Index

Note: Page numbers followed by f indicate figures, t indicate tables and b indicate boxes.

abs, 14–15, 55–56, 106, 548–549, 583 Absolute value, 548 Abstract data types, 384 Access, 413 Action of loop, 153 Addition, complex numbers, 546 Advanced plotting techniques animation, 435–436 applications, 452–457 area functions, 428–432 bar functions, 428–432 core graphics objects, 444–452 customizing plots, 428–438 file data plotting, 454–457 function plotting, 452–454 histograms, 432–434 log scales, 434–435 pie charts, 432–434 plot functions, 428–438 saving and printing plots, 457–458 stem functions, 428–432 3D plots, 439–444 Algorithms, 80–81 all, 64–65, 188, 583 angle, 549, 583 Animation, 435–436 Anonymous functions, 359, 367–369 any, 64, 188, 583 API calls, 346 App Designer, 481, 499–511 in Command Window, 500–505	examples, 508–511 simple label, 503f slider and label, 509f StartupFcn function, 509–510 UI figure function, 505–508 uilabel function, 505 Appending to file, 102–103 Application Programming Interface (API), 346, 348–349 area, 428–432, 429f, 583 Area plots, 428 Argument(s), 14–15, 55–59, 108, 112–114, 359–365 Arithmetic mean, 529, 532 Array division, 61–62 multiplication, 61–62 one-dimensional, 38 operations, 38, 60–61 operators, 62 ASCII, 19, 26 asin, 26, 583 asind, 26, 583 asind, 26, 583 asind, 26, 583 asind, 26, 583 Assignment operator, 6 Assignment statement, 6–8 Associativity, 13 Attributes, 413, 418–419 Audio file formats, 513 Audio files. See Sound files audioinfo, 513 audioplayer, 513, 583 audioread, 513 audiorecorder, 513, 583	Banded matrix, 554 bar, 428–432, 429f, 436–437, 583 bar3, 439–440, 583 Bar chart, 99, 428, 431f labels from file data, 456f matrix data, 431f subplot, 437f barh, 428–432, 436–437, 583 bar3h, 439–440, 583 BarWidth property, 428–430, 434–438 Base, 384 Base case, 373 Base workspace, 115, 222–224 Binary operator, 12 Bins, 432 blanks, 249, 583 Block comment, 84 Boolean expressions, 19 Branching statements. See Selection statements Breakpoint alley, 231–232 Breakpoints, 231–232, 236 bsxfun, 377 Bug, 228 Button groups, 497–499 color choice for text, 499f radio buttons, 499f C Calculus operations differentiation, 572–573 integration, 570–572 Symbolic Math Toolbox TM , 573–575
components, 499–500	axis off, 445–446	573–575 trapezoidal rule, 570–572

