# Symbols

./ (array division) 54,74

.^ (array exponentiation) 54,74

.\* (array multiplication) 51,74

= (assignment operator) 21

\ (backslash) 126, 271

: (colon operator) 54, 56, 74 . (dot) 154, 160

...(ellipses) 35, 136, 149

[] (empty vector) 50

= = (equal to) 54,74

> (greater than) 54,74 > = (greater than or equal to) 54,74

< (less than) 54,74

< = (less than or equal to) 54,74

- (minus sign) 52

~= (not equal to) 54,74

2-D plots/plotting 234-239 enhancement tools 237 parametric 238-239 simple plots 235–237

3-D plots/plotting 239–243 linear 239–241

parametric plots 241-242

& (element-wise AND) 53 (element-wise OR) 53

/ (matrix division). see matrix division (/)

^ (matrix exponentiation) 271, 286

\* (matrix multiplication) 51, 268–270, 272–273, 286

% (percent sign) 33, 126

; (semicolon) 28, 62

&& (short-circuit AND) 53,87

|| (short-circuit OR) 53,87

~ (unary not) 54, 87, 100

\_ (underscore character) 22

A\* algorithm 411–413

code for 412 A/D (analog-to-digital) device 317

abstraction 18-19, 46, 106, 268

acosd() function 193

activation stack 186-187

actual parameters 109

adjacency matrix 399, 406 creation of 400

algorithms 19

A\* 411–413

Breadth-First Search 407–408

bubble sort 373–375, 383

complex, analyzing 370-371 Dijkstra's 408–411

insertion sort 371-373, 382-383

measuring cost of 368-371

merge sort 377–379, 383 performance analysis of 380–382

Prim's 404-406

quick sort 375–377, 383 radix sort 379-380, 383

for sorting data 371-380

all() function 87, 100 alpha() function 255, 261

ALU. see Arithmetic and Logic Unit

(ALU)

American Standard Code for Information

Interchange (ASCII) 122, 129

ampersand (&) 53 analog-to-digital (A/D) device 317

AND element-wise (&) 53

short-circuit (&&) 53, 54, 87

any() function 87, 100 API. see Application Programmer Interface (API)

Application Programmer Interface (API) 108

Arithmetic and Logic Unit (ALU) 5

arithmetic operations 213 with arrays 64

on character strings 125

with vectors 51-52

array division (./) 54 array exponentiation (.^) 54

array multiplication (.\*) 51

arrays 60-71

arithmetic operations with 64

cell (see cell arrays) of character strings 131–132

concatenation 66-67

creating 62 elements of 61, 62–64

inserting data into 214

library functions with 65–66 linear 46

linearized 67-71

logical operations with 64-65 matrices vs., 60

operations 64-71

properties of 61

reshaping 67 slicing of 67

structure 150-156 (see also

structure arrays)

transpose of 61

ASCII. see American Standard Code for Information Interchange

(ASCII)

