Because of the high demand for networking and hardware skills in commerce and in industry worldwide, computer networking and hardware courses are becoming increasingly popular in universities, polytechnic institutions, postsecondary colleges, and private training institutions around the globe. Despite this, it is often difficult to motivate students to learn computer networking and hardware concepts because students appear to find the subject technical and rather dry and boring. We strongly believe, as do many others, that students learn computer networking and hardware fundamentals better and feel more engaged with their courses if they are given interactive practical exercises that illustrate theoretical concepts.

There are numerous textbooks on computer networking and hardware concepts as well as publications, including journals and conference proceedings, in computer education and Web-based learning. However, these publications have very limited discussion on software and hardware tools that enhance teaching and learning computer networking and hardware concepts. To address this need, we have written *Tools for Teaching Computer Networking and Hardware Concepts*, focusing on the development and use of innovative tools for teaching and learning various aspects of computer networking and hardware concepts.

We believe the proposed book is unique and is a useful resource to both students and teachers at university, polytechnic, postsecondary, and private training institutions. This book: (1) provides comprehensive coverage of tools and techniques for teaching and learning computer networking and hardware concepts at introductory and advanced levels; (2) can be used as a resource both by students and by teachers in different teaching and learning contexts; (3) offers both students and teachers an opportunity to benefit from the experience of teachers and researchers in other countries in the areas of teaching and
learning computer networking and hardware; (4) represents a rich starting point for researchers interested in developing innovative tools for teaching and learning computer networking and hardware concepts; and (5) raises the awareness of the need to enhance face-to-face teaching through the use of online interactive learning and flexible mode of delivery of papers. Although various hardware and software tools, methods, and laboratory settings are discussed in the text, an emphasis has been placed on the development and use of tools and techniques in the classroom that enhance the teaching and learning of various aspects of computer networking and hardware concepts.

**Organization and Outline**

The book is organized into five sections.

**Section I: Introduction.** Section I (Chapter I) provides a rationale and introduction to the book. It provides an introduction to computer networking and hardware concepts and highlights the use of software and hardware tools as an aid to enhance teaching and learning computer networking and hardware fundamentals. It also outlines the remainder of this book.

**Section II: Teaching and Learning Computer Networking.** Section II consists of six chapters (II through VII) and provides detailed coverage of the software and hardware tools and lab activities designed to enhance teaching and learning various aspects of computer networking. Chapter II describes the development and use of an interactive software tool (named WebLan-Designer) as an aid to enhance teaching and learning both wired and wireless LAN design. Chapter III describes INetwork, an interactive learning tool for communication networks. Chapter IV emphasizes the use of a network simulation tool in large classes to enhance student understanding of computer networking concepts effectively. Chapter V highlights the use of simulation and animation tools in teaching communication protocols. Chapter VI describes a low-cost laboratory infrastructure for enhancing student understanding of packet-forwarding concepts and theories. Chapter VII examines the use of the tool Ethereal in the classroom for teaching TCP/IP protocols in a practical way.

**Section III: Wireless Networking and Information Security.** Section III consists of three chapters (VIII through X) and provides detailed coverage of the software and hardware tools, cases, and lab activities designed to enhance teaching and learning various aspects of wireless networking concepts and information security risk analysis. Chapter VIII describes a series of wireless projects for teaching and learning wireless communication networks. Chapter IX focuses on teaching and learning Wi-Fi networking and propagation measurements using limited resources. Chapter X highlights teaching and learning information security risk analysis using a teaching hospital model.
Section IV: Teaching and Learning Computer Hardware. Section IV consists of six chapters (XI through XVI) and provides software and hardware tools, including processor simulator and lab activities, to enhance teaching and learning various aspects of computer hardware concepts. Chapter XI provides a practical introduction to input and output ports. Chapter XII describes a set of PIC-based practical laboratory exercises for teaching and learning computer hardware concepts. Chapter XIII focuses on teaching computer hardware concepts using PBL theory. Chapter XIV discusses the use of a processor simulator in teaching computer architecture both at introductory and advanced levels. Chapter XV describes a remotely accessible embedded systems laboratory for teaching and learning computer hardware. Chapter XVI reports on the development and use of a software tool (named LOGIC-Minimiser) for teaching and learning minimization of Boolean expressions.

Section V: Data Communication Protocols and Learning Tools. Section V consists of two chapters (XVII and XVIII) and provides detailed coverage of learning tools and techniques designed to enhance teaching and learning various aspects of data communication protocols. Chapter XVII provides a practical introduction to serial protocols for data communications, and Chapter XVIII describes the use of VMware in teaching and learning contexts.

Target Audience for This Book

Teachers, tutors, and students in schools of business, information technology, engineering, computer and information sciences, and other related disciplines will benefit from the use of this book. Moreover, the book will provide insights and support for both instructors and students involved in training courses in networking and hardware fundamentals at various vocational training institutions.

How to Use This Book

The innovative open source software and hardware tools and new ideas presented in the book enable the book to be used by both teachers and students as a resource to enhance teaching and learning computer networking and hardware concepts in a variety of teaching and learning contexts. Students can also benefit from the learning aids, such as learning objectives, summary, key terms and definitions, figures and illustrations, examples and review questions, and references that are provided in each chapter.
Learning Aids

The book provides the following learning aids:

- **Learning Objectives**: Each chapter begins with a list of learning objectives that previews the chapter’s key ideas and highlights the key concepts and skills that students can achieve by completing the chapter. Learning objectives also assist teachers in preparing a lesson plan for a particular topic.

- **Figures and Illustrations**: The key concepts in both computer networking and hardware are illustrated using diagrams and screenshots throughout the book. These illustrations help students to develop a better understanding of the key concepts in computer hardware and networking.

- **Examples**: Various real-world examples have been introduced in the chapters to explain the use of tools and techniques learned from the text.

- **Summary**: Each chapter provides a brief summary of the contents presented in the chapter. This helps students to preview key ideas in the chapter before moving on to the next chapter.

- **Key Terms and Definitions**: Each chapter provides a set of key terms and their definitions. Both students and teachers can benefit by using the listing of key terms and definitions to recall key networking and hardware concepts before and after reading the chapter.

- **Review Questions**: Each chapter provides a set of end-of-chapter review questions linked to the learning objectives, allowing the teachers to evaluate their teaching effectiveness. Answers to most of the review questions can be found in the relevant chapter(s), and hence students are encouraged to revisit the relevant sections of the chapter in order to find the answers. By answering the review questions, students can develop a deeper understanding of many key networking and hardware concepts and tools. Teachers and instructors can use the review questions to test their teaching effectiveness and to initiate class discussion.