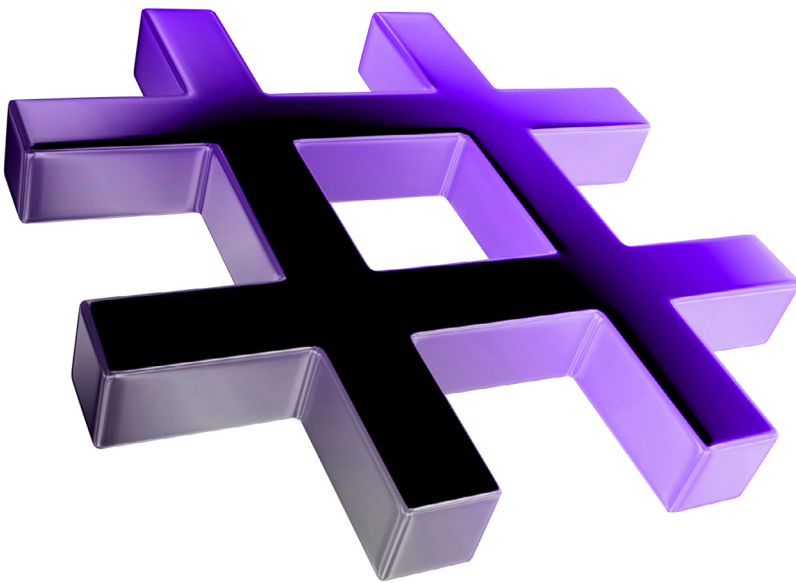# Introduction to Computers, the Internet and Visual C#

1

Objectives

In this chapter you'll:

- Learn basic computer hardware, software and data concepts.

- Be introduced to the different types of computer programming languages.

- Understand the history of the Visual C# programming language and the Windows operating system.

- Learn what cloud computing with Microsoft Azure is.

- Understand the basics of object technology.

- Be introduced to the history of the Internet and the World Wide Web.

- Understand the parts that Windows, .NET, Visual Studio and C# play in the C# ecosystem.

- Test-drive a Visual C# drawing app.

Self-Review Exercises

1.1   Fill in the blanks in each of the following statements:

a) Computers process data under the control of sequences of instructions called _____.

ANS: computer programs.

b) A computer consists of various devices referred to as _____, such as the keyboard, screen, mouse, hard disks, memory, DVD drives and processing units.

ANS: hardware.

c) Data items processed by computers form a(n) _____ that becomes larger and more complex in structure as we progress from the simplest data items (called "bits") to richer data items, such as characters, fields, and so on.

ANS: data hierarchy.

d) Computers can directly understand only their _____ language, which is composed only of 1s and 0s.

ANS: machine.

e) The three types of computer programming languages discussed in the chapter are machine languages, _____ and _____.

ANS: assembly languages, high-level languages.

f) Programs that translate high-level-language programs into machine language are called _____.

ANS: compilers.

g) A(n) _____ processor implements several processors on a single "microchip"—a dual-core processor has two CPUs and a quad-core processor has four CPUs.

ANS: multicore.

h) Windows 10 introduced the _____ for building Windows apps that run on desktop computers, notebook computers, tablets, phones, Xbox and even Microsoft's new HoloLens augmented reality holographic headset—all using nearly identical code.

ANS: Universal Windows Platform (UWP).

1.2   Fill in the blanks in each of the following statements:

a) Objects, or more precisely the _____ that objects come from, are essentially reusable software components.

ANS: classes.

b) You send messages to an object. Each message is implemented as a method _____ that tells a method of the object to perform its task.

ANS: call.

c) A new class of objects can be created quickly and conveniently by _____; the new class absorbs the characteristics of an existing class, possibly customizing them and adding unique characteristics of its own.

ANS: inheritance.

d) To create the best solutions, you should follow a detailed analysis process for determining your project's _____ (i.e., defining what the system is supposed to do) and developing a design that satisfies them (i.e., deciding how the system should do it).

