

INDEX

SYMBOLS

`+=` (addition assignment operator), 18, 132
`+` (addition operator), 10, 20, 77
`&&` (and operator), 27, 33–34
`=` (assignment operator), 13
`\` (backslash), 23
``` (backtick), 24  
`^` (caret), 292  
`--` (decrement operator), 17, 64  
`/=` (division assignment operator), 18  
`/` (division operator), 11  
`$` (dollar sign), 292  
`==` (double equals operator), 31  
`"` (double quotation mark), 19  
`//` (forward slashes), 165, 292  
`>` (greater than), 30  
`>=` (greater than or equal to), 30  
`#` (hash mark), 122–123, 215  
`++` (increment operator), 17  
`<` (less than), 30  
`<=` (less than or equal to), 30  
`*=` (multiplication assignment operator), 18  
`*` (multiplication operator), 11  
`!` (not operator), 28  
`||` (or operator), 27–28, 33–34  
`()` (parentheses), 79  
`%` (percent character), 301  
`.` (period), 123  
`|` (pipe character), 241–242  
`{ }` (placeholder syntax), 24–25  
`?` (question mark), 301  
`;` (semicolon), 10  
`'` (single quotation mark), 19  
`[ ]` (square brackets), 21, 48–49  
`!==` (strict inequality operator), 32  
`-=` (subtraction assignment operator), 18  
`-` (subtraction operator), 11  
`===` (triple equals operator), 29

## A

absolute positions, 262–263  
abstract classes, 98  
accidentals, 215  
`addEventListener` method, 129  
`add` function, 75–76  
addition assignment operator (`+=`), 18, 132  
addition (`+`) operator, 20, 77  
`adjustAngle` function, 174  
ADSR envelope, 211–212  
AI (artificial intelligence), 181  
`alert` function, 5  
Amazon S3 (Simple Storage Service), 233  
ancestors, 114  
and operator (`&&`), 27, 33–34  
animating  
    bar graphs, 296–297, 322–324  
    canvas elements, 152–153  
anonymous functions, 80, 153  
APIs (application programming interfaces), 115  
    authenticated APIs, 302–303  
    Canvas API, 144, 256  
    DOM API, 115–116, 129  
    GitHub Search API, 299–328  
    JSON API, 300  
    Web Audio API, 206–209  
appended elements, 275  
`arc` method, 146–147  
arguments, 21  
    defined, 5  
    parameters vs., 75  
    passing functions as, 74, 78–79  
arrays, 38–47  
    arrays of arrays, 39–41  
    creation and indexing, 38–39  
    methods, 41–47  
        adding element to array, 42  
        combining arrays, 44–45

- arrays (*continued*)
    - methods (*continued*)
      - finding index of element in array, 45
      - removing element from array, 43–44
      - turning array into string, 45–46
    - nesting
      - exploring nested objects in console, 54–55
      - with literals, 52–53
      - printing nested objects with `JSON.stringify`, 55–56
      - with variables, 53–54
    - taking callback functions, 85–87
  - `arr.includes(elem)` method, 46
  - arrow functions, 82–83
  - `arr.reverse()` method, 46
  - `arr.slice(start, end)` method, 46–47
  - `arr.sort()` method, 46
  - `arr.splice(index, count)` method, 47
  - artificial intelligence (AI), 181
  - assignment operator (=), 13
  - attack, ADSR, 211–212, 234
  - attributes, 116–118
  - `attr` method, 269
  - audio context, 207–208
  - authenticated APIs, 302–303
  - axes
    - drawing, 305–307
    - labeling, 288–291
    - labeling left, 318–319
- B**
- backend code, 303
  - backslash (\), 23
  - backticks (`), 24
  - ball, Pong, 161–162, 195–197
  - bandpass filter, 226
  - bandwidth method, 287
  - bar graphs, 279–297, 304–319
    - animating changes, 296–297
    - calculating character frequencies, 280–282
    - cleaning data, 295
    - color-coding bars, 314–318
    - creating elements, 304–305
    - drawing, 282–291
      - axes, 305–307
      - bars, 308–309
      - labeled axes, 288–291
      - scaling bars, 284–288
    - labeling left axis, 318–319
    - setting up, 279–280
    - showing repository info, 310–314