Callback functions, 419, 485, 487,	circshift function, 71	Component library, 501f, 503
487 <i>f</i>	class, 11, 368, 583	Components, 499-500
Call-by-value method, 208	classdef, 394	Computer program, 79
Cascading if-else statement, 134	Class definition, 384, 394–398	Concatenation, 40, 251–255
case expressions, 138–139	access methods, 416-418	Conditional loops, 153
cast, 25, 583	advantages, 420	conj, 584
Casting, 23–26	constructor functions, 415-416	connector, 28-29, 584
Categorical arrays, 278, 301–302	destructor functions, 419	Constants, 15–16
categorical function, 301	method attributes, 418-419	Constructor functions, 394,
categories function, 301	Classes, 10, 383-384	415–416
countcats and summary function,	clear, 10, 227-228, 583	contains, 265, 584
301–302	clearvars, 9-10, 583	Content indexing, 280–281
ordinal categorical arrays, 302	clf, 98–99, 428, 583	Continuation operator, 12
sorting, 311	clock, 17, 584	Control characters, 245–246
categorical function, 301, 583	Code Analyzer Reports, 189	Conversion character, 88–89
categories, 301, 583	Code cells, 235–237	Convert numbers to strings, 265–268
ceil, 26, 583	coefs, 540–541	Copy constructor functions, 415–416
cell, 279, 583	collect, 565, 584	Core graphics objects, 444–452
Cell array, 277-284, 360	Colon operator, 39–40	cos function, 100, 101 <i>f</i>
celldisp, 281–282	colorbar, 441–443, 584	count, 259, 584
cell indexing, 280–282	colorcube, 513	countcats function, 301-302
cellplot, 281–282	colormap, 468–474, 584	Counted loops, 153
cellstr, 283	Column major order, 45	cross, 70–71, 584
content indexing, 280-281	Column vector, 38, 42	Cross product, 70-71
creation, 278-279	Columnwise, 45	cummax, 57-59, 529, 584
sorting, 311	comet, 584	cummin, 57-59, 529, 584
store strings, 282–284	comet3, 439, 441, 584	cumprod, 57–58, 182, 188, 529–531
iscellstr, 284	Command History Window, 5, 8	584
strlength, 283	Commands and functions, 116-117	cumsum, 57–58, 182, 188, 529–531,
strsplit and strjoin, 283–284	Command Window, 4, 5 <i>f</i> , 28–29,	584
celldisp, 281–282, 583	204-205, 222-224, 226-227,	Current Folder Window, 5
Cell indexing, 280–282	231	Curve-fitting functions, 539–540
cellplot, 281–282, 583	Comma-separated list, 281, 293	defined, 527
cellstr, 283, 583	Comment blocks, 84–85	discrete/continuous properties,
char, 11, 25, 245-246, 248-250, 265,	Comments, 83–84	539-540
280, 583	Common logarithm, 28	extrapolation, 540–543
Character, 18-19, 245-249, 255	Commutative operators, 22	interpolation, 540–543
Character encoding, 18	Compiler, 81	polynomials, 539
Character set, 18	complex, 584	Curve-Fitting Toolbox [™] , 538
Character vectors, 11, 23, 245-249	Complex conjugate, 548	Customizing plots, 94–101
is function, 264–265	Complex numbers	cylinder, 584
operations on, 249–251	absolute value/magnitude, 548	
changing case, 256	addition, 546	D
comparsion, 256-258	complex conjugate, 548	Database, 278, 295
creating and concatenating,	complex equations as polynomials,	datafun, 528–529
251–255	548	Data sets
find, replace and separate,	defined, 544	median, 533–534
258–262	equality, 546	mode, 533
remove trailing/leading blanks,	multiplication, 547–548	Data transfer
255	plotting, 549–550, 550f	dlmread, 349
checkcode, 189, 228, 583	polar form, 549	dlmwrite, 349
Child class, 384	subtraction, 546	load, 327, 329, 331, 335–336,
chirp, 511, 512f	Complex plane, 549	338–339

lower-level file I/O functions, 327,	Documentation, 83–84	F
331	dot, 70, 584	FaceAlpha property, 443–444, 443f
alternate file input functions,	Dot operator, 285–288	FaceColor property, 450–451
338–345	dot product, 70	Faces, 450
fscanf, 338–339	double, 10–11, 23–25, 62–63, 71,	FaceVertexCData, 450–451
opening and closing, 332–333	106, 177, 265, 384, 401,	factor, 565, 585
read from files, 334-336	404, 468, 477, 545, 566,	factorial, 169, 182, 369, 374-375,
textscan, 338–341	569, 584	585
write/append to files, 336–338	Double precision, 10	false, 21-22, 64, 585
MAT-files, 328–329	Dynamic field name, 289, 308	fclose, 333–334, 337–340, 585
setpref, 348		feof, 334, 585
weboptions, 347		feval, 372, 585
webread, 346–348	E	fgetl, 334-339, 585
with web sites, 345–349	echo, 230, 584	fgets, 334, 585
webwrite, 346–347	Echo-printing, 156–157	fieldnames, 288, 585
writing and reading spreadsheet	Editor, 82f, 230–232, 344	Fields, 277, 284
files, 329–331	Efficient code, writing, 188–189	Field width, 90
date, 261–262, 584	Elements, 38	figure, 98–99, 481, 585
datetick, 458	elfun, 26–27	Figure Window, 95
dbcont, 231, 584	Ellipsis, 11–12	File identifier, 332
dbquit, 231, 584	else clause, 130–132	File input and output (file I/O),
dbstatus, 236	elseif clause, 134–138	101–106, 327–345
dbstep, 231, 584	Empty array, 85–86	appending data to data file, 103
dbstop, 231, 584	Empty vectors, 52–54	load function, 327, 329, 331,
deblank, 255, 584	end, 49, 202, 394, 584	335–336, 338–339
Debugging techniques	End of the file, 334, 338,	lower-level file I/O functions, 327,
checkcode, 228	343–344	331
Editor/Debugger, 230-232	Endpoint, 346	alternate file input functions,
errors types, 228–229	endsWith, 265, 584	338–345
function stubs, 232-233	Equality	fscanf, 338–339
tracing, 229–230	for complex numbers, 546	opening and closing, 332–333
Default, 11	operator for, 19	read from files, 334–336
Default input device, 80	erase, 255–256, 585	textscan, 338–341
Default output device, 81	errorbar, 458	write/append to files, 336–338
deg2rad, 28, 584	Error-checking, 131, 176–179	reading from file, 103–106
delete, 419	error function, 132, 585	save function, 327–328, 331
Delete elements, 53	Error message, 87	writing data to file, 102–103
Delimiter, 259–262	Errors, types, 228–229	File types, 327
demo, 4, 584	eval, 585	find, 64–67, 188, 585
Derived class, 384	Event-driven programming, 419–420,	fix, 26, 106, 585
Destructor functions, 419	485	flip, 50, 585
det, 561, 584	Events, 419–420, 485	fliplr, 50, 585
diag, 552, 584	Executable file, 81	flipud, 50, 106, 585
Diagonal matrix, 551-552	Execute a program, 81	Floating point, 10
diff, 59, 66–67, 573, 584	Execution-time errors, 228–229	floor, 26, 585
Differentiation, 572–573	exit, 4, 585	fopen, 332–333, 335, 337–340,
Dimensions of vectors and matrices,	exp, 28, 215–216, 585	585
47–52	expand, 565, 585	for loop, 153–161, 375, 436
disp, 88–93, 127–129, 132, 286, 327,	Extending a vector, 174	general form, 154
398–399, 545, 584	External file, 80	input in, 156–157
dlmread, 349	Extrapolation, 540–543	iterator variable, 156
dlmwrite, 349	eye, 554, 585	preallocating vectors, 158–159
doc, 4, 584	ezplot, 585	subplot, 159–161
		545P104 155 151

