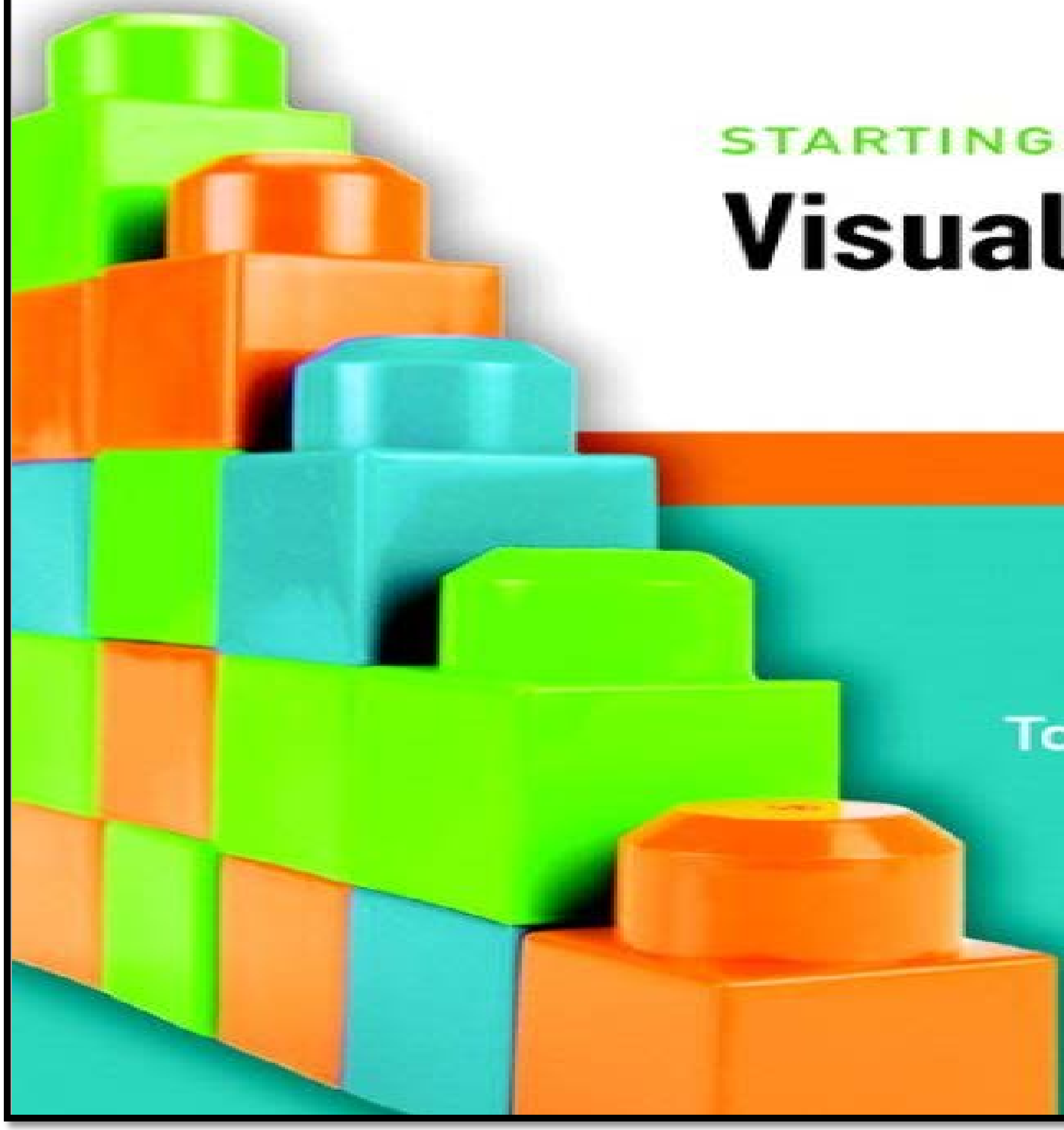
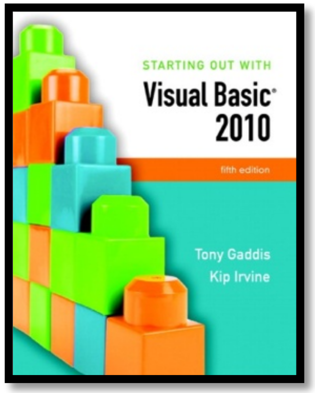


STARTING OUT WITH

Visual Basic® 2010

fifth edition

Tony Gaddis
Kip Irvine

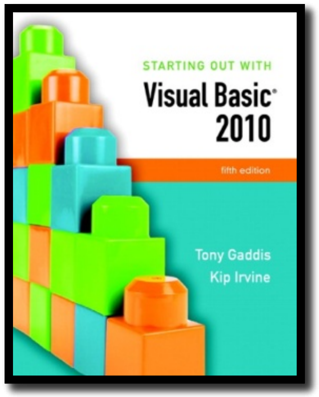


Chapter 6

Procedures and Functions

Introduction

- A **procedure** is a collection of statements that performs a task
  - Event handlers are a type of procedure
- A **function** is a collection of statements that performs a task and returns a value to the part of the program that executed it
  - You have already worked with Visual Basic’s built-in functions, such as **CInt** and **IsNumeric**
- A **method** can be either a procedure or a function



Section 6.1

PROCEDURES

You can write your own general purpose procedures that perform specific tasks. General purpose procedures are not triggered by events, but are called from statements in other procedures.

