

Algorithms

OBJECTIVES

After reading this chapter, the reader should be able to:

- Understand the concept of an algorithm.
- Define and use the three constructs for developing algorithms: sequence, decision, and repetition.
- Understand and use three tools to represent algorithms: flowchart, pseudocode, and structure chart.
- Understand the concept of modularity and subalgorithms.
- List and comprehend common algorithms.

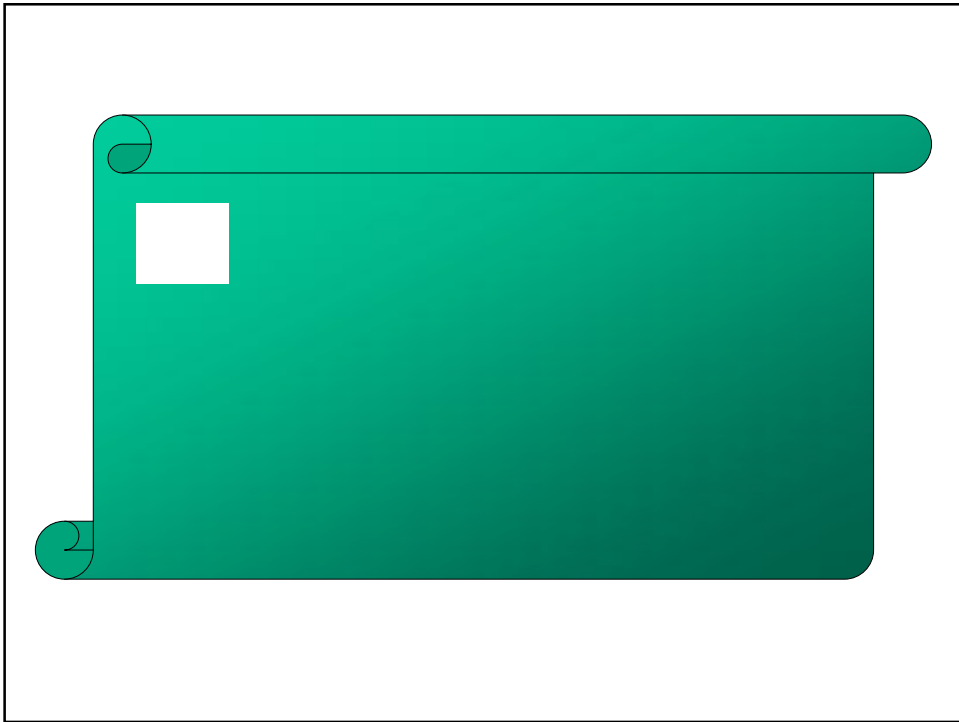


Figure 8-1

Informal definition of an algorithm used in a computer

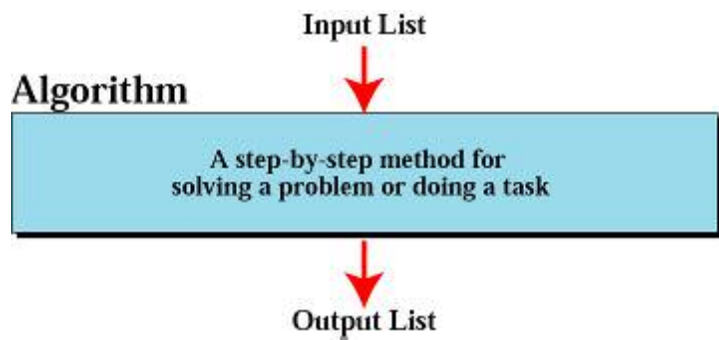


Figure 8-2

Finding the largest integer among five integers

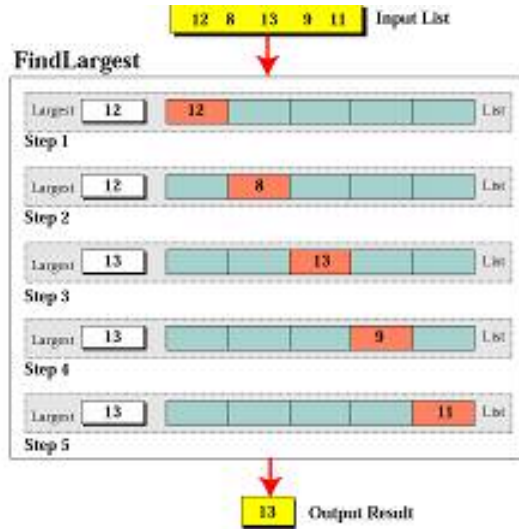


Figure 8-3

Defining actions in FindLargest algorithm

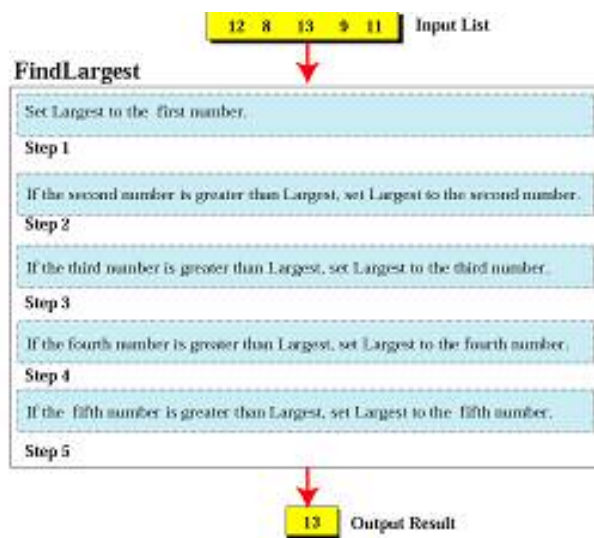


Figure 8-4

FindLargest refined

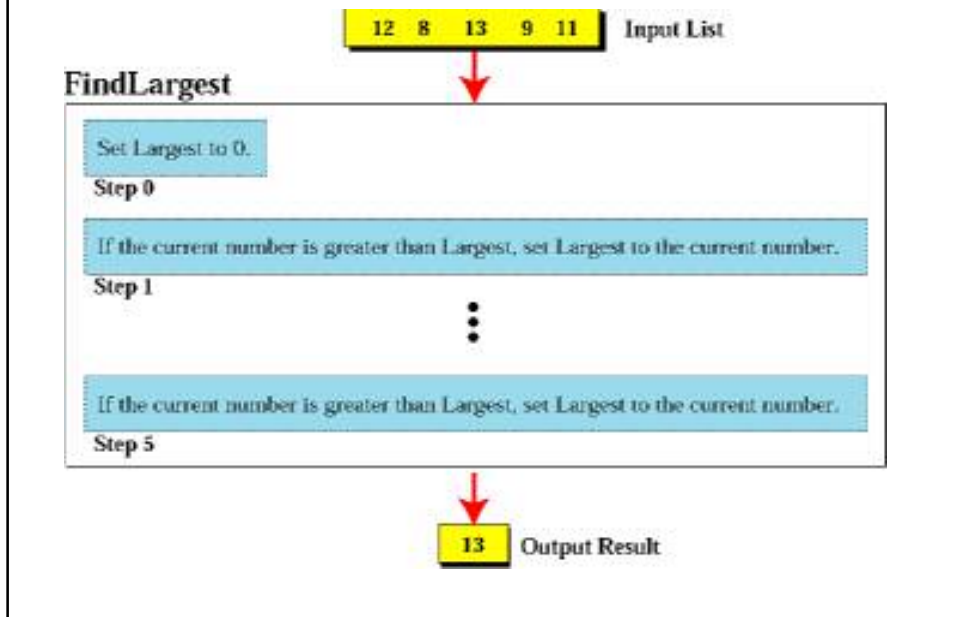
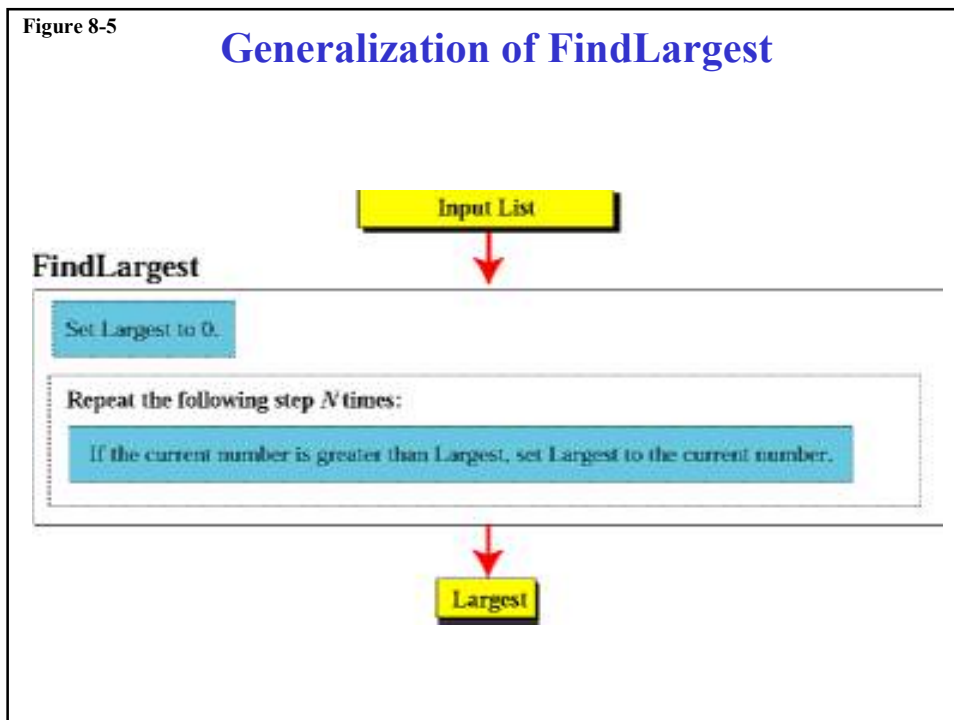


