Programming Logic and Design Seventh Edition

Chapter 1

An Overview of Computers and Programming

Objectives

In this chapter, you will learn about:

- Computer systems
- Simple program logic
- The steps involved in the program development cycle
- Pseudocode statements and flowchart symbols
- Using a sentinel value to end a program
- Programming and user environments
- The evolution of programming models

Understanding Computer Systems

- **Computer system**
  - Combination of all the components required to process and store data using a computer
- **Hardware**
  - Equipment associated with a computer
- **Software**
  - System & Application
  - Computer instructions that tell the hardware what to do
  - **Programs**
    - Software written in a language to perform a particular task

Understanding Computer Systems (continued)

- **Programming**
  - writing complete programs
  - writing portions of a program (modules)
- Computer hardware and software accomplish three major operations: [Information Processing Cycle]
  - **Input**
    - **Data items** enter computer
  - **Process**
    - By **central processing unit (CPU**)
  - **Output**
  - **Store**

Understanding Computer Systems (continued)

- **Programming language**
  - Use to write computer instructions
  - Examples:
    - Visual Basic, C#, C++, Java, Ada, Python, Ruby
- **Syntax**
  - Rules governing the construction of valid statements in a language [keywords, operators, identifiers, punctuation]
  - Conventions
- **Computer memory** [RAM]
  - Computer's temporary, internal storage
  - **Volatile**

Understanding Computer Systems (continued)

- Permanent storage devices
  - **Non-volatile** storage
- **Translator**
  - **Compiler** and/or an **interpreter**
  - Translates program code into **machine language** (**binary language**)
  - Checks for syntax errors
  - Many modern languages use both a compiler and an interpreter
- Program **executes** or **runs**
  - Input will be accepted, some processing will occur, and results will be output

Understanding Simple Program Logic

- Program with syntax errors cannot execute
- Program with logic errors can execute, but…
  - Errors in program logic produce incorrect output as a result
- **Logic** of the computer program
  - Sequence of specific instructions in specific order
- **Variable** [fundamental concept in program design]
  - Named memory location whose value can vary
- Syntax & Semantics

Understanding the Program Development Cycle

- **Program development cycle**

– Understand	the problem
– Plan	the logic
– Code	the program
– Translate	the program into machine language using software (a compiler and/or interpreter)
– Test	the program
– Deploy	the program (make available for use)
– Maintain	the program

- Detailed information follows…

Understanding the Program Development Cycle (continued)