assignment operator ( = ) 21 .au files 317

auread() function 317,334

auwrite() function 334

auxiliary (local) functions 111 axis() function 232,260

## I-2 Index

cell arrays 142–146 compile-time errors 12 В accessing 143-145 Babbage, Charles 3 conversion to string 394 back dividing 271, 273, 286 creating 142–143 backslash (\) 126, 271 extracting/sorting 382 inserting data into 214 backward difference processing 145-146 approximation 356 using 145 bar() function 239, 260 central difference bar3() function 242, 261 approximation 357 barh() function 239,260 Central Processing Unit (CPU) barh3() function 243, 261 5, 7, 186 Basic Input/Output System char() function 123, 125, 132, 136 (BIOS) 7,9 character generators 121 before() function 215 character mapping 122 behavioral abstraction 268 character strings 121-135 BFS. see Breadth-First Search (BFS) arithmetic operation on 125 Big Oalgebra 368-371 arrays of 131–132 O(1) (independent of N) 369 casting 122–123 O(logN) (binary search) comparison of 129-131 369-370 concatenation of 124 O(2<sup>N</sup>) (exponential growth) 370 conversion from numbers to 125-127 O(N) (linear with N) 369  $O(N^2)$  (proportional to  $N^2$ ) 370 conversion to numbers 127-129 and delimiter 123 binary files 168 example using 132-135 binary search (O(logN)) 369-370 format control strings 126 BIOS. see Basic Input/Output System logical operation on 125 (BIOS) mapping 122 bits 6 MATLAB implementation black box view, functions 106-107 123-125 bodies of rotation 250-255 as numerical values 122 operations 129-131 continuous functions, slicing of 124 rotating 251-253 discrete functions, rotating and token 123 253-255 class() function 145, 160 boolean value 50, 82, 84, 86–87, 100 classes 24 Breadth-First Search (BFS) 407–408 clc command 26,33 break points 36 clear command 33 break statement 94, 96, 97, 100 clf command 232, 260 bubble sort 373–375, 383 close all command 232, 260 building (operation) 213, 216 code blocks 81,82 coef() function 347-348 C colon operator (:) 56 C (programming language) 12 color mapped images 294 color masking 296-301 cache memory 7 colormap() function 232, 260 CAD. see computer-aided design (CAD) Colossus 3-4 case keyword 88, 89, 100 column vector 61 casting 122-123 Command History window 26-27 catch keyword 192, 193, 194, 207 Command window 25-26, 92, 107, CAToString() function 394 112, 122 ceil() function 55,74 comments 33

compilers 11-12 compound surfaces, assembling 256 computer hardware (see hardware, computer) internal details 6 internal organization of 5 memory (see memory, computer) software (see software, computer) computer-aided design (CAD) 10 computer architectures, history of 3-5 computer languages 2-3, 10-11 concatenation of arrays 66-67 of character strings 124 of sounds 318-320 of vectors 55 conditional execution 82-83 continue statement 96, 100 continuous function, rotating 251-253contour() function 255, 261 Control Unit 5 CPU. see Central Processing Unit (CPU) cross() function 60,74 csvread() function 170, 173, 177, 179 csvwrite() function 170,179 cubic spline interpolation 343-344 cumsum() function 353, 354, 361 cumtrapz() function 354,361 Current Directory window 30-31, 34-35, 107, 108 curve fitting 345-351 example of 349-351 linear regression 345–347 polynomial regression 347–349 cycles, graphs 396 cylinder, construction of 248-249 cylinder() function 107-109, 255, 261 D/A (digital-to-analog) device 317 data abstraction 19, 46, 268

data bus 6 data collection. see also problemsolving building 216 filtering 217–218