for loop (Continued)	gcf, 585	Help browser, 90
sums and products, finding,	ge, 407	Help command, 84
157–158	General (inductive) case, 373	help topics, 14
format, 11–12, 585	geomean, 532, 534	High-level languages, 81
Format specifier, 88	Geometric mean, 531	hilb function, 71
Formatting, 88	get, 585	histogram, 428, 432–434, 432f, 529
fplot , 371–372, 372 <i>b</i> , 567–568, 567 <i>f</i> ,	GetAccess, 413	586
585	getaudiodata, 513–514, 585	hold, 98–99, 428, 586
fprintf, 88–94, 117, 132, 163, 251,	getframe, 586	hold on, 99, 101
253, 286, 327, 336–339, 341,	ginput, 458, 586	Hybrid languages, 383
545, 585	Global stream, 17	
fread, 348	Global variables, 224	1
frewind, 348	gong, 511	i, 16, 586
fscanf, 338-339, 585	graph2d, 95	Identifier names, 9
fseek, 348	graph3d, 95	Identity matrix, 553-554
func2str, 370-371, 585	Graphical User Interface	if-else statement, 130-132, 374-375
Function arguments, 14–15, 55–59	Development Environment	if statement, 125-130
function call, 107	(GUIDE), 481	nested for loops and, combining,
Function functions, 359, 369–372	Graphical user interfaces (GUIs), 420	166–168
Function handles, 359, 367–373	callback functions, 491f	imag, 586
Functions, 383	editable text box, 487f	image, 470, 475, 479f, 586
anonymous functions, 367-369	multiple callback functions,	Image files, 477-480
calling, 14–15, 109–111	490–491	Image processing
commands and, 116–117	objects, 384, 393–420	alternate number types for image
definitions, 107-109, 376	button groups, 497-499	matrices, 480
function handles, 367-373	push buttons, 484–494	colormaps, 468–474
with local variables, 114–115	sliders, 484–494	image files, 477-480
nested functions, 366-367	text boxes, 484-494	RGB matrices (see True color
passing structures to, 287-288	units property, 484	matrices)
recursive functions, 373-377	SelectedObject property, 497	true color matrices, 468, 474-477
stubs, 232-233	static text box, 483f	imagesc, 514
subfunctions, 213-215	Visible property, 482	im2double, 586
user-defined	Graphics	imfinfo, 513
categories, 201–209	core objects, 444-452	imread, 477, 586
does not return any values,	objects, 384–393	imshow, 478, 586
206–207	and plot properties, 385-393	imwrite, 477, 586
function definition, 202-203,	primitives, 444–445	Index, 40
206	Graphics objects, 444–452	Index vector, 41, 312-315
passing arguments, 208–209	grid, 98–99, 428, 439, 586	ind2sub function, 71
returns more than one value,	groot, 385, 482	inf, 16, 339, 586
202–206	gt, 407	Infinite loop, 169
that returns values, 207–208	gtext, 447, 458, 586	Infinite recursion, 374
variable number of arguments,	guihandles, 514	Inheritance, 384
359–365	GUIs. See Graphical user interfaces	handle classes, 403-413
input arguments, 360–362	(GUIs)	subclasses, 401-403
output arguments, 362–365		value classes, 403-413
fwrite, 348	Н	Inner dimensions, 68
fzero, 372–373, 585	handel, 384, 511	Inner functions, 366
	Handle classes, 384, 403-413	Inner loop, 161
G	harmmean, 532, 534	Inner parentheses, 13
gallery function, 71	Harmonic mean, 531	Inner product, 70
Gauss-Jordan method, 562	help, 4, 14, 26, 43, 97–99, 111, 117,	input, 85–89, 93–94, 143–144, 249,
gca, 585	204, 214–215, 586	253, 586