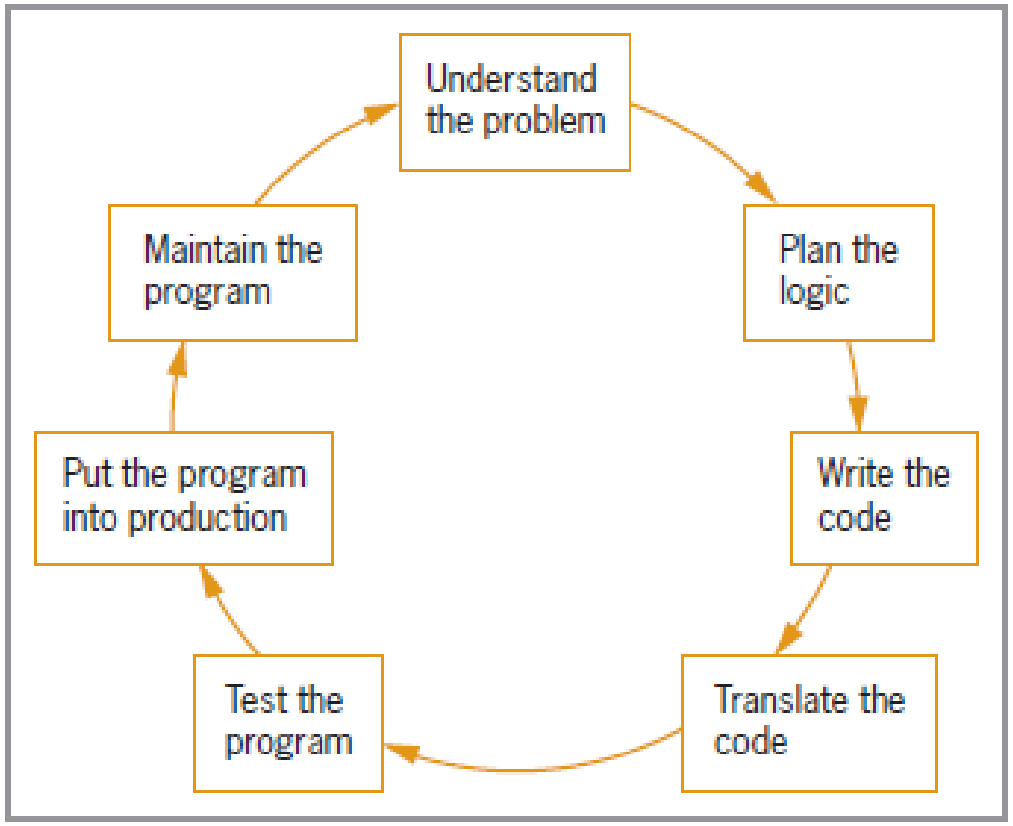


Figure 1-1 The program development cycle

Understanding the Problem

- **One of the most difficult aspects of programming**

- **Users (end users)**
  - People for whom program is written

- **Documentation**
  - Supporting paperwork for a program
    - flowchart / pseudocode
    - hierarchy chart (aka structure chart or VTOC)
    - screen / printer spacing chart
    - end user instructions

Plan the Logic

- Heart of the programming process
- Most common logic planning tools
  - Flowcharts
  - Pseudocode
  - hierarchy chart
- **Desk-checking**
  - Walking through a program's logic on paper before you actually write the program

Code the Program

- Hundreds of programming languages are available
  - Choose based on:
    - features
    - organizational requirements
- Most languages are similar in their basic capabilities
- Easier than planning step (not necessarily so for new programming students…)

Using Software to Translate the Program into Machine Language

- **Translator program**
  - Compiler and/or interpreter
  - Changes the programmer's English-like **high-level programming language** into the **low-level machine language**
- **Syntax error**
  - Misuse of a language's grammar rules
  - Programmer corrects listed syntax errors
  - Might need to recompile the code several times
    - misspelled variable names
    - unmatched curly braces

Languages / File Types

- Source language
  - Java, C++, Visual Basic, etc.
  - file types (extensions):
    - java
    - cpp
    - vb
- Compiled language (destination language)
  - other high-level language (cross compiler)
  - machine language
  - virtual machine language (intermediate language)
    - Java class file (.class)
    - MSIL (Microsoft Intermediate Language)
  - files types (extensions):
    - class
    - msil
    - obj
    - exe

Using Software to Translate the Program into Machine Language (continued)

