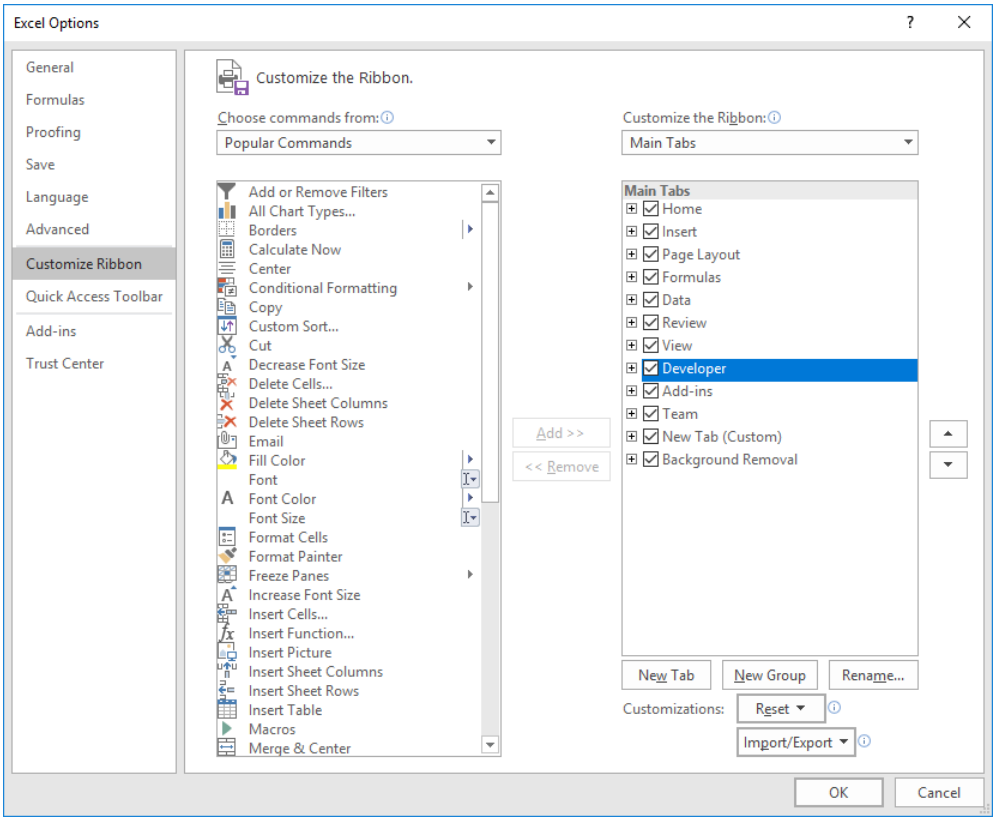
1. Macro

1.1 Overview

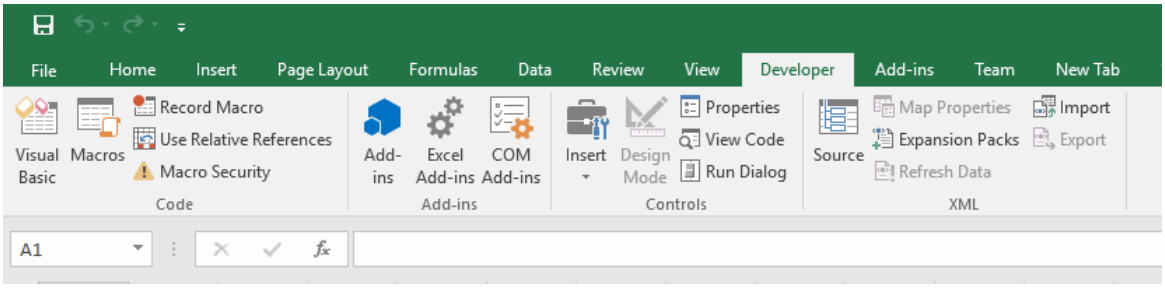
If you perform a task repeatedly in Microsoft Excel, you can automate the task with a macro. A macro is a series of commands and functions that are stored in a Microsoft Visual Basic module and can be run whenever you need to perform the task. For example, if you often enter long text strings in cells, you can create a macro to format those cells so that the text wraps.

1.2 Enable Developer Tab in Ribbon

1. Click the **Microsoft Office Button**, and then click **Excel Options**.
2. Click **Popular**, and then select the **Show Developer** tab in the **Ribbon** check box, and press **[OK]** to confirm.



3. The Developer tab will be enabled.

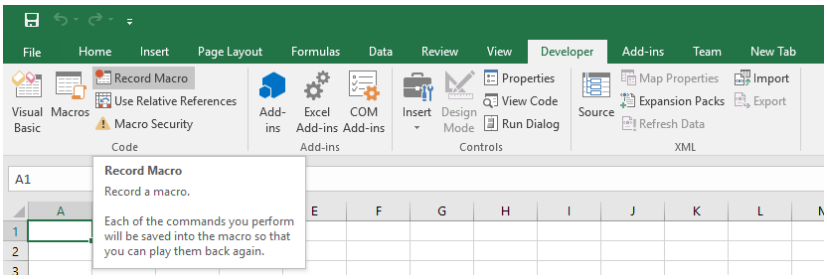


1.3 Recording Macro

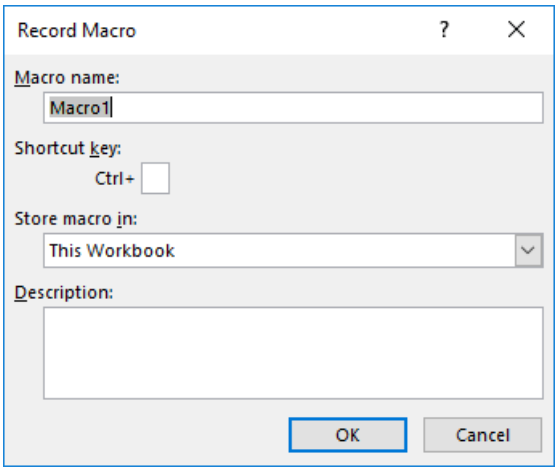
1.3.1 Record Macro using Macro Recorder

When you record a macro, Excel stores information about each step you take as you perform a series of commands. You then run the macro to repeat, or play back, the commands. If you make a mistake when you record the macro, corrections you make are also recorded. Visual Basic stores each macro in a new module attached to a workbook.

