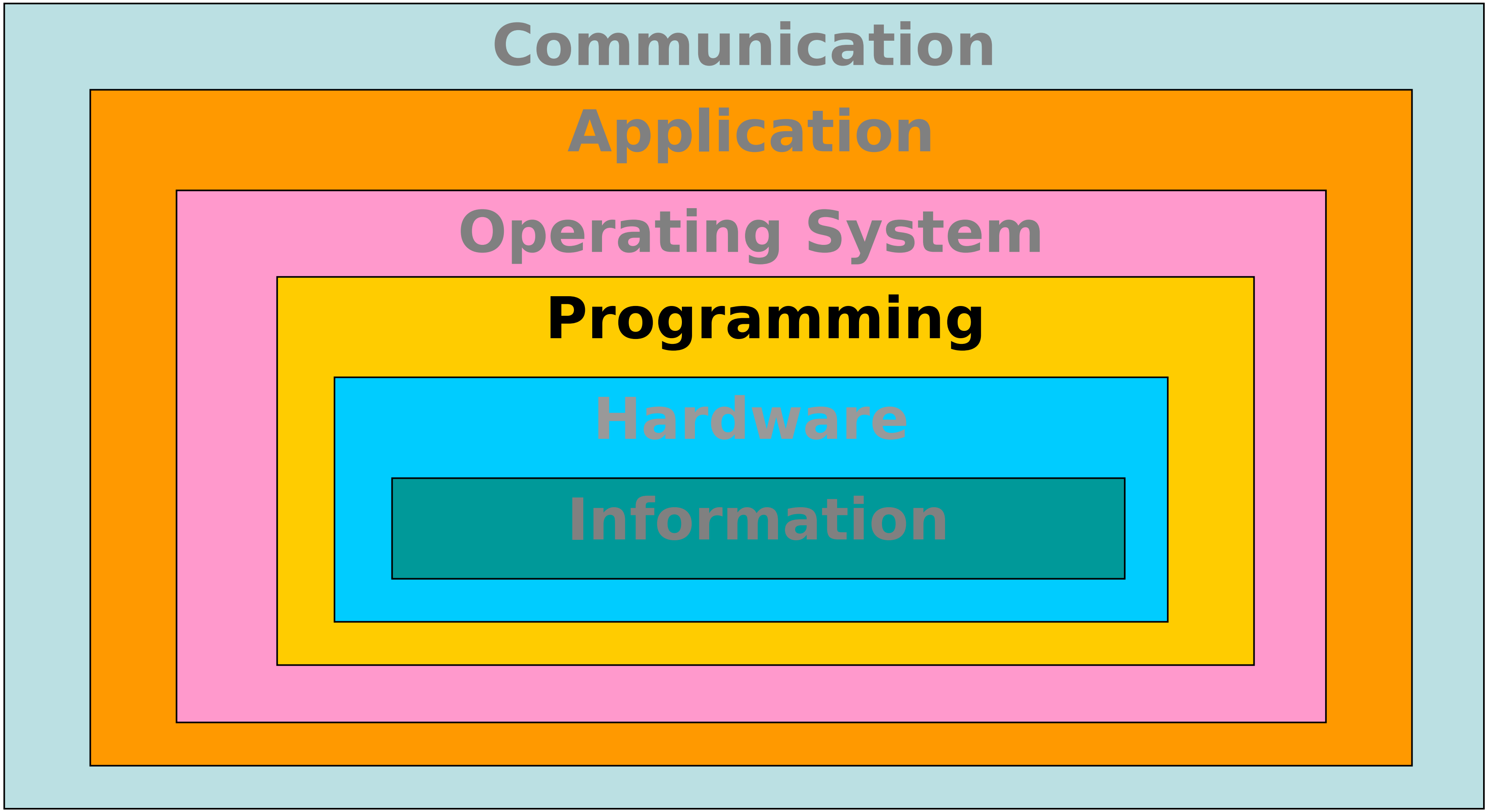
Chapter 8
(Part 1)

High Level Programming Languages

Layers of a Computing System



Communication

Application

Operating System

Programming

Hardware

Information

Chapter Goals

- Describe the translation process and distinguish between assembly, compilation, interpretation, and execution
- Name four distinct programming paradigms and name a language characteristic of each
- Describe the following constructs: stream input and output, selection, looping, and subprograms
- Construct Boolean expressions and describe how they are used to alter the flow of control of an algorithm
- . . . Some Hands-On