Input arguments, 359–362	J	logical true/false, 62-65, 67, 72,
Instances, 384	j, 16, 587	129–130, 143
Instantiation, 384	Javascript Object Notation (JSON),	logical vectors, 62–67
int, 573, 586	346–348	loglog, 434–435, 587
int8, 10, 586	jet, 469, 471 <i>f</i> , 587	log2, log10, 28
int16, 10, 586	join, 263–264, 587	Log scales, 434–435
int32, 10, 23–25, 177, 586	jsondecode, 347–348	logspace, 40, 587
int64, 10, 586	jsonencode, 347–348	lookfor, 4, 84, 587
Integers, error-checking for,	Jsonencode, 547-546	Looping statements
177–179	K	for loop, 154–161
Integration, 570–572		input, 156–157
Interpolation, 540–543	Keywords, 9	iterator variable, 156
Interpreter, 81–82		preallocating vectors, 158-159
intersect, 586	L	subplot, 159–161
intmax, 23, 586	laughter, 511	sums and products, 157–158
intmin, 23, 586	le, 407	nested for loops, 161–168
int2str, 266, 586	Leading blanks, 90, 249	timing, 189–191
inv, 556–557, 559, 563, 586	legend, 98–99, 101, 428, 587	vectorizing, 179–189
isa, 586	length, 47–48, 72, 86, 107, 587	sums and products, 180–183
isbanded, 556, 586	limit, 574, 587	writing efficient code, 188–189
iscellstr, 284, 586	line, 384–385, 445, 446 <i>f</i> , 587	while loops, 168–179
	background color, 447f	counting, 174–175
ischar, 145, 264, 586 iscolumn, 145	modified edge color, 447f	input in, 172–174
	text box, 447f	multiple conditions, 170
isdiag, 556, 586	use of, 446f	•
isempty, 143–144, 178, 250,	Linear algebraic equations, 557–563	reading from file, 170–172
586	augmented matrix, 562–563	Loop variable, 154
isequal, 65, 142, 188, 586	Reduced Row Echelon Form, 562	lower, 256, 587
isfield, 288–289, 586	Symbolic Math Toolbox TM , 551	Lower-level file I/O functions, 327,
isfloat, 145	2 x 2 systems, 559–561	331
is function, 142–145, 264–265	Linear indexing, 45	alternate file input functions,
isinteger function, 145	Line types, 98	338–345
iskeyword, 144–145, 586	linspace, 39–40, 87–88, 587	fscanf, 338–339
isletter, 142, 188, 264, 586	a. <u>I</u> a	opening and closing, 332–333
islogical function, 145	listdlg, 140–142, 141 <i>f</i> , 587	fclose, 333–334
ismember, 535, 586	Listeners, 419–420	file identifier, 332
isnumeric function, 145	Live Editor, 233–234, 234–235f	fopen, 332–333
isreal, 145, 545–546, 587	Live script, 80, 233–237	permission string, 332
isrow function, 145	load, 102–104, 106, 117, 327, 329,	read from files, 334–336
issorted, 587	331, 335–336, 338–339, 587	fgetl, 334–336
issortedrows, 311, 587	Locale setting, 26	fgets, 334
isspace, 264, 587	Local functions, 115–116, 213–215	fscanf, 338–345
isstr function, 145	Local variables, 114–115, 222–223	textscan, 338–345
isstring, 264, 587	log, 28, 587	textscan, 338–341
isStringScalar, 264–265, 587	log2, 587	write/append to files, 336-338
isstrprop, 265, 587	log10, 587	Lower triangular matrix, 554–555
isstruct, 288, 587	Logarithm, 28	lt, 407
issymmetric, 556, 587	logical, 11, 19–20, 188, 587	
istril, 556, 587	Logical arrays, 64, 71	M
istriu, 556, 587	Logical built-in functions, 64–67	Machine language, 81
isvarname function, 145	Logical errors, 228–229	Maclaurin series, 216
isvector function, 145	Logical expressions, 19	magic function, 71
Iterate, 39	Logical indexing, 63	Main function, 213–215, 224
Iterator variable, 154, 156	Logical operators, 19, 21, 22t	Main program, 210, 216–217, 232

