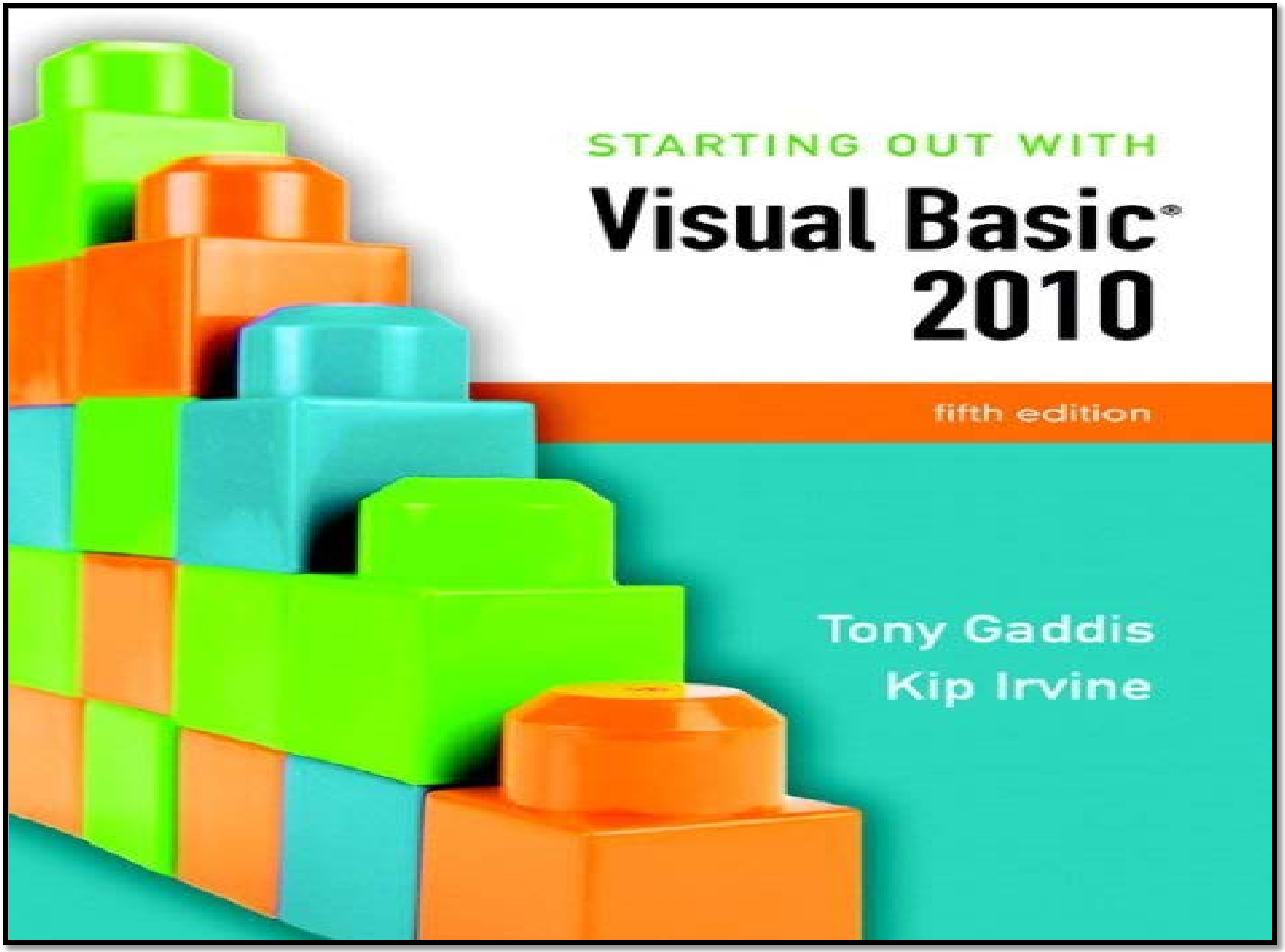
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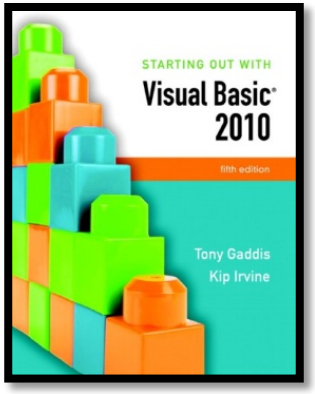

Chapter 5

Lists and Loops

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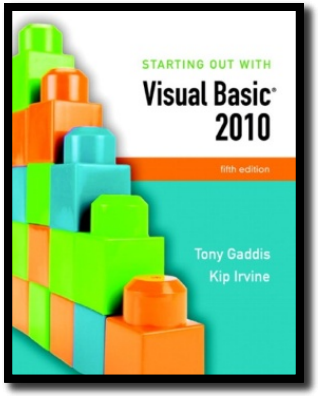
Introduction

- This chapter introduces:
  - Input boxes
  - List and combo boxes
  - Loops
  - Random numbers
  - The ToolTip control



Section 5.1

INPUT BOXES

Input boxes provide a simple way to gather input without placing a text box on a form.

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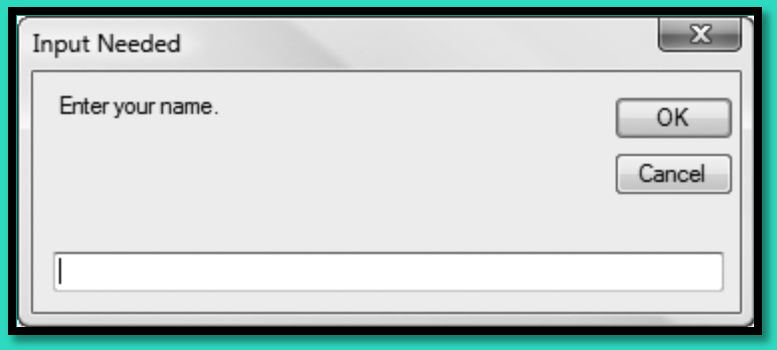
Overview

- An **input box** provides a quick and simple way to ask the user to enter data



  - User types a value in the text box
  - OK button returns a string value containing user input
  - Cancel button returns an empty string
  - Should not be used as a primary method of input
  - Convenient tool for developing & testing applications

General Format

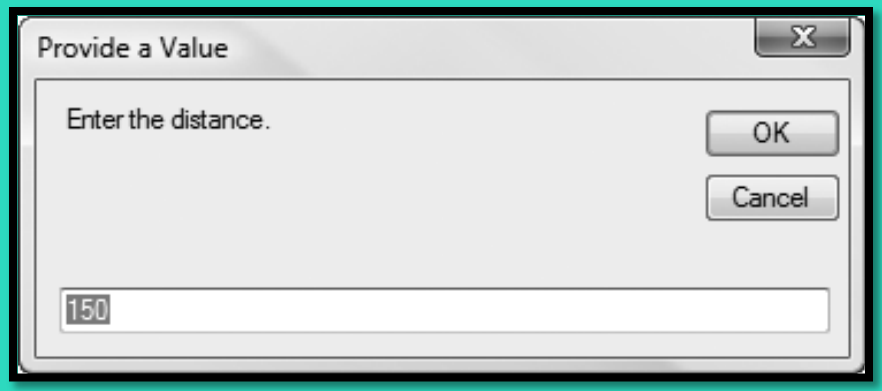
InputBox(Prompt [,Title] [,Default] [,Xpos] [,Ypos])

Argument	Description
Prompt	String displayed in the input box, normally asks the user for a value
[Optional arguments]	
Title	String that appears in the title bar, contains project name by default
Default	String to be initially displayed in the text box, empty by default
Xpos	Integer that specifies the distance (in pixels) of the leftmost edge of the input box from the left edge of the screen, centered horizontally by default
Ypos	Integer that specifies the distance (in pixels) of the topmost edge of the input box from the top of the screen, placed near the top of the screen by default

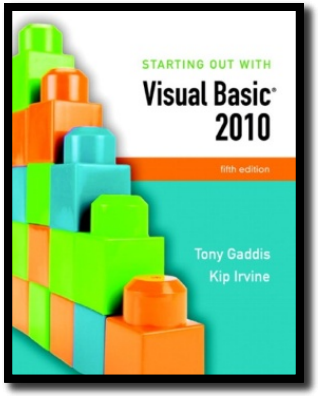
Example Usage

- To retrieve the value returned by the **InputBox** function, use the assignment operator to assign it to a variable
- For example, the following statement assigns the string value returned by the **InputBox** function to the string variable **strUserInput**

```
Dim strUserInput As String = InputBox("Enter the distance.",
                                      "Provide a Value",
                                      "150")
```



- The string value that appears inside the text box will be stored in the **strUserInput** variable after the OK button is clicked and the input box closes



Section 5.2

LIST BOXES

List boxes display a list of items and allow the user to select an item from the list.

