Extended contents

xix Foreword by John Maeda

xxi Preface
xxi Contents
xxii How to read this book
xxiii Casey's introduction
xxiv Ben's introduction
xxv Acknowledgments

1 Processing...
1 Software
3 Literacy
4 Open
4 Education
6 Network
7 Context

9 Using Processing
9 Download, Install
9 Environment
10 Export
11 Example walk-through
16 Reference

17 Structure 1: Code Elements
17 Comments
`//, /* */`
18 Functions
18 Expressions, Statements
`";", ","`
20 Case sensitivity
20 Whitespace
20 Console
`print(), println()`

23 Shape 1: Coordinates, Primitives
23 Coordinates
`size()`
25 Primitive shapes
`point(), line(), triangle(), quad(), rect(), ellipse(), bezier()`
31 Drawing order
31 Gray values
`background(), fill(),stroke(), noFill(), noStroke()`
33 Drawing attributes
`smooth(), noSmooth(), strokeWeight(), strokeCap(), strokeJoin()`
34 Drawing modes
`ellipseMode(), rectMode()`

37 Data 1: Variables
37 Data types
`int, float, boolean, true, false`
38 Variables
`=`
40 Processing variables
`width, height`

43 Math 1: Arithmetic, Functions
43 Arithmetic
`+, -, *, /, %`
47 Operator precedence, Grouping
`()`
48 Shortcuts
`++, --, +=, -=, *=, /=, -`
49 Constraining numbers
`ceil(), floor(), round(), min(), max()`

51 Control 1: Decisions
51 Relational expressions
>, <, >=, <=, ==, !=
53 Conditionals
if, else, {}
57 Logical operators
||, &&, !

61 Control 2: Repetition
61 Iteration
for
65 Nested iteration
67 Formatting code blocks

69 Shape 2: Vertices
69 Vertex
beginShape(), endShape(),
vertex()
71 Points, Lines
72 Shapes
74 Curves
curveVertex(), bezierVertex()

79 Math 2: Curves
79 Exponents, Roots
sq(), sqrt(), pow()
80 Normalizing, Mapping
norm(), lerp(), map()
83 Simple curves

85 Color 1: Color by Numbers
86 Setting colors
89 Color data
color, color()
89 RGB, HSB
colorMode()
93 Hexadecimal

95 Image 1: Display, Tint
96 Display
PImage, loadImage(), image()
97 Image color, Transparency
tint(), noTint()

101 Data 2: Text
102 Characters
char
103 Words, Sentences
String

105 Data 3: Conversion, Objects
105 Data conversion
boolean(), byte(), char(),
int(), float(), str()
107 Objects
".",
PImage.width, PImage.height,
String.length,
String.startsWith(),
String.endsWith();
String.charAt(),
String.toCharArray(),
String.subString(),
String.toLowerCase(),
String.toUpperCase(),
String.equals()

111 Typography 1: Display
112 Loading fonts, Drawing text
PFont, loadFont(),
textFont(), text()
114 Text attributes
textSize(), textLeading(),
textAlign(), textWidth()

117 Math 3: Trigonometry
117 Angles, Waves
PI, QUARTER_PI, HALF_PI,
TWO_PI, sin(), cos(),
radians(), degrees()
123 Circles, Arcs, Spirals
arc()

127 Math 4: Random
127 Unexpected numbers
random(), randomSeed()
130 Noise
noise(), noiseSeed()

133 Transform 1: Translate, Matrices
133 Translation
translate()
134 Controlling transformations
pushMatrix(), popMatrix()

137 Transform 2: Rotate, Scale
137 Rotation, Scaling
rotate(), scale()
139 Combining transformations
142 New coordinates

145 Development 1: Sketching, Techniques
145 Sketching software
146 Programming techniques

149 Synthesis 1: Form and Code
150 Collage Engine
151 Riley Waves
152 Wilson Grids
153 Mandelbrot Set

155 Interviews 1: Print
157 Jared Tarbell.
Fractal.Invaders, Substrate
161 Martin Wattenberg.
Shape of Song
165 James Paterson.
The Objectivity Engine
169 LettError.
RandomFont Beowolf

173 Structure 2: Continuous
173 Continuous evaluation
draw(), frameRate(),
frameCount
177 Controlling the flow
setup(), noLoop(),
178 Variable scope

181 Structure 3: Functions
182 Abstraction
183 Creating functions
void
193 Function overloading
194 Calculating and returning values
return

197 Shape 3: Parameters, Recursion
197 Parameterized form
201 Recursion

205 Input 1: Mouse I
205 Mouse data
mouseX, mouseY,
pmouseX, pmouseY
212 Mouse buttons
mousePressed, mouseButton
213 Cursor icon
cursor(), noCursor()

217 Drawing 1: Static Forms
218 Simple tools
221 Drawing with images

223 Input 2: Keyboard
224 Keyboard data
keyPressed, key
227 Coded keys
keyCode

229 Input 3: Events
229 Mouse events
mousePressed(),
mouseReleased(),
mouseMoved(), mouseDragged()
232 Key events
keyPressed(), keyReleased()
235 Controlling the flow
loop(), redraw()

237 Input 4: Mouse II
237 Constrain
constrain()
238 Distance
dist()
239 Easing
abs()
242 Speed
243 Orientation
atan2()

245 Input 5: Time, Date
245 Seconds, Minutes, Hours
second(), minute(), hour(), millis()
249 Date
day(), month(), year()

251 Development 2: Iteration, Debugging
251 Iteration
252 Debugging

255 Synthesis 2: Input and Response
256 Tennis
257 Cursor. Peter Cho
258 Typing
259 Banded Clock. Golan Levin

261 Interviews 2: Software, Web
263 Ed Burton. *Sodaconstructor*
267 Josh On. *They Rule*
271 Jürg Lehni. *Hektor and Scriptographer*
275 Auriea Harvey and Michaël Samyn. *The Endless Forest*

