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**
  - Computer instructions
  - Tells the hardware what to do
  - **Programs**
    - Instructions written by programmers

Understanding Computer Systems (continued)

- **Application software** such as word processing, spreadsheets, payroll and inventory, even games
- **System software** such as operating systems like Windows, Linux, or UNIX

- Computer hardware and software accomplish three major operations
  - **Input**
    - **Data items** such as text, numbers, images, and sound
  - **Processing**
    - Calculations and comparisons performed by the **central processing unit** (**CPU**)

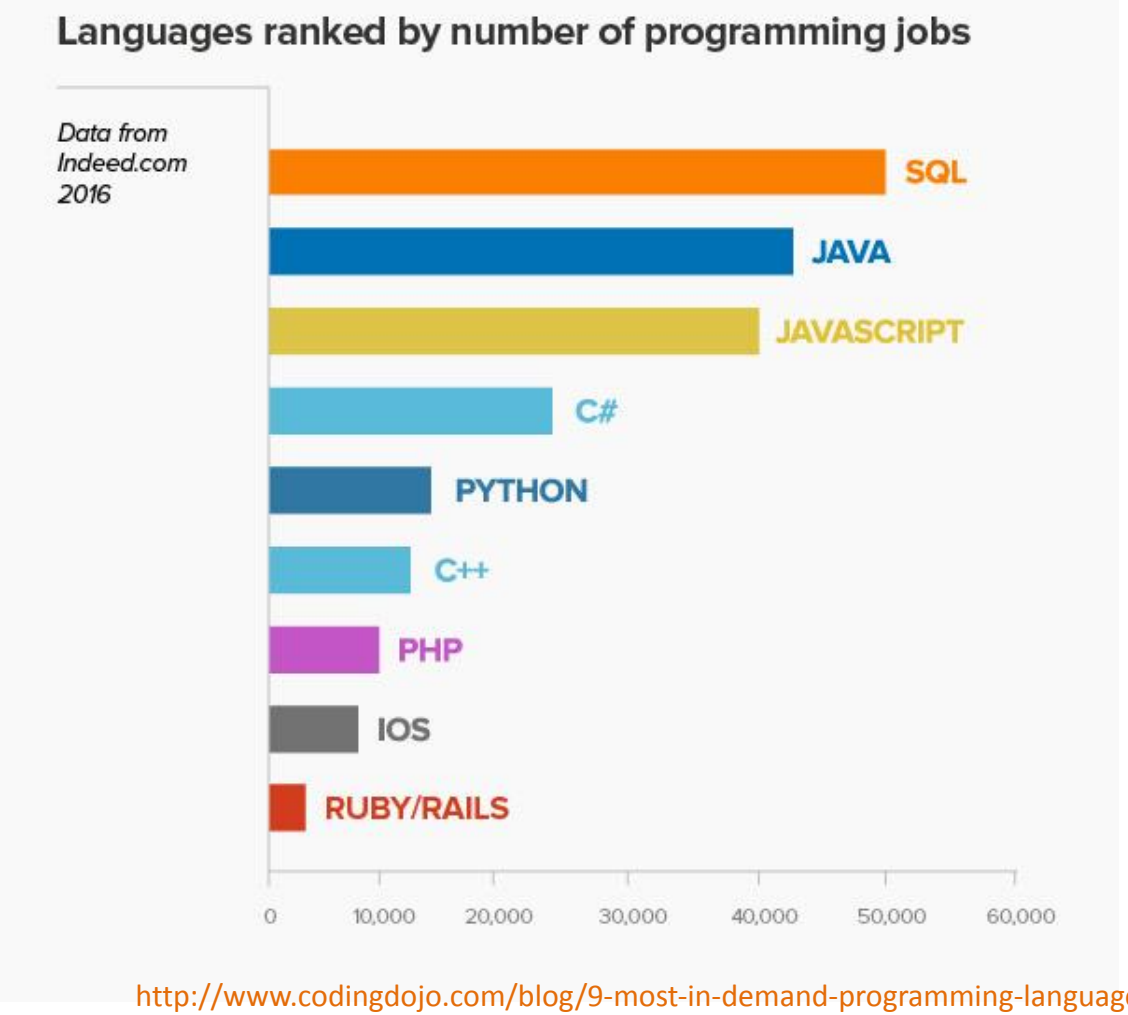
Understanding Computer Systems (continued)

- **Output**
  - Resulting information that is sent to a printer, a monitor, or **storage devices** after processing

- **Programming language**
  - Used to write computer instructions
  - Examples
    - Visual Basic, C#, C++, or Java

- **Syntax**
  - Rules governing word usage and punctuation

The 9 Most In-Demand Programming Languages of 2016



http://www.codingdojo.com/blog/9-most-in-demand-programming-languages-of-2016/

Understanding Computer Systems (continued)

