## **CONTENTS IN DETAIL**

ACKNOWLEDGMENTS	XVII
INTRODUCTION	XIX
Who This Book Is For	xx
Installing Go	
Recommended Development Environments	
What's in This Book	xxi
PART I: NETWORK ARCHITECTURE	1
1	
AN OVERVIEW OF NETWORKED SYSTEMS	3
Choosing a Network Topology	3
Bandwidth vs. Latency	
The Open Systems Interconnection Reference Model	
The Hierarchal Layers of the OSI Reference Model	۱۸
The TCP/IP Model	
The Application Layer	
The Transport Layer	
The Internet Layer	
The Link Layer	
What You've Learned	15
2	17
RESOURCE LOCATION AND TRAFFIC ROUTING	17
The Internet Protocol	
IPv4 Addressing     Network and Host IDs	
Subdividing IPv4 Addresses into Subnets	
Ports and Socket Addresses	
Network Address Translation	
Unicasting, Multicasting, and Broadcasting	25
Resolving the MAC Address to a Physical Network Connection	26
IPv6 Addressing   Writing IPv6 Addresses	26
IPv6 Address Categories	
Advantages of IPv6 over IPv4	
The Internet Control Message Protocol	31
Internet Traffic Routing	
Routing Protocols	
The Border Gateway Protocol	34

Name and Address Resolution	. 35
Multicast DNS	
Privacy and Security Considerations of DNS Queries	
	43
PART II: SOCKET-LEVEL PROGRAMMING	43
3 RELIABLE TCP DATA STREAMS	45
What Makes TCP Reliable?	. 46
Working with TCP Sessions	
Establishing a Session with the TCP Handshake	
Acknowledging Receipt of Packets by Using Their Sequence Numbers Receive Buffers and Window Sizes	
Gracefully Terminating TCP Sessions	
Handling Less Graceful Terminations	. 51
Establishing a TCP Connection by Using Go's Standard Library	
Binding, Listening for, and Accepting Connections	
Implementing Deadlines	
What You've Learned	
4	
SENDING TCP DATA	73
Using the net.Conn Interface	. 74
Sending and Receiving Data	. 74
Reading Data into a Fixed Buffer	
Delimited Reading by Using a Scanner	
Handling Errors While Reading and Writing Data	
Creating Robust Network Applications by Using the io Package	. 87
Proxying Data Between Connections	
Monitoring a Network Connection	
Exploring Go's TCPConn Object	
Controlling Keepalive Messages	. 99
Handling Pending Data on Close	. 99
Overriding Default Receive and Send Buffers	
Solving Common Go TCP Network Problems	
Sockets Stuck in the CLOSE_WAIT State	
What You've Learned	
5	
UNRELIABLE UDP COMMUNICATION	105
Using UDP: Simple and Unreliable	
Sending and Receiving UDP Data	
Usina a UDP Echo Server	107

	eceiving Data from the Echo Server
	sing net.Conn in UDP
	ragmentation
	ve Learned
6	
	NG UDP RELIABILITY 119
	e Transfers Using TFTP11
	ead Requests
	cknowledgments
H	andling Errors
	erver
	/riting the Server Code
	andling Read Requests
	rarting the Server
	ng Files over UDP
vviidi 100 v	ve teamed
7	
UNIX DO	OMAIN SOCKETS 14
What Are U	Unix Domain Sockets?
	Unix Domain Socket Files
	hanging a Socket File's Ownership and Permissions
	nderstanding Unix Domain Socket Types
	Service That Authenticates Clients
	√riting the Service
	esting the Service with Netcat
What You'v	ve Learned
	III: APPLICATION-LEVEL
PKOG	RAMMING 163
8	
WRITING	HTTP CLIENTS 165
Understand	ling the Basics of HTTP
	niform Resource Locators
	lient Resource Requests
	erver Responses
	om Request to Rendered Page
	Web Resources in Go       173         sing Go's Default HTTP Client       173
	losing the Response Body
	nplementing Time-outs and Cancellations
	isablina Persistent TCP Connections

