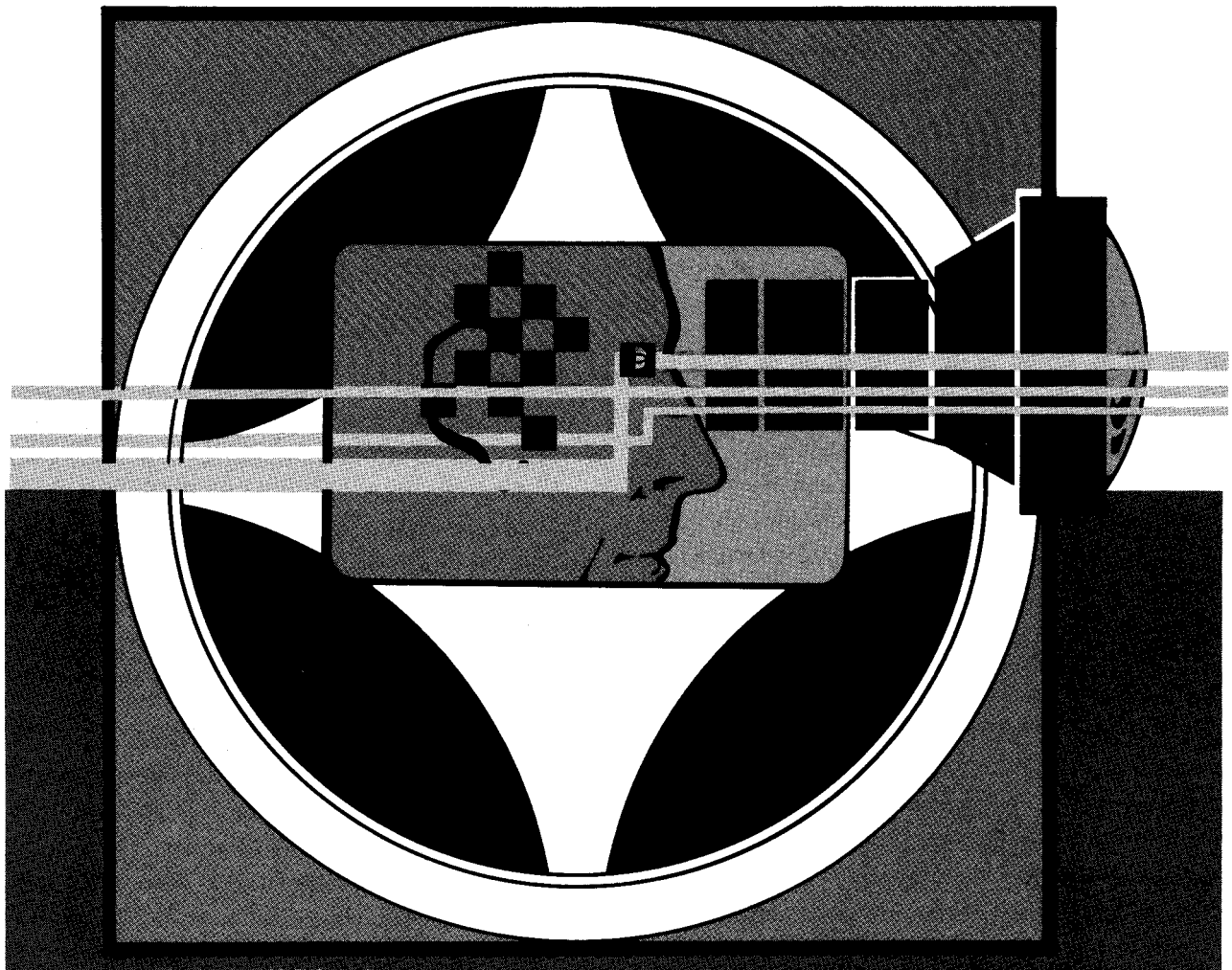
TUTORIAL:

PRINCIPLES OF COMMUNICATION AND NETWORKING PROTOCOLS

Simon S. Lam



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PREFACE

For a computer communication network to provide communication services with desirable characteristics to its users and to utilize its resources efficiently, many protocols are needed. Such protocols are implemented as collections of parallel programs. Like any large programming system, the development of the protocols of a large network will benefit from a structured approach. Technical issues in the design and construction of protocols for computer communication networks constitute the subject matter of this tutorial. Protocols for most categories of packet-switching networks (local area nets, wide area nets and internets) are considered. This book is, however, different from the two other IEEE Computer Society tutorials in the general area of networking (*Local Computer Networks* by Thurber and Freeman and *Computer Networks* by Abrams and Cotton). Our emphasis is on the technical problems encountered in the design and construction of protocols and on solutions to these problems. We strive to illustrate fundamental principles for understanding protocols. For example, we do not present the open systems interconnection (OSI) model as *the* architectural model. Instead, we discuss protocol structuring principles (in Chapter 1). The OSI model is then presented as one of many models that can be derived from an application of such principles.

This book is organized into seven chapters. Chapter 1 presents fundamentals of computer communication networks. Chapter 2 covers data link control protocols. Chapter 3 covers multiple access protocols. Chapter 4 discusses local area networks. Chapter 5 addresses resource allocation problems and solution techniques in store-and-forward networks with point-to-point links. Chapter 6 covers communication protocols for wide area networks and internetworks. Chapter 7 presents some models and methods for protocol verification and construction. Each chapter begins with several sections of original text, followed by a list of references and a set of reprinted articles. We attempt to point out in the original text how the referenced articles and the reprinted articles in each chapter fit into some general framework and how different ideas and techniques relate to each other.

Most of the reprinted articles have been used in graduate courses on data communications and on network protocols that I have taught at the University of Texas at Austin over the past seven years. This book is intended to be a tutorial text and *not* a reprint collection of seminal articles and articles describing important developments for the first time. Although some of the reprinted articles are indeed seminal papers, many of the reprinted articles were chosen on the basis of their subject coverage, their depth of coverage, and writing style. For example, the Shoch-Dalal-Redell-Crane article on Ethernet is reprinted rather than the seminal paper by Metcalfe and Boggs. The reference lists also tend to be representative rather than bibliographical in nature. We believe that they provide an adequate starting set for newcomers to this field. But there is no doubt that we have left out numerous important articles in the literature.

This book should be appropriate as the text or a source of supplemental readings for a graduate-level course on computer communication networks. It should be valuable also as a reference for systems engineers and analysts who desire an understanding of the technical principles that underlie the design of communication network software and the performance tradeoffs involved in its design.

All of the original text and the majority of the reprinted articles can be read without any special background in mathematics. However, some experience with computer programming (in any high-level language) is helpful. Many of the reprinted articles in Chapters 3 and 7 and some in Chapter 5 do require a certain amount of back-

ground in calculus and basic probability theory. These articles are placed at the end of those chapters and can be skipped by the reader if so desired.

I wish to express my appreciation to the authors and publishers of the articles we have reprinted. I would also like to thank the Computer Society Press editor, Professor Chuan-Lin Wu, and the reviewers for their valuable inputs.

The final packaging of this tutorial was done by Margaret Brown of the Computer Society Press. The original text was typed by K. F. Carbone of the University of Texas at Austin. Both of them should be congratulated for a job well done.

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