- **Computer memory**
  - Computer's temporary, internal storage – **random access memory** (**RAM**)
  - **Volatile** memory – lost when the power is off
- Permanent storage devices
  - **Nonvolatile** memory
- **Compiler** or **interpreter**
  - Translates source code into **machine language** (**binary language**) statements called **object code**
  - Checks for syntax errors

Understanding Simple Program Logic

- Program **executes** or **runs**
  - Input will be accepted, some processing will occur, and results will be output
- Programs with syntax errors cannot execute
- **Logical errors**
  - Errors in program logic produce incorrect output
- **Logic** of the computer program
  - Sequence of specific instructions in specific order
- **Variable**
  - Named memory location whose value can vary. Also called an **identifier.** At any moment a variable holds just one value.

Understanding the Program Development Cycle

Program development cycle

1. Understand the problem
2. Plan the logic
3. Code the program
4. Use software (a compiler or interpreter) to translate the program into machine language
5. Test the program
6. Put the program into production
7. Maintain the program

Understanding the Program Development Cycle

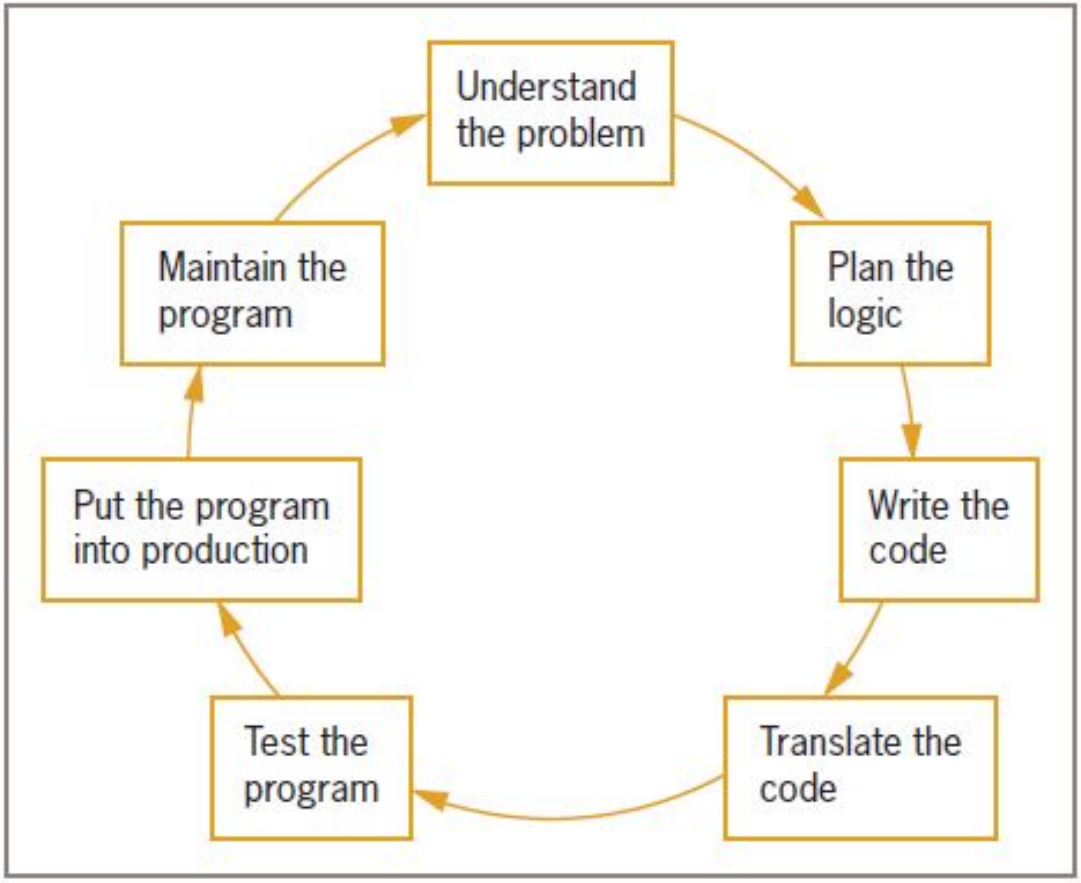


Figure 1-1 The program development cycle

1-Understanding the Problem

- One of the most difficult aspects of programming
- **Users** or **end users**
  - People for whom a program is written
- **Documentation**
  - Supporting paperwork for a program

2-Planning the Logic

- Heart of the programming process
- Most common planning tools
  - Flowcharts
  - Pseudocode
  - **IPO charts** (input, processing, and output)
  - **TOE charts** (tasks, objects, and events)
- **Desk-checking**
  - Walking through a program's logic on paper before you actually write the program

3-Coding the Program

- Hundreds of programming languages available
  - Choose based on features
  - Similar in their basic capabilities
- Easier than the planning step

