

# Preface

The paradigm shift in towards Internet of Things (IoT) is becoming the vital component of Internet. Low-cost sensing and actuation are available to the whole world, which enable seamless information exchange and networked interactions of physical and digital objects. This interconnectivity together with large-scale data processing, advanced machine learning, robotics and new fabrication techniques are steadily bringing in innovation and business models of digital space into the physical world. Further, IoT is expected to improve the intelligence, promote the interaction between the human and the environment, as well to enhance reliability, resilience, operational efficiency, energy efficiency and resource consumption. Subsequently, many of the IoT systems and technologies are relatively novel, there are still many untapped applications areas, numerous challenges and issues that need to be improved.

Cognitive science has broad horizons, which cover different characteristics of cognition. The field is highly transdisciplinary in nature, combining ideas, principles and methods of psychology, computer science, linguistics, philosophy, neuroscience, etc. In addition, cognitive computing is the creation of self-learning systems that use data mining, pattern recognition and natural language processing (NLP) to solve complicated problems without constant human oversight.

Cognitive computing will bring a high level of fluidity to analytics. The chapters included in this book aim on addressing recent trends, innovative ideas, challenges and cognitive computing solutions in big data and IoT. Moreover, these chapters specify novel in-depth fundamental research contributions from a methodological/application in data science accomplishing sustainable solution for the future perspective. Further, this book provides a comprehensive overview of constituent paradigms underlying cognitive computing methods, which are illustrating more attention to big data over IoT problems as they evolve. Hence, the main objective of the book is to facilitate a forum to a large variety of researchers, where decision-making approaches under cognitive computing paradigms are adapted to demonstrate how the proposed procedures as well as big data and IoT problems can be handled in practice.

## Need for a Book on the Proposed Topics

Data science techniques have been adopted to improve the IoT in terms of data throughput, optimization and management. Moreover, the data science techniques carry major impact on the future of IoT, allowing researchers to reproduce scenarios and optimize the acquisition, analysis and visualization of the data acquired by IoT devices. One of the most ambitious and exciting challenges in data science is to model and replicate how people think and learn. This book explores domain knowledge and reasoning of data science and cognitive methods over the IoT. The idea of embodying this concept would be to extend existing data science approaches by incorporating knowledge from experts as well as a notion of artificial intelligence, and performing inference on the knowledge. The main focus is design of best cognitive embedded data science technologies to process and analyse the large amount of data collected through IoT and help for good decision-making. Consequently, the cognitive data science research facilitates a platform to scientific community to work for the best solution of challenges related with cognitive methods and data science model issues to support IoT solutions towards smart infrastructure and meet the requirement of modern world. This book addresses a wide spectrum of cognitive computing paradigms, making decisions of an industry or organization happened at all the levels of data science challenges. In addition, this book aims to provide relevant theoretical frameworks and the latest empirical research findings in the area. Solutions for big data over IoT problems have been effectively handled through wide range of algorithmic and cognitive computing frameworks, such as optimization, machine learning, decision support systems and meta-heuristics. In addition, the main contributions to this volume address big data over IoT problems in computing and information processing environments and technologies, and at various levels of the cognitive computing paradigms.

## Organization of the Book

The volume is organized into 15 chapters. A brief description of each chapter is given as follows:

Chapter “[Beyond Automation: The Cognitive IoT. Artificial Intelligence Brings Sense to the Internet of Things](#)” gives an overview of Intelligent IoT is named as Cognitive IoT (CIoT) describes the convergence of IoT with artificial intelligence techniques. In addition, this chapter introduces a preliminary idea of cognitive computing that discusses several aspects of CIoT through different forms such as Cognitive Network, Cognitive Devices and Cognitive Analytics.

Chapter “[Cybercrimes Investigation and Intrusion Detection in Internet of Things Based on Data Science Methods](#)” introduces the principles of Digital Forensics, Intrusion Detection and Internet of Things as well as exploring the data science concepts and methods. The chapter authors highlight the need for

employing data science, data mining and big data analytics methods in cybercrime investigation area because they have many advantages to support the digital investigation.

Chapter “[Modelling and Analysis of Multi-Objective Service Selection Scheme in IoT-Cloud Environment](#)” presents computational intelligent paradigm based on fuzzy multi-criteria decision-making approaches (AHP and TOPSIS) to select an optimal cloud for accessing different services of cloud. The offloading data is evaluating the weights of important criteria’s and by calculating the final ranking of alternative clouds. In addition, this chapter addresses the significance of the proposed approach in better understanding of the whole evaluation process and their efficiency of decision-making process in cloud path selection for offloading in Mobile Cloud Computing (MCC) environment.