Figure 8-5

Generalization of FindLargest



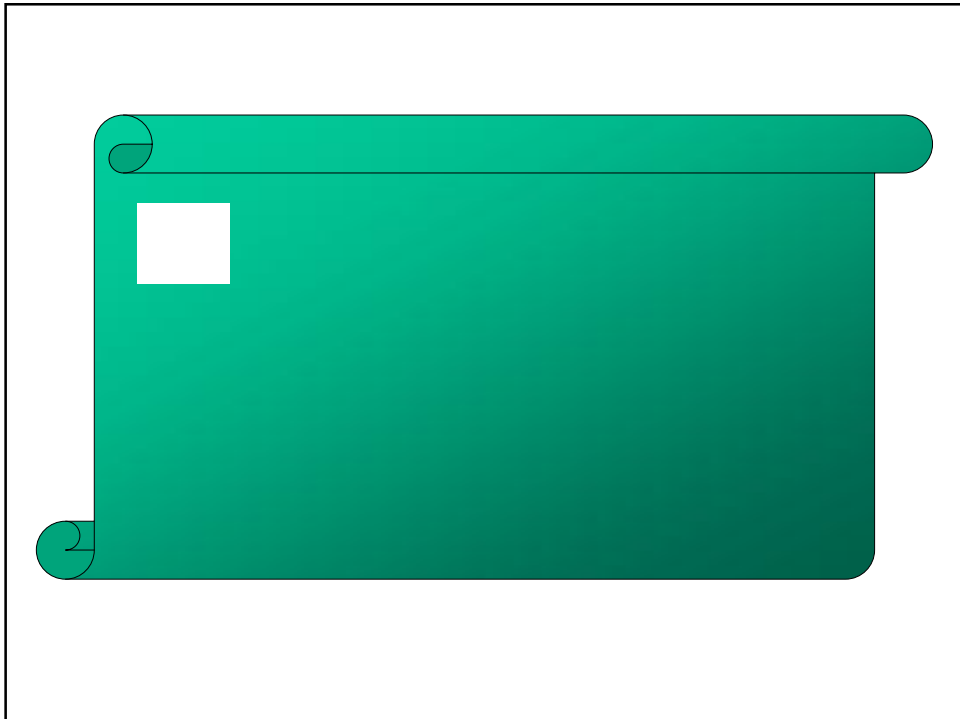
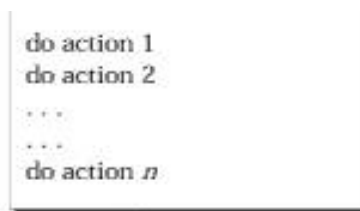
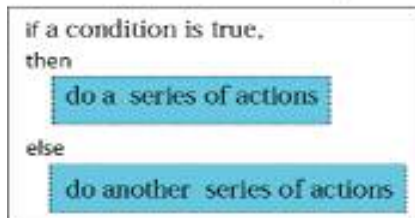


