1. Record Nr. UNINA9910795958503321

Autore	Magrab Edward B.
Titolo	An engineer's guide to Mathematica / / Edward B. Magrab
Pubbl/distr/stampa	Chichester, England : , : Wiley, , 2014 2014
ISBN	1-119-11855-7 1-118-82125-4
Descrizione fisica	1 online resource (xx, 431 pages) : illustrations
Disciplina	510.285/53
Soggetti	Engineering mathematics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references at the end of each chapters and index.
Nota di contenuto	Preface xiii Table of Engineering Applications xvii Part 1 Introduction 1 Mathematica Environment and Basic Syntax 3 1.1 Introduction 3 1.2 Selecting Notebook Characteristics 4 1.3 Notebook Cells 8 1.4 Delimiters 12 1.5 Basic Syntax 12 1.5.1 Introduction 12 1.5.2 Templates: Greek Symbols and Mathematical Notation 15 1.5.3 Variable Names and Global Variables 18 1.6 Mathematical Constants 19 1.7 Complex Numbers 21 1.8 Elementary, Trigonometric, Hyperbolic, and a Few Special Functions 22 1.9 Strings 25 1.9.1 String Creation: StringJoin[] and ToString[] 25 1.9.2 Labeled Output: Print[], NumberForm[], EngineeringForm[], and TraditionalForm[] 26 1.10 Conversions, Relational Operators, and Transformation Rule 28 1.11 Engineering Units and Unit Conversions: Quantity[] and UnitConvert[] 30 1.12 Creation of CDF Documents and Documents in Other Formats 33 1.13 Functions Introduced in Chapter 1 34 Exercises 35 2 List Creation and Manipulation: Vectors and Matrices 39 2.1 Introduction 39 2.2 Creating Lists and Vectors 39 2.2.1 Introduction 39 2.2.2 Creating a List with Table[] 45 2.2.3 Summing Elements of a List: Total[] 46 2.2.4 Selecting Elements of a List 47 2.2.5 Identifying List Elements Matching a Pattern: Position[] 49 2.3 Creating Matrices 51 2.3.1 Introduction 51 2.3.2 Matrix Generation Using Table[] 54 2.3.3 Accessing Elements of Arrays 55 2.4 Matrix Operations on Vectors and Arrays 56 2.4.1 Introduction 56 2.4.2 Matrix Inverse and Determinant: Inverse[] and Det

[] 57 2.5 Solution of a Linear System of Equations: LinearSolve[] 58 2.6 Eigenvalues and Eigenvectors: EigenSystem[] 59 2.7 Functions Introduced in Chapter 2 61 References 61 Exercises 61 3 User-Created Functions, Repetitive Operations, and Conditionals 69 3.1 Introduction 69 3.2 Expressions and Procedures as Functions 69 3.2.1 Introduction 69 3.2.2 Pure Function: Function[] 74 3.2.3 Module[] 78 3.3 Find Elements of a List that Meet a Criterion: Select[] 80 3.4 Conditionals 82 3.4.1 If[] 82 3.4.2 Which[] 83 3.5 Repetitive Operations 83 3.5.1 Do[] 83 3.5.2 While[] 83 3.5.3 Nest[] 84 3.5.4 Map[] 84 3.6 Examples of Repetitive Operations and Conditionals 85 3.7 Functions Introduced in Chapter 3 92 Exercises 92 4 Symbolic Operations 95 4.1 Introduction 95 4.2 Assumption Options 101 4.3 Solutions of Equations: Solve[] 101 4.4 Limits: Limit[] 105 4.5 Power Series: Series[], Coefficient[], and CoefficientList[] 108 4.6 Optimization: Maximize[]/Minimize[] 112 4.7 Differentiation: D[] 114 4.8 Integration: Integrate[] 120 4.9 Solutions of Ordinary Differential Equations: DSolve[] 126 4.10 Solutions of Partial Differential Equations: DSolve[] 136 4.11 Laplace Transform: LaplaceTransform[] and InverseLaplaceTransform[] 138 4.12 Functions Introduced in Chapter 4 145 References 145 Exercises 146 5 Numerical Evaluations of Equations 151 5.1 Introduction 151 5.2 Numerical Integration: NIntegrate[] 151 5.3 Numerical Solutions of Differential Equations: NDSolveValue[] and ParametricNDSolveValue[] 154 5.4 Numerical Solutions of Equations: NSolve[] 178 5.5 Roots of Transcendental Equations: FindRoot[] 180 5.6 Minimum and Maximum: FindMinimum[] and FindMaximum[] 182 5.7 Fitting of Data: Interpolation[] and FindFit[] 186 5.8 Discrete Fourier Transforms and Correlation: Fourier[], InverseFourier[], and ListCorrelate[] 189 5.9 Functions Introduced in Chapter 5 194 References 195 Exercises 196 6 Graphics 209 6.1 Introduction 209 6.2 2D Graphics 209 6.2.1 Basic Plotting 209 6.2.2 Basic Graph Enhancements 213 6.2.3 Common 2D Shapes: Graphics[] 217 6.2.4 Additional Graph Enhancements 222 6.2.5 Combining Figures: Show[] and GraphicsGrid[] 238 6.2.6 Tooltip[] 241 6.2.7 Exporting Graphics 244 6.3 3D Graphics 244 6.4 Summary of Functions Introduced in Chapter 6 253 References 254 Exercises 254 7 Interactive Graphics 263 7.1 Interactive Graphics: Manipulate[] 263 References 287 Exercises 287 Part 2 Engineering Applications 8 Vibrations of Spring Mass Systems and Thin Beams 293 8.1 Introduction 293 8.2 Single Degree-of-Freedom Systems 294 8.2.1 Periodic Force on a Single Degree-of-Freedom System 294 8.2.2 Squeeze Film Damping and Viscous Fluid Damping 298 8.2.3 Electrostatic Attraction 302 8.2.4 Single Degree-of-Freedom System Energy Harvester 304 8.3 Two Degrees-of-Freedom Systems 307 8.3.1 Governing Equations 307 8.3.2 Response to Harmonic Excitation: Amplitude Response Functions 307 8.3.3 Enhanced Energy Harvester 310 8.4 Thin Beams 315 8.4.1 Natural Frequencies and Mode Shapes of a Cantilever Beam with In-Span Attachments 315 8.4.2 Effects of Electrostatic Force on the Natural Frequency and Stability of a Beam 318 8.4.3 Response of a Cantilever Beam with an In-Span Attachment to an Impulse Force 323 References 326 9 Statistics 327 9.1 Descriptive Statistics 327 9.1.1 Introduction 327 9.1.2 Location Statistics: Mean[], StandardDeviation[], and Quartile[] 327 9.1.3 Continuous Distribution Functions: PDF[] and CDF[] 329 9.1.4 Histograms and Probability Plots: Histogram[] and ProbabilityScalePlot [] 331 9.1.5 Whisker Plot: BoxWhiskerChart[] 332 9.1.6 Creating Data with Specified Distributions: RandomVariate[] 334 9.2 Probability of Continuous Random Variables 334 9.2.1 Probability for Different Distributions: NProbability[] 334 9.2.2 Inverse Cumulative Distribution Function: InverseCDF[] 337 9.2.3 Distribution Parameter Estimation: EstimatedDistribution[] and

