

---

# Table of Contents

Preface.....	xiii
--------------	------

---

## Part I. Getting Started

<b>1. Your First Shiny App.....</b>	<b>3</b>
Introduction	3
Create App Directory and File	3
Running and Stopping	4
Adding UI Controls	6
Adding Behavior	7
Reducing Duplication with Reactive Expressions	8
Summary	9
Exercises	10
<b>2. Basic UI.....</b>	<b>15</b>
Introduction	15
Inputs	15
Common Structure	16
Free Text	16
Numeric Inputs	17
Dates	18
Limited Choices	18
File Uploads	20
Action Buttons	20
Exercises	21
Outputs	22
Text	22

---

Tables	24
Plots	25
Downloads	25
Exercises	26
Summary	26
<b>3. Basic Reactivity.....</b>	<b>27</b>
Introduction	27
The Server Function	27
Input	28
Output	29
Reactive Programming	30
Imperative Versus Declarative Programming	31
Laziness	32
The Reactive Graph	33
Reactive Expressions	33
Execution Order	34
Exercises	35
Reactive Expressions	36
The Motivation	36
The App	38
The Reactive Graph	40
Simplifying the Graph	41
Why Do We Need Reactive Expressions?	43
Controlling Timing of Evaluation	44
Timed Invalidation	45
On Click	46
Observers	49
Summary	50
<b>4. Case Study: ER Injuries.....</b>	<b>51</b>
Introduction	51
The Data	51
Exploration	53
Prototype	57
Polish Tables	60
Rate Versus Count	61
Narrative	63
Exercises	64
Summary	64

---

## Part II. Shiny in Action

<b>5. Workflow.....</b>	<b>67</b>
Development Workflow	67
Creating the App	68
Seeing Your Changes	69
Controlling the View	70
Debugging	70
Reading Tracebacks	71
Tracebacks in Shiny	72
The Interactive Debugger	74
Case Study	75
Debugging Reactivity	79
Getting Help	80
Reprex Basics	81
Making a Reprex	81
Making a Minimal Reprex	82
Case Study	83
Summary	87
<b>6. Layout, Themes, HTML.....</b>	<b>89</b>
Introduction	89
Single-Page Layouts	89
Page Functions	90
Page with Sidebar	91
Multirow	93
Exercises	94
Multipage Layouts	94
Tabsets	94
Navlists and Navbars	96
Bootstrap	97
Themes	98
Getting Started	98
Shiny Themes	99
Plot Themes	100
Exercises	101
Under the Hood	101
Summary	103
<b>7. Graphics.....</b>	<b>105</b>
Interactivity	105
Basics	105

Clicking	107
Other Point Events	109
Brushing	109
Modifying the Plot	111
Interactivity Limitations	115
Dynamic Height and Width	115
Images	116
Summary	118
<b>8. User Feedback.....</b>	<b>119</b>
Validation	119
Validating Input	120
Canceling Execution with req()	121
req() and Validation	124
Validate Output	125
Notifications	126
Transient Notification	127
Removing on Completion	128
Progressive Updates	129
Progress Bars	129
Shiny	130
Waiter	132
Spinners	133
Confirming and Undoing	136
Explicit Confirmation	136
Undoing an Action	137
Trash	139
Summary	139
<b>9. Uploads and Downloads.....</b>	<b>141</b>
Upload	141
UI	141
Server	142
Uploading Data	143
Download	144
Basics	144
Downloading Data	145
Downloading Reports	146
Case Study	149
Exercises	151
Summary	152

<b>10. Dynamic UI.....</b>	<b>153</b>
Updating Inputs	153
Simple Uses	155
Hierarchical Select Boxes	156
Freezing Reactive Inputs	158
Circular References	160
Interrelated Inputs	160
Exercises	161
Dynamic Visibility	162
Conditional UI	163
Wizard Interface	165
Exercises	166
Creating UI with Code	166
Getting Started	167
Multiple Controls	168
Dynamic Filtering	171
Dialog Boxes	175
Exercises	176
Summary	177
<b>11. Bookmarking.....</b>	<b>179</b>
Basic Idea	179
Updating the URL	182
Storing Richer State	182
Bookmarking Challenges	183
Exercises	184
Summary	184
<b>12. Tidy Evaluation.....</b>	<b>185</b>
Motivation	185
Data-Masking	187
Getting Started	187
Example: ggplot2	189
Example: dplyr	191
User-Supplied Data	193
Why Not Use Base R?	194
Tidy-Selection	195
Indirection	195
Tidy-Selection and Data-Masking	196
parse() and eval()	197
Summary	197