Compilers

- **Compiler** A program that translates a high-level language program into machine code
- High-level languages provide a richer set of instructions that makes the programmer’s life even easier

Compilers

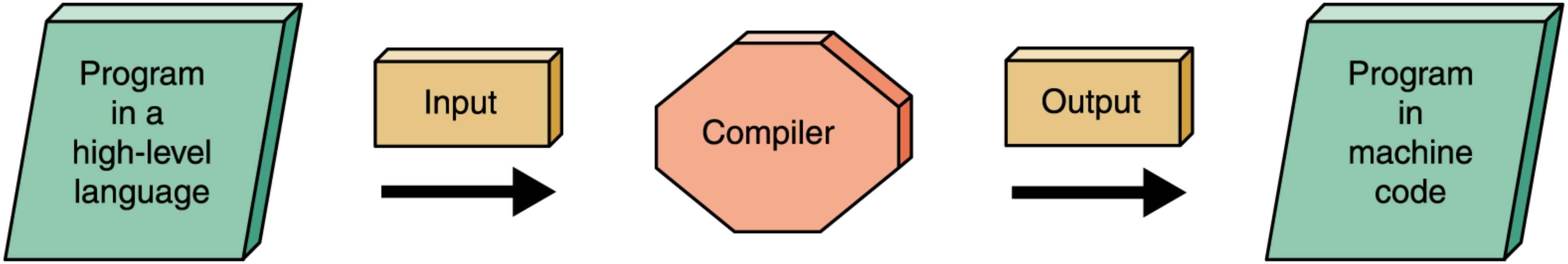


Figure 8.1 **Compilation process**

Interpreters

- **Interpreter** A translating program that translates and executes the statements in sequence
  - Unlike an assembler or compiler which produce machine code as output, which is then executed in a separate step
  - An interpreter translates a statement and then immediately executes the statement
  - Interpreters can be viewed as *simulators*

Java

- Introduced in 1996 and swept the computing community by storm
- Portability was of primary importance
- Java is compiled into a standard machine language called **Bytecode**
- A software interpreter called the JVM (Java Virtual Machine) takes the Bytecode program and executes it

Programming Language Paradigms

- *What is a paradigm*?
- A set of assumptions, concepts, values, and practices that constitute a way of viewing reality

