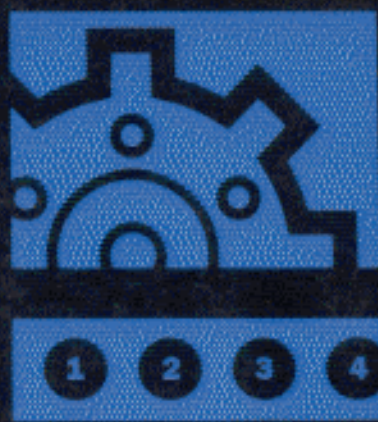
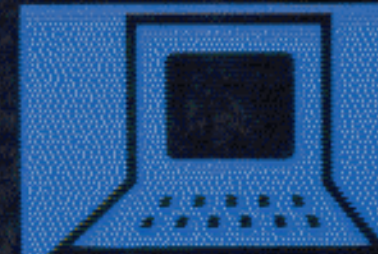


$$\Gamma_L(f) = \frac{Z_L(f)}{Z(f)}$$



Linux[®] Programming

B Y E X A M P L E



```
printf("n n n n nWhat is the  
name? "); gets(item.name);  
printf("What is the city?  
getzip(item.zipcode),ans=getchar(),  
if((fp=fopen(FILENAME,"r+"))==NULL){  
err_msg("Head error-ensure file exists")  
return 1;  
}
```



Table of Contents

Linux Programming by Example	1
About This Book	1
Who Should Read This Book?	2
Linux Programming by Example, Chapter by Chapter	2
Part I The Linux Programming Environment	5
1 Compiling Programs	7
Using GNU cc (gcc)	8
Invoking gcc	8
Example	8
Invoking gcc Step by Step	10
Example	11
Using Multiple Source Code Files	12
Example	12
Options and Arguments	14
Examples	16
GNU C Extensions	22
Examples	24
Using egcs	28
Enhancements to gcc	29
2 Controlling the Build Process—GNU make	33
Why make?	34
Using make	34
Creating Makefiles	35
Example	36
Invoking make	37
Examples	38
Creating Rules	40
Phony Targets	40
Examples	41
Variables	41
Example	42
Examples	44
Example	45
Example	46
Example	47

	Implicit Rules	48
	Example	48
	Pattern Rules	49
	Example	49
	Comments	50
	Useful Makefile Targets	50
	Example	51
	Handling Errors	52
3	About the Project	55
	The Music CD Database Program	56
	Components and Subsystems	56
Part II	System Programming	59
4	Processes	61
	What Is a Process?	62
	Process Attributes	62
	Process Identifiers	62
	Example	63
	Real and Effective IDs	64
	Examples	65
	setuid and setgid Programs	66
	User Information	67
	Example	67
	Additional Process Information	69
	Sessions and Process Groups	76
	Manipulating Processes	77
	Creating Processes	77
	Example	83
	Waiting on Processes	84
	Example	85
	Killing Processes	86
	When to Manipulate Processes	89
5	Signals	93
	Signal Concepts	94
	What Is a Signal?	94
	Signal Terminology	94
	Signal History	95
	Available Signals	95

Sending Signals	99
Using the kill Command	99
Example	99
Using the kill Function	100
Example	101
Catching Signals	102
Setting an Alarm	102
Examples	103
Using the pause Function	105
Example	105
Defining a Signal Handler	106
Examples	107
Examples	111
Detecting Pending Signals	114
Example	114
6 System Calls	119
Understanding System Calls	120
What Is a System Call?	120
System Call Limitations	121
Why Use System Calls?	121
Using System Calls	122
Common System Calls	122
System Call Return Codes	124
Examples	124
Table of System Call Error Codes	124
Handling Errors	126
Examples	127
7 Basic Linux File Handling	131
Characteristics and Concepts	132
The File Mode	134
Example	137
The File-Handling Interface	138
Opening and Closing Files	139
Example	140
Reading and Writing Files	141
Example	141
Positioning the File Pointer	143

	Example	143
	Truncating Files	145
	Example	146
	Getting File Information	147
	Example	149
	Changing File Characteristics	151
	Examples	152
8	Advanced Linux File Handling	157
	Changing File Timestamps	158
	Example	159
	Features of the ext2 Filesystem	160
	Example	161
	Working with Directories	163
	Changing Directories	163
	Examples	163
	Creating and Removing Directories	165
	Examples	166
	Listing a Directory	167
	Example	168
	I/O Multiplexing	169
	Example	171
	Memory Mapping Files	174
	Creating a Memory Map	175
	Example	177
	Using a Mapped File	179
	Example	180
	File Locking	182
	Lock Files	183
	Example	184
	Record Locking	185
	Example	187
9	Daemons	191
	Understanding Daemons	192
	Creating a Daemon	192
	Function Calls	193
	Example	194
	Handling Errors	196
	Example	198

