

LabVIEW for Engineers

Ronald W. Larsen



About ESource

Your Introductory Engineering Course—Your Way

Welcome to ESource, Prentice Hall's Introductory Engineering series. Over 25 modules in this series cover topics frequently taught in introductory engineering courses. Topics include an introduction to the various fields of engineering, design and problem solving skills, communication and teamwork, computer applications such as MATLAB and Mathcad, an introduction to engineering graphics and visualization, and more. All the books in the ESource series are written by educators specifically for freshman/first-year students. A complete list of all of our ESource authors and their respective backgrounds is available at www.prenhall.com/esource.

Customize

Every book in this series is available separately or packaged together at a discount to students—or, using our electronic customization program—instructors can create their own customized ESource textbook, selecting any combination and sequence of chapters from any of the books in the series. Plus, instructors can add their own material to the book as well (syllabi, course notes, etc.) For more information, visit www.prenhall.com/esource.

ESource Access

Instructors who choose to bundle two or more texts from the ESource series or use a customized ESource textbook can provide their students with an on-line library of selected ESource content—ESource Access. Student access codes are valid for six months after initial registration. Contact your local Prentice Hall sales representative for more information.

Classroom and Instructor Resources

A wealth of resources are available to adopting instructors, including PowerPoints and Instructors Manuals. Visit www.prenhall.com/esource for more information.