Chapter “[Cognitive Data Science Automatic Fraud Detection Solution, Based on Benford’s Law, fuzzy Logic with Elements of Machine Learning](#)” presents computational intelligence based heuristic approach for maximizing energy efficiency in the Internet of Things (IoT). The authors present the Modified Multi-Objective Particle Swarm Optimization (MMOPSO) algorithm based on the concept of dominance to solve the mobile cloud task scheduling problem. Overall, this chapter explores IoT and cloud computing as well as their symbiosis based on the common environment of distributed processing.

Chapter “[Reliable Cross Layer Design for E-health Applications—IOT Perspective](#)” illustrates cognitive data science automatic fraud detection solution, based on Benford’ s law, fuzzy logic with elements of machine learning. Moreover, proposed methodology gives solution for automatic seeking patterns within data with focus on fraud detection.

Chapter “[Erasure Codes for Reliable Communication in Internet of Things \(IoT\) embedded with Wireless Sensors](#)” provides a comprehensive overview of existing erasure codes in the wireless sensor networks which are integral part of Internet of Things communication. This chapter presents the construction methods of extensively used Reed–Solomon codes and Fountain codes that are provided in addition to decentralized erasure codes. Further, basic communication paradigm of information transmission namely end-to-end transmission and hop-by-hop transmission are discussed in detail with and without emphasis on erasure codes.

Chapter “[Review: Security and Privacy Issues of Fog Computing for the Internet of Things \(IoT\)](#)” highlights the security and privacy issues of fog computing through a comprehensive review of fog computing and suggests solutions for identified problems. The chapter authors highlighted the areas that need attention in fog computing research.

Chapter “[A Review on Security and Privacy Challenges of Big Data](#)” emphasizes on certain gaps in the literature to evaluate possible solutions to a rising problem in various privacy and security issues in different areas of big data. The chapter authors have addressed gaps in the literature by highlighting security and privacy issues that big companies face with recent technological advancements in corporate societies.

Chapter “[Recent Trends in Deep Learning with Applications](#)” presents the overview review of understanding the deep learning methods and their recent advances in Internet of things. The deep learning methods are divided into four classifications such as Convolutional Neural Networks, Restricted Boltzmann Machines, Auto-encoder and Sparse Coding. The applications with respect to Internet of things such as image caption, object detection and visual tracking are also discussed in this chapter.

Chapter “[High-Level Knowledge Representation and Reasoning in a Cognitive IoT/WoT Context](#)” presents an overview of the Generalized World Entities (GWEs) paradigm, used to add a semantic/conceptual dimension to the ordinary IoT/WoT procedures. This chapter have focused on development in effective SWOT (Semantic Web of Things) applications via high-level Cognitive Science/Artificial Intelligence techniques. It is necessary to overcome the shortcomings of the present cognitive/conceptual IoT/WoT approaches.

Chapter “[Applications of IoT in Healthcare](#)” focuses on how Internet of things (IoT) capabilities can be leveraged in providing better healthcare. This chapter also discusses the key enabling technologies of the IoT (e.g., sensors and Wireless Sensor Networks (WSN)), their characteristics and challenges.

Chapter “[Security Stipulations on IoT Networks](#)” discusses on various attacks which are possible in the IoT connected network. This chapter will provide readers with an understanding about the security policies and mechanisms in complex IoT systems. Moreover, the chapter authors have illustrated the various security aspects and its countermeasures were analysed and discussed.

Chapter “[A Hyper Heuristic Localization Based Cloned Node Detection Technique using GSA Based Simulated Annealing in Sensor Networks](#)” presents a Residual Energy and GSA based Simulated Annealing (RE-GSASA) for detecting and isolating the cloned attack node in WSN. The chapter authors have proposed a novel Residual Energy and GSA based Simulated Annealing (RE-GSASA) method is introduced to reduce the energy consumption during data aggregation and improve the packet delivery ratio.

Chapter “[Review on Analysis of the Application Areas and Algorithms used in Data Wrangling in Big Data](#)” presents an extended review on the analysis of the application areas and algorithms used in data wrangling in Big Data. This chapter results show that data wrangling and clustering algorithm can solve medical data storage issues.

Chapter “[An Innovation Model for Smart Traffic Management System Using Internet of Things \(IoT\)](#)” discusses about an architecture which integrates Internet of things and other moving components like data management techniques to create a model for traffic management and monitoring. The model comprises of a single platform where this platform will communicate with the large number of decentralized heterogeneous components.

## **Audience**

The intended audience of this book includes scientists, professionals, researchers and academicians, who deal with the new challenges and advances in the specific areas mentioned above. Designers and developers of applications in these fields can learn from other experts and colleagues through studying this book. Many universities have started to offer courses on cognitive computing, big data analytics on the graduate/postgraduate level in information technology and management disciplines. This book starts with an introduction to cognitive computing and data science approaches, hence suitable for university level courses as well as research scholars. Their insightful discussions and knowledge, based on references and research work, will lead to an excellent book and a great knowledge source.

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