    - styling with CSS and regular expressions, 292–295
  - baseline, 257
  - base URL, 301
  - bass lines, 240–242
  - beats per minute (BPM), 217
  - `bezierCurveTo` method, 147
  - bindings, 12–16
    - constants, 14–15
    - naming conventions, 15–16
    - variables, 13–14
  - block body syntax, 82–83
  - body
    - of control structure, 59
    - function, 74
  - body element, 113
  - Booleans, 26–30
    - comparison operators, 29–30
    - as conditions, 60–61
    - logical operators, 27–28
    - using subexpressions in, 171
  - bouncing
    - near paddle ends, 174–175
    - overview, 165–166
  - BPM (beats per minute), 217
  - braces, 63
  - bubbling events, 130
- C**
- callbacks
    - array methods taking, 85–87
    - custom functions taking, 88–89
    - defined, 78
    - event handlers and, 129
  - calling functions, 74–78
    - parameter types, 77
    - return values, 75–76
    - side effects, 77–78
  - calling methods, 21
  - `call` method, 289

- camelCase, 15
- C and C++, 334
- Canvas API, 144, 256
- canvas elements, 141–154
  - animating, 152–153
  - creating, 142
  - drawing Pong game on, 160–161
  - interacting with, 147–151
  - making static drawings, 142–147
    - drawing other shapes using paths, 145–147
    - drawing outlined rectangles, 144–145
- caret (^), 292
- Cascading Style Sheets. *See* CSS
- case sensitivity, 15
- CDN (content delivery network), 210
- chained if...else statement, 61–63
- chaining methods, 130, 269
- change event handler, 151
- characters
  - frequencies of, 280–282
  - from strings, 21–22
- checkCollision function, 165–166
- child elements, 114
- chords, 242–244
- Chrome
  - accessing JavaScript console, 4
  - calling functions in, 75–76
  - exploring nested objects in, 54–55
  - indentation in, 40
  - Web Audio API, 206
- circle element, 260–261
  - advanced joins, 276–279
  - data binding, 270–271
  - data joins, 271–273
- class attribute, 122
- classes, 93–108
  - creating instances and, 94–97
  - inheritance, 97–101
  - prototype-based inheritance, 101–108
    - comparing constructors and classes, 104–105
    - exploring `Object.prototype`, 105–106
    - overriding method, 107–108
    - using constructors and prototypes, 102–104
    - walking the prototype chain, 106–107
- class selectors, 123
- cleaning data, 295
- clearInterval function, 83
- clearRect method, 151
- click handler, 148
- clock, JavaScript, 220–221
- closures, 90
- CodePen, 331
- coercion, 30–35, 77
  - equality with, 31–32
  - truthiness, 32–35
- collision detection
  - bouncing, 165–166
  - defined, 163–164
  - in object-oriented Pong, 195–197
  - for paddles, 170–173
- color
  - color-coding bars, 314–318
  - RGBA color, 150
  - RGB color, 261
  - sound of oscillator as, 213
- combining arrays, 44–45
- combining objects, 51–52
- comments, 165
- comparison operators, 29–30
- complete code
  - GitHub Search API, 325–328
  - Pong, 185–188
  - song writing, 247–252
- composition, 199
- compound data types, 37–56
  - arrays, 38–47
    - arrays of arrays, 39–41
    - creation and indexing, 38–39
    - methods, 41–47
  - nesting objects and arrays, 52–56
    - exploring nested objects in the console, 54–55
    - with literals, 52–53
    - printing nested objects with `JSON.stringify`, 55–56
    - with variables, 53–54

- compound data types (*continued*)
    - objects, 47–52
      - accessing values in, 48
      - creating, 47–48
      - setting values to, 49
      - working with, 49–52
  - compound expression, 10
  - Computer class, 197–198
  - computer control, 180–182
  - concat method, 44
  - concise body syntax, 82–83
  - concrete classes, 98
  - condition, of control structure, 58
  - conditionals, 57–63
    - chained if...else statement, 61–63
