Chapter 8
(Part 2)

High Level Programming Languages

Chapter Goals

- Define the concepts of a data type and strong typing
- Explain the concept of a parameter and distinguish between value and reference parameters
- Describe two composite data-structuring mechanisms
- Name, describe, and give examples of the three essential ingredients of an object-oriented language
- . . . Some Hands-On

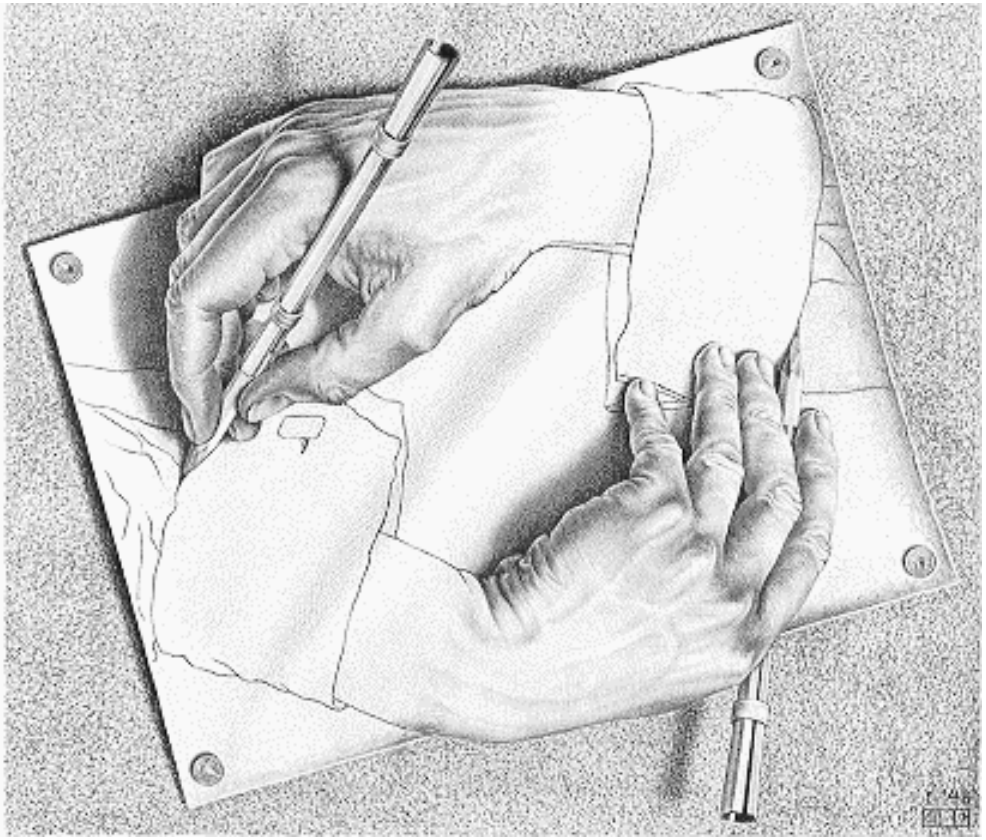
Input/Output Structures

- 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

comment

declare

control

```
<script type="text/javascript">
//Write a "Good morning" greeting if
//the time is less than 10

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

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

Control Structures

- **Control structure** An instruction that determines the order in which other instructions in a program are executed
- **Structured programming** A programming methodology in which each logical unit of a program should have just one entry and one exit
