INDEX

Symbols
** (dictionary unpacking), 498
%(modulo), 134, 296
**(power), 69
∑ (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
bisection, 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

deg bugger, 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
def, 24
lambda, 26
None, 120

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

InkStructure, application, 188
integrated development environment, xxxi

integration test, 381, 447
internal forces, 389
interpolation, 192
ease-in-out, 194

iterator, 30

JSON format, 248

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

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

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
assertRaisers, 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 \( \epsilon \), 393
stress \( \sigma \), 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