Figure 8-6

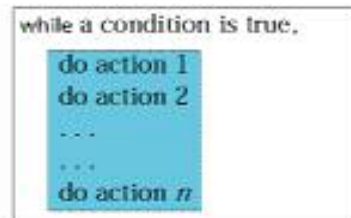
Three constructs



a. Sequence



b. Decision



c. Repetition

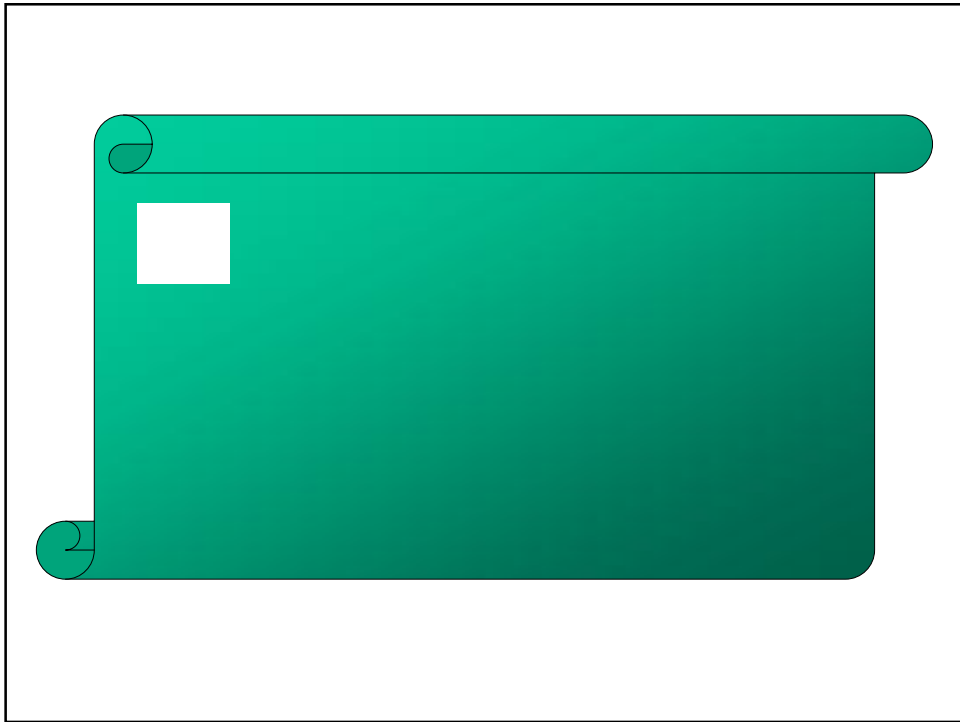


Figure 8-7

Flowcharts for three constructs

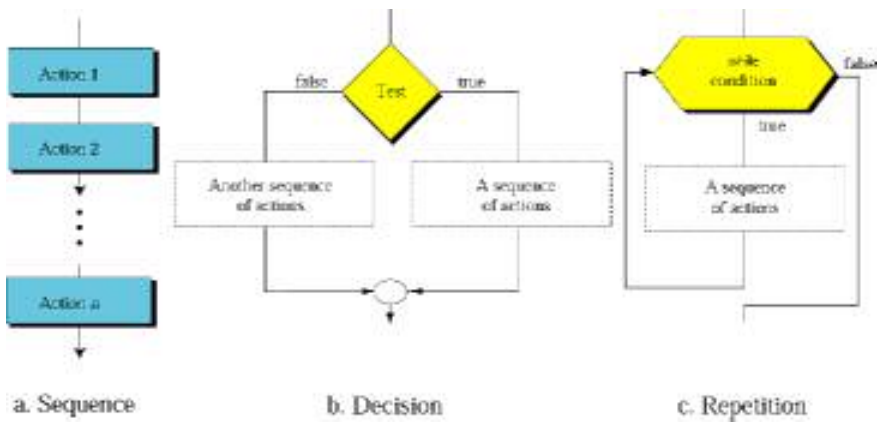
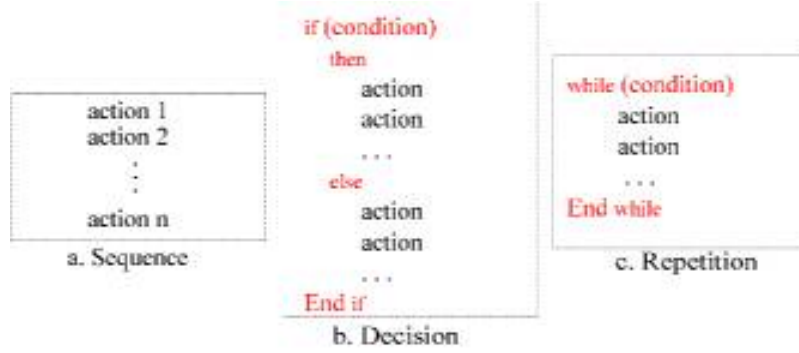


Figure 8-8

Pseudocode for three constructs



Example 1

Solution

Algorithm 8.1: Average of two

AverageOfTwo

Input: Two numbers

- 1. Add the two numbers**
- 2. Divide the result by 2**
- 3. Return the result by step 2**

End

Example 2

Solution

Algorithm 8.2: Pass/no pass Grade

Pass/NoPassGrade

Input: One number

1. if (the number is greater than or equal to 70)
then
 - 1.1 Set the grade to “pass”
 - else
 - 1.2 Set the grade to “nopass”
- End if
2. Return the grade
- End

Example 3

Solution

Algorithm 8.3: Letter grade

LetterGrade

Input: One number

1. if (the number is between 90 and 100, inclusive)
then
 - 1.1 Set the grade to “A”End if
2. if (the number is between 80 and 89, inclusive)
then
 - 2.1 Set the grade to “B”End if

Continues on the next slide

Algorithm 8.3: Letter grade (continued)

3. if (the number is between 70 and 79, inclusive)
then
 - 3.1 Set the grade to “C”End if
4. if (the number is between 60 and 69, inclusive)
then
 - 4.1 Set the grade to “D”End if

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Algorithm 8.3: Letter grade (continued)

