

ALGORITHMIC DESIGN I



Introduction to Computers and Java

Chapter 1

Algorithms

- An algorithm is a set of instructions for solving a problem.
- An algorithm must be expressed completely and precisely.
- Algorithms usually are expressed in English or in pseudocode.

Hardware and Software

- Computer systems consist of hardware and software.
 - Hardware includes the tangible parts of computer systems.
 - Software includes programs- sets of instructions for the computer to follow.
- Familiarity with hardware basics helps us understand software.

Hardware and Memory

- Most modern computers have similar components including
 - Input devices (keyboard, mouse, etc.)
 - Output devices (display screen, printer, etc.)
 - A processor
 - Two kinds of memory (main memory and auxiliary memory).

Memory

- Memory holds
 - programs
 - data for the computer to process
 - the results of intermediate processing.
- Two kinds of memory
 - main memory
 - auxiliary memory

Main memory

- Working memory used to store
 - The current program
 - The data the program is using
 - The results of intermediate calculations
- Usually measured in megabytes (e.g. 8 gigabytes of RAM)
 - RAM is short for random access memory
 - A byte is a quantity of memory

Auxiliary Memory

- Also called secondary memory
- Disk drives, CDs, DVDs, flash drives, etc.
- More or less permanent (nonvolatile)
- Usually measured in gigabytes (e.g. 50 gigabyte hard drive)

Bits, Bytes, and Addresses

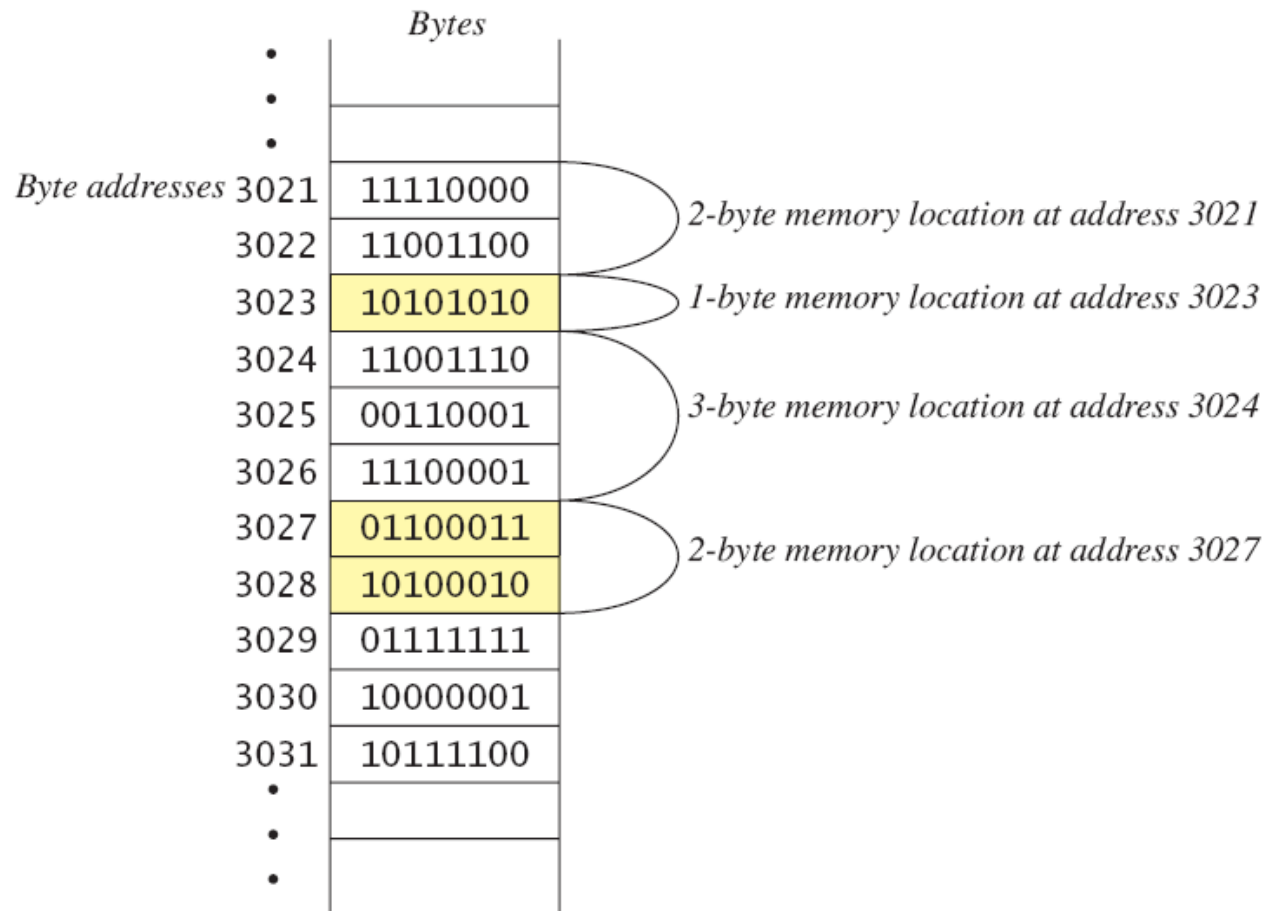
- A bit is a digit with a value of either 0 or 1.
- A byte consists of 8 bits.
- Each byte in main memory resides at a numbered location called its address.

