**Chapter 1**

**1.1**

a) Computers process data under the control of sets of instructions called programs.  
b) The key logical units of the computer are the input unit, output unit, memory unit, arithmetic and logic unit (ALU), control unit, and secondary storage unit.  
c) The three types of languages are machine languages, assembly languages, and high-level languages.  
d) The programs that translate high-level language programs into machine language are called compilers.  
e) Android is an operating system for mobile devices based on the Linux kernel and Java.  
f) Production (or release) software is generally feature-complete, bug-free, and ready for use by the community.  
g) The Wii Remote, as well as many smartphones, uses an accelerometer, which allows the device to respond to motion.

**1.2**

a) The java command from the JDK executes a Java application.  
b) The javac command from the JDK compiles a Java program.  
c) A Java source code file must end with the .java file extension.  
d) When a Java program is compiled, the file produced by the compiler ends with the .class file extension.  
e) The file produced by the Java compiler contains byte codes that are executed by the Java Virtual Machine.

**1.3**

a) Objects enable the design practice of information hiding (or encapsulation)—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.  
b) Java programmers concentrate on creating classes, which contain fields and the set of methods that manipulate those fields and provide services to clients.  
c) The process of analyzing and designing a system from an object-oriented point of view is called object-oriented analysis and design (OOAD).  
d) A new class of objects can be created conveniently by inheritance—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.  
e) UML (Unified Modeling Language) is a graphical language that allows people who design software systems to use an industry-standard notation to represent them.  
f) The size, shape, color, and weight of an object are considered attributes (or properties) of the object’s class.

**1.4**

a) The logical unit that receives information from outside the computer for use by the computer is the input unit.  
b) The process of instructing the computer to solve a problem is called programming.  
c) Assembly language is a type of computer language that uses English-like abbreviations for machine-language instructions.  
d) Output unit is a logical unit that sends information that has already been processed by the computer to various devices so that it may be used outside the computer.  
e) Memory unit and secondary storage unit are logical units of the computer that retain information.  
f) Arithmetic and logic unit (ALU) is a logical unit of the computer that performs calculations.  
g) Arithmetic and logic unit (ALU) is a logical unit of the computer that makes logical decisions.  
h) High-level languages are most convenient to the programmer for writing programs quickly and easily.  
i) The only language a computer can directly understand is that computer’s machine language.  
j) Control unit is a logical unit of the computer that coordinates the activities of all the other logical units.

**1.5**

a) The Java 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.  
b) C initially became widely known as the development language of the UNIX operating system.  
c) The TCP (Transmission Control Protocol) ensures that messages, consisting of sequentially numbered pieces called bytes, are properly routed from sender to receiver, arrive intact, and are assembled in the correct order.  
d) The C++ programming language was developed by Bjarne Stroustrup in the early 1980s at Bell Laboratories.

**1.6**

a) Java programs normally go through five phases—edit, compile, load, verify, and execute.  
b) An integrated development environment (IDE) 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.  
c) The command java invokes the Java Virtual Machine (JVM), which executes Java programs.  
d) A virtual machine is a software application that simulates a computer, but hides the underlying operating system and hardware from the programs that interact with it.  
e) The class loader takes the .class files containing the program’s byte codes and transfers them to primary memory.  
f) The byte code verifier examines byte codes to ensure that they’re valid.

1.7 Explain the two compilation phases of Java programs.

1. **Compilation phase** – This is when Java compiler (JAVAC) translate java source code files (.java) to byte codes (.class) so that it can be executed.
2. **Execution phase** – The Java Virtual Machine (JVM) loads the byte codes, verifies it, and interprets or just-in-time compiles (JIT) it into machine code suitable for the host system to executing the program.

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.

**Watches** are objects that possess **attributes** such as brand, color, and size, and exhibit **behaviors** like ticking and showing the time. This class defines the general characteristics of a watch.

An **Alarm Clock** (subclass) can **inherit** the behaviors and attributes of the **Watches** (superclass) while adding its own unique features, such as the ability to **set an alarm**.

The **Alarm Clock’s internal mechanism** is hidden behind its **interface**, where the user interacts to view the time or set the alarm. This hiding of internal details is known as **encapsulation**, and it helps prevent unnecessary or sensitive information from being exposed.

**Making a Difference**

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 combatted if individuals take steps to limit their use of carbon-based fuels. Organizations and individuals are increasingly concerned about their “carbon footprints.” Websites such as TerraPass http://www.terrapass.com/carbon-footprint-calculator/ 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, use the web to research the formulas for calculating carbon footprints.

**•** Carbon footprint calculations consider factors such as **energy use, transportation, diet, and consumption habits**, combining **CO₂ emission rates per activity** (for example, kilograms of CO₂ emitted per liter of fuel).

1.10 (Test-Drive: Body Mass Index Calculator)

Obesity 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. A forthcoming exercise will ask you to program your own BMI calculator. To prepare for this, use the web to research the formulas for calculating BMI.

**The formula for Body Mass Index (BMI) is:   
  BMI = weight (kg) / [height (m)] ²  
For U.S. customary units: BMI = 703 × weight (lb.) / [height (in)] ²**

1.11 (Attributes of Hybrid Vehicles)

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. Some common attributes include city-miles-per-gallon and highway-miles-per-gallon. Also list the attributes of the batteries (type, weight, etc.).

**• Example attributes include: city MPG, highway MPG, battery type, battery capacity (kWh), battery weight, engine size, CO₂ emissions per mile, electric-only range, fuel tank capacity, and charging time.**

1.12 (Gender Neutrality)

Many 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 both “wife” and “husband” with “spouse,” “man” and “woman” with “person,” “daughter” and “son” with “child”), 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?” You’ll soon 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. We’ll show how to develop algorithms then convert them to Java programs which can be run on computers.

**•** **Procedure:** Read the text word by word, compare each term to a list of gendered words, replace them with gender-neutral alternatives, and then save the revised text.  
**•** **Problem:** Unintended words (for example, “woperchild”) may appear if replacements are applied to **substrings** instead of **whole words**.