I-3

Index

inserting data into 213-215 ellipsoid() function 255,261 simple spectral analysis mapping 216-217 using 327-328 else keyword 83, 100 searching 219-220 fclose() function 174, 180  $\verb|elseif| keyword 84,100$ sorting 220 FFT. see Fast Fourier Transform (FFT) empty vector ([]) 50 summarizing 218-219 fft() function 327, 334 encapsulation 106, 111-112 traversing 215–216 fget1() function 174,180 end keyword 193 data typing 22-24 fgets() function 174,180 end statement 83, 84, 89, 92, 100 deal() function 143-145, 160 fib() function 199 endless recursion 188 debugging 36 Fibonacci series 198–199 engineering applications del2() function 248 ceramic composition 283–285 .field operator 152 delimited text files 169, 172-173 detecting edges 306-309 fieldnames() function 147, 153, 154 delimiter 123, 168 electrical circuit analysis 285–286 figure() function 232,260 dequeue() function 390,391 encryption 132-135 Figure window 31-32 derivative, of function 356 forces and moments 58-60 files design templates 83-84 geographic data, visualizing 256-259 binary 168 for functions in MATLAB, 107 delimited text 169 geopolitical data, for if statement 84 opening/closing 174 processing 221–226 for loop 91 reading/writing 170 graphs 415 for switch statement 88 text (see text files) liquid levels, computation of for while loop 94-95fill() function 239, 260 97\_99 diag() function 62,74 music synthesizer 332-334 filtering (operation) 213, 217–218 diagonal array 61 physical structure, find() function 68,74 diff() function 357,361 assembling 156-160 fix() function 55,74 difference engine, Babbage 3 robot arm motion 202-206 soil volume, computation of 71-73 floor() function 55,74 differentiation 356-357 flowcharts 83 solid object measurement 113–114 digital-to-analog (D/A) device 317 sorting 384-386 folding (operation) 213 Dijkstra's algorithm 408-411 spacecraft launch 36-39 fopen() function 174, 180 code for 410 spreadsheet data 177–179 for loop 90–94, 100 directional edges 396 synthesizer notes, shaping 359-360 breaking out of 94 discrete functions, rotating 253–255 enqueue() function 390, 391, 393 example of 92 disp() function 58,74,129,136 equal to ( = = ) 54, 74 indexing implementation division error() function 193, 207 using 93-94 matrix 271, 273-274 MATLAB implementation 91–92 Excel spreadsheets 170–172 dlmread() function 170, 172-173, 179 structure of 91 exceptions 190-194 template 91 dlmwrite() function 170, 173, 179 generic implementation for while loop vs., 90 documentation section 107 191–192 formal parameters 109 historical approach 191 dot (.) notation 154, 160 MATLAB implementation format control strings 126 dot operator 64 193-194 forward difference double() function 123, 136 approximation 356 execution errors 12 drivers 7 fprintf() function 92, 129, 130, exponential growth (O(2<sup>N</sup>)) 370 136, 176, 180 extrapolation 344-345 Ε frame, stack 187 eye() function 270, 286 frequency, sound 322-324 edges, graphs 396 function name section 107 Editor window 32–33, 36 functional programming 20 element-wise AND (a) 53,54 fact() function 195 function(s) element-wise OR (|) 53, 54 false values 50, 74, 83, 84, 86, 100 acosd() 193 elements Fast Fourier Transform (FFT) all() 87,100 arrays 61, 62-64 324-328 alpha() 255 vectors 47 implementa any() 87,100 ellipses (...) 35, 136, 149 overview 325–326 auread() 317,334

# I-4

function(s) (continued) axis() 232,260 bar() 239,260 bar3() 242 barh() 239,260 barh3() 243 before() 215 black box view of 106-107 CAToString() 394 ceil() 55 char() 123, 125, 132, 136  ${\tt class()} \quad 145,160$ coef() 347-348 colormap() 232,260 contour() 255  ${\tt cross()}$  60,74csvread() 170, 173, 177, 179 csvwrite() 170,179 cumsum() 353, 354, 361 cumtrapz() 354,361 cylinder() 107-109,255  ${\tt deal()} \quad 143 \text{--} 145, 160$ defined 106, 107-108 del2() 248 dequeue() 390,391 derivative of 356 diag() 62 diff() 357,361 disp() 58, 129, 136 dlmread() 170,172-173,179 dlmwrite() 170,173,179 double() 123,136 ellipsoid() 255 enqueue() 390,391,393 error() 193,207 eye() 270,286 fact() 195 fclose() 174 fft() 327,334 fgetl() 174,180  ${\tt fgets()} \quad 174,180$ fib() 199  $\mathtt{fieldnames()} \quad 147, 153, 154$ figure() 232,260 fill() 239,260 find() 68 fix() 55 floor() 55 fopen() 174,180 fprintf() 92, 129, 130, 136, 176, 180 getfield() 155 gplot() 405 grAdjacency() 399 grid off() 232,260 grid on() 232,260 qt() 373,376 hist() 239,260