ANS: requirements.

e) Visual C# is _____ driven. You'll write programs that respond to mouse clicks, keystrokes, timer expirations and touches and finger swipes.

ANS: event.

f) A key goal of Java is to be able to write programs that will run on a great variety of computer systems and computer-control devices. This is sometimes called _____.

ANS: write once, run anywhere.

1.3   Fill in the blanks in each of the following statements:

a) The _____ executes .NET programs.

ANS: Common Language Runtime (CLR) of the .NET Framework.

b) The CLR provides various services to _____ code, such as integrating software components written in different .NET languages, error handling between such components, enhanced security and more.

ANS: managed.

c) The ability of a program to run without modification across multiple platforms is known as platform _____.

ANS: independence.

d) Visual Studio is a(n) _____ in which C# programs are developed.

ANS: IDE.

e) You can sell your own Windows Phone apps in the _____.

ANS: Windows Store.

1.4 State whether each of the following is *true* or *false*. If *false*, explain why.

a) Software objects model both abstract and real-world things.

ANS: True.

b) The most popular database model is the *relational database* in which data is stored in simple *tables*. A table includes *records* and *fields*.

ANS: True.

c) A database is a collection of data that's organized for easy access and manipulation.

ANS: True.

d) Secondary storage data takes much longer to access than data in primary memory, but the cost per unit of secondary storage is much higher than that of primary memory.

ANS: False: The cost per unit of secondary storage is much lower than that of primary memory.

e) High-level languages allow you to write instructions that look almost like everyday English and contain commonly used mathematical expressions.

ANS: True.

f) An object has attributes that it carries along as it's used in a program.

ANS: True.

g) The Transmission Control Protocol (TCP) ensures that messages, consisting of sequentially numbered pieces called bytes, were properly routed from sender to receiver, arrived intact and were assembled in the correct order

ANS: False. The pieces are called packets, not bytes.

h) The information-carrying capacity of communications lines on the Internet has increased tremendously, while hardware costs have increased.

ANS: False. Hardware costs have decreased.

i) You can build web-based apps with C# and Microsoft's ASP.NET technology.

ANS: True.

j) Java has become the key programming language for the Mac OS X desktop operating system and all iOS-based devices, such as iPods, iPhones and iPads.

ANS: False. The language is Swift, not Java.

k) Microsoft's ASP.WEB technology is used to create web apps.

ANS: False. It's ASP.NET technology.

l) Microsoft's Windows operating system is the most widely used desktop operating system worldwide.

ANS: True.

1.5 Arrange these byte measurements in order from smallest to largest: terabyte, megabyte, petabyte, gigabyte and kilobyte.

ANS: kilobyte, megabyte, gigabyte, terabyte, petabyte.

1.6   Describe the two-step translation process for preparing your C# code to execute on your particular computer.

> **ANS:** C# code is first compiled into MSIL and placed in an executable file. When the app executes, another compiler called the JIT (just-in-time) compiler in the CLR translates the MSIL in the executable file into machine-language code (for a particular platform).

Exercises

1.7   Fill in the blanks in each of the following statements:

a) The programs that run on a computer are referred to as _____.

> **ANS:** software

b) Systems such as smartphones, appliances, game controllers, cable set-top boxes and automobiles that contain small computers are called _____.

> **ANS:** embedded systems

c) Just as characters are composed of bits, _____ are composed of characters or bytes.

> **ANS:** fields

d) Information on secondary storage devices is _____; it's preserved even when the computer's power is turned off.

> **ANS:** persistent

e) Translator programs called _____ convert high-level language code into machine-language code.

> **ANS:** compilers

f) In object-oriented programming languages, we create a program unit called a(n) _____ to house the set of methods that perform its tasks.

> **ANS:** class

g) Use a building-block approach to creating your programs. Avoid reinventing the wheel—use existing pieces wherever possible. Such software _____ is a key benefit of object-oriented programming.