1. Select **Developer** tab, **Code** Group, **Record Macros**



2. Perform the following action in the **Record Macro** dialog box.

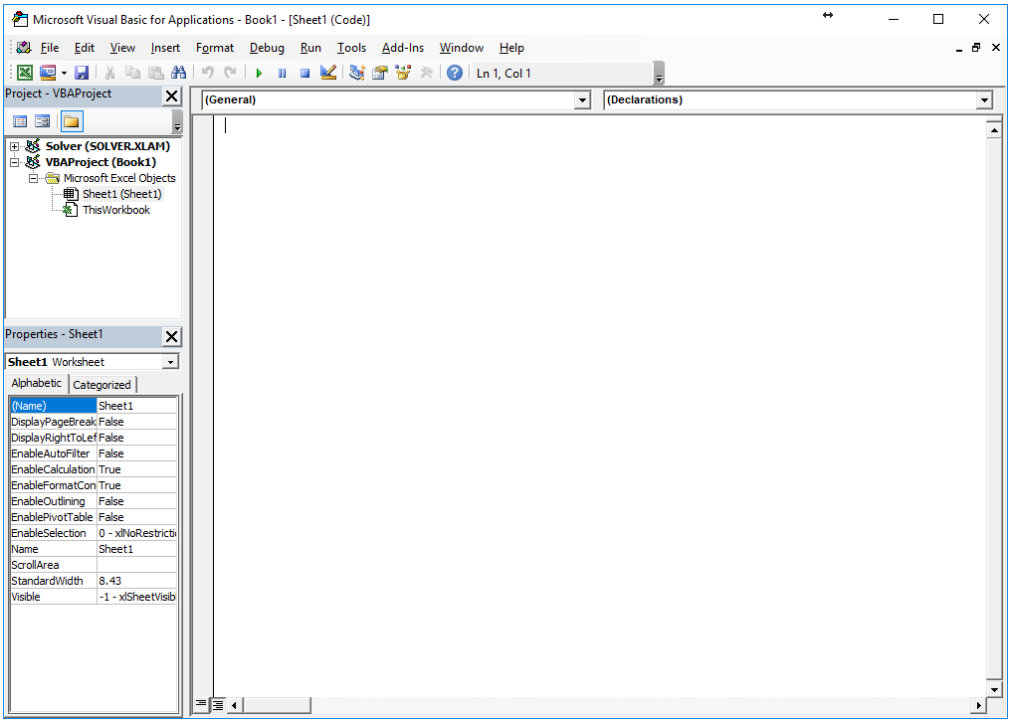


- In the **Record Macro** dialog box, enter a name in the **Macro Name** box
- If you want to run the macro by pressing a keyboard shortcut key, enter a letter in the **Shortcut** key box. The shortcut key will override any equivalent default Excel shortcut keys while the workbook that contains the macro is open
- In the **Store macro in** box, click the location where you want to store the macro. If you want a macro to be available whenever you use Excel, select **Personal Macro Workbook**.
- If you want to include a description of the macro, type it in the **Description** box.
- Click **[OK]**. If you want the macro to run relative to the position of the active cell, record it using relative cell references. On the **Stop Recording** toolbar, click **Relative Reference** so that it is selected. Excel will continue to record macros with relative references until you quit Microsoft Excel or until you click **Relative Reference** again, so that it is not selected.

3. Carry out the actions you want to record.
4. Select **View** tab, **Code** Group, **Stop Macro** when finish the record.

1.3.2 Create Macro using Visual Basic Editor

1. Select **Developer** tab, **Code** Group, **Visual Basic**
2. Select the **Insert ➔ Module** in the **Microsoft Visual Basic Editor**.
3. Type or copy your code into the code window of the module.
4. If you want to run the macro from the module window, press **[F5]**.
5. When you're finished editing, click **File ➔ Close and Return to Microsoft Excel**.

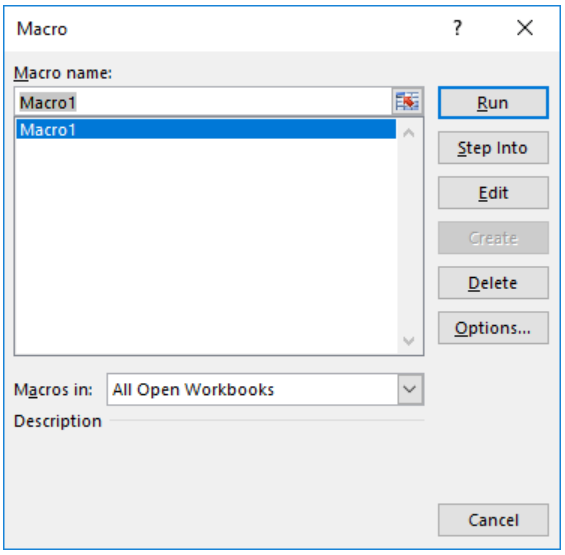


1.4 Executing Macro

The next time you need to flag a cell, you can run the macro. If you're going to use the macro frequently, you can create a toolbar button for it, or assign a keystroke for it, or both.