- Sequence, selection statements, looping statements, and subprogram statements are control structures

Selection Statements

- The ***if*** statement allows the program to test the state of the program variables using a Boolean expression

Language	if Statement

Ada	`if Temperature > 75 then`
	`  Put(Item => "No jacket is necessary")`
	`else`
	`  Put (Item => "A light jacket is appropriate");`
	`end if;`

VB.NET	`if (Temperature > 75) Then`
	`  MsgBox("No jacket is necessary")`
	`Else`
	`  MsgBox("A light jacket is appropriate")`
	`End if`

C++	`if (temperature > 75)`
	`  cout << "No jacket is necessary";`
	`else`
	`  cout << "A light jacket is appropriate";`

Java	`if (temperature > 75)`
	`  System.out.print("No jacket is necessary");`
	`else`
	`  System.out.print("A light jacket is appropriate");`

Selection Statements

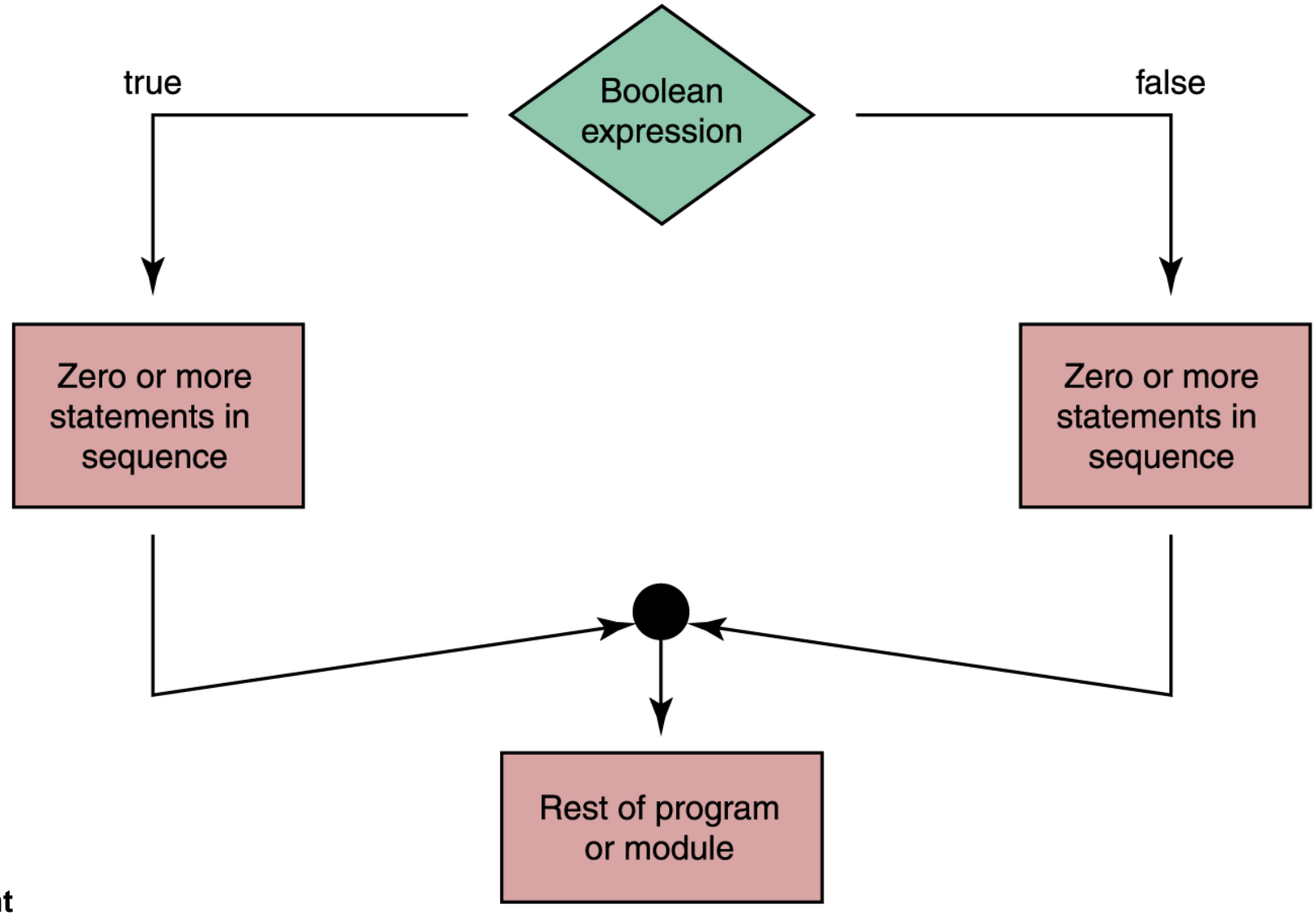


Figure 8.3
Flow of control of *if* statement

```
<html>
<body>
<script type="text/javascript">
//If the time is less than 10, you will get  "Good morning,"
//Otherwise you will get a "Good day" greeting.