> **ANS:** reuse

1.8   Fill in the blanks in each of the following statements:

a) Although many different OOAD processes exist, a single graphical language for communicating the results of *any* OOAD process has come into wide use. This language, known as the _____, is now the most widely used graphical scheme for modeling object-oriented systems.

> **ANS:** UML

b) Tim Berners-Lee developed the _____ for sharing information via "hyperlinked" text documents on the web.

> **ANS:** HyperText Markup Language (HTML)

c) The CLR is a(n) _____ machine. It is software that manages the execution of programs and hides from them the underlying operating system and hardware.

> **ANS:** virtual

d) Converting a program to run on a different platform from which it was originally intended is called _____.

> **ANS:** porting.

e) Microsoft's Windows _____ is a cloud-computing platform that allows you to develop, manage and distribute your apps in the cloud.

> **ANS:** Azure. (Instructor Note: "Microsoft's Windows" should be simply "Microsoft" in this exercise.)

    f) By using existing controls—which are objects—you can create powerful apps much faster than if you had to write all the code yourself. This is a key benefit of software _____.

    ANS: reuse

1.9   State whether each of the following is *true* or *false*. If *false*, explain why.

    a) The smallest data item in a computer can assume the value 1 or the value 2. Such a data item is called a **bit** (short for "binary digit"—a digit that can assume either of *two* values).

    ANS: False. Such items have the value 0 or 1.

    b) The Unicode character set is a popular subset of ASCII that represents uppercase and lowercase letters, digits and some common special characters.

    ANS: False. ASCII is a subset of Unicode.

    c) Each of the following is a form of computer output: data displayed on screens, printed on paper, played as audio or video on PCs and media players, used to control other devices, such as robots, 3D printers and "intelligent" appliances.

    ANS: True.

    d) Reuse helps you build more reliable and effective systems, because existing classes and components often have gone through extensive testing, debugging and performance tuning.

    ANS: True.

    e) One of the W3C's primary goals is to make the web universally accessible to everyone regardless of disabilities, language or culture.

    ANS: True.

    f) C# is available only on Microsoft Windows.

    ANS: False. There are ports of C# for other platforms, such as Linux.

    g) The .NET Framework Class Library has millions of valuable prebuilt classes that have been tested and tuned to maximize performance.

    ANS: False. Thousands, not millions, of prebuilt classes.

    h) .NET programs can run on any platform.

    ANS: False. .NET prorgrams run on the Common Language Runtime, which is a virtual machine.

    i) The Universal Windows Platform (UWP) is designed to provide a common platform (the underlying system on which apps run) and user experience across all of your devices including personal computers, smartphones, tablets and Xbox Live.

    ANS: True.

1.10   What is a key advantage of interpreters over compilers? What is a key disadvantage?

    ANS: A key advantage is that interpreters can execute high-level language programs directly (without the need for compilation). A key disadvantage is that interpreted programs exexute more slowly than compiled programs.

1.11   What is the key advantage of using the new `async` feature in preference to using old-style multithreading?

    ANS: The new features simplify asynchronous programming, because the compiler hides much of the associated complexity from the developer.

1.12   What are operating systems?

    ANS: Operating systems are software systems that make using computers more convenient for users, app developers and system administrators. They provide services that allow each app to execute safely, efficiently and concurrently (i.e., in parallel) with other apps.

1.13   Why is using cloud-computing resources sometimes preferable to purchasing all the hardware you need for your own computer?

> **ANS:** Cloud computing gives you the flexibility to increase or decrease computing resources to meet your resource needs at any given time, making it more cost effective than purchasing expensive hardware to ensure that you have enough storage and processing power at their occasional peak levels.