Programming Language Paradigms

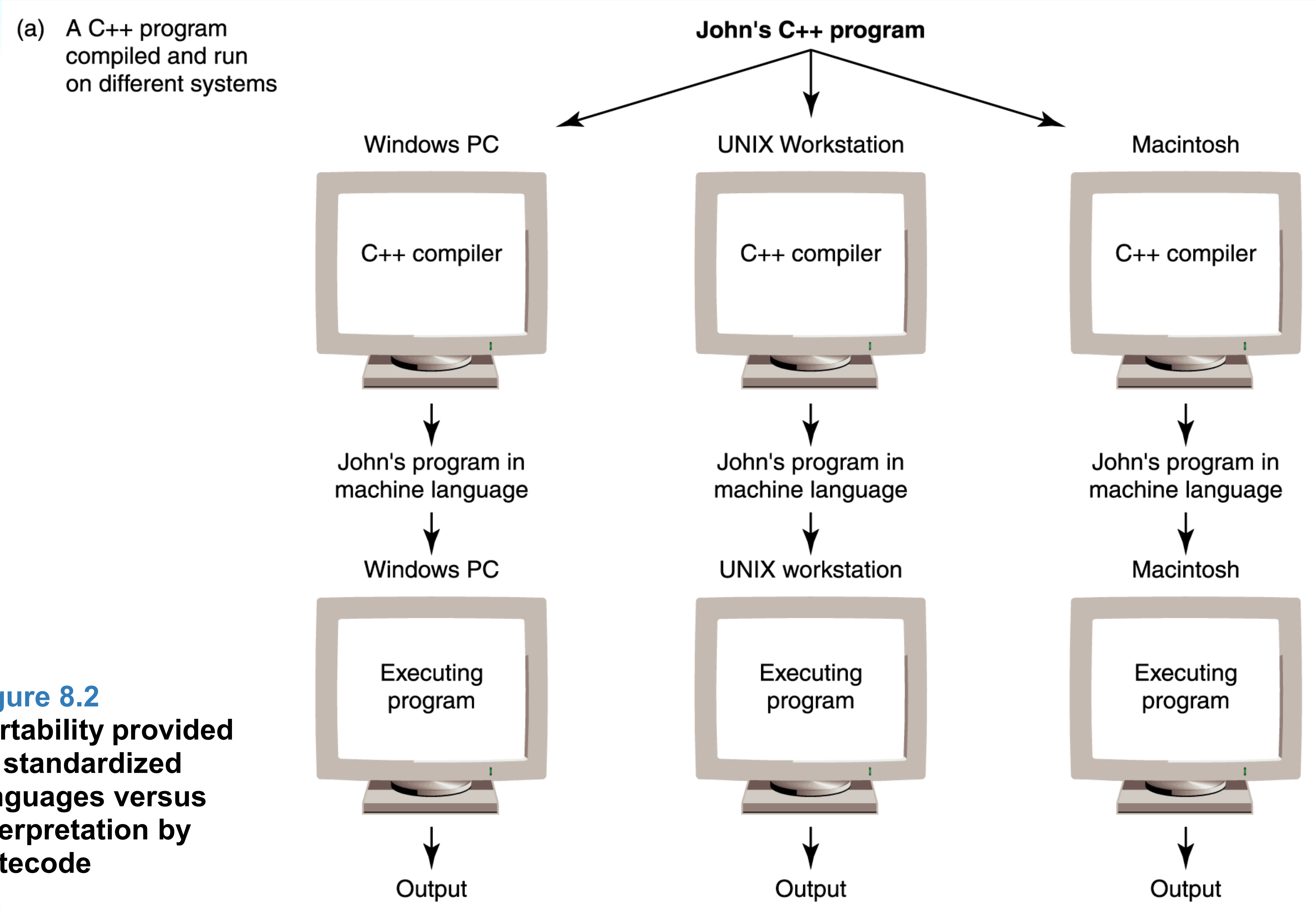
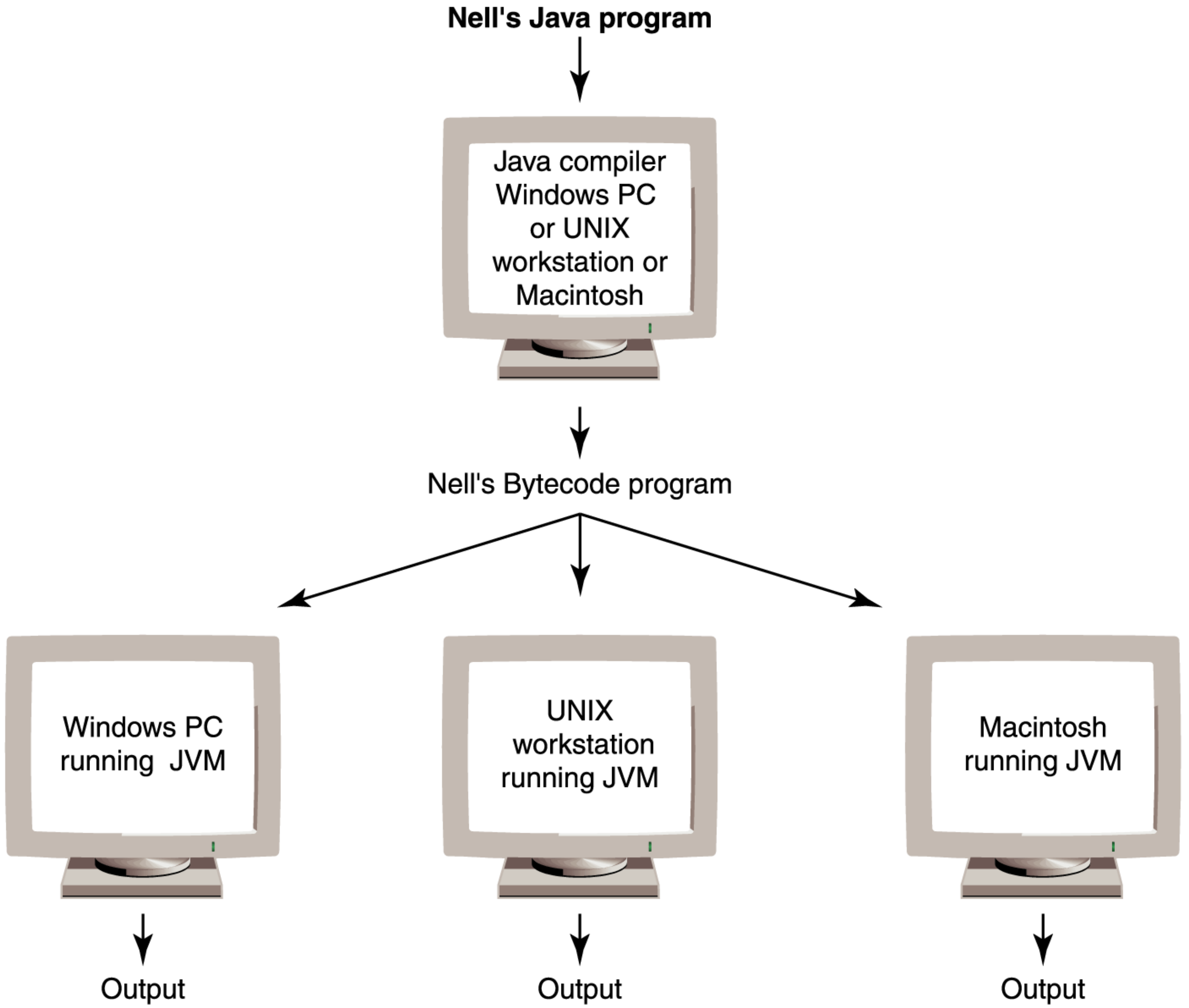


