STARTING OUT WITH

Visual C#®

Fifth Edition

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Haywood Community College

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Preface

Welcome to *Starting Out with Visual C#*, Fifth Edition. This book is intended for an introductory programming course and is ideal for students with no prior experience. Students who are new to programming will appreciate the clear, down-to-earth explanations and the detailed walk-throughs that are provided by the hands-on tutorials. More experienced students will appreciate the depth of detail as they learn about the .NET Framework, databases, Language-Integrated Query, and other topics.

As with all the books in the *Starting Out With* series, the hallmark of this text is its clear, friendly, and easy-to-understand writing. In addition, it is rich in example programs that are concise and practical. The programs in this book include short examples that highlight specific programming topics, as well as more involved examples that focus on problem solving. Each chapter provides numerous hands-on tutorials that guide the student through each step of the development of an application. In addition to detailed, step-by-step instructions, the tutorials also provide the application's completed code and screen captures of the completed forms.

New to This Edition

The biggest changes in this edition appear in the last half of the book. Some of the chapters have been reorganized, and two new chapters have been added. Here is a summary of the reorganization:

- **The ImageList control is now covered along with Arrays and Lists in Chapter 7.** Since an ImageList is a collection of images, it is fitting that this control be covered in the same chapter as Arrays and Lists.
- **Chapter 8 has been split into two chapters, with new material added to both of the resulting chapters.** In this edition, Chapter 8 is titled *Text Processing* and Chapter 9 is titled *Structures, Enumerated Types, and Dictionaries*.
- **Two new chapters have been added.** In this edition, Chapter 13 is titled *Delegates and Lambda Expressions* and Chapter 14 is titled *Language-Integrated Query (LINQ)*.

An abundance of new topics and improvements has been added to this edition:

- **`var` Keyword:** This edition introduces the `var` keyword for variable declaration.
- **Advanced String Formatting:** Chapter 8 includes a new section on formatting strings with the `String.Format` method.
- **Working with Dates and Times:** Chapter 9 includes a new section about working with dates and **times**. The section covers the `DateTime` and `TimeSpan` data types, as well as the DateTimePicker control.
- **Dictionaries:** Chapter 9 includes a new section on the `Dictionary` collection. The student learns to store and work with data as key–value pairs in dictionaries.
- **More Use of Auto-Properties:** In the previous editions, property declarations were almost always written with explicitly declared backing fields, even when the properties were simply used to set and get a value. Where possible, those property declarations have been rewritten as auto-properties.
- **Object Initializer Syntax:** Object initializer syntax is introduced in Chapters 8 and 10 as an alternative way to **declare** and initialize structures and class instances.
- **Static Members:** Chapter 10 has a new section on static fields, properties, methods, and classes.
- **Sealed Classes and Methods:** Chapter 11 has a new discussion on using the `sealed` keyword to prevent classes from being inherited from, and to prevent methods from being overridden.

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- **Extension Methods:** Chapter 11 covers extension methods, which allow you to extend classes that you cannot inherit from, as well as the primitive data types.
- **Interfaces**: Chapter 11 now includes a section on writing and using interfaces.
- **Delegates:** Chapter 13 introduces the student to delegates.
- **Anonymous Methods:** Chapter 13 also introduces anonymous methods, which go hand-in-hand with delegates.
- **Lambda Expressions:** Chapter 13 concludes by showing the student how to use a lambda expression to concisely create a delegate and anonymous method.
- **Language-Integrated Query (LINQ):** Chapter 14 introduces LINQ, and shows how to query simple data structures such as arrays and Lists using **LINQ to Objects**, and how to query databases using **LINQ to SQL**.

A GUI-Based Approach

Beginning students are more motivated to learn programming when their applications have some sort of graphical element, such as a graphical user interface (GUI). Students using this book will learn to create GUI-based, event-driven, Visual C# applications. The Visual Studio environment is used to create forms that are rich with user interface controls and graphical images.

Learn to Use Objects Early, Learn to Write Classes Later

This book explains what an object is very early and shows the student how to create objects from classes that are provided by the .NET Framework. It then introduces the student to the fundamentals of input and output, control structures, methods, arrays and lists, and file operations. Then, the student learns to write his or her own classes and explores the topics of inheritance and polymorphism.

Brief Overview of Each Chapter

Chapter 1: Introduction to Computers and Programming. This chapter begins by giving a very concrete and easy-to-understand explanation of how computers work, how data is stored and manipulated, and why we write programs in high-level languages. In this chapter, the student learns what an object is and sees several examples by studying the objects that make up a program's GUI. The chapter discusses steps in the programming development cycle. It also gives an introduction to the Visual Studio environment.