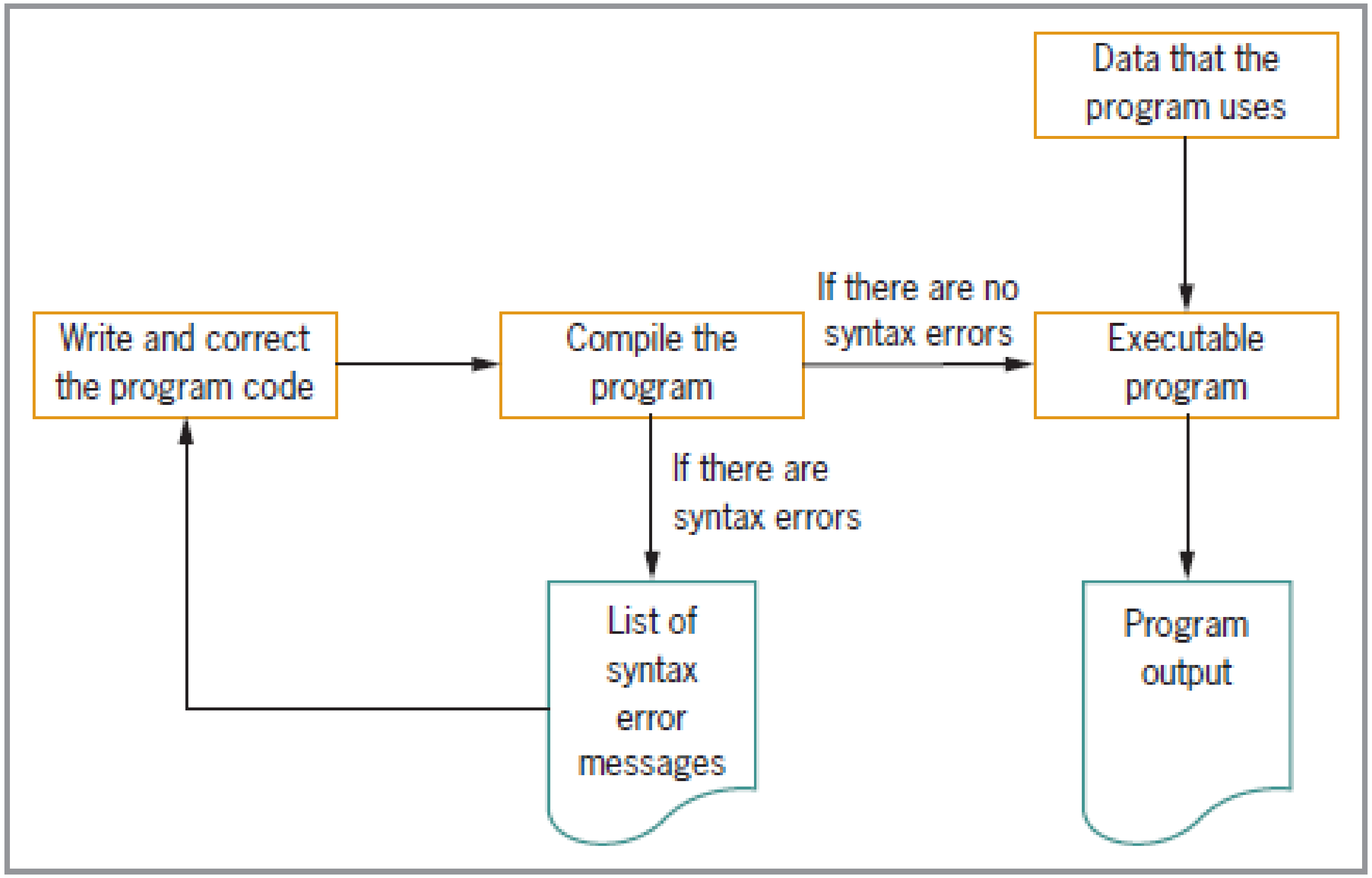

Data that the program uses
Write and correct the program code
Compile the program
If there are no syntax errors
Executable program
If there are syntax errors
List of syntax error messages
Program output

Figure 1-2 Creating an executable program

Test the Program

- Logical error
  - Use a syntactically correct statement but use the wrong one for the current context
- Run-time error
  - program ends abnormally when the user runs the program (sometimes or every time)
- **Test Data**
  - Execute the program with some sample test data to see whether the results are logically correct

Deploy the Program
Make the Program Available for Use

- Process depends on program’s purpose
  - May take several months

- **Conversion**
  - Entire set of actions an organization must take to switch over to using a new program or set of programs

Maintain the Program

- **Maintenance**
  - Making changes after program is put into production
- Common first programming job
  - Maintaining previously written programs
- Make changes to existing programs
  - Repeat the development cycle

Using Pseudocode Statements and Flowchart Symbols

- **Pseudocode**
  - English-like representation of the logical steps it takes to solve a problem
- **Flowchart**
  - Pictorial representation of the logical steps it takes to solve a problem

Writing Pseudocode

- Pseudocode representation of a number-doubling problem

```
start
    input myNumber
    set myAnswer = myNumber * 2
    output myAnswer
stop
```

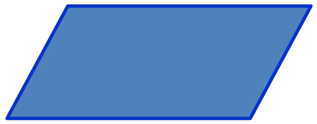
Writing Pseudocode (continued)

- Programmers preface their pseudocode with a beginning statement like `start` and end it with a terminating statement like `stop`
- Flexible because it is a planning tool
- English-like
- Doesn’t require any software/hardware

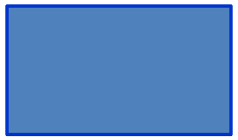
Drawing a Flowchart

- Create a flowchart
  - Draw geometric shapes that contain an **individual action**
  - Connect shapes with arrows

- **Input symbol**
  - Indicates input operation
  - Parallelogram



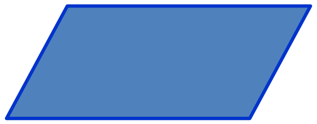
- **Processing symbol**
  - Processing statements such as arithmetic
  - Rectangle



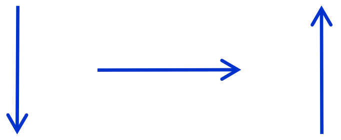
- **Connector symbol**
  - Used to connect flowlines
  - small circle

Drawing Flowcharts (continued)

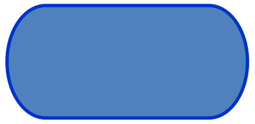
- **Output symbol**
  - Represents output statements
  - Parallelogram



