**Chapter 1**

**Self-Review Exercises 1.1**

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

1. 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\_\_\_\_,\_arithmetic and logic unit\_\_\_\_\_\_,\_output unit\_\_\_\_\_\_\_ ,\_central processing unit\_\_\_\_ ,\_\_secondary storage\_\_\_\_ and \_memory unit\_\_\_\_\_.

c) The three types of languages they are\_machine \_\_\_\_\_\_ , assembly\_\_\_\_\_\_\_\_\_and \_\_\_\_high-level languages\_\_\_\_.

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

e) \_Google’s android\_\_\_\_\_\_\_is an operating system for mobile devices based on the Linux kernel and Java.

f) \_release candidates\_\_\_\_\_\_ 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 \_ bitecodes \_\_\_\_\_\_\_\_ 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\_\_information\_\_hiding\_\_\_ —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 obeject-oriented analysis and designs (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) \_\_\_The unified modelling 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 \_\_\_\_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) \_\_\_\_the output 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\_\_\_\_\_and \_\_\_secondary memory\_\_\_ are logical units of the computer that retain information.

f) \_Arithmetic and logic unit\_\_\_\_\_\_\_\_\_ is a logical unit of the computer that performs calculations.

g) \_\_Arithmetic and logic unit\_\_\_\_\_\_ 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) \_\_contro 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 programming language\_\_\_\_\_\_\_\_ initially became widely known as the development language of the UNIX operating system.

c) The \_transmission control protocol\_\_\_\_\_\_\_ 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\_\_\_\_\_\_\_\_ 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 virtul machine\_\_\_\_\_\_, which executes Java programs.

d) A(n) \_\_\_\_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 bytecodes and transfers them to primary memory. f) The examines bytecodes to ensure that they’re valid.

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

1.7 Explain the two compilation phases of Java programs.

Phase 1; Lexical Analysis

The first step in the compilation process is lexical analysis. During this stage, the source code is read and converted into a sequence of tokens. A token is a basic unit of meaning, like keywords (if, while), variables, constants, operators (+, -), and punctuation.

During lexical analysis, the compiler also removes comments, annotations (like // or /\*...\*/), and whitespace (such as spaces, tabs, and newlines). These are ignored because they are not needed for understanding the logic of the program, but they help in writing human-readable code.

This step is performed by the lexer or scanner, which breaks down the source code into these tokens.

Phase 2; Syntax Analysis

The next stage is syntax analysis (also known as parsing). The compiler takes the tokens generated in the previous stage and checks whether they are arranged in a valid way according to the grammar (syntax) of the programming language.

A parser is used to create a parse tree or abstract syntax tree (AST). This tree represents the structure of the program, showing how different parts of the code relate to each other according to the language rules. For example, the parser will check if statements are correctly formed, like ensuring that an if statement has the proper condition and body.

The purpose is to ensure the code follows the language’s syntax rules and that the sequence of tokens makes sense logically in the structure of the program.

During the syntax analysis, if a syntax error is detected, the compilation process stops here and an error message is generated.

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.

**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.

Product Carbon Footprint (PCF) is the total greenhouse gas emissions, measured as carbon dioxide equivalent (CO₂e), created across a product’s entire lifecycle. This covers every stage – from extracting raw materials, through production and manufacturing, all the way to distribution, use, and final disposal.

To make this practical, businesses use two main boundary types:

Cradle-to-gate: Calculates emissions from raw material extraction up to the point the product leaves your factory.

Cradle-to-grave: Includes all stages, from raw materials through production, distribution, use, and end-of-life treatment.

Every step in a product’s journey adds to its footprint. For example, manufacturing a single automobile can result in a footprint of around 40 tonnes of CO₂e. Even a plastic water bottle’s footprint is measured and tracked across sourcing, production, transport, use, and disposal

***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 most common formula for calculating body mass is the Body Mass Index (BMI), which is weight divided by height squared.

There are different formulas for metric and US customary units:

BMI = weight (kg) / [height (m)]\({}^{2}\) or

BMI = [weight (lbs) / height (in)]\({}^{2}\) x 703.

You can also use an alternative metric formula:

BMI = [weight (kg) / height (cm)]\({}^{2}\) x 10,000.

 Metric Units Formula 1:

BMI = weight (kg) / [height (m)]\({}^{2}\)

Formula 2: BMI = [weight (kg) / height (cm)]\({}^{2}\) x 10,000

Example: For a person who weighs \(70\) kg and is \(170\) cm tall:BMI = (\(70\) / (\(170\) \* \(170\))) \* \(10,000\)BMI = (\(70\) / \(28,900\)) \* \(10,000\)BMI \(\approx \) \(24.22\)

Formula: BMI = [weight (lbs) / height (in)]\({}^{2}\) x 703

***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.).

Features

* Motor
* Fuel economy
* Internal combustion engine
* Regenerative breaking
* Less fuel consumption
* Automatic start and stop
* Light material

***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.