**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 a program.

b) The key logical units of the computer are the input unit, output unit, memory unit, Arithmetic and logic unit, control unit and central processing unit.

c) The three types of languages they are: Machine Language, Assembly Language, High-Level Language

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) Release Candidate 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 **bytecode** 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 **object-oriented analysis and design**.

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) **UMLL (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** 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) **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) **Memory unit** and **storage unit** are logical units of the computer that retain information.

f) **ALU(Arithmetic and Logic Unit**) is a logical unit of the computer that performs calculations.

g) **Control 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) **Central Processing 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 **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(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(Java Virtual 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 **bytecode verifier** examines bytecodes to ensure that they’re valid.

1.7 Explain the two compilation phases of Java programs.

Java programs go through two main compilation phases:

1. **Source Code Compilation**: The Java compiler (javac) translates the high-level Java source code (in .java files) into an intermediate form called bytecode, which is stored in .class files.

2. **Bytecode Execution**: The Java Virtual Machine (JVM) loads and interprets the bytecode. The JVM can either interpret the bytecode or use a Just-In-Time (JIT) compiler to translate it into native machine code for execution, making the program run faster.

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.

- **Object:** A wristwatch is an instance of an object. It represents a real-world entity with attributes and behaviors.

- **Attributes:** The wristwatch has attributes like size, color, material, brand, and the current time.

- **Behaviors:** The behaviors of the watch include displaying time, setting the alarm, adjusting the time, and starting a stopwatch.

- **Class:** The wristwatch can be a class representing the blueprint for creating specific watch objects.

- **Inheritance:** An alarm clock is a subclass that inherits attributes and behaviors of a regular watch but adds new features, like an alarm function.

- **Modeling:** Creating a software representation of a wristwatch involves defining the watch's attributes and behaviors in a class structure.

**- Messages:** A watch object can receive messages like "set time" or "start stopwatch," which instruct the object to perform a specific behavior.

- **Encapsulation:** The internal mechanisms of the watch, like how it keeps track of time, are hidden from the user. Only the necessary interfaces for interacting with the watch (like buttons) are exposed.

- **Interface:** The interface of the watch includes the display and buttons, which allow the user to interact with the watch's features.

**- Information Hiding:** The details of how the watch keeps track of time internally are hidden from the user. The user only needs to know how to use the interface.

**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.

The formula for calculating carbon footprint is activity multiplied by emission factor:

* Business Carbon Footprint: Calculate, reduce and report

18 Jan 2022 — The formula to calculate the carbon footprint of a business is simple: the result is obtained by multiplying the activi...

Selectra Climate Consulting

* How to Calculate Carbon Footprint? - Biocode

The carbon footprint is calculated by multiplying the activity variable by the emission factor. Initially, an inventory of all emi...

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Biocode

E=A×EF×(1−ER/100)cap E equals cap A cross cap E cap F cross open paren 1 minus cap E cap R / 100 close paren

𝐸=𝐴×𝐸𝐹×(1−𝐸𝑅/100)

Where:

* **E** = emissions
* **A** = activity rate
* **EF** = emission factor
* **ER** = overall emission reduction efficiency, %

***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 calculating body mass index (BMI) depends on the units of measurement used:

Metric units: BMI = weight (kg) / [height (m)]^2

US customary units: BMI = weight (lb) / [height (in)]^2 x 703

If you're using the metric system and your height is in centimeters, you can use the formula BMI = [weight (kg) / height (cm)^2] x 10,000.

***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. Toyota Prius (2024)

- **City/Highway/Combined MPG:** 57/56/57

- **Battery:** Lithium-ion, lightweight

**- Hybrid System:** Parallel hybrid, regenerative braking

2. **Kia Sportage Hybrid (2024)**

- City/Highway/Combined MPG : 42/44/43

- Battery : High-voltage lithium polymer

- System Power : Combines a gasoline engine with electric motor

3. Ford Maverick (2024)

- City/Highway/Combined MPG : 42/33/37

- Hybrid Powertrain : Full hybrid, efficient for both urban and highway use

- Battery : Compact but durable, placed under the rear seats

4. Hyundai Santa Fe Hybrid (2024)

- City/Highway/Combined MPG : 36/35/36

- Battery Type : Lithium-ion polymer battery, enhancing durability and performance

- System Features : Includes electronic all-wheel drive

***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.

1. Input : Read the paragraph of text.

2. Process :

- Split the text into individual words.

- Check each word against your dictionary of gender-specific terms.

- If a match is found, replace it with the gender-neutral equivalent.

- Ensure no accidental word fragments are created during replacement (e.g., replacing "woman" in "womanhood" might incorrectly produce "personhood").

3. Output : Reconstruct the text and output the modified version.

Generating terms like "woperchild" might occur if word boundaries are not correctly respected during replacement. For example, replacing "wo" in "woman" before replacing "man" could merge fragments into an incorrect word. Managing such replacements requires careful programming logic to handle word boundaries.