4-Using Software to Translate the Program into Machine Language

- **Translator program**
  - Compiler 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

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

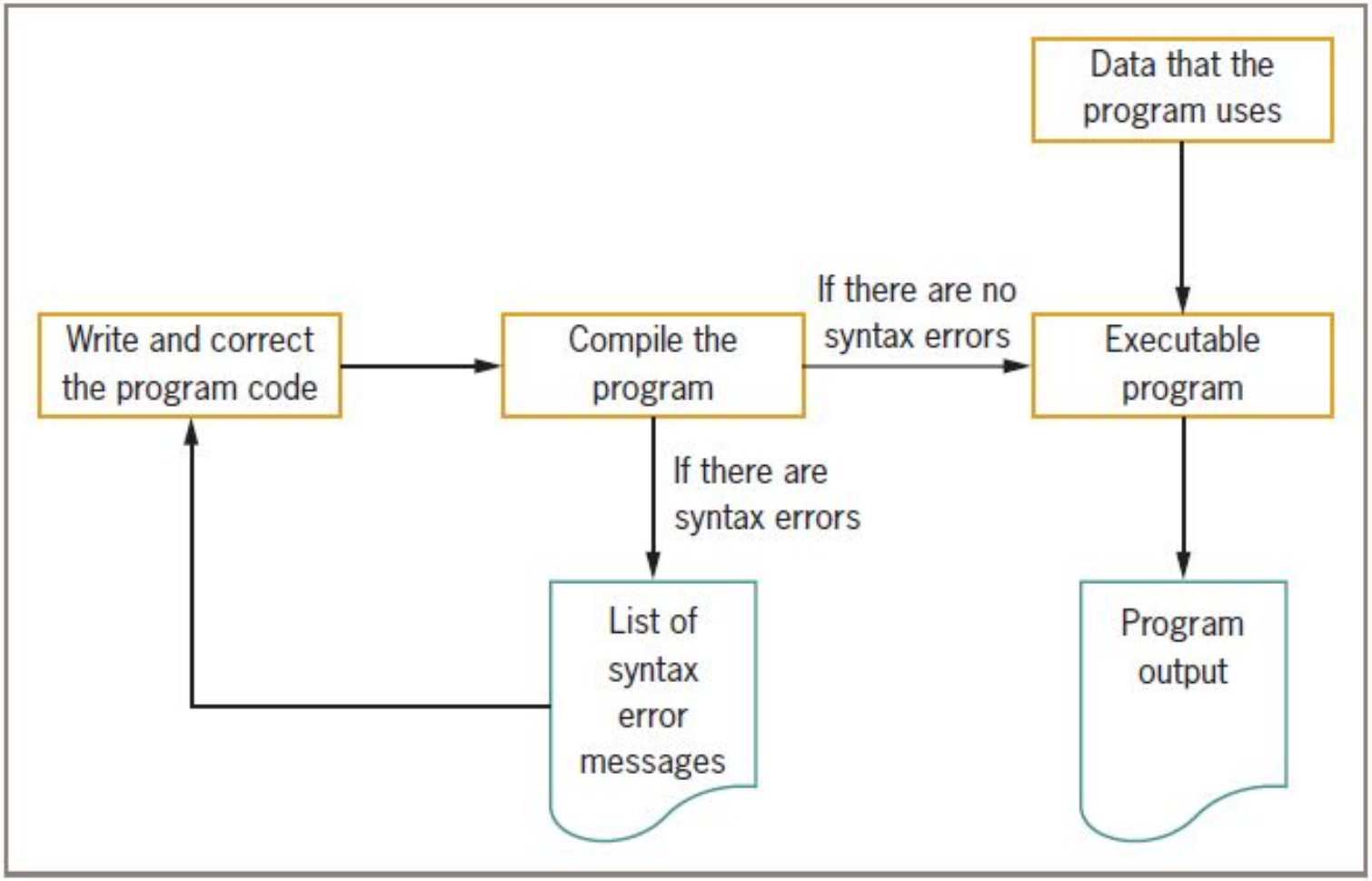


Figure 1-2 Creating an executable program

5-Testing the Program

- Program is free of syntax error doesn't mean to be free of logical (semantic) errors.
- Execute the program with sample data and check results whether it is logically correct.
- **Logical error**
  - Results when a syntactically correct statement, but the wrong one for the current context, is used
- **Test**
  - Execute the program with some sample data to see whether the results are logically correct
- **Debugging** is the process of finding and correcting program errors
- Programs should be tested with many sets of data

6-Putting the Program into Production

- Process depends on program's purpose
  - May take several months
- **Conversion**
  - Set of actions an organization must take to switch over to using a new program or set of programs

