**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 **programs**.

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

c) The three types of languages they are **Machine**, **Assembly** and **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) **Production**  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 **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 **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 **Object specified 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 **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** and **storage** are logical units of the computer that retain information.

f) **Arithmeric logic unit (ALU)** is a logical unit of the computer that performs calculations. g) **Arithmeric 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 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) **java** initially became widely known as the development language of the UNIX operating system.

c) The **Transmission control protocol (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— **Editing**, **compiling** ,**loading** , **verification** and **Execution** .

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 (VM)** 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. **Bytecode verifier** 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.

**The Phase 1: Compilation**

**The Java compiler reads the Java code and checks for errors. If there are no errors, it converts the code into a special format called bytecode.**

**The Phase 2: Loading and Verification**

**The Java Virtual Machine (JVM) reads the bytecode, checks if it's correct and safe to run, and then loads it into memory so it can be executed.**

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 watch is an object with its own characteristics, like a car or a phone.**

**Attributes**

**A watch has attributes like time, date, alarm settings, and stopwatch settings. These are its characteristics.**

**Behaviors**

**A watch can display time, set alarms, start/stop the stopwatch, and more. These are its actions.**

**Class**

**A Watch class defines common attributes (characteristics) and behaviors (actions) for all watches.**

**Inheritance**

**An AlarmClock class can inherit from Watch and add new features like playing alarm sounds or snoozing.**

**Modeling**

**A watch can be modeled to simulate its behavior, like how it displays time or responds to button presses.**

**Messages**

**Messages are interactions with the watch, like "Set time" or "Start stopwatch." You send messages to the watch using buttons.**

**Encapsulation**

**A watch hides its internal mechanisms (gears, circuits) and only shows a simple interface (buttons, display). This makes it easy to use.**

**Interface**

**The interface is how you interact with the watch (buttons, display). It's like a conversation between you and the watch.**

**Information Hiding**

**A watch hides its internal details (how it works) and only shows necessary information (time, date). This keeps things simple and easy to understand.**

**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.

**Calculating carbon footprint: WEB Search for Formulas**

**Energy Consumption**

1. Electricity: Carbon footprint (kg CO2e) = Electricity consumption (kWh) x Emission factor (kg CO2e/kWh)

- Emission factor: varies by region, e.g., 0.623 kg CO2e/kWh (US average)

2. Natural Gas: Carbon footprint (kg CO2e) = Natural Gas consumption (therms) x Emission factor (kg CO2e/therm)

- Emission factor: varies by region, e.g., 5.3 kg CO2e/therm (US average)

**Transportation**

1. Driving: Carbon footprint (kg CO2e) = Distance driven (miles) x Fuel efficiency (miles/gallon) x Emission factor (kg CO2e/gallon)

- Emission factor: varies by fuel type, e.g., 8.81 kg CO2e/gallon (gasoline)

2. Flying: Carbon footprint (kg CO2e) = Distance flown (miles) x Emission factor (kg CO2e/mile)

- Emission factor: varies by flight type, e.g., 0.24 kg CO2e/mile (domestic flight)

3. Transportation (freight): Carbon footprint (kg CO2e) = Distance traveled (km) x Load weight (tons) x Emission factor (kg CO2e/ton-km)

**Food and Waste**

1. Food: Carbon footprint (kg CO2e) = Food consumption (kg) x Emission factor (kg CO2e/kg food)

- Emission factor: varies by food type, e.g., 1.9 kg CO2e/kg beef

2. Waste: Carbon footprint (kg CO2e) = Waste generation (kg) x Emission factor (kg CO2e/kg waste)

- Emission factor: varies by waste type, e.g., 0.6 kg CO2e/kg municipal solid waste

**Water and Paper**

1. Water usage: Carbon footprint (kg CO2e) = Water consumption (liters) x Emission factor (kg CO2e/liter)

2. Paper usage: Carbon footprint (kg CO2e) = Paper consumption (kg) x Emission factor (kg CO2e/kg paper)

**Industry-Specific Factors**

1. Agriculture: Carbon footprint (kg CO2e) = Land use (hectares) x Emission factor (kg CO2e/hectare)

2. Manufacturing: Carbon footprint (kg CO2e) = Production volume (units) x Emission factor (kg CO2e/unit)

**Air Conditioning and Heating**

1. Air conditioning: Carbon footprint (kg CO2e) = Energy consumption (kWh) x Emission factor (kg CO2e/kWh)

2. Heating: Carbon footprint (kg CO2e) = Energy consumption (kWh) x Emission factor (kg CO2e/kWh)

**Other Considerations**

1. Embodied energy: Carbon footprint (kg CO2e) = Material usage (kg) x Embodied energy (MJ/kg)

2. End-of-life emissions: Carbon footprint (kg CO2e) = Waste generation (kg) x Emission factor (kg CO2e/kg waste)

3. Population: Carbon footprint (kg CO2e) = Population size x Per-capita emission factor (kg CO2e/person)

4. GDP: Carbon footprint (kg CO2e) = GDP (USD) x Emission intensity (kg CO2e/USD)

These formulas and factors can help estimate carbon footprints from various sources.

