How to read this book

1. To appreciate the fundamentals of computer science

Read Chapters 1, 2, 3, 4, 5, and 6, up to the Key Concepts summary in each chapter. These chapters take the reader from the beginnings of digital computers to a description of how computer hardware and software work together to solve a problem. The ideas of programming languages and software engineering are covered in Chapter 4, and computer algorithms in Chapter 5. Chapter 6 is probably the most difficult chapter in the book as it tries to explain the fundamental theoretical insights of Alan Turing and Alonzo Church on computability and universality. This chapter can be skipped on a first reading without jeopardizing the understandability of the later chapters.

2. To learn about more of the early history of computing

Read all of the preceding, plus the history sections after the Key Concepts summaries in Chapters 1 and 2. In Chapter 1 we describe the very early ideas of Charles Babbage and Ada Lovelace, as well as the little-known Colossus computer, developed at the UK Post Office's Dollis Hill research laboratory, and LEO, the first business computer. The pioneering, independent computer developments of Konrad Zuse in Germany, Sergei Lebedev in Russia, and Trevor Pearcey in Australia are also summarized. Chapter 2 gives more details about the first stored program computers, the Manchester Baby and the Cambridge EDSAC, developed in the United Kingdom as well as some history of computer memory technologies. In Chapter 8 on the origins of personal computers there is also a history section describing the pioneers of interactive and personal computing as well as some insights on developments in computer architecture and some interesting anecdotes.

3. To understand Moore's law and semiconductor technologies

Chapter 7 contains an account of the discovery of the transistor and the integrated circuit or silicon chip and the origins of Moore's law and Dennard

scaling. Chapter 7 also contains a brief summary of the quantum mechanics of semiconductors. A fuller, but still elementary, account of quantum theory can be found in *The New Quantum Universe*, also published by Cambridge. Chapter 15 looks at some future alternatives to silicon as the miniaturization level approaches atomic dimensions.

4. To understand the origins of personal computers, smart phones, and computer games

Chapter 8 describes the development of personal computers based around microprocessors. This chapter looks at the origins of the WIMP environment and WYSIWYG word processors at Xerox Corporation's Palo Alto Research Center (PARC). It also describes the key roles played by IBM, Microsoft, and Apple in developing personal computers and briefly looks at the present era of smart phones, tablets, and touch interfaces. Chapter 9 describes the origins of computer games and computer graphics.

5. To learn about the Internet, the World Wide Web, and search engines as well as the dangers of computer malware and hackers

The three key chapters are Chapters 10, 11, and 12. Chapter 10 describes the origin of the Internet with the ARPANET and packet switching. Chapter 11 looks at the World Wide Web and hypertext and web browsers. It also includes an account of the PageRank algorithm and the rise in importance of Internet search engines and the social web. Chapter 12 describes the history of computer malware with viruses, worms, and botnets. It also includes an introduction to cryptography, key exchange, and one-way functions.

6. To learn about the ideas of artificial intelligence (AI) and artificial neural networks and modern applications of machine learning applied to computer vision and natural language processing

These topics are covered in Chapters 13 and 14 with a look to the future in Chapter 16. Chapter 13 describes early ideas about AI and the famous Turing Test. There is also an account of computer chess and IBM's Deep Blue machine and a summary of developments in artificial neural networks. Chapter 14 starts with an introduction to Bayesian statistics before describing modern applications of machine learning technologies applied to computer vision, speech, and language processing. The chapter ends with a summary of IBM's Watson machine on the TV game show *Jeopardy!* The last chapter in this book looks to the future with an account of progress in robotics and the coming Internet of Things. Chapter 16 ends with a look at "strong AI" and the problem of consciousness.