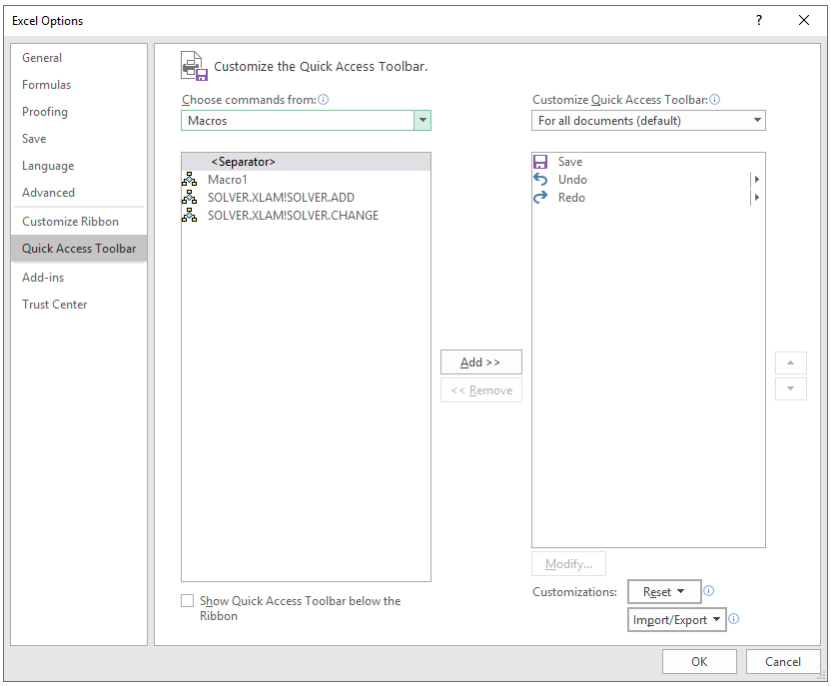
1.4.1 Running Macro using Tools Menu

1. Select **View** tab, **Code** Group, Macros to call the **Macro** dialog box.
2. Click the name of your macro, and then click **Run**.



1.4.2 Create Toolbar Button for Running Macro

1. Click the Microsoft Office Button, and then click **Excel Options**, and in the **Quick Access Toolbar** tab.
2. Select **Macros** in the **Choose command from**
3. Select the macro you want to assign and press the **Add** button, and then click **[OK]**.



1.4.3 Assign Keystroke for Running Macro

1. Click the worksheet, and then select **Developer** tab, **Code** Group, **Macro**.
2. Select the name of your macro, and then click **[Options]**.
3. In the Shortcut key box, type the key to use along with **[Ctrl]** button to run your macro.

1.5 Managing Macros

After you record a macro, you can view the macro code with the Visual Basic Editor to correct errors or change what the macro does. For example, if you wanted the text-wrapping macro to also make the text bold, you could record another macro to make a cell bold and then copy the instructions from that macro to the text-wrapping macro.

The Visual Basic Editor is a program designed to make writing and editing macro code easy for beginners and provides plenty of online Help. You don't have to learn how to program or use the Visual Basic language to make simple changes to your macros. With the Visual Basic Editor, you can edit macros, copy macros from one module to another, copy macros between different workbooks, and rename the modules that store the macros, or rename the macros.

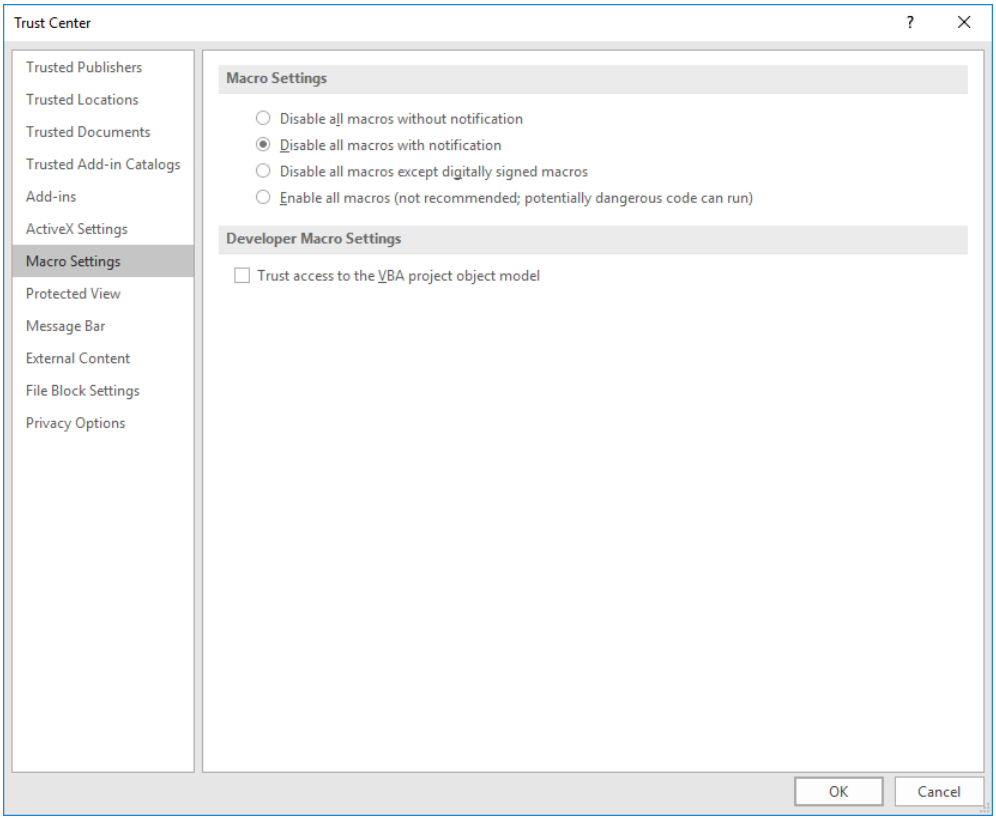
1.6 Macro Security

In Microsoft Office Excel, you can change the macro security settings to control which macros run and under what circumstances when you open a workbook. For example, you might allow macros to run based on whether they are digitally signed by a trusted developer.

1.6.1 Change Macro Security Settings

You can change macro security settings in the Trust Center, unless a system administrator in your organization has changed the default settings to prevent you from changing the settings.

1. On the **Developer** tab, in the **Code** group, click **Macro Security**.
2. In the **Macro Settings** category, under **Macro Settings**, click the option that you want. Any changes that you make in the Macro Settings category in Excel apply only to Excel and do not affect any other Microsoft Office program.



1.6.2 Macro Security Settings and their Effects

The following list summarizes the various macro security settings. Under all settings, if antivirus software that works with 2007 Microsoft Office system is installed and the workbook contains macros, the workbook is scanned for known viruses before it is opened.