Chapter 2: Introduction to Visual C#. In this chapter, the student learns to create forms with labels, buttons, and picture boxes and learns to modify control properties. The student is introduced to C# code and learns the organizational structure of namespaces, classes, and methods. The student learns to write simple event-driven applications that respond to button clicks or provide interaction through clickable images. The importance of commenting code is also discussed.

Chapter 3: Processing Data. This chapter introduces variables and data types. It discusses the use of local variables and variables declared as fields within a form class. The student learns to create applications that read input from TextBox controls, perform mathematical operations, and produce formatted output. The student learns about the exceptions that can occur when the user enters invalid data into a TextBox and learns to write simple exception-handling code to deal with those problems. Named constants are introduced as a way of representing unchanging values and creating self-documenting, maintainable code. The student also learns more intricacies of creating graphical user interfaces. The chapter concludes with a discussion and tutorial on using the Visual Studio debugger to locate logic errors by single-stepping through an application's code.

Chapter 4: Making Decisions. In this chapter, the student learns about relational operators and Boolean expressions and is shown how to control the flow of a program

with decision structures. The `if`, `if-else`, and `if-else-if` statements are covered. Nested decision structures, logical operators, and the `switch` statement are also discussed. The student learns to use the `TryParse` family of methods to validate input and prevent exceptions. Radio buttons, check boxes, and list boxes are introduced as ways to let the user select items in a GUI.

Chapter 5: Loops, Files, and Random Numbers. This chapter shows the student how to use loops to create repetition structures. The `while` loop, the `for` loop, and the `do-while` loop are presented. Counters, accumulators, and running totals are also discussed. This chapter also introduces sequential file input and output and using text files. The student learns various programming techniques for writing data to text files and reading the contents of test files. The chapter concludes with a discussion of pseudorandom numbers, their applications, and how to generate them.

Chapter 6: Modularizing Your Code with Methods. In this chapter, the student first learns how to write and call `void` methods as well as value-returning methods. The chapter shows the benefits of using methods to modularize programs and discusses the top-down design approach. Then, the student learns to pass arguments to methods. Passing by value, by reference, and output parameters are discussed. The chapter concludes with a discussion and tutorial on debugging methods with the Visual Studio step-into, step-over, and step-out, commands.

Chapter 7: Arrays and Lists. Arrays and lists are reference-type objects in C# so this chapter begins by discussing the difference between value type and reference type objects in the C# language. Then, the student learns to create and work with single-dimensional and two-dimensional arrays. The student learns to pass arrays as arguments to methods, transfer data between arrays and files, work with partially filled arrays, and create jagged arrays. Many examples of array processing are provided, including examples of finding the sum, average, highest, and lowest values in an array. Finally, the student learns to create `List` objects and store data in them, and use the ImageList control, a data structure for storing and retrieving images.

Chapter 8: Text Processing. This chapter discusses various techniques for working with text. The topics include working with characters, working with substrings, tokenizing strings, and formatting strings.

Chapter 9: Structures, Enumerated Types, and Dictionaries. In this chapter, the student learns to use structures to encapsulate several variables into a single item. The student next learns to create and use enumerated types. Last, the student learns to use the Dictionary collection from the .NET Framework to store and work with data as key–value pairs.

Chapter 10: Introduction to Classes. Up to this point, the student has extensively used objects that are instances of .NET Framework classes. In this chapter, the student learns to write classes to create his or her own objects with fields, methods, and constructors. The student learns how to implement various types of properties within a class, including auto-properties and read-only auto-properties. Creating arrays of objects and storing objects in a `List` are also discussed. A primer on finding the classes in a problem as well as their responsibilities is provided. The chapter shows the student how to create multiple form classes in a project, instantiate those classes, and display them. A tutorial is given where the student creates a multiform application in which the code in one form accesses controls on another form. The chapter concludes by discussing static members and static classes.

Chapter 11: Inheritance, Polymorphism, and Interfaces. The study of classes continues in this chapter with the subjects of inheritance and polymorphism. The topics covered include base classes, derived classes, how constructors functions work in inheritance, method overriding, and polymorphism. Abstract classes and abstract methods are also discussed. The chapter discusses extension methods, and concludes with a section on interfaces.

Chapter 12: Databases. This chapter introduces the student to basic database concepts. The student first learns about tables, rows, and columns and how to create an SQL Server database in Visual Studio. The student then learns how to connect a database to a Visual C# application and display a table in a DataGridView control, a Details view, and other data-bound controls. Finally, the student learns how to write SQL Select statements to retrieve data from a table.

