Web3

Web3 is a new frontier of Internet architecture emphasizing decentralization and user control. This text for MBA students and industry professionals explores key Web3 concepts, starting from foundational principles and moving to advanced topics such as blockchain, smart contracts, tokenomics, and DeFi. The book takes a clear, practical approach to demystify the tech behind NFTs and DAOs as well as the complex regulatory landscape. It confronts challenges of blockchain scalability, a barrier to mainstream adoption of this transformative technology, and examines smart contracts and the growing ecosystem leveraging their potential. The book also explains the nuances of tokenomics, a vital element underpinning Web3's new economic model. This book is ideal for readers seeking to stay on top of emerging trends in the digital economy.

KEN HUANG is an influential leader in Web3, AI, and Cyber Security. As Chair of the CSA GCR Blockchain Security Working Group, he shapes best practices globally. He is coauthor of the book *Blockchain and Web3*, recommended as a "must-read" by TechTarget. With over 20 years of experience across FinTech, government, and startups, he provides Web3 and AI consulting as CEO of DistributedApps. He was a judge for major AI and blockchain startup contests run by Google, Softbank, and Stanford in 2018. He has presented globally at Davos, ACM, IEEE, the World Bank, and the 2023 CSA AI Summit.

YOUWEI YANG is Chief Economist and Vice President of Mining at BIT Mining Limited (NYSE: BTCM). He received his Ph.D. from Cornell University and specializes in financial economics, derivatives, and FinTech, particularly crypto and blockchain. He has frequently appeared in CoinDesk, CNBC, Bloomberg, Reuters, BlockWorks, The Block, and KitCo. Before joining BTCM, he was Director of Financial Analytics at StoneX (Nasdaq: SNEX), a Fortune 100 company offering diverse financial services, where he managed commodity analysis, data modeling, crypto research, and institutional digital asset trading. He also teaches FinTech courses to master's and MBA students at several top universities in China.

FAN ZHANG is Assistant Professor of Computer Science at Yale University. His research interests include the security, privacy, and scalability of decentralized systems. His work has seen industry uptake and been featured in *Forbes*, *MIT Tech Review*, *IEEE Spectrum*, CoinDesk, and *Bitcoin Magazine*. He received an NSF SaTC Frontier grant (co-PI), three Ethereum Academic Grant awards, a Flashbots Research Grant, a Yale Roberts Innovation Award, and an IBM Ph.D Fellowship. He received his Ph.D. from Cornell, advised by Professor Ari Juels. Additionally, he is a Faculty Advisor at Chainlink Labs.

XI CHEN is Full Professor and Andre Meyer Fellow at NYU's Stern School of Business. His research focuses on machine learning and its applications to digital advertising, operations management, quantitative finance, tokenomics, and Decentralized Finance (DeFi). His groundbreaking work earned him recognition on Forbes 30 Under 30 list, Poets & Quants' Best 40 Under 40 MBA Professors, and faculty awards from Google, Facebook, Adobe, JP Morgan, and Bloomberg. He has spent two years as a principal scientist at Amazon Ads. He earned his Ph.D. at Carnegie Mellon and completed postdoctoral work at UC Berkeley under Professor Michael I. Jordan.

FENG ZHU is MBA Class of 1958 Professor of Business Administration at Harvard Business School, where he leads the Platform Lab within the Digital, Data, and Design Institute and cochairs the Harvard Business Analytics Program. Professor Zhu is an expert on platform strategy, digital innovation and transformation, competitive strategy, and business model innovation. His research has appeared in leading academic journals, including the *American Economic Review*, *Management Science*, *Marketing Science*, *Organization Science*, the *Strategic Management Journal*, and *Information Systems Research*. It has been covered by the *Washington Post*, the *Financial Times*, the *New York Times*, and the *Wall Street Journal*.

This book is a comprehensive yet remarkably accessible guide to the intricate world of Web3. Designed to be understood by readers at all levels, it provides clear and thorough explanations of complex topics. Whether you are a novice or an expert in the field, this book is a pivotal resource for navigating the decentralized future of the internet.

—Christopher A. Smith, author of *Privacy Pandemic* and Founder of DFend

This book is an excellent and comprehensive overview of Web3, its foundation, and potential. Very readable and non-technical, it provides students, policymakers, and the intellectually curious a solid basis for understanding Web3. It touches on use cases in risks and regulatory issues and is a very sound grounding for all who want to understand the next iteration of the Internet – Web3, the Internet of Value.