- **Disable all macros without notification**. Click this option if you don't trust macros. All macros in documents and security alerts about macros are disabled. If there are documents that contain unsigned macros that you do trust, you can put those documents into a trusted location. Documents in trusted locations are allowed to run without being checked by the Trust Center security system.
- **Disable all macros with notification.** This is the default setting. Click this option if you want macros to be disabled, but you want to get security alerts if there are macros present. This way, you can choose when to enable those macros on a case by case basis.
- **Disable all macros except digitally signed macros.** This setting is the same as the Disable all macros with notification option, except that if the macro is digitally signed by a trusted publisher, the macro can run if you have already trusted the publisher. If you have not trusted the publisher, you are notified. That way, you can choose to enable those signed macros or trust the publisher.

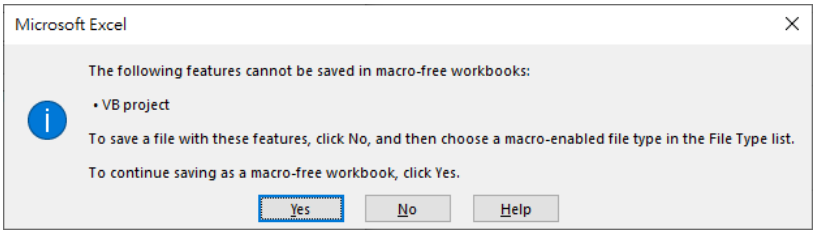
All unsigned macros are disabled without notification.

- **Enable all macros (not recommended, potentially dangerous code can run).** Click this option to allow all macros to run. Using this setting makes your computer vulnerable to potentially malicious code and is not recommended.
- **Trust access to the VBA project object model.** This setting is for developers and is used to deliberately lock out or allow programmatic access to the VBA object model from any Automation client. In other words, it provides a security option for code that is written to automate an Office program and programmatically manipulate the VBA environment and object model. This is a per user and per application setting, and denies access by default. This security option makes it more difficult for unauthorized programs to build "self-replicating" code that can harm end-user systems. For any Automation client to be able to access the VBA object model programmatically, the user running the code must explicitly grant access. To turn on access, select the check box.

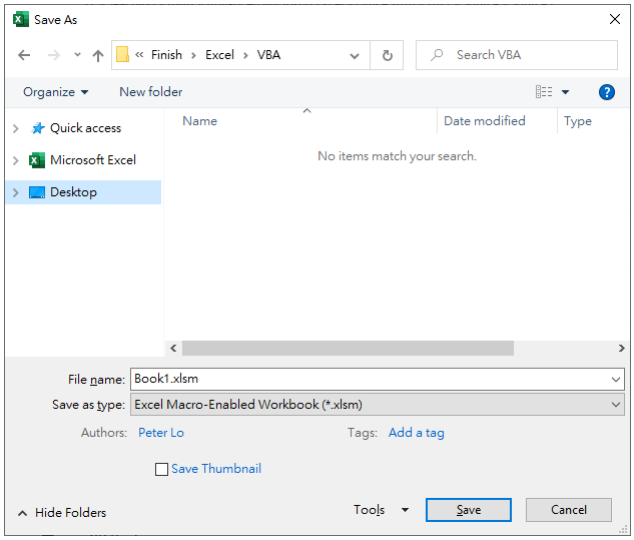
1.7 Saving Macro

After you've created your macro, you'll want to save it so you can use it again. But saving a workbook with macros is a little different because it needs to be in a special "macro-enabled" file format. When you try to save it, Excel prompts you with two choices:

- Save it as a macro-enabled workbook (*.xlsm file type) by clicking **[No]**.
- Save it as a macro-free workbook by clicking **[Yes]**.



In order to save it as a macro-enabled workbook, click **[No]**. choose **Excel Macro-Enabled Workbook (*.xlsm)** in the Save As box, in the Save as type list box,