Procedure Uses

- An event handler is a type of procedure
  - Automatically executed when an event such as a mouse click occurs
- General purpose procedures are triggered by statements in other procedures, not by events
- Procedures help simplify & **modularize** code by:
  - Breaking it into small, manageable pieces
  - Performing a task that is needed repeatedly
  - Dividing a program into a set of logical tasks
- Tutorial 6-1 examines an application with a procedure

Declaring a Procedure

- The general format of a **procedure declaration** is as follows:

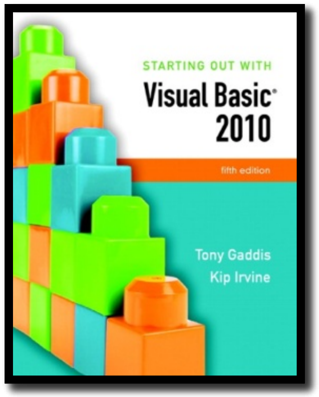
  [AccessSpecifier] Sub ProcedureName ([ParameterList])
      [Statements]
  End Sub
- ***AccessSpecifier*** is optional and establishes accessibility to the program
- **Sub** and **End** are keywords
- ***ProcedureName*** used to refer to procedure
  - Use **Pascal casing** to capitalize 1st character of the name and each new word in the name
- ***ParameterList*** is a list of variables or values being passed to the sub procedure
- Tutorial 6-2 guides you through the process of writing procedures

Static Local Variables

- Variables needed only in a procedure, should be declared within that procedure
  - Creates a local variable with scope only within the procedure where declared
  - Local variable values are not saved from one procedure call to the next
- To save value between procedure calls, use **Static** keyword to create a **static local variable**

Static VariableName As DataType

  - Scope is still only within the procedure
  - But variable exists for lifetime of application



Section 6.2

PASSING ARGUMENTS TO PROCEDURES

When calling a procedure, you can pass it values known as arguments.

Arguments

- An **Argument** is value passed to a procedure
- For example:

  CInt(txtInput.Text)

  - Calls the **CInt** function
  - Passes **txtInput.Text** as an argument

- Two ways to pass arguments
  - **by value** is a temporary copy of the original argument
  - **by reference** is the original argument and can be changed

Passing Arguments By Value

```
DisplayValue(5)               ' Call DisplayValue procedure

Sub DisplayValue(ByVal intNumber As Integer)
        ' This procedure displays a value in a message box.
        MessageBox.Show(intNumber.ToString)
End Sub
```

- **intNumber** declared as an integer argument
- Storage location **intNumber** created by procedure
- A value, **5** in this case, must be supplied and is copied into the storage location for **intNumber**
- The **DisplayValue** procedure then executes
- Tutorial 6-3 demonstrates passing arguments

Passing Multiple Arguments

```
ShowSum(intValue1, intValue2)          ' Call ShowSum procedure

Sub ShowSum(ByVal intNum1 As Integer, ByVal intNum2 As Integer)
   Dim intSum As Integer 'Local variable to hold a sum
   'Get the sum of the two arguments.
   intSum = intNum1 + intNum2
   'Display the sum.
   MessageBox.Show("The sum is " & intSum.ToString())
End Sub
```

- Multiple arguments separated by commas
- Value of first argument is copied to first
- Second to second, etc.

More about Passing Arguments by Reference

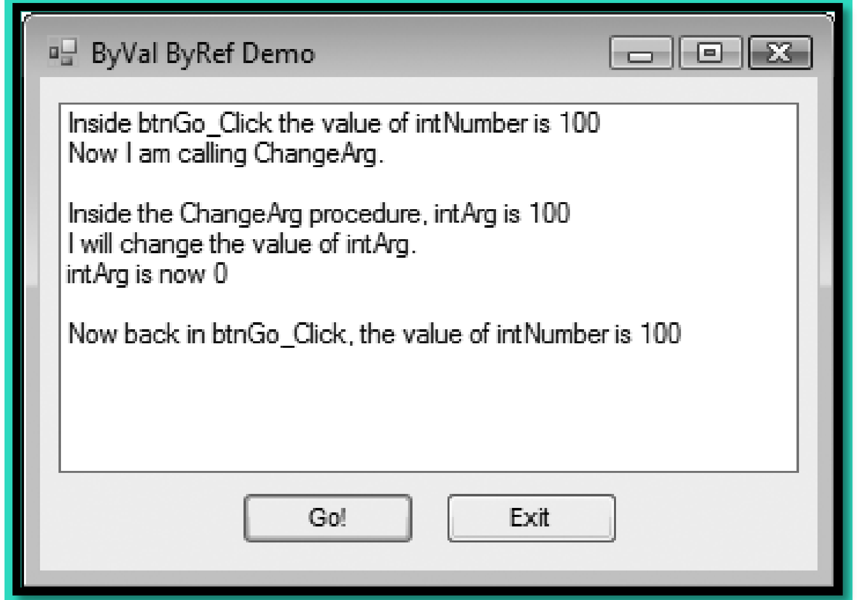
- Arguments are usually passed **ByVal**
  - New storage location created for procedure
  - Storage location gets a copy of the value
  - Any changes in value are made to the copy
  - Calling procedure won’t “see” the changes

- Arguments can also be passed **ByRef**
  - Procedure points to (references) argument’s original storage location
  - Any changes are made to the original value
  - Calling procedure “sees” the changes

- Tutorial 6-4 demonstrates the difference between **ByVal** and **ByRef**

Working with **ByVal** and **ByRef**

- Passing the argument **ByVal**
  - Does not change the value of **intNumber**

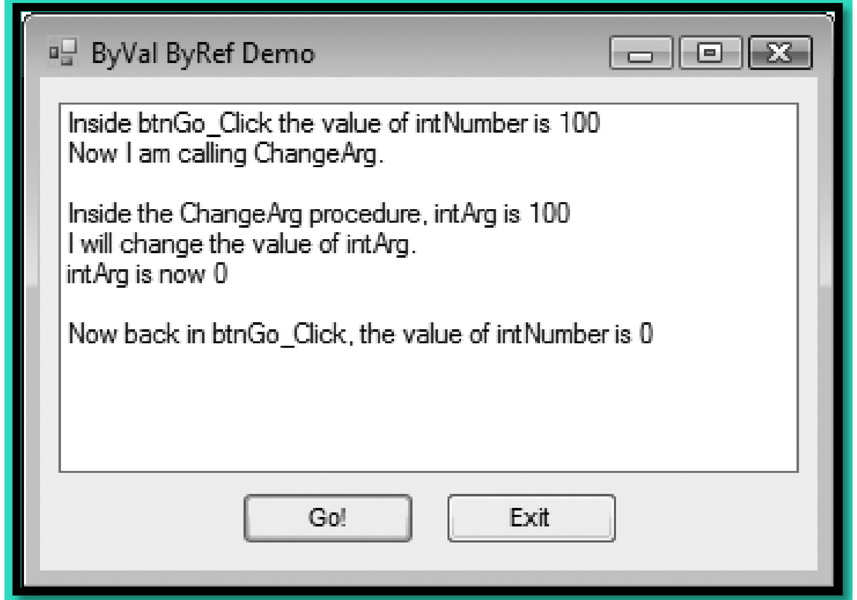


```
Inside btnGo_Click the value of intNumber is 100
Now I am calling ChangeArg.

Inside the ChangeArg procedure, intArg is 100
I will change the value of intArg.
intArg is now 0

Now back in btnGo_Click, the value of intNumber is 100
```

