Compiling and Compiler Errors

August 22, 2007

ComS 207: Programming I (in Java)
Iowa State University, FALL 2007
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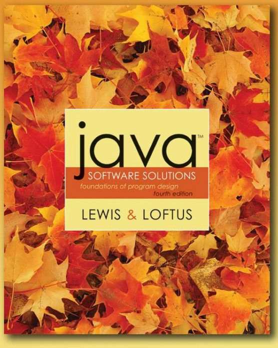
Chapter 1

Introduction



Our First Program

```
//  comments about the class
public class MyProgram
{
   //  comments about the method
   public static void main (String[] args)
   {
      System.out.println("Hello World");
   }

}
```

Java Program Structure

```
//  comments about the class
public class MyProgram
{
```

class header

class body

Comments can be placed almost anywhere

```
}
```

Java Program Structure

```
//  comments about the class
public class MyProgram
{
   //  comments about the method
   public static void main (String[] args)
   {

   }

}
```

method body

method header

Comments

- **Comments in a program are called *inline documentation***
- **They should be included to explain the purpose of the program and describe processing steps**
- **They do not affect how a program works**
- **Java comments can take three forms:**

```
// this comment runs to the end of the line

/*  this comment runs to the terminating
    symbol, even across line breaks        */

/** this is a javadoc comment   */
```

Our First Program

```
//  comments about the class
public class MyProgram
{
   //  comments about the method
   public static void main (String[] args)
   {
     System.out.println(“Hello World”);
   }

}
```

Identifiers

- *Identifiers* are the words a programmer uses in a program
- An identifier can be made up of letters, digits, the underscore character (_), and the dollar sign
- Identifiers cannot begin with a digit
- Java is *case sensitive* - `Total`, `total`, and `TOTAL` are different identifiers
- By convention, programmers use different case styles for different types of identifiers, such as
  - *title case* for class names - `Lincoln`
  - *upper case* for constants - `MAXIMUM`

Identifiers

- Sometimes we choose identifiers ourselves when writing a program (such as `Lincoln`)
- Sometimes we are using another programmer's code, so we use the identifiers that he or she chose (such as `println`)
- Often we use special identifiers called *reserved words* that already have a predefined meaning in the language
- A reserved word cannot be used in any other way

Reserved Words

- The Java reserved words:

```
abstract     else          interface    switch
assert       enum          long         synchronized
boolean      extends       native       this
break        false         new          throw
byte         final         null         throws
case         finally       package      transient
catch        float         private      true
char         for           protected    try
class        goto          public       void
const        if            return       volatile
continue     implements    short        while
default      import        static
do           instanceof    strictfp
double       int           super
```

White Space

- Spaces, blank lines, and tabs are called *white space*
- White space is used to separate words and symbols in a program
- Extra white space is ignored
- A valid Java program can be formatted many ways
- Programs should be formatted to enhance readability, using consistent indentation
- See `Lincoln2.java` (page 34)
- See `Lincoln3.java` (page 35)

This code is still valid, but hard to read

```
//  comments about the class
public class MyProgram
{  //  comments about the method
  public      static     void main (String[] args)
{ System.out.println(“Hello World”);  }  }
```

Run examples from the book

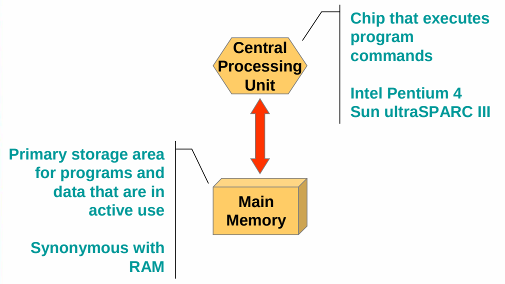
Hardware and Software

- Hardware
  - the physical, tangible parts of a computer
  - keyboard, monitor, disks, wires, chips, etc.
- Software
  - programs and data
  - a *program* is a series of instructions
- A computer requires both hardware and software
- Each is essentially useless without the other

A Computer Specification

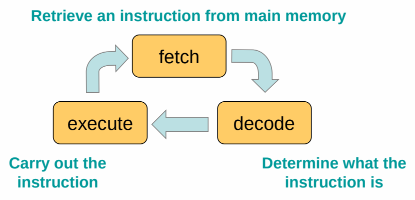
- Consider the following specification for a personal computer:
  - 2.8 GHz Pentium 4 Processor
  - 512 MB RAM
  - 80 GB Hard Disk
  - 48x CD-RW / DVD-ROM Combo Drive
  - 17” Video Display with 1280 x 1024 resolution
  - 56 Kb/s Modem
- What does it all mean?

