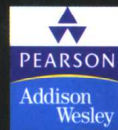


国外经典教材

# 分布式计算原理与应用

(影印版)

(美) M. L. Liu 著



*Distributed*

*Computing*

PRINCIPLES and APPLICATIONS



*M. L. Liu*



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北 京

# *Distributed Computing*

## PRINCIPLES and APPLICATIONS

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## 内 容 简 介

这是专门为本科生和研究生设计的教材,供分布式计算课程使用,不仅详细介绍了分布式程序设计技术的核心概念和原理,还采用 learn by doing 方法,使读者能通过程序设计和实验练习来巩固所学知识。

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# *Distributed Computing*

PRINCIPLES and APPLICATIONS

# Preface

In the Year 2001 Model Curricula for Computing (Computing Curricula 2001) (<http://www.computer.org/education/cc2001/report/index.html>) developed by the Joint IEEE Computer Society/ACM Task Force, net-centric computing is included as a key area in the Computer Science body of knowledge:

*Recent advances in computer and telecommunications networking, particularly those based on TCP/IP, have increased the importance of networking technologies in the computing discipline. Net-centric computing covers a range of subspecialties, including computer communication network concepts and protocols, multimedia systems, Web standards and technologies, network security, wireless and mobile computing, and distributed systems.*

*Mastery of this subject area involves both theory and practice. Learning experiences that involve hands-on experimentation and analysis are strongly recommended as they reinforce student understanding of concepts and their application to real-world problems. Laboratory experiments should involve data collection and synthesis, empirical modeling, protocol analysis at the source code level, network packet monitoring, software construction, and evaluation of alternative design models. All of these are important concepts that can be best understood by laboratory experimentation.*

The ACM model curricula lists a number of topics in this area, specifying a minimum of 15 hours of core topics and additional elective topics. Many of these topics are covered in a series of courses in distributed computing that I initiated and have taught at California Polytechnic State University (Cal Poly), San Luis Obispo, since 1996. For these courses I employed excerpts from various publications, as well as materials I developed, including overhead slides, code samples, and laboratory/problem/research assignments, which I provided as a course package to my students.

This textbook is a synthesis of the course materials I accumulated over a span of six years, designed for a sequence of technical elective courses for upper-division undergraduates.

## Reasons for the Book

Traditionally, distributed computing courses are offered at the graduate level. With the growth of Internet and intranet applications, more and more undergraduate students are engaged in net-centric computing, either at the workplace or on their own initiative. Distributed computing is distinct from (1) communications and networks and (2) distributed operating systems. It operates at a higher level of abstraction than the network layer and the operating systems layer and deals with programming paradigms, application program interfaces (APIs) or toolkits, and protocols and standards in the context of net-centric computing. Although there are numerous books available on network programming and technologies, there is a lack of books written in a textbook style, combining the theory and practice of distributed computing.

This book has the following distinctive features:

- It is designed to introduce **undergraduate students** to the principles of distributed computing, topics formerly reserved for graduate students.
- It focuses on the upper layers of the architecture for net-centric computing, specifically on **computing abstractions and paradigms**.
- It incorporates both conceptual topics and practical topics, using program samples and hands-on exercises to illustrate and reinforce the concepts presented.
- It is designed as a textbook, with a narrative style suitable for academic settings, diagrams to illustrate the topics, exercises at the end of each chapter, and a list of references for student research.
- It is designed for **learn-by-doing teaching**: programming samples are used to reinforce the topics presented, and **laboratory** activities are incorporated in the exercises at the end of each chapter.
- **Supplementary teaching materials**, including presentation slides, program samples, a Web site, and an instructor's manual, will be provided by the author.
- In addition to printed books and articles, this book cites reliable references that are accessible via the World Wide Web. For example, the references include a link to the archival sites where Internet Requests for Comments (RFCs) can be looked up online. It is the author's belief that undergraduate students are more inclined to look up references that are readily available on the Web. (*Note:* Although I have chosen to include as references Web links that are reliable and stable, it is possible that some of the links may become obsolete over time. I would appreciate receiving reports of inactive links.)

## What This Book Is Not About

- **This book is not about networking.** In a general sense, networking encompasses distributed computing in as much as distributed computing involves networked computers. But in academia, courses in networking typically focus



on the lower layers of the network architecture and address topics such as signal transmission, error corrections, data link layer protocols, transport layer protocols, and the Internet layer protocol. By comparison, this book deals with the uppermost layers of the network architecture, namely the application, presentation, and session layers, and more from the viewpoint of computing paradigms and abstractions than from the viewpoint of system architecture.

- **This book is not about distributed systems.** Our focus is not on system architecture or system resources.
- **This book is not about Web application development.** Although the Internet is the most popular network, programming for the Internet is a specialized form of distributed computing. This book addresses distributed computing for networks in general, including the Internet, intranet, and local area networks.
- **This book is not about application program interfaces (APIs) or technologies.** Although a number of APIs are introduced in the book, they are presented as representative toolkits that support particular paradigms; the introduction of these APIs is meant to allow students to write programs for hands-on laboratory exercises that reinforce the concepts and principles.