—Jane Thomason, Founder and CEO of the Web3 Institute

As an educator at the forefront of financial technological advances in Singapore, it is a pleasure to endorse the work of Ken Huang and his team of esteemed co-authors from Harvard, Yale, and New York University. In this comprehensive guide, the authors successfully strike a balance between in-depth technical insight and accessible explanation. The careful attention to key areas such as blockchain, Decentralized Finance, NFTs, DAOs, and the intersection of AI with Web3 showcases their expert grasp of these revolutionary concepts. The book's value for MBA students, university scholars, and anyone interested in this rapidly evolving field is undeniable. I highly recommend *Web3: Blockchain, the New Economy, and the Self-Sovereign Internet* to anyone looking to grasp the fundamental principles and transformative potential of Web3 and related technologies.

—David Lee Kuo Chuen, Professor at the Singapore University of Social Sciences and Vice President of the Economic Society of Singapore

If you seek to understand the fascinating realm of Web3, blockchain technology, Tokenomics, NFT, and decentralized autonomous organizations, this book is a must-read. It deciphers complex concepts and provides a thorough understanding of the revolutionary Web3 architecture.

—Jyoti Ponnapalli, SVP / Head of Innovation Strategy & Research of the Trust Bank and former Director of Blockchain/DLT Technology Strategy at DTCC

I had the privilege of reading an early draft of this book and had the honor of performing the initial copyediting under a grant from Harvard

University. I was impressed by the book's readability and the depth of its coverage of Web3's impact on the economy and the next generation of the internet. I wholeheartedly recommend this book.

—Grace Huang, Project Manager at PIMCO Investment Management Company

A comprehensive exploration of DAOs, NFTs, DeFi, and more that dives into the heart of the Web3 revolution. This book balances technical details with big-picture insights, making it a valuable resource for anyone interested in the future of the Internet and digital economics.

—Henry Wang, Founder and CEO of SmartMesh and Founder and President of the International Blockchain Application Federation (IBAF)

This book covers the complex underpinnings of the emerging New Economy leveraging Web3, blockchain, and self-sovereignty. The authors offer a comprehensive overview of these complex technologies which would satisfy the most avid practitioners.

—Dr. Yannis Kalfoglou, seasoned Web3 and AI expert, former BP, former Samsung AI strategist

Web3

Blockchain, the New Economy, and the Self-Sovereign Internet

KEN HUANG
DistributedApps.ai

YOUWEI YANG
Bit Mining Limited

FAN ZHANG
Yale University

XI CHEN
New York University

FENG ZHU
Harvard Business School

Forewords by Anthony Scaramucci and Yale Li

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About the Authors

Ken Huang is an influential leader in Web3, AI, and Cyber Security. As Chair of the CSA GCR Blockchain Security Working Group, he shapes best practices globally. He is the author of multiple acclaimed books on Web3 and AI, including the 2023 must-read *Blockchain and Web3* recommended by TechTarget and the upcoming *Beyond AI* book from Springer in 2024.

With over 20 years of experience across FinTech, government, and startups, Ken provides Web3 and AI consulting as CEO of DistributedApps. He was a judge for major AI and blockchain startup contests by Google, Softbank, and Stanford in 2018.

Ken contributes extensively to standards bodies, including W3C Credentials and the NIST Generative AI Working Group, underscoring his technical expertise. He is also a core contributor to the OWASP Top 10 for LLM Applications.

A sought-after speaker, Ken has presented globally at Davos, ACM, IEEE, the World Bank, and as a keynote at the 2023 CSA AI Summit. Through his diverse contributions, Ken Huang has established himself as an influential authority at the intersection of Web3, AI, and Cyber Security.

About the Authors

Youwei Yang is Chief Economist and Vice President of Mining at BIT Mining Limited (NYSE: BTCM), a public crypto miner. He specializes in financial economics and FinTech applications, particularly commodities and financial derivatives, as well as in crypto and blockchain. He has over seven years of financial industry experience in addition to doctoral education and research from Cornell University. He has appeared in or on CoinDesk, CNBC, Bloomberg, Reuters, BlockWorks, and The Block. Before joining BIT Mining Limited, he was Director of Financial Analytics and Crypto Research Head at StoneX (Nasdaq: SNEX), a Fortune Top 100 company that offers diverse financial services, where he managed projects in commodity analysis, data modeling, and crypto research. He also teaches FinTech courses to master's and MBA students at several top universities in China.