7-Maintaining the Program

- **Maintenance**
  - Making changes after the 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
```

- Or Pseudocode representation of a **Adding Two Integers:**

```
start
    input myNumber1, myNumber2
    set myAnswer = myNumber1 + myNumber2
    output myAnswer
Stop
```

Program to Add Two Integers in C Language

```
#include <stdio.h>
int main()
{
    int myNumber1, myNumber2, myAnswer;
    printf("Enter two integers:    ");

    // Two integers entered by user is stored using scanf()   function
    scanf("%d  %d", &myNumber1, &myNumber2);

    // sum of two numbers in stored in variable myAnswer
     myAnswer = myNumber1 + myNumber2;

    // Displays sum
    printf("%d + %d = %d", myNumber1, myNumber2, myAnswer);

    return 0;
}
```

Enter two integers: 12, 11
12 + 11 = 23

Explanation of the Adding C Program

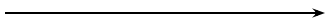
- In this program, user is asked to enter two integers. Two integers entered by the user is stored in variables `myNumber1 and myNumber2` respectively. This is done using `scanf()` function.
- Then, variables `myNumber1` and `myNumber2` are added using + operator and the result is stored in `myAnswer`.

Writing Pseudocode (continued)

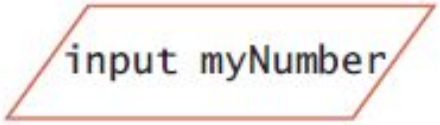
- Programmers preface their pseudocode with a beginning statement like `start` and end it with a terminating statement like `stop`
- Flexible planning tool

Drawing Flowcharts

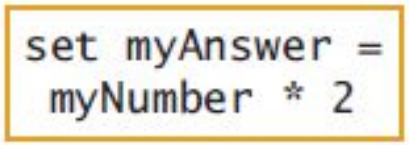
- Create a flowchart
  - Draw geometric shapes that contain the individual statements
  - Connect shapes with arrows



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

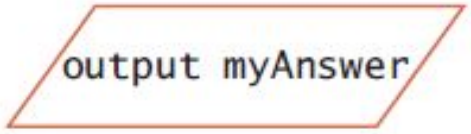


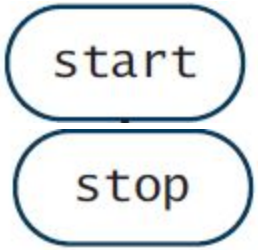
- **Processing symbol**
  - Contains processing statements such as arithmetic
  - Rectangle



Drawing Flowcharts (continued)

- **Output symbol**