Figure 8.2
Portability provided by standardized languages versus interpretation by Bytecode

Programming Language Paradigms

(b) Java program compiled into Bytecode and run on different systems



Nell's Java program

Java compiler Windows PC or UNIX workstation or Macintosh

Nell's Bytecode program

Windows PC running JVM

UNIX workstation running JVM

Macintosh running JVM

Output

Output

Output

Figure 8.2
Portability provided by standardized languages versus interpretation by Bytecode

Programming Language Paradigms

- Imperative or procedural model
  - FORTRAN, COBOL, BASIC, C, Pascal, Ada, and C++
- Functional model
  - LISP, Scheme (a derivative of LISP), and ML

Programming Language Paradigms

- Logic programming
  - PROLOG
- Object-oriented paradigm
  - SIMULA and Smalltalk
  - C++ is as an imperative language with some object-oriented features
  - Java is an object-oriented language with some imperative features

Functionality of Imperative Languages

- **Sequence** Executing statements in sequence until an instruction is encountered that changes this sequencing
- **Selection** Deciding which action to take
- **Iteration** (looping) Repeating an action

Both selection and iteration require the use of a Boolean expression

Boolean Expressions

- **Boolean expression** A sequence of identifiers, separated by compatible operators, that evaluates to *true* or *false*
- Boolean expression can be
  - A Boolean variable
  - An arithmetic expression followed by a relational operator followed by an arithmetic expression
  - A Boolean expression followed by a Boolean operator followed by a Boolean expression