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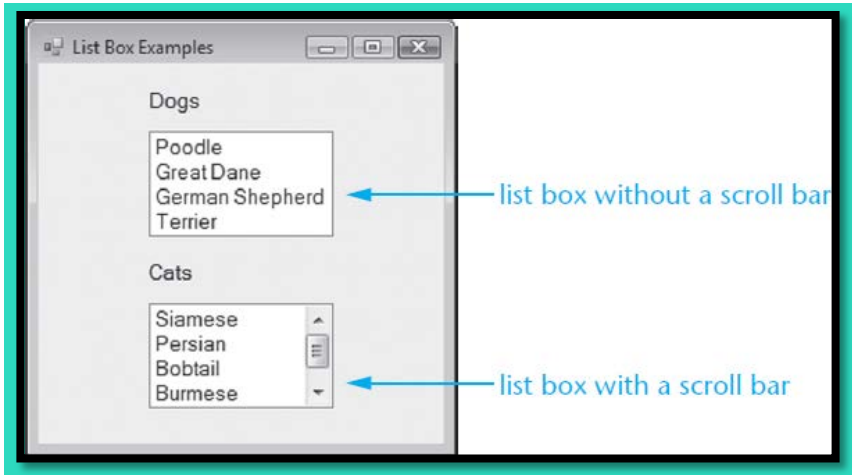
Overview

- A **ListBox** control displays a list of items and also allows the user to select one or more items from the list
  - Displays a scroll bar when all items cannot be shown
- To create a ListBox control:
  - Double-click the ListBox icon in the ***Toolbox*** window
  - Position and resize the control as necessary



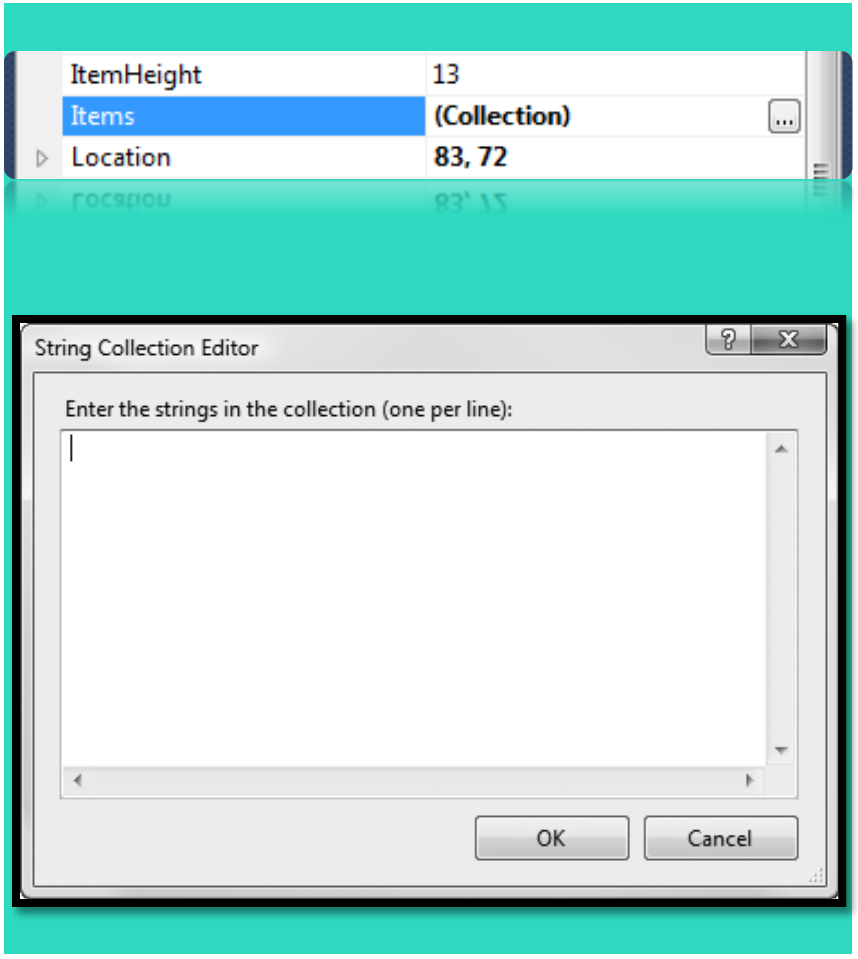
- In ***Design*** mode, the list box appears as a rectangle
  - The size of the rectangle determines the size of the list box
- Use the **lst** prefix when naming a list box (***lstListBox***)

The **Items** Property

- The entries in a list box are stored in a property named **Items**
  - The **Items property** holds an entire list of values from which the user may choose
  - The list of values may be established at design time or runtime
  - Items are stored in a ***Collection*** called the **Items Collection**

Adding Items to the Items Collection

- To store values in the **Items** property at design time:
  - Select the **ListBox control** in the ***Designer*** window
  - In the ***Properties*** window, click the Items **(Collection)** ellipsis button (...)
  - Type each value on a separate line in the ***String Collection Editor*** dialog box



The **Items.Count** Property

- The **Items.Count** property returns the number of list box items or zero if the list is empty
- For example, the **Items.Count** return value:
  - Can be used in an **If** statement:

```
If lstEmployees.Items.Count = 0 Then
  MessageBox.Show("The list has no items!")
End If
```

  - Or assigned to a variable

```
IntNumEmployees = lstEmployees.Items.Count
```

Item Indexing

- The **Items** property values can be accessed from your VB code
- Each item value is given a sequential index
  - The first item has an index of 0
  - The second item has an index of 1, etc.
- When assigning an item to a variable, you must explicitly convert the item to the same data type as the variable
  - Examples:

```
strName  = lstCustomers.Items(2).ToString()

intRoomNumber = CInt(lstRoomNumbers.Items(0))
```

Handling Exceptions Caused by Indexes

- An exception is thrown if an index is out of range
  - An exception handler can be used to trap indexing errors

```
Try
  strInput = lstMonths.Items(intIndex).ToString()
Catch ex As Exception
  MessageBox.Show(ex.Message)
End Try
```

  - Some programmers prefer to use an **If** statement to handle indexing errors

```
If intIndex >= 0 And intIndex < lstMonths.Items.Count Then
  strInput = lstMonths.Items(intIndex).ToString()
Else
  MessageBox.Show("Index is out of range: " & intIndex)
End If
```

The **SelectedIndex** Property

- The **SelectedIndex** property returns an integer with the index of the item selected by the user
- If no item is selected, the value is set to -1 (an invalid index value)
- Can use **SelectedIndex** to determine if an item has been selected by comparing to -1
- Example:

```
If lstLocations.SelectedIndex <> -1 Then
  strLocation = lstLocations.Items(lstLocations.SelectedIndex).ToString()
End If
```

The **SelectedItem** Property

- The **SelectedItem** property contains the currently selected item from the list box
- For example:

```
If lstItems.SelectedIndex <> -1
   strItemName = lstItems.SelectedItem.ToString()
End If
```

The **Sorted** Property

- **Sorted** is a Boolean property
- When set to **True**, values in the **Items** property are displayed in alphabetical order
- When set to **False**, values in the **Items** property are displayed in the order they were added
- Set to **False** by default

The **Items.Add** Method

- To store values in the Items property with code at runtime, use the **Items.Add** method
- Here is the general format:

ListBox.Items.Add(Item)

- ***ListBox*** is the name of the **ListBox** control
- ***Item*** is the value to be added to the Items property
- Example:

lstStudents.Items.Add("Sharon")

The **Items.Insert** Method

- To insert an item at a specific position, use the **Items.Insert** method
- General Format:

ListBox.Items.Insert(Index, Item)