    - complex conditions, 60–61
    - if...else statement, 59–60
    - if statement, 58–59
  - console.log method, 23
  - constants
    - naming conventions, 15–16
    - overview, 14–15
    - static, 194
  - const keyword, 13, 16
  - constructors, 49, 95, 102–104
    - comparing classes and, 104–105
    - defined, 101
  - content, element, 112
  - content delivery network (CDN), 210
  - control structures
    - conditionals, 57–63
      - chained if...else statement, 61–63
      - complex conditions, 60–61
      - if...else statement, 59–60
      - if statement, 58–59
    - loops, 63–71
      - for...in loop, 70–71
      - for loop, 65–66
      - for...of loop, 67–69
      - while loop, 63–64
  - CSS (Cascading Style Sheets), 120–124
    - flexbox layouts, 311–312
    - link element, 120
    - rulesets, 121
    - selectors
      - overview, 121–124
      - using in JavaScript, 124–125
    - styling bar graphs with, 292–295
    - styling SVG elements with, 264–266
- ## D
- D3 (D3.js) library, 255–297
    - advanced joins, 276–279
    - bar graphs, 279–297
      - animating changes, 296–297
      - calculating character frequencies, 280–282
      - cleaning data, 295
      - drawing, 282–291
      - setting up, 279–280
      - styling with CSS and regular expressions, 292–295
    - data binding, 270–271
    - data joins, 271–273
    - real-time updates, 273–275
    - selections, 269–270
    - setup, 268
    - SVG graphics format, 256–268
      - adding interactivity with JavaScript, 266–268
      - defining paths, 261–264
      - drawing circles, 260–261
      - grouping elements, 258–259
      - styling elements with CSS, 264–266
    - transitions and key functions, 275–276
  - data attributes, 267
  - data binding, 268, 270–271
  - Data-Driven Documents. *See* D3 library
  - data visualizations
    - D3 library, 255–297
      - advanced joins, 276–279
      - bar graphs, 279–297
      - data binding, 270–271
      - data joins, 271–273
      - real-time updates, 273–275
      - selections, 269–270
      - setup, 268
      - SVG graphics format, 256–268
      - transitions and key functions, 275–276
    - GitHub Search API, 299–328
      - adding interactivity, 319–324
      - basic visualization, 304–309

- complete code, 325–328
- fetching data, 300–304
- improving visualization, 310–319
  - setting up, 300
- decay, ADSR, 211–212
- decibels (dB), 212
- declarations
  - defined, 13
  - in rulesets, 121
  - separating from initialization, 178–179
- declaring functions, 74–78
  - parameter types, 77
  - return values, 75–76
  - side effects, 77–78
- decrementing, 16–19
  - addition and subtraction
    - assignment, 18
  - multiplication and division
    - assignment, 18
- decrement operator (--), 17, 64
- delegating events, 131–134
- De Morgan's law, 28
- descendants, 114
- descendant selectors, 123
- destructuring assignment, 69
- distanceTo method, 98–100
- div element, 135, 148
- division assignment operator (/=), 18
- doctype, 113
- document object, 115
- Document Object Model (DOM), 114–118
  - DOM API, 115–116
    - element identifiers, 116–118
- document.querySelectorAll
  - method, 124
- document.querySelector method, 160–161
- dollar sign (\$), 292
- domain, 284
- DOM API, 115–116, 129
- dot notation, 48–49
- double equals (==) operator, 31
- double quotation marks ("), 19
- doubler function, 88
- drawCircle function, 149–150

- draw function, 163
- drawing context, 143
- draw method, 192
- drum sounds, 224–232
  - drum loop, 230–232
  - hi-hat synthesis, 224–226
  - kick synthesis, 228
  - making drumbeat, 237–240
  - reverb, 228–230
  - snare synthesis, 226–227
- dynamically typed programming language, 77
- dynamic visualizations, 256

## E

- eighth notes, 217
- elements