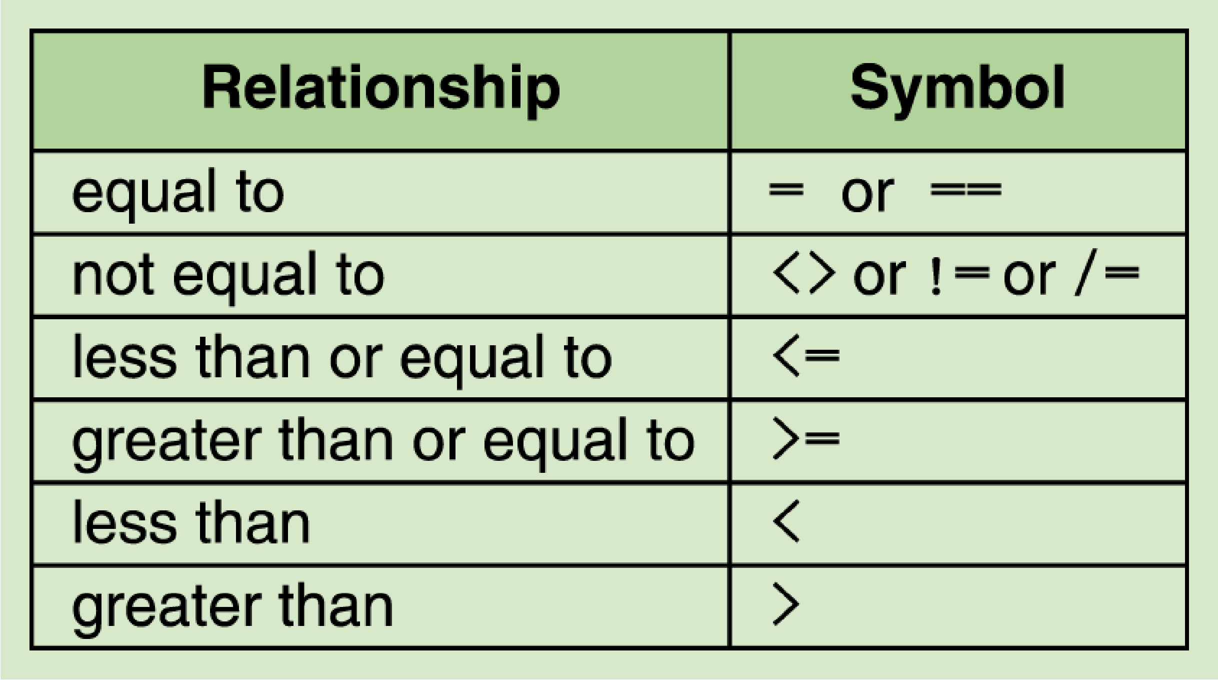
Boolean Expressions

- **Variable** A location in memory that is referenced by an identifier that contains a data value

  Thus, a Boolean variable is a location in memory that can contain either *true* or *false*

Boolean Expressions

- A relational operator between two arithmetic expressions is asking if the relationship exists between the two expressions
- For example, *xValue < yValue*



Relationship	Symbol
equal to	= or ==
not equal to	<> or != or /=
less than or equal to	<=
greater than or equal to	>=
less than	<
greater than	>

Strong Typing

- **Strong typing** The requirement that only a value of the proper type can be stored into a variable
- **Data type** A description of the set of values and the basic set of operations that can be applied to values of the type

Data Types

- Integer numbers
- Real numbers
- Characters
- Boolean values
- Strings

Integers

- The range varies depending upon how many bytes are assigned to represent an integer value
- Some high-level languages provide several integer types of different sizes
- Operations that can be applied to integers are the standard arithmetic and relational operations

Reals

- Like the integer data type, the range varies depending on the number of bytes assigned to represent a real number
- Many high-level languages have two sizes of real numbers
- The operations that can be applied to real numbers are the same as those that can be applied to integer numbers

Characters

- It takes one byte to represent characters in the ASCII character set
- Two bytes to represent characters in the Unicode character set
- Our English alphabet is represented in ASCII, which is a subset of Unicode

Characters

- Applying arithmetic operations to characters doesn’t make much sense
- Comparing characters does make sense, so the relational operators can be applied to characters
- The meaning of “less than” and “greater than” when applied to characters is “comes before” and “comes after” in the character set

Boolean

- The Boolean data type consists of two values: ***true*** and ***false***
- Not all high-level languages support the Boolean data type
- If a language does not, then you can simulate Boolean values by saying that the Boolean value ***true*** is represented by 1 and ***false*** is represented by 0