0s and 1s

- Machines with only 2 stable states are easy to make, but programming using only 0s and 1s is difficult.
- Fortunately, the conversion of numbers, letters, strings of characters, audio, video, and programs is done automatically.

Main Memory

- Figure 1.1



Storing Data

- Data of all kinds (numbers, letters, strings of characters, audio, video, even programs) are encoded and stored using 1s and 0s.
- When more than a single byte is needed, several adjacent bytes are used.
 - The address of the first byte is the address of the unit of bytes.

Files

- Large groups of bytes in auxiliary memory are called files.
- Files have names.
- Files are organized into groups called directories or folders.
- Java programs are stored in files.
- Programs files are copied from auxiliary memory to main memory in order to be run.

Programs

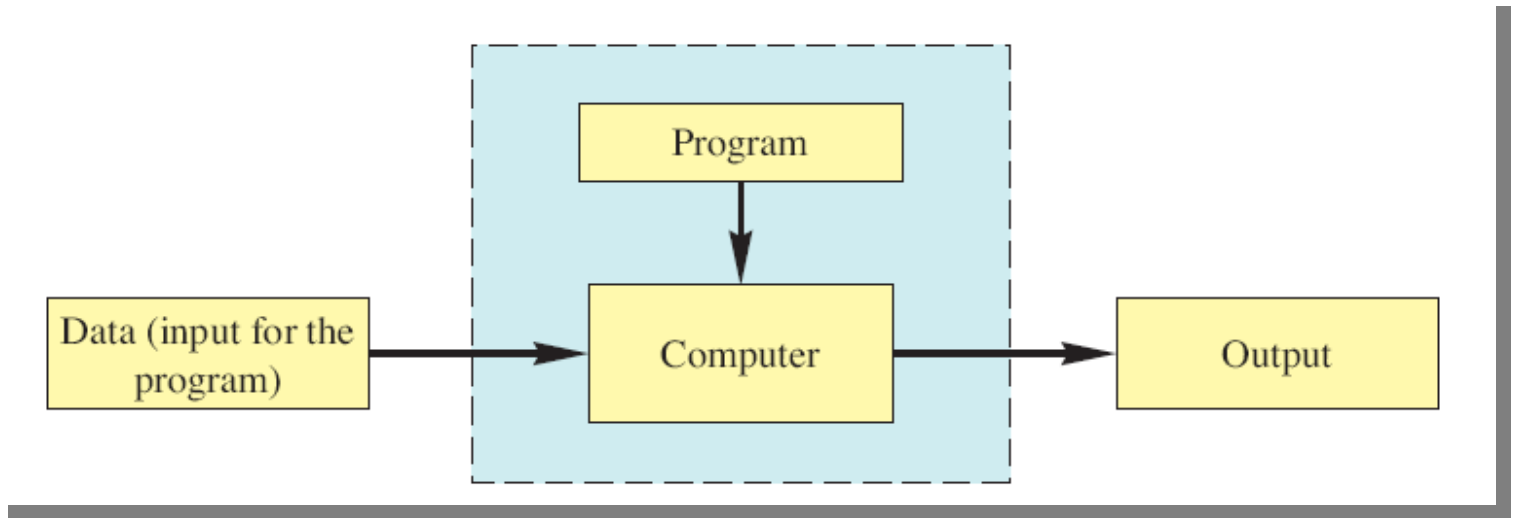
- A program is a set of instructions for a computer to follow.
- We use programs almost daily (email, word processors, video games, bank ATMs, etc.).
- Following the instructions is called running or executing the program.

Input and Output

- Normally, a computer receives two kinds of input:
 - The program
 - The data needed by the program.
- The output is the result(s) produced by following the instructions in the program.

Running a Program

- Figure 1.2



- Sometimes the computer and the program are considered to be one unit.
 - Programmers typically find this view to be more convenient.

The Operating System

- The operating system is a supervisory program that oversees the operation of the computer.
- The operating system retrieves and starts program for you.
- Well-known operating systems including: Microsoft Windows, Apple's Mac OS, Linux, and UNIX.