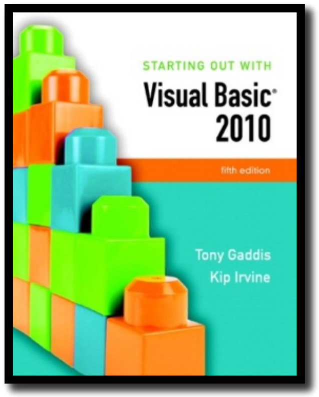
- Passing the argument **ByRef**
  - Allows the value of **intNumber** to change



```
Inside btnGo_Click the value of intNumber is 100
Now I am calling ChangeArg.

Inside the ChangeArg procedure, intArg is 100
I will change the value of intArg.
intArg is now 0

Now back in btnGo_Click, the value of intNumber is 0
```



Section 6.3

FUNCTIONS

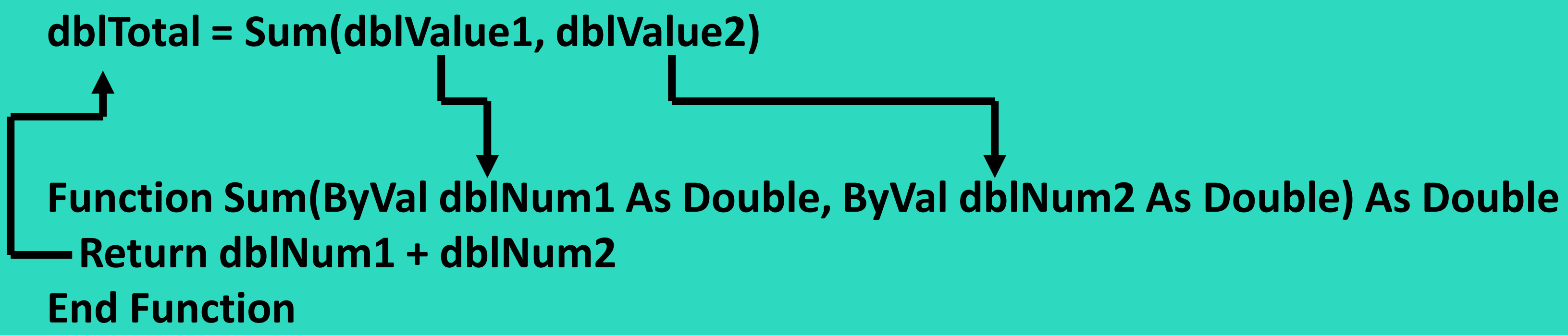
A function returns a value to the part of the program that called the function.

Declaring a Function

```
[AccessSpecifier] Function FunctionName ([ParameterList]) As DataType
   [Statements]
End Function
```

- New keyword **Function**
- Also new is **As DataType** which states the data type of the value to be returned
- Return value is specified in a **Return** expression

Function Call Example



```
dblTotal = Sum(dblValue1, dblValue2)

Function Sum(ByVal dblNum1 As Double, ByVal dblNum2 As Double) As Double
  Return dblNum1 + dblNum2
End Function
```

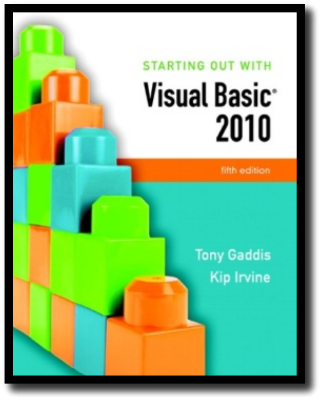
- The **Sum** function
  - Passes the variables **dblValue1** and **dblValue2** as arguments
  - Data types must agree with parameter list
  - Assigns the value returned by the **Sum** function to the variable **dblTotal**, agrees with return value
- Tutorial 6-5 demonstrates function use

Returning Nonnumeric Values

- Functions can return nonnumeric values, such as strings and Boolean values

```
strCustomer = FullName("John", "Martin")

Function FullName(ByVal strFirst As String,
                  ByVal strLast As String) As String
   ' Local variable to hold the full name
   Dim strName As String
   ' Append the last name to the first
   ' name and assign the result to strName.
   strName = strFirst & " " & strLast
   ' Return the full name.
   Return strName
End Function
```



Section 6.4

MORE ABOUT DEBUGGING: STEPPING INTO, OVER, AND OUT OF PROCEDURES AND FUNCTIONS

Visual Basic debugging commands allow you to single-step through applications with procedure and function calls. The *Step Into* command allows you to single-step through a called procedure or function. The *Step Over* command allows you to execute a procedure or function call without single-stepping through its lines. The *Step Out* command allows you to execute all remaining lines of a procedure or function you are debugging without stepping through them.

The **Step Into** Command

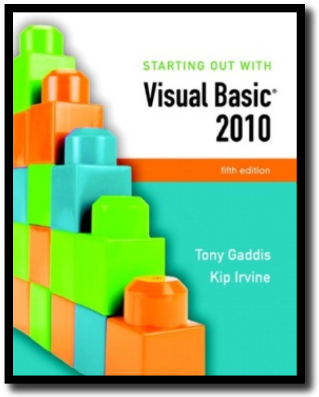
- The **Step Into command**
  - Continue to debug by single-stepping through a procedure
    - Press the F8 key
    - Select *Debug from the menu bar, and then select Step Into from the Debug menu*
    - Click the *Step Into button on the Debug Toolbar, if the toolbar is visible*
- Tutorial 6-6 demonstrates the **Step Into** command

The **Step Over** Command

- The **Step Over command**
  - Run procedure without single-stepping, continue single-step after the call
    - Press the Shift + F8 key
    - Select *Debug from the menu bar, and then select Step Over from the Debug menu*
    - Click the *Step Over button on the Debug Toolbar, if the toolbar is visible*
- Tutorial 6-7 demonstrates the **Step Over** command

The **Step Out** Command

- The **Step Out command**
  - End single-stepping in procedure, continue single-step after the call
    - Press the Ctrl + Shift + F8 key
    - Select *Debug from the menu bar, and then select Step Out from the Debug menu*
    - Click the *Step Out button on the Debug Toolbar, if the toolbar is visible*
- Tutorial 6-8 demonstrates the **Step Out** command



Section 6.5

FOCUS ON PROGRAM DESIGN AND PROBLEM SOLVING: BUILDING THE *BAGEL AND COFFEE PRICE CALCULATOR* APPLICATION

In this section you build the *Bagel and Coffee Price Calculator* application. It uses procedures and functions to calculate the total of a customer order.