## A Word to Fellow Instructors

The book is designed for use in a technical elective course during an academic term. The entire twelve chapters of the book can be covered in a quarter at a fast pace or in a semester at a more leisurely pace. The material requires no advanced knowledge of networks, operating systems, or software engineering. A course taught using the book can be taken by an upper-division undergraduate student.

With a field as wide as distributed computing, it is impossible for one book to cover every corner of the discipline. In particular, there is no intention here to cover the latest technologies. The book is meant to convey fundamental concepts in interprocess communication.

A common thread that runs through this book is the idea of abstraction, in the sense of detail encapsulation—how that idea applies in the various paradigms of distributed computing and the trade-offs between tools that provide different levels of abstraction. It is my firm belief that these concepts and ideas are important to each student in computer science and computer engineering, regardless of the student's chosen area of specialization. With an understanding of these fundamental concepts, students should be well equipped to explore new tools and technologies on their own, as they will be expected to do throughout their career.

The first three chapters of the book contain introductory background material that can be covered in the first one or two weeks of an academic term, during which students are gently introduced to a multitude of issues to which they may

or may not have been exposed already. Subsequent chapters are more technical and detailed and can be covered at roughly a chapter each week.

Broad as the subject of distributed computing is, you will likely feel compelled to supplement this text with additional material that you deem important. For example, you may be inclined to add an introduction to distributed algorithms, or to go into more depth in the area of security. To allow time for such additions, you may consider omitting selected chapters from this book.

It is not assumed that readers of this book have had prior expertise in distributed computing. At Cal Poly, I have used the material to teach students with diverse backgrounds, ranging from some students who had no experience with multiprocess programming, to those who were already sophisticated network software developers. While the material worked best with the former, those with advanced backgrounds would find the topics of interest nevertheless.

## Readers, Please Note

A word on the use of typefaces in the narrative of this book:

- Key terms and phrases are emphasized through the use of boldface; for example: This book addresses **distributed computing**.
- A special word, such as one used as a program identifier, nonstandard protocol name, or operation name, is expressed in *italic* to distinguish it from the rest of the text in a sentence; for example: What do you expect the outcome to be when *RunThread3* is executed? Compile and run it.
- Reserved words and identifiers, such as those stipulated by the Java Language or by a well-known protocol, appear in *italic*; for example: To support threading in a program, Java provides a class named *Thread* as well as an interface named *Runnable* interface.

A word on the article inserts and Web links:

Throughout the text of this book, excerpts from articles previously published in various media are inserted. These articles were chosen for their relevance to the topics, and for the interest that they may bring to the readers.

Many of the references listed at the end of each chapter are Web links. This is a deliberate choice, because the author believes that the accessibility of Web-available contents will enhance a student's initiative to pursue research in a topic. The Web links chosen are those that the author deemed to be reliable and stable. But obsolescence of some links is inevitable, in which case the author offers an apology and welcomes your notification of such an occurrence.

## Contacting the Author

The compilation of a textbook is a painstaking and consuming task. To the best of my ability, I have attempted to maximize the accuracy of the materials pre-

sented within the pages of this book. If you discover any errors or inaccuracy, or if you have suggestions for improvements, I shall be grateful to hear from you. Please email to [mliu@csc.calpoly.edu](mailto:mliu@csc.calpoly.edu).

## Supplementary Materials

Supplementary materials, including the source files for programming samples and overhead slides, are available at URL [www.aw.com](http://www.aw.com).

Additional supplementary materials for instructors only are available by contacting your local Addison Wesley sales representative.

## Acknowledgments

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*M. L. Liu  
Cal Poly, San Luis Obispo  
January, 2003*

# Contents

<b>Preface</b>	<b>v</b>
----------------	----------

<b>Acknowledgments</b>	<b>ix</b>
------------------------	-----------

## CHAPTER 1

<b>Distributed Computing, An Introduction</b>	<b>1</b>
---	----------

1.1 Definitions	1
-----------------	---

1.2 The History of Distributed Computing	2
--	---

1.3 Different Forms of Computing	5
----------------------------------	---

Monolithic Computing	5
----------------------	---

Distributed Computing	5
-----------------------	---

Parallel Computing	6
--------------------	---

Cooperative Computing	8
-----------------------	---

1.4 The Strengths and Weaknesses of Distributed Computing	8
---	---

1.5 Basics of Operating Systems	12
---------------------------------	----

Computer Programs and Processes	12
---------------------------------	----

Concurrent Programming	16
------------------------	----

1.6 Network Basics	20
--------------------	----

Protocols	20
-----------	----

Network Architecture	21
----------------------	----

Network Architecture Protocols	23
--------------------------------	----

Connection-Oriented versus Connectionless Communication	23
---	----

Network Resources	26
-------------------	----

Host Identification and Internet Protocol Addresses	26
Identifying Processes with Protocol Ports	31
Email Addresses	32
URLs	32
<b>1.7 Software Engineering Basics</b>	<b>35</b>
Procedural versus Object-Oriented Programming	35
The Unified Modeling Language	35
The Architecture of Distributed Applications	36
Toolkits, Frameworks, and Components	37
<b>Summary</b>	<b>38</b>
<i>Exercises 39 ■ References 45</i>	