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

if (time < 10)
{
document.write("Good morning!")
}
else
{
document.write("Good day!")
}
</script>
</body>
</html>
```

Selection Statements

Language	if Statement

Ada	`if Temperature > 75 then`
	`  Put(Item => "No jacket is necessary")`
	`else`
	`  Put (Item => "A light jacket is appropriate");`
	`end if;`

VB.NET	`if (Temperature > 75) Then`
	`  MsgBox("No jacket is necessary")`
	`Else`
	`  MsgBox("A light jacket is appropriate")`
	`End if`

C++	`if (temperature > 75)`
	`  cout << "No jacket is necessary";`
	`else`
	`  cout << "A light jacket is appropriate";`

Java	`if (temperature > 75)`
	`  System.out.print("No jacket is necessary");`
	`else`
	`  System.out.print("A light jacket is appropriate");`

Selection Statements

```
If (temperature > 90)
        Write "Texas weather: wear shorts"
Else If (temperature > 70)
        Write "Ideal weather: short sleeves are fine"
Else if (temperature > 50)
        Write "A little chilly: wear a light jacket"
Else If (temperature > 32)
        Write "Philadelphia weather: wear a heavy coat"
Else
        Write "Stay inside"
```

```
<html>
<body>
<script type="text/javascript">
var d = new Date()
var time = d.getHours()
if (time < 10)
{
document.write("<b>Good morning!</b>")
}
else if (time>10 && time<16)
{
document.write("<b>Good day!</b>")
}
else
{
document.write("<b>Good evening!</b>")
}
</script>
</body>
</html>
```

case Statement

- For convenience, many high-level languages include a case (or switch) statement
- Allows us to make multiple-choice decisions easier, provided the choices are discrete

```
CASE operator OF
'+'   : Set answer to one + two
'-'   : Set answer to one – two
'*'   : Set answer to one * two
'/'   : Set answer to one / two
```

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```
<script type="text/javascript">
//You will receive a different greeting based
//on what day it is. Note that Sunday=0,
//Monday=1, Tuesday=2, etc.

var d=new Date()
theDay=d.getDay()
switch (theDay)
{
case 5:
  document.write("Finally Friday")
  break
case 6:
  document.write("Super Saturday")
  break
case 0:
  document.write("Sleepy Sunday")
  break
default:
  document.write("I'm looking forward to this weekend!")
}
</script>
```

Looping Statements

- The ***while*** statement is used to repeat a course of action
- Let's look at two distinct types of repetitions

Looping Statements

- ***Count-controlled loops***
  - Repeat a specified number of times
  - Use of a special variable called a loop control variable