  - for basic visualization, 304–305
  - defined, 112
  - game, 193–197
    - ball, 195–197
    - paddles, 194
- else if clause, 61–62
- em element, 128
- empty strings, 31–32
- encapsulation, 190–191
- enter, element, 277
- Entity superclass, 194
- equality, with coercion, 31–32
- error messages, 14–15
- escape sequences, 23–24
- evaluation, 10
- event-based programming, 127–139
  - event handlers, 128–134
    - event bubbling, 130
    - event delegation, 131–134
  - keyboard events, 137–138
  - mouse movement events, 134–136
- exit, element, 277
- expressions, 10
- Extensible Markup Language (XML), 256

## F

- false value, 32–33
- fetching data, 300–304
- fillRect method, 143, 161–162
- fillStyle property, 143

- filtering data by license, 319–322
- filter method, 86
- find array method, 85–86
- first-class citizens, 78
- flat, 215
- flexbox layouts, 311–312
- floating-point numbers, 11–12
- FM (frequency modulation), 240
- FM synthesis, 240–241
- focus, 137
- for...in loop, 70–71
- for loop, 65–66
- for...of loop, 67–69
- forward slashes (//), 165, 292
- frequencies, character, 280–282
- frequency modulation (FM), 240
- frontend code, 303
- function declarations, 74, 79–80
- function expressions (function literal), 80–82
- function keyword, 74, 80
- functions, 73–91
  - arrow functions, 82–83
  - declaring and calling, 74–78
    - parameter types, 77
    - return values, 75–76
    - side effects, 77–78
  - defined, 5
  - function expressions, 80–82
  - higher-order functions, 85–90
    - array methods taking
      - callbacks, 85–87
    - custom functions taking
      - callbacks, 88–89
    - functions returning functions, 89–90
  - methods vs., 94
  - passing as arguments, 78–79
  - rest parameters, 84–85
- fundamental, tone, 214

**G**

- gain nodes, 208
- Game class, 198–201
- game creation projects
  - object-oriented Pong, 189–202
    - design, 190–191
    - file structure, 191
  - Game class, 198–201
  - game elements, 193–197
  - GameView class, 191–193
  - Scores and Computer classes, 197–198
  - starting game, 201
- Pong, 159–202
  - bouncing, 165–166
  - complete code, 185–188
  - computer control, 180–182
  - drawing ball, 161–162
  - game loop, 163–165
  - game over, 182–184
  - overview, 159–160
  - paddles, 166–175
  - refactoring, 162–163
  - scoring points, 176–180
  - setup, 160–161
- game loop, 163–165
- game over, 182–184
- GameView class, 191–193
- g element, 258–259
- getContext method, 143
- getElementById method, 117
- Git, 330
- GitHub, 331
- GitHub Search API, 299–328
  - adding interactivity, 319–324
    - animating changes, 322–324
    - filtering data by license, 319–322
  - basic visualization, 304–309
    - creating elements, 304–305
    - drawing axes, 305–307
    - drawing bars, 308–309
  - complete code, 325–328
  - fetching data, 300–304
  - improving visualization, 310–319
    - color-coding bars, 314–318
    - labeling left axis, 318–319
    - showing repository info, 310–314
  - setting up, 300
- Glitch, 331
- Google Chrome. *See* Chrome
- greater than (>), 30
- greater than or equal to (>=), 30
- grouping elements, 258–259

## H

- handlers, event, 128–134
  - event bubbling, 130
  - event delegation, 131–134
  - song writing, 236–237
- harmonics, 214
- hash mark (#), 122–123, 215
- hasOwnProperty method, 105
- head element, 113, 119
- hex colors (hexadecimal color syntax), 260–261
- hidden licenses, 319–322
- higher-order functions, 85–90
  - array methods taking callbacks, 85–87
  - custom functions taking callbacks, 88–89
  - functions returning functions, 89–90
- hi-hat synthesis, 224–226
- :hover pseudo-class, 133
- href attribute, 119
- HTML (HyperText Markup Language), 111–125, 332
  - creating HTML document, 112–113
  - CSS, 120–124
