INDEX

Symbols

** (dictionary unpacking), 498
% (modulo), 134, 296
** (power), 69
$\sum$ (summation), 366

A

abstraction, 299
affine space, 172
affine transformation, 172–174
  augmented matrix, 173
  concatenation, 181
  identity transformation, 174, 193
  inverse, 185
  rotation, 190
  scaling, 187
analytic solution, 290
animation, 288
  frame, 288
architecture, software, 234
attribute, class, 37
attribute chaining, 104

B

backward substitution, 364, 377
balanced system of forces, 389
binary operator
  intersection, 160
bisector, 128
bitmap image, 204
browser
  developer tools, 205
byte string, 213

C

Cholesky decomposition, numerical method, 365
circle
  center, 148
  chord, 155
  radius, 148
class, 37
  __dict__, 69
  __init__, 38
  instantiation, 37
  self, 38
clean code, 155
coefficient matrix, 360
collections, 11–20
  dictionary, 18
  list, 15
  set, 11
  tuple, 12
collinear forces, 397
color
  #rrggbbaa, 206
column vector, 340
command
  cat, 54
  cd, 52
  chmod, 262
  echo, 53
  ls, 52
  mkdir, 53
  pwd, 51
  rm, 54
  sudo, 56
  touch, 53
  whoami, 51
command line, 49
  absolute path, 52
  argument, *See* option
  option, 54
  processor, 49
  program, 233
  relative path, 52
  standard input, 58
  standard output, 58
compound inequality, 158
cross product, 79
Crout, numerical method, 363

D

debugger, xxxix–xliii
  breakpoint, xl
  console, xliii
  run configuration, xli
  stack frame, xlii
  Step into, xli
  Step over, xli
decoding, 213
decorator
  `property`, 39
decoupled, 308
degrees of freedom, 397
Demeter, law of, *See* principle of least knowledge
destructuring, 20–21
deterministic, 99
differential equation, 290
direction vector, 103
direction versor, 103
docstring, 9
documentation
  Sphinx, 10
domain logic, 233
domain of knowledge, 160
Doolittle, numerical method, 363
dot product, 77
dunder methods, *See* magic methods
duplication of code, *See* knowledge duplication
dynamic dispatching, 42

E

edge case, 143
eigenvalues, 362
environment variable, 262
  `PWD`, 262
  `PYTHONPATH`, 262
errors
  `AttributeError`, 41
  `EOFError`, 317
  `IndexError`, 15, 341
  `ValueError`, 133
  `ZeroDivisionError`, 143
Euler's numerical method, 290
event driven, 267
event handler, 267
exception
  user-defined, 111

F

f-strings, 89
factory function, 89
fail fast, 109
force
  axial, 390
  axial component, 78
  compression, 390, 393
  normal, *See* axial
  shear, 391
  shear component, 83
  tangent, *See* shear
  tensile, 393
  tension, 390
forward substitution, 364, 375
fracture strain, 394
frames per second (FPS), 290
free body diagram, 288
frictionless union, 396
function
  access modifiers, 29
  higher-order, 27–29
  inside function, 28
  lambda, 26–27
  predicate, 30
  pure, 24–25
  reducer, 32
  shared state, 25
  side effect, 25
functional programming, 23–36
functools
  `reduce`, 32–35

G

geometry
  t parameter, 107
  circle, 148–149
  line, 124
  parallelogram, 164
  point, 67–71
  polygon, 132–133
  rectangle, 155–157
  segment, 101
  vector, 71–85
  versor, 75, 90
Git, xxix
GitHub, xxix
global
  `dict`, 18

enumerate, 14, 16
filter, 30–31
help, 10
len, 11, 13, 15
list, 15
map, 31–32
range, 146
set, 11
str, 88
tuple, 13

H

hard-coding, 248
Hooke's law, 392

I

IDE, *See* integrated development environment
immutability, 23, 25–26
immutable, 12, 219
import
  alias, 8, 430
  relative, 9, 240
__init__.py, 4
InkStructure, application, 188
integrated development environment, xxxi
integration test, 381, 447
internal forces, 389
interpolation, 192
  ease-in-out, 194
iterator, 30

J

JSON format, 248

K

keyword
  class, 37
  def, 24
  lambda, 26
  None, 120
knowledge duplication, 160

L

lambda calculus, 26
linear equation, 359
  coefficients, 360
  free term, 360
  unknown, 360
linear interpolation, 193
linear transformation, 172
Linux
  distro, 50
  superuser, 56
list
  append, 16
  flatten, 280
  slice, 16–17
list comprehension, 35–36
LU factorization, 362