<b>CHAPTER 2</b>	
<b>Interprocess Communications</b>	<b>47</b>
<b>2.1 An Archetypal IPC Program Interface</b>	<b>49</b>
<b>2.2 Event Synchronization</b>	<b>50</b>
Synchronous <i>Send</i> and Synchronous <i>Receive</i>	52
Asynchronous <i>Send</i> and Synchronous <i>Receive</i>	53
Synchronous <i>Send</i> and Asynchronous <i>Receive</i>	54
Asynchronous <i>Send</i> and Asynchronous <i>Receive</i>	54
<b>2.3 Timeouts and Threading</b>	<b>56</b>
<b>2.4 Deadlocks and Timeouts</b>	<b>57</b>
<b>2.5 Data Representation</b>	<b>58</b>
<b>2.6 Data Encoding</b>	<b>59</b>
<b>2.7 Text-Based Protocols</b>	<b>61</b>
<b>2.8 Request-Response Protocols</b>	<b>62</b>
<b>2.9 Event Diagram and Sequence Diagram</b>	<b>62</b>
<b>2.10 Connection-Oriented versus Connectionless IPC</b>	<b>65</b>
<b>2.11 The Evolution of Paradigms for Interprocess Communications</b>	<b>66</b>
<b>Summary</b>	<b>67</b>
<i>Exercises 69 ■ References 73</i>	

**CHAPTER 3**

<b>Distributed Computing Paradigms</b>	<b>75</b>
3.1 Paradigms and Abstraction	75
Abstraction	75
Paradigms	76
3.2 An Example Application	77
3.3 Paradigms for Distributed Applications	77
Message Passing	77
The Client-Server Paradigm	78
The Peer-to-Peer Paradigm	79
The Message System Paradigm	82
Remote Procedure Call Model	83
The Distributed Objects Paradigms	85
The Object Space	87
The Mobile Agent Paradigm	88
The Network Services Paradigm	89
The Collaborative Application (Groupware) Paradigm	90
3.4 Trade-offs	91
Level of Abstraction versus Overhead	92
Scalability	93
Cross-Platform Support	93
Summary	94
<i>Exercises 95 ■ References 95</i>	

**CHAPTER 4**

<b>The Socket API</b>	<b>97</b>
4.1 Background	97
4.2 The Socket Metaphor in IPC	98
4.3 The Datagram Socket API	98
The Connectionless Datagram Socket	99
Connection-Oriented Datagram Socket API	110
4.4 The Stream-Mode Socket API	113
Operations and Event Synchronization	115

4.5	Sockets with Nonblocking I/O Operations	124
4.6	Secure Socket API	124
	The Secure Socket Layer	125
	The Java™ Secure Socket Extension	126
	Summary	126
	<i>Exercises 128 ■ References 132</i>	

## CHAPTER 5

	<b>The Client-Server Paradigm</b>	<b>133</b>
5.1	Background	133
5.2	Client-Server Paradigm Issues	134
	A Service Session	134
	The Protocol for a Service	135
	Interprocess Communications and Event Synchronization	136
	Data Representation	138
5.3	Software Engineering for a Network Service	138
	Software Architecture	139
	IPC Mechanism	140
	<i>Daytime</i> Client-Server Using Connectionless Datagram Socket	140
	<i>Daytime</i> Client-Server Using Stream-Mode Socket	147
	Testing a Network Service	154
5.4	Connection-Oriented and Connectionless Servers	155
	Connectionless <i>Echo</i> Client-Server	155
	The <i>Echo</i> Server	156
	Connection-Oriented <i>Echo</i> Client-Server	158
5.5	Iterative Server and Concurrent Server	163
5.6	Stateful Servers	167
	Global State Information	167
	Session State Information	170
	Summary	174
	<i>Exercises 175 ■ References 179</i>	



**CHAPTER 6**

<b>Group Communication</b>	<b>181</b>
6.1 Unicasting versus Multicasting	181
6.2 An Archetypal Multicast API	182
6.3 Connectionless versus Connection-Oriented Multicast	183
6.4 Reliable Multicasting versus Unreliable Multicasting	183
Unreliable Multicasting	184
Reliable Multicasting	184
6.5 The Java Basic Multicast API	187
IP Multicast Addresses	187
Joining a Multicast Group	189
Sending to a Multicast Group	189
6.6 Reliable Multicast API	195
Summary	196
<i>Exercises 197 ■ References 200</i>	

**CHAPTER 7**

<b>Distributed Objects</b>	<b>203</b>
7.1 Message Passing versus Distributed Objects	203
7.2 An Archetypal Distributed Object Architecture	205
7.3 Distributed Object Systems	207
7.4 Remote Procedure Calls	207
7.5 Remote Method Invocation	209
7.6 The Java RMI Architecture	210
Client-Side Architecture	210
Server-Side Architecture	210
Object Registry	211
7.7 The API for the Java RMI	212
The Remote Interface	212
The Server-Side Software	214
The Client-Side Software	218