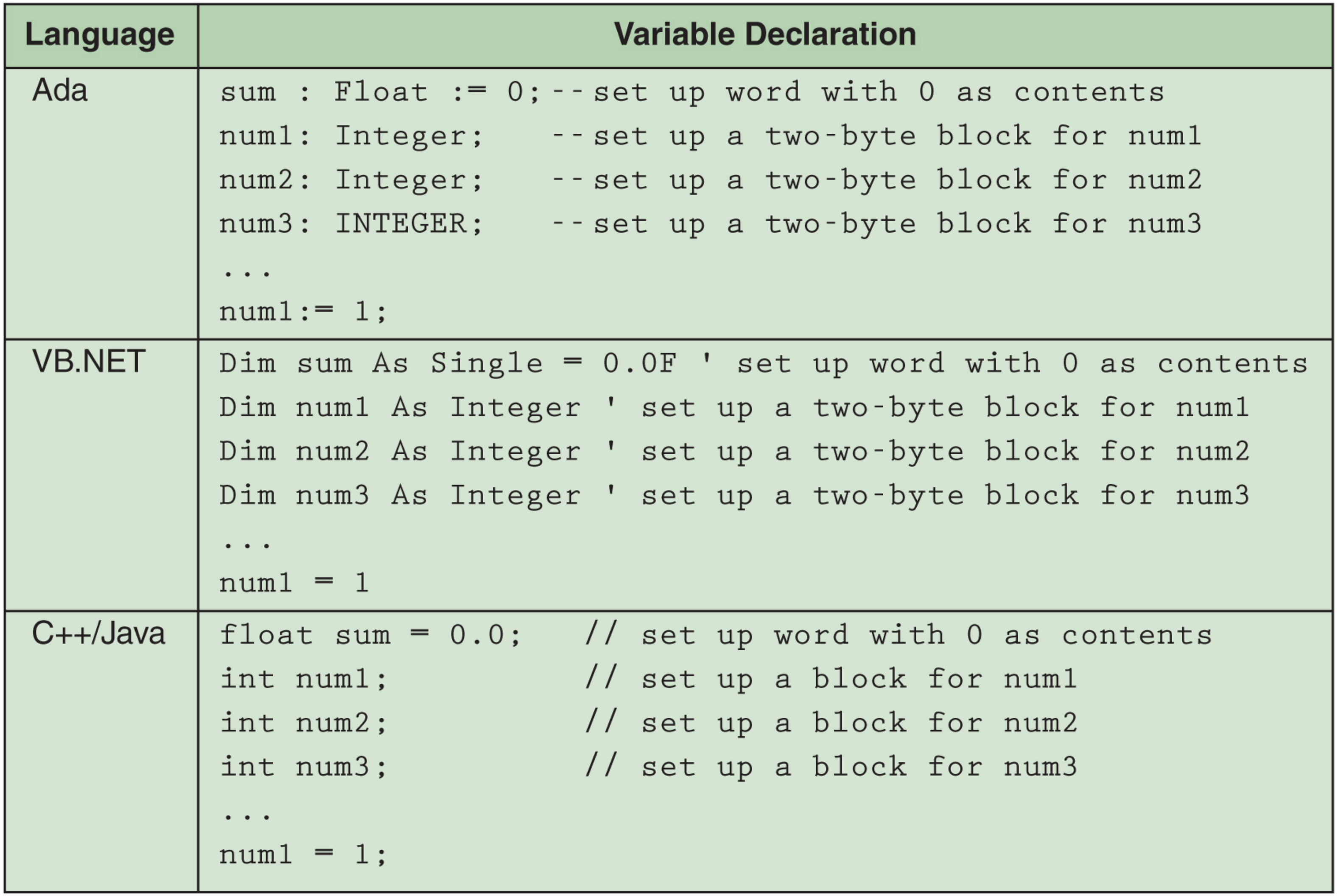
Strings

- A string is a sequence of characters considered as one data value
- For example: ***“This is a string.”***
  - Containing 17 characters: one uppercase letter, 12 lowercase letters, three blanks, and a period
- The operations defined on strings vary from language to language
  - They include concatenation of strings and comparison of strings in terms of lexicographic order

Declarations

- **Declaration** A statement that associates an identifier with a variable, an action, or some other entity within the language that can be given a name so that the programmer can refer to that item by name

Declarations



Language	Variable Declaration

Ada	`sum : Float := 0;--set up word with 0 as contents`
	`num1: Integer;   --set up a two-byte block for num1`
	`num2: Integer;   --set up a two-byte block for num2`
	`num3: INTEGER;   --set up a two-byte block for num3`
	`...`
	`num1:= 1;`

VB.NET	`Dim sum As Single = 0.0F ' set up word with 0 as contents`
	`Dim num1 As Integer ' set up a two-byte block for num1`
	`Dim num2 As Integer ' set up a two-byte block for num2`
	`Dim num3 As Integer ' set up a two-byte block for num3`
	`...`
	`num1 = 1`

C++/Java	`float sum = 0.0;   // set up word with 0 as contents`
	`int num1;          // set up a block for num1`
	`int num2;          // set up a block for num2`
	`int num3;          // set up a block for num3`
	`...`
	`num1 = 1;`