Introduction

- The owner of Brandi's Bagel House has asked you to write an application that her staff can use to record an order as it is called in
- Customers may call in and order
  - White and whole wheat bagels with a variety of toppings
  - Three different types of coffee
- The application should display
  - The total of the order, including **6%** sales tax

- **Bagels:**

White bagel	$1.25
Whole wheat bagel	$1.50

- **Toppings:**

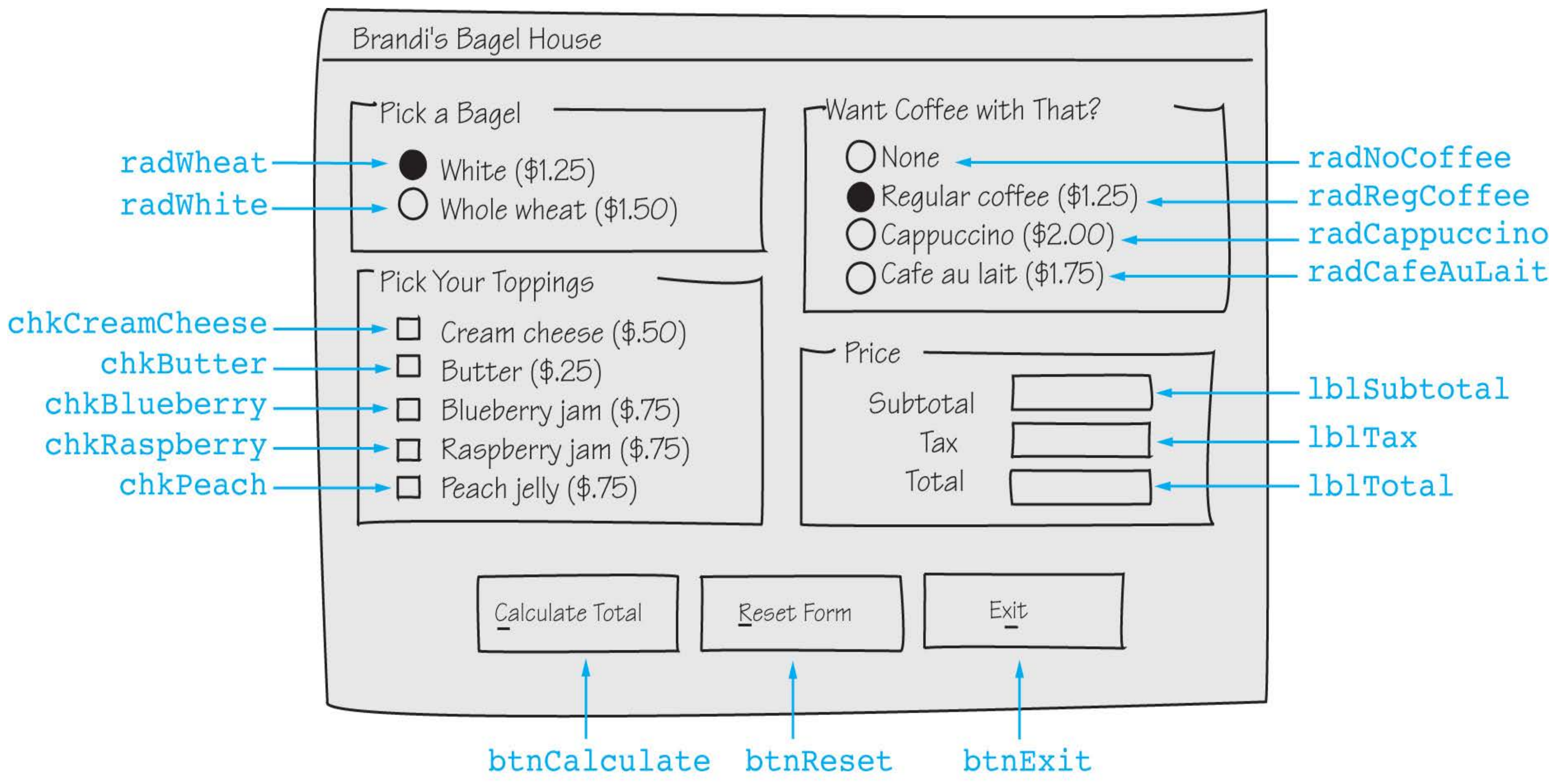
Cream cheese	$0.50
Butter	$0.25
Blueberry jam	$0.75
Raspberry jam	$0.75
Peach jelly	$0.75

- **Coffee:**

Regular coffee	$1.25
Cappuccino	$2.00
Café au lait	$1.75

(Note: Delivery for coffee alone is not offered.)

