教育部高等教育司推荐
国外优秀信息科学与技术系列教学用书

Visual Basic.NET 程序设计导论

（第五版　影印版）

AN INTRODUCTION TO PROGRAMMING USING VISUAL BASIC.NET

(Fifth Edition)

■ David I. Schneider

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David I. Schneider

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前　言

20 世纪末，以计算机和通信技术为代表的信息科学和技术对世界经济、科技、军事、教育和文化等产生了深刻影响。信息科学技术的迅速普及和应用，带动了世界范围信息产业的蓬勃发展，为许多国家带来了丰厚的回报。

进入 21 世纪，尤其随着我国加入 WTO，信息产业的国际竞争将更加激烈。我国信息产业虽然在 20 世纪末取得了迅猛发展，但与发达国家相比，甚至与印度、爱尔兰等国家相比，还有很大差距。国家信息化的发展速度和信息产业的国际竞争能力，最终都将取决于信息科学技术人才的质量和数量。引进国外信息科学和技术优秀教材，在有条件的学校推动开展英语授课或双语教学，是教育部为加快培养大批高质量的信息技术人才采取的一项重要举措。

为此，教育部要求由高等教育出版社首先开展信息科学和技术教材的引进试点工作。同时提出了两点要求，一是要高水平，二是要低价格。在高等教育出版社和信息科学技术引进教材专家组的努力下，经过比较短的时间，第一批引进的 20 多种教材已经陆续出版。这套教材出版后受到了广泛的好评，其中有不少是世界信息科学技术领域著名专家、教授的经典之作和反映信息科学技术最新进展的优秀作品，代表了目前世界信息科学技术教育的一流水平，而且价格也是最优惠的，与国内同类自编教材相当。

这项教材引进工作是在教育部高等教育司和高教社的共同组织下，由国内信息科学技术领域的专家、教授广泛参与，在对大量国外教材进行多次遴选的基础上，参考了国内和国外著名大学相关专业的课程设置进行系统引进的。其中，John Wiley 公司出版的贝尔实验室信息科学研究中心副总裁 Silberschatz 教授的经典著作《操作系统概念》，是我们经过反复谈判，做了很多努力才得以引进的。William Stallings 先生曾编写了在美国深受欢迎的信息科学技术系列教材，其中有多种教材获得过美国教材和学术著作者协会颁发的计算机科学与工程教材奖，这批引进教材中就有他的两本著作。留美中国学者 Jiawei Han 先生的《数据挖掘》是该领域中具有里程碑意义的著作。由达特茅斯学院 Thomas Cormen 和麻省理工学院、哥伦比亚大学的几

位学者共同编著的经典著作《算法导论》，在经历了 11 年的锤炼之后于 2001 年出版了第二版。目前任教于美国 Massachusetts 大学的 James Kurose 教授，曾在美国三所高校先后 10 次获得杰出教师或杰出教学奖，由他主编的《计算机网络》出版后，以其体系新颖、内容先进而倍受欢迎。在努力降低引进教材售价方面，高等教育出版社做了大量和细致的工作。这套引进的教材体现了权威性、系统性、先进性和经济性等特点。

教育部也希望国内和国外的出版商积极参与此项工作，共同促进中国信息技术教育和信息产业的发展。我们在与外商的谈判工作中，不仅要坚定不移地引进国外最优秀的教材，而且还要千方百计地将版权转让费降下来，要让引进教材的价格与国内自编教材相当，让广大教师和学生负担得起。中国的教育市场巨大，外国出版公司和国内出版社要通过扩大发行数量取得效益。

在引进教材的同时，我们还应做好消化吸收，注意学习国外先进的教学思想和教学方法，提高自编教材的水平，使我们的教学和教材在内容体系上，在理论与实践的结合上，在培养学生的动手能力上能有较大的突破和创新。