M

magic methods, 43
  __add__, 44, 70
  __eq__, 45, 86
  __str__, 88
  __sub__, 44, 70
magic numbers, 110, 430
__main__, 4
main loop, *See* time loop
markdown, xxx
matrix, 337
  identity, 184
  lower-triangular, 362
  main diagonal, 361
  nonsingular, 363
  positive definite, 362
  square, 346, 361
  symmetric, 361
  transposed, 349
  upper-triangular, 362
mechanical stress, 390
model space, 184
modular arithmetic, 135
module, 4
  argparse, 531
    add_argument, 533
    ArgumentParser, 532
  import, 5–9
  json, 249
    loads, 249, 496
  math, 66
    copysign, 82
    fabs, 66

operator, 34
os
getcwd, 261
os.path
normpath, 261
sys
path, 259
Tkinter, 266
unittest, 92
assertAlmostEqual, 92
assertEqual, 95
assertFalse, 97
assertIsNone, 121
assertRaises, 112
assertTrue, 97
TestCase, 92
moment
bending, 392
normal to section, 391
tangent to section, 391
torsional, 391
multiple assignment, 120
mutable, 219

N

__name__, 4
Newton's third law, 423
nonlinear equation, 360
normal (perpendicular) versor, 104
number
floating point, *See* real
real, 65
numerical method, 359, 361
direct, 361
iterative, 361

O

object, 36
encapsulation, 346
method, 40–43
signature, 43
property, 39–40
state, 277
object-oriented programming, 36–45
open interval, 160
open source, 98
operator
** (dictionary unpacking), 498
% (modulo), 134, 296
** (power), 69
in, 11, 14, 19
overloading, 43, 70
ternary, 349
out of bounds, *See* errors: IndexError

P

package, 4
parser, 468
parsing, 483
pascal case, 37
pass, 293
PEP 238, 240
plaintext file, 235
plane truss, 394
point
projections, 67
polygon
centroid, 137
perimeter, 133
side, 132, 133
vertex, 132
polygonal chain, 132
principle of least knowledge, 125
proportional limit, 394
Python Enhancement Proposal, *See* PEP
Python Standard Library, xxvi

R

raise exception, 111
raster image, *See* bitmap image
raw string literal, 245
ray casting algorithm, 139
reaction force, 412
readme, xxix
rectangle
origin, 155
overlap, 158
size, 155
refactoring code, 301
regex, *See* regular expression
regression, 91
regular expression, 241–246
capture group, 245
character set, 242
quantifier, 243

resistant element, 388
reusability, 308
rich-text editor, 205, 235
rotation
  pivot, 189
row vector, 340
run configuration, xxxvi, 236

S

Scalable Vector Graphics, *See* SVG
scientific notation, number, 526
screen space, 184
script, 4
segment
  direction, 103
set
  `add`, 12
  `difference`, 12
  `remove`, 12
  `union`, 12
side effect, 24
silent fail, 109
simulation, 289
  ahead of time, 290
  motion, 297
  real time, 290
  system, 288
  time delta, 291
static equilibrium, 389, 417
stiffness, 397
stiffness matrix, 398
strain ϵ, 393
stress σ, 393
stress-strain diagrams, 393
string, 211
  `join`, 214
structure, 388
  external constraint, 395
  external support, *See* external constraint
  node, 395
  two-force member, 397
SVG, 204
  attributes, 206, 215
  circle, 221
  group, 225
  line, 217
  polygon, 222
  polyline, 223
  rect, 219
  text, 224
  `transform`, 208
  `viewBox`, 207
system of equations
  matrix form, 337, 360

T

TDD, *See* Test-Driven Development
template, 210
  placeholder, 210
test
  assertion, 91
  fixture, 98
  subject, 91, 98
test double, 447
  dummy, 447
  fake, 447
  mock, 448
  stub, 448
test-driven development, 371
time loop, 291
Tkinter
  `Button`, 269
  `Canvas`, 270
  `Entry`, 268
  `Label`, 268
  main loop, 267
  widget, 266
traceback, 94
truss structure, 388
tuple
  `count`, 13
  `index`, 14
type hints, 45–46
  `float`, 46
  `int`, 46
  `str`, 46

U

ultimate strength, *See* ultimate stress
ultimate stress, 394
Unicode characters, 525–526
unit testing, 90–91
  three golden rules, 97–99
    Controlled Environment, 98
    One Reason to Fail, 98
    Test Independence, 99

Unix
prompt, *See* terminal
shell, *See* terminal
terminal, 50
unpacking, *See* destructuring
UTF-8 encoding, 213
utils package, 134

V

vector
angle, 81
norm, 74
normal, 75
normalize, 75
parallelism, 81
perpendicularity, 81
unit, 75
vector image, 204
version control system, xxix
visibility diagram, 308

W

winding number algorithm, 140
Windows Subsystem for Linux, 50
working directory, 259
World Wide Web Consortium (W3C), 204
wrapper class, 276

X

XML, 205
namespace, 205

Y

yield strength, *See* yield stress
yield stress, 394
yielding, material, 394
Young's modulus, 392