Part III Linux APIs (Application Programming Interface)	201
10 The Database API	203
The Berkeley Database	204
Creating, Opening, and Closing a Database	205
Creating and Opening a Database	206
Closing a Database	206
Example	207
Storing Items in a Database	208
Example	208
Deleting Items in a Database	210
Example	210
Retrieving Items from a Database	212
Example	212
Navigating a Database	213
Syncing a Database	215
Example	215
11 Screen Manipulation with ncurses	219
ncurses' Features	220
Terminal Independence	220
Capabilities	220
Compiling with ncurses	220
Examples	221
Terminology and Concepts	223
Terms	223
Window Layout	223
Example	224
Function Naming Conventions	225
Examples	226
Initialization and Termination	226
ncurses Initialization	226
Example	227
ncurses Termination	228
Example	229
Output	230
Character Output	230
Example	233
String Output	234

	Example	235
	Miscellaneous Output	237
	Example	240
	Input Routines	242
	Character Input	242
	Example	243
	String Input	245
	Example	245
12	Advanced ncurses Programming	249
	Using Color	250
	Example	251
	Window Management	253
	Subwindows	254
	Example	254
	New Windows	255
	Example	256
	Using the Mouse	257
	Overview of the Mouse Interface	258
	Using Menus	264
	Example	267
	Using Forms	269
	Example	272
13	The Sound API: OSS/Free	277
	Sounding Off	278
	Sound Hardware	278
	Sound Devices	278
	Guidelines for Sound Programming	279
	Using the Sound API	279
	Examples	281
	Audio Programming	287
14	Creating and Using Programming Libraries	297
	Library Tools	298
	The nm Command	298
	Example	298
	The ar Command	299
	The ldd Command	300

Example	300
The ldconfig Command	300
Environment Variables and Configuration Files	301
Static Libraries	301
Creating a Static Library	302
Example	302
Using a Static Library	306
Example	306
Shared Libraries	308
Building a Shared Library	309
Example	309
Using a Shared Library	310
Example	310
Dynamically Loaded Objects	310
What Are They?	310
The dl Interface	312
Using the dl Interface	313
Example	313
Part IV Interprocess Communication	317
15 Pipes and FIFOs	319
Pipes	320
Opening and Closing Pipes	322
Example	323
Reading and Writing Pipes	323
Example	325
A Simpler Way	327
Example	328
FIFOs	329
Understanding FIFOs	330
Example	330
Creating a FIFO	331
Example	332
Opening and Closing FIFOs	333
Reading and Writing FIFOs	333
Example	333

16	Shared Memory	339
	Introducing System V IPC	340
	Problems with System V IPC	342
	Understanding Shared Memory	343
	Creating a Shared Memory Segment	345
	Example	345
	Attaching a Shared Memory Segment	346
	Examples	347
17	Semaphores and Message Queues	353
	Linux and System V IPC	354
	Message Queues	354
	Creating and Opening a Queue	356
	Example	356
	Writing a Message to a Queue	357
	Example	359
	Reading Queued Messages	361
	Example	361
	Removing Message Queues	363
	Example	364
	Semaphores	366
	Creating a Semaphore	366
	Example	368
	Controlling and Removing Semaphores	369
	Example	370
18	TCP/IP and Socket Programming	375
	Network Concepts and Terminology	376
	The Berkeley Socket API	378
	Socket Basics	379
	Creating a Socket	379
	Connecting to a Socket	381
	Examples	383
	UNIX Domain Sockets	387
	Creating a UNIX Domain Socket	387
	Example	387
	Reading and Writing a UNIX Domain Socket	388
	Example	388

TCP/IP Programming	390
Network Numbers	390
Network Addresses	391
Examples	393
Reading and Writing TCP/IP Sockets	396
Example	396
Using Hostnames	399
Example	401
Part V Linux Programming Utilities	405
19 Tracking Source Code Changes: The Revision Control System	407
Why RCS?	408
Version Control Terminology	408
Using RCS	409
Checking Files In and Out	409
Example	410
Making Changes to Repository Files	411
Example	411
Additional Command-Line Options	411
Examples	412
RCS Keywords	413
\$Id\$	413
\$Log\$	413
Example	413
Other RCS Keywords	414
The ident Command	415
Example	415
Using rcsdiff	416
Examples	416
Other RCS Commands	418
Using rcsclean	418
Example	419
Using rlog	419
Example	419
Using rcs	420
Example	420

20	A Debugging Toolkit	423
	Using gdb	424
	Compiling with Debugging Support	424
	Example	425
	Basic Commands	425
	Finding and Fixing Memory Problems	433
	Types of Memory Bugs	433
	Example	434
	Memory Debuggers	435
	Using mpr and mcheck	439
21	Software Distribution	443
	Using tar and gzip	444
	tar Usage	444
	Using the install Command	447
	Invoking install	448
	Examples	448
	Using RPM	451
	Minimum Requirements	451
	Creating an RPM	452
	Building the Package	457
	Example	457
22	Programming Project: A Music CD Database	461
	The Code, Module by Module	462
Part VI Appendixes		495
A	Additional Resources	497
	Annotated Bibliography	497
	Internet Resources	500
	Web Sites	500
	Usenet	504
	Mailing Lists	504
B	Additional Programming Tools	507
	Certification	507
	Compilers and Languages	507
	Database Software	508
	Editors	508

509	Graphics	509
509	Libraries	509
509	Application Frameworks	509
509	Miscellaneous	509
510	Scientific and Mathematical Software	510
510	Software Distribution	510
510	Tools	510
513	Index	513