# Introduction to Computers, the Internet and Java

# 1

## Objectives

In this chapter you'll:

- Learn about exciting recent developments in the computer field.
- Learn computer hardware, software and networking basics.
- Understand the data hierarchy.
- Understand the different types of programming languages.
- Understand the importance of Java and other leading programming languages.
- Understand object-oriented programming basics.
- Learn Internet and web basics.
- Learn a typical Java program-development environment.
- Test-drive a Java application.
- Learn some key recent software technologies.

## Self-Review Exercises

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

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

**ANS:** programs.

b) The key logical units of the computer are the _____, _____, _____, _____, _____ and _____.

**ANS:** input unit, output unit, memory unit, central processing unit, arithmetic and logic unit, secondary storage unit.

c) The three types of languages discussed in the chapter are _____, _____ and _____.

**ANS:** machine languages, assembly languages, high-level languages.

d) The programs that translate high-level language programs into machine language are called _____.

**ANS:** compilers.

e) _____ is an operating system for mobile devices based on the Linux kernel and Java.

**ANS:** Android.

f) _____ software is generally feature complete, (supposedly) bug free and ready for use by the community.

**ANS:** Release candidate.

g) The Wii Remote, as well as many smartphones, use a(n) _____ which allows the device to respond to motion.

**ANS:** accelerometer.

**1.2** Fill in the blanks in each of the following sentences about the Java environment:

a) The _____ command from the JDK executes a Java application.

**ANS:** `java`.

b) The _____ command from the JDK compiles a Java program.

**ANS:** `javac`.

c) A Java source code file must end with the _____ file extension.

**ANS:** `.java`.

d) When a Java program is compiled, the file produced by the compiler ends with the _____ file extension.

**ANS:** `.class`.

e) The file produced by the Java compiler contains _____ that are executed by the Java Virtual Machine.

**ANS:** bytecodes.

**1.3** Fill in the blanks in each of the following statements (based on Section 1.5):

a) Objects enable the design practice of _____—although they may know how to communicate with one another across well-defined interfaces, they normally are not allowed to know how other objects are implemented.

**ANS:** information hiding.

b) Java programmers concentrate on creating _____, which contain fields and the set of methods that manipulate those fields and provide services to clients.

**ANS:** classes.

c) The process of analyzing and designing a system from an object-oriented point of view is called _____.

**ANS:** object-oriented analysis and design (OOAD).

d) A new class of objects can be created conveniently by _____ —the new class (called the subclass) starts with the characteristics of an existing class (called the superclass), possibly customizing them and adding unique characteristics of its own.

**ANS:** Inheritance.

e) _____ is a graphical language that allows people who design software systems to use an industry-standard notation to represent them.

**ANS:** The Unified Modeling Language (UML).

f) The size, shape, color and weight of an object are considered _____ of the object's class.

**ANS:** attributes.

## Exercises

**1.4** Fill in the blanks in each of the following statements:

a) The logical unit that receives information from outside the computer for use by the computer is the _____.

**ANS:** input unit.

b) The process of instructing the computer to solve a problem is called _____.

**ANS:** computer programming.

c) _____ is a type of computer language that uses Englishlike abbreviations for machine-language instructions.

**ANS:** Assembly language.

d) _____ is a logical unit that sends information which has already been processed by the computer to various devices so that it may be used outside the computer.

**ANS:** The output unit.

e) _____ and _____ are logical units of the computer that retain information.

**ANS:** The memory unit, the secondary storage unit.

f) _____ is a logical unit of the computer that performs calculations.

**ANS:** The arithmetic and logic unit (ALU).

g) _____ is a logical unit of the computer that makes logical decisions.

**ANS:** The arithmetic and logic unit (ALU).

h) _____ languages are most convenient to the programmer for writing programs quickly and easily.

**ANS:** High-level.

i) The only language a computer can directly understand is that computer's _____.

**ANS:** machine language.

j) _____ is a logical unit of the computer that coordinates the activities of all the other logical units.

**ANS:** The central processing unit (CPU).

**1.5** Fill in the blanks in each of the following statements:

a) The _____ programming language is now used to develop large-scale enterprise applications, to enhance the functionality of web servers, to provide applications for consumer devices and for many other purposes.