    - link element, 120
    - rulesets, 121
    - selectors, 121–124
  - defined, 5–6
  - DOM, 114–118
    - DOM API, 115–116
    - element identifiers, 116–118
  - nested relationships, 114
  - script elements, 118–119
  - using CSS selectors in JavaScript, 124–125

## I

- id attribute, 116
- identifiers, 13
- ID selector, 122
- if...else statement
  - chained, 61–63
  - keydown handler including, 138
  - overview, 59–60
- if statement, 58–59, 179–180

- incrementing, 16–19
  - addition and subtraction
    - assignment, 18
  - multiplication and division
    - assignment, 18
- increment operator (++), 17
- indentation, 40, 113
- indexes
  - in arrays, 38–39
  - finding index of element in
    - array, 45
  - in strings, 21–22
- indexOf method, 45
- infinite loops, 65
- inheritance, 97–101
- initialization, 13, 178–179
- inline element, 122
- innerText property, 117
- input element, 148
- instanceof keyword, 100
- instances, creating, 94–97
- interactivity, 319–324
  - animating changes, 322–324
  - with canvas elements, 147–151
  - filtering data by license, 319–322
  - visualizations, 256

## J

- JavaScript
  - adding interactivity to SVG
    - graphics format, 266–268
  - bindings, 12–16
    - constants, 14–15
    - naming conventions, 15–16
    - variables, 13–14
  - Booleans, 26–30
    - comparison operators, 29–30
    - logical operators, 27–28
  - classes, 93–108
    - creating instances and, 94–97
    - inheritance, 97–101
    - prototype-based inheritance, 101–108
  - coercion, 30–35
    - equality with, 31–32
    - truthiness, 32–35
  - compound data types, 37–56
    - arrays, 38–47

## JavaScript (*continued*)

- compound data types (*continued*)
  - nesting objects and arrays, 52–56
  - objects, 47–52
- conditionals, 57–63
- escape sequences, 23–24
- expressions and statements, 10
- frameworks and libraries, 332
- functions, 73–91
  - arrow functions, 82–83
  - declaring and calling, 74–78
  - function expressions, 80–82
  - higher-order functions, 85–90
  - passing as arguments, 78–79
  - rest parameters, 84–85
- incrementing and decrementing, 16–19
  - addition and subtraction
    - assignment, 18
  - multiplication and division
    - assignment, 18
- loops, 63–71
- numbers and operators, 10–12
  - floating point, 11–12
  - order of operations, 11
- strings, 19–23
  - finding length of, 20–21
  - getting character from, 21
  - getting multiple characters
    - from, 21–22
  - joining, 20
  - trimming whitespace from, 22
- template literals, 24–26
- undefined and null, 26
- using CSS selectors in, 124–125
- writing code, 3–7
  - using JavaScript Console, 4–5
  - using text editor, 5–6

JavaScript clock, 220–221

JavaScript Console, 4–5

Jest, 333

join-by-index mode, 276

joining strings, 20

join method, 45–46, 271–273, 276–279

JSON (JavaScript Object Notation), 55

JSON API, 300

JSON.stringify method, 55–56

## K

keyboard events, 137–138

keydown events, 137–138

key function, 275–276

keys, object

defined, 47

getting, 49–50

getting values and, 50–51

key-value pair, 47

keywords, 13

kick synthesis, 228

## L

labeled axes, 288–291

label element, 148–149

left-aligned text, 177

length property, 20–21

less than (<), 30

less than or equal to (<=), 30

let keyword, 13, 16

licenses

filtering data by, 319–322

names, 315–318

li element, 131

lineTo method, 146

link element, 120

listener, event, 129

literals

defined, 10

nesting with, 52–53

logical operators, 27–28

lookahead time, 221

looping variable, 65–66

loops, 63–71

for...in loop, 70–71

for loop, 65–66

for...of loop, 67–69

while loop, 63–64

## M

makeAppender function, 90

map array method, 86–87

matching elements, 121

Math.hypot method, 98

MDN (Mozilla Developer Network)

Web Docs, 147, 263, 292