Chapter 13: Delegates and Lambda Expressions. Lambda expressions have become commonplace in C# programming. Before the student can really understand lambda expressions, he or she must first understand delegates and anonymous methods. The goal of this chapter is to build a foundation of knowledge about how delegates and anonymous methods work, and then build an understanding of lambda expressions.

Chapter 14: Language-Integrated Query (LINQ). This chapter begins by introducing the student to LINQ as a tool for querying the data in common data structures such as arrays and Lists, using LINQ to Objects. It discusses both query syntax and method syntax. Several useful LINQ extension methods are also discussed. The chapter concludes with a section on LINQ to SQL and discusses how to use LINQ to query a database.

Appendix A: C# Primitive Data Types. This appendix gives an overview of the primitive data types available in C#.

Appendix B: Additional User Interface Controls. This appendix shows how to create a variety of controls such as ToolTips, combo boxes, scroll bars, TabControls, WebBrowser controls, ErrorProvider components, and menu systems.

Appendix C: ASCII/Unicode Characters. This appendix lists the ASCII (American Standard Code for Information Interchange) character set, which is also the Latin Subset of Unicode.

Appendix D: Answers to Checkpoint Questions. This appendix provides the answers to the Checkpoint questions that appear throughout each chapter in the book.

Appendix E: Installing LINQ to SQL. This appendix shows how to use the Visual Studio Installer to download and install LINQ to SQL.

Organization of the Text

The text teaches Visual C# step by step. Each chapter covers a major set of programming topics, introduces controls and GUI elements, and builds knowledge as the student progresses through the book. Although the chapters can be easily taught in their existing sequence, there is some flexibility. Figure P-1 shows the chapter dependencies. As shown in the figure, Chapters 1–7 present the fundamentals of Visual C# programming and should be covered in sequence. Then, you can move directly to Chapter 8, 9, 10, or 12. Chapter 11 should be covered after Chapter 10. Then Chapter 13 and 14 can be covered in order.

Features of the Text

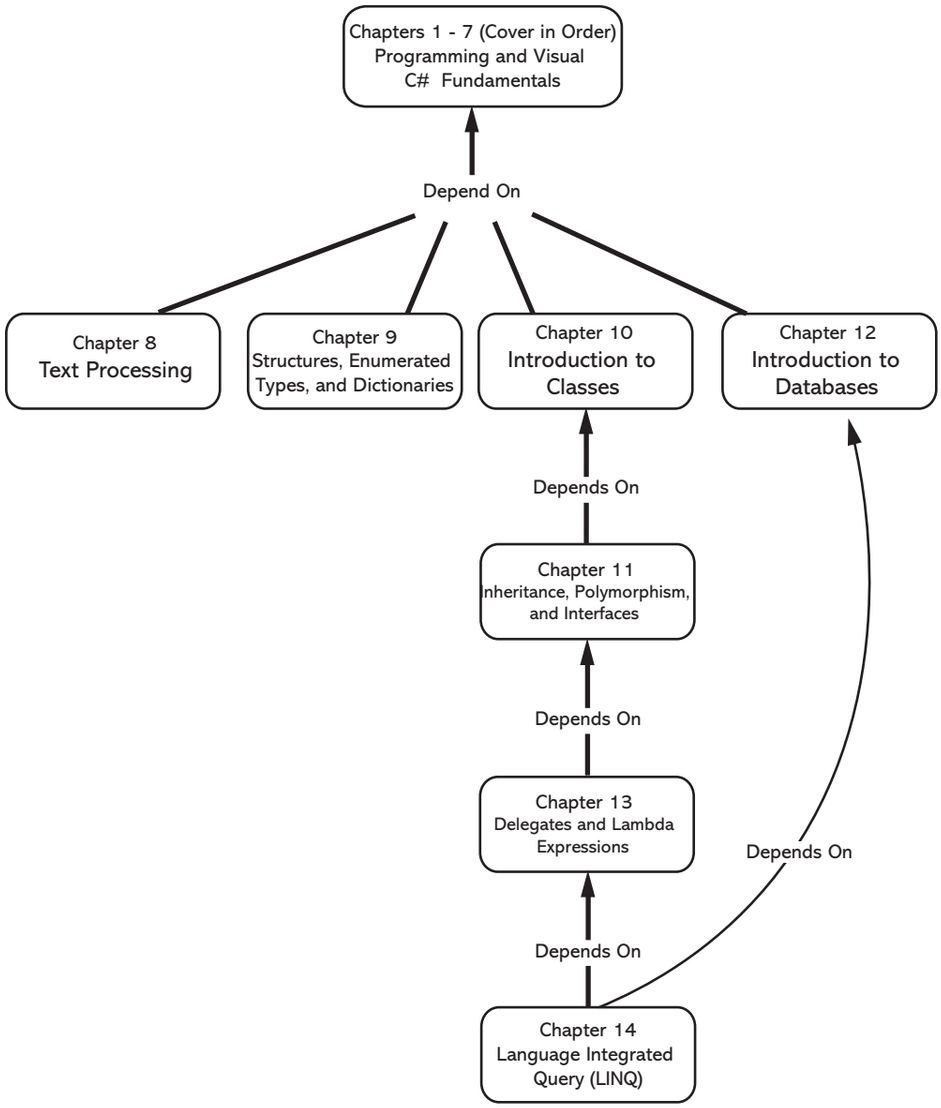
Concept Statements. Each major section of the text starts with a concept statement. This statement concisely summarizes the main point of the section.