 $\verb|hold off()| 233,260$ hold on() 233,261 ifft() 327,334 image() 295,310 imread() 295,310 imshow() 295,310 imwrite() 295,310 input() 89, 90, 96, 112, 127-128, 136, 192 instances 187 integral of 351 interp1() 341,344,361 interp2() 343,361 interp3() 343,361 int2str() 125,136 inv() 271,286 isa() 146,161 is\_before() 391-392,393 iscell() 146,161 ischar() 125, 136, 146, 161 isempty() 390 isfield() 155,161 islogical() 146,161 isnumeric() 146,161 isPal() 197 isspace() 125,136 isstruct() 146,161 it() 372,376 largest() 145 lasterror() 193,207 legend() 233, 261 length() 48,58,61 lightangle() 248 linspace() 47,74,310load() 180 loglog() 237,261 magic() 62,75 MATLAB implementation (see functions, in MATLAB) max() 66,92 mean() 55,66 mesh() 243 meshc() 255  $\texttt{meshgrid()} \quad 243, 245, 255$ meshz() 255 min() 66 nargin() 110 nargout() 110 num2str() 125,136 ones() 47,62,305peek() 390 pie() 239,261 pie3() 243 plot() 232, 235, 239, 261 plot3() 239 plotyy() 237 polar() 239,261 polyfit() 347-348,361,384,385

polyval() 348,361 rand() 47,62 randn() 47 read() 173 readStruct() 179 reshape() 67,279,286 rmfield() 147, 153, 155 rot90() 310 round() 55 save() 180 semilogx() 237,261 semilogy() 237,261 setfield() 155,161 shading() 233,261  $\verb|size()| 48, 58, 61, 146|$ sort() 155, 161, 382 sound() 318,335 sphere() 255 spline() 344,361 sprintf() 126, 129, 130, 136, 348 sscanf() 127, 129, 136 strcmp() 130, 131, 136 strcmpi() 131,136 str2num() 127, 128, 129, 136 strtok() 129,180 struct() 149, 150, 161 subplot() 233-234, 261 sum() 55,66,155 surf() 243,244 surfc() 247,255 surfz() 255 text() 233,261 textscan() 175,180 title() 233,261 toString() 394 tril() 310 uint8/16() 123,136,310 view() 247,261 waterfall() 255 wavread() 317,335 wavwrite() 335 xlabel() 233,261 xlsread() 170, 177, 180  $\texttt{xlswrite()} \quad 170, 172, 180$ ylabel() 233,261 zeros() 47,62 zeros of 199-202 zlabel() 233,261 functions, in MATLAB, 46, 107-114 auxiliary (local) 111 calling 109 defined 107-108 encapsulation in 111–112 and global variables 112–113 returning multiple results from 110–111 storing/using 109