目前，教育部正在全国 35 所高校推动示范性软件学院的建设和实施，这也是加快培养信息科学技术人才的重要举措之一。示范性软件学院要立足于培养具有国际竞争力的实用性软件人才，与国外知名高校或著名企业合作办学，以国内外著名 IT 企业为实践教学基地，聘请国内外知名教授和软件专家授课，还要率先使用引进教材开展教学。

我们希望通过这些举措，能在较短的时间，为我国培养一大批高质量的信息技术人才，提高我国软件人才的国际竞争力，促进我国信息产业的快速发展，加快推动国家信息化进程，进而带动整个国民经济的跨越式发展。

教育部高等教育司

二〇〇二年三月

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PREFACE

In July 2000, Microsoft announced the .NET initiative. In the announcement, Microsoft chairman Bill Gates said that the goal of .NET is to connect every computing device, from desktop PCs to cell phones, and tie them to the Internet.

Since its introduction in 1991, Visual Basic has beeen the most widely used programming language in the world. The latest incarnation of Visual Basic, called Visual Basic .NET, brings the language into the Internet age by incorporating the .NET Framework. Visual Basic programmers are enthusiastically embracing the new features of the language. Likewise, students learning their first programming language will find VB.NET the ideal tool to understand the development of computer programs.

My objectives when writing this text were as follows:

1. *To develop focused chapters.* Rather than covering many topics superficially, I concentrate on important subjects and cover them thoroughly.
2. *To use examples and exercises that students can appreciate and with which they can relate, and feel comfortable.* I frequently use real data. Examples do not have so many embellishments that students are distracted from the programming techniques illustrated.
3. *To produce compactly written text that students will find both readable and informative.* The main points of each topic are discussed first, and then the peripheral details are presented as comments.
4. *To teach good programming practices that are in step with modern programming methodology.* Problem-solving techniques and structured programming are discussed early and used throughout the book. The style follows object-oriented programming principles.
5. *To provide insights into the major applications of computers.*

Unique and Distinguishing Features

Exercises for Most Sections. Each section that teaches programming has an exercise set. The exercises both reinforce the understanding of the key ideas of the section and challenge the student to explore applications. Most of the exercise sets require the student to trace programs, find errors, and write programs. The answers to all the odd-numbered exercises in Chapters 2 through 10 and selected odd-numbered exercises from Chapter 11 are given at the end of the text.

Practice Problems. Practice Problems are carefully selected exercises located at the end of a section, just before the exercise set. Complete solutions are given following the exercise set. The practice problems often focus on points that are potentially confusing or are best appreciated after the student has worked on them. The reader should seriously attempt the practice problems and study their solutions before moving on to the exercises.

Programming Projects. Beginning with Chapter 3, chapters contain programming projects. The programming projects not only reflect the variety of ways that computers are used in the business community, but also present some games and general-interest topics. The large number and range of difficulty of the programming projects provide the flexibility to adapt the course to

the interests and abilities of the students. Some programming projects in later chapters can be assigned as end-of-the-semester projects.

Comments. Extensions and fine points of new topics are deferred to the "Comments" portion at the end of each section so that they will not interfere with the flow of the presentation.

Case Studies. Each of the four case studies focuses on an important programming application. The problems are analyzed and the programs are developed with top-down charts and pseudocode. The programs can be found in the PROGRAMS directory of the accompanying CD.

Chapter Summaries. In Chapters 3 through 11, the key results are stated and the important terms are summarized at the end of the chapter.

Procedures. The early introduction of procedures in Chapter 4 allows structured programming to be used in simple situations before being applied to complex problems. However, the text is written so that the presentation of procedures easily can be postponed until decision and repetition structures have been presented. In Chapters 5 and 6 (and Sections 7.1 and 7.2), all programs using procedures appear at the ends of sections and can be deferred or omitted.

Arrays. Arrays are introduced gently in two sections. The first section presents the basic definitions and avoids procedures. The second section presents the techniques for manipulating arrays and shows how to pass arrays to procedures.

