Computer Programs and Programming Languages

What Is a Computer Program?

- Computer programs
  - Also called software
  - Are a list of instructions
    - Instructions are called code
  - CPU performs the instructions
- Three types
  - System software: Operating system, Utility and others
  - Application software

Hardware/Software Interaction

- Code
  - Statements written in a programming language
  - Writing code can be tedious
    - Code must be perfect
    - Order of steps must be exact
  - Writing code is quite exciting
    - Problems are solved
    - New ideas are formed

Hardware/Software Interaction

- Machine code
  - Recall that computers think in binary
  - Code is translated into machine code
    - CPU executes the machine code
  - CPUs have a unique machine code

Hardware/Software Interaction

- Programming languages
  - Simplifies the writing of code
    - English is used to describe the binary
  - Original code is called source code
  - Several hundred languages exist

Programming languages

TABLE 1.1 Popular High-Level Programming Languages

Language	*Description*
Ada	Named for Ada Lovelace, who worked on mechanical general-purpose computers. The Ada language was developed for the Department of Defense and is used mainly in defense projects.
BASIC	Beginner's All-purpose Symbolic Instruction Code. It was designed to be learned and used easily by beginners.
C	Developed at Bell Laboratories. C combines the power of an assembly language with the ease of use and portability of a high-level language.
C++	C++ is an object-oriented language, based on C.
C#	Pronounced "C Sharp." It is a hybrid of Java and C++ and was developed by Microsoft.
COBOL	COmmon Business Oriented Language. Used for business applications.
FORTRAN	FORmula TRANslation. Popular for scientific and mathematical applications.
Java	Developed by Sun Microsystems, now part of Oracle. It is widely used for developing platform-independent Internet applications.
Pascal	Named for Blaise Pascal, who pioneered calculating machines in the seventeenth century. It is a simple, structured, general-purpose language primarily for teaching programming.
Python	A simple general-purpose scripting language good for writing short programs.
Visual Basic	Visual Basic was developed by Microsoft and it enables the programmers to rapidly develop Windows-based applications.

Hardware/Software Interaction

- Compilers and interpreters
  - Converts source code into binary
    - Allows code to execute
  - Checks source code for correctness

Hardware/Software Interaction

- Compiler
  - Creates an executable file
    - Contents are called object code
  - Executable can run on its own
  - Each language has its own compiler
  - C++ and Java are compiled languages

Hardware/Software Interaction

- Interpreter
  - Runs program one line at a time
  - More flexible than compilers
  - Slower than compilers
  - Always needed to execute program
  - Visual Basic and Perl are interpreted

Interpreter vs. Compiler

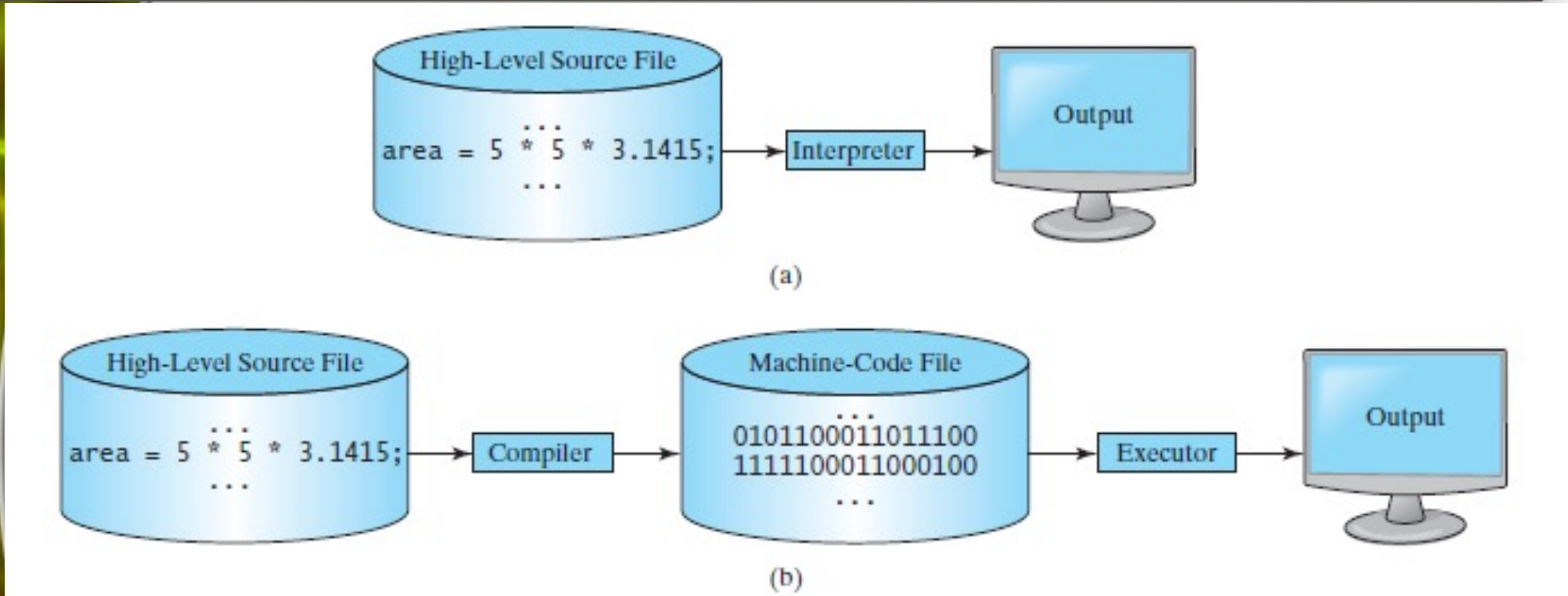


FIGURE 1.9 (a) An interpreter translates and executes a program one statement at a time. (b) A compiler translates the entire source program into a machine-language file for execution.