metadata, 113



- methods
    - for arrays, 41–47
      - adding element to array, 42
      - combining arrays, 44–45
      - finding index of element in array, 45
      - removing element from array, 43–44
      - turning array into string, 45–46
    - chaining, 130, 269
    - defined, 21
    - functions vs., 94
    - overriding, 107–108
  - middle C, 215
  - monophonic synth, 216
  - monospace, 177
  - mouse movement events, 134–136, 169
  - move method, 95–97
  - moveTo method, 146
  - Mozilla Developer Network (MDN)
    - Web Docs, 147, 263, 292
  - multidimensional arrays, 39
  - multiplication assignment operator (\*=), 18
  - music projects, 205–252
    - making drum sounds, 224–232
      - drum loop, 230–232
      - hi-hat synthesis, 224–226
      - kick synthesis, 228
      - reverb, 228–230
      - snare synthesis, 226–227
    - sampling, 232–234
    - song writing, 235–252
      - adding bass lines, 240–242
      - adding chords, 242–244
      - complete code, 247–252
      - event handling, 236–237
      - getting organized, 235–236
      - making drumbeat, 237–240
      - playing tunes, 244–246
    - Tone.js library, 210–217
      - generating tone with, 210–211
      - playing more notes in sequence, 215–216
      - playing multiple notes at once, 216–217
    - Tone.Synth options, 211–215
    - Tone.js transport, 217–224
      - Tone.Loop, 218–220
      - Tone.Part, 223–224
      - Tone.Sequence, 221–222
    - Web Audio API, 206–209
      - generating tone with, 207–209
      - setting up, 206–207
  - mutations, 41
- ## N
- named function expressions, 81
  - naming conventions, 15–16
    - classes, 95
    - constructors, 102
  - nested relationships, 114
  - nesting, 52–56
    - elements, 112
    - exploring nested objects in console, 54–55
    - with literals, 52–53
    - printing nested objects with JSON.stringify, 55–56
    - with variables, 53–54
  - new keyword, 96
  - nice method, 291
  - Node.js, 303, 330
  - Nodelist, 124–125
  - nodes, 206
  - notes
    - playing in sequence, 215–216
    - playing multiple notes at once, 216–217
  - not operator (!), 28
  - null value, 26
  - number literals, 10
  - numbers, 10–12
    - floating point, 11–12
    - order of operations, 11
- ## O
- Object.assign method, 51–52
  - Object constructor, 105
  - Object.entries method, 71
  - Object.keys method, 49–50
  - object literal, 47
  - object literal shorthand syntax, 238

- object-oriented Pong, 189–202
    - design, 190–191
    - file structure, 191
    - Game class, 198–201
    - game elements, 193–197
      - ball, 195–197
      - paddles, 194
    - GameView class, 191–193
    - Scores and Computer classes, 197–198
    - starting game, 201
  - object-oriented programming, 93
  - Object.prototype, 105–106
  - objects, 47–52
    - accessing values in, 48
    - creating, 47–48
    - nesting
      - exploring nested objects in console, 54–55
      - with literals, 52–53
      - printing nested objects with `JSON.stringify`, 55–56
      - with variables, 53–54
    - setting values to, 49
    - working with, 49–52
      - combining objects, 51–52
      - getting object’s keys, 49–50
      - getting object’s keys and values, 50–51
  - offsetX and offsetY properties, 150
  - open source code owners, 304
  - open source repositories, 299
  - operands, 27
  - operators, 10–12
    - defined, 10
    - floating-point numbers, 11–12
    - order of operations, 11
  - optional chaining operator, 313
  - order of operations, 11
  - or operator (`||`), 27–28, 33–34
  - oscillators, 208
  - outlined rectangles, drawing, 144–145
  - overriding methods, 107–108
  - overtones, 214
- P**
- paddles, Pong, 166–175
    - bouncing near ends of, 174–175
      - detecting collisions, 170–173