279 Motion 1: Lines, Curves
279 Controlling motion
284 Moving along curves
287 Motion through transformation

291 Motion 2: Machine, Organism
291 Mechanical motion
295 Organic motion

301 Data 4: Arrays
303 Using arrays
Array, [], new, Array.length
306 Storing mouse data
309 Array functions
append(), shorten(), expand(), arraycopy()
312 Two-dimensional arrays

315 Image 2: Animation
316 Sequential images
319 Images in motion

321 Image 3: Pixels
321 Reading pixels
get()
324 Writing pixels
set()

327 Typography 2: Motion
327 Words in motion
331 Letters in motion

333 Typography 3: Response
333 Responsive words
335 Responsive letters

337 Color 2: Components
337 Extracting color
red(), blue(), green(), alpha(), hue(), saturation(), brightness(),
341 Dynamic color palettes

347 Image 4: Filter, Blend, Copy, Mask
347 Filtering, Blending
filter(), blend(), blendColor()
353 Copying pixels
copy()
354 Masking
mask()

355 Image 5: Image Processing
356 Pixels
`pixels[], loadPixels(), updatePixels(), createImage()`
359 Pixel components
360 Convolution
364 Image as data

367 Output 1: Images
368 Saving images
`save()`
369 Saving sequential images
`saveFrame()`

371 Synthesis 3: Motion and Arrays
372 Centipede. Ariel Malka
373 Chronodraw. Andreas Gysin
374 AmoebaAbstract_03. Marius Watz
375 Mr. Roboto. Leon Hong

377 Interviews 3: Animation, Video
379 Motion Theory. *R.E.M. "Animal"*
383 Bob Sabiston. *Waking Life*
387 Jennifer Steinkamp. *Eye Catching*
391 Semiconductor. *The Mini-Epoch Series*

395 Structure 4: Objects I
395 Object-oriented programming
398 Using classes and objects
`class, Object`
406 Arrays of objects
409 Multiple files

413 Drawing 2: Kinetic Forms
414 Active tools
416 Active drawings

421 Output 2: File Export
421 Formatting data
`nf()`
422 Exporting files
`saveStrings(), PrintWriter, createWriter(), PrintWriter.flush(), PrintWriter.close(), exit()`

427 Input 6: File Import
428 Loading numbers
`loadStrings(), split(), splitTokens()`
431 Loading characters
`WHITESPACE`

435 Input 7: Interface
436 Rollover, Button, Dragging
442 Check boxes, Radio buttons
448 Scrollbar

453 Structure 5: Objects II
453 Multiple constructors
454 Composite objects
456 Inheritance
`extends, super`

461 Simulate 1: Biology
461 Cellular automata
469 Autonomous agents

477 Simulate 2: Physics
477 Motion simulation
481 Particle systems
487 Springs

495 Synthesis 4: Structure, Interface
496 WithoutTitle. Lia
497 Pond. William Ngan
498 Swingtree. ART+COM, Andreas Schlegel
499 SodaProcessing. Ed Burton

501 Interviews 4: Performance, Installation
503 SUE.C. *Mini Movies*
507 Chris Csikszentmihályi. *DJ I, Robot Sound System*
511 Golan Levin, Zachary Lieberman. *Messa di Voce*
515 Marc Hansen. *Listening Post*

519 Extension 1: Continuing...
519 Extending Processing
521 Processing and Java
522 Other programming languages

525 Extension 2: 3D. Simon Greenwold
525 A short history of 3D software
526 3D form
531 Camera
532 Material and lights
536 Tools for 3D
538 Conclusion
539 Code
545 Resources

547 Extension 3: Vision. Golan Levin
547 Computer vision in interactive art
549 Elementary computer vision techniques
552 Computer vision in the physical world
554 Tools for computer vision
555 Conclusion
556 Code
561 Resources

563 Extension 4: Network. Alexander R. Galloway
563 The Internet and the arts
565 Internet protocols and concepts
569 Network tools
571 Conclusion
572 Code
576 Resources

579 Extension 5: Sound. R. Luke DuBois
579 Music and sound programming in the arts
582 Sound and musical informatics
584 Digital representation of sound and music
588 Music as information
591 Tools for sound programming
592 Conclusion
593 Code
599 Resources

603 Extension 6: Print. Casey Reas
603 Print and computers
606 High-resolution file export
608 Production
612 Conclusion
613 Code
615 Resources

617 Extension 7: Mobile. Francis Li
617 Mobile software applications
619 The mobile platform
622 Programming for mobile phones
624 Mobile programming platforms
625 Conclusion
626 Code
631 Resources

633 Extension 8: Electronics. Hernando Barragán and Casey Reas
633 Electronics in the arts
635 Electricity
637 Components
638 Circuits
639 Microcontrollers and I/O boards
642 Sensors and communication
646 Controlling physical media
648 Conclusion
649 Code
658 Resources

661 Appendix A: Order of Operations
663 Appendix B: Reserved Words
664 Appendix C: ASCII, Unicode
669 Appendix D: Bit, Binary, Hex
673 Appendix E: Optimization
679 Appendix F: Programming Languages
686 Appendix G: Code Comparison

693 Related Media
699 Glossary
703 Code Index
705 Index