Programming Languages

- High-level languages are relatively easy to use
 - Java, C#, C++, Visual Basic, Python, Ruby.
- Unfortunately, computer hardware does not understand high-level languages.
 - Therefore, a high-level language program must be translated into a low-level language.

Compilers

- A compiler translates a program from a high-level language to a low-level language the computer can run.
- You compile a program by running the compiler on the high-level-language version of the program called the source program.
- Compilers produce machine-or assembly-language programs called object programs.

Compilers

- Most high-level languages need a different compiler for each type of computer and for each operating system.
- Most compilers are very large programs that are expensive to produce.

Java Byte-Code

- The Java compiler does not translate a Java program into assembly language or machine language for a particular computer.
- Instead, it translates a Java program into byte-code
 - Byte-code is the machine language for a hypothetical computer (or interpreter) called the Java Virtual Machine.

Java Byte-Code

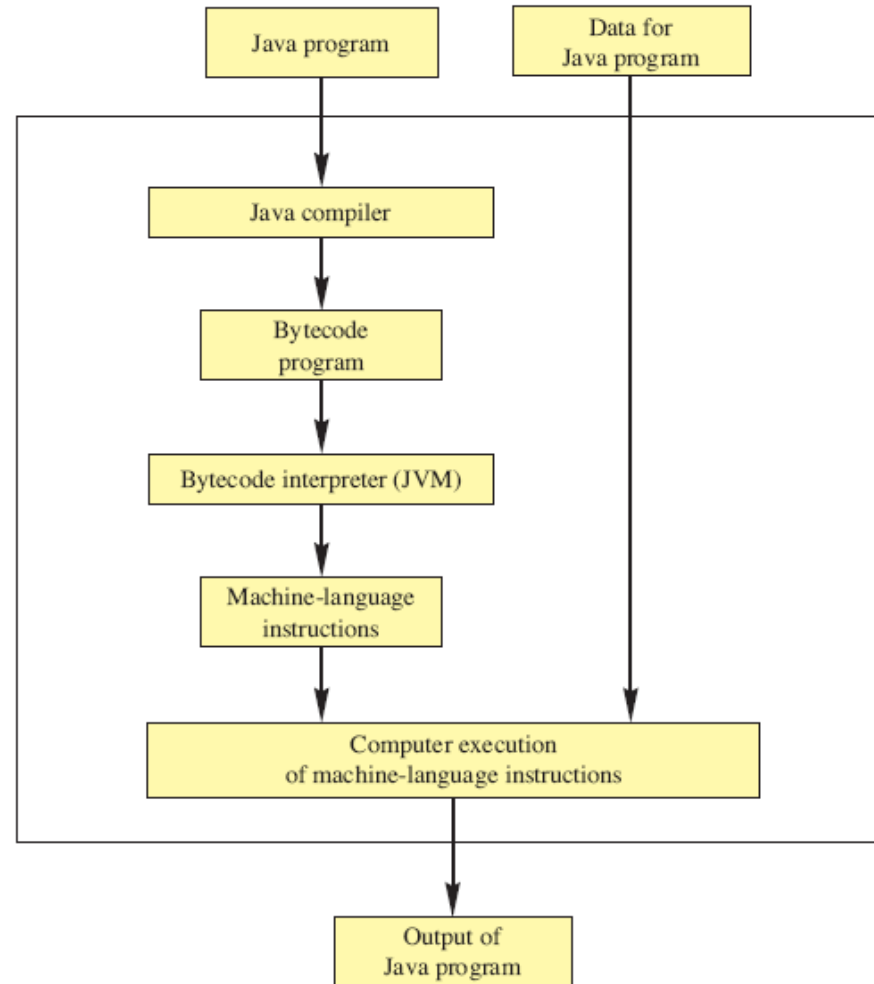
- A byte-code program is easy to translate into machine language for any particular computer.
- A program called an interpreter translates each byte-code instruction, executing the resulting machine-language instructions on the particular computer before translating the next byte-code instruction.
- Most Java programs today are executed using a Just-In-Time or JIT compiler in which byte-code is compiled as needed and stored for later reuse without needing to be re-compiled.

Compiling, Interpreting, Running

- Use the compiler to translate the Java program into byte-code (done using the `javac` command).
- Use the Java virtual machine for your computer to translate each byte-code instruction into machine language and to run the resulting machine-language instructions (done using the `java` command).

Compiling and Running a Program

- Figure 1.3



Compiling and Running

- A Java program can involve any number of classes.
- The class to run will contain the words

public static void main(String[] args)

somewhere in the file

Printing to the Screen

```
System.out.println ("Whatever you want to print");
```

- `System.out` is an object for sending output to the screen.
- `println` is a method to print whatever is in parentheses to the screen.