Fan Zhang is Assistant Professor in the Department of Computer Science at Yale University. His research interests include the security, privacy, and scalability of decentralized systems, in particular those enabled by blockchains and trusted execution environments (TEEs). Several of his works have seen industry uptake, and have been featured in *Forbes*, *MIT Tech Review*, *IEEE Spectrum*, CoinDesk, *Bitcoin Magazine*, and numerous other blockchain news outlets. He is the recipient of an NSF SaTC Frontier grant (co-PI), three Ethereum Academic Grant awards, a Flashbots Research Grant, a Yale Roberts Innovation Award, and an

IBM Ph.D Fellowship. He has served on program committees of top-tier conferences such as ACM CCS, IEEE S&P, USENIX Security, Financial Cryptography, PoPETS, as well as blockchain-focused venues such as SBC, ACM AFT, ACM CCS DeFi, FCDeFi, and so forth. He received a Ph.D in Computer Science from Cornell University, advised by Professor Ari Juels. He received a BS from Tsinghua University, China. In his separate capacity, he is a faculty advisor at Chainlink Labs.

Dr. Xi Chen holds the position of full professor and is the Andre Meyer Faculty Fellow at New York University's Stern School of Business. Additionally, he is an affiliated faculty member in the Computer Science Department and the Center for Data Science at NYU.

His research spans various fields, focusing on machine learning technology and its applications to operations management, digital advertising, quantitative finance, tokenomics, and the burgeoning field of Decentralized Finance. Doctor Chen's groundbreaking work earned him a spot on the Forbes 30 Under 30 list in 2017, and in 2020, Poets & Quants named him one of the World's Best 40 Under 40 MBA Professors. Doctor Chen has been honored with several other awards: He received the Best Paper Award at the first NeurIPS Workshop on Decentralization and Trustworthy Machine Learning in Web3, earned the COPSS (Committee of Presidents of Statistical Societies) Emerging Leader Award, and was granted a prestigious Simons-Berkeley research fellowship.

His collaborative efforts with industry giants such as Google, Facebook, Adobe, JP Morgan, and Bloomberg have addressed a range of technical and business challenges, garnering him outstanding faculty research awards from each. Furthermore, Doctor Chen contributed two years as a principal scientist at Amazon Ads, where he spearheaded a science team to advance forecasting and delivery systems in digital advertising.

He received his PhD in machine learning from Carnegie Mellon University's School of Computer Science and completed postdoctoral training with Professor Michael I. Jordan at UC Berkeley.

About the Authors

Professor Feng Zhu is MBA Class 1958 Professor of Business Administration at Harvard Business School. He is an expert on platform strategy, digital transformation, and innovation. He co-directs the Platform Lab at the Digital, Data, and Design Institute at Harvard and co-chairs the Harvard Business Analytics Program.

Professor Zhu's research has appeared in leading academic journals, including the *American Economic Review*, *Management Science*, *Marketing Science*, *Organization Science*, *Strategic Management Journal*, and *Information Systems Research*. It has been covered by such media as the *Washington Post*, the *Financial Times*, the *New York Times*, and the *Wall Street Journal*. He has published multiple popular managerial pieces in the *Harvard Business Review*. His research and teaching have won several international awards, including the Inaugural Practical Impacts Award from the Institute for Operations Research and the Management Sciences (INFORMS) Information Systems Society, which honors distinguished information systems academics who have demonstrated outstanding leadership and sustained impact on the industry. The same organization also awarded him the 2021 Haim Mendelson Teaching Innovation Award for his outstanding pedagogical contributions to the information systems discipline.

Professor Zhu earned his PhD in science, technology and management and a master's in computer science at Harvard University. He completed his undergraduate work in computer science, economics, and mathematics at Williams College.

Foreword by Anthony Scaramucci

In an era marked by technological breakthroughs, none seems more disruptive, or more promising, than the advent of Web3, the so-called self-sovereign Internet. It is my distinct pleasure to present the book *Web3: Blockchain, the New Economy, and the Self-Sovereign Internet*, a comprehensive guide coauthored by Ken Huang and a team of distinguished academics from Harvard, Yale, and New York University.

Web3 represents an evolutionary leap in the digital world, a decentralized frontier promising greater privacy, security, and individual control. But like all revolutions, it does not come without its complexities and challenges. That's where this work comes into play. Huang and his team have managed to do something extraordinary – they have made this complex subject accessible and engaging, without sacrificing the depth of analysis needed for a comprehensive understanding.