2. Visual Basic Editor

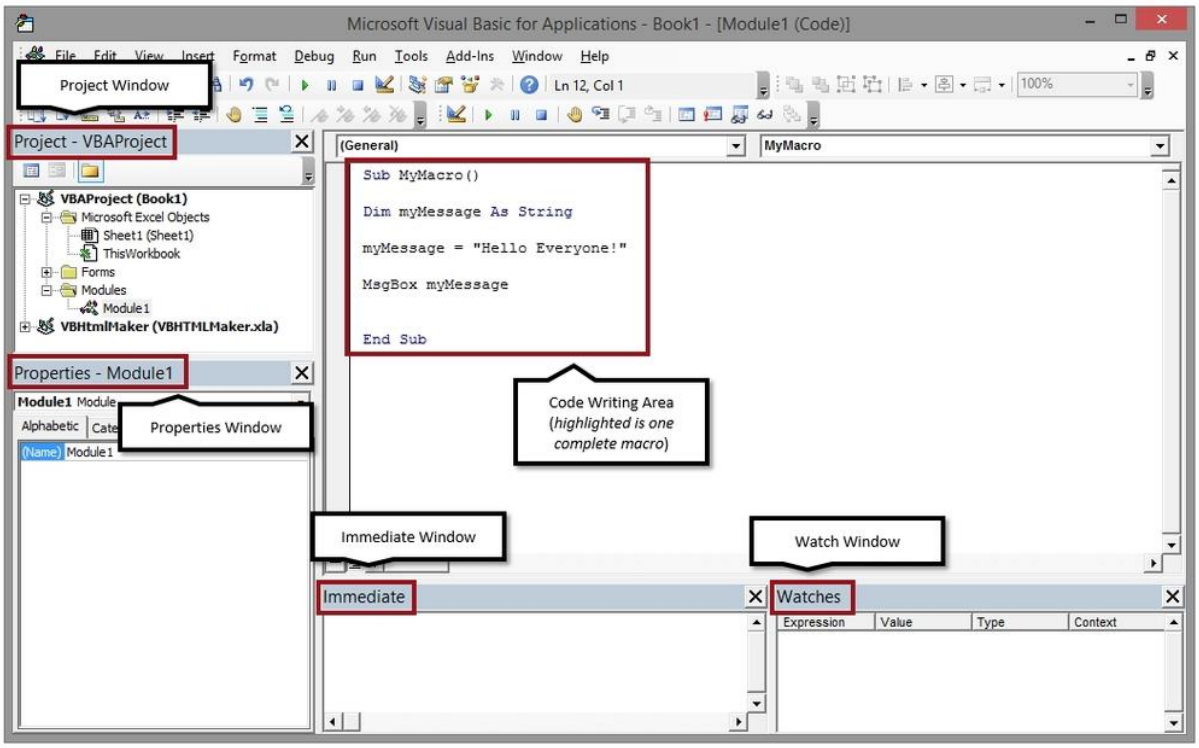
2.1 Introduction to Visual Basic Editor

The Visual Basis Editor is the workspace for creating VBA code. The editor can be accessed through your Developer Tab or by using the shortcut **[Alt]** + **[F11]**. The editor will display in a completely separate window than your Office Application and each one of the programs in the Office Suite has its own VBA Editor

There are several main areas in the VBA Editor:

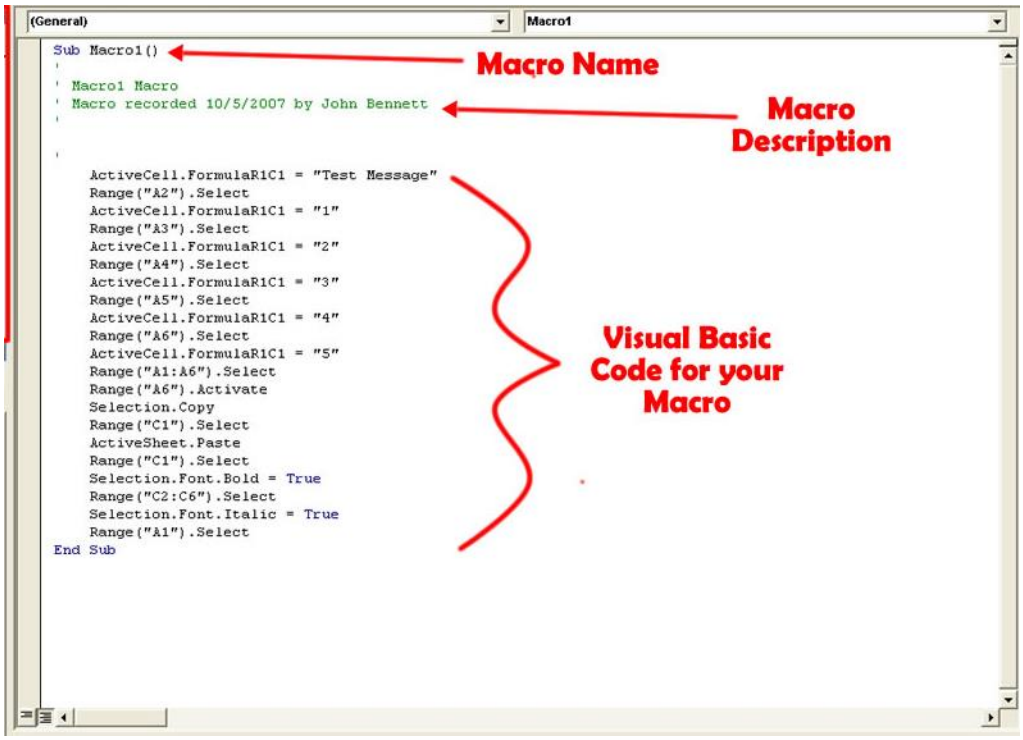
- Project Explorer
- Code Window
- Immediate Window
- Watch Window
- Properties Window

This is what is known as an Integrated Development Environment (which means everything you need to write programs and code are all in this one window)



2.2 Using the Visual Basic Editor

The Visual Basic Editor is a powerful tool that lets you extend the power and versatility of macros beyond anything that can be done through recording alone.



2.2.1 Name of Macro

The basic macro is made up of three parts, its name, description and code. Every macro must have the keyword "**Sub**" before whatever you decide to name your macro and open and close parenthesis after. If you wanted to name your macro **Hello_World**, then the first line on your macro will be **Sub Hello_World()**.

2.2.2 Macro Description

The description is in green because it is a comment section. Any part of a macro that is commented out will be ignored when the macro is actually run, so you can type anything you want there.

To comment out a section, all you need to do is add a single quote before the line you want to comment ‘. You are then able to comment on anything you would like. Comments can be put anywhere within the macro code.

2.2.3 Code for Macro

The actual code is what the macro will be doing when you tell it to run. Anything you type in the section will be attempted to be run by the macro, so if you type something incorrectly that the macro doesn't understand, it will give you an error to debug. Over the next few posts we will be looking at some commands we can give the visual basic editor to make it do what we want.

2.2.4 End of Macro

After the code is complete you have to end the macro with the line **End Sub**. This just lets the macro know that it has reached the end of the executable code and its job is complete.

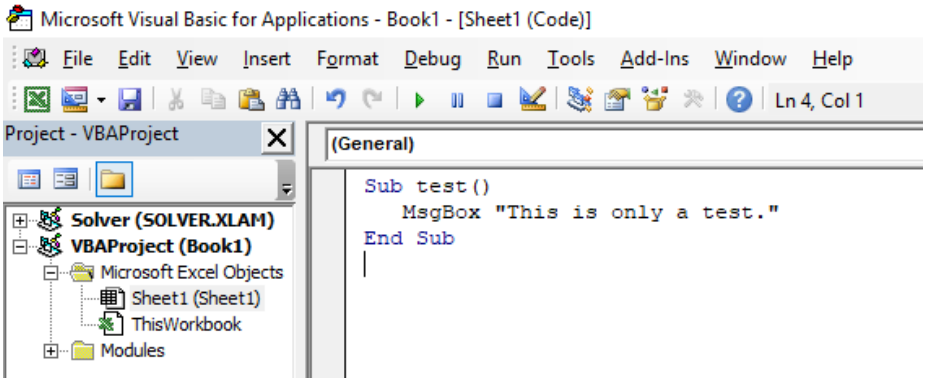
2.2.5 Example

Below is the example for creating an sample Macro program using VBA:

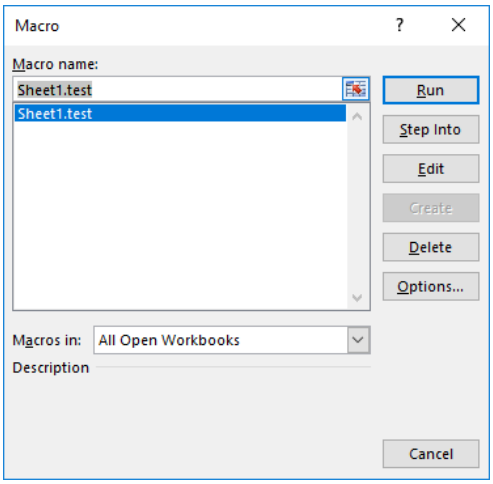
1. Start Excel and open a new, blank workbook.
2. Select **Developer** tab, **Code** Group, **Visual Basic**.
3. In the **Project** window, double-click **ThisWorkbook**.
4. Enter this code into the code window:

```
sub test( )
    MsgBox "This is only a test."
end sub
```

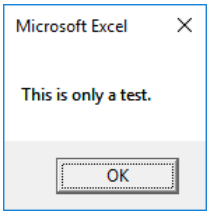
5. Save the file and then select **File ➔ Visual Basic Editor and close the workbook**.



6. Select **Developer** tab, **Code** Group, **Macros** in the Excel worksheet. Then select the previous macro “text” we created in the Visual Basic Editor.



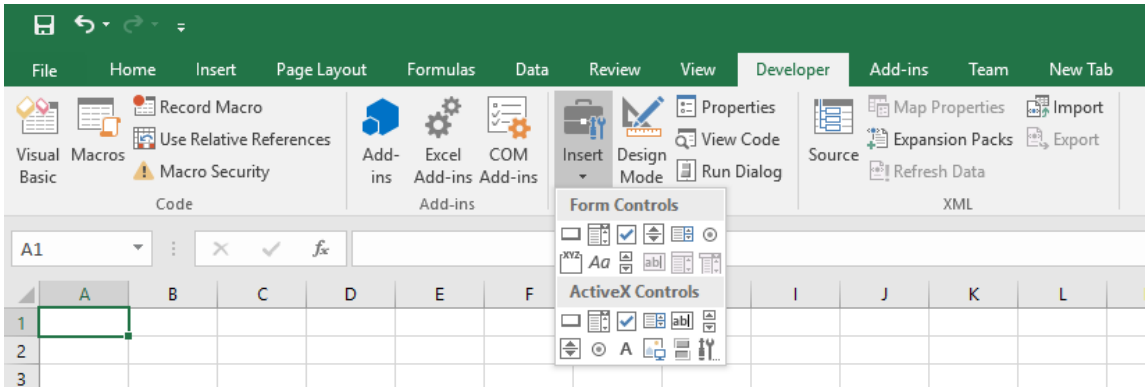
7. Press **[Run]** to execute the macro and a message box will be displayed.



3. Working with Excel VBA Control

3.1 Overview

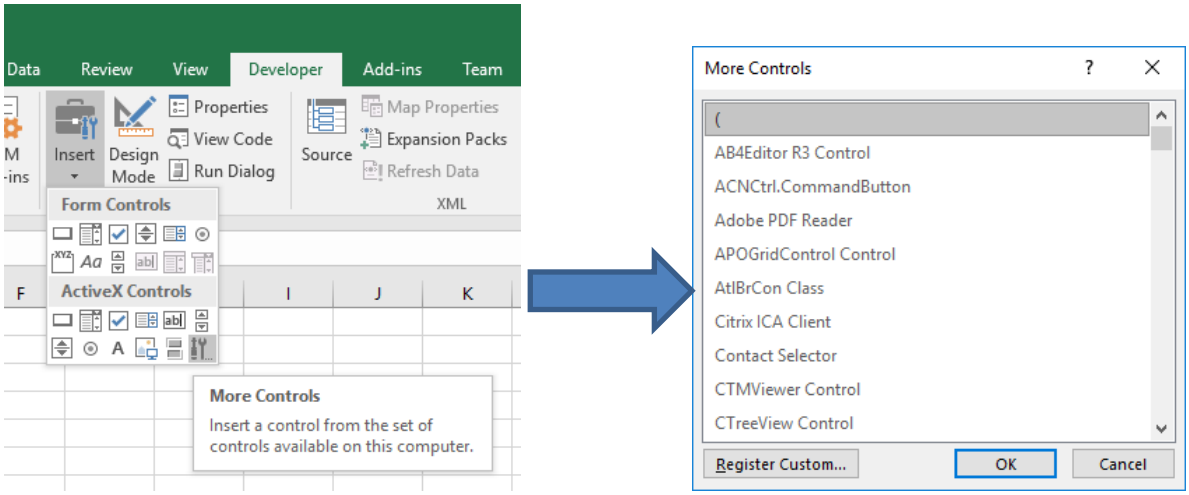
The main objects used to help a person interact with the computer are Windows controls. There are two main ways you can access these objects when working with Microsoft Excel. If you are working in Microsoft Excel, you can add or position some Windows controls on the document. To do that, on the Ribbon, click Developer. In the Control section, click Insert.



This would display the list of controls available in Microsoft Excel. The controls appear in two sections: Form Controls and ActiveX Controls. If you are working on a spreadsheet in Microsoft Excel, you should use only the controls in the ActiveX Controls section. If you are working on a form in Microsoft Visual Basic, a Toolbox equipped with various controls will appear.