- ***ListBox*** is the name of the **ListBox** control
- ***Index*** is an integer value for the position where ***Item*** is to be placed in the **Items collection**
- ***Item*** is the item you wish to insert
- Items that follow are moved down
- For example:

lstStudents.Items.Insert(2, "Jean")

Methods to Remove Items

- ***ListBox.Items.RemoveAt(Index)***
  - Removes item at the specified ***Index***
- ***ListBox.Items.Remove(Item)***
  - Removes item with value specified by ***Item***
- ***ListBox.Items.Clear()***
  - Removes all items in the Items property
- Examples:

```
lstStudents.Items.RemoveAt(2)          ' Remove 3rd item
lstStudents.Items.Remove("Jean")       ' Remove item "Jean"
lstStudents.Items.Clear()              ' Remove all items
```

Other List Box Methods

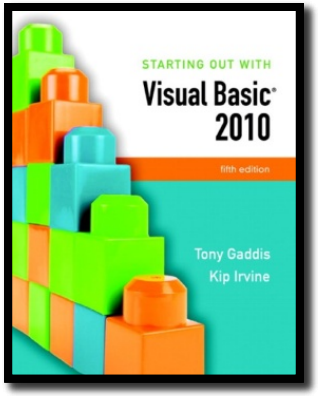
- ***ListBox.Items.Contains(Item)***
  - Returns **True** if ***Item*** is found in the collection
- ***ListBox.Items.IndexOf(Item)***
  - Returns an integer with the index position of the first occurrence of ***Item*** in the collection
- Examples:

```
blnFound = lstMonths.Items.Contains("March")
intIndex = lstMonths.Items.IndexOf("March")
```

- Tutorial 5-1 provides more examples of list box controls, methods and properties

Important Collection Methods and Properties

Method or Property	Description
Add (*item As Object*)	**Method**: adds *item to the collection, returning* its index position
Clear ( )	**Method**: removes all items in the collection. No return value
Contains (*value As Object*)	**Method**: returns *True if value is found at least* once in the collection.
Count	**Property**: returns the number of items in the collection. Read-only
IndexOf (*value As Object*)	**Method**: returns the Integer index position of the first occurrence of *value in the collection.* If *value is not found, the return value is –1*
Insert (*index As Integer, item As Object*)	**Method**: insert *item in the collection at* position *index. No return value*
Item *(index As Integer*)	**Property**: returns the object located at position *index*
Remove (*value As Object*)	**Method**: removes *value from the collection.* No return value
RemoveAt *(index As Integer*)	**Method**: removes the item at the specified *index. No return value*



Section 5.3

INTRODUCTION TO LOOPS: THE DO WHILE LOOP

A loop is a repeating structure that contains a block of program statements.

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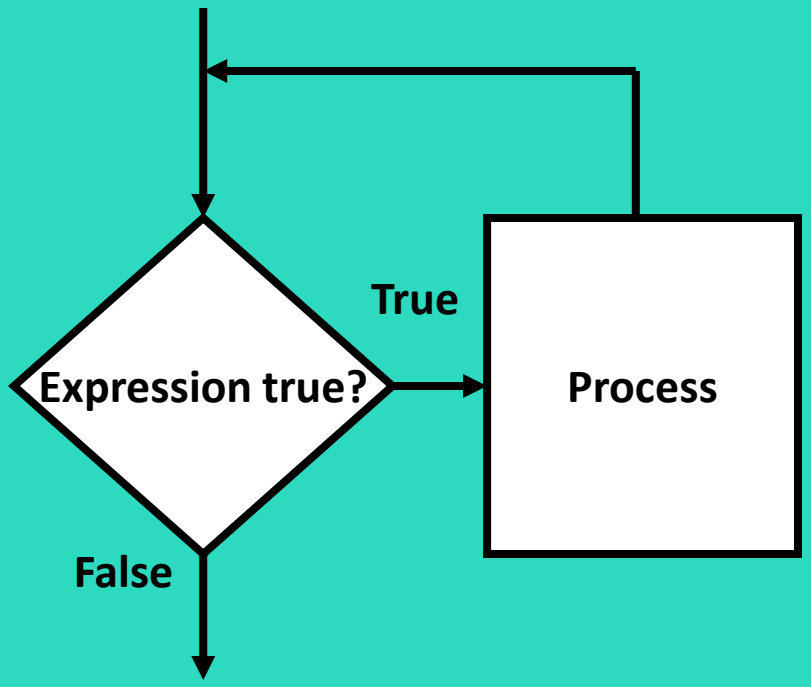
Introduction

- A **repetition structure**, or **loop** causes one or more statements to repeat
- Each repetition of the loop is called an **iteration**
- Visual Basic has three types of loops:
  - **Do While**
  - **Do Until**
  - **For… Next**
- The difference among them is how they control the repetition

The **Do While** Loop

- The **Do While** loop has two important parts:
  - a Boolean expression that is tested for a **True** or **False** value
  - a statement or group of statements that is repeated as long as the Boolean expression is true, called **Conditionally executed statements**

Do While *BooleanExpression*
statement
(more statements may follow)
Loop



Example Do While Loop

- **intCount** initialized to **0**
- Expression **intCount < 10** is tested
- If **True**, execute body:
  - **"Hello"** added to **lstOutput** Items Collection
  - **intCount** increases by **1**
- Test expression again
  - Repeat until **intCount < 10** becomes **False**

```
Dim intCount As Integer = 0
Do While intCount < 10
   lstOutput.Items.Add("Hello")
   intCount += 1
Loop
```

Infinite Loops

- A loop must have some way to end itself
- Something within the body of the loop must eventually force the test expression to false
- In the previous example
  - The loop continues to repeat
  - **intCount** increases by one for each repetition
  - Finally **intCount** is not **< 10** and the loop ends
- If the test expression can never be false, the loop will continue to repeat forever
  - This is called an **infinite loop**

Counters

- A **counter** is a variable that is regularly incremented or decremented each time a loop iterates
- **Increment** means to **add 1** to the counter's value
  - **intX = intX + 1**
  - **intX += 1**
- **Decrement** means to **subtract 1** from the counter's value
  - **intX = intX - 1**
  - **intX -= 1**

- Counters generally initialized before loop begins

```
' Start at zero
Dim intCount As Integer = 0
```

- Counter must be modified in body of loop

```
' Increment the counter variable
intCount += 1
```

- Loop ends when of value counter variable exceeds the range of the test expression

```
' False after ten iterations
intCount < 10
```

Pretest and Posttest **Do While** Loops

- Previous **Do While** loops are in **pretest** form
  - Expression is tested before the body of the loop is executed
  - The body may not be executed at all

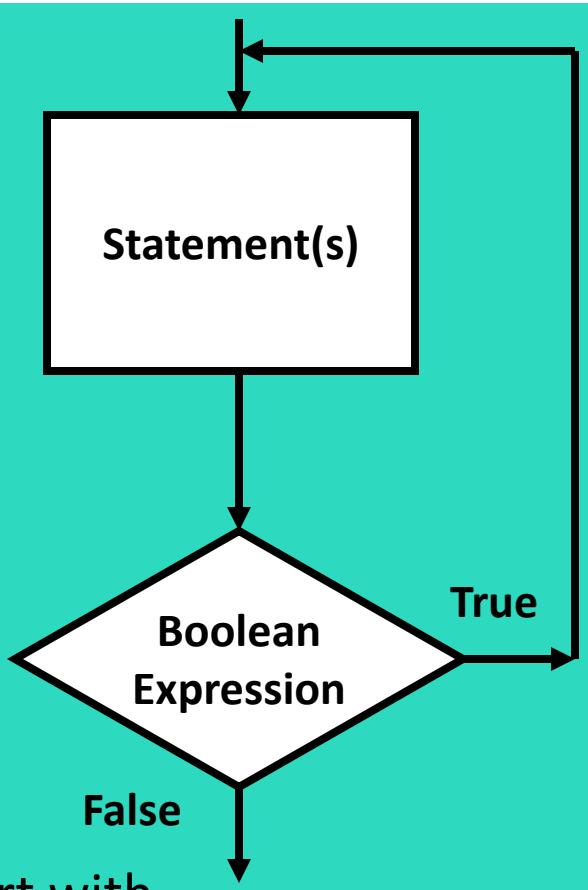
- **Do While** loops also have a **posttest** form
  - The body of the loop is executed first
  - Then the expression is evaluated
  - Body repeats as long as expression is true
  - A posttest loop always executes the body of the loop at least once

