**Chapter 1**

**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 \_\_\_\_\_Computer programs\_\_\_\_\_\_ .

b) The key logical units of the computer are the \_\_\_\_\_\_Input unit,\_\_\_Output unit\_\_\_,\_\_\_Memory unit\_\_\_\_\_ ,\_\_\_Arithmetic and logic unit\_\_ ,\_\_\_Central processing unit\_\_\_ and \_\_Secondary storage unit\_\_\_\_.

c) The three types of languages they are\_\_\_Machine language\_\_\_\_ , \_\_\_\_Assembly language\_\_\_\_\_and \_\_\_High level language\_\_\_\_\_.

d) The programs that translate high-level language programs into machine language are called \_\_\_\_\_Compilers\_\_\_\_\_\_\_ .

e) \_\_\_\_Andriod\_\_\_\_is an operating system for mobile devices based on the Linux kernel and Java.

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

g) The Wii Remote, as well as many smartphones, use a(n) \_\_\_\_Accelerometer\_\_\_\_which allows the device to respond to motion.

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

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 \_\_\_\_Bytecodes\_\_\_\_\_ that are executed by the Java Virtual Machine.

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

a) Objects enable the design practice of\_\_\_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) \_\_\_\_Unified modeling language (UML)\_\_\_\_ 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\_\_\_\_ of the object’s class.

**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 \_\_\_\_Output unit\_\_\_ .

b) The process of instructing the computer to solve a problem is called \_\_\_Programming\_\_ .

c) \_\_\_Assemblers\_\_\_ is a type of computer language that uses English-like abbreviations for machine-language instructions.

d) \_\_\_\_Input unit\_\_\_\_ 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.

e) \_\_\_\_Primary memory\_\_\_\_and \_\_\_RAM\_\_\_ are logical units of the computer that retain information.

f) \_\_\_\_\_Arithmetic\_\_\_\_\_ is a logical unit of the computer that performs calculations. g) \_\_\_\_Logic\_\_\_\_ 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 Fill in the blanks in each of the following statements:**

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\_\_\_\_ 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.

d) The \_\_\_\_\_C++\_\_\_\_\_\_\_ programming language was developed by Bjarne Stroustrup in the early 1980s at Bell Laboratories.

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

a) Java programs normally go through five phases— \_\_\_edit\_\_\_, \_\_\_compile\_\_\_\_ ,\_\_\_\_\_load\_\_\_\_ , \_\_\_\_verify\_\_\_\_\_ and \_\_\_\_execute\_\_\_\_\_ .

b) A(n)\_\_\_\_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 \_\_\_\_\_JVM\_\_\_\_\_, which executes Java programs.

d) A(n) \_\_\_\_JVM\_\_\_\_ 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 \_\_\_\_JVM’s class loader\_\_\_\_\_ takes the .class files containing the program’s bytecodes and transfers them to primary memory. f) The examines bytecodes to ensure that they’re valid.

f) The \_\_\_\_Bytecode verifier\_\_\_\_\_\_ examines bytecodes to ensure that they’re valid.

1.7 Explain the two compilation phases of Java programs.

Java programs undergo two main compilation phases:

1. Source Code Compilation:

- The Java source code (`.java` files) is compiled by the Java Compiler (`javac`) into bytecode, which is stored in `.class` files. This bytecode is platform-independent.

2. Bytecode Execution:

- The Java Virtual Machine (JVM) executes the bytecode. It can interpret the bytecode or use Just-In-Time (JIT) compilation to convert it into native machine code for execution. This phase includes runtime checks and memory management.

These phases enable Java's "write once, run anywhere" capability.

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.

**1. Object**

A **watch** is an **object** — a specific, real-world thing that can be represented in software.

**2. Attributes**

These are the **characteristics or data** of the watch, such as:

* Color, brand, shape, weight, time format (12/24-hour), material, and battery level.

**3. Behaviors**

These are the **actions or functions** the watch can perform, such as:

* Displaying time, setting the time/date, starting a stopwatch, or ringing an alarm.

**4. Class**

The **class** is the **blueprint** or **template** from which watch objects are created.

* Example: class Watch could define all common features and behaviors of watches.

**5. Inheritance**

A **subclass** can inherit from the main Watch class.

* Example: An **AlarmClock** class can **inherit** from Watch and **add** new behavior like setAlarm() and ringAlarm().

**6. Modeling**

**Modeling** means representing the real-world watch as a software object.

* We capture its attributes and behaviors in a structured way so a computer can simulate it.

**7. Messages**

**Messages** are the **requests sent between objects** to perform actions.

* Example: A “set time” message sent to the watch object causes it to adjust its time.

**8. Encapsulation**

Encapsulation means **bundling data (attributes)** and **methods (behaviors)** inside one unit — the watch object — so they work together.

**9. Interface**

An **interface** defines **how other objects or users interact** with the watch.

* Example: Buttons or touchscreen functions that allow users to set time or start a stopwatch.

**10. Information Hiding**

The watch **hides its internal working** (like how it tracks time) from the user — the user only interacts through its interface (e.g., pressing buttons), not by accessing internal data directly.

**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.

***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.

***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.).

***1. 2025 Toyota Prius (standard hybrid)***

\* City/Highway/Combined MPG: 56/57/57 mpg (approx) for LE FWD.

\* Battery capacity: 0.9 kWh (for the HEV version) in some trims.

\* Plug-in version (2025 Toyota Prius Plug‑in Hybrid) battery: 13.6 kWh.

\* EV-only range (Plug-in version): ~72 km (~45 miles) in some markets.

***2. 2025 Toyota Camry Hybrid***

\* City/Highway/Combined MPG: 51/50/51 for LE FWD.

\* Battery pack: type = Lithium-Ion; nominal voltage ~251.6 V (68 cells) for one specification.

\* Hybrid system net horsepower: 225 hp (FWD) / 232 hp (AWD) for 2025.

***3. 2025 Hyundai Sonata Hybrid***

\* Combined MPG: ~47 mpg. City/Highway ~44/51 mpg.

\* Battery size: ~1.6 kWh for the hybrid version (non-plug-in).

***4. 2025 Volvo XC70 PHEV (plug-in hybrid)***

\* Battery: Two options noted: 21.22 kWh LFP and 39.63 kWh NMC.

\* Electric-only range: ~72 miles (for smaller battery) and ~131 miles (for larger battery) depending on trim.

***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.