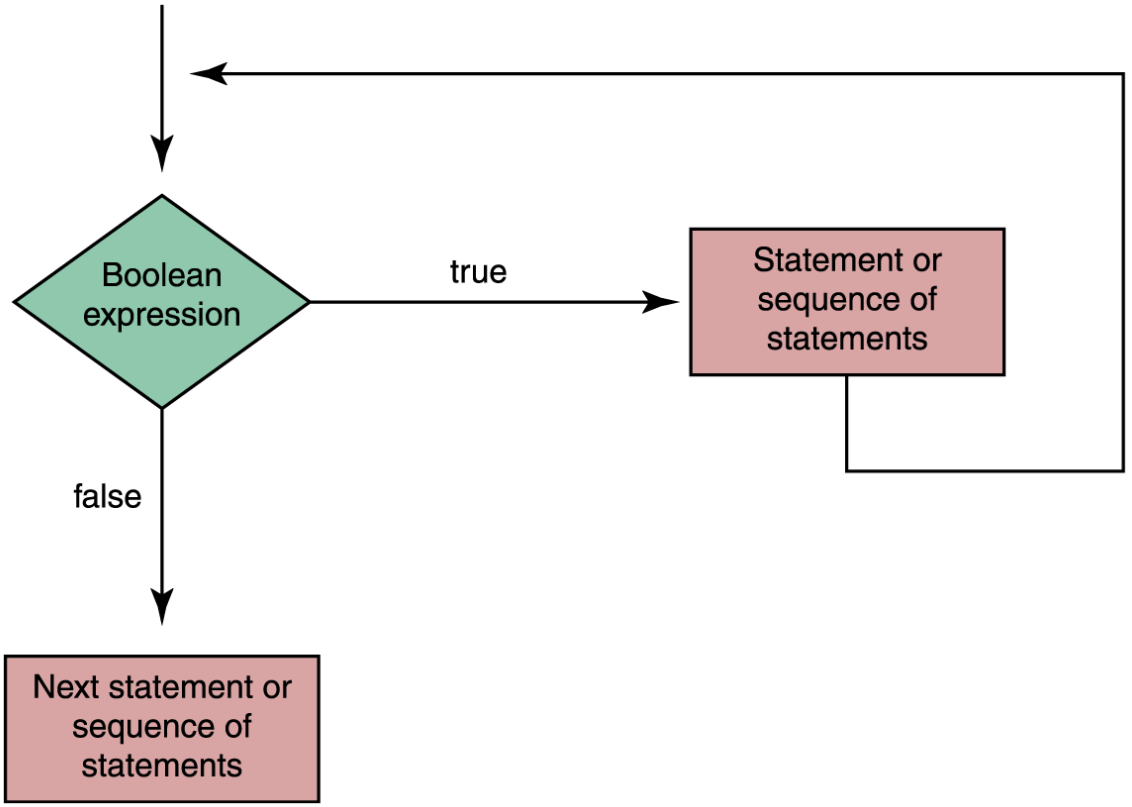

Figure 8.4
Flow of control of *while* statement

Looping Statements

- *Count-controlled* loops

Language	Count-Controlled Loop with a while Statement

Ada	`Count := 1;`
	`while Count <= Limit loop`
	`  ...`
	`  Count := Count + 1;`
	`end loop;`

VB.NET	`Count = 1`
	`While (count <= limit)`
	`  ...`
	`  count = count + 1`
	`End While`

C++/Java	`count = 1;`
	`while (count <= limit)`
	`{`
	`  ...`
	`  count = count + 1;`
	`}`

Looping Statements

- ***Event-controlled* loops**
  - The number of repetitions is controlled by an event that occurs within the body of the loop itself

```
Read a value                Initialize event
While (value >= 0)          Test event
    ...                     Body of loop
    Read a value            Update event
...                         Statement(s) following loop
```

Looping Statements

- *Event-controlled* loops

```
Set sum to 0                              Initialize sum to zero
Set posCount to 0                         Initialize event
While (posCount <= 10)                    Test event
      Read a value
      If (value > 0)                      Test to see if event should be updated
            Set posCount to posCount + 1      Update event
            Set sum to sum + value            Add value into sum
...                                       Statement(s) following loop
```

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Looping Statement

```
<html>
<body>
<script type="text/javascript">
var i=0
while (i<=10)
{
document.write("The number is " + i)
document.write("<br />")
i=i+1
}
</script>
</body>
</html>
```

Looping Statement

The number is 0
The number is 1
The number is 2
The number is 3
The number is 4
The number is 5
The number is 6
The number is 7
The number is 8
The number is 9
The number is 10

Subprogram Statements

- We can give a section of code a name and use that name as a statement in another part of the program
- When the name is encountered, the processing in the other part of the program halts while the named code is executed

Subprogram Statements

- There are times when the calling unit needs to give information to the subprogram to use in its processing
- A **parameter list** is a list of the identifiers with which the subprogram is to work, along with the types of each identifier placed in parentheses beside the subprogram name