CPU and Main Memory

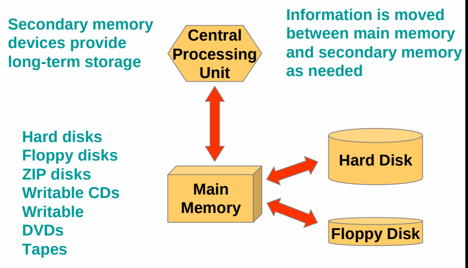

Chip that executes program commands
Intel Pentium 4
Sun ultraSPARC III
Central Processing Unit
Primary storage area for programs and data that are in active use
Synonymous with RAM
Main Memory

The Central Processing Unit

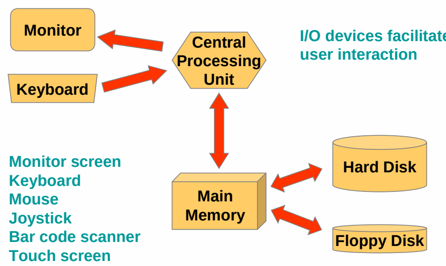
- A CPU is on a chip called a *microprocessor*
- It continuously follows the *fetch-decode-execute cycle:*


Retrieve an instruction from main memory
fetch
decode
execute
Carry out the instruction
Determine what the instruction is

Secondary Memory Devices


Secondary memory devices provide long-term storage
Central Processing Unit
Information is moved between main memory and secondary memory as needed
Hard disks
Floppy disks
ZIP disks
Writable CDs
Writable DVDs
Tapes
Main Memory
Hard Disk
Floppy Disk

Input / Output Devices



I/O devices facilitate user interaction

Monitor screen
Keyboard
Mouse
Joystick
Bar code scanner
Touch screen

Software Categories

- Operating System
  - controls all machine activities
  - provides the user interface to the computer
  - manages resources such as the CPU and memory
  - Windows XP, Unix, Linux, Mac OS
- Application program
  - generic term for any other kind of software
  - word processors, missile control systems, games
- Most operating systems and application programs have a *graphical user interface* (GUI)

Analog vs. Digital

- There are two basic ways to store and manage data:
- *Analog*
  - continuous, in direct proportion to the data represented
  - music on a record album - a needle rides on ridges in the grooves that are directly proportional to the voltages sent to the speaker
- *Digital*
  - the information is broken down into pieces, and each piece is represented separately
  - music on a compact disc - the disc stores numbers representing specific voltage levels sampled at specific times

Digital Information

- Computers store all information digitally:
  - numbers
  - text
  - graphics and images
  - video
  - audio
  - program instructions
- In some way, all information is *digitized* - broken down into pieces and represented as numbers

Representing Text Digitally

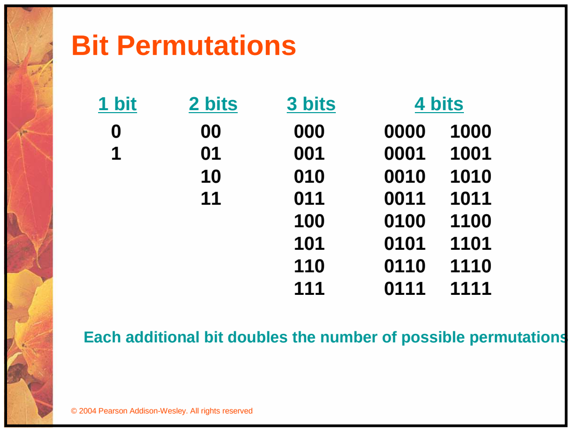
- For example, every character is stored as a number, including spaces, digits, and punctuation
- Corresponding upper and lower case letters are separate characters

H i ,   H e a t h e r .