  - Represents output statements
  - Parallelogram
- **Flowlines**
  - Arrows that connect steps
- **Terminal symbols**
  - Start/stop symbols
  - Shaped like a racetrack
  - Also called lozenges





Drawing Flowcharts (continued)

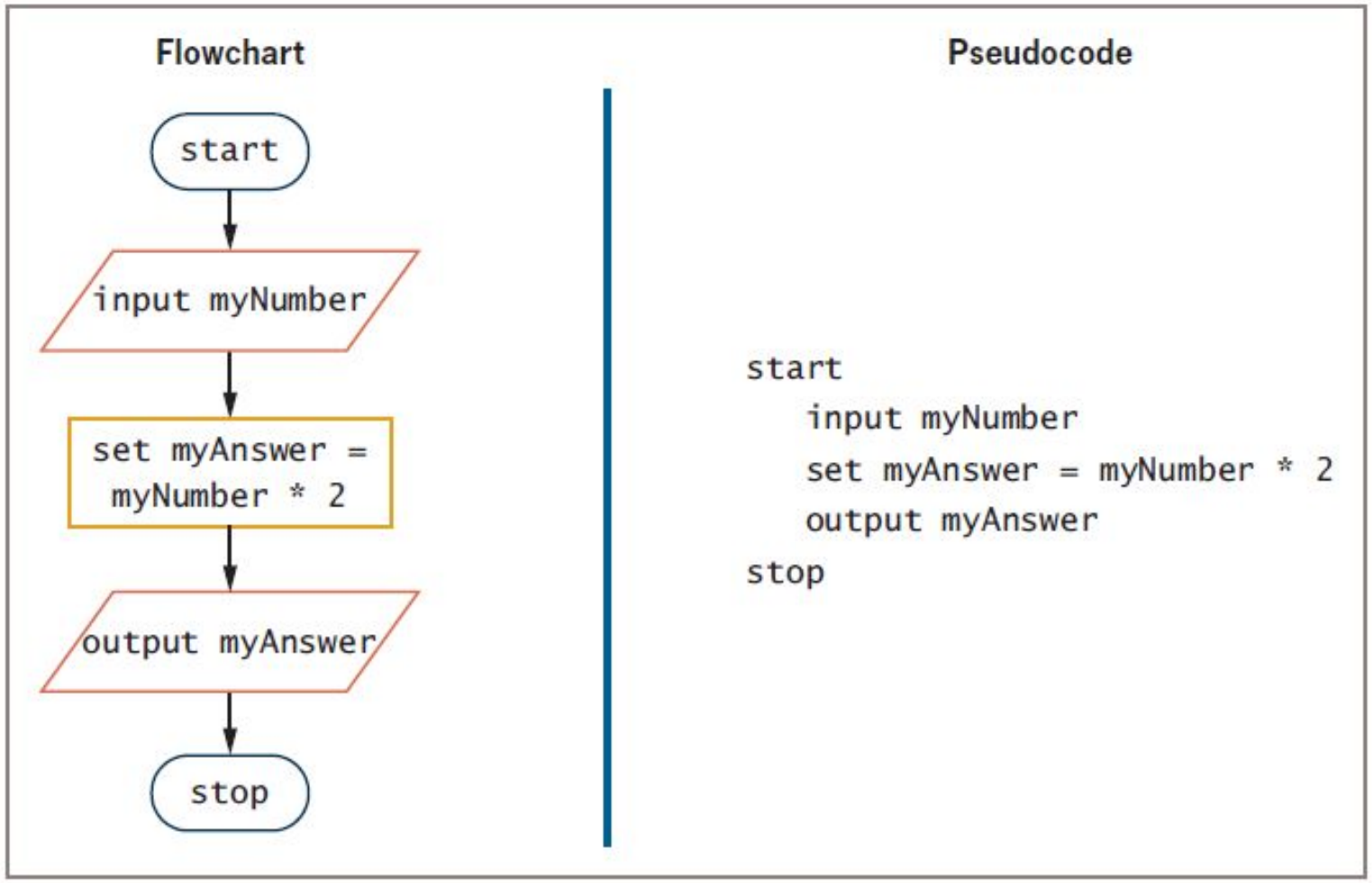


Figure 1-6 Flowchart and pseudocode of program that doubles a number

Repeating Instructions

- Program in Figure 1-6 only works for one number
- Not feasible to run the program over and over 10,000 times
- Not feasible to add 10,000 lines of code to a program
- Create a **loop** (repetition of a series of steps) instead
- Avoid an **infinite loop** (repeating flow of logic that never ends)

Repeating Instructions (continued)

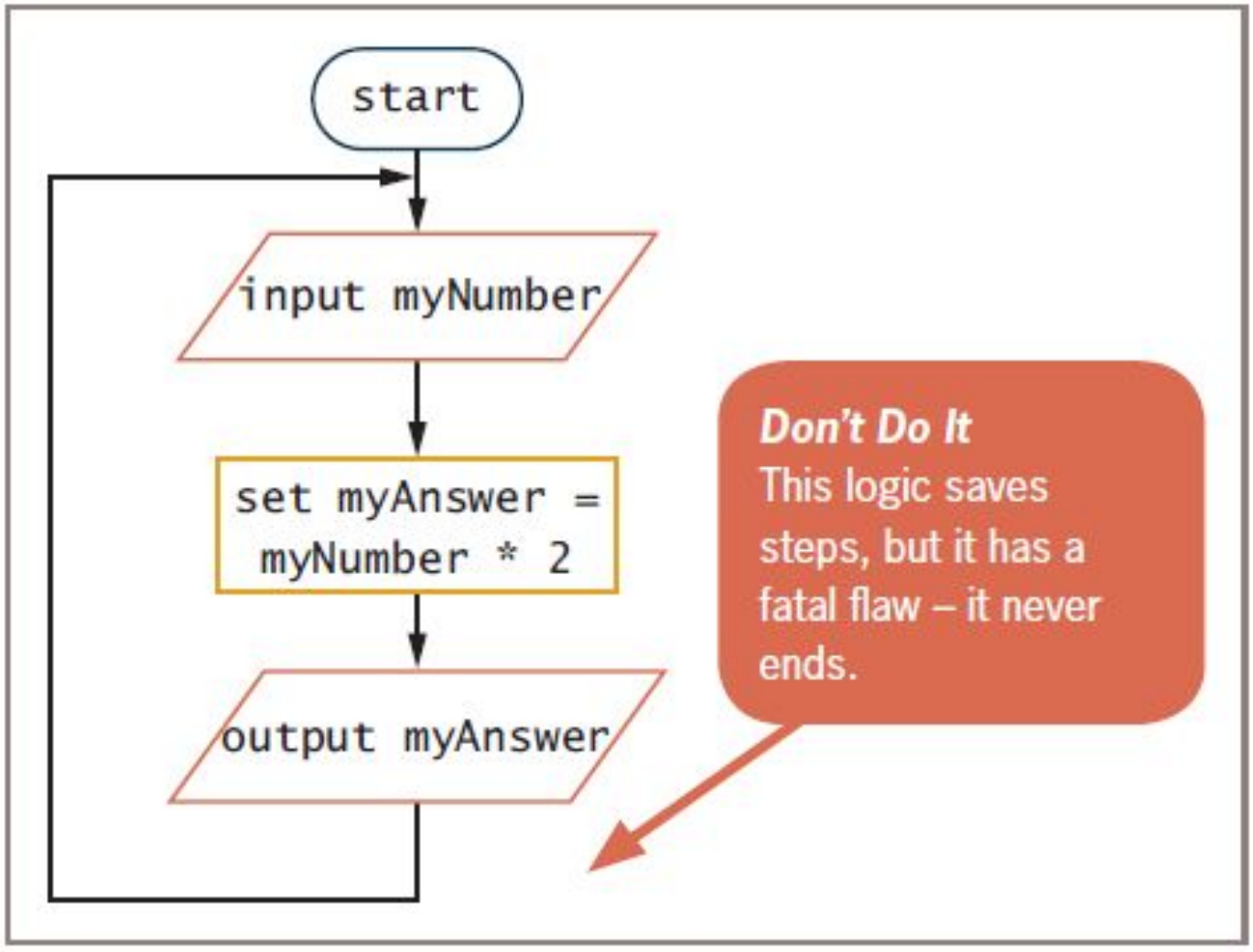
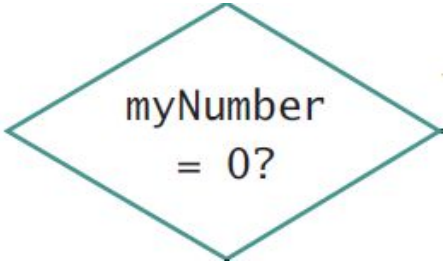


Figure 1-8 Flowchart of infinite number-doubling program

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)

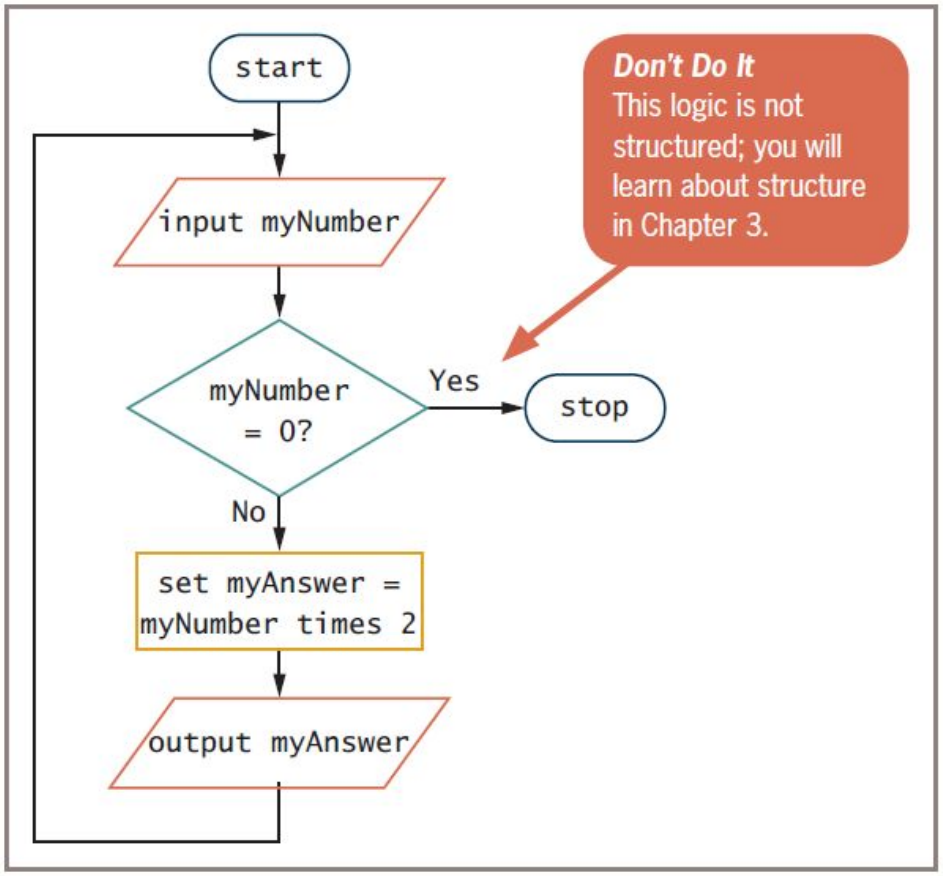