Markers, 98	scope of variables, 115	nargin, 360–361, 377, 394, 396–397,
MAT-files, 328–329	that returns values, 207-208	400, 588
appending variables to, 329	variable scope, 222–227	narginchk, 377
reading from, 329	base workspace, 222	nargout, 364, 588
writing variables, 328–329	global variables, 224	nargoutchk, 377
MathWorks, 28	local variables, 222–223	Natural exponential base, 215–216
MathWorks Cloud, 28–29	persistent variables, 225–227	Natural logarithm, 28
MATLAB Command Window, 4, 5f	Matrix	ndims function, 71
MATLAB Drive, 29	augmentation, 557	Nested for loops, 161–168
MATLAB Mobile, 28–29	elements, 44–46	Nested functions, 359, 366–367
MATLAB Online [™] , 29	multiplication, 68–71	Nested if-else statements, 132-138
MATLAB programs, 4	operations, 551–557, 562–563	Nested parentheses, 13
algorithms, 80-81	properties, 551–557	Nested structure, 297-300
code cells, 235–237	square, 551–556	newline, 246, 588
commands and functions, 116–117	three-dimensional, 54–55	Newline character, 89, 246
debugging techniques	variables, 42–46	nthroot, 27–28, 588
checkcode, 228	max, 56–58, 188, 436, 528–529, 587	numden, 566–567, 588
Editor/Debugger, 230–232	maxk, 529, 587	numel, 48, 72, 588
errors types, 228–229	mean, 529–532, 587	Numerical expressions, 11–18
function stubs, 232–233	median, 533–534, 587	Numerical functions, 26–28
tracing, 229–230	menu, 140–141, 145, 587	num2str, 266, 588
file input/output, 101–106	Menu-driven modular program,	
appending data to data file, 103	215–222	0
reading from file, 103-106	mesh, 441, 588	Object code, 81
writing data to file, 102–103	meshc, 458	Object handle, 384
input function, 85–88	meshgrid, 71, 444f, 588	Object-oriented programming (OOP)
live script, 233–237	methods, 384, 394–396, 588	
local functions, 213–215	access methods, 416–418	abstract data types, 384
local functions in scripts,	attributes, 418–419	built-in data types, 384
=	constructor functions, 415–416	class definition, 384, 394–398
115–116		classes, 10, 383–384
menu-driven modular program,	destructor functions, 419	constructor functions, 394,
215–222	min, 56–57, 188, 436, 528–529, 588	415–416
modular programs, 210–212	mink, 529, 588	graphics and plot properties,
output function, 88–93	mlock, 237	385–393
scripts, 81–84	Mnemonic, 9	inheritance, 384
customizing plots, 94-101	mobiledev, 28–29, 588	handle classes, 403-413
documentation, 83-84	mod, 26–27, 588	subclasses, 401–403
with input and output, 93-94	mode, 102, 533, 588	value classes, 403–413
user-defined functions, 106–115	Modular approach, 80	instances, 384
calling from script, 111-112	Modular programs, 210–212,	objects, 393–420
calling function, 109–111	215–222	user-defined classes and objects
categories, 201–209	movegui, 482, 588	
does not return any values,	movie, 588	access methods, 416–418
206–207	Multiple arguments, 112–114	advantages, 420
	1 0	class definition, 384, 394–398
function definition, 202–203,	Multiple components properties,	constructor functions, 415–416
206	508	destructor functions, 419
function definitions, 107–109	Multiplication, complex numbers,	method attributes, 418-419
local variables, 114–115	547–548	value classes, 384, 403-413
passing arguments, 208–209	munlock, 237	Objects, 384, 393-420
passing multiple arguments,		ode23, 377
112–114	N	ode45, 377
returns more than one value,	namelengthmax, 9, 588	odeset, 377
202–206	NaN, 16, 588	One-dimensional array, 38
	, 10, 500	one annenoional anay, 50