Planning a Computer Program

- Plans
  - The steps to solve a problem
  - Describe the expected results
  - Programming without a plan is difficult

Planning Tools

- Pseudo code
  - Natural language statements that resemble code
  - Describes what must be done
  - Can be written by non programmers
  - Programmers develop unique versions

Planning Tools

- Input-processing-output (IPO) charts
  - Determines what is needed
  - Input column
    - Data inputted by the user
  - Processing column
    - Pseudo code describing the problem solution
  - Output column
    - Desired output from the program

IPO Chart

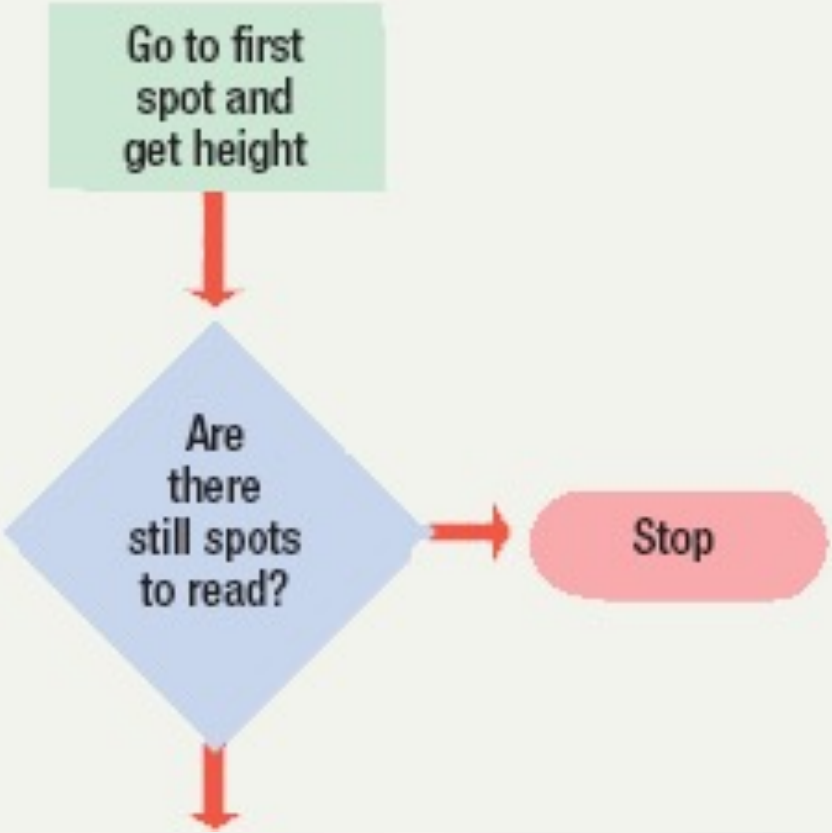
The IPO Chart for a Program That Calculates Gross Pay for an Hourly Employee

Input	Processing	Output
Hours worked	Input hours worked	Gross pay
Hourly wage	Input hourly wage	
	Validate data	
	Pay = hours worked * hourly wage	
	Display gross pay	

How Programs Solve Problems

- Algorithm
  - Set of steps
    - Always leads to a solution
    - Steps are always the same
  - Flowcharts can describe algorithms
    - Structured tool for drawing algorithms
  - Algorithms appear in all programs

Flowchart


Go to first spot and get height
Are there still spots to read?
Stop

Structured Programming

- Programming using defined structures
- Creates easy to read code
- Programs are efficient and run fast
- Several defined structures

Structured Programming

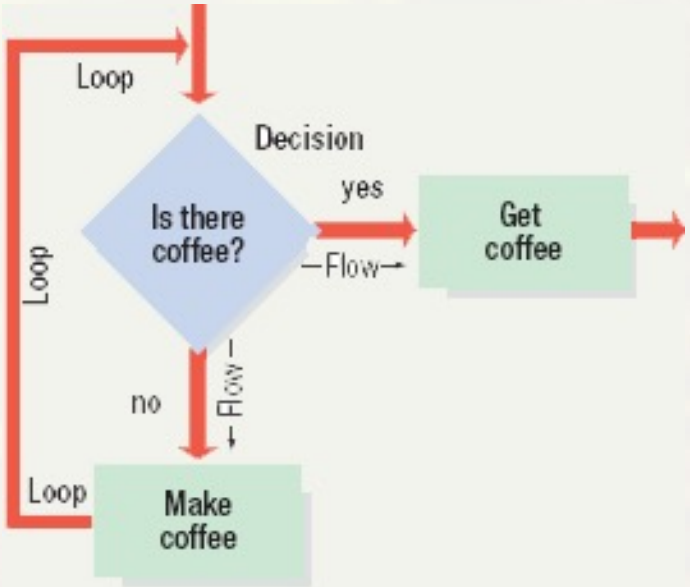
- Sequence structure
  - Describes the flow of the program
  - Typically executed in order
  - Branching statements allow multiple flows

Structured Programming

- Selection statement
  - Also called conditional statement
  - Performs a true or false test
  - Determines which code to execute next

Structured Programming

- Repetition statements
  - Also called looping structures
  - Repeats a section of code
    - Until an exit condition is reached



Programming Languages

- Used to generate source code
- Avoids using machine code
- Have strict rules of syntax
  - Symbols and punctuation have meaning
  - Spelling must be exact
- Code is converted into machine language