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5. If (the number is less than 60)
   then
     5.1 Set the grade to "F"
   End if
6. Return the grade
End
```

Example 4

Solution

Algorithm 8.4: Find largest

FindLargest

Input: A list of positive integers

1. Set Largest to 0
 2. while (more integers)
 - 2.1 if (the integer is greater than Largest)
then
 - 2.1.1 Set largest to the value of the integer
 - End if
 - End while
 3. Return Largest
- End**

Example 5

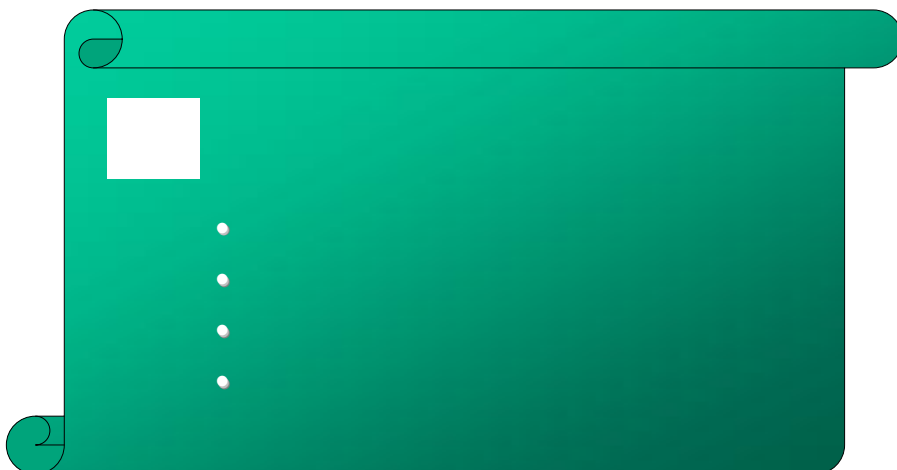
Solution

Algorithm 8.5: *Find largest of 1000 numbers*

FindLargest

Input: 1000 positive integers

1. Set Largest to 0
 2. Set Counter to 0
 3. while (Counter less than 1000)
 - 3.1 if (the integer is greater than Largest)
then