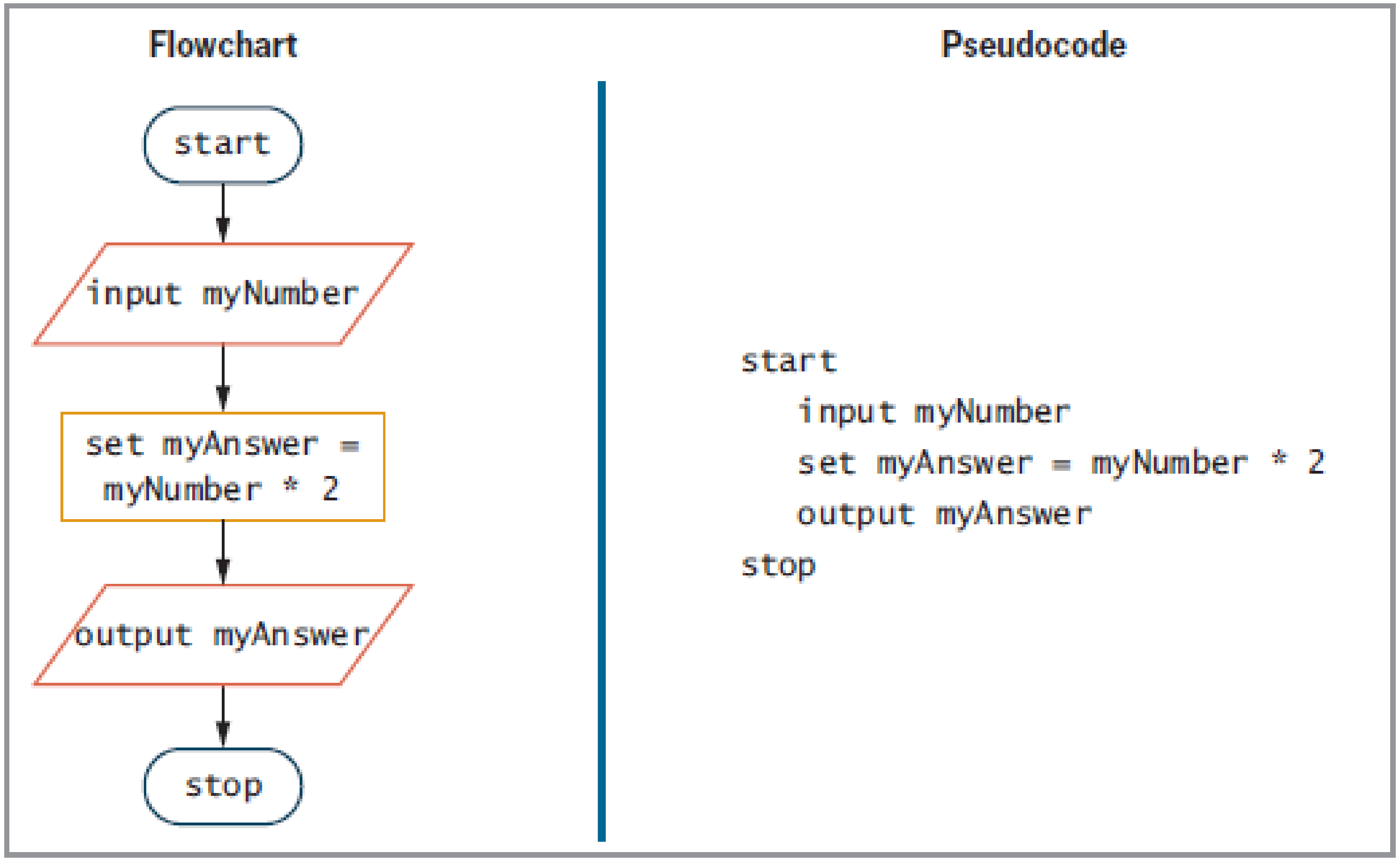
- **Flowlines**
  - Lines and Arrows that connect steps



- **Terminal** symbols
  - Start/stop symbols
  - Shaped like a racetrack
  - Also called lozenge or capsule



Drawing Flowcharts (continued)



```
start
   input myNumber
   set myAnswer = myNumber * 2
   output myAnswer
stop
```

Figure 1-6 Flowchart and pseudocode of program that doubles a number

Repeating Instructions

- **Loop**
  - Repeats a series of steps
  - referred to as looping, repetition, and iteration (synonyms)

- **Infinite loop**
  - Repeating flow of logic with no end (repeat forever)

Repeating Instructions (continued)