3.2 Using Additional Objects

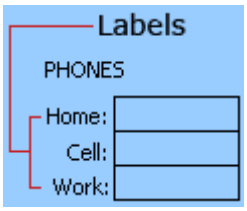
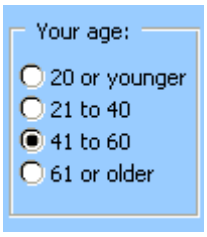
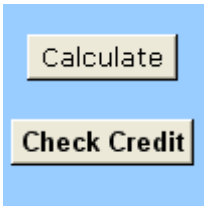
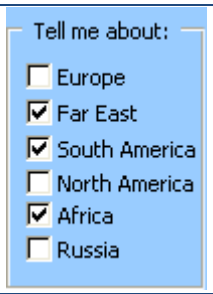
The Developer tab of the Ribbon in Microsoft Excel provides the most regularly used controls. These controls are enough for any normal spreadsheet you are developing. Besides these objects, other controls are left out but are still available. To use one or more of these left out controls, in the Controls section of the Ribbon, click Insert and click the More Controls button. This would open the More Controls dialog box. You can scroll up and down in the window to locate the desired control. If you see a control you want to use, click it and click [OK].

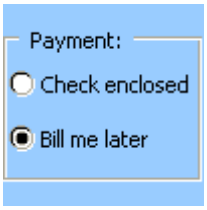
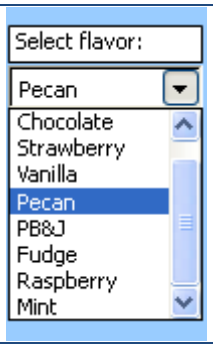
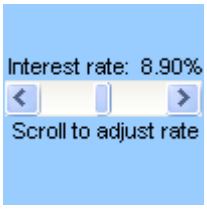
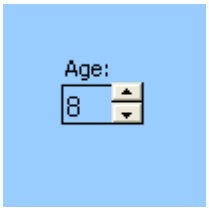


3.3 Form Controls

Form controls are the original controls that are compatible with earlier versions of Excel, starting with Excel version 5.0. Form controls are also designed for use on XLM macro sheets. You use Form controls when you want to easily reference and interact with cell data without using VBA code, and when you want to add controls to chart sheets. For example, after you add a list box control to a worksheet and linking it to a cell, you can return a numeric value for the current position of the selected item in the control. You can then use that numeric value in conjunction with the INDEX function to select different items from the list.

You can also run macros by using Form controls. You can attach an existing macro to a control, or write or record a new macro. When a user of the form clicks the control, the control runs the macro. However, these controls cannot be added to UserForms, used to control events, or modified to run Web scripts on Web pages.

Icon	Name	Example	Description
	Label		Identifies the purpose of a cell or text box, or displays descriptive text (such as titles, captions, pictures) or brief instructions.
	Group box		Groups related controls into one visual unit in a rectangle with an optional label. Typically, option buttons, check boxes, or closely related contents are grouped.
	Button		Runs a macro that performs an action when a user clicks it. A button is also referred to as a push button.
	Check Box		Turns on or off a value that indicates an opposite and unambiguous choice. You can select more than one check box on a worksheet or in a group box. A check box can have one of three states: selected (turned on), cleared (turned off), and mixed, meaning a combination of on and off states (as in a multiple selection).

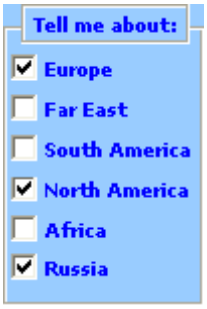
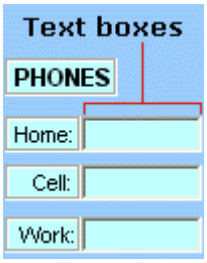
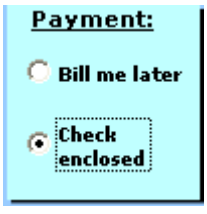
Icon	Name	Example	Description
	Option Button		Allows a single choice within a limited set of mutually exclusive choices; an option button is usually contained in a group box or a frame. An option button can have one of three states: selected (turned on), cleared (turned off), and mixed, meaning a combination of on and off states (as in a multiple selection). An option button is also referred to as a radio button.
	List Box		Displays a list of one or more items of text from which a user can choose. Use a list box for displaying large numbers of choices that vary in number or content. There are three types of list boxes: A single-selection list box enables only one choice. In this case, a list box resembles a group of option buttons, except that a list box can handle a large number of items more efficiently. A multiple-selection list box enables either one choice or contiguous (adjacent) choices. An extended-selection list box enables one choice, contiguous choices, and noncontiguous (or disjointed) choices.
	Combo Box		Combines a text box with a list box to create a drop-down list box. A combo box is more compact than a list box but requires the user to click the down arrow to display the list of items. Use a combo box to enable a user to either type an entry or choose only one item from the list. The control displays the current value in the text box, regardless of how that value is entered.
	Scroll Bar		Scrolls through a range of values when you click the scroll arrows or drag the scroll box. In addition, you can move through a page (a preset interval) of values by clicking the area between the scroll box and either of the scroll arrows. Typically, a user can also type a text value directly into an associated cell or text box.
	Spin Button		Increases or decreases a value, such as a number increment, time, or date. To increase the value, click the up arrow; to decrease the value, click the down arrow. Typically, a user can also type a text value directly into an associated cell or text box.

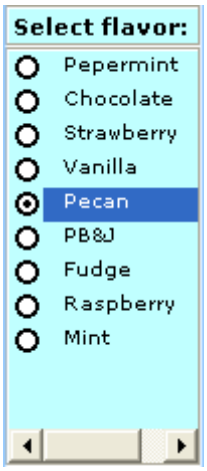
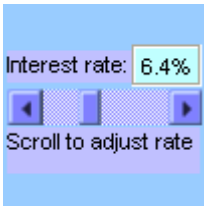
3.4 ActiveX controls

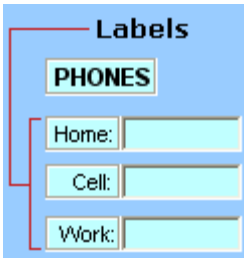
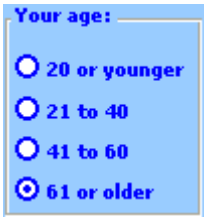
ActiveX controls can be used on worksheet forms, with or without the use of VBA code, and on VBA UserForms. In general, use ActiveX controls when you need more flexible design requirements than those provided by Form controls. ActiveX controls have extensive properties that you can use to customize their appearance, behavior, fonts, and other characteristics.