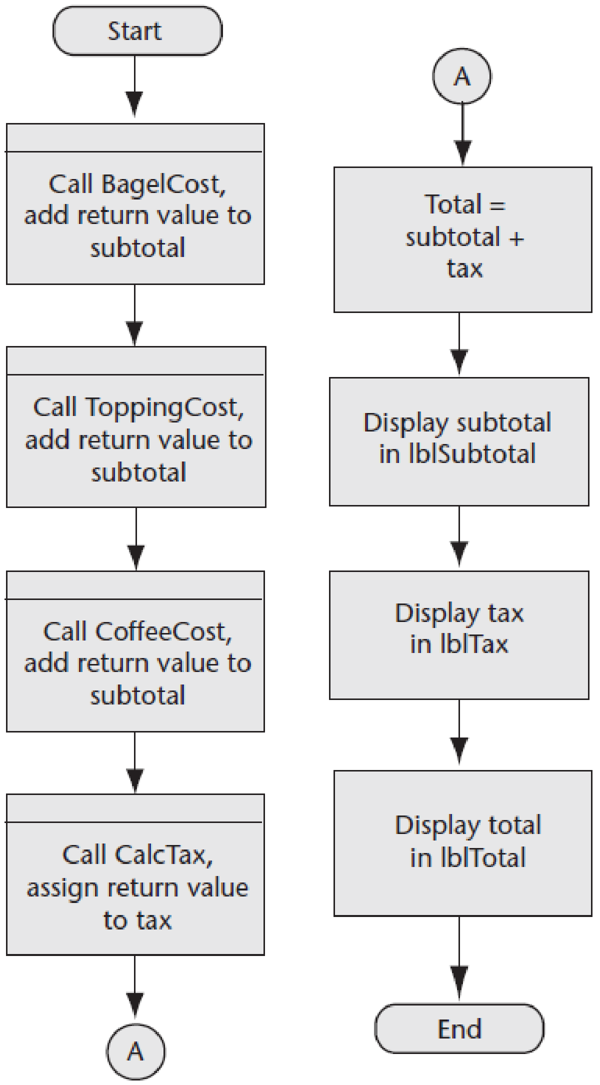
Sketch of Brandi's Bagel House Form



Description of Click Event Handlers

Name	Description
btnCalculate_Click	Calculates and displays the total of an order Calls the following functions: **BagelCost**, **CoffeeCost**, **ToppingCost**, and **CalcTax**
btnExit_Click	Ends the application
btnReset_Click	Resets the controls on the form to their initial values Calls the following procedures: **ResetBagels**, **ResetToppings**, **ResetCoffee**, and **ResetPrice**

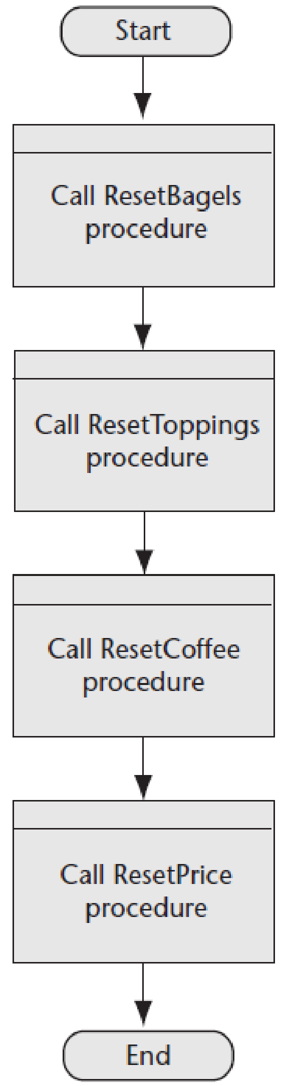
btnCalculate_Click Flowchart and Pseudocode



Start
Call BagelCost, add return value to subtotal
Call ToppingCost, add return value to subtotal
Call CoffeeCost, add return value to subtotal
Call CalcTax, assign return value to tax
A
A
Total = subtotal + tax
Display subtotal in lblSubtotal
Display tax in lblTax
Display total in lblTotal
End

```
subtotal = BagelCost() + ToppingCost() + CoffeeCost()
tax = CalcTax(subtotal)
total = subtotal + tax
lblSubtotal.Text = subtotal
lblTax.Text = tax
lblTotal.Text = total
```

btnReset_Click
Flowchart and Pseudocode

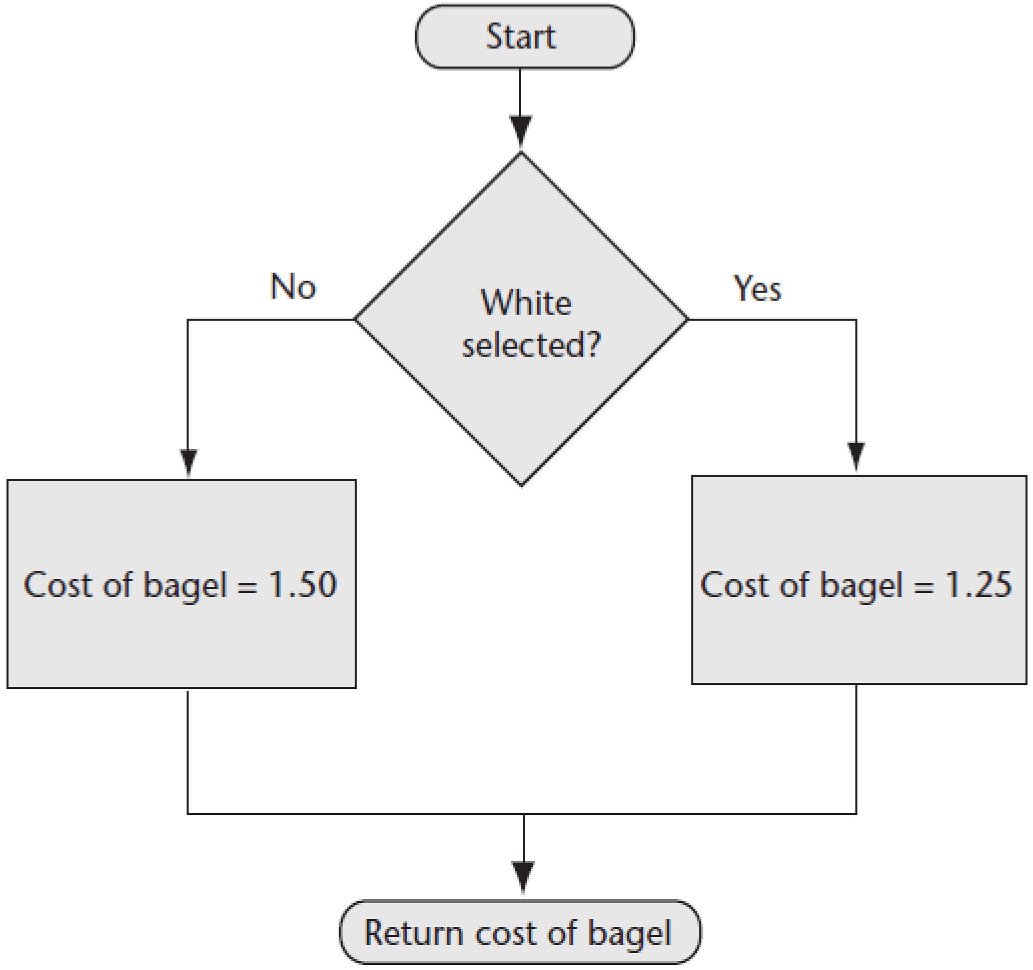

Start
Call ResetBagels procedure
Call ResetToppings procedure
Call ResetCoffee procedure
Call ResetPrice procedure
End

```
ResetBagels()
ResetToppings()
ResetCoffee()
ResetPrice()
```