---

## Part III. Mastering Reactivity

<b>13. Why Reactivity?</b> .....	<b>201</b>
Introduction	201
Why Do We Need Reactive Programming?	202
Why Can't You Use Variables?	202
What About Functions?	202
Event-Driven Programming	203
Reactive Programming	204
A Brief History of Reactive Programming	206
Summary	207
<b>14. The Reactive Graph</b> .....	<b>209</b>
Introduction	209
A Step-by-Step Tour of Reactive Execution	209
A Session Begins	211
Execution Begins	211
Reading a Reactive Expression	212
Reading an Input	213
Reactive Expression Completes	213
Output Completes	214
The Next Output Executes	214
Execution Completes, Outputs Flushed	214
An Input Changes	215
Invalidating the Inputs	215
Notifying Dependencies	216
Removing Relationships	216
Re-execution	217
Exercises	217
Dynamism	218
The Reactlog Package	220
Summary	221
<b>15. Reactive Building Blocks</b> .....	<b>223</b>
Reactive Values	223
Exercises	224
Reactive Expressions	225
Errors	225
on.exit()	226
Exercises	226
Observers and Outputs	226
Isolating Code	228

isolate()	228
observeEvent() and eventReactive()	229
Exercises	230
Timed Invalidation	230
Polling	231
Long-Running Reactives	231
Timer Accuracy	232
Exercises	233
Summary	233

<b>16. Escaping the Graph.....</b>	<b>235</b>
Introduction	235
What Doesn't the Reactive Graph Capture?	235
Case Studies	237
One Output Modified by Multiple Inputs	237
Accumulating Inputs	238
Pausing Animations	239
Exercises	240
Antipatterns	240
Summary	242

---

## Part IV. Best Practices

<b>17. General Guidelines.....</b>	<b>245</b>
Introduction	245
Code Organization	246
Testing	247
Dependency Management	247
Source Code Management	248
Continuous Integration/Deployment	249
Code Reviews	249
Summary	250
<b>18. Functions.....</b>	<b>251</b>
File Organization	252
UI Functions	252
Other Applications	253
Functional Programming	254
UI as Data	254
Server Functions	255
Reading Uploaded Data	255

Internal Functions	256
Summary	257
<b>19. Shiny Modules.....</b>	<b>259</b>
Motivation	259
Module Basics	261
Module UI	262
Module Server	262
Updated App	263
Namespacing	264
Naming Conventions	265
Exercises	265
Inputs and Outputs	266
Getting Started: UI Input and Server Output	267
Case Study: Selecting a Numeric Variable	268
Server Inputs	269
Modules Inside of Modules	270
Case Study: Histogram	271
Multiple Outputs	272
Exercises	274
Case Studies	275
Limited Selection and Other	275
Wizard	278
Dynamic UI	282
Single Object Modules	284
Summary	286
<b>20. Packages.....</b>	<b>287</b>
Converting an Existing App	288
Single File	289
Module Files	290
A Package	291
Benefits	292
Workflow	292
Sharing	293
Extra Steps	294
Deploying Your App-Package	294
R CMD check	294
Summary	296
<b>21. Testing.....</b>	<b>297</b>
Testing Functions	298

Basic Structure	298
Basic Workflow	299
Key Expectations	300
User Interface Functions	302
Workflow	304
Code Coverage	304
Keyboard Shortcuts	304
Workflow Summary	305
Testing Reactivity	305
Modules	307
Limitations	309
Testing JavaScript	309
Basic Operation	310
Case Study	311
Testing Visuals	313
Philosophy	314
When Should You Write Tests?	314
Summary	315
<b>22. Security.....</b>	<b>317</b>
Data	318
Compute Resources	319
<b>23. Performance.....</b>	<b>323</b>
Dining at Restaurant Shiny	324
Benchmark	325
Recording	325
Replay	326
Analysis	327
Profiling	328
The Flame Graph	329
Profiling R Code	331
Profiling a Shiny App	332
Limitations	333
Improve Performance	333
Caching	334
Basics	334
Caching a Reactive	335
Caching Plots	336
Cache Key	337
Cache Scope	338
Other Optimizations	338

Schedule Data Munging	338
Manage User Expectations	339
Summary	340
<b>Index.....</b>	<b>341</b>