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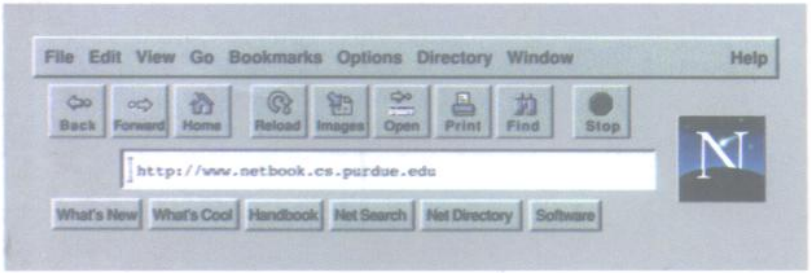
附光盘

Computer Networks and Internets



计算机网络与因特网

Douglas E.Comer

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出版前言

我们的大学生、研究生毕业后，面临的将是一个国际化的信息时代。他们将需要随时查阅大量的外文资料；会有更多的机会参加国际性学术交流活动；接待外国学者；走上国际会议的讲坛。作为科技工作者，他们不仅应有与国外同行进行口头和书面交流的能力，更为重要的是，他们必须具备极强的查阅外文资料获取信息的能力。有鉴于此，在国家教委所颁布的“大学英语教学大纲”中有一条规定：专业阅读应作为必修课程开设。同时，在大纲中还规定了这门课程的学时和教学要求。有些高校除开设“专业阅读”课之外，还在某些专业课拟进行英语授课。但教、学双方都苦于没有一定数量的合适的英文原版教材作为教学参考书。为满足这方面的需要，我们挑选了 7 本计算机科学方面最新版本的教材，进行影印出版。首批影印出版的 6 本书受到广大读者的热情欢迎，我们深受鼓舞，今后还将陆续推出新书。希望读者继续给予大力支持。Prentice Hall 公司和清华大学出版社这次合作将国际先进水平的教材引入我国高等学校，为师生们提供了教学用书，相信会对高校教材改革产生积极的影响。

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Preface

This text answers the basic question "how do computer networks and internets operate?" in the broadest sense. The text provides a comprehensive, self-contained tour through all of networking from the lowest levels of data transmission and wiring to the highest levels of application software. At each level, it shows how the facilities and services provided by lower levels are used and extended in the next level. Thus, after describing how a modem uses a carrier to encode data, the text shows how packet-switching systems use modems to send frames. After describing frame transmission, the text shows how protocols use frames to provide reliable stream transfer. Finally, the text explains how applications use reliable stream transfer to provide high-level services.

The text is intended for advanced undergraduates or beginning graduate students who have little or no background in networking. It does not use sophisticated mathematics, nor does it assume a knowledge of operating systems. Instead, the text defines concepts by giving analogies and examples, and states results of analysis without providing mathematical proofs.

The text is organized into four sections. The first section (Chapters 1-4) provides a brief explanation of how the underlying hardware works. The section explains the concept of a carrier signal, discusses modulating a carrier, and shows how a modem encodes data on a carrier wave for transfer. The section also discusses asynchronous, character-oriented data transmission, and defines terms such as *bandwidth* and *baud* that arise in later chapters.

The second section (Chapters 5-12) focuses on packet switching. The section introduces the motivation for using packets, and then describes characteristics used to categorize networks as: LANs or WANs, public or private, connection-oriented or connectionless, as well as network topologies and wiring schemes. The section also introduces the concepts of next-hop routing, switching, and protocol layering, and a large set of basic terminology. Finally, the section uses several common network technologies in examples including: Ethernet, FDDI, Token Ring, and ATM.

The third section (Chapters 13-20) focuses on internetworking. After discussing the motivation for internetworking, the section describes internet architecture and routers, internet addressing, address binding, and the TCP/IP protocols. Protocols such as TCP and ARP are reviewed in more detail, allowing students to understand how the concepts relate to practice. Chapter *20* on TCP covers the important and deep topic of reliability in transport protocols.