Subprogram Statements

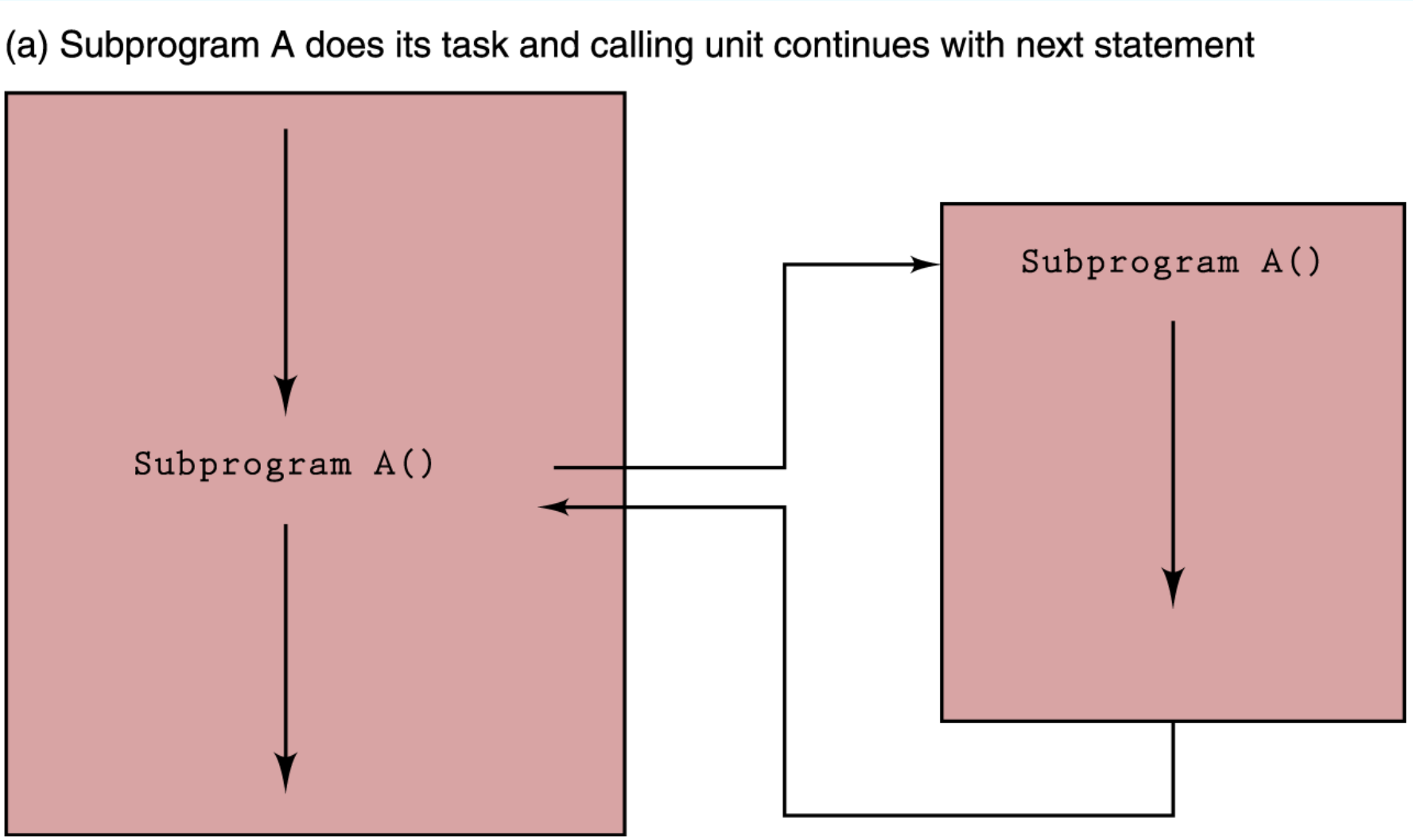

Figure 8.5 **Subprogram flow of control**

Subprogram Statements

(b) Subprogram B does its task and returns a value that is added to 5 and stored in `x`