ones, 44, 54, 60, 64, 588	animation, 435-436	R
Open interval, 16	applications, 452–457	rad2deg, 28, 589
Operators	colorbar functions, 441-443	rand, 16–17, 43–44, 54, 589
binary, 12	colormaps, 473-474	randi, 43, 589
dot, 285–288	customizing, 97–98	randn, 17, 589
logical, 19, 21, 22t	file data plotting, 454–457	Random numbers
with numerical expressions,	GUI Figure Window, 495f	global stream, 17
12–14	properties, 436	pseudorandom, 16
precedence rules, 13-14, 22-23,	saving and printing plots,	rand function, 16–17
22t, 67t	457–458	randi function, 17–18
scientific/exponential notation, 13	3D pie chart, 441f	randn function, 17
short-circuit, 21	3D plots, 427, 439–444, 439f	rng function, 16–17
unary, 12	plotyy, 458	seed, 16
Ordinal categorical arrays, 302,	plus, 15, 250, 588	range function, 23-26, 71
311–312	Polar form, 549	Reading from file. See also File input
Ordinary differential equation	polarplot, 549, 588	and output (file I/O)
(ODE), 377	polyder, 572–573, 589	MATLAB programs, 103–106
Ordinary method, 397	polyfit, 540–541, 589	while loops, 170–172
Outer dimensions, 68	polyint, 572, 589	real, 589
Outer functions, 366	Polynomials, 539, 548	Record, 278
Outer loop, 161	poly2sym, 564–565, 589	recordblocking, 513, 589
outer product, 70–71	polytemp, 541	rectangle, 448–449f, 589
Output arguments, 359–360,	polyval, 539, 541–542, 548–549,	Recursive functions
362–365	572–573, 589	base case, 373
Output, scripts with, 93–94	Preadon as 12	defined, 359, 373
Output statements, 88–93	Precedence, 13	general (inductive) case, 373
Overloading functions, 398–400	pretty, 567, 589	infinite recursion, 374
P	Primitive objects, 384–385	Reduced Row Echelon Form, 562
•	print, 589	Relational expressions, 19–23
Parent, 384	Printing vectors and matrices, 91–93	logical operators, 19, 21, 22t
parula, 469–470, 470f, 473–474, 588	Private access, 413, 418	operator precedence rules, 22–23,
pascal function, 71	Procedural programming language, 383	22 <i>t</i>
patch, 449–452, 451–452f, 588	prod, 56–57, 182, 188, 529–531, 589	relational operators, 19
pause function, 191	profile, 589	with vectors and matrices, 62–64
Permission string, 332	profile off, 191	Relational operators, 19
Persistent variables, 225–227	profile on, 191	rem, 26–27, 589
pi, 15–16, 588	profile viewer, 191	repelem, 52, 589
pie, 433–434, 588	Programming concepts, 530 <i>b</i>	repmat, 51, 589
pie3, 439, 588	Programs. See MATLAB programs	Reserved words, 9
Pie charts, 428, 432–434, 433–434 <i>f</i> , 438–439	Prompting, 4, 80	reshape, 49–50, 589
exploding, 438 <i>f</i>	properties, 384, 394–396, 413–415,	RESTful, 346–347
labels from file data, 456f	589	Return value(s), 14–15
pink, 588	Protected access, 413, 418	rgb2gray, 589
Pixels, 467–468	Pseudorandom, 16	RGB matrices, 468, 474, 480
Place holder, 88–89	Public access, 413, 418	rmfield, 286–287, 589
play, 588	Publishing code, 235–237	rng, 16–17, 589 roots, 385, 548, 589
plot, 95–98, 550–551, 588	Push buttons, 484–494	rot90, 50–51, 589
plot3, 588. See also Three-		round, 26–27, 589
dimensional plots	Q	Roundoff errors, 23
Plot symbols, 98	quad, 571–572, 589	Row vector, 38–41
Plotting, 549–550. <i>See also</i> Advanced	Query parameters, 346, 348–349	rref, 562–563, 589
plotting techniques	quit, 4, 589	Run a program, 81
1 0 1	• ' '	ran a program, or