      - elements, 194
      - moving with player input, 169–170
  - parameters, 74
    - arguments vs., 75
    - functions, 77
    - rest parameters, 84–85
  - parent elements, 114
  - parentheses (`()`), 79
  - path element, 261–264
  - paths, drawing shapes using, 145–147
  - p element, 112
  - PEMDAS rule, 11
  - pentatonic scale, 219
  - percent (%) characters, 301
  - period (`.`), 123
  - pipe character (`|`), 241–242
  - placeholder syntax (`{}`), 24–25
  - player input, moving paddles with, 169–170
  - polymorphism, 191
  - polyphonic synth, 216–217
  - Pong, 159–202
    - bouncing, 165–166
    - complete code, 185–188
    - computer control, 180–182
    - drawing ball, 161–162
    - game loop, 163–165
    - game over, 182–184
    - object-oriented Pong, 189–202
      - design, 190–191
      - file structure, 191
      - Game class, 198–201
      - game elements, 193–197
      - GameView class, 191–193
      - Scores and Computer classes, 197–198
      - starting game, 201
    - overview, 159–160
    - paddles, 166–175
      - bouncing near ends of, 174–175
      - detecting collisions, 170–173
      - moving with player input, 169–170
    - refactoring, 162–163
    - scoring points, 176–180
    - setup, 160–161

- pop method, 43
- postfix incrementing and
  - decrementing, 17
- prefix incrementing and
  - decrementing, 17
- prepended elements, 275
- printing nested objects, 55–56
- projects
  - data visualizations
    - D3 library, 255–297
    - GitHub Search API, 299–328
  - game creation
    - object-oriented Pong, 189–202
    - Pong, 159–188
  - making music
    - generating sound, 205–252
    - song writing, 235–252
- properties, defined, 20
- prototype-based inheritance, 101–108
  - comparing constructors and
    - classes, 104–105
  - exploring `Object.prototype`,
    - 105–106
  - overriding method, 107–108
  - using constructors and prototypes,
    - 102–104
  - walking the prototype chain,
    - 106–107
- [[Prototype]] property, 55, 103
- prototypes, 101–104
- pseudo-classes, 133, 266
- push method, 42
- Python, 334

## Q

- `quadraticCurveTo` method, 147
- `querySelectorAll` method, 124
- question mark (?), 301
- queues, 43

## R

- range, 284
- rate limiting, 78
- React, 332
- real-time updates, 273–275
- receivers, 94
- rectangles, drawing outlined, 144–145
- refactoring, 162–163

- regular expressions, 292–295
- relationships, 97
- relative position, 262–263
- `rel` attribute, 119
- release, ADSR, 211–212
- repository info, 310–314
- rest parameters, 84–85
- rests, 222
- return keyword, 89
- return values
  - functions, 75–76
  - methods, 21
  - with side effects, 77–78
- reverb, 228–230
- RGBA color, 150
- RGB color, 261
- right-aligned text, 177
- rotation, 258
- rulesets, 121
- Rust, 334–335

## S

- sampling, 232–234
- Scalable Vector Graphics. *See* SVG
- scaling
  - bars in D3, 284–288
  - SVG supporting, 258
- scope, 67, 179
- Scores class, 197–198
- scoring points, 176–180
- script elements, 6, 118–119
- selections, 269–270
- selectors
  - overview, 121–124
  - using in JavaScript, 124–125
- self-documenting, 87
- semicolon (;), 10
- Set constructor, 315
- `setInterval` function, 83
- `setTimeout` function, 79, 81–82, 220
- shadowing, 108
- shapes, drawing using paths, 145–147
- sharp, 215
- `shiftKey` property, 267
- `shift` method, 43–44
- short-circuiting, 34
- siblings, 114
- sidebars, 310–314

- side effects, 77–78
- Simple Storage Service
  - (Amazon S3), 233
- sine wave, 208
- single quotation mark ('), 19
- sixteenth notes, 217
- skewing, 258
- slice method, 21–22
- slider, 148
- snake\_case, 15
- snare synthesis, 226–227
- song writing, 235–252
  - adding bass lines, 240–242
  - adding chords, 242–244
  - complete code, 247–252