72 105 44 32 72 101 97 116 104 101 114 46

Binary Numbers

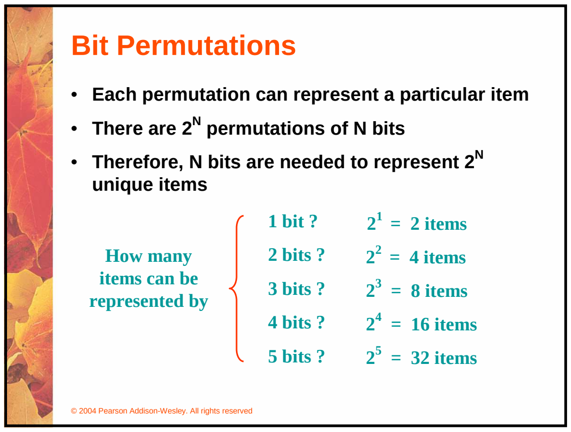
- Once information is digitized, it is represented and stored in memory using the *binary number system*
- A single binary digit (0 or 1) is called a *bit*
- Devices that store and move information are cheaper and more reliable if they have to represent only two states
- A single bit can represent two possible states, like a light bulb that is either on (1) or off (0)
- Permutations of bits are used to store values



Bit Permutations

1 bit	2 bits	3 bits	4 bits	
0	00	000	0000	1000
1	01	001	0001	1001
	10	010	0010	1010
	11	011	0011	1011
		100	0100	1100
		101	0101	1101
		110	0110	1110
		111	0111	1111

Each additional bit doubles the number of possible permutations

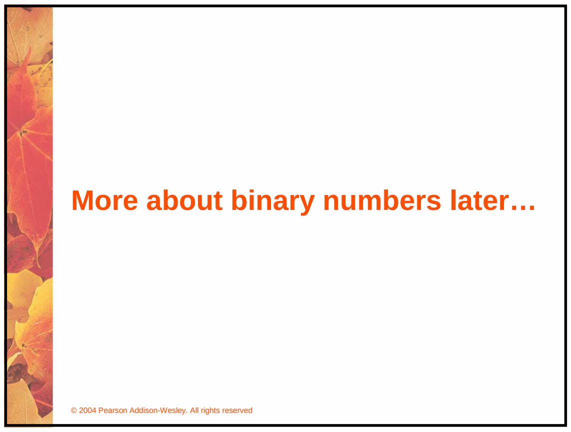


Bit Permutations

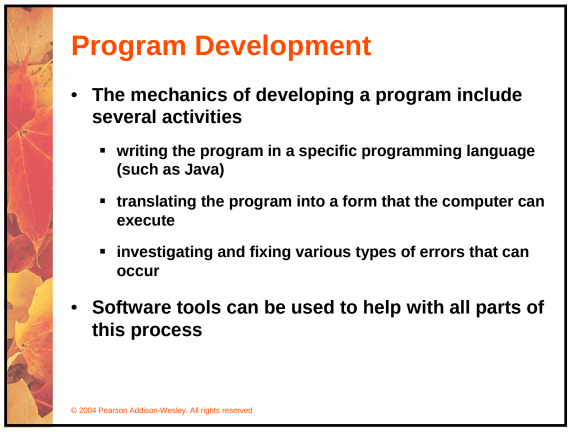
- Each permutation can represent a particular item
- There are 2^N permutations of N bits
- Therefore, N bits are needed to represent 2^N unique items

How many items can be represented by

1 bit ?	$2^1 = 2$ items
2 bits ?	$2^2 = 4$ items
3 bits ?	$2^3 = 8$ items
4 bits ?	$2^4 = 16$ items
5 bits ?	$2^5 = 32$ items

