Advanced Technologies and Societal Change

Ch. Satyanarayana
Xiao-Zhi Gao
Choo-Yee Ting
Naresh Babu Muppalaneni *Editors*

Machine Learning and Internet of Things for Societal Issues

Springer

Advanced Technologies and Societal Change

This series covers monographs, both authored and edited, conference proceedings and novel engineering literature related to technology enabled solutions in the area of Humanitarian and Philanthropic empowerment. The series includes sustainable humanitarian research outcomes, engineering innovations, material related to sustainable and lasting impact on health related challenges, technology enabled solutions to fight disasters, improve quality of life and underserved community solutions broadly. Impactful solutions fit to be scaled, research socially fit to be adopted and focused communities with rehabilitation related technological outcomes get a place in this series. The series also publishes proceedings from reputed engineering and technology conferences related to solar, water, electricity, green energy, social technological implications and agricultural solutions apart from humanitarian technology and human centric community based solutions.

Major areas of submission/contribution into this series include, but not limited to: Humanitarian solutions enabled by green technologies, medical technology, photonics technology, artificial intelligence and machine learning approaches, IOT based solutions, smart manufacturing solutions, smart industrial electronics, smart hospitals, robotics enabled engineering solutions, spectroscopy based solutions and sensor technology, smart villages, smart agriculture, any other technology fulfilling Humanitarian cause and low cost solutions to improve quality of life.

More information about this series at https://link.springer.com/bookseries/10038

Ch. Satyanarayana · Xiao-Zhi Gao ·
Choo-Yee Ting · Naresh Babu Muppalaneni
Editors

Machine Learning and Internet of Things for Societal Issues

Springer

Editors
Ch. Satyanarayana
Department of Computer Science
and Engineering
Jawaharlal Nehru Technological University
Kakinada
Kakinanda, Andhra Pradesh, India

Choo-Yee Ting
Faculty of Computing and Informatics
Multimedia University
Cyberjaya, Malaysia

Xiao-Zhi Gao
School of Computing
University of Eastern Finland
Kuopio, Finland

Naresh Babu Muppalaneni
Department of Computer Science
and Engineering
National Institute of Technology Silchar
Silchar, Assam, India

ISSN 2191-6853 ISSN 2191-6861 (electronic)
Advanced Technologies and Societal Change
ISBN 978-981-16-5089-5 ISBN 978-981-16-5090-1 (eBook)
https://doi.org/10.1007/978-981-16-5090-1

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

This book aims to provide theoretical and practical machine learning concepts (ML) and IoT techniques for various intelligent applications. The main objective of machine learning is to identify the pattern in the present data and make predictions on future data. Huge data is generated from various sensors and devices connected through Internet, called Internet of things. Technology is bringing changes in day-to-day activities. Intelligent systems are playing a key role for the betterment of society. We have also witnessed that many smart devices are interconnected. The data generated is being analyzed and processed with machine learning models for prediction, classification, etc., to solve human needs in various sectors like health, road safety, agriculture, and education. We can turn on air conditioner at home from a remote location, our refrigerator can send alert messages to fill it with vegetables, fruits, etc., farmers can turn on the motor by sitting at home, and electricity bills are generated automatically every month like this there are much new innovation and intelligent solutions for making our life easy. This book covers a variety of machine learning, IoT applications in the fields of agriculture, health care, education, etc.

Kakinanda, India — Dr. Ch. Satyanarayana
Kuopio, Finland — Dr. Xiao-Zhi Gao
Cyberjaya, Malaysia — Dr. Choo-Yee Ting
Silchar, India — Dr. Naresh Babu Muppalaneni

Introduction

Just like electric energy, machine learning and Internet of things (IoT) will inspire our life in many ways some of which are not even susceptible today. This book provides a thorough abstract perceptive of machine learning and IoT techniques and algorithmic program, many are mathematical concepts that explained in a spontaneous manner. The book starts with a summary of machine learning and IoT and supports mathematical and statistical concepts before moving on to machine learning and IoT topics. It step by step builds up the depth, concealing many of the present-day machine learning and IoT algorithms, ending in deep learning and employ reinforcement learning algorithms. This book also covers some of the mostly used machine learning and IoT applications. The crucial part of the book in is individual to any specific programming languages or hardware so that reader can try these concepts on whichever platforms they are already familiar.