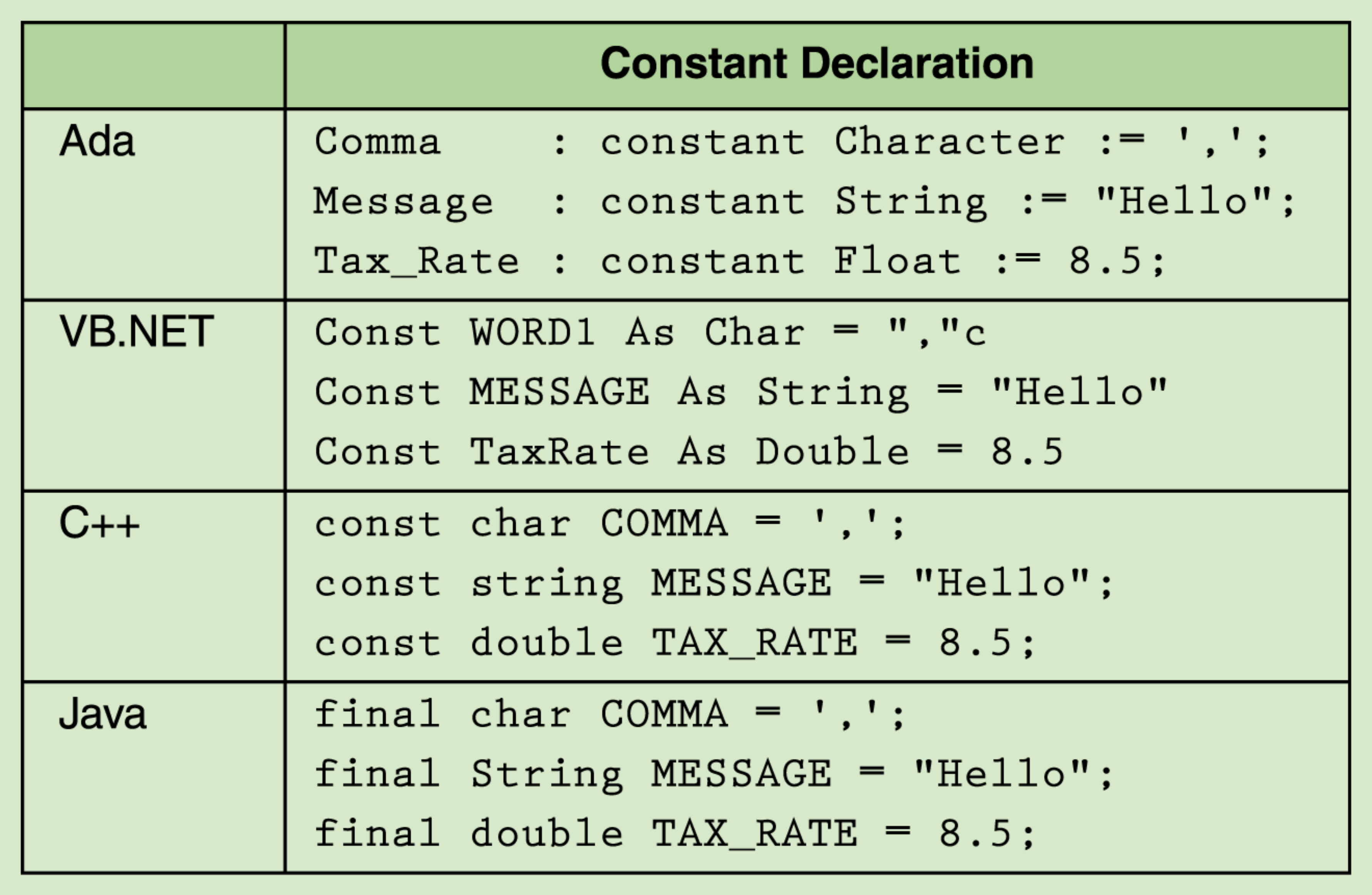
Declarations

- **Reserved word** A word in a language that has special meaning
- **Case-sensitive** Uppercase and lowercase letters are considered the same

Assignment statement

- **Assignment statement** An action statement (not a declaration) that says to evaluate the expression on the right-hand side of the symbol and store that value into the place named on the left-hand side
- **Named constant** A location in memory, referenced by an identifier, that contains a data value that cannot be changed

Assignment Statement



	Constant Declaration

Ada	Comma : constant Character := ',';
	Message : constant String := "Hello";
	Tax_Rate : constant Float := 8.5;

VB.NET	Const WORD1 As Char = ","c Const MESSAGE As String = "Hello" Const TaxRate As Double = 8.5

C++	const char COMMA = ',';
	const string MESSAGE = "Hello";
	const double TAX_RATE = 8.5;

Java	final char COMMA = ',';
	final String MESSAGE = "Hello";
	final double TAX_RATE = 8.5;