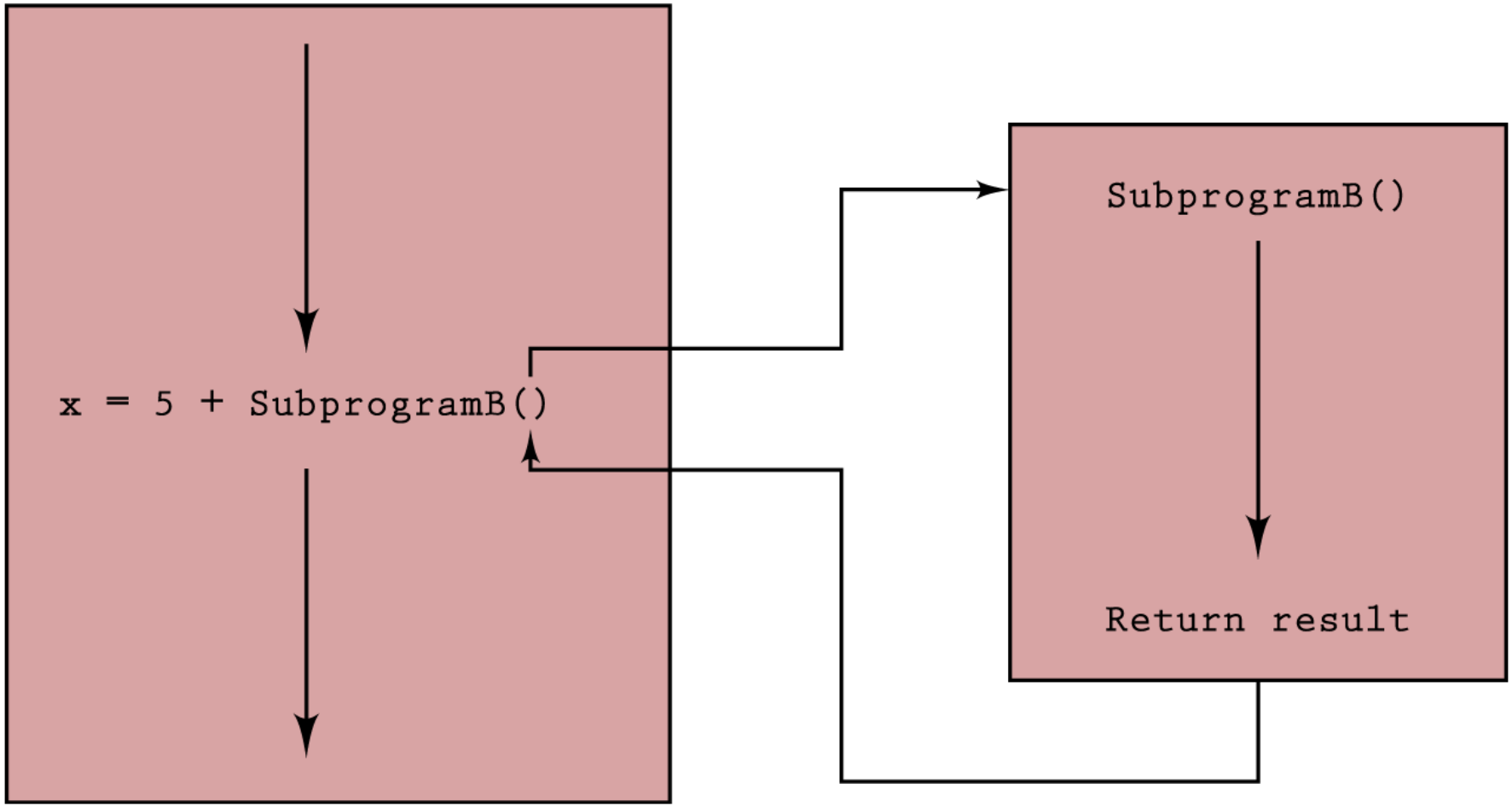

Figure 8.5 **Subprogram flow of control**

Subprogram Statements

- **Parameters** Identifiers listed in parentheses beside the subprogram declaration; sometimes they are called **formal parameters**
- **Arguments** Identifiers listed in parentheses on the subprogram call; sometimes they are called **actual parameters**

Subprogram Statements

- **Value parameter** A parameter that expects a copy of its argument to be passed by the calling unit (put on the message board)
- **Reference parameter** A parameter that expects the address of its argument to be passed by the calling unit (put on the message board)

Subprogram Statements

Language	Subprogram Declaration

VB.NET	`Public Sub Example(ByVal one As Integer,`
	`  ByVal two As Integer,`
	`  ByRef three As Single)`
	`  ...`
	`End Sub`

C++/Java	`void Example(int one; int two; float& three)`
	`{`
	`  ...`
	`}`

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Functions

```
<html>
<head>
<script type="text/javascript">
function displaymessage()
{
alert("Hello World!")
}
</script>
</head>

<body>
<form>
<input type="button" value="Click me!"
onclick="displaymessage()" >
</form>
</body>
</html>
```

Recursion

- **Recursion** The ability of a subprogram to call itself
- Each recursive solution has at least two cases
  - **Base case** The case to which we have an answer
  - **General case** The case that expresses the solution in terms of a call to itself with a smaller version of the problem
- For example, the factorial of a number is defined as the number times the product of all the numbers between itself and 0:

$$N! = N * (N - 1)!$$

Asynchronous Processing

- **Asynchronous processing** The concept that input and output can be accomplished through windows on the screen
  - *Clicking* has become a major form of input to the computer
  - Mouse clicking is not within the sequence of the program
  - A user can click a mouse at any time during the execution of a program
  - This type of processing is called **asynchronous**

Composite Data Types

- **Records**
  - A record is a named *heterogeneous* collection of items in which individual items are accessed by name
  - The elements in the collection can be of various types

Composite Data Types

Language	Record Type Declaration

Ada	`type Name_String is String (1..10);`
	`type Employee_Type is`
	`  record`
	`  Name : Name_String;`
	`  Age  : Integer range 0..100;`
	`  Hourly_Wage : Float range 1.0..5000.0;`
	`end record;`