Machine Learning

Humans are able categorize the things like books, pen, pencil, vehicles, etc., as the brain trained itself. Similarly, to make machine to understand, we need to train using the past data to predict future. Machine learning is an area of computing machine that is concerned with developing algorithmic rule along with method for providing intuitive solutions for complex problems that are otherwise hard to deal with using traditional programming methods. These traditional programming methods comprise of two defined phases. The first phase creates a detailed design for the program to be employed. It thus comprises of a fixed set of steps or rules to be followed for dealing with the problem. The later deals with implementing this design on any application in the form of a computer program.

ML solutions are challenged for many real-life application problems for creating a elaborated design that can be usually tough to deal with a given problem. Among many problems that ML needs to deal with, detecting or recognizing handwritten characters in an image one of them. Machine Learning is solving many issues in

helping humans, and one such application is the recognition of handwritten characters. By learning the elaborated design from a set of large labeled data set, the ML can deal with such problems. The more they extract features, results become more accurate. The goal of a machine learning algorithm is to train a model from a labeled data set so that it can predict for unknown data points correctly.

Machine learning is a subset of artificial intelligence (AI). ML generally extracts relevant features from the data and equips these features to the models that can be learned, understood, and used for socialite issues. Many technologies such as facial recognition systems, OCR, and recommendation engines have tremendous benefits from ML.

Many social media platforms, with the utility of facial recognizers, can automatically identify faces on photos and automatically suggests tags to them. The optical character recognition (OCR) technologies are also recognition engines that can convert a piece of text in an image into portable format. Recommendation engines, also a widely used application of ML, suggest users movies or shows by learning their interests based on their previous playlists, thus while working with the machine learning models

Applications employing ML have been highly developing and improving day by day. Hence, one should take care of a number of things while working with these machine learning methodologies.

Machine Learning Methods

The machine learning methodologies are classified into two categories which are based on learning and feedback provided to the system in order to train the model.

These two learning methods are: **Supervised and unsupervised learning**. The former trains the model based on labelled data, while the later trains the model by learning structures of the unlabeled data.

Supervised Learning

For supervised learning, we need labeled data which means each record contains attributes called features, and the label is called class. Usually, the data is divided into training set and testing set. Employing the various machine learning algorithms such as support vector machine (SVM), decision tree, and Naive Bayes, the training is performed on the training dataset which means understanding the patterns using the algorithm with minimal error with target class. In supervised learning, the model is trained with inputs that are labeled with their corresponding outputs or labels. The advantage of using such a model is that the model trains and rebuilds itself by computing an error and trying to reduce the error at every iteration. It computes the error by comparing the actual output with the predicted output. Supervised learning

tries to label or classify the unseen or unlabeled data points by learning and training on the labeled and seen data. Hence, one can say that this type of learning trains model on past data and predicts upon the future data. It can use the knowledge from the past stalk information and gain insight into upcoming fluctuations or tag unlabeled photos or images based on previously seen images of labeled ones.

Unsupervised Learning

In contrast to supervised learning, unsupervised machine learning deals with unlabeled or unclassified data or input to train the model. So, it learns similarity patterns among the input data on its own and classifies the unseen and unlabeled data. Thus, this type of learning discovers hidden or unseen patterns in the data and then extracts relevant features from them and uses this knowledge of the features to classify new raw data.

Unsupervised learning is employed on basically online available data. The purchase data of items of all the clients may be available at a system, but there is no available similarity measure that relates the client's profile to the type of purchases that they make. So, this data can be given into a supervised learning model or algorithm which can learn similar patterns from the provided input data and learn relationships among the type of client and their purchases. It is supposed observed that women of a particular age group who buys unscented soaps are pregnant, and hence, a campaign relating to pregnancy and baby care products can be targeted in order to increase the purchases of the shop/market.

Internet of Things

What if weather conditions are sensed by an umbrella and remind the user to carry it day along, or wearable devices monitoring a patient's health condition and convey the same to the doctor, or if a car could predict the system which reminds the owner about the servicing schedules to avoid malfunction before head.