How To Appendix. Appendix B provides a compact, step-by-step reference on how to carry out standard tasks in the VB.NET environment.

Appendix on Debugging. Placing of the discussion of VB.NET's sophisticated debugger in Appendix D allows the instructor flexibility in deciding when to cover this topic.

Examples and Case Studies CD. Each book contains a CD holding all the examples and case studies from this text. In addition, the CD holds all the text files and databases needed for the exercises.

Instructors CD. A CD containing the solution to every exercise and programming project and a test item file for each chapter is available for instructors.

Web Site for Instructors and Students. A companion Web site provides an on-line study guide for students that includes additional exercises and learning resources. The instructors' portion includes, among other materials, PowerPoint slides.

What's New in the Fifth Edition

1. Suggestions from students and reviewers have been incorporated as much as possible.
2. The real-life data in the examples and exercises have been updated and revised.
3. The version of Visual Basic has been upgraded from Visual Basic 6.0 to VB.NET and the relevant new features of VB.NET (such as inheritance) have been explained.
4. An appendix titled "Converting from Visual Basic 6.0 to VB.NET" has been added. The language changes from VB 6.0 to VB.NET are substantial. This appendix discusses those changes relevant to this book.

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Many talented instructors, students, and programmers provided helpful comments and constructive suggestions during the preparation of this text. For their contributions to the quality of the first four editions of the book I extend my gratitude to A. Abonomah, University of Akron; Timothy Babbitt, Rochester Institute of Technology; William Barnett, Northwestern State University; Sherry Barriclow, Grand Valley State University; Robert Berman, Wayne State University; William Burrows, University of Washington; David Chao, San Francisco State University; Christopher Chisolm, University of Nebraska, Omaha; Robert Coil, Cincinnati State Technical and Community College; Gary Cornell, University of Connecticut; Ronit Dancis; John DaPonte, Southern Connecticut State University; Ward Deutschman, Briarcliff; Ralph Duffy, North Seattle Community College; Charles Fairchild; Pat Fenton, West Valley College; David Fichbohm, Golden Gate University; Robert Fritz, American River College; Matthew Goddard, New Hampshire Technical College; Mickie Goodro, Casper College; Wade T. Graves, Grayson Community College; Christine Griffin; Gary Haw, MIPS Software Development Inc.; Shelly Hawkins, Microsoft; Tom Janicki, Kent State University; Dana Johnson, North Dakota State University; Dan Joseph, Rochester Institute of Technology; Del Kimber, Clemson University; Wanda Kunkle, Rowan College; Paul Lecoq, San Francisco Community College; David Leitch, Devry Institute; David Letcher, The College of New Jersey; Kieran Mathieson, Oakland University; Charlie Miri, Delaware Tech; George Nezlek, DePaul University; Ron Notes, Hebrew Academy of Greater Washington; Mike Paul, Berry University; T. S. Pennington, Maple Woods Community College; Arland Richmond, Computer Learning Center; David Rosser, Essex County College; Arturo Salazar, San Francisco State; Susanne Peterson, Microsoft; Janie Schwark, Microsoft; Mike Talber, Portland Community College; Steve Turek, Devry Institute of Technology, Kansas City; Jac Van Deventer, Washington State University; Randy Weinberg, St. Cloud State University; Laurie Werner, Miami University; Melinda White, Santa Fe Community College; Ronald Williams, Central Piedmont Community College.

The current edition benefited greatly from the valuable comments of the following knowledgeable reviewers:

Amit Kalani, CIStems Solutions LLC
Priti Kalani, MobiEcast Corporation
Chris Panell, Heald College
Kevin Parker, Idaho State University
TJ Racoosin, rSolutions
Bill Tinker, Aries Software

Two talented programmers, John Tarcza and Thomas Bechtold, helped me at every stage in the development of the book. They provided insights into the new features of VB.NET and ideas on how to explain the material to beginning programming students. In addition, they proofread the book and supplied many of the solutions to the exercises. Alan Hu, a close friend who has been a part of the computer revolution for the last twenty years, updated the discussion of computing in the first chapter.