1.14   Categorize each of the following items as either hardware or software:

> a) CPU
> **ANS:** Hardware.
> b) Compiler
> **ANS:** Software
> c) Input unit
> **ANS:** Hardware.
> d) A word-processor program
> **ANS:** Software
> e) A C# program
> **ANS:** Software

1.15   Translator programs, such as assemblers and compilers, convert programs from one language (referred to as the source language) to another language (referred to as the target language). Determine which of the following statements are *true* and which are *false*:

> a) An assembler translates source-language programs into machine-language programs.
> **ANS:** True.
> b) High-level languages are generally machine dependent.
> **ANS:** False. A high-level language must be compiled into machine-dependent language before it can be executed. This allows high-level languages to be used on all computers with appropriate compilers.
> c) A machine-language program requires translation before it can be run on a computer.
> **ANS:** False. A machine-language program is native to a specific machine.
> d) The C# compiler translates high-level-language programs into SMIL.
> **ANS:** False. It translates C# into MSIL.

1.16   Expand each of the following acronyms:

> a) W3C
> **ANS:** World Wide Web Consortium
> b) OOP
> **ANS:** Object-Oriented Programming
> c) CLR
> **ANS:** Common Language Runtime
> d) MSIL
> **ANS:** Microsoft Intermediate Language
> e) UML
> **ANS:** Unified Modeling Language
> f) IDE
> **ANS:** Integrated Development Environment

1.17   What are the key benefits of the .NET Framework and the CLR? What are the drawbacks?

> **ANS:** The key benefits are portability between operating systems and interoperability between languages. As long as a CLR exists for a platform, it can run any .NET program. Programmers can concentrate on program logic instead of platform-specific details. Thus, the double compilation (code-to-MSIL, and MSIL-to-machine code) allows for platform independence: Programs can be written once and executed on any

platform supporting the CLR—this is known as platform independence. Code written once could easily be used on another machine without modification, saving time and money. A second benefit of the .NET framework is language interoperability—software components written in different languages can interact (language independence). A drawback associated with these features is that .NET programs cannot be run until the .NET Framework is developed for a platform. Another is the overhead of the double compilation that is needed before a .NET-language program can be executed.

1.18   What are the advantages to using object-oriented techniques?

ANS: Programs that use object-oriented programming techniques are easier to understand, correct and modify. The key advantage with using object-oriented programming is that it tends to produce software that is more understandable, because it is better organized and has fewer maintenance requirements than software produced with earlier methodologies. OOP helps the programmer build applications faster by reusing existing software components that model items in the real world. OOP also helps programmers create new software components that can be reused on future software development projects. Building software quickly, correctly, and economically has been an elusive goal in the software industry. The modular, object-oriented design and implementation approach has been found to increase productivity while reducing development time, errors, and cost.

1.19   You are probably wearing on your wrist one of the world's most common types of objects—a watch. Discuss how each of the following terms and concepts applies to the notion of a watch: object, attributes and behaviors.

ANS: The entire watch is an object that is composed of many other objects (the moving parts, the band, the face, etc.) Watch attributes are time, color, band style, technology (digital or analog), and the like. The behaviors of the watch include setting the time and getting the time. A watch can be considered a specific type of clock (as can an alarm clock).

1.20   What is the key accomplishment of the UML?

ANS: It replaced the many different graphical modeling languages with a single (unified) language for modeling that can be used by developers regardless of the different OOAD processes they may use.

1.21   What did the chief benefit of the early Internet prove to be?

ANS: Communication by e-mail. Today, that communication is also facilitated by applications such as instant messaging and file transfer.

1.22   What is the key capability of the web?

ANS: It allows computer users to locate and view multimedia-based documents on almost any subject over the Internet.

1.23   What is the key vision of Microsoft's .NET initiative?

ANS: To embrace the Internet and the web in the development and use of software.

1.24   How does the .NET Framework Class Library facilitate the development of .NET apps?

ANS: First, the Framework Class Library is a large library of reusable classes that reduces development time. Programmers can build software quickly by reusing framework's classes, rather than building new classes "from scratch." Second, the Framework Class Library is shared by all of the .NET languages, which means that programmers who work in multiple languages have to learn only one class library.

1.25   Besides the obvious benefits of reuse made possible by OOP, what do many organizations report as another key benefit of OOP?

> **ANS:** That OOP tends to produce software that is more understandable, better organized, and easier to maintain, modify and debug.