This book is unique in its ability to delve deep into the technicalities of Web3 while maintaining a clear and comprehensible discourse. From the disruptive potential of blockchain and its transformative impact on the economic landscape to the groundbreaking realm of NFTs, this work manages to capture the essence of these exciting new territories. The authors explore the pivotal role of decentralization in the future of governance and organizational systems with the introduction of decentralized autonomous organizations (DAOs), along with the potential impacts of regulatory aspects in this rapidly evolving field.

Having had the pleasure of reviewing a previous book coauthored by Ken Huang on a similar topic, I can attest to his insightful understanding of the digital landscape. His passion for unraveling the complexities of blockchain and Web3, combined with his team's extensive academic expertise, has resulted in an enlightening guide to the future of the Internet.

xvi   Foreword by Anthony Scaramucci

Web3: Blockchain, the New Economy, and the Self-Sovereign Internet is more than just a book; it's an invitation to embark on a journey to comprehend the transformative potential of these innovative technologies. This is a vital resource for anyone looking to stay at the forefront, whether they are technologists, investors, students, or simply curious individuals.

In this rapidly evolving digital era, understanding the implications and opportunities of Web3 is more than advantageous – it's essential. This book paves the way for that understanding. As you delve into these pages, be prepared to challenge your preconceptions and embrace the potential of what lies ahead. This is the future unfolding, and we are privileged to be part of it.

—Anthony Scaramucci
SkyBridge Founder and CEO

Foreword by Yale Li

The digital transformation era has arrived, and it is redefining itself through digital technologies, including the emergence of Web3 technologies, a topic comprehensively covered in this indispensable book *Web3: Blockchain, the New Economy, and the Self-Sovereign Internet*. This volume serves not just as a technological treatise but as an essential guide for entrepreneurs, executives, business strategists, and any professionals who are eager to harness the revolutionary changes brought about by blockchain technology.

Initiating the discourse with foundational principles of blockchain, this book offers a robust framework for understanding how this groundbreaking innovation is poised to reshape our businesses and economies. It brings into focus the unique attributes of trust and transparency inherent in blockchain technology, showcasing their transformative potential across diverse industries, from finance to supply chain management and beyond.

Progressing to the technical aspects, the book illuminates the complexities of scalability and the smart contract ecosystem. This section equips the reader with a deep understanding of the challenges and opportunities that lie in adopting these innovations. It demystifies the various scalability solutions and explores the enormous potential of smart contracts to automate and streamline business processes.

Moreover, the book casts a spotlight on the intricacies of tokenomics and Decentralized Finance (DeFi), both of which are pivotal to the emerging new digital economy. Through these discussions, the book outlines a vision for an inclusive and efficient financial landscape, one that leverages decentralized technologies to redefine how wealth is created and distributed.

As the narrative unfolds, we are introduced to the dynamic worlds of non-fungible tokens (NFTs) and decentralized autonomous organizations (DAOs). These sections offer a glimpse into a future where the boundaries of creativity

and collaboration are expanded, opening up unparalleled opportunities for both businesses and individuals to participate in a more inclusive digital economy.

However, this transformative journey is full of challenges. Regulatory frameworks are evolving and becoming increasingly complex, making it imperative for businesses to understand and navigate these intricate legal landscapes. The book offers an in-depth, global perspective on these regulatory aspects, serving as a valuable resource for thoughtful discussion and strategic planning.

In its concluding sections, the book takes a visionary leap into the future of Web3, where cutting-edge technologies such as generative AI, mobile applications, and the Metaverse are becoming integral components of the digital economy. This forward-looking perspective enables businesses and individuals to anticipate and prepare for the next wave of digital transformation.

In sum, *Web3: Blockchain, the New Economy, and the Self-Sovereign Internet* is an invaluable tool for anyone seeking to understand, navigate, and succeed in this new digital era. It provides the intellectual and practical resources needed to seize the vast opportunities presented by Web3 technologies, ensuring that we are not merely spectators but active participants in this exciting new frontier.

—Yale Li
Founder and Deputy Chairman of the World Digital Technology
Academy under the Auspices of the United Nations
Commission on Science and Technology for Development

Preface

The Internet, an ongoing revolution that has transformed human communication, economy, and culture, is undergoing an epochal transition from the centralized models of Web2 to the decentralized ethos of Web3. This seismic shift carries with it not just technological advancements but also a reimagining of the Internet's economic and governance structures. Web3 does not merely offer a set of new tools; it creates the foundation for a new digital economy and catalyzes the concept of a Self-Sovereign Internet.