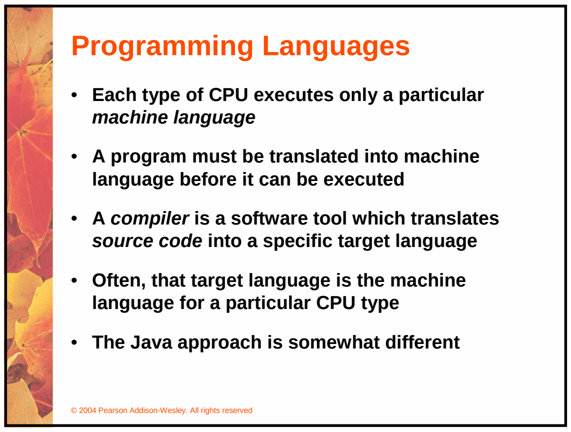


More about binary numbers later…



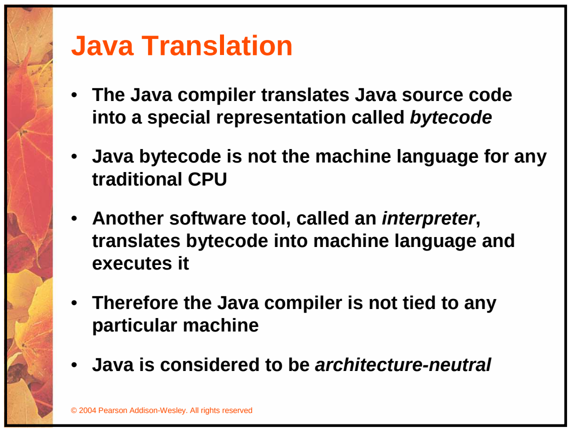
Program Development

- The mechanics of developing a program include several activities
  - writing the program in a specific programming language (such as Java)
  - translating the program into a form that the computer can execute
  - investigating and fixing various types of errors that can occur
- Software tools can be used to help with all parts of this process



Programming Languages

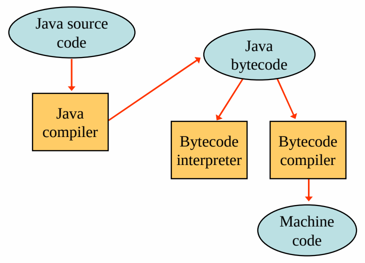
- Each type of CPU executes only a particular *machine language*
- A program must be translated into machine language before it can be executed
- A *compiler* is a software tool which translates *source code* into a specific target language
- Often, that target language is the machine language for a particular CPU type
- The Java approach is somewhat different



Java Translation

- The Java compiler translates Java source code into a special representation called *bytecode*
- Java bytecode is not the machine language for any traditional CPU
- Another software tool, called an *interpreter*, translates bytecode into machine language and executes it
- Therefore the Java compiler is not tied to any particular machine
- Java is considered to be *architecture-neutral*

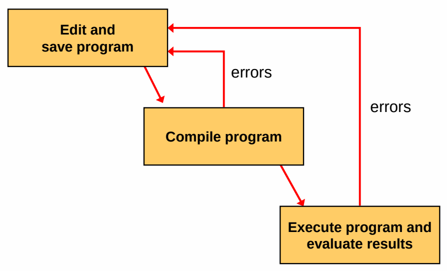
Java Translation



Syntax and Semantics

- The *syntax rules* of a language define how we can put together symbols, reserved words, and identifiers to make a valid program
- The *semantics* of a program statement define what that statement means (its purpose or role in a program)
- A program that is syntactically correct is not necessarily logically (semantically) correct
- A program will always do what we tell it to do, not what we meant to tell it to do

Basic Program Development



Errors

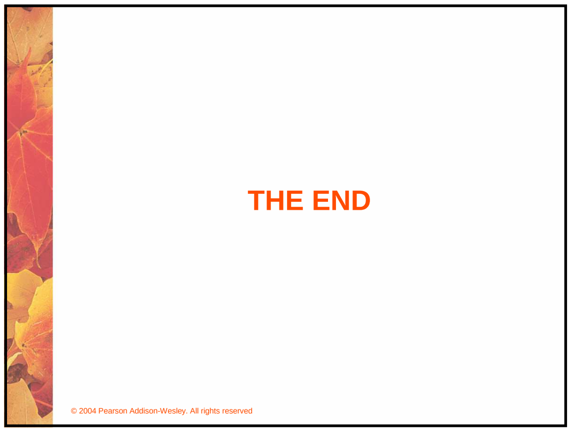
- A program can have three types of errors
- The compiler will find syntax errors and other basic problems (*compile-time errors*)
  - If compile-time errors exist, an executable version of the program is not created
- A problem can occur during program execution, such as trying to divide by zero, which causes a program to terminate abnormally (*run-time errors*)
- A program may run, but produce incorrect results, perhaps using an incorrect formula (*logical errors*)

Development Environments

- There are many programs that support the development of Java software, including:
  - Sun Java Development Kit (JDK)
  - Sun NetBeans
  - IBM Eclipse
  - Borland JBuilder
  - MetroWerks CodeWarrior
  - BlueJ
  - jGRASP
- Though the details of these environments differ, the basic compilation and execution process is essentially the same

HW 1 is out

- Posted on the class web page



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