The final section (Chapters 21-32) examines network applications. As with other sections of the text, coverage is quite broad – the section includes a discussion of both general principles and specific applications. The section begins by describing the client-server model that network applications use. The section then describes the socket API, and shows code from an example client and server that use sockets to communicate. The section describes name resolution with the domain name system and applications such as e-mail, file transfer, and Web browsing, including an explanation of dynamic CGI documents and active Java documents. In each case, the text describes the structure of software, and explains how a client and server interact to provide the service. Later chapters in the section discuss network security and explain how application software can be used for network management. Finally, a chapter considers the interesting problem of initialization. The chapter shows how application-level software can achieve what seems to be impossible – use protocol software to obtain information needed to initialize the protocol software.

The text contains more than enough material for two undergraduate courses, or parts can be selected for a single, more condensed course. For a two-course sequence, the logical break between semesters occurs after Chapter 12, with the first semester concentrating on networking and the second semester concentrating on internetworking. More aggressive students may be dissatisfied that the first semester does not cover transport protocols. However, average undergraduates will need time to absorb many concepts.

For a one-semester course, the low-level material in section *1* can be condensed into a week, sections *2* and *3* can be allocated five weeks each, leaving four weeks for the section on applications. For a one-semester course in networking, instructors may find it difficult to decide which material to omit. Students at Purdue are most interested in finding out about the Internet. Unfortunately, understanding internetworking requires some basic knowledge of networks.

When teaching either a one-semester or two-semester version of the course, remember that the key to a successful course is planning from the start to introduce new material in each class. Keep in mind that the goal is breadth, not depth – to cover the subject, one cannot focus on a few technologies or a few concepts. Let students know why we emphasize concepts and principles: the technologies they study now may become obsolete in ten years, but the principles will remain. Also try to give students a feeling for the excitement that pervades networking.

Although no single topic is challenging, students may find the quantity of material daunting. In courses at Purdue, I expect undergraduate students to master terminology and basic concepts, not to become experts in networking. Thus, by the end of the semester, students know general characteristics of LAN or WAN systems, and can cite examples of each kind. However, they are not expected to know the engineering details of any technology.

Students are faced with a plethora of new terms and jargon. Moreover, networking acronyms and jargon can be especially confusing; students spend much of the time becoming accustomed to using proper terms. To help students master terminology, Appendix *1* provides a glossary of terms and acronyms; students will find it useful.

Programming and experimentation are important parts of learning about networks. During early chapters, for example, students who have access to low-level hardware can write programs to send and receive characters over serial lines. Students without access to such hardware can simulate serial I/O using files.

For sections *2* and *3*, access to a network analyzer (sometimes called a *sniffer*) is invaluable. Students who can watch packets on a real network seem to understand the material much better. If a dedicated analyzer is not available, an inexpensive analyzer can be configured by installing appropriate software on a standard PC. I require graduate students in my networking courses to build their own analyzers (we provide an operating system, hardware on which the analyzer runs, and a driver that can place the network interface in promiscuous mode).

While students are studying basics, they can be using network applications. After they have covered Chapters *21* through *23*, students will know enough to write their own distributed applications.

The CD-ROM included with the text and the Web site both contain materials that will make teaching easier and help students. For example, the CD-ROM contains copies of figures from the text that can be used in presentations; some are animated to help clarify the concepts. The CD-ROM also contains materials not in the text, including digitized images of network wiring and equipment, and files of data that can be used as input to student programs. The data files include packet traces captured with a network analyzer. The CD-ROM also includes a keyword search mechanism to aid in finding terms in the on-line version of the glossary, suggestions for using the material, and links to the Web site, which will be updated continuously.

The Web site for the text can be found using URL:

http://www.netbook.cs.purdue.edu

Two electronic mailing lists have been established for the text: general discussion occurs on *netbook@cs.purdue.edu*; discussion about teaching the material occurs on *netbook-inst@cs.purdue.edu*. To join either list, send an e-mail message to the list name *-request* with a body that consists of the word *subscribe*. To avoid having the mail server send multiple copies of each message over the Internet, instructors are requested to establish a single local alias for all students at their site.

I thank all the people who have contributed to this book. Scott Ballew and John Lin proofread chapters. John Steele reviewed sections on data transmission. Tim Korb and Vince Russo reviewed the sections on Web browsing; Vince converted the sample client and server from Chapter *23* to run under Winsock. Ralph Droms proofread chapters and contributed ideas, especially for the chapter on initialization; Ralph prepared the CD-ROM, and manages the Web materials. Special thanks go to my wife and partner, Chris, whose careful editing and helpful suggestions made many improvements throughout.

Douglas E. Comer

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PART IV Network Applications