Figure 1-9 Flowchart of number-doubling program with sentinel value of 0

Using a Sentinel Value to End a Program (continued)

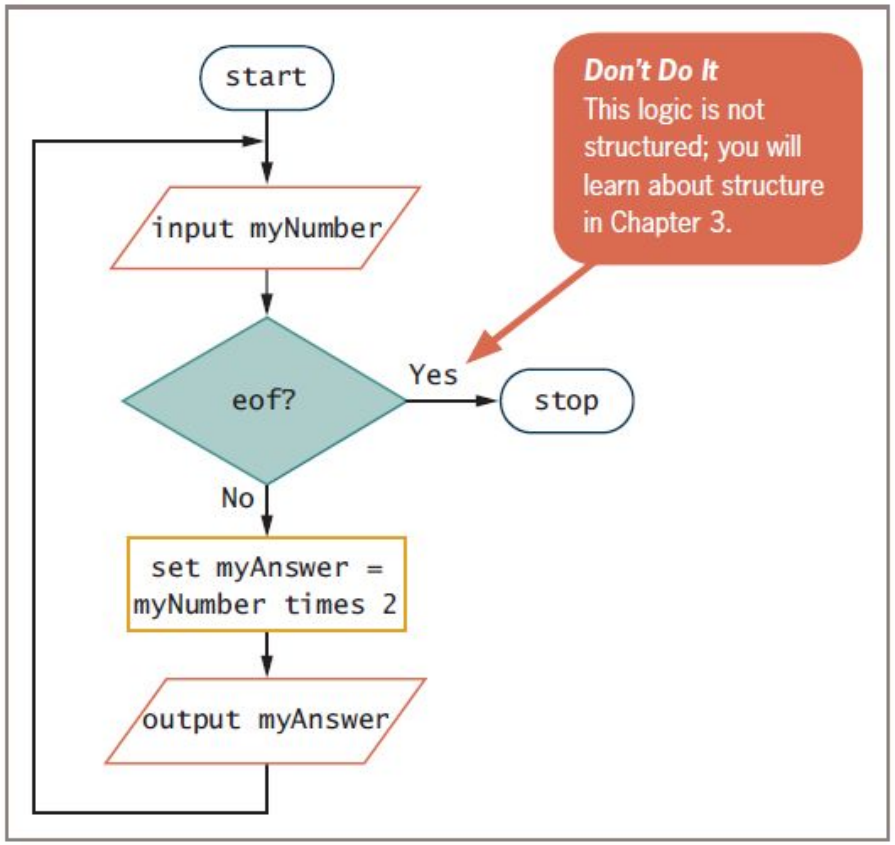


Figure 1-10 Flowchart using `eof`

Understanding Programming and User Environments بيئة المستخدم

- Many options for programming and user environments
  - Planning
    - Flowchart
    - Pseudocode
  - Coding
    - Text editors
  - Executing
    - Input from keyboard, mouse, microphone
  - Outputting
    - Text, images, sound

Understanding Programming Environments فهم بيئة البرنامج

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

Understanding Programming Environments (continued)

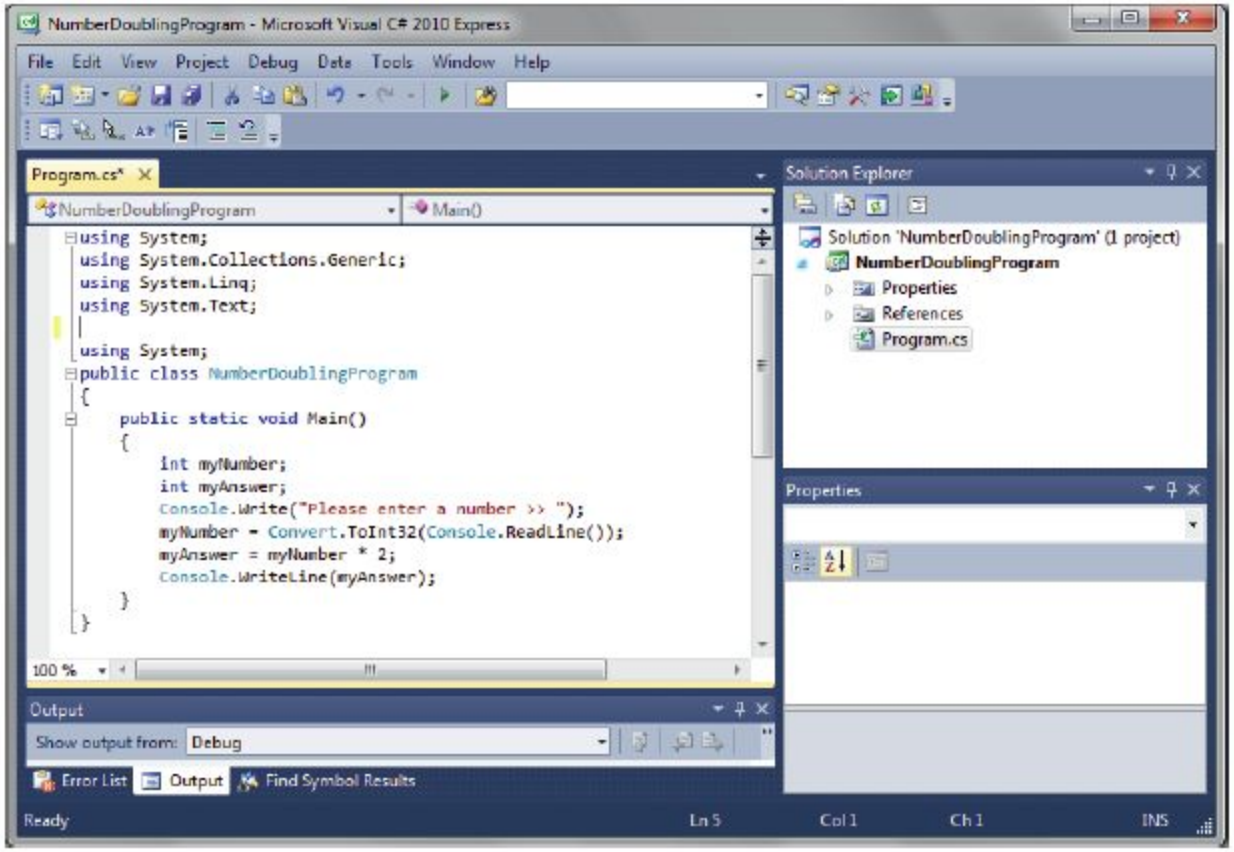


Figure 1-12 A C# number-doubling program in Visual Studio

Understanding User Environments

- **Command line**
  - Location on your computer screen where 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)

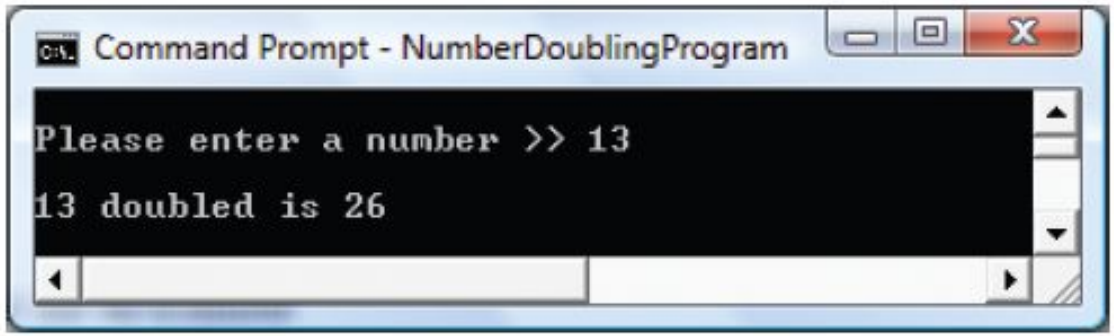