The Posttest **Do While** Loop

- The **Do While** loop can also be written as a *posttest* loop:

  Do
  Statement
  (More statements may follow)
  Loop While *BooleanExpression*

- **While *BooleanExpression*** *appears* after the **Loop** keyword
- Tests its Boolean expression after each loop iteration
- Will always perform at least one iteration, even if its Boolean expression is false to start with



Example Posttest **Do While** Loop

```
Dim intCount As Integer = 100
Do
   MessageBox.Show("Hello World!")
   intCount += 1
Loop While intCount < 10
```

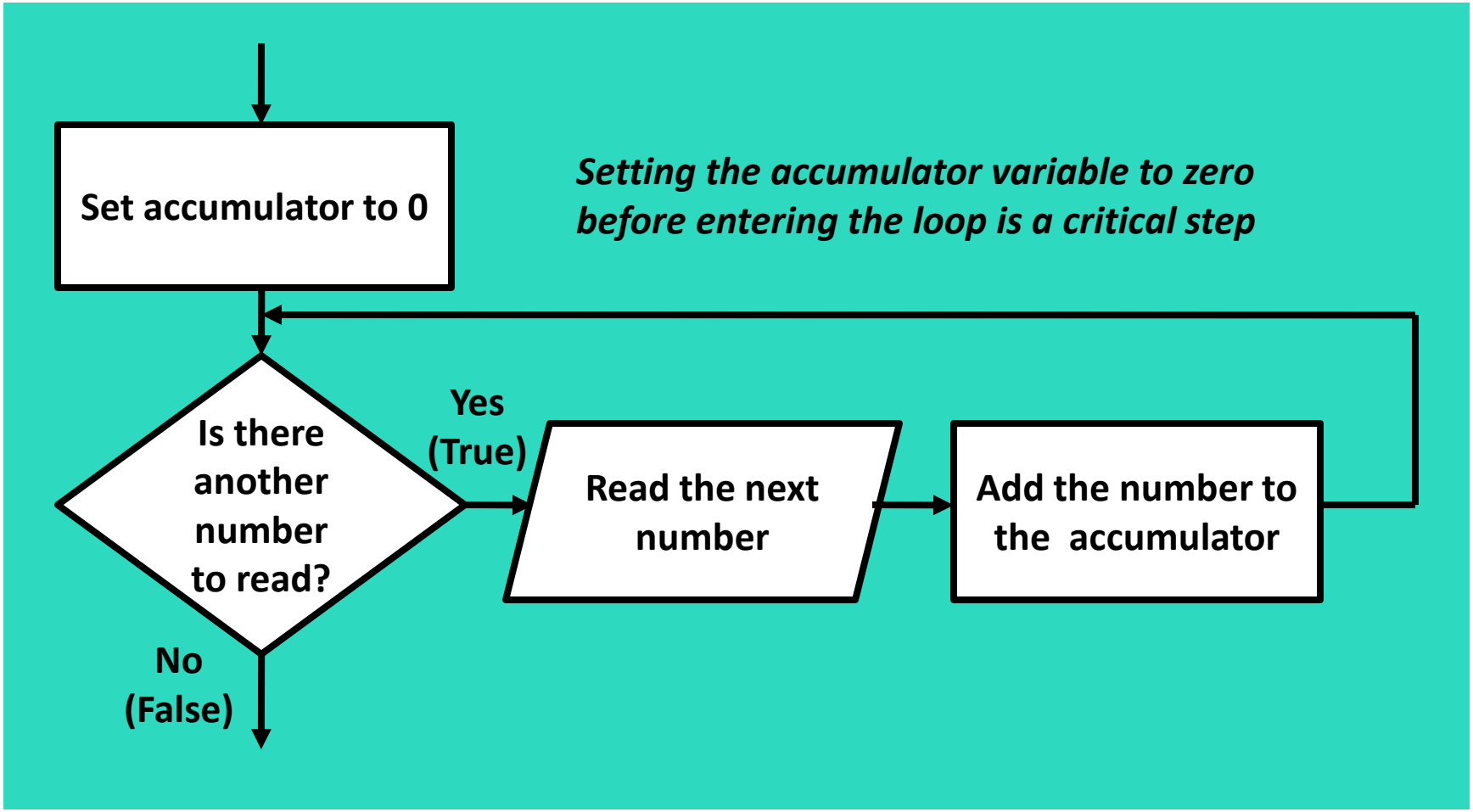
- **intCount** is initialized to **100**
- The statements in the body of the loop execute
- The expression **intCount < 10** is tested
- The expression is **False**
- The loop stops after the first iteration

- Tutorial 5-3 modifies Tutorial 5-2 to use a posttest **Do While** Loop

Keeping a Running Total

- Many programming tasks require you to calculate the total of a series of numbers
  - Sales Totals
  - Scores
- This calculation generally requires two elements:
  - A loop that reads each number in the series and accumulates the total, called a **running total**
  - A variable that accumulates the total, called an **accumulator**

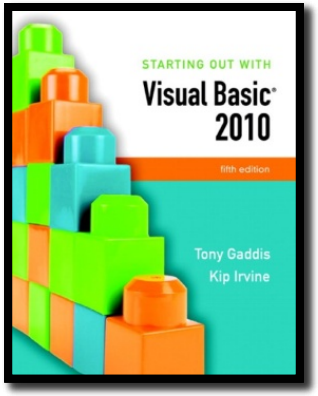
Logic for Keeping a Running Total



A Posttest Running Total Loop

```
Const intNUM_DAYS = 5        ' Number days
Dim intCount As Integer = 1  ' Loop counter
Dim decSales As Decimal      ' Daily sales
Dim decTotal As Decimal = 0  ' Total sales
Dim strInput As String       ' Input string
' Get sales for each day.
Do
  ' Get daily sales amount from the user.
  strInput = InputBox("Enter the sales for day"
                      & intCount.ToString())
  ' Convert user input string to a decimal.
  If Decimal.TryParse(strInput, decSales) Then
    decTotal  += decSales    ' Increment total
    intCount += 1            ' Input counter
  Else
    MessageBox.Show("Enter a number.")
  End If
Loop While intCount <= intNUM_DAYS
```

- Tutorial 5-4 uses the code shown here in pretest form as part of a more complete example
- Tutorial 5-5 demonstrates how to structure a loop such that the user can specify the iterations



Section 5.4

THE DO UNTIL AND FOR...NEXT LOOPS

The **Do Until** loop iterates until its test expression is true. The **For...Next** loop uses a counter variable and iterates a specific number of times.

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The **Do Until** Loop

- A **Do Until** loop iterates until an expression is true
  - Repeats as long as its test expression is **False**
  - Ends when its test expression becomes **True**
  - Can be written in either pretest or posttest form

Pretest General Format:

Do Until ***BooleanExpression***
  Statement
  (More statements may follow)
Loop

Posttest General Format:

Do
  Statement
  (More statements may follow)
Loop Until ***BooleanExpression***

- Tutorial 5-6 provides a hands-on example of a pretest **Do Until** loop

The **For...Next** Loop

- Ideal for loops that require a counter, pretest form only

  For *CounterVariable = StartValue To EndValue [Step Increment]*
  statement
  (more statements may follow)
  Next [*CounterVariable*]