Many people are involved in the successful publication of a book. I wish to thank the dedicated team at Prentice Hall whose support and diligence made this textbook possible. Lakshmi Balasubramanian, Camille Trentacoste, Vince O'Brien, and Lisa McDowell did a fantastic job producing the book and keeping it on schedule. Jonathan Boylan created the attractive cover and interior design, and Xiaohong Zhu produced the vast amount of art appearing in the book. Crissy Statuto, Sarah Burrows, and Marcia Horton provided valuable editorial support and assistance.

I extend special thanks to my editor Petra Recter. Her ideas and enthusiasm helped immensely with the preparation of the book.

ACCOMPANYING CD

This CD contains all the programs from the examples and case studies set forth in this textbook, most of the TXT files needed for the exercises, all databases needed for the exercises, and several BMP (picture) files. All these files are contained in the folder "Programs" in the subfolders "Ch03", "Ch04", "Ch05", and so on. Each chapter file contains a subfolder named "Text Files for Exercises" which contains TXT files needed for that chapter's exercises. The folder "Ch09" has a subfolder named "Pictures" that contains the BMP files. The folder "Ch10" has a subfolder named "Databases" containing all the databases needed for the exercises.

Each program is contained in a folder with a name in the form *chapter–section–number*. For instance, the program in Chapter 3, Section 5, Example 2 is contained in the folder "3–5–2". Many of the programs make use of a TXT file in the subfolder of the program's folder named "bin."

Every folder and file on the CD has its Read-only attribute turned on. None of the programs will run unless they are copied onto a hard drive or diskette and their Read-only attributes are turned off. Follow these steps to turn off the Read-only attributes of all the subfolders and files in a folder:

1. Copy the folder onto a hard drive (or diskette).
2. Locate the folder with Windows Explorer.
3. Right click on the folder name, and click on Properties in the dropdown list.
4. In the Attributes section of the Properties window, delete the check mark from the Read-only box, and click on OK.
5. When a Confirm Attribute Changes window appears, select "Apply changes to this folder, subfolders and files" and click on OK.

Attention:

This CD DOES NOT contain VB.NET! you will need a compiler to run the programs contained in this CD.

The programs on this CD require the .NET runtime which is installed automatically on your computer when Visual Basic .NET or Visual Studio .NET is installed.

Required third-party Software:

– Visual Basic .NET
– Microsoft Windows NT® 4.0 or later operating system
– Internet Browser (Internet Explorer 5.0 or higher)

Using This Book for a Short or Condensed Course

This book provides more than enough material for a complete semester course. The topics must be trimmed for courses lasting considerably less than a full semester. The following syllabus provides one possible way to present an abbreviated introduction to programming.

1 An Introduction to Computers and Visual Basic .NET

- 1.2 Using Windows
- 1.3 Files and Folders

3 Fundamentals of Programming in VB.NET

- 3.1 VB.NET Controls
- 3.2 VB.NET Events
- 3.3 Numbers
- 3.4 Strings
- 3.5 Input and Output

4 Procedures

- 4.1 Subprograms, Part I
- 4.2 Subprograms, Part II
- 4.3 Functions

5 Decisions

- 5.1 Relational and Logical Operators
- 5.2 If Blocks
- 5.3 Select Case Blocks

6 Repetition

- 6.1 Do Loops
- 6.2 Processing Lists of Data with Do Loops
- 6.3 For...Next Loops

7 Arrays

- 7.1 Creating and Accessing Arrays
- 7.2 Using Arrays (Omit Merging Two Ordered Arrays)
- 7.3 Some Additional Types of Arrays (Omit Control Arrays)

9 Additional Controls and Objects

- 9.1 List Boxes, Combo Boxes, and the File-Opening Control
- 9.2 Seven Elementary Controls (Check box and Radio button controls only)

