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Artificial Intelligence, Machine Learning, and Deep Learning for Sustainable Industry 5.0

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Preface

This book offers an insight into the applications of Artificial Intelligence (AI)- Machine Learning Algorithms and Deep Learning (DL) in Bigdata Analytics to Industry 4.0/5.0 and Society 5.0 with transformative power responsibly. It has delved into how these technologies are disrupting industries, fostering innovation, and solving age-old social problems-so that readers have an understanding of where the digital world is headed. These chapters cover the big picture subjects of using AI with Big data analytics aimed mostly at increasing industrial efficiency, healthcare optimization, retail transformation, construction industry transformation, autonomous vehicles development and environmental sustainability improvement. The book covers each of these technologies extensively applied to full chapters devoted to detail studies, methodologies and practical usages. One of the central concepts in the book is how we evolve from industry 4.0 to industry 5.0. Therefore, Industry 4.0 relies on the automation and data exchange in manufacturing technologies using cyber-physical systems, the Internet of Things and cloud computing route to intelligent factories. During this phase, it improves operational efficiency, predictive maintenance and real-time monitoring which lowers down time and other operating costs by considerable amount.

As industries move towards Industry 5.0, a lot has been noted-human-oriented solutions that combine human creativity and intelligence with highly automated and distributed technological tools. More cooperation between humans and machines during such times will, therefore, result in more customized production aimed at sustainable processes. The book details how, thanks to digital twins-that is, innumerable virtual replicas of physical systems-the further step is taken, allowing for real-time data analysis and, consequently innovative ways of manufacturing where the interests of the workers and customers come first. The present book discusses how AI and big data analytics transcend industrial applications to meet more societal ends as society ushers in its fifth revolution. Society 5.0 postulates that a super-smart digital society will drive transformation in all aspects of

life, ranging from health and education to planning urban resources and infrastructure and ensuring public safety. The combination of AI with Big Data makes personalized healthcare services possible, competent resource planning in cities, and environmental sustainability in place via predictive analytics or simulation models.

One such industry in which significant changes are coming, according to AI and Big Data analytics, is healthcare. This book shows how these technologies improve diagnostic accuracy, enable personalized treatment plans, and optimize resource allocations. Predictive insights can predict outbreaks and admissions, which helps better preparedness against diseases and also optimizes health resource utilization. AI in medical imaging and anomaly detection strengthens the efficiency of professional health experts, thus delivering better patient outcomes. AI and big data analytics have further remodelled the retail industry by providing retailers profound insights into consumer behaviour and preferences. With this information, retailers can adopt person-segmented marketing techniques and optimize inventory levels while enabling high levels of customer service using AI-fuelled chatbots and virtual assistants. These technologies help retailers stay competitive in an ever-developing market environment by offering solutions structured based on individual needs expressed by customers. AI and big data analytics combine to form one synergy connected with autonomous vehicles. It further goes on to discuss the huge amount of data needed for training these AI models and big data analytics in refining the accuracy and safety of autonomous driving systems.

Another critical area in which AI and Big Data Analytics make a considerable impact is environmental sustainability. By applying these analyses to large data sets relating to climatic changes, energy consumption, and natural resources, AI models can establish trends and recognize patterns indicating future changes. This predictive ability equips organizations and governments with tools to develop lower environmental footprints and promote sustainable practices proactively. It further explains AI-enabled energy management systems that drive optimized energy use in buildings to reduce carbon emissions and save on associated costs. This certainly looks like something for a vast readership: it speaks more to academics, professionals working in the industry, and decision-makers-but, really, to anybody who seeks to grasp the transformative powerfulness of AI and big data analytics. This source will provide information on overall guidance and a rich source of inspiration in using these technologies to enable innovation and sustainable development across different sectors. Actual case examples and practical applications are given to convey the knowledge and elements that readers need to know as they go about using AI and big data analytics.

This book also includes discussions concerning the dynamic policy and regulatory scenes of AI, pointing out that it is necessary to have standard policies that should be

implemented to have ethical deployment of AI that reduces risks. This book also focuses on challenges in implementing AI for intelligent and sustainable industries, meaning technical, ethical, and operational barriers. It outlines high costs, low-quality data, and the need for skilled professionals; ethical concerns and robust cybersecurity measures become necessary. As such, this book will engross an audience ranging from academics to industry professionals and policymakers working toward understanding and using AI and big data for sustainable development and technological advancement.

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