In this book, we focus on the foundational concepts that serve as the bedrock of Web3, employing ground truth analysis and first principle thinking to demystify this complex landscape. We zero in on the elemental principles that make Web3 a paradigm shift in digital interaction and governance. By dissecting these core tenets, we aim to provide a clearer understanding of why Web3 has the potential to revolutionize not only technology but also the very fabric of our digital society. At its core, Web3 champions an open, decentralized web where users, rather than corporations, exert control. This is not merely an upgrade; it's a philosophical shift, echoing the early ideals of the Internet. The ethos of Web3 encapsulates the principles of financial and data sovereignty, moving us closer to a Self-Sovereign Internet. In this new paradigm, users will own their data, identities, transactions, and, fundamentally, their digital lives.

It's imperative to recognize that the evolution toward Web3 will not transpire in isolation; it's laden with multifaceted challenges that we have already glimpsed through the disintegration of notable crypto entities such as Terra/Luna, Celsius, and FTX. These instances function as stark admonitions, highlighting that the aspirational landscape of Web3 is beset by a labyrinthine network of technical intricacies, ethical dilemmas, and legal ambiguities. The situation is further exacerbated by malicious players who exploit Web3's nascent infrastructure to deceive unsophisticated investors and ecosystem

stakeholders. Despite these formidable obstacles, the foundational tenets of Web3 continue to serve as a guiding light, directing us toward a future Internet that is not only more democratized but also user-centric.

The initial days of the Internet were fueled by a spirit of innovation, creativity, and decentralization. However, as the web matured, it fell prey to the seductive powers of centralization. A handful of colossal platforms emerged, wielding unprecedented control over data, commerce, and digital interactions. In this centralized landscape, our data became a commodity, and our digital autonomy was compromised. Web3, with its blockchain-based architecture, seeks to redress this imbalance. Through mechanisms such as peer-to-peer exchanges, transparent governance models, censorship resistance, and open financial systems, Web3 aims to resurrect the Internet's lost ethos of user control and decentralization.

This book is designed to provide a nuanced yet optimistic narrative on the burgeoning era of Web3. We dissect the key technologies underpinning this revolution, evaluate the myriad opportunities it opens up, and critically examine the associated risks. The objective is to offer a balanced assessment, giving you the knowledge to navigate this transformative landscape. Whether you are a college student, a CEO, a developer, an architect, a policy maker, or a lawyer, our aim is to make the intricate world of Web3 accessible and comprehensible.

In this discourse, we do not just look at Web3 as a technological upgrade; we explore its potential to redefine economic models and governance structures, creating a Self-Sovereign Internet. The promise of Web3 is profound. It offers a blueprint for a new kind of web – a web that returns power to the people, fosters financial inclusivity, and serves as a platform for democratic, user-led governance.

As we venture into this decentralized future, it's essential to remember that we are collectively writing a new chapter in the annals of human civilization. The journey ahead is uncharted but electrifying, replete with new ideas, experiments, and breakthroughs. Through this book, we invite you to join us on this transformative adventure. Let us work together to build not just a new Internet but also a new digital society. Welcome to the age of Web3 and the self-sovereign Internet.

This book has four parts and 11 chapters, divided as follows:

Part I (Chapters 1–2)

Part I establishes a strong foundation by introducing Web3 concepts and principles. Chapter 1 defines Web3 by exploring its multidisciplinary

convergence of technologies, communities, and paradigms. Different perspectives on Web3's potential are discussed. Chapter 2 delves into the core philosophical and economic principles underpinning Web3, including decentralization, transparency, open participation, and empowering users. Together, these chapters provide a conceptual basis for Web3 by examining its origins, aims, and the new models it enables. Readers will develop a framework for reasoning about Web3 and why it represents a monumental shift from previous Internet architectures.

Part II (Chapters 3–5)

Part II explores the technological building blocks of Web3. Chapter 3 covers blockchain technology and its foundational role in enabling trustless decentralized consensus and exchange. Chapter 4 discusses solutions to blockchain scalability, which remains a barrier to mainstream adoption. Chapter 5 provides an overview of smart contracts, their key properties, and examples of how they can be applied to automate processes from financial derivatives to supply chain logistics. These chapters offer a technical primer on the protocols, architecture, and applications that distinguish Web3 from legacy web infrastructure. Readers will learn how technological innovations unite to open new possibilities.