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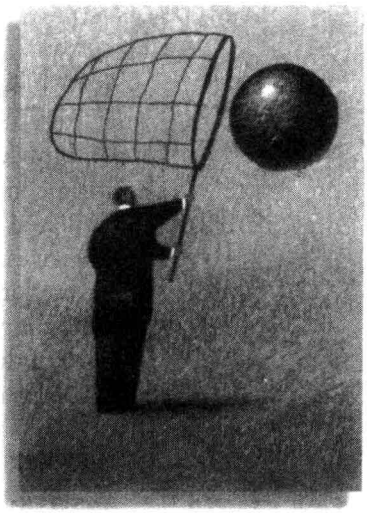

An Introduction to Computers and Visual Basic .NET

1.1 **An Introduction to Computers**

1.2 **Using Windows**

◆ Mouse Pointers ◆ Mouse Actions ◆ Windows and Its Little Windows ◆ Using the Notepad

1.3 **Files and Folders**

◆ Using Windows Explorer ◆ Using the Open and Save As Dialog Boxes ◆ Read-Only Attribute

1.4 **An Introduction to Visual Basic .NET**

◆ Why Windows and Why VB.NET? ◆ How You Develop a VB.NET Application ◆ The Different Versions of Visual Basic

1.5 **Biographical History of Computing**

◆ 1800s ◆ 1930s ◆ 1940s ◆ 1950s ◆ 1960s ◆ 1970s ◆ 1980s ◆ 1990s

1.1 An Introduction To Computers

An Introduction to Programming Using Visual Basic .NET is a book about problem solving using computers. The programming language used is Visual Basic .NET (hereafter abbreviated as VB.NET), but the principles taught apply to many modern programming languages. The examples and exercises present a sampling of the ways that computers are used in society.

Computers are so common today that you certainly have seen them in use and heard some of the terminology applied to them. Here are some of the questions that you might have about computers and programming.

QUESTION: *What is meant by a "personal" computer?*

ANSWER: The word "personal" does not mean that the computer is intended for personal, as opposed to business, purposes. Rather, it indicates that the machine is operated by one person at a time instead of by many people.

QUESTION: *What are the main components of a personal computer?*

ANSWER: Hidden from view inside the system unit are the microprocessor and the memory of the computer. The microprocessor, often referred to as the Central Processing Unit (CPU), which can be thought of as the brain of the computer, carries out all computations. The memory, often referred to as Random Access Memory (RAM), stores the instructions and data being processed by the computer. The contents of memory are lost when the computer's power is turned off. A hard disk drive is used to store instructions and data when they are not being used in memory, and when the computer is turned off. A network card or a modem is used to send and receive information to and from other computers. Network cards can be used to connect to a local area network (LAN) of computers, while a modem uses a telephone line to connect to any computer that can be reached by a phone call. The personal computer also has several devices known as input and output devices, which are used to communicate with the computer. Standard input devices include the keyboard and mouse. Standard output devices include the monitor, printer, and sound card. Instructions are entered into the computer by typing them on the keyboard, clicking a mouse, or loading them from a file located on a disk drive or downloaded from a network. Characters normally appear on the monitor as they are typed. Information processed by the computer can be displayed on the monitor, printed on the printer, or recorded on a disk drive.

QUESTION: *What are some uses of computers in our society?*

ANSWER: The dramatic decrease in the cost of hardware and software technology has made computers widely available to consumers and corporations alike. Whenever we make a phone call, a computer determines how to route the call and calculates the cost of the call. Banks store all customer transactions on computers and process these data to revise the balance for each customer. Airlines record all reservations with computers. This information, which is said to form a database, can be accessed to determine the status of any flight. NASA uses computers to calculate the trajectories of satellites. Business analysts use computers to create pie and bar charts that give visual impact to data. With the Internet connecting the millions of home computers, families and friends

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