FindDistributionParameters[] 337 9.2.4 Confidence Intervals: CI[] 340 9.2.5 Hypothesis Testing: LocationTest[] and VarianceTest[] 342 9.3 Regression Analysis: LinearModelFit[] 343 9.3.1 Simple Linear Regression 343 9.3.2 Multiple Linear Regression 347 9.4 Nonlinear Regression Analysis: NonLinearModelFit[] 351 9.5 Analysis of Variance (ANOVA) and Factorial Designs: ANOVA[] 354 9.6 Functions Introduced in Chapter 9 358 10 Control Systems and Signal Processing 359 10.1 Introduction 359 10.2 Model Generation: State-Space and Transfer Function Representation 359 10.2.1 Introduction 359 10.2.2 State-Space Models: StateSpaceModel[] 360 10.2.3 Transfer Function Models: TransferFunctionModel[] 362 10.3 Model Connections Closed-Loop Systems and System Response: SystemsModelFeedbackConnect[] and SystemsModelSeriesConnect[] 363 10.4 Design Methods 369 10.4.1 Root Locus: RootLocusPlot[] 369 10.4.2 Bode Plot: BodePlot[] 371 10.4.3 Nichols Plot: NicholsPlot[] 372 10.5 Signal Processing 374 10.5.1 Filter Models: ButterworthFilterModel[], EllipticFilterModel[], ... 374 10.5.2 Windows: HammingWindow[], HannWindow[], ... 381 10.5.3 Spectrum Averaging 385 10.6 Aliasing 388 10.7 Functions Introduced in Chapter 10 390 Reference 391 11 Heat Transfer and Fluid Mechanics 393 11.1 Introduction 393 11.2 Conduction Heat Transfer 394 11.2.1 One-Dimensional Transient Heat Diffusion in Solids 394 11.2.2 Heat Transfer in Concentric Spheres: Ablation of a Tumor 398 11.2.3 Heat Flow Through Fins 401 11.3 Natural Convection Along Heated Plates 405 11.4 View Factor Between Two Parallel Rectangular Surfaces 408 11.5 Internal Viscous Flow 411 11.5.1 Laminar Flow in Horizontal Cylindrical Pipes 411 11.5.2 Flow in Three Reservoirs 412 11.6 External Flow 416 11.6.1 Pressure Coefficient of a Joukowski Airfoil 416 11.6.2 Surface Profile in Nonuniform Flow in Open Channels 419 References 423 Index 425.

Sommario/riassunto

"Provides the tools for the reader to generate Mathematica programs to obtain numerical solutions to a wide range of engineering topics. An Engineer's Guide to Mathematica provides the tools to be able to generate verifiably correct Mathematica programs that obtain symbolic and numerical solutions to a wide range of engineering topics, and to display the numerical results with annotated graphics and, when appropriate, interactive graphics. The first part of the book introduces the fundamentals of Mathematica's syntax and a subset of commands useful in solving engineering problems. The second part uses the fundamentals to obtain numerical solutions in a wide range of engineering specialties, including vibrations, fluid mechanics, heat transfer, controls and signal processing, and engineering statistics. Provides the tools for the reader to generate Mathematica programs to obtain numerical solutions to a wide range of engineering topics Introduces the fundamentals of Mathematica's syntax Contains examples covering vibrations, fluid mechanics and aerodynamics, heat transfer, controls and signal processing, optimization, and structures Includes exercises ranging in complexity. Accompanied by a website hosting a solutions manual".
"Provides the tools for the reader to generate Mathematica programs to obtain numerical solutions to a wide range of engineering topics.