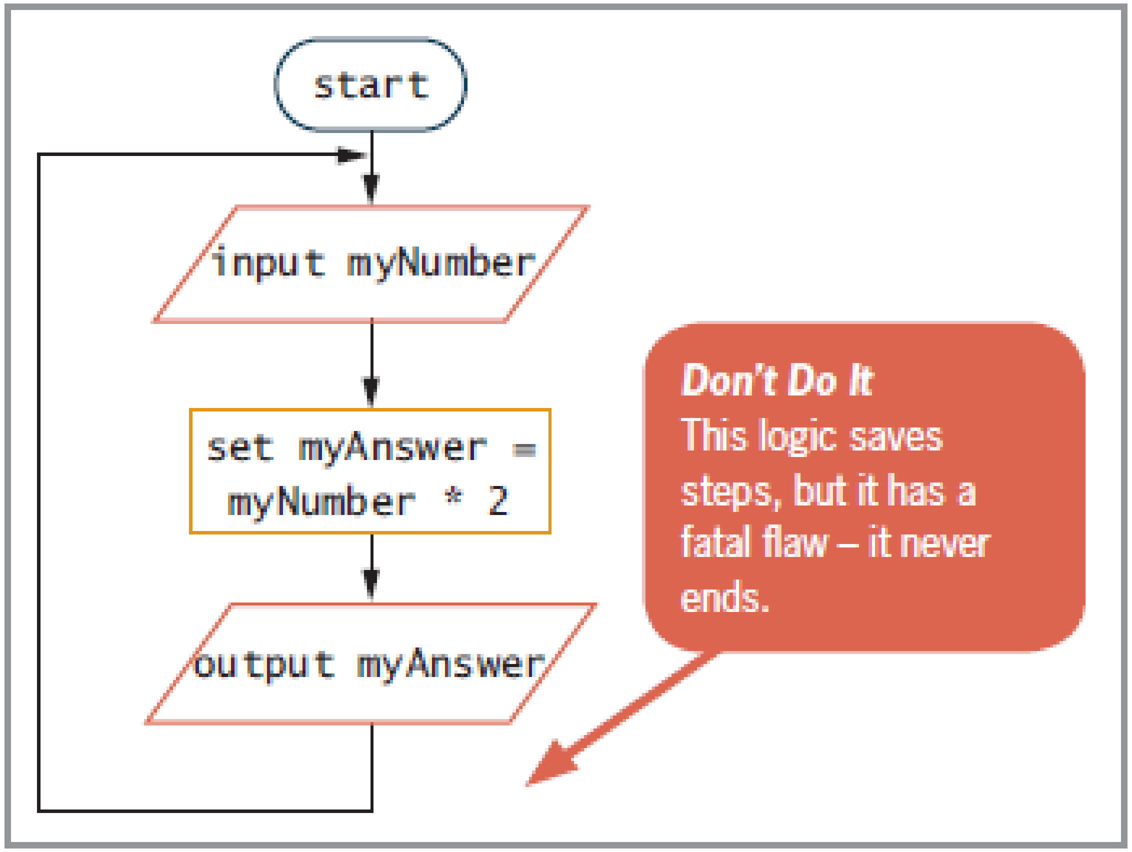

start
input myNumber
set myAnswer = myNumber * 2
output myAnswer
Don't Do It
This logic saves steps, but it has a fatal flaw – it never ends.

Figure 1-8 Flowchart of infinite number-doubling program

Using a **Sentinel Value** to End a Program

- **Making a decision**
  - Testing a value
  - **Decision symbol**
    - Diamond shape
- **Dummy value**
  - Data-entry value that the user will never need
  - **Sentinel value**
- **eof** ("end of file")
  - Marker at the end of a file that automatically acts as a sentinel

Using a Sentinel Value to End a Program (continued)