Making-a-Difference Exercises

The Making-a-Difference exercises will ask you to work on problems that really matter to individuals, communities, countries and the world.

1.26   *(Test Drive: Carbon Footprint Calculator)* Some scientists believe that carbon emissions, especially from the burning of fossil fuels, contribute significantly to global warming and that this can be combatted if individuals take steps to limit their use of carbon-based fuels. Various organizations and individuals are increasingly concerned about their "carbon footprints." Websites such as TerraPass

> `http://www.terrapass.com/carbon-footprint-calculator-2/`

and Carbon Footprint

> `http://www.carbonfootprint.com/calculator.aspx`

provide carbon-footprint calculators. Test drive these calculators to determine your carbon footprint. Exercises in later chapters will ask you to program your own carbon-footprint calculator. To prepare for this, research the formulas for calculating carbon footprints.

1.27   *(Test Drive: Body-Mass-Index Calculator)* By recent estimates, two-thirds of the people in the United States are overweight and about half of those are obese. This causes significant increases in illnesses such as diabetes and heart disease. To determine whether a person is overweight or obese, you can use a measure called the body mass index (BMI). The United States Department of Health and Human Services provides a BMI calculator at `http://www.nhlbi.nih.gov/guidelines/obesity/BMI/bmicalc.htm`. Use it to calculate your own BMI. An exercise in Chapter 3 will ask you to program your own BMI calculator. To prepare for this, research the formulas for calculating BMI.

1.28   *(Attributes of Hybrid Vehicles)* In this chapter you learned the basics of classes. Now you'll begin "fleshing out" aspects of a class called "Hybrid Vehicle." Hybrid vehicles are becoming increasingly popular, because they often get much better mileage than purely gasoline-powered vehicles. Browse the web and study the features of four or five of today's popular hybrid cars, then list as many of their hybrid-related attributes as you can. For example, common attributes include city-miles-per-gallon and highway-miles-per-gallon. Also list the attributes of the batteries (type, weight, etc.).

> **ANS:**

- Manufacturer
- Type of Hybrid—Battery hybrid (Hybrid Electric Vehicles), Plug-in hybrid, Fuel cell etc.
- Driver feedback system—so the driver can monitor fuel efficiency based on their driving
- Energy recovery—for example, regenerative breaking
- Carbon footprint—tons of CO_2 per year
- Fuel capacity
- City-miles-per-gallon
- Highway-miles-per-gallon
- Two-mode hybrid propulsion system
- Engine size—V6, V8, etc.
- Vehicle type—SUV, crossover, compact, mid-size, etc.

- Seating capacity
- Horse power
- Drive train (front wheel drive, all wheel drive)
- Top speed
- Torque
- Price

1.29   *(Gender Neutrality)* Some people want to eliminate sexism in all forms of communication. You've been asked to create a program that can process a paragraph of text and replace gender-specific words with gender-neutral ones. Assuming that you've been given a list of gender-specific words and their gender-neutral replacements (e.g., replace "wife" with "spouse," "man" with "person," "daughter" with "child" and so on), explain the procedure you'd use to read through a paragraph of text and manually perform these replacements. How might your procedure generate a strange term like "woperchild," which is actually listed in the Urban Dictionary (`www.urbandictionary.com`)? In Chapter 5, you'll learn that a more formal term for "procedure" is "algorithm," and that an algorithm specifies the steps to be performed and the order in which to perform them.

    ANS: Search through the entire paragraph for a word such as "wife" and replace every occurrence with "spouse." Repeat this searching process for every gender specific word in the list. You could accidentally get a word like "woperchild" if you are not careful about how you perform replacements. For example, the word "man" can be part of a larger word, like "woman." So, replacing every occurrence of "man" can yield strange results. Consider the process of replacing "man" with "person" then replacing "son" with "child." If you encounter the word "woman," which contains the word "man," you'd replace "man" with "person" resulting in the word "woperson." In a subsequent pass you'd encounter "woperson" and replace "son" with "child" resulting in the "woperchild."