Posting Data over HTTP	1 <i>7</i> 9
Posting JSON to a Web Server	
Posting a Multipart Form with Attached Files	
What You've Learned	
9	
BUILDING HTTP SERVICES	187
The Anatomy of a Go HTTP Server	
Clients Don't Respect Your Time	
Adding TLS Support	
Handlers	
Test Your Handlers with httptest	
How You Write the Response Matters	
Any Type Can Be a Handler	198
Injecting Dependencies into Handlers	
Middleware	
Timing Out Slow Clients	
Protecting Sensitive Files	
Multiplexers	
HTTP/2 Server Pushes	
Pushing Resources to the Client	
Don't Be Too Pushy	
What You've Learned	215
vvnai rou ve Learnea	213
vynai fou ve teamea	213
10	
	217
10 CADDY: A CONTEMPORARY WEB SERVER	217
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy?	<b>217</b>
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy?	<b>217</b> 218 218
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation?	<b>217</b> 218 218 219
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation?	<b>217</b>
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation? Retrieving Caddy Downloading Caddy	<b>217</b>
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation? Retrieving Caddy. Downloading Caddy. Building Caddy from Source Code	217
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation? Retrieving Caddy. Downloading Caddy. Building Caddy from Source Code Running and Configuring Caddy	217
10 CADDY: A CONTEMPORARY WEB SERVER What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation? Retrieving Caddy. Downloading Caddy. Building Caddy from Source Code Running and Configuring Caddy Modifying Caddy's Configuration in Real Time	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy.  Downloading Caddy.  Building Caddy from Source Code  Running and Configuring Caddy.  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File.	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy. Downloading Caddy. Building Caddy from Source Code  Running and Configuring Caddy. Modifying Caddy's Configuration in Real Time Storing the Configuration in a File.  Extending Caddy with Modules and Adapters.	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy? Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy Downloading Caddy Building Caddy from Source Code  Running and Configuring Caddy Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters Writing a Configuration Adapter	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy  Downloading Caddy  Building Caddy from Source Code  Running and Configuring Caddy  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters  Writing a Configuration Adapter  Writing a Restrict Prefix Middleware Module	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy Downloading Caddy Building Caddy from Source Code  Running and Configuring Caddy Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters Writing a Configuration Adapter Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy Downloading Caddy Building Caddy from Source Code  Running and Configuring Caddy Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters Writing a Configuration Adapter Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy Downloading Caddy Building Caddy from Source Code  Running and Configuring Caddy Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters Writing a Configuration Adapter Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy Downloading Caddy Building Caddy from Source Code  Running and Configuring Caddy Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters Writing a Configuration Adapter Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service Setting Up Caddy's Configuration	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy  Downloading Caddy  Building Caddy from Source Code  Running and Configuring Caddy  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File  Extending Caddy with Modules and Adapters  Writing a Configuration Adapter  Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service Setting Up Caddy's Configuration Adding a Reverse-Proxy to Your Service	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy.  Downloading Caddy.  Building Caddy from Source Code  Running and Configuring Caddy  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File.  Extending Caddy with Modules and Adapters  Writing a Configuration Adapter  Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service Setting Up Caddy's Configuration Adding a Reverse-Proxy to Your Service Serving Static Files	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy.  Downloading Caddy.  Building Caddy from Source Code  Running and Configuring Caddy  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File.  Extending Caddy with Modules and Adapters  Writing a Configuration Adapter  Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy.  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service Setting Up Caddy's Configuration Adding a Reverse-Proxy to Your Service Serving Static Files Checking Your Work	217
CADDY: A CONTEMPORARY WEB SERVER  What Is Caddy?  Let's Encrypt Integration How Does Caddy Fit into the Equation?  Retrieving Caddy.  Downloading Caddy.  Building Caddy from Source Code  Running and Configuring Caddy  Modifying Caddy's Configuration in Real Time Storing the Configuration in a File.  Extending Caddy with Modules and Adapters  Writing a Configuration Adapter  Writing a Restrict Prefix Middleware Module Injecting Your Module into Caddy  Reverse-Proxying Requests to a Backend Web Service Creating a Simple Backend Web Service Setting Up Caddy's Configuration Adding a Reverse-Proxy to Your Service Serving Static Files	217

1 1 SECURING COMMUNICATIONS WITH TLS	241
A Closer Look at Transport Layer Security	
Forward Secrecy	243
In Certificate Authorities We Trust	
How to Compromise TLS	
Protecting Data in Transit	
Client-side TLS	
Server-side TLS	
Certificate Pinning.	
Mutual TLS Authentication	
Generating Certificates for Authentication	
Implementing Mutual TLS	
What You've Learned	265
PART IV: SERVICE ARCHITECTURE	267
12	
DATA SERIALIZATION	269
Serializing Objects	270
JSON	
Gob	
Protocol Buffers	
Transmitting Serialized Objects	
Connecting Services with gRPC	
Creating a TLS-Enabled gRPC Server	
Creating a gRPC Client to Test the Server	
What You've Learned	294
13	005
LOGGING AND METRICS	295
Event Logging	296
The log Package Leveled Log Entries	
Structured Logging	
Scaling Up with Wide Event Logging	312
Log Rotation with Lumberjack	315
Instrumenting Your Code	
Setup	
Counters	
Gauges	318
Histograms and Summaries	319
Instrumenting a Basic HTTP Server	
What You've Learned	326

|--|

MOVING TO THE CLOUD	329
Laying Some Groundwork	330
AWS Lambda	
Installing the AWS Command Line Interface	
Configuring the CLI	
Creating a Role	
Defining an AWS Lambda Function	
Compiling, Packaging, and Deploying Your Function	
Testing Your AWS Lambda Function	
Google Cloud Functions	
Installing the Google Cloud Software Development Kit	
Initializing the Google Cloud SDK	
Enable Billing and Cloud Functions	
Defining a Cloud Function	
Deploying Your Cloud Function	
Testing Your Google Cloud Function	
Azure Functions	
Installing the Azure Command Line Interface	
Configuring the Azure CLI	
Installing Azure Functions Core Tools	
Creating a Custom Handler	
Defining a Custom Handler	
Locally Testing the Custom Handler	
Deploying the Custom Handler	
Testing the Custom Handler	
What You've Learned	353
INDEX	355