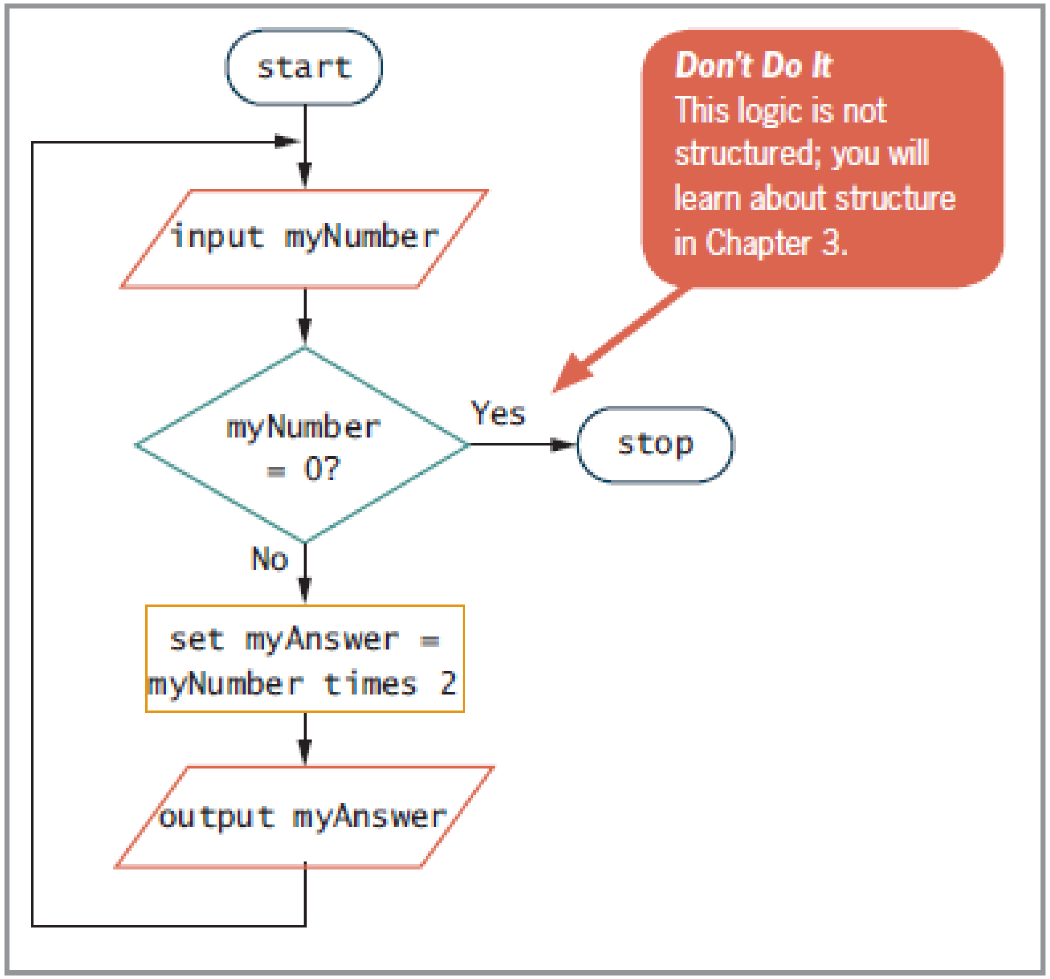
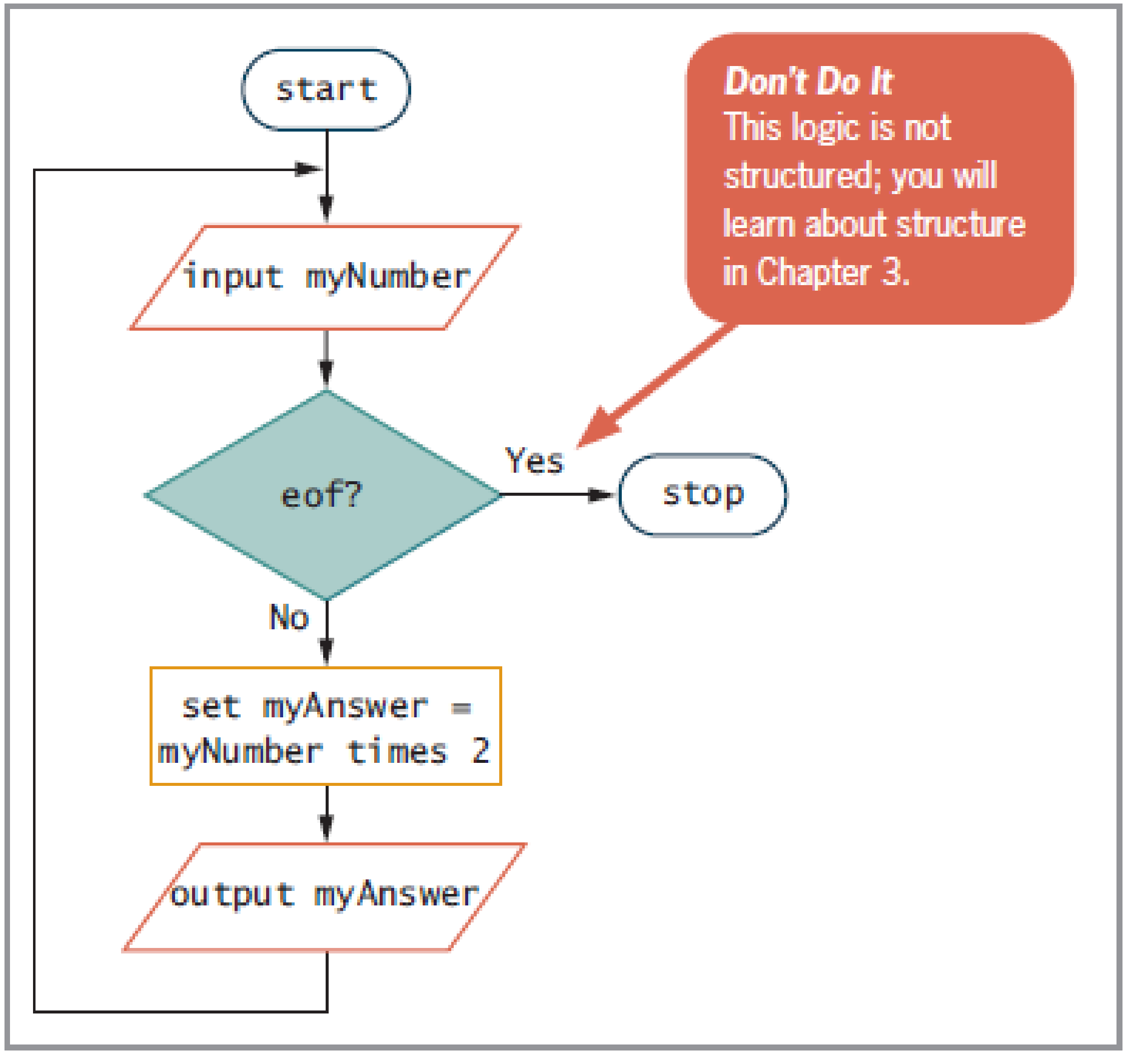

start
input myNumber
myNumber = 0?
Yes
stop
No
set myAnswer = myNumber times 2
output myAnswer
Don't Do It
This logic is not structured; you will learn about structure in Chapter 3.