 - 3.1.1 Set Largest to the value of the integer
 - End if
 - 3.2 Increment Counter
 - End while
 4. Return Largest
- End**



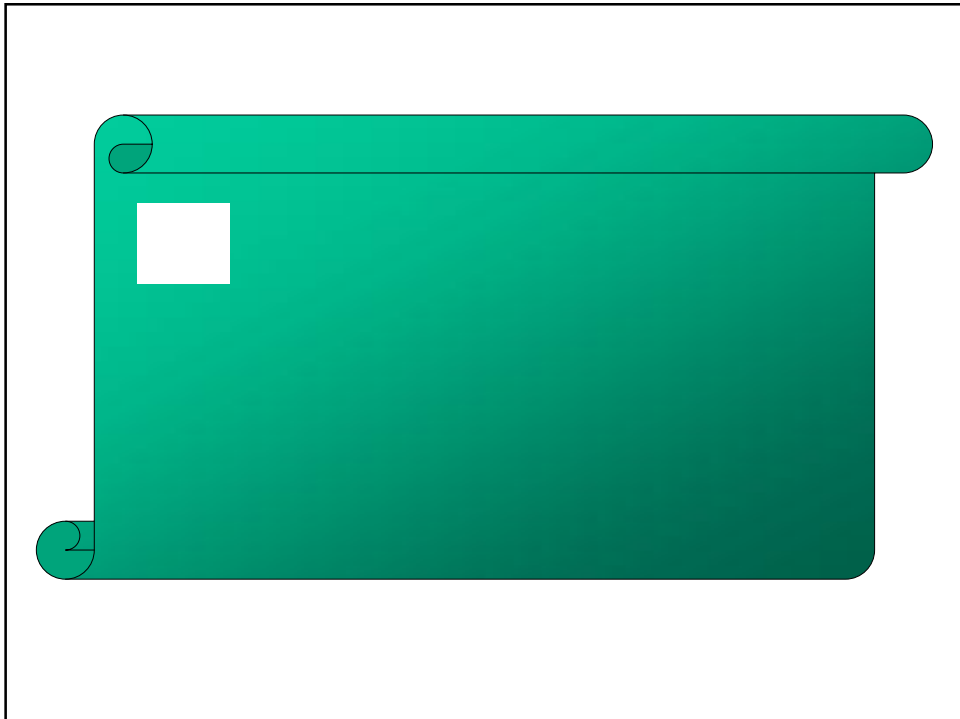
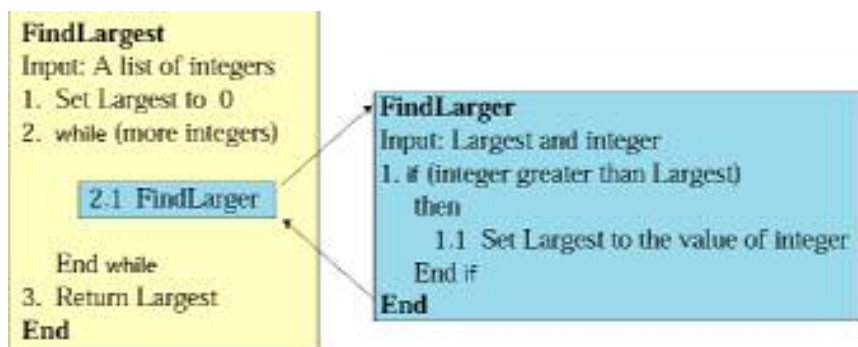


Figure 8-9

Concept of a subalgorithm



Algorithm 8.6: Find largest

FindLargest

Input: A list of positive integers

1. Set Largest to 0
 2. while (more integers)
 - 2.1 FindLargerEnd while
 3. Return Largest
- End**

Subalgorithm: Find larger

FindLarger

Input: Largest and current integer

1. if (the integer is greater than Largest)
then
 - 1.1 Set Largest to the value of the integerEnd if
- End**

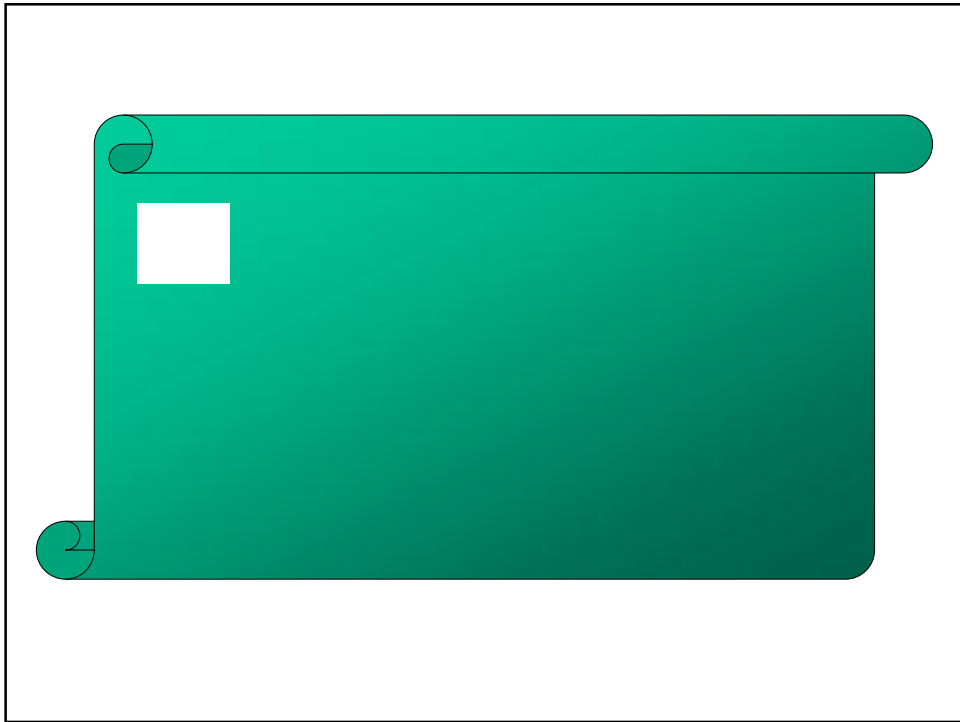


Figure 8-10

Summation

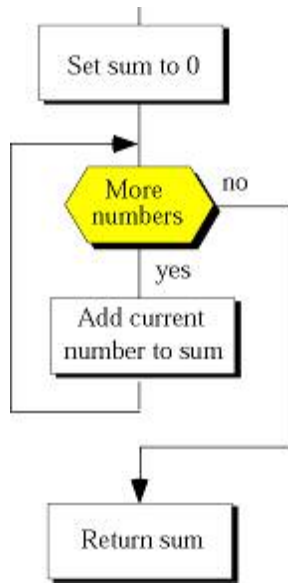


Figure 8-11

Product