Figure 1-13 Executing a number-doubling program in a command-line environment

Understanding User Environments (continued)

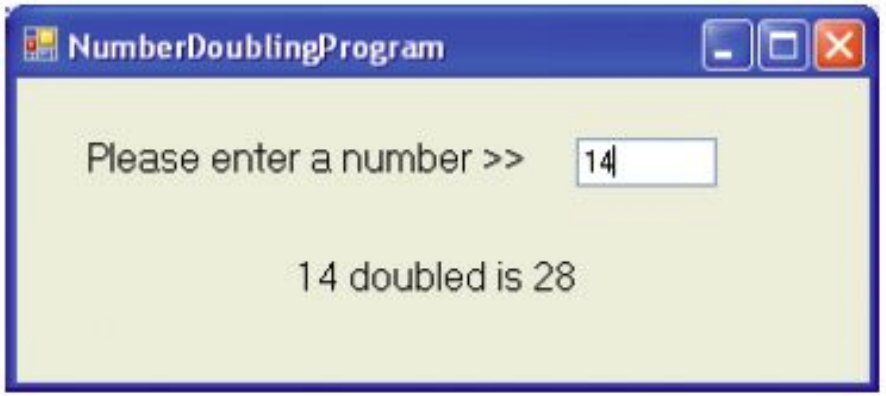


Figure 1-14 Executing a number-doubling program in a GUI environment

Understanding the Evolution of Programming Models

- People have been writing modern computer programs since the 1940s
- **Newer programming languages**
  - Look much more like natural language
  - Are 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
  - This text
    - Focuses on procedural programming techniques

Summary

- Hardware and software accomplish input, processing, and output
- Logic must be developed correctly
- Logical errors are much more difficult to locate than syntax errors
- Use flowcharts, pseudocode, IPO charts, and TOE charts to plan the logic
- Avoid infinite loops by testing for a sentinel value
- Use a text editor or an IDE to enter your program statements