Figure 1-9 Flowchart of number-doubling program with sentinel value of 0

Using a Sentinel Value to End a Program (continued)

Figure


start
input myNumber
eof?
Yes
stop
No
set myAnswer = myNumber times 2
output myAnswer
Don't Do It
This logic is not structured; you will learn about structure in Chapter 3.

Understanding Programming and User Environments

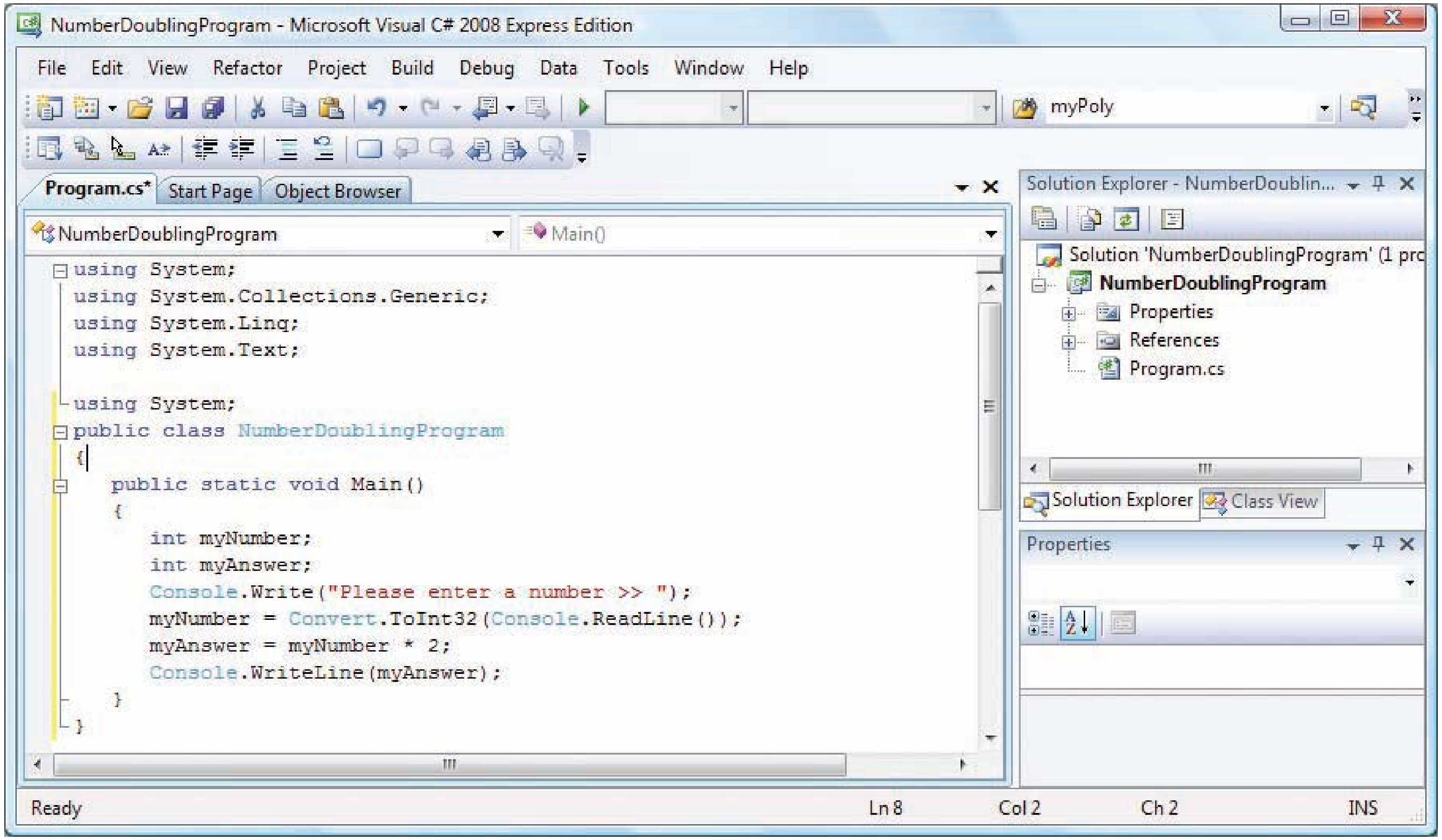
- Many options for programming and user environments:
  - simple text editor such as Notepad
  - “Smart Editor” such as Brief or ConTEXT
  - IDE (Integrated Development Environment) such as jGRASP or Visual Studio or Eclipse

