of developments in software engineering that utilize machine learning techniques, including *Higher Order Neural Network Architectures for Agent-Based Computational Economics and Finance* by John Seiffert and Donald C. Wunsch II. As suggested by the title, the applications of machine learning are vast: from economics and finance to medicine, tourism, sports, and especially to science and technology. Section 2 is a great resource for developers and designers working in the field of machine learning, but also for practitioners in any of the above mentioned applied fields.

Section 3, **Tools and Technologies**, presents extensive coverage of the various tools and technologies used in the development and implementation of machine learning. The first chapter, *Application of Machine Learning Techniques to Predict Software Reliability* by Ramakanta Mohanty, V. Ravi, and M. R. Patra, is a perfect example of the kind of chapter found throughout section 3 of this book. For software designers and engineers, this chapter breaks down some of the latest research within the field's many applications to software, specifically in forecasting reliability. Other chapters within this section detail other applications within software engineering, such as *A Recovery-Oriented Approach for Software Fault Diagnosis in Complex Critical Systems* by Gabriella Carrozza and Roberto Natella, or *Application of Artificial Immune Systems Paradigm for Developing Software Fault Prediction Models* by Soumya Banerjee and Cagatay Catal. Another application featured in this section of tools and technologies can be found in *Hybrid Intelligent Diagnosis Approach Based On Neural Pattern Recognition and Fuzzy Decision-Making* by Véronique Amarger, Amine Chohra, Nadia Kanaoui, and Kurosh Madani. This chapter breaks down new hybrid tools for creating adaptive technologies that aid diagnostic systems. Chapters in this section are more technical, featuring advanced algorithms and specific, detailed depictions of new tools and techniques.

Section 4, **Utilization and Application**, describes how machine learning has been utilized and offers insight on and important lessons for its continued use and evolution. The section begins with a discussion of applied use of machine learning techniques in bioinformatics: *Machine Learning and Data Mining in Bioinformatics* by George Tzanis, Christos Berberidis, and Ioannis Vlahavas. Other medical applications discussed in section 4 include biometrics, diagnosis systems, imaging, and clinical data processing. In the middle of the section come two chapters by Adam J. Conover: *A Simulation of Temporally Variant Agent Interaction via Passive Inquiry* and *A Simulation of Temporally Variant Agent Interaction via Belief Promulgation*. These two chapters present a comprehensive look at two techniques, giving a more holistic picture of the applications of machine learning within agent interaction. Where section 3 was more technical, getting into the specifics of some of the latest tools and technologies, section 4 is more interested in showing the variety of applications within machine learning.

Section 5, **Organizational and Social Implications**, includes chapters discussing the organizational and social impact of machine learning. Introducing the section is *Conservation of Information (COI)* by Max E. Stachura, Elena V. Astapova, Hui-Lien Tung, Donald A. Sofge, James Grayson, Margo Bergman, and Joseph Wood. This chapter is a fantastic introduction to a section that breaks down the behavioral, social, and organizational impacts machine learning has on various institutions. Continuing the section's focus on organizational implications of machine learning is a look at resource allocation within businesses: *Improving Automated Planning with Machine Learning*, by Susana Fernández Arregui, Sergio Jiménez Celorrio, and Tomás de la Rosa Turbides. This chapter shows machine learning techniques for assisting automated planners classified in: techniques for the improvement of the planning search processes and

techniques for the automatic definition of planning action models. The section continues through various applications within organizations. Where section 5 hints at some techniques that managers can use to improve resources within their company or industry, section six goes further to detail managerial impact.

Section 6, **Managerial Impact**, presents focused coverage of machine learning as it relates to effective uses of resource allocation, forecasting, modeling, and much more. The section begins with an introductory chapter, *Introducing AI and IA into a Non Computer Science Graduate Programme* by Maria Fasli, Petros Kefalas, and Ioanna Stamatopoulou. The section continues with applications to the medical field, with chapters such as *Cost-Sensitive Learning in Medicine* by Alberto Freitas, Pavel Brazdil, and Altamiro Costa-Pereira, a wonderful look at ways to effectively manage hospital systems while keeping an eye towards budgetary concerns. Another application can be seen in *Forecasting Supply Chain Demand Using Machine Learning Algorithms* by Réal Carbonneau, Rustam Vahidov, and Kevin Laframboise, showing how businesses can use some of the latest machine learning algorithms to adapt and grow their enterprises and streamline their supply chain.

Section 7, **Critical Issues**, presents coverage of academic and research perspectives on machine learning tools and applications. The section begins with an expository chapter, *Problems for Structure Learning*, by Frank Wimberly, David Danks, Clark Glymour, and Tianjiao Chu, which will lay some of the fundamental and terminological groundwork through which much of the other topics in the section will focus their explanations. Another excellent chapter is *Artificial Moral Agency in Technoethics* by John P. Sullins, detailing some of the latest insight into how machines develop a “conscience” that allows them to adapt in situations revolving around technoethics. The chapter continues through various looks at emotional, cognitive, behavioral, social, and various technical viewpoints and perspective within machine learning. Though this section will prove a vital resource for academics and practitioners alike, the “critical” in the section title refers more to the analytical nature of the chapter selections rather than the relevance or importance of their publications. Section 8 is more of a look at the latter, upcoming technologies and applications of machine learning.

Section 8, **Emerging Trends**, highlights areas for future research within the field of machine learning, while exploring new avenues for the advancement of the discipline. Beginning this section are two fantastic chapters: *Learning with Partial Supervision* by Abdelhamid Bouchachia, and *Brain-Like Processing and Classification of Chemical Data* by Michael Schmuker and Gisbert Schneider. These two chapters are an excellent introduction to the section because they detail two emerging trends within the field of machine learning: supervision (or the lack thereof) and brain-like processing. As machines adapt and evolve, the amount of programming required on the front-end is increasing, but learning techniques require less and less maintenance and upkeep as machines continue to learn on their own. The concluding chapter of the book, *Dependency Parsing: Recent Advances* by Ruket Çakici, is a review of statistical dependency parsing for different languages and current challenges of designing dependency treebanks and dependency parsing.

Although the primary organization of the contents in this multi-volume work is based on its eight sections, offering a progression of coverage of the important concepts, methodologies, technologies, applications, social issues, and emerging trends, the reader can also identify specific contents by utilizing the extensive indexing system listed at the end of each volume. Furthermore to ensure that the scholar, researcher, and educator have access to the entire contents of this multi volume set as well as additional coverage that could not be included in the print version of this publication, the publisher will provide unlimited multi-user electronic access to the online aggregated database of this collection for the life of the edition, free of charge when a library purchases a print copy. This aggregated database provides

far more contents than what can be included in the print version in addition to continual updates. This unlimited access, coupled with the continuous updates to the database ensures that the most current research is accessible to knowledge seekers.

As a comprehensive collection of research on the latest findings related to using technology to providing various services, *Machine Learning: Concepts, Methodologies, Tools and Applications*, provides researchers, administrators and all audiences with a complete understanding of the development of applications and concepts in machine learning. Given the vast number of issues concerning usage, failure, success, policies, strategies, and applications of machine learning in organizations, *Machine Learning: Concepts, Methodologies, Tools and Applications* addresses the demand for a resource that encompasses the most pertinent research in machine learning development, deployment, and impact.