  - event handling, 236–237
  - getting organized, 235–236
  - making drumbeat, 237–240
  - playing tunes, 244–246
- span elements, 310–311
- square brackets ([]), 21, 48–49
- src attribute, 119
- starting game, 201
- state, 152
- statements, 10
- statically typed language, 77
- static drawings, 142–147
  - outlined rectangles, 144–145
  - using paths, 145–147
- static methods, 49, 198
- static properties, 194
- strict inequality (!==) operator, 32
- str.includes(otherStr)* method, 23
- string literal, 19
- strings, 19–23
  - finding length of, 20–21
  - getting character from, 21
  - getting multiple characters from, 21–22
  - joining, 20
  - trimming whitespace from, 22
  - turning array into, 45–46
- strokeRect method, 144
- strong elements, 122–123
- str.padStart(num, char)* method, 23
- str.repeat(count)* method, 23
- str.toLowerCase()* method, 23
- subclasses, 97
- subexpressions, 171
- subtraction assignment operator (-=), 18
- superclass, 97
- super keyword, 99
- sustain, ADSR, 211–212
- SVG (Scalable Vector Graphics)
  - graphics format, 256–268
    - adding interactivity with
      - JavaScript, 266–268
    - defining paths, 261–264
    - drawing circles, 260–261
    - grouping elements, 258–259
    - styling elements with CSS, 264–266
- SvgPathEditor, 263
- syntactic sugar, 101
- synthesizer, 211

## T

- tags, 6, 112
- template literals, 24–26
- testing, 332–333
- text editors, 5–6
- this keyword, 95–97
- 3D graphics, 143
- tic-tac-toe game, 39–41
- timbre, 213
- time, Web Audio API, 220–221
- tone generation
  - with Tone.js library, 210–211
  - with Web Audio API, 207–209
- Tone.js library, 210–217
  - generating tone with, 210–211
  - playing more notes in sequence, 215–216
  - playing multiple notes at once, 216–217
  - Tone.Synth options, 211–215
- Tone.js transport, 217–224
  - Tone.Loop, 218–220
  - Tone.Part, 223–224
  - Tone.Sequence, 221–222
- Tone.Loop, 218–220
- Tone.Part, 223–224
- Tone.Sequence, 221–222
- Tone.Synth options, 211–215
- tooltips, 310
- transformations, 258

transitions, 275–276, 296–297  
translation, 258–259  
transport, Tone.js. *See* Tone.js transport  
trim method, 22  
triple equals (===) operator, 29  
true constants, 15–16  
true value, 32–33  
trumpet notes, 233  
truthiness, coercion, 32–35  
tune playing, 244–246  
TypeScript language, 333–334

## U

ul element, 131  
unauthenticated APIs, 302–303  
undefined behavior, 117  
undefined value, 26  
unshift method, 43  
update, element, 277  
update function, 153, 164  
URL encoding system, 301  
URLs, 300–301

## V

valid identifiers, 48  
values, object  
  accessing, 48  
  setting, 49  
variables  
  naming conventions, 15–16  
  nesting with, 53–54  
  overview, 13–14  
var keyword, 13  
vector graphics, 256  
visualizing data  
  D3 library, 255–297  
    advanced joins, 276–279  
    bar graphs, 279–297  
    data binding, 270–271  
    data joins, 271–273

real-time updates, 273–275  
selections, 269–270  
setup, 268  
SVG graphics format, 256–268  
transitions and key functions,  
  275–276

GitHub Search API, 299–328  
  adding interactivity, 319–324  
  basic visualization, 304–309  
  complete code, 325–328  
  fetching data, 300–304  
  improving visualization,  
    310–319  
  setting up, 300

VS Code (Visual Studio Code)

  if statement in, 58–59  
  indentation in, 40  
  overview, 5–6

Vue.js, 332

## W

W3C (World Wide Web  
  Consortium), 206  
walking the prototype chain, 106–107  
Web Audio API, 206–209  
  generating tone with, 207–209  
  setting up, 206–207  
web development, 332  
while loop, 63–64  
white noise, 224  
whitespace, 22, 295  
World Wide Web Consortium  
  (W3C), 206

## X

XML (Extensible Markup  
  Language), 256

## Z

zero-based indexing, 21, 38, 218