Understanding Programming Environments

- Use a keyboard to type program statements into an editor
  - Plain **text editor**
    - Similar to a word processor but without as many features
  - Text editor that is part of an **integrated development environment (IDE)**
    - Software package that provides an editor, compiler, and other programming tools

Understanding Programming Environments (continued)

Figure 1-12 A C# number-doubling program in Visual Studio


NumberDoublingProgram - Microsoft Visual C# 2008 Express Edition
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Main()
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References
Program.cs
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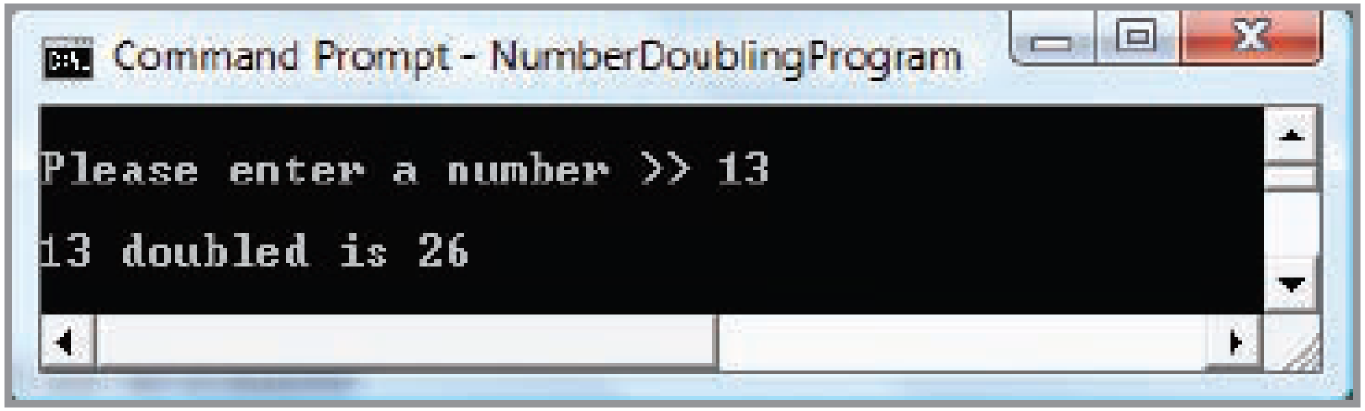
```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

using System;
public class NumberDoublingProgram
{
    public static void Main()
    {
        int myNumber;
        int myAnswer;
        Console.Write("Please enter a number >> ");
        myNumber = Convert.ToInt32(Console.ReadLine());
        myAnswer = myNumber * 2;
        Console.WriteLine(myAnswer);
    }
}
```

Understanding User Environments

- **Command line**
  - Location on your computer screen at which you type text entries to communicate with the computer's operating system
- **Graphical user interface (GUI)**
  - Allows users to interact with a program in a graphical environment

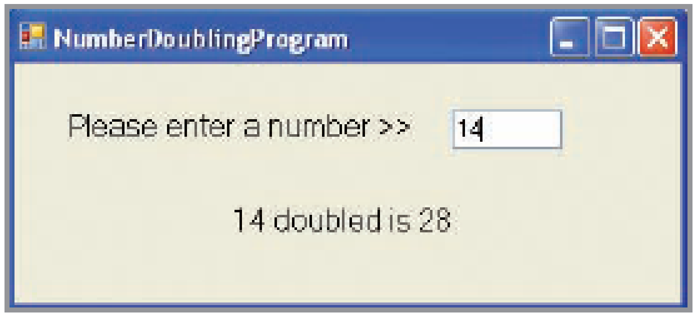
Understanding User Environments (continued)

Figure 1-13 Executing a number-doubling program in a command-line environment



```
Please enter a number >> 13
13 doubled is 26
```

Understanding User Environments (continued)



Please enter a number >> 14

14 doubled is 28

Figure 1-14 Executing a number-doubling program in a GUI environment

Understanding the Evolution of Programming Models

- People have been writing computer programs since the 1940s
- Newer programming languages
  - Look much more like natural language
  - Easier to use
  - Create self-contained modules or program segments that can be pieced together in a variety of ways

Understanding the Evolution of Programming Models (continued)

- Major models or paradigms used by programmers
  - **Procedural programming**
    - Focuses on the procedures that programmers create
  - **Object-oriented programming**
    - Focuses on objects, or “things,” and describes their features (or attributes) and their behaviors
  - Major difference
    - Focus the programmer takes during the earliest planning stages of a project

Summary

- Computer programming
  - Requires specific syntax
  - Must develop correct logic
- Programmer’s job
  - Understanding the problem, planning the logic, coding the program, translating the program into machine language, testing the program, putting the program into production, and maintaining it
- Procedural and object-oriented programmers approach problems differently