Description of Functions

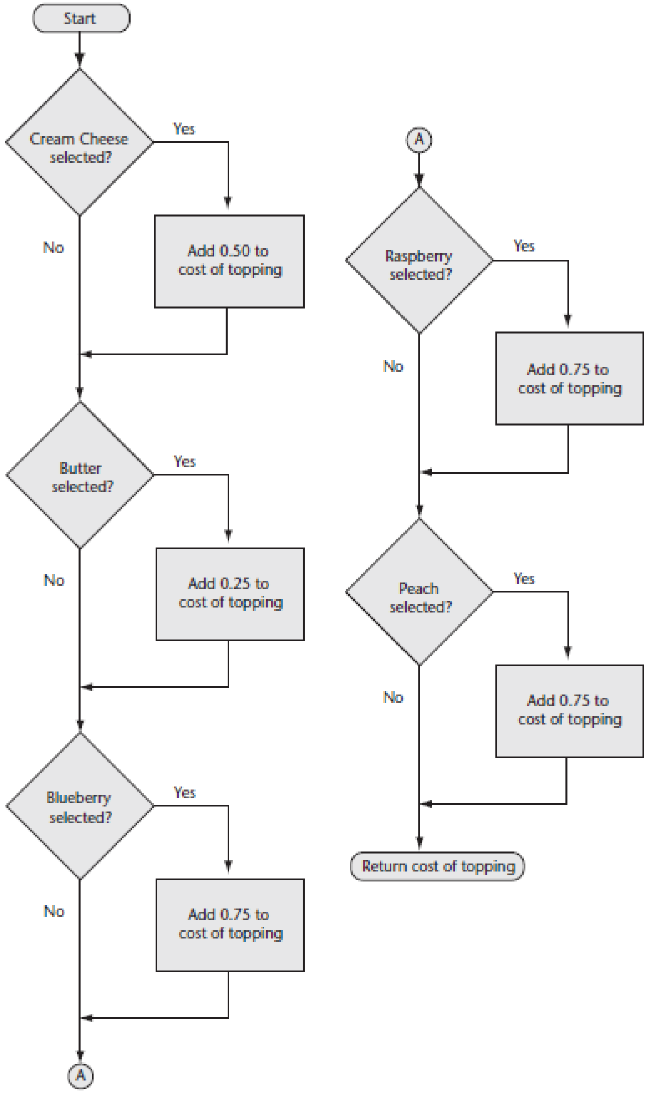
Name	Description
BagelCost	Returns the price of the selected bagel
ToppingCost	Returns the total price of the selected toppings
CoffeeCost	Returns the price of the selected coffee
CalcTax	Accepts the amount of a sale as an argument Returns the amount of sales tax on that amount The tax rate is stored in a class-level constant, **decTAX_RATE**

BagelCost Function
Flowchart and Pseudocode



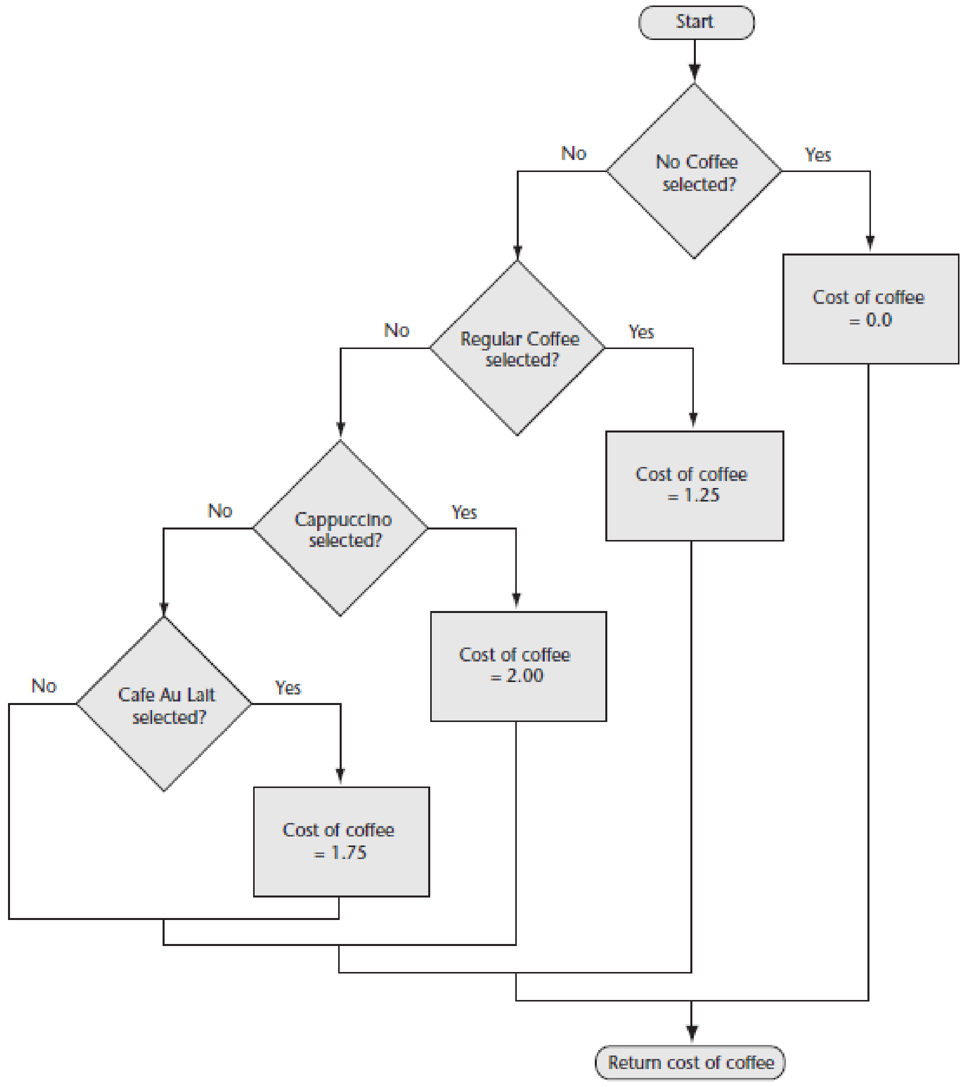
```
If White Is Selected Then
   cost of bagel = 1.25
Else
   cost of bagel = 1.5
End If
Return cost of bagel
```