**ANS:** Java.

b) _____ initially became widely known as the development language of the UNIX operating system.

**ANS:** C.

c) The _____ 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:** Transmission Control Protocol (TCP).

d) The _____ programming language was developed by Bjarne Stroustrup in the early 1980s at Bell Laboratories.

**ANS:** C++.

**1.6** Fill in the blanks in each of the following statements:

a) Java programs normally go through five phases—_____, _____, _____, _____ and _____.

**ANS:** edit, compile, load, verify, execute.

b) A(n) _____ provides many tools that support the software development process, such as editors for writing and editing programs, debuggers for locating logic errors in programs, and many other features.

**ANS:** integrated development environment (IDE).

c) The command `java` invokes the _____, which executes Java programs.

**ANS:** Java Virtual Machine (JVM).

d) A(n) _____ is a software application that simulates a computer, but hides the underlying operating system and hardware from the programs that interact with it.

**ANS:** virtual machine (VM).

e) The _____ takes the `.class` files containing the program's bytecodes and transfers them to primary memory.

**ANS:** class loader.

f) The _____ examines bytecodes to ensure that they're valid.

**ANS:** bytecode verifier.

**1.7** Explain the two compilation phases of Java programs.

**ANS:** The two compilation phases that Java programs typically go through include one in which source code is translated into bytecodes which are portable across JVMs and a second in which the bytecodes are translated into machine language for the actual computer on which the program executes. In early Java versions, the JVM was simply an interpreter for Java bytecodes. This caused most Java programs to execute slowly because the JVM would interpret and execute one bytecode at a time. Today's JVMs typically execute bytecodes using a combination of interpretation and so-called just-in-time (JIT) compilation. In this process, The JVM analyzes the bytecodes as they are interpreted, searching for hot spots—parts of the bytecodes that execute frequently. For these parts, a just-in-time (JIT) compiler—known as the Java HotSpot compiler—translates the bytecodes into the underlying computer's machine language. When the JVM encounters these compiled parts again, the faster machine-language code executes.

**1.8** One of the world's most common objects is a wrist watch. Discuss how each of the following terms and concepts applies to the notion of a watch: object, attributes, behaviors, class, inheritance (consider, for example, an alarm clock), modeling, messages, encapsulation, interface and information hiding.

**ANS:** The entire watch is an object that is composed of many other objects (such as the moving parts, the band, the face, etc.) Watch attributes are time, color, band, style (digital or analog), etc. 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). With that in mind, it is possible that a class called `Clock` could exist from which other classes such as watch and alarm clock could inherit the basic features in

the clock. The watch is an abstraction of the mechanics needed to keep track of the time. The user of the watch does not need to know the mechanics of the watch in order to use it; the user only needs to know that the watch keeps the proper time. In this sense, the mechanics of the watch are encapsulated (hidden) inside the watch. The interface to the watch (its face and controls for setting the time) allows the user to set and get the time. The user is not allowed to directly touch the internal mechanics of the watch. All interaction with the internal mechanics is controlled by the interface to the watch. The data members stored in the watch are hidden inside the watch and the member functions (looking at the face to get the time and setting the time) provide the interface to the data.

## Making a Difference

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

**1.9** *(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 combated 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

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http://www.terrapass.com/carbon-footprint-calculator-2/
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and Carbon Footprint

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

**1.10** *(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.

**1.11** *(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

**1.12** ***(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?" In Chapter 4, 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."

**1.13** ***(Intelligent Assistants)*** Developments in the field of artificial intelligence have been accelerating in recent years. Many companies now offer computerized intelligent assistants, such as IBM's Watson, Amazon's Alexa, Apple's Siri, Google's Google Now and Microsoft's Cortana. Research these and others and list uses that can improve people's lives.

**1.14** ***(Big Data)*** Research the rapidly growing field of big data. List applications that hold great promise in fields such as healthcare and scientific research.

**1.15** ***(Internet of Things)*** It's now possible to have a microprocessor at the heart of just about any device and to connect those devices to the Internet. This has led to the notion of the Internet of Things (IoT), which already interconnects tens of billions of devices. Research the IoT and indicate the many ways it's improving people's lives.