Input/Output Structures

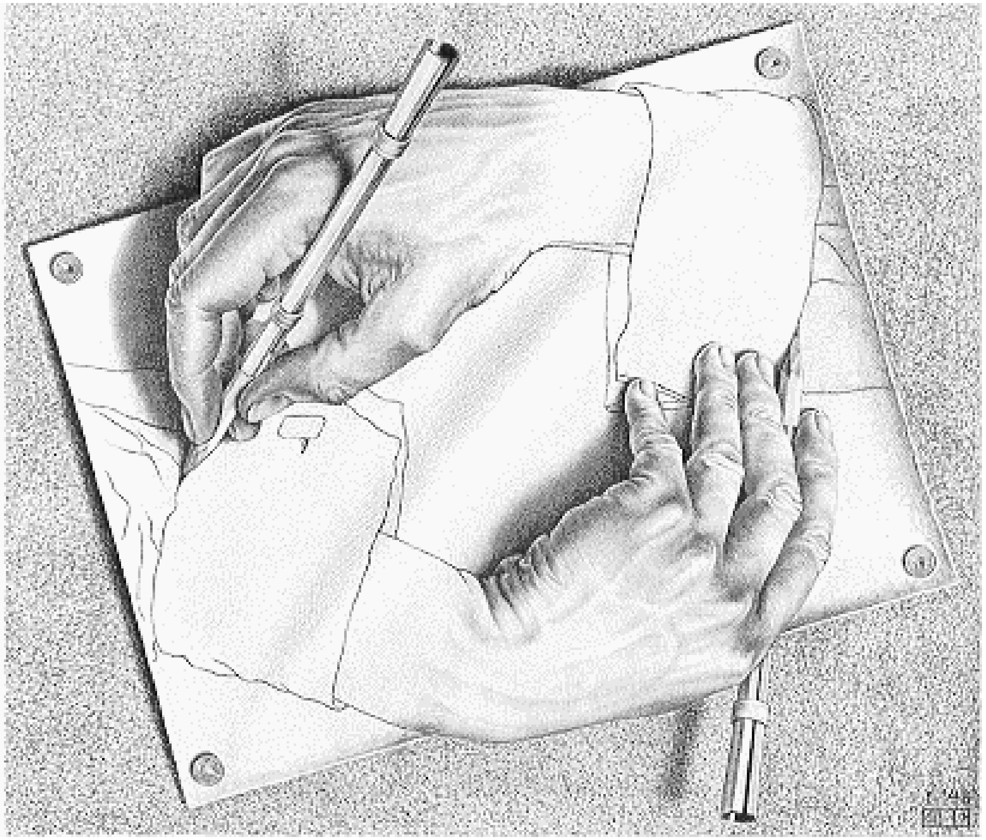
- In our pseudocode algorithms we have used the expressions ***Read*** and ***Write***
- High-level languages view input data as a stream of characters divided into lines

Input/Output Structures

- The key to the processing is in the data type that determines how characters are to be converted to a bit pattern (input) and how a bit pattern is to be converted to characters (output)

- We do not give examples of input/output statements because the syntax is often quite complex and differs so widely among high-level languages

A Little Hands On



Hello World

```
<html>
<body>
<script type="text/javascript">
document.write("Hello World!")
</script>
</body>
</html>
```

An External JavaScript

```
<html>
<head>
<script src="xxx.js"></script>
</head>
<body>
</body>
</html>
```

Declaring Variables

You can create a variable with the var statement:

```
var strname = some value
```

You can also create a variable without the var statement:

```
strname = some value
```

You can assign a value to a variable like this:

```
var strname = "Hello World!"
```

Or like this:

```
strname = "Hello World!"
```

Control Statements

```
<script type="text/javascript">
```

comment

```
//Write a "Good morning" greeting if
//the time is less than 10
```

declare

```
var d=new Date()
var time=d.getHours()
```

control

```
if (time<10)
{
document.write("<b>Good morning</b>")
}
</script>
```

Homework

- **Read Chapter Eight, Sections 8.1 – 8.3 (Up to Control Structures)**
- **“PLAY” with JavaScript** **http://www.w3schools.com/js/js_howto.asp**

Mid-Term

- Due Back: **Tonight**
- No Lateness!!!

No Class

- There will be **no class** on **Monday, 10/30**

Good Night

"WHY CAN'T THEY MAKE A SPELL CHECKER THAT KNOWS HOW TO CHECK SPELLS???"