ToppingCost Function
Flowchart and Pseudocode



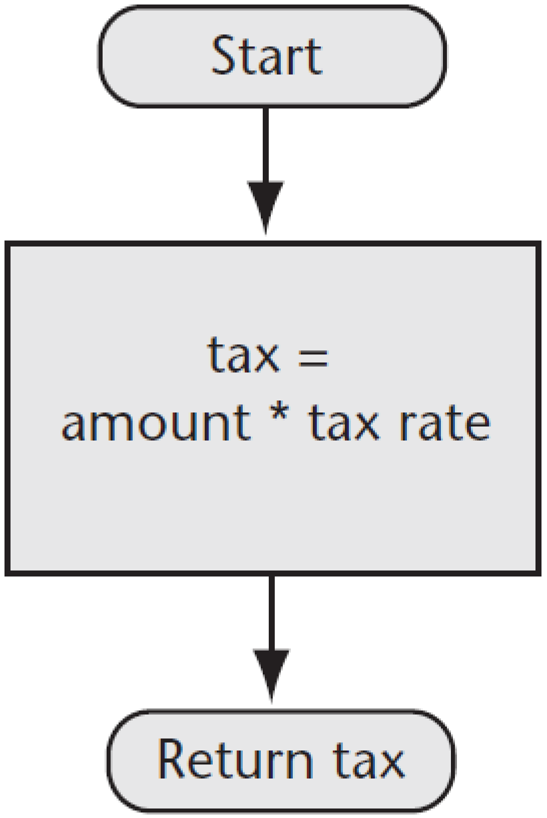
```
cost of topping = 0.0
If Cream Cheese Is Selected Then
   cost of topping += 0.5
End If
If Butter Is Selected Then
   cost of topping += 0.25
End If
If Blueberry Is Selected Then
   cost of topping += 0.75
End If
If Raspberry Is Selected Then
   cost of topping += 0.75
End If
If Peach Is Selected Then
   cost of topping += 0.75
End If
Return cost of topping
```

CoffeeCost Function Flowchart and Pseudocode



```
If No Coffee Is Selected Then
   cost of coffee = 0
ElseIf Regular Coffee Is Selected Then
   cost of coffee = 1.25
ElseIf Cappuccino Is Selected Then
   cost of coffee = 2
ElseIf Café Au Lait Is Selected Then
   cost of coffee = 1.75
End If
Return cost of coffee
```

CalcTax Function Flowchart and Pseudocode



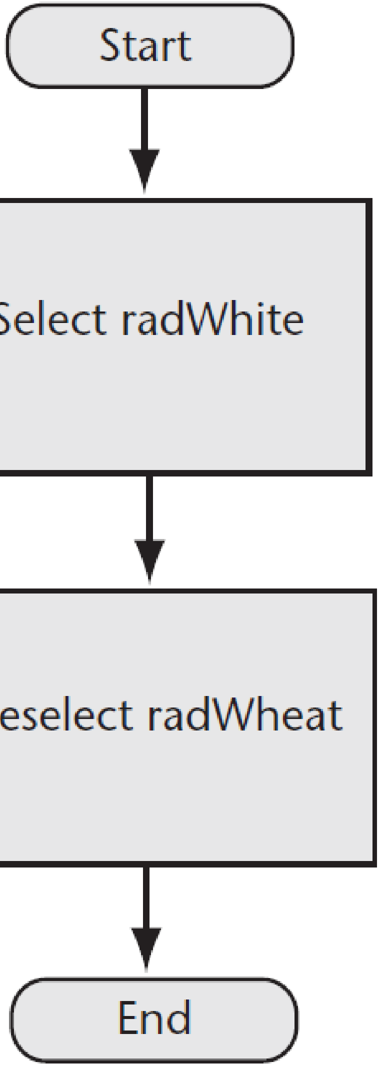
Note: amount is the function parameter

```
sales tax = amount * tax rate
Return sales tax
```

Description of Procedures

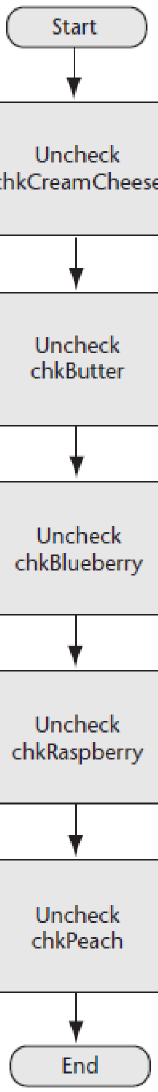
Name	Description
ResetBagels	Resets the bagel type radio buttons to their initial value
ResetToppings	Resets the topping check boxes to unchecked
ResetCoffee	Resets the coffee radio buttons to their initial values
ResetPrice	Sets the **Text** property of the **lblSubtotal**, **lblTax**, and **lblTotal** labels to **String.Empty**

ResetBagels Procedure Flowchart and Pseudocode



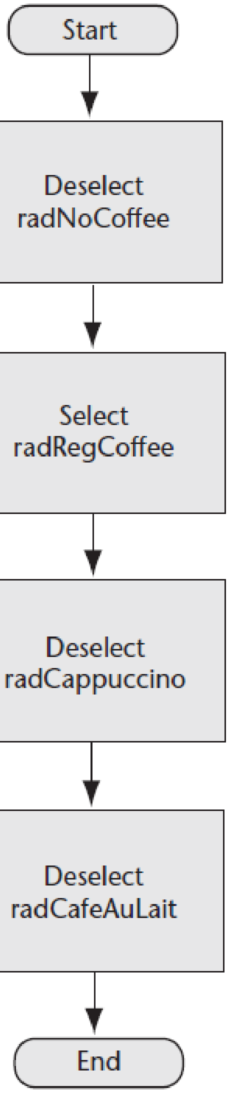
```
radWhite = Selected
radWheat = Deselected
```