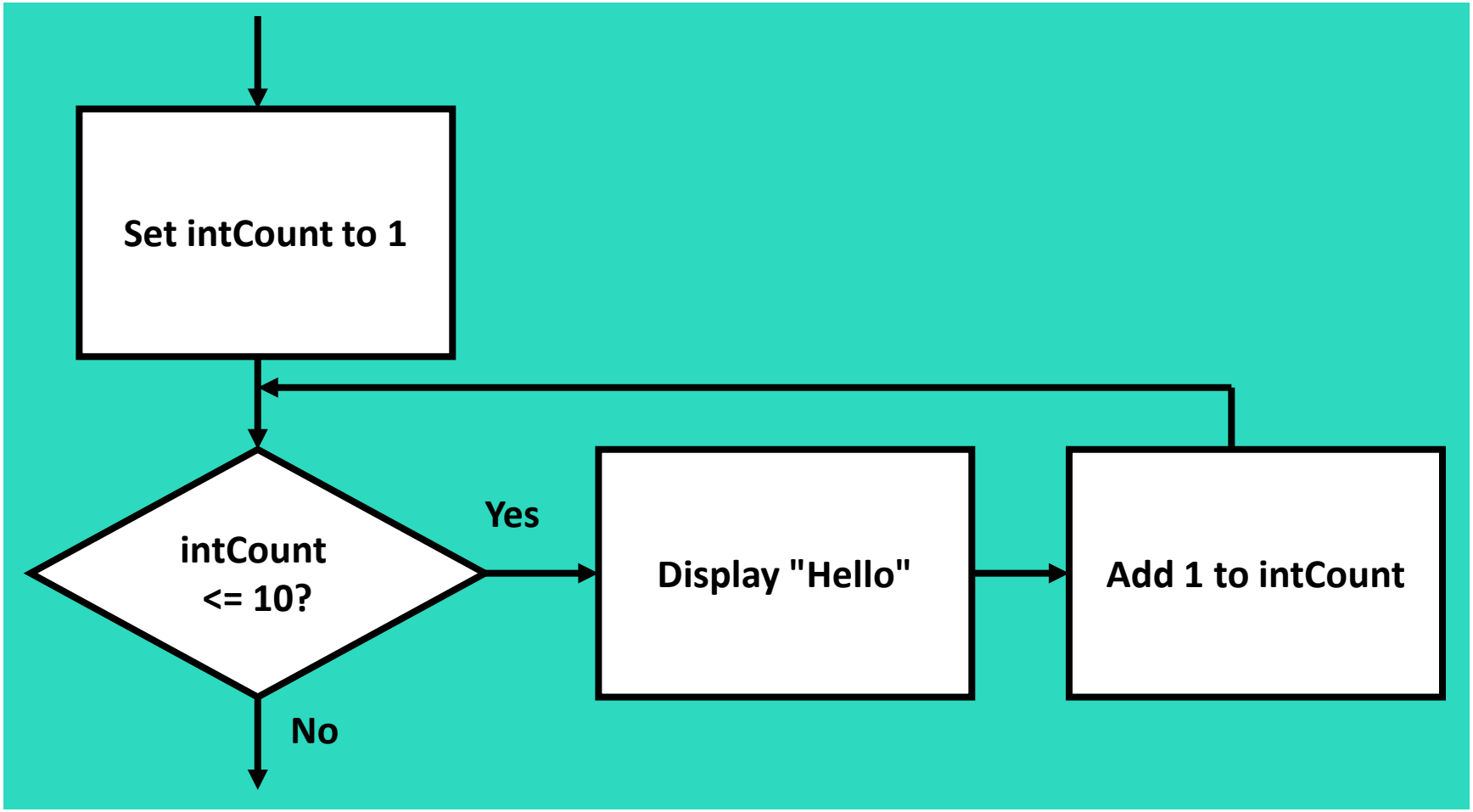
- ***For***, ***To***, and ***Next*** are keywords
- ***CounterVariable*** tracks number of iterations
- ***StartValue*** is initial value of counter
- ***EndValue*** is counter number of final iteration
- Optional ***Step Increment*** allows the counter to increment at a value other than 1 at each iteration of the loop

Example of For…Next Loop

```
For intCount = 1 To 10
MessageBox.Show("Hello")
Next
```

- **Step 1**: **intCount** is set to **1** (the start value)
- **Step 2**: **intCount** is compared to **10** (the end value)
  - » If **intCount** is less than or equal to **10**
    - Continue to **Step 3**
    - Otherwise the loop is exited
- **Step 3**: The **MessageBox.Show("Hello")** statement is executed
- **Step 4**: **intCount** is incremented by **1**
- **Step 5**: Go back to **Step 2** and repeat this sequence

Flowchart of **For…Next** Loop



Specifying a Step Value

- The **step** value is the value added to the counter variable at the end of each iteration
- Optional and if not specified, defaults to 1
- The following loop iterates 10 times with counter values 0, 10, 20, …, 80, 90, 100

```
For intCount = 0 To 100 Step 10
  MessageBox.Show(intCount.ToString())
Next
```

- Step value may be negative, causing the loop to count downward

```
For intCount = 10 To 1 Step -1
  MessageBox.Show(intCount.ToString())
Next
```

Summing a Series of Numbers

- The **For...Next** loop can be used to calculate the sum of a series of numbers

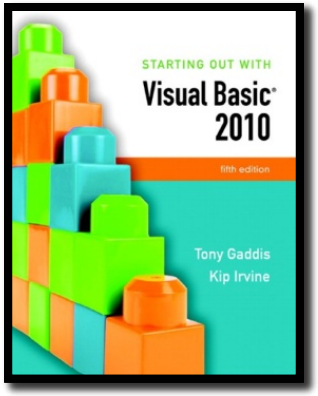
```
Dim intCount As Integer ' Loop counter
Dim intTotal As Integer = 0 ' Accumulator
' Add the numbers 1 through 100.
For intCount = 1 To 100
   intTotal += intCount
Next
' Display the sum of the numbers.
MessageBox.Show("The sum of 1 through 100 is " & intTotal.ToString())
```

Breaking Out of a Loop

- In some cases it is convenient to end a loop before the test condition would end it
- The following statements accomplish this
  - **Exit Do** (used in **Do While** or **Do Until** loops)
  - **Exit For** (used in **For…Next** loops)
- Use this capability with caution
  - It bypasses normal loop termination
  - Makes code more difficult to debug

Deciding Which Loop to Use

- Each type of loop works best in different situations
  - The **Do While** loop
    - When you wish the loop to repeat as long as the test expression is true or at least once as a pretest loop
  - The **Do Until** loop
    - When you wish the loop to repeat as long as the test expression is false or at least once as a pretest loop
  - The **For…Next** loop
    - Primarily used when the number of required iterations is known



Section 5.5

NESTED LOOPS

A loop that is contained inside another loop is called a nested loop.

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Introduction

- A **nested loop** is a loop inside another loop
- The hands of a clock make a good example
  - The hour hand makes 1 revolution for every 60 revolutions of the minute hand
  - The minute hand makes 1 revolution for every 60 revolutions of the second hand
  - For every revolution of the hour hand the second hand makes 36,000 revolutions

Nested Loop Example

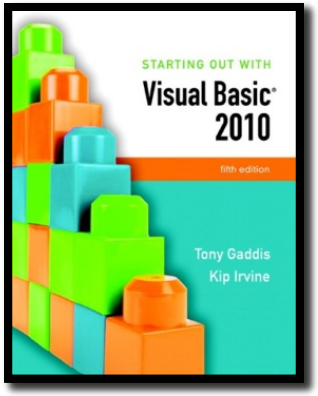
- The simulated clock example contains
  - An outer loop for the hours
  - A nested middle loop for the minutes
  - A nested inner loop for the seconds

```
For intHours = 0 To 23
  lblHours.Text = intHours.ToString()
  For intMinutes = 0 To 59
    lblMinutes.Text = intMinutes.ToString()
     For intSeconds = 0 To 59
       lblSeconds.Text = intSeconds.ToString()
     Next
   Next
Next
```

Nested Loop Example Analysis

- The innermost (seconds) loop will iterate 60 times for each iteration of the middle (minutes) loop
- The middle (minutes) loop will iterate 60 times for each iteration of the outermost (hours) loop
- 24 iterations of the outermost (hours) loop require:
  - 1,440 iterations of the middle (minutes) loop
  - 86,400 iterations of the innermost (seconds) loop

- An inner loop goes through all its iterations for each iteration of the outer loop
- Multiply iterations of all loops to get the total iterations of the innermost loop



Section 5.6

MULTICOLUMN LIST BOXES, CHECKED LIST BOXES, AND COMBO BOXES

A multicolumn list box displays items in columns with a horizontal scroll bar, if necessary. A checked list box displays a check box next to each item in the list. A combo box performs many of the same functions as a list box, and it can also let the user enter text.