VB.NET	`Structure Employee`
	`  Dim Name As String`
	`  Dim Age As Integer`
	`  Dim HourlyWage As Single`
	`End Structure`

C++	`struct EmployeeType`
	`{`
	`  string name;`
	`  int age;`
	`  float hourlyWage;`
	`};`

Composite Data Types

Language	Record Variable Declaration and Usage

Ada	`An_Employee : Employee_Type;`
	`...`
	`  An_Employee.Name = "Sarah Gale";`
	`  An_Employee.Age = 32;`
	`  An_Employee.Hourly_Wage = 95.00;`

VB.NET	`Dim AnEmployee As EmployeeType`
	`...`
	`  AnEmployee.Name = "Sarah Gale"`
	`  AnEmployee.Age = 32`
	`  AnEmployee.HourlyWage  95.00`

C++	`EmployeeType anEmployee;`
	`...`
	`  anEmployee.name = "Sarah Gale";`
	`  anEmployee.age = 32;`
	`  anEmployee.hourlyWage = 95.00;`

Arrays

- An **array** is a named collection of homogeneous items in which individual items are accessed by their place within the collection
  - The place within the collection is called an ***index***

Language	Array Declaration
Ada	`type Index_Range is range 1..10;` `type Ten_Things is array (Index_Range) of Integer;`
VB.NET	`Dim TenThings(10) As Integer`
C++/Java	`int tenThings[10];`