These scenarios can be practically implemented in the real world with the help of **Internet of things (IoT)** and Internet connected with cloud platform. It can thus be viewed as a dynamic network having all the physical and virtual objects interconnected with each other. The main streams of IoT include cloud computing, artificial intelligence, and wireless sensor networks can be practically incorporated to healthcare, transportation, and logistics as well.

Organization of the Book

In this book, the author walks through all the major design and implementation details of various functionalities done with IoT. It is an idea which enables communication between interworking devices and applications, where physical things communicate over the Internet. Reality is made up of smart cities and is also expected to make self-driving cars.

However despite these efforts, some issues are still challenges, such as IoT services should be increased, functions like scalability, accessing control, storage, fault tolerance, and privacy.

Main challenges still facing the Internet of things

- IoT security.
- Lack of regulation followed in IoT.
- Challenges and compatibility.
- Bandwidth is limit.
- Customer prospect.

Chapter 1 describes generator adversarial networks (GANS) which is one kind of deep learning model based on Min-Max algorithm. It is a modeled network; it translates data from images which can be utilized for image-to-image translations, semantic image-to-photo translations and text-to-image translations. They are different types of GANS, and a comparative report of various generative adversarial networks is given in terms of different Inception Scores.

Chapter 2 highlights the vast opportunity of machine learning that create in educational environment, where machine learning are deployed along with other technologies to provide fast, efficient, and quality learning experiences and also highlighted its issues and challenges to be faced by the educational environment in terms of expenditure, evaluating student's performance process and providing e-resources for online learners and challenging different approaches to dominate the digital world.

Chapter 3 describes the sensor technology for continuous monitoring of the glucose in diabetics patients using IoT. This monitoring method includes processing of data with timely readings to reduce the diabetic complications at about 35–70%. The monitored values of glucose levels for a single patient that are diagnosed are found to be accurate at all the intervals of time to overcome a stay in the hospitals.

Chapter 4 describes one of the challenging roles of machine learning and IoT in agriculture. Good farming is based on smart farming cycle which includes observation, diagnostics, decisions, and action. IoT-cloud platform collects the data from IoT devices for observations, and actions are performed. Its main application is to target at traditional farming operations and its challenges in order to satisfy rising demand and reduce production losses.

Chapter 5 describes the technologies like block chain, machine learning and IoT and proposed a model to counter COVID-19 and future sustainability. It considers the effects and severity of pandemic and provided a model to safeguard the airport which forms the central and critical point of disease spread. Maintenance is also a

part of challenge in terms of health and hygiene which is monitored through IoT devices by setting up a threshold value.

Chapter 6 discusses the comparative study made with others on COVID-19 symptoms by using modified conventional neural networks. Evaluating different acoustic features of cough, breath, and speech voices were performed. The research elegantly compares and concludes a patients' voice inconvenient accuracy and is found to be proportional to his/her cough and breathe sounds. It also surfaces the main reason behind these inefficient preliminary results, as time constraints and computing power. It reduces computational cost, by working with copious amount of training data which is better than the existing system for prediction of COVID-19.

Chapter 7 describes a cyber-physical system (CPS) model, which takes care of issues occurred at toll booths. This model will help to overcome the waiting time of vehicles at tolling booths by removing all sort of human interaction. Five cases are identified and considered and reported how the system works under this cases which are identified smoothly. When electronic toll collection systems go down, human interaction is needed to handle such situations to overcome the waiting time and fuel.

Chapter 8 discussed the sentimental analysis of machine learning, where Telugu code mixed tweet (STCMT) is used extract the sentiments, and pre-processing steps are implemented; language identification of each word in the tweet is transliterated into Telugu script by using Telugu SentiWordNet, sentiments are extracted from the Telugu words, and comparative study is discussed.

Chapter 9 describes integrated neural network design for image processing and a novel approach for object recognition with visual information by considering the input shape in complex plane and represented with the measure of vortex flow on the cylinder with angle of attack. The Fourier transform is used to describe the input object, and performance measures indicate the efficiency of the proposed approach for classifying the input medical images.

Chapter 10 explains the hybrid approach using fuzzy C-means (FCM) and gradient vector flow (GVF) active contour model. It is applied to segment the tumor from the MR image of the brain. Results are collected conducting the experiment with the MRI datasets from brain web database. Performance is evaluated by using various metrics.