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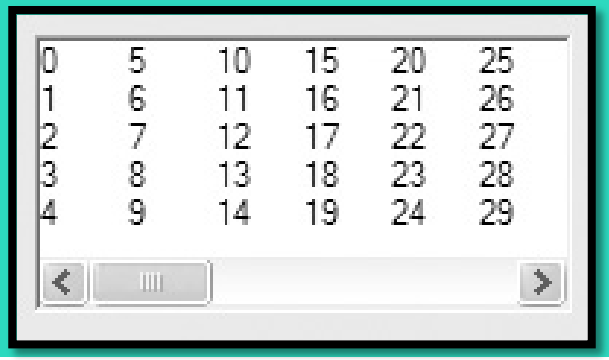
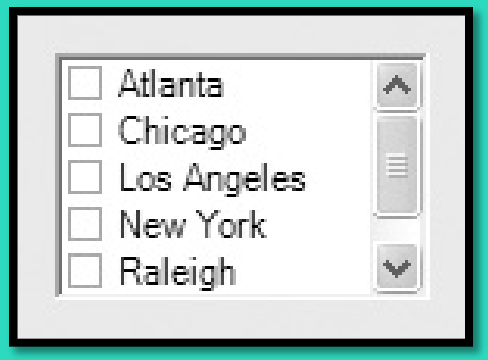
Multicolumn List Boxes

- ListBox control has a **Multicolumn** property
  - Boolean property with default value of **False**
  - If set to **True**, entries can appear side by side
- Below, **ColumnWidth** is set to **30**
- Note the appearance of a horizontal scroll bar in this case



Checked List Boxes

- A form of ListBox with the list box properties and methods already discussed
- One item at a time may be selected but many items in a **Checked List Box** can be checked
- The **CheckOnClick** property determines how items may be checked
  - **False** - user clicks item once to select it, again to check it
  - **True** - user clicks item only once to both select it and check it



Finding the Status of Checked Items

- The **GetItemChecked** method determines if an item is checked by returning a Boolean value
- General Format:

CheckedListBox.GetItemChecked(Index)

  - Returns **True** if the item at ***Index*** has been checked
  - Otherwise, returns **False**

GetItemsChecked Example

- The following code counts the number of checked items:

```
Dim intIndex As Integer                  ' List box index
Dim intCheckedCities As Integer = 0      ' To count the checked cities

' Step through the items in the list box, counting
' the number of checked items.
For intIndex = 0 To clbCities.Items.Count - 1
   If clbCities.GetItemChecked(intIndex) = True Then
      intCheckedCities += 1
   End If
Next

' Display the number of checked cities.
MessageBox.Show("You checked " & intCheckedCities.ToString() &" cities.")
```

Combo Boxes Similar to List Boxes

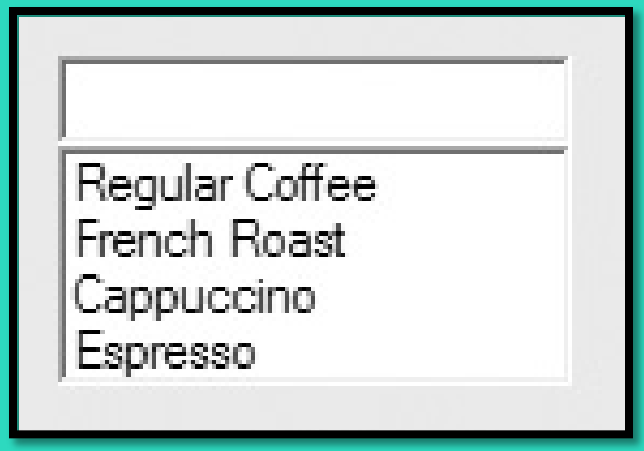
- Both display a list of items to the user
- Both have **Items**, **Items.Count**, **SelectedIndex**, **SelectedItem**, and **Sorted** properties
- Both have **Items.Add**, **Items.Clear**, **Items.Remove**, and **Items.RemoveAt** methods
- These properties and methods work the same with combo boxes and list boxes

Additional Combo Box Features

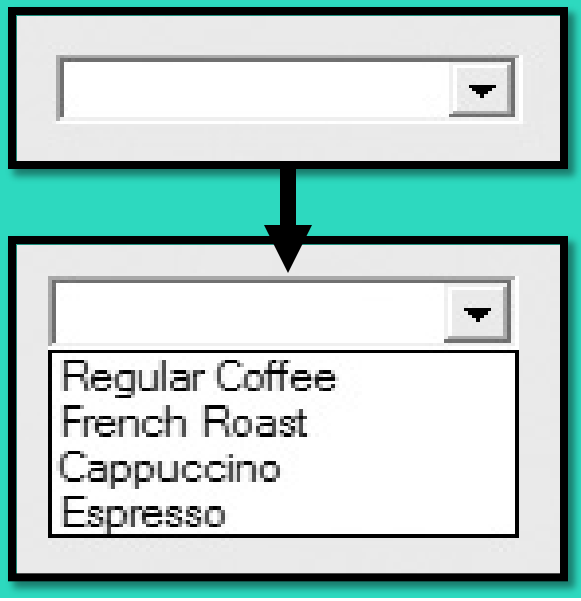
- A combo box also functions like a text box
- The combo box has a **Text** property
- The user may enter text into a combo box
- Or the user may select the text from a series of list box type choices
- In code, we use the **cbo** prefix when naming combo boxes

Combo Box Styles

- Simple Combo Box
  - List is always shown

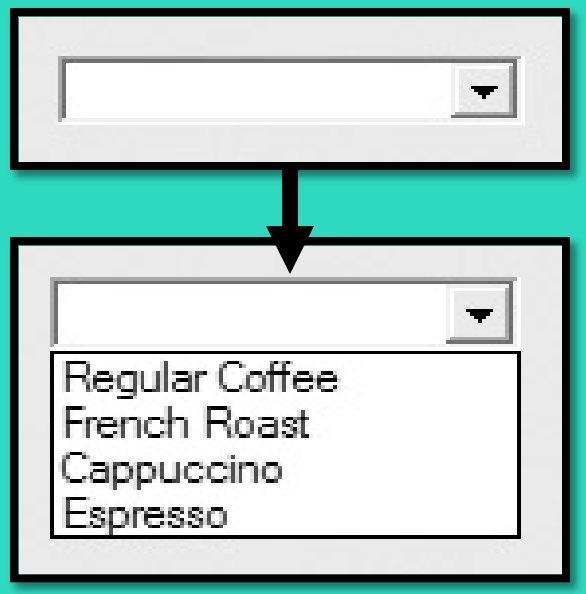


- Drop-down Combo Box
  - List appears when user clicks down arrow
  - User can type text or select



Combo Box Styles

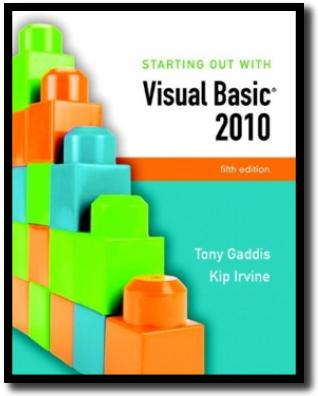
- Drop-down List Combo Box
  - Behaves like a Drop-Down Combo Box, but the user may not enter text directly



- Tutorial 5-9 demonstrates the combo box

List Boxes versus Combo Boxes

- If restricting the user to select items listed
  - If empty space
    - Use list box
  - If limited space
    - Use drop-down list combo box
- If allowing user to select an item listed or enter an entirely new item
  - If empty space
    - Use simple combo box
  - If limited space
    - Use drop-down combo box



Section 5.7

RANDOM NUMBERS

Visual Basic provides tools to generate random numbers and initialize the sequence of random numbers with a random seed value.