Part III (Chapters 6–9)

Part III examines key applications within the Web3 stack. Chapter 6 covers crypto asset tokenomics and incentive designs to understand what gives decentralized networks and economies their functionality. Chapter 7 introduces Decentralized Finance and its potential to disrupt traditional FinTech. Chapter 8 explores non-fungible tokens and their novel uses for digital ownership and identity. Chapter 9 objectively evaluates the promises and challenges of decentralized autonomous organizations. Together, these chapters demonstrate the utility and early traction of Web3 apps, while also assessing their limitations. Readers will gain practical knowledge of built and emerging use cases.

Part IV (Chapters 10–11)

Part IV explores the hurdles and horizons facing Web3. Chapter 10 discusses the complex regulatory landscape, highlighting initiatives from major

jurisdictions grappling with risks and uncertainties posed by decentralized technologies. Chapter 11 concludes by assessing potential future trends and developments as Web3 evolves.

Now, let us take a closer look at the structure of the book. It is divided into 11 chapters, each focusing on a specific aspect of Web3:

- Chapter 1 – Web3 Concepts and General Introduction: This chapter defines Web3 as the convergence of various forces and explores its different perspectives, setting the foundation for further exploration.
- Chapter 2 – The First Principles of Web3: Here, we delve into the first principles that underpin Web3, providing a solid framework for understanding its core concepts.
- Chapter 3 – Blockchains: The Foundation: This chapter explores the foundational technology behind Web3, offering insights into blockchain's role and significance.
- Chapter 4 – The Scalability of Web3: In this chapter, we tackle the critical issue of scalability in Web3, discussing various approaches and solutions to ensure efficient and widespread adoption.
- Chapter 5 – The Smart Contract Ecosystem: Here, we explore the role of smart contracts in Web3, examining their capabilities, challenges, and potential applications.
- Chapter 6 – The Tokenomics for Web3: This chapter delves into the token economy of Web3, discussing the principles and mechanisms governing tokens and their role in incentivizing participation and value creation.
- Chapter 7 – DeFi and the Next Generation of FinTech: Focusing on Decentralized Finance (DeFi), this chapter explores the disruptive potential of Web3 in revolutionizing traditional financial systems.
- Chapter 8 – NFT and Its Ecosystem: Here, we dive into the world of non-fungible tokens (NFTs), examining their standards, creation, utilization, and the broader ecosystem surrounding them.
- Chapter 9 – Decentralized Autonomous Organizations and Organization Formation on Web3: This chapter provides an objective overview of decentralized autonomous organizations (DAOs), analyzing their benefits, drawbacks, and their potential to reshape social collaboration at a global scale.
- Chapter 10 – Regulatory Aspects of Web3: This chapter sheds light on the regulatory frameworks and challenges associated with Web3, examining regulation initiatives in different countries.
- Chapter 11 – Web3 and the Future of Web: In the final chapter, we discuss the potential future trends and developments of Web3, offering valuable insights into the direction this technology may take.

This book is intended to equip you with the essential knowledge and insights needed to navigate the evolving landscape of Web3. Whether you are an aspiring entrepreneur, a business professional, or simply curious about the future of the Internet, this book aims to provide a comprehensive and systematic understanding of Web3's multifaceted components.

We hope that you find this book both informative and thought-provoking and that it serves as a valuable resource on your journey to mastering the intricacies of Web3.

Acknowledgments

We wish to convey our profound gratitude to the distinguished leaders within the domain who have graciously furnished forewords and endorsements for this book. In addition, our coauthors deserve substantial acknowledgment for their collaborative endeavors that were instrumental in realizing this publication. We extend our appreciation to Dr. Youwei Yang of Bitmine, Professor Fan Zhang of Yale University, Professor Xi Chen of New York University, and Professor Feng Zhu of Harvard University for their invaluable contributions. The synergy of our collective expertise has significantly enriched the discourse presented within these pages.

Moreover, our heartfelt appreciation is extended to Sally Guo, whose exquisite illustrations have markedly augmented the aesthetic and instructional value of our text. Her artistic acumen has imbued our narrative with a visual resonance that will enhance the comprehension and engagement of our readers.

Additionally, we express our sincere thanks to a host of industry professionals and academic counterparts whose meticulous reviews and sharp critiques of initial manuscript drafts were indispensable in refining this publication. Their rigorous scrutiny and insightful feedback have honed the content, ensuring that this book stands as a significant resource for the community.

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Concluding, this acknowledgment is a humble attempt to thank all the brilliant minds and diligent hands that have come together to make this book a reality.

Ken Huang
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