Chapter 11 discusses deep learning-based image segmentation which is a strong instrument in picture division. Tumors are of various structures and have various highlights and various medicines. A model is proposed to identify brain tumors using deep learning techniques. This model is built using YOLOv3 architecture, and results are impressive and have better performance when compared with existing methods.

Chapter 12 describes the effectively simulated CdS thin-film solar cell and its properties using ANN by predicting various parameters. A three-layered ANN architecture is implemented with various experimental datasets. Predictions of the parameters are carried out with various hidden layer neurons and comparative results are presented.

Chapter 13 describes the deduplication concept in cloud storage for data collected through sensor. A deduplication approach is not to have repeated sensor data. Subsequently, the sensor data will be less vital blocks in order to support the architecture. Tests are performed on 01, 05, and 10 deduplicators of planned model, and results are comparatively shocking.

Contents

About the Editors

Dr. Ch. Satyanarayana is currently working as Professor in the Department of Computer Science and Engineering, Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh, India. He received his Ph.D. in 2007 from JNTU. He has 20+ years of teaching, research experience, and ten years of administrative experience in various capacities like controller of examinations, head of the department, director academic and planning. He has supervised 23 Ph.D. students and 100+ master's students. He is Senior Member of IEEE. His research interests include image processing, speech recognition, pattern recognition, network security and big data analytics and computational intelligence.

Dr. Xiao-Zhi Gao received his B.Sc. and M.Sc. degrees from the Harbin Institute of Technology, China, in 1993 and 1996, respectively. He obtained his D.Sc. (Tech.) degree from the Helsinki University of Technology (now Aalto University), Finland, in 1999. In January 2004, he was appointed as Docent (Adjunct Professor) at the same university. He is now working as a professor of data science at the University of Eastern Finland, Finland. He is also Guest Professor at the Harbin Institute of Technology, Beijing Normal University, and Shanghai Maritime University, China. Prof. Gao has published more than 400 technical papers on refereed journals and international conferences, and his current Google Scholar H-index is 32. His research interests are nature-inspired computing methods (e.g., neural networks,

fuzzy logic, evolutionary computing, swarm intelligence, and artificial immune systems) with their applications in optimization, data mining, machine learning, control, signal processing, and industrial electronics.

Dr. Choo-Yee Ting is currently working as Professor at the Faculty of Computing and Informatics, Multimedia University, Cyberjaya, Malaysia. He is also Deputy Dean of the Institute for Postgraduate Studies, Multimedia University. In year 2002, Choo-Yee Ting was awarded the Fellow of Microsoft Research by Microsoft Research Asia, Beijing, China. He has been active in research projects related to predictive analytics and big data. Most of the projects were funded by MOE, MOSTI, Telekom Malaysia, MDeC, and industries. In year 2014, he and his team members won two national level big data analytics competitions. Dr. Ting has been the trainer for MDeC and INTAN for courses related to big data and data science. He is also the consultant, mentor, and assessor for projects under MDeC funding. Currently, he is working on Trouble Ticket Resolution prediction for Telekom Malaysia, AirAsia seat capacity optimization, and dengue outbreak prediction for the government of Philippines. Dr. Ting is certified in Microsoft Technology Associate (Database), IBM DB2 CDA, and the Coursera Data Science Specialization (John Hopkins University).

Dr. Naresh Babu Muppalaneni working as Assistant Professor in the Department of Computer Science and Engineering at National Institute of Technology Silchar. He received his M.Tech. from Andhra University and Ph.D. from Acharya Nagarjuna University. He has published more than 30 papers in different International journals, book chapters, conference proceedings, and edited research volumes. He has published five volumes in Springer Briefs in Forensic and Medical Bioinformatics. He is a fellow of IETE, life member of CSI, member of ISCA, and senior member of IEEE. He is a recipient of Best Teacher Award from JNTU Kakinada. He has completed research projects worth of 2 crore rupees from DST, DRDO. He has organized six international conferences and four workshops. His research interests are artificial intelligence in biomedical

engineering, human and machine interaction and applications of intelligent system techniques, social network analysis computational systems biology, bioinformatics, and cryptography.