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The **Random** Object

- Random numbers are used in games and simulations to create random events
- Computers create **pseudo-random** numbers, which are not truly random
- To generate random numbers in Visual Basic, create a **Random** object reference variable
- For example:

Dim rand As New Random

  - Creates a new **Random** object in memory called **rand**
  - The **rand** variable can be used to call the object's methods for generating random numbers

The **Next** Method

- Once you have created a **Random** object, call its **Next** method to get a random integer number

intNum = rand.Next()

- Calling **Next** with no arguments
  - Generates an integer between **0** and **2,147,483,647**
- Alternatively, you can specify an integer argument for the upper limit
  - The following **Next** method generates a number between **0** and **99**

intNum = rand.Next(100)

- Numeric range does not have to begin at zero
  - Add or subtract to shift the numeric range upward or downward

intNum = rand.Next(10) + 1

intNum = rand.Next(100) - 50

The **NextDouble** Method

- Call a **Random** object's **NextDouble** method to get a random floating-point number in the range of **0.0** up to (but not including) **1.0**

```
dblNum = rand.NextDouble()
```

- If you want the random number to fall within a larger range, multiply it by a scaling factor
  - The following statement generates a random number between **0.0** and **500.0**

```
dblNum = rand.NextDouble() * 500.0
```

  - The following statement generates a random number between **100.0** and **600.0**

```
dblNum = (rand.NextDouble() * 500.0) + 100.0
```

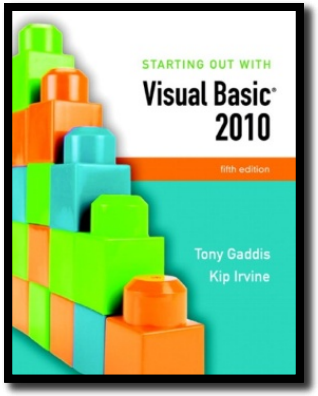
- Tutorial 5-10 uses random numbers to simulate a coin toss

Random Number Seeds

- The **seed value** is used in the calculation that returns the next random number in the series
- Using the same seed value results in the same series of random numbers
- The system time, which changes every hundredth of a second, is the preferred seed value used by a **Random** object in most cases
- You can specify the seed value if you desire, when you create a **Random** object
- For example:

Dim rand As New Random(1000)

  - **1000** as the seed value generates the same series of random numbers
  - Useful for specific tests and validations
  - Boring and repetitive for computer games or simulations



Section 5.8

SIMPLIFYING CODE WITH THE WITH...END WITH STATEMENT

The **With...End With** statement allows you to simplify a series of consecutive statements that perform operations using the same object.

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The **With…End With** Statement

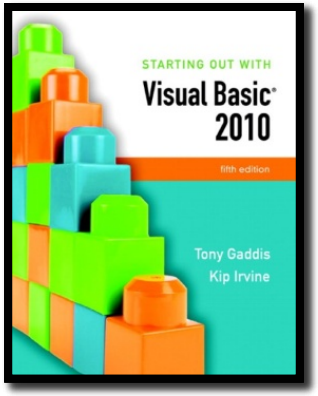
- Multiple statements that use the same control or other object

```
txtName.Clear()
txtName.ForeColor = Color.Blue
txtName.BackColor = Color.Yellow
txtName.BorderStyle = BorderStyle.Fixed3D
```

- Can be simplified using the **With…End With** statement

```
With txtName
   .Clear()
   .ForeColor = Color.Blue
   .BackColor = Color.Yellow
   .BorderStyle = BorderStyle.Fixed3D
End With
```

- Eliminates the need to repeatedly type the control name



Section 5.9

TOOLTIPS

ToolTips are a standard and convenient way of providing help to the users of an application. The ToolTip control allows you to assign pop-up hints to the other controls on a form.

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What is a Tool Tip?

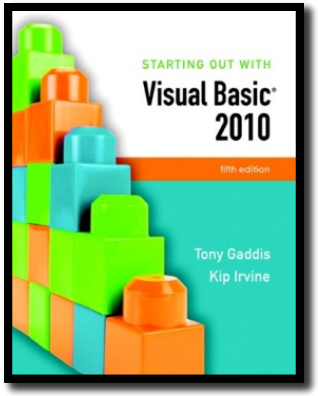
- A **Tool Tip** is the short text message you see when holding the mouse over a control
- These are easy to set up and use in Visual Basic forms
- The **ToolTip control** allows you to create tool tips for other controls on a form

Adding a **ToolTip** Control

- Display the form in ***Design*** view
- Double-click the **ToolTip** tool in the ***Toolbox***
- The **ToolTip** control is invisible at runtime
  - It appears in the **component tray**, not the form
  - Component tray is a resizable region at the bottom of the ***Design*** window that hold invisible controls
- Form controls now have a **ToolTip property**
- This new property holds the text string that will be displayed for that control

ToolTip Properties

- Select the **ToolTip** control from the tray
- View ***Properties*** window to see the following
  - An **InitialDelay** property that regulates the delay before a tip appears
  - An **AutoPopDelay** property that determines how long a tip is displayed
  - The **ReshowDelay** property determines the time between the display of different tips as the user moves the mouse from control to control
- Tutorial 5-11 demonstrates adding tool tips to a form



Section 5.10

FOCUS ON PROGRAM DESIGN AND PROBLEM SOLVING: BUILDING THE *VEHICLE LOAN CALCULATOR APPLICATION*

In this section, you build the *Vehicle Loan Calculator* application. The application uses a loop, input validation, and ToolTips. This section also covers some of the Visual Basic intrinsic financial functions.

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Introduction

- Visual Basic has several built-in functions for performing financial calculations
- You will build a program named *Vehicle Loan Calculator*
- It uses the following functions:
  - **Pmt**
  - **Ipmt**
  - **PPmt**

The **Pmt** Function

- The **Pmt function** returns the periodic payment amount for a loan with a fixed interest rate

  Pmt(*PeriodicInterestRate, NumberOfPeriods, –LoanAmount)*

  - ***PeriodicInterestRate*** is the rate of interest per period
  - ***NumberOfPeriods*** is the total number of months
  - ***LoanAmount*** is the amount being borrowed, must be negative
- For example:

  dblPayment = Pmt(dblAnnInt / 12, 24, -5000)

  - **dblAnnInt** holds the annual interest rate
  - **24** is the number of months of the loan
  - The amount of the loan is **$5000**
  - **dblPayment** holds the fixed monthly payment amount

The **IPmt** Function

- The **IPmt function** returns the interest payment for a specific period of a loan with a fixed interest rate and fixed monthly payments

  IPmt(*PeriodicInterestRate, Period, NumberOfPeriods, –LoanAmount)*

  - ***PeriodicInterestRate*** is the rate of interest per period
  - ***Period*** is the period for which you would like the payment
  - ***NumberOfPeriods*** is the total number of months
  - ***LoanAmount*** is the amount being borrowed, must be negative
- For example:

  dblInterest = IPmt(dblAnnInt / 12, 6, 24, -5000)

  - **dblAnnInt** holds the annual interest rate
  - **6** is the number of the month for which to calculate the payment
  - **24** is the number of months of the loan
  - The amount of the loan is **$5000**
  - **dblInterest** holds the amount of interest paid in month **6** of the loan

The **PPmt** Function

- The **PPmt function** returns the principal payment for a specific period on a loan with a fixed interest rate and fixed monthly payments

  PPmt(*PeriodicInterestRate, Period, NumberOfPeriods, –LoanAmount)*

  - ***PeriodicInterestRate*** is the rate of interest per period
  - ***Period*** is the period for which you would like the payment
  - ***NumberOfPeriods*** is the total number of months
  - ***LoanAmount*** is the amount being borrowed, must be negative
- For example:

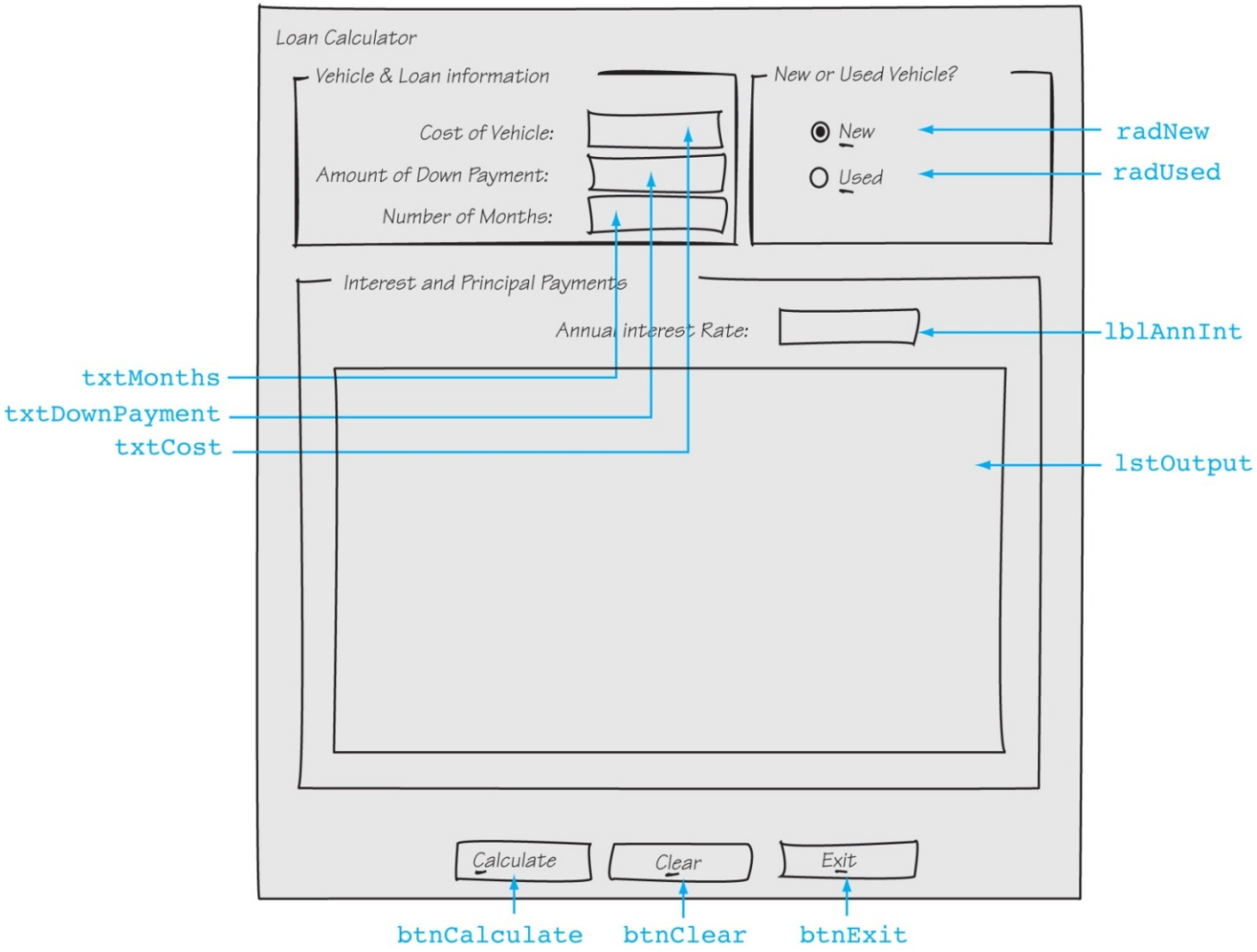
  dblPrincipal = PPmt(dblAnnInt / 12, 6, 24, -5000)

  - **dblAnnInt** holds the annual interest rate
  - **6** is the number of the month for which to calculate the payment
  - **24** is the number of months of the loan
  - The amount of the loan is **$5000**
  - **dblPrincipal** holds the amount of principal paid in month **6** of the loan

The Case Study

- A credit union branch manager asks you to write an application named *Vehicle Loan Calculator* that displays the following information for a loan:
  - The monthly payment amount
  - The amount of the monthly payment applied toward interest
  - The amount of the monthly payment applied toward principal
- The credit union currently charges
  - **8.9%** annual interest for new vehicle loans
  - **9.5%** annual interest on used vehicle loans

Sketch of the Vehicle Loan Calculator Form



Event Handlers

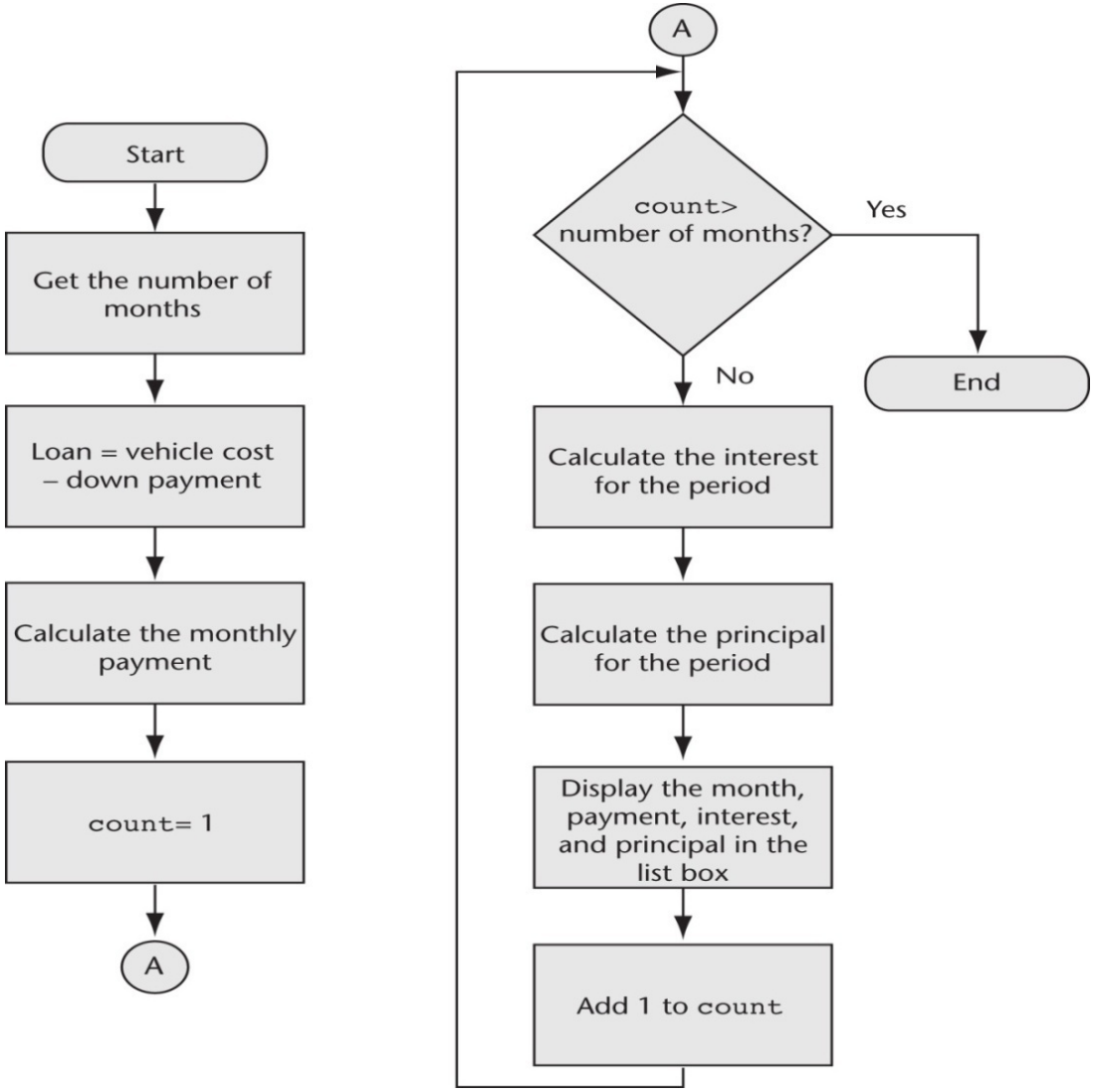
Method	Description
btnCalculate_Click	Calculates and displays a table in the list box showing interest and principal payments for the loan
btnClear_Click	Resets the interest rate, clears the text boxes, and clears the list box
btnExit_Click	Ends the application
radNew_CheckedChanged	Updates the annual interest rate if the user selects a new vehicle loan
radUsed_CheckedChanged	Updates the annual interest rate if the user selects a used vehicle loan

btnCalculate_Click Event Handler Pseudocode

The pseudocode does not indicate input validation, and the actual arguments that need to be passed to the Pmt, IPmt, and PPmt functions are not shown

```
Get VehicleCost from the form
Get DownPayment from the form
Get Months from the form
Loan = VehicleCost – DownPayment
MonthlyPayment = Pmt()
For Count = 0 To Months
   Interest = IPmt()
   Principal = PPmt()
   Display Month, Payment, Interest, and Principal in list box
Next
```

btnCalculate_Click Event Handler Flowchart



radNew_CheckedChanged & radUsed_CheckedChanged Event Handler Pseudocode

```
If radNew is selected Then
   Annual Interest Rate = 0.089
   Display Annual Interest Rate in lblAnnInt
End If


If radUsed is selected Then
   Annual Interest Rate = 0.095
   Display Annual Interest Rate in lblAnnInt
End If
```

radNew_CheckedChanged & radUsed_CheckedChanged Event Handler Pseudocode