Running sum, 57, 157	Simpson's method, 571–572	Statistics, 528
Runtime errors, 228–229	Simulink toolboxes, 593	std, 532–533, 590
	sin, 14, 26, 100, 101f, 106, 131,	stem, 428–432, 429f, 590
5	370–372, 370f, 372f, 435–436,	stem3, 439, 590
Sampling frequency, 511	590	Step value, 39
Saturation arithmetic, 24	sind, 26, 131, 590	strcat, 251, 590
save, 102–104, 106, 327–328, 331,	single, 10, 590	strcmp, 256–257, 590
589	sinh, 26, 590	strcmpi, 590
Scalar and array operations, 59–62	size, 47–48, 136, 590	str2double, 266–268, 336, 590
Scalar multiplication, 60	Sliders, 484–494	strfind, 258, 590
Scalars, 21, 38	App Designer, 505–511	str2func, 371, 452-454, 590
Scientific/exponential notation, 13	GUI, 494–496	string, 247, 250–251, 590
Scope of variables, 115	solve, 568, 590	String arrays, 245–249, 262–263
Script files, 4, 81–83	sort, 306, 309-311, 590	Strings, 11, 18–19
Scripts, 79–84	Sorting, 278, 304–312	convert numbers to strings,
customizing plots, 94–101	ascending/descending, 304, 306	265–268
documentation, 83–84	categorical arrays, 311-312	is function, 264–265
with input and output, 93–94	issortedrows function, 311	operations on, 250–251
local functions in, 115–116	programming concept, 305b	changing case, 256
user-defined function from,	selection sort, 305–306, 305b	comparsion, 256–258
111–112	sortrows function, 310–311	creating and concatenating,
Seed, 16	strings, 309-312	251–255
SelectedObject property, 497	tables, 310–311	find, replace and separate,
Selection sort, 305–306, 305b	vector of structures, 306-309	258–262
Selection statements, 125	sortrows, 310–311, 590	remove trailing/leading blanks,
if-else statement, 130–132	sound, 590	255
if statement, 125–130	Sound files, 511–514	sorting, 309–312
is functions, 142–145	Sound wave, 511	strings, 250, 262, 267–268, 590
nested if-else statements, 132–138	sphere, 590	String scalar, 246–247
switch statement, 138–142	functions, 441, 474f	strip, 255, 590
semilogx, 434–435, 589	mesh plot, 442f	strjoin, 263, 283, 591
semilogy, 434–435, 435 <i>f</i> , 589	surf plot, FaceAlpha modified,	strlength, 247, 250, 262, 283, 591
sendmail, 348	442–443f	strncmp, 257, 591
Sentinel, 170–171	spiral, 440–441, 590	strncmpi, 257, 591
set, 590	splat, 511	str2num, 266–268, 590
SetAccess, 413	Spreadsheet files, 329–331	strrep, 259, 261, 591
setdiff, 590	sprintf, 251–255, 253f, 428,	strsplit, 263, 283–284, 591
Set operations	590	strtok, 259, 261–262, 336, 375, 591
intersect function, 535–538	sqrt, 27–28, 532–533, 590	strtrim, 255, 591
ismember function, 537–538	Square matrix, 43, 551–556	struct, 284–285, 591
issorted function, 535	Standard deviation, 532–533	Structures, 277, 284-300
setdiff function, 535–536	Standard error, 332-333	disp, 286
setxor function, 535–536	Standard input, 332-333	dot operator, 285–288
union function, 535–536	Standard output, 332–333	fieldnames, 288
unique function, 535–536	startsWith, 265, 590	fields, 284
setpref, 348	Statistical functions	fprintf function, 286
setxor, 590	geometric mean, 531	index vectors, 312–315
shiftdim function, 71	harmonic mean, 531	isfield, 288
Short-circuit operators, 21	mean, 529–532	isstruct, 288
Side effects, 207	median, 533–534	nested structure, 297–300
sign, 26–27, 56, 66–67, 184, 590	mode, 533	rmfield, 286–287
Simplification functions, 565–566	standard deviation, 532-533	sorting vector of structures,
simplify, 590	variance, 532–533	306–309
,,		