LabVIEW for Engineers uPDF eBook

Table of Contents

Cover

Cover1

Contents

ESource Reviewers

Chapter 1: Introduction

1.1 What is LabVIEW

1.2 Assumptions

1.2.1 Target Audience

1.2.2 LabVIEW Versions

1.3 Conventions in the Text

1.4 LabVIEW VIs

1.5 Starting LabVIEW

1.5.1 The LabVIEW Editing Environment

1.5.2 The Tools Palette

1.6 Creating a VI

1.6.1 Developing a Simple Virtual InstrumentExample 1

1.7 LabVIEW Menus

1.7.1 File Menu

1.7.2 Edit Menu

1.7.3 View Menu

1.7.4 Project Menu

1.7.5 Operate Menu

1.7.6 Tools Menu

1.7.7 Window Menu

1.7.8 Help Menu

Key Terms

Summary

Table of Contents

Self-Assessment

Chapter 2: LabVIEW Basics

2.1 Opening a VI

2.2 Basic Math in LabVIEW Using Functions

2.2.1 Example: Using a LabVIEW Math Function

2.3 Programming Preview: While Loops

2.4 Dataflow Programming

2.5 Data Types and Conversions

2.6 Documenting VIs

2.6.1 Labeling VIs

2.6.2 Descriptive Information

2.6.3 Descriptions with SubVIs

2.7 Printing a VI

2.8 Saving Your Work

2.8.1 Using the Save <VI name> As dialog

2.9 Closing a VI

Key Terms

Summary

Self-Assessment

Problems

Chapter 3: LabVIEW Math Functions

3.1 Introduction

3.2 Basic Math Functions

3.2.1 Basic Math Functions

3.2.2 Less Commonly Used Numeric Functions

3.3 Trigonometric and Hyperbolic Trigonometric Functions

3.4 Exponential and Logarithm Functions

3.5 Boolean and Comparison Functions

3.6 Programming Preview: Debugging

3.6.1 Fixing Broken Wires

3.6.2 Using the Broken Run Button

Table of Contents

3.6.3 Execution Highlighting

3.6.4 Single-Step Execution

3.6.5 Probes

3.6.6 Breakpoints

Key Terms

Summary

Self-Assessment

Problems

Chapter 4: Matrix Math Using LabVIEW

4.1 Working with Matrices and Arrays in LabVIEW

4.1.1 Should You Use Arrays or Matrices?

4.2 Extracting a Subarray from a Larger Array or Matrix

4.3 Adding Arrays

4.4 Transpose Array

4.5 Multiplying an Array by a Scalar

4.6 Matrix Multiplication

4.7 Element by Element Multiplication

4.8 Condition Number

4.9 Matrix Determinant

4.10 Inverse Matrix

4.11 Solving Simultaneous Linear Equations

4.12 Programming Preview: For Loops

Key Terms

Summary

Self-Assessment

Problems

Chapter 5: Data Acquisition with LabVIEW

5.1 Overview of Data Acquisition

5.2 Sensors, Signals and Signal Conditioning

5.2.1 Signal Conditioning

Table of Contents

5.3 Data Acquisition Hardware

5.3.1 Types of Signals

5.3.2 Differential or Single-Ended Inputs

5.3.3 Analog to Digital Converters

5.3.4 Sample Rate

5.3.5 Installing a Data Acquisition System

5.4 Using LabVIEW to Collect Data

5.4.1 Configuring Tasks Using the Measurement and Automation Explorer

5.4.2 Acquiring Data with LabVIEW

Key Terms

Summary

Self-Assessment

Problems

Chapter 6: Getting Data Into and Out of LabVIEW without Data Acquisition

6.1 Introduction

6.2 Writing LabVIEW Data to a Spreadsheet File

6.2.1 Format Strings

6.3 Writing LabVIEW Data to a Measurement File

6.4 Reading a LabVIEW Measurement File

6.5 Reading a Spreadsheet File in LabVIEW

6.5.1 Pulling Single Columns or Rows from 2D Arrays

6.6 Using Spreadsheet Data to Initialize a Matrix Control

Key Terms

Summary

Self-Assessment

Problems

Chapter 7: Graphing with LabVIEW

7.1 Introduction

7.2 Using Waveform Charts

7.2.1 Waveform ChartsPoint-by-Point Plotting

7.2.2 Waveform ChartsArray Plotting

Table of Contents

7.2.3 Using the Waveform Chart with Data Acquisition

7.2.4 Displaying Multiple Curves on a Waveform Chart

7.3 Using Waveform Graphs

7.3.1 Comparing the Waveform Charts and Waveform Graphs

7.3.2 Plotting Multiple Curves Using Waveform Graphs

7.3.3 Data Acquisition and Waveforms

7.4 Modifying Graph Features

7.5 Generating 1D Arrays for Graphing

7.6 Putting LabVIEW Graphs to Work

7.7 Using XY Graphs2D Plotting

7.8 3D Graphing

7.8.1 A Look Ahead

7.9 Getting Graphs onto Paper and into Reports

Key Terms

Summary

Self-Assessment

Problems

Chapter 8: Data Analysis Using LabVIEW VIs

8.1 Introduction

8.2 Basic Statistics

8.3 Interpolation

8.4 Curve Fitting

8.5 Regression

8.5.1 Linear Fit

8.5.2 Gaussian Fit

8.5.3 Polynomial Regression

Key Terms

Summary

Self-Assessment

Problems

Chapter 9: Programming in LabVIEW

Table of Contents

9.1 Introduction

9.2 LabVIEW Programming Basics, Expanded

9.2.1 Front Panel: Controls and Indicators

9.2.2 Block Diagram: Nodes, Terminals, and Wires

9.2.3 SubVIs

9.2.4 LabVIEW Projects

9.3 Structures

9.3.1 While Loop

9.3.2 For Loop

9.3.3 Shift Registers Accessing Values from the Previous Loop Iteration

9.3.4 Case Structures

9.3.5 Sequence Structures

9.3.6 Formula Node

9.3.7 MathScript

Key Terms

Summary

Self-Assessment

Problems

Chapter 10: Looking Forward: Advanced Math Using LabVIEW VIs

10.1 Introduction

10.2 Working with Polynomials

10.3 Statistics: Hypothesis Testing

10.4 Differentiation

10.5 Integration

10.6 RungeKutta Integration

10.7 Exponential Filter

10.8 Spectral Analysis

10.9 Monte Carlo Simulation

10.10 PID Controller

Appendix: Printing VIs

Index

Table of Contents