ResetToppings Procedure Flowchart and Pseudocode



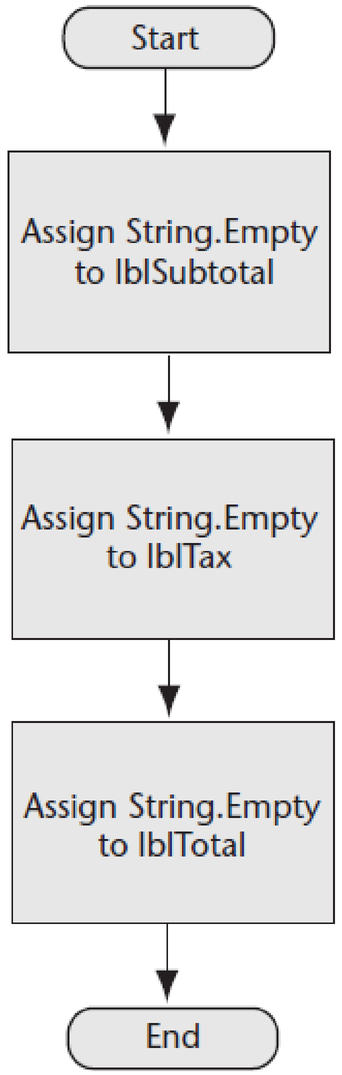
```
chkCreamCheese = Unchecked
chkButter = Unchecked
chkBlueberry = Unchecked
chkRaspberry = Unchecked
chkPeach = Unchecked
```

ResetCoffee Procedure Flowchart and Pseudocode



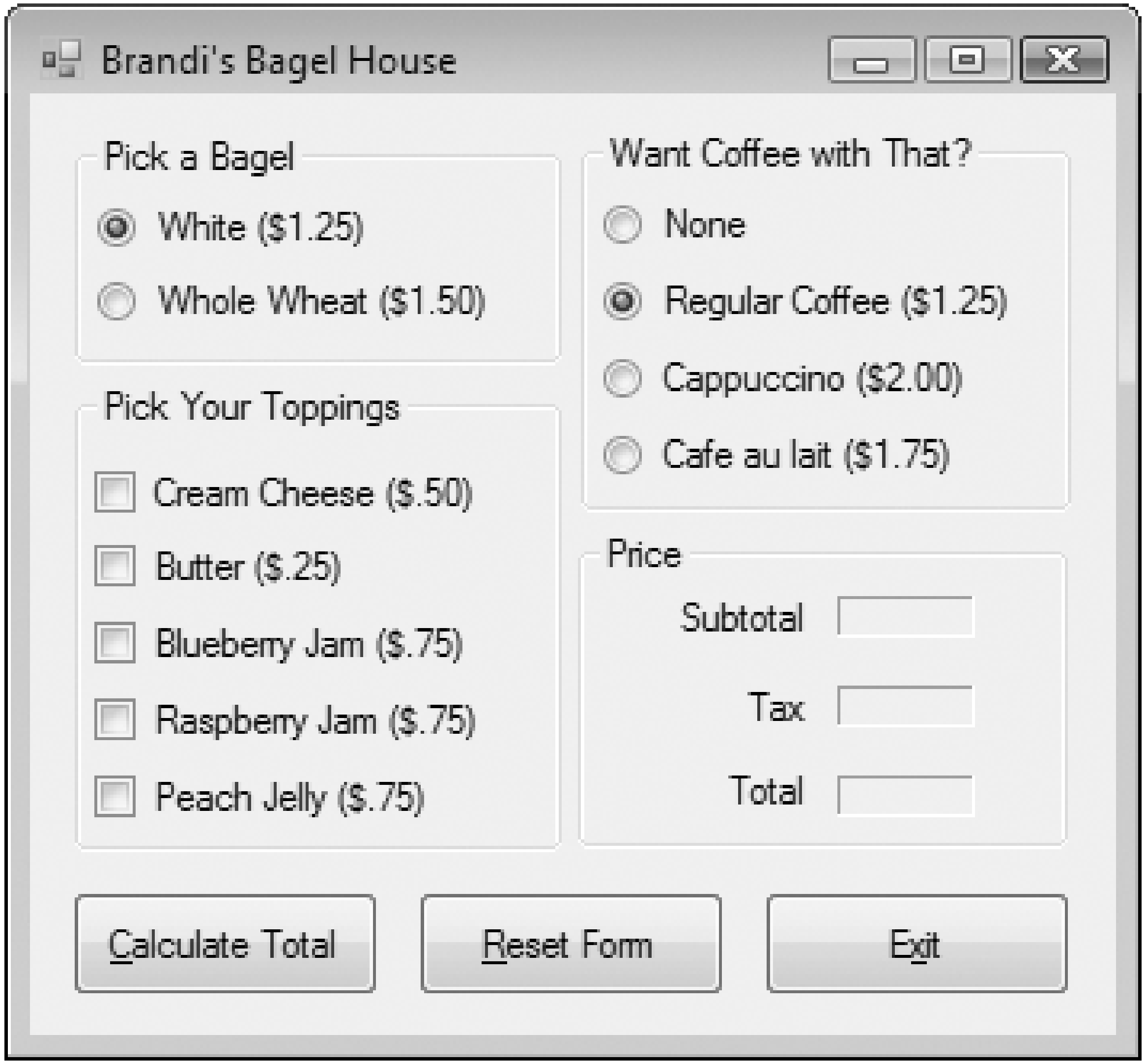
```
radNoCoffee = Deselected
radRegCoffee = Selected
radCappuccino = Deselected
radCafeAuLait = Deselected
```

ResetPrice Procedure Flowchart and Pseudocode


Start
Assign String.Empty to lblSubtotal
Assign String.Empty to lblTax
Assign String.Empty to lblTotal
End

```
lblSubtotal.Text = String.Empty
lblTax.Text = String.Empty
lblTotal.Text = String.Empty
```

Brandi's Bagel House Form


Brandi's Bagel House

Pick a Bagel
- (●) White ($1.25)
- ( ) Whole Wheat ($1.50)

Pick Your Toppings
- ☐ Cream Cheese ($.50)
- ☐ Butter ($.25)
- ☐ Blueberry Jam ($.75)
- ☐ Raspberry Jam ($.75)
- ☐ Peach Jelly ($.75)

Want Coffee with That?
- ( ) None
- (●) Regular Coffee ($1.25)
- ( ) Cappuccino ($2.00)
- ( ) Cafe au lait ($1.75)

Price

Subtotal	
Tax	
Total	