Arrays

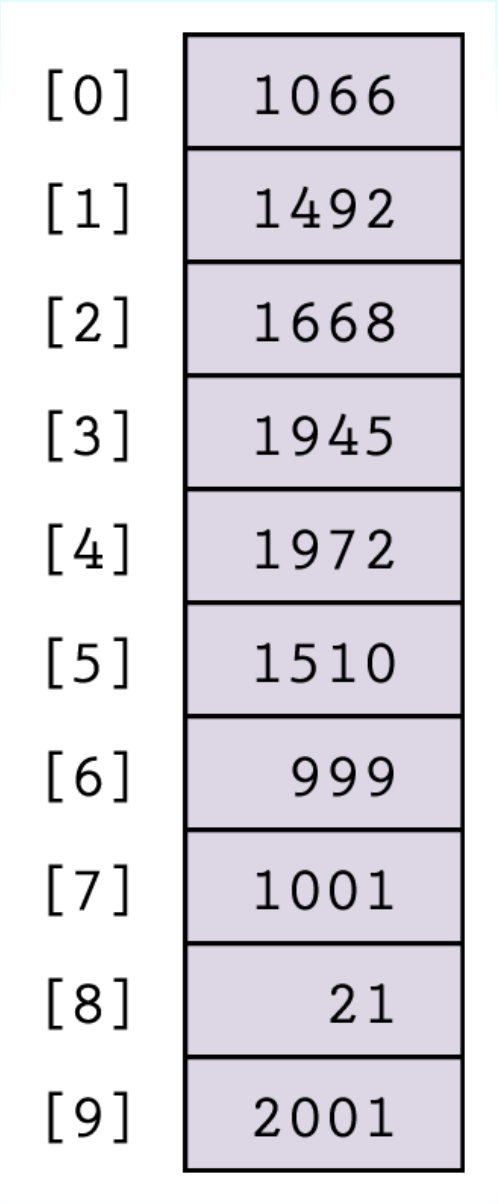


Figure 8.8
Array variable *tenThings* **accessed from** *0..9*

Functionality of Object-Oriented Languages

- **Encapsulation**
- **Inheritance**
- **Polymorphism**

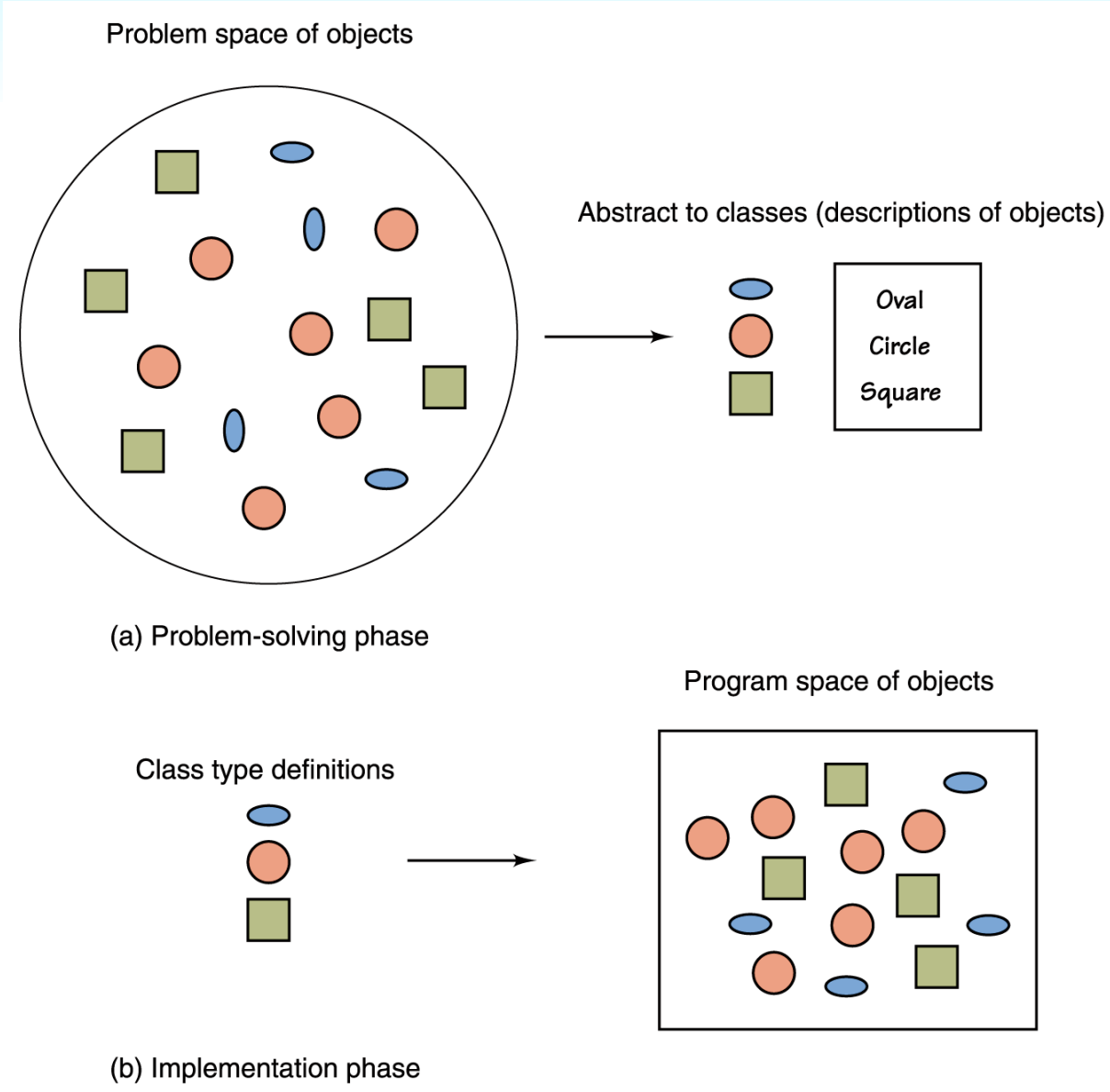
Encapsulation

- **Encapsulation** A language feature that enforces information hiding
- **Class** A language construct that is a pattern for an object and provides a mechanism for encapsulating the properties and actions of the object class
- **Instantiate** Create an object from a class

Inheritance

- **Inheritance** A construct that fosters reuse by allowing an application to take an already-tested class and derive a class from it that inherits the properties the application needs
- **Polymorphism** The ability of a language to have duplicate method names in an inheritance hierarchy and to apply the method that is appropriate for the object to which the method is applied

Inheritance



- Inheritance and polymorphism combined allow the programmer to build useful hierarchies of classes that can be reused in different applications

Figure 8.9
Mapping of problem into solution

Homework

- **Read Chapter Eight, Sections 8.3 – 8.4**
- **“PLAY” with JavaScript**
  http://www.w3schools.com/js/js_howto.asp
- **Do some of the hands-on examples in class**

Mid-Term

- Due Back: **Tonight**
- Sorry For The Web Site Outage!!!

No Class

- **There Will Be No Class On Monday, 10/30**
- **Next Class Is Wednesday, 11/1**

Have A Great Weekend