struct function, 284-285	Throwing an error, 132	User, 6, 85
vector of structures, 289–297	tic/toc, 189–190, 373, 591	User-defined classes and objects
Subclasses, 384, 401–403	timeit, 373, 591	access methods, 416–418
sub2ind function, 71	Timing functions, 189–191, 373	
		advantages, 420
subplot, 159–161, 428–430,	title, 95, 428, 591	class definition, 384, 394–398
434–437, 511, 542–543, 591	toggle, 99	constructor functions, 415–416
file types, 453f	Token, 259–260	destructor functions, 419
subs, 565–566, 591	Toolstrip, 6, 82f	inheritance and handle class,
Subscript, 40	Top-down design approach, 80	401–413
Subscripted indexing, 44	trace, 552, 591	method attributes, 418–419
Substring, 249	Tracing, 229–230	overloading functions and
Subtraction, complex numbers, 546	Trailing blanks, 249	operators, 398–400
sum, 56–58, 63, 71, 188, 293,	Trailing zeros, 90	property definition blocks,
296–297, 529–531, 591	train , 511, 512 <i>f</i>	413–415
summary, 301–302, 591	Transpose, 42	User-defined function, 106–115, 367.
Sums and products	Trapezoidal rule, 570–572	See also Functions
finding, 157–158	trapz, 591	calling from script, 111–112
vectorizing, 180–183	Tridiagonal matrix, 554	calling function, 109-111
Superclass, 384, 401	Trigonometric functions, 26	categories, 201–209
surf, 441, 591	tril, 555, 591	does not return any values,
surfc, 458	trimmean, 532	206–207
Switch statement, 138-142	triu, 555, 591	function definition, 107-109,
sym, 563–564, 591	true, 21-22, 64, 399-400, 591	202–203, 206
Symbolic mathematics, 551	True color matrices, 468, 474-477	local variables, 114–115
defined, 528	Truth table, 22, 22t	passing arguments, 208–209
expressions, 563–565, 567	try/catch functions, 145	passing multiple arguments,
simplification functions, 565–566	type, 82–83, 102–103, 335, 337,	112–114
solving equations, 568–569	591	returns more than one value,
variables, 563–565	Type casting, 23–26	202–206
symmetric, 555–556	Type ranges, 23–26	output arguments, 203, 205
sym2poly, 564–565, 591	1) pe langes, 23-20	scope of variables, 115
syms, 564, 591	U	that returns values, 207–208
Syntax errors, 228		User-defined handle class, 404–405
Sylitax Cirols, 220	uibuttongroup, 481, 497, 514, 591	doct defined natione class, 404–405
T	uicontrol, 482, 505, 591	V
-	uifigure, 505	•
Tab completion, 15	UI Figure Functions, 505–508	Value classes, 384, 403–413
table function, 302–303, 591	UI Figure Window, 501–502,	var, 532, 592
Tables, 278, 302–304	505–506 <i>f</i>	varargin, 361–362, 377, 396–397,
Temporary variable, 128	uilabel, 505	592
Text. See also Character; Character	uint8, 10, 468, 592	varargout, 362–363, 365, 592
vectors; Strings	uint16, 10, 591	Variable number of arguments,
convert text to numbers, 265–268	uint32, 10, 591	359–365
operations on, 249–263	uint64, 10, 591	input arguments, 360–362
text, 447, 591	uipanel, 481, 592	output arguments, 362–365
text box, 446–447, 484–494	uislider, 505–506	Variables
textscan, 338–341, 456–457, 591	uitable, 514	assignment statement, 6–11
Three-dimensional bar chart, 440f	Unary operator, 12	decrementing, 9
Three-dimensional matrix, 54-55,	union, 592	identifier names, 9-10
480	unique, 592	incrementing, 8
Three-dimensional pie chart, 441f	Unsigned integer types, 10	initializing, 8
Three-dimensional plots, 427,	Unwinds, 45	MAT-files, 328–329
439–444, 439f	upper, 256, 592	types, 10–11, 23–26
Three-dimensional space, 451–452	Upper triangular matrix, 555	char, 11

Variables (Continued)
classes, 10
integer, 10
logical, 11
single and double, 10
string, 11
unsigned, 10
Variable scope, 222–227
base workspace, 222
global variables, 224
local variables, 222–223
persistent variables, 225-227
Variance, 532-533
Vectorized code, 154, 179-189
Vectorizing, 179–189
selection statements, 184-188
sums and products, 180-183
writing efficient code, 188-189
Vectors and matrices, 38-55
column vectors, 42
dimensions, 47–52
elements, referring and modifying,
40–41
empty vectors, 52-54
extending, 174

as function arguments, 55-59 logical built-in functions, 64–67 loops with, 179-189 matrix multiplication, 68-71 matrix variables, 42-46 preallocating, 158-159 printing, 91-93 relational expressions with, 62-64 row vectors, 38-41 scalar and array operations on, 59-62 of structures, 306-309, 314-315 three-dimensional matrices, 54-55 of variables, 47 Vertices, 450 Visible property, 482



weboptions, 347 webread, 346–348 webwrite, 346–347 While loops, 153–154, 168–179 counting, 174–175 input in, 172–174 multiple conditions, 170 reading from file, 170–172 White space characters, 245–246 who, 9, 328, 592 whos, 9, 592 Workspace Window, 5–8, 10–11, 24, 29, 545 Writing to file, 102–103



xlabel, 95, 428, 592 xlim, 458 xlsread, 329–331, 592 xlswrite, 329–330, 592 xor, 21, 592 xticklabels, 454–455, 455f, 592



ylabel, 95, 428, 592 ylim, 458

7

Zero crossings, 66–67 zeros, 44, 48, 54, 60, 64, 158, 592 zlabel, 439, 592 zlim, 458