**Sources**:

**- United States Environmental Protection Agency (EPA)**

**- Intergovernmental Panel on Climate Change (IPCC)**

**- World Resources Institute (WRI)**

**- Carbon Footprint Ltd.**

**- United Nations Framework Convention on Climate Change (UNFCCC)**

**- International Energy Agency (IEA)**

**- World Business Council for Sustainable Development (WBCSD)**

***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.

**formulas for calculating BMI.**

**For Adults**

1. Weight (kg): Divide weight in pounds by 2.20462 to convert to kilograms.

2. Height (meters): Multiply height in inches by 0.0254 to convert to meters.

3. BMI: Calculate BMI using the formula: BMI = weight (kg) / height (meters)²

**For Children and Teens**

1. Weight (kg): Convert weight from pounds to kilograms.

2. Height (meters): Convert height from inches to meters.

3. BMI Percentile: Use a BMI percentile calculator or chart to determine the BMI percentile based on age, sex, weight, and height.

**BMI Categories**

1. Underweight: BMI < 18.5

2. Normal weight: BMI = 18.5-24.9

3. Overweight: BMI = 25-29.9

4. Obese: BMI ≥ 30

**Alternative Formula**

1. BMI: Calculate BMI using the formula: BMI = (weight (lb) / height (inches)²) x 703

Remember to consult a healthcare professional for accurate BMI assessment and interpretation.

**Sources**:

**1. United States Department of Health and Human Services**

**2. Centers for Disease Control and Prevention (CDC)**

**3. World Health Organization (WHO)**

***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.).

**HYBRID-RELATED ATTRIBUTES:**

**General Attributes**

1. Combined MPG: Overall fuel economy of the vehicle.

2. Electric-Only Range: Distance the vehicle can travel on electric power alone.

3. Hybrid System Type: Series, parallel, or series-parallel hybrid system.

4. Fuel Type: Gasoline, diesel, or alternative fuels like hydrogen or natural gas.

**Battery Attributes**

1. Battery Type: Nickel-metal hydride (NiMH), lithium-ion (Li-ion), or lithium-ion polymer.

2. Battery Capacity: Total energy storage capacity of the battery pack (e.g., kWh).

3. Battery Voltage: Operating voltage of the battery pack (e.g., 240V).

4. Battery Weight: Total weight of the battery pack (e.g., kg or lbs).

5. Battery Location: Placement of the battery pack in the vehicle (e.g., trunk, under floor).

**Electric Motor Attributes**

1. Electric Motor Type: Permanent magnet, induction, or switched reluctance motor.

2. Electric Motor Power: Maximum power output of the electric motor (e.g., kW or hp).

3. Electric Motor Torque: Maximum torque output of the electric motor (e.g., Nm or lb-ft).

**Engine Attributes**

1. Engine Type: Internal combustion engine type (e.g., gasoline, diesel, or hybrid-specific).

2. Engine Displacement: Engine size (e.g., liters or cubic inches).

3. Engine Power: Maximum power output of the engine (e.g., kW or hp).

4. Engine Torque: Maximum torque output of the engine (e.g., Nm or lb-ft).

**Transmission and Drivetrain Attributes**

1. Transmission Type: Automatic, manual, continuously variable (CVT), or dual-clutch transmission.

2. Drivetrain Type: Front-wheel drive (FWD), rear-wheel drive (RWD), all-wheel drive (AWD), or four-wheel drive (4WD).

**Performance Attributes**

1. 0-60 mph Time: Acceleration time from 0 to 60 mph.

2. Top Speed: Maximum speed of the vehicle.

3. Towing Capacity: Maximum weight the vehicle can tow.

**Emissions and Fuel Economy Attributes**

1. CO2 Emissions: Grams of CO2 emitted per kilometer or mile.

2. Fuel Economy (City): Fuel economy in city driving conditions (e.g., mpg or L/100km).

3. Fuel Economy (Highway): Fuel economy in highway driving conditions (e.g., mpg or L/100km).

4. Fuel Economy (Combined): Overall fuel economy (e.g., mpg or L/100km).

**Charging Attributes (for plug-in hybrids)**

1. Charging Time (Level 1): Time to charge the battery using a Level 1 (120V) charger.

2. Charging Time (Level 2): Time to charge the battery using a Level 2 (240V) charger.

3. Charging Time (DC Fast Charging): Time to charge the battery using a DC Fast Charging station.

4. Charging Port Type: Type of charging port (e.g., SAE J1772, CCS, or CHAdeMO).

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***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** **FOR**  **REPLACING**  **GENDER**-**SPECIFIC WORDS**

**Step 1: Prepare the Text**

Read the given paragraph of text and write it down.

**Step 2: Identify Gender-Specific Words**

Go through the text and identify the gender-specific words that need to be replaced.

**Step 3: Replace Words**

Replace each identified gender-specific word with its corresponding gender-neutral replacement.

**Step 4: Review and Refine**

Review the modified text to ensure that all replacements were made correctly and that no new errors were introduced.

**Potential Issue: Word Boundary Errors**

If not careful, replacing words without considering word boundaries can lead to strange terms like "woperchild." For example:

- Original text: "My daughter operates a lawnmower."

- Replacement: Replace "daughter" with "child" and "operates" with "oper" (part of "operator").

- Resulting text: "My childoper operates a lawnmower."

To avoid such errors, it's essential to consider word boundaries when replacing words.

**Algorithm Development**

This procedure can be developed into a more formal algorithm, which can then be converted into a Java program. The algorithm will specify the steps to be performed and the order in which to perform them.

**Key Considerations**

- Word boundaries: Ensure that word replacements do not cross word boundaries.

- Contextual understanding: Consider the context in which the word is used to ensure accurate replacement.

- Handling exceptions: Develop a plan for handling exceptions, such as words with multiple meanings or words that are not found in the replacement list.