You can also control different events that occur when an ActiveX control is interacted with. For example, you can perform different actions, depending on which choice a user selects from a list box control, or you can query a database to refill a combo box with items when a user clicks a button. You can also write macros that respond to events associated with ActiveX controls. When a user of the form interacts with the control, your VBA code then runs to process any events that occur for that control.

Your computer also contains many ActiveX controls that were installed by Excel and other programs, such as Calendar Control 12.0 and Windows Media Player.

Icon	Name	Example	Description
	Check Box		Turns on or off a value that indicates an opposite and unambiguous choice. You can select more than one check box at a time on a worksheet or in a group box. A check box can have one of three states: selected (turned on), cleared (turned off), and mixed, meaning a combination of on and off states (as in a multiple selection).
	Text Box		Enables you to, in a rectangular box, view, type, or edit text or data that is bound to a cell. A text box can also be a static text field that presents read-only information.
	Command Button		Runs a macro that performs an action when a user clicks it. A command button is also referred to as a push button.
	Option Button		Allows a single choice within a limited set of mutually exclusive choices usually contained in a group box or frame. An option button can have one of three states: selected (turned on), cleared (turned off), and mixed, meaning a combination of on and off states (as in a multiple selection). An option button is also referred to as a radio button.

Icon	Name	Example	Description
	List Box		Displays a list of one or more items of text from which a user can choose. Use a list box for displaying large numbers of choices that vary in number or content. There are three types of list boxes: • A single-selection list box enables only one choice. In this case, a list box resembles a group of option buttons, except that a list box can handle a large number of items more efficiently. • A multiple selection list box enables either one choice or contiguous (adjacent) choices. • An extended-selection list box enables one choice, contiguous choices, and noncontiguous (or disjointed) choices.
	Combo Box		Combines a text box with a list box to create a drop-down list box. A combo box is more compact than a list box, but requires the user to click the down arrow to display the list of items. Use to allow a user to either type an entry or choose only one item from the list. The control displays the current value in the text box, regardless of how that value is entered.
	Toggle button		Indicates a state, such as Yes/No, or a mode, such as On/Off. The button alternates between an enabled and disabled state when it is clicked.
	Spin Button		Increases or decreases a value, such as a number increment, time, or date. To increase the value, click the up arrow; to decrease the value, click the down arrow. Typically, a user can also type a text value into an associated cell or text box.
	Scroll Bar		Scrolls through a range of values when you click the scroll arrows or drag the scroll box. In addition, you can move through a page (a preset interval) of values by clicking the area between the scroll box and either of the scroll arrows. Typically, a user can also type a text value directly into an associated cell or text box.

Icon	Name	Example	Description
	Label		Identifies the purpose of a cell or text box, displays descriptive text (such as titles, captions, pictures), or provides brief instructions.
	Image		Embeds a picture, such as a bitmap, JPEG, or GIF.
	Frame Control		A rectangular object with an optional label that groups related controls into one visual unit. Typically, option buttons, check boxes, or closely related contents are grouped in a frame control. *Note: The ActiveX frame control is not available in the ActiveX Controls section of the Insert command. However, you can add the control from the More Controls dialog box by selecting Microsoft Forms 2.0 Frame.*
	More Controls		Displays a list of additional ActiveX controls available on your computer that you can add to a custom form, such as Calendar Control 12.0 and Windows Media Player. You can also register a custom control in this dialog box.

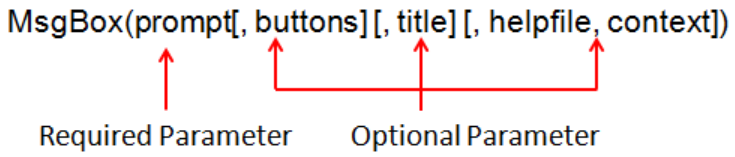
4. Interactive with User

4.1 Using Message box and Input box

There are many built-in functions available in Excel VBA which we can use to streamline our VBA programs. Among them, message box and input box are most commonly used. These two functions are useful because they make the Excel VBA macro programs more interactive. The input box allows the user to enter the data while the message box displays output to the user.

4.2 The MsgBox ( ) Function

The objective of the MsgBox function is to produce a pop-up message box and prompt the user to click on a command button before he or she can continue. The code for the message box is as follows:



4.2.1 Style Values

The Style Value determines what type of command button that will appear in the message box. Moreover, to make the message box looks more sophisticated, you can add an icon beside the message.

Style Values

Style Value	Named Constant	Button Displayed
0	vbOkOnly	Ok button
1	vbOkCancel	Ok and Cancel buttons
2	vbAbortRetryIgnore	Abort, Retry and Ignore buttons.
3	vbYesNoCancel	Yes, No and Cancel buttons
4	vbYesNo	Yes and No buttons
5	vbRetryCancel	Retry and Cancel buttons

Message Icon

Value	Named Constant	Icon
16	vbCritical	
32	vbQuestion	
48	vbExclamation	
64	vbInformation	

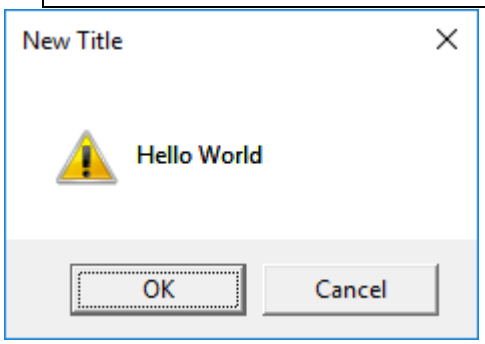
4.2.2 Returned Values

Value	Named Constant	Button Clicked
1	vbOk	Ok button
2	vbCancel	Cancel button
3	vbAbort	Abort button
4	vbRetry	Retry button
5	vbIgnore	Ignore button
6