Tutorials. Each chapter has several hands-on tutorials that guide the student through the development of an application. Each tutorial provides detailed, step-by-step instructions, as well as the application's completed code and screen captures of the completed forms.

Example Programs. Each chapter has an abundant number of code examples designed to highlight the current topic.

Notes. Notes appear at several places throughout the text. They are short explanations of interesting or often misunderstood points relevant to the topic at hand.

Figure P-1 Chapter dependencies



Tips. Tips advise the student on the best techniques for approaching different programming or animation problems.

Warnings. Warnings caution students about programming techniques or practices that can lead to malfunctioning programs or lost data.

Checkpoints. Checkpoints are questions placed at intervals throughout each chapter. They are designed to query the student's knowledge quickly after learning a new topic. The answers to the Checkpoint questions can be found in Appendix D.

Review Questions. Each chapter presents a thorough and diverse set of Review Questions. They include Multiple Choice, True/False, Algorithm Workbench, and Short Answer.

Programming Problems. Each chapter offers a pool of Programming Problems designed to solidify the student's knowledge of the topics currently being studied.

VideoNote

VideoNotes. Each tutorial in the book has an accompanying online VideoNote that can be accessed on the book's companion Web site www.pearson.com/gaddis. Students can

follow along with the author as he or she works through each tutorial in the videos. Also, one programming problem at the end of each chapter has an accompanying VideoNote that shows the student how to create the solution.

Supplements

Student The following supplementary material is available with the book:

- Source code and files required for the chapter tutorials are available at www.pearson.com/cs-resources
- A complete set of online VideoNotes that take the student through each tutorial in the book. Also, one programming problem from each chapter has an accompanying VideoNote that helps the student create a solution. You may access the VideoNotes by going to www.pearson.com/cs-resources.

Instructor The following supplements are available to qualified instructors:

- Answers to all Review Questions in the text
- Solutions for all Programming Problems in the text
- Completed versions of all tutorials
- PowerPoint presentation slides for every chapter
- Test bank

For information on how to access these supplements, visit the Pearson Education Instructor Resource Center at www.pearsonhighered.com/irc.

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Tony Gaddis is the principal author of the *Starting Out With* series of textbooks. Tony has nearly 20 years experience teaching computer science courses at Haywood Community College in North Carolina. He is a highly acclaimed instructor who was previously selected as the North Carolina Community College Teacher of the Year and has received the Teaching Excellence Award from the National Institute for Staff and Organizational Development.

The *Starting Out With* series includes introductory books using the C++ programming language, the Java™ programming language, Microsoft® Visual Basic®, Microsoft® C#®, Python, Programming Logic and Design, MIT App Inventor, and Alice, all published by Pearson Education.

Attention Students

Installing Visual Studio

To complete the tutorials and programming problems in this book, you need to install Visual Studio 2017, or a later version, on your computer. We recommend that you download Visual Studio Community 2017 from the following website, and install it on your system:

www.visualstudio.com

Visual Studio Community 2017 is a free, full-featured development environment, and is a perfect companion for this textbook.

NOTE: If you are working in your school's computer lab, there is a good chance that **Microsoft Visual Studio** has already been installed. If this is the case, your instructor will show you how to start Visual Studio.

Installing the Student Sample Program Files

The Student Sample Program files that accompany this book are available for download from the book's companion Web site at:

www.pearson.com/cs-resources

These files are required for many of the book's tutorials. Simply download the Student Sample Program files to a location on your hard drive where you can easily access them.

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