I-5

Index

structures 148–150	I	interpreted code 13
template of 107	I/O. see Input/Output (I/O)	int2str() function 125,136
G	identity matrix 270	inv() function 271, 273, 274, 286
Gaussian Elimination 271	if statements 83–88, 100, 131	isa() function 146, 161
generations, of computer	example 85	is_before() function 391-392,393
language 10–11	in logical expressions 86–87	iscell() function 146,161
getfield() function 155	MATLAB implementation 84–86	ischar() function 125, 136, 146, 161
	script with 86	isempty() function 390
global keyword 112, 207	short-circuit evaluation 87–88	isfield() function 155, 161
Global Scope 112	template for 84	islogical() function 146, 161
global variables 112–113, 115	ifft() function 327, 334	isnumeric() function 146,161
gplot() function 405	image() function 295, 310	isPal() function 197
grAdjacency() function 399	images 291–309	
graphs 396–404	color mapped 294 color masking with 296–301	isspace() function 125, 136
A* algorithm 411–413	displaying 295	isstruct() function 146, 161
Breadth-First Search 407–408	format of 294–295	it() function 372, 376
building 398–401	gray scale 293	iteration 90
creating 31, 32 cycles 396	kaleidoscope, creation of 301-303	
defined 389	nature of 292	J
Dijkstra's algorithm 408–411	operation on 295–306	Joint Photographic Experts Group
examples 396–397, 415	reading 295	(JPEG) 294, 301
minimum spanning trees of (see	resolution of 292 stretching/shrinking 295–296	
minimum spanning trees (MSTs))	on surface 303–306	K
nodes 389	true color 293	kaleidoscope, creation of 301–303
paths on 396, 406–414 processing 397–398	types 293–295	1 ',
searching 403–404	writing 295	L
traversal 401–403	imread() function 295,310	
weighted 396, 398	imshow() function 295,310	largest() function 145
gray scale images 293	imwrite() function 295,310	lasterror() function 193,207
greater than (>) 54, 74	in-line coding 195	least squares technique 346
greater than or equal to $(> =)$ 54, 74	inner dimensions 269	legalist approach 195
grid off() function 232, 260	input() function 89,90,96,100,	legend() function 233, 261
grid on() function 232, 260	112, 127–128, 136, 192	length() function 48,58,61,74
gt() function 373, 376	Input/Output (I/O) 6, 168–179	less than (<) 54, 74
	devices 5,7	less than or equal to $(< =)$ 54, 74
Н	high-level 169–173 ( <i>see also</i> high-level I/O functions)	library functions
hardware, computer 5–6	lower-level 174–177 (see also	with arrays 65–66
interaction with software 8	lower-level I/O functions)	with vectors 54, 55
hardwiring 6	and MATLAB workspace 168–169	lightangle() function 248,261
heap 8	inserting data, in collection 213–215	linear arrays 46
help command 108, 115	template for 215	linear equations, simultaneous
helper functions 111	insertion sort 371–373, 382–383	281–283
heterogeneous collections 142	integral, of function 351	linear interpolation 340–343
high-level I/O functions 169-173	integration 351–355	linear matrices 47
with delimited text files 172–173	interp1() function 341,344,361	linear regression 345–347
with Excel spreadsheets 170–172	interp2() function 343,361	linearized array 67–71
exploration 169–170	interp3() function 343,361	line(s)
hist() function 239, 260	interpolation 340-345	intersecting 282–283
hold off() function 233, 260	cubic spline 343–344	rotating 275–276
hold on() function 233, 261	extrapolation 344–345	linker 12
homogeneous collections 46	linear 340–343	linspace() function 47,74,310

load() function 180 loader 12 Local Scope 112 logic errors 12, 23 logical expressions 86–87 logical indexing 50

logical operations with arrays 64–65 on character strings 125

with vectors 52–54 logical value 50 loglog() function 237, 261

loop-and-a-half iteration style

magic() function 62,75

lower-level I/O functions 174-177 opening/closing files 174

96-97

mapping character 122 operation 213, 216-217 mass memory 7 MATLAB advantages 18 components of 18 and data manipulation 20-24 introduction to 13–14, 17–18 and problem-solving 14–15 programming concepts 14 starting/stopping 20–21

user interface 24–33 (see also user

interface) matrix(-ces) 267-286 adjacency 399, 400, 406 arrays vs., 60 examples using 283–286 identity 270 implementation 271–274 linear 47 operations on 268-274 rotating coordinates 274–281

sparse 399, 400 matrix division (/) 271, 273-274, 286 for solving simultaneous linear equations 281–283

matrix exponentiation (^) 271, 286 matrix multiplication (\*) 51, 268-270, 272–273, 286 for 2-D rotation 274-278 for 3-D rotation 278–281

max() function 66, 75, 92 nean() function 55, 66, 75 mechanical memory 6–7

memory, computer 6–8 layout 8

Mercator projection 303 merge sort 377-379, 383

mesh() function 243, 261 meshc() function 255, 262 meshgrid() function 243, 245,

255, 262 meshz() function 255, 262 min() function 66,75

minimum spanning trees (MSTs) 404-406 minus, unary (-) 52

music synthesizer 332-334

multiplication array 51 matrix. see matrix multiplication (\*)

musical sounds 321-324 about 321

changing frequency of 322-324

Nan keyword 344, 361, 392 nargin() function 110, 115 nargout() function 110,115 Newton's method 202 nodes, graphs 389

not equal to  $(\sim=)$  54 numbers conversion, to strings 125-127 conversion from strings to  $\,$  127–129

numerical indexing 49–50 numerical methods 339-360 analytical operations 357

curve fitting 345-351 (see also curve fitting) differentiation 356-357 example using 359-360 implementation 357–358

integration 351–355 interpolation 340-345 (see also interpolation)

numerical values 122 num2str() function 125,136

object code 12 object-oriented programming (OOP) 20 objects 24 ones() function 47,62,75,305 OOP. see object-oriented

programming (OOP)

operating systems (OS) 7–8, 9

operation(s) analytical 357 on arrays 64–71

character string 129–131 frequency domain 328-332 on graphs 397–398

on queues 390 summary of 212-220

on vectors 51–58 operators

dot 64 .field 152 logical 53 precedence 54

element-wise (|) 53, 54 short-circuit (||) 53, 54, 87

OS. see operating systems (OS) otherwise keyword 88, 89, 100

page buffer 7 palindromes, determination 197-198 parabolic dish 245-247 paradigms, programming 20 parameters cell arrays of 145 formal vs. actual 109 value 126 variable numbers of 109–110 parameters section 107 parametric plots 2-D 238-239 3-D 241-242

passing by reference 109 passing by value 109 paths, on graphs 396 A\* algorithm 411–413 Breadth-First Search 407–408 Dijkstra's algorithm 408-411

searching 406–414 pause() function 323 peek() function 390 percent sign (%) 33, 126

pie() function 239, 261 pie3() function 243, 262 pixels 292

plots (plotting) 231–259

plaid surface 243 playback 316-317

plot() function 232, 235, 239, 261 olot3() function 239, 262

I-7

Index

2-D 234-239 (see also 2-D plots/ readStruct() function 179 of sounds 318-320 of vectors 56–58 plotting) recording, sound 316–317 3-D 239-243 (see also 3-D plots/ software, computer 8–10 recursion 185-206 plotting) activation stack 186-187 categories of 8 data, manipulation of 256 interaction with hardware 8 defined 187-188 enhancement tools 237 tools (see software tools) endless 188 figures as containers for 232 examples 197-202 software tools 9-10 functions for enhancement implementation 188–190 solid-state memory 6-7 232-233 reshape() function 67,279,286 manually editing 234–235 sort() function 155, 161, 382 resolution subplots 233-234 sorting 213, 220, 367–386 of images 292 surface plots 243–256 (see also algorithm for 371-380 of recorded data 317 surface plots) applications 382–383 <return info section>, 107 plotyy() function 237 bubble 373–375, 383 RGB (red, green, and blue) 292 example using 384–386 polar() function 239, 261 rmfield() function 147, 153, 155 insertion 371–373, 382–383 polyfit() function 347-348, 361, and measuring algorithm 384, 385 ROM. see Read-Only Memory (ROM) cost 368-371 polynomial regression 347-349 rot90() function 310 merge 377-379, 383 rotations polyval() function 348,361 quick 375-377, 383 2-D 275-278 radix 379–380, 383 Prim's algorithm 404-406 3-D 278–281 priority queues 391-393 sound() function 318, 319, round() function 55,75 323, 335 problem-solving 14-15, 211-226. see runtime errors 12 also data collection sound(s) 315-334 assembling solution steps for 212 example using 332–334 example 221-226 Fast Fourier Transform 325–328 inserting into collection 213–215 (see also Fast Fourier Transform save() function 180 larger problems 220–221 (FFT)) scalar vectors 51 plan for 212 frequency domain scale, playing a musical 322-323 operations 328-332 procedural abstraction 19, 106, 268 scripts 33-39 intensity 316 procedural programming 20 creating 33-34 musical 321-324 program bugs 12 debugging 36 physics of 316 programming 211 example using 36-39 recording/playback 316-317 programming languages 10–11 punctuating 35 slicing/concatenating 318–320 overview of 18–20 running 35 source code 12 searching (operation) 213, 219–220 spacecraft launch, example 36-39 semicolon (;) 28, 62 sparse matrix 399, 400 queue(s) 390-396 semilogx() function 237,261 implementation 390-391 sphere, construction of 249-250 semilogy() function 237, 261 nature of 390 sphere() function 255, 262 operations on 390 setfield() function 155, 161 spline() function 344,361 overview 390 shading() function 233, 261 spreadsheets 170-172 priority 391-393 short-circuit AND (&&) 53, 54, 87 sprintf() function 126, 129, 130, testing 393-396 short-circuit evaluation 87–88 136, 348 quick sort 375–377, 383 short-circuit OR (||) 53, 54, 87 square array 61 shortening, of vector 50-51 sscanf() function 127, 129, 136 radix sort 379–380, 383 shrinking images 295–296 stack 8, 186-187 RAM. see Random-Access Memory Simpson's rule 351, 353 stremp() function 130, 131, 136 simultaneous linear equations, strcmpi() function 131, 136 rand() function 47,62,75 solving 281–283 stretching images 295–296 randn() function 47,62,75size() function 48,58,61,75,146 strings Random-Access Memory (RAM) 7 slicing cell arrays conversion to 394 read() function 173 character 121–135 (see also Read-Only Memory (ROM) 7 of character strings 124 character strings)

# I-8

text() function 233, 261

title() function 233, 261

toString() function 394

trapezoidal rule 351, 352-353

token 123

textscan() function 175,180

traversing (operation) 213, 215–216  $strings\ (continued)$ library functions with 54, 55 graphs 401-403 conversion from numbers to 125-127 tril() function 310 scalar 51 str2num() function 127, 128, 129, 136 true color images 293 strong typing 24 true values 50, 82, 84, 86, 100 size of 48 strtok() function 129, 180 try keyword 192, 193, 194, 207 struct() function 149, 150, 161 tune, playing 323-324 structure arrays 150-156 type, data 24 constructing 150-152 typographical errors 13, 23 elements, accssing 152–154 inserting data into 214 manipulation 154-156 uint8/16() function 123, 136, structure(s) 146-150 293, 310 constructing/accessing 147–148 unary minus (-) 52 functions 148-150 manipulation 154-156 unary not (~) 54, 87, 100 subplot() function 233-234, 261 underscore character (\_) 22 untyped languages 22 sum() function 55, 66, 75, 155, 346 user interface 24–33 surf() function 243, 244, 262, 303 Command History window surface, images on 303-306 26-27 surface plots 243-256 Command window 25-26, 92, 3-D parametric surfaces 248–250 breaking 97 107, 112, 122 example 95 bodies of rotation 250-255 (see Current Directory window also bodies of rotation) 30-31, 34-35, 107 compound surfaces, assembly Editor window 32–33, 36 of 256 Figure window 31–32 cube 243-245 Variable Editor window 31 functions to create 243 Workspace window 27–30, 48 manipulation of 247-248 utilities, operating systems 9 parabolic dish 245–247 surfc() function 247, 255, 262 surfz() function 255 value parameters 126 switch statement 88–90, 100 MATLAB implementation 89-90 value(s) 24 assigning, to variables 21–22 template for 88 boolean/logical 50 synthesizer notes, shaping 359–360 parameters 126 Variable Editor window 31 variable scoping 112 technology, advancement in 2 variable(s) text files 33 assigning values to 21–22 delimited 169, 172-173 global 112–113 reading 174–176 names 21–22 writing 176-177

vector(s) 46-60

elements 47

concatenation of 55 creating 47-48

extracting/sorting 382

inserting data into 213

indexing of 48–50

arithmetic operations with 51-52

logical operations with 52-54 operating on 51–58 shortening 50-51 slicing 56–58 vectors of indices 56 view() function 247, 261 virtual memory 7 von Neumann architecture 4-5 waterfall() function 255, 262 .wav files 317, 318 wavread() function 317,335 wavwrite() function 335 weak typing 24 weighted graph 396, 398 while loop 94-97, 100 loop-and-a-half iteration style 96–97 for loop vs., 90 MATLAB implementation 95 structure of 94 template for 94-95 who command 30 whos command 30 workspace, saving 168–169 Workspace window 27–30, 48 wrapper function 185, 195-197 template for 196 xlabel() function 233, 261 xlsread() function 170, 177, 180

xlswrite() function 170, 172, 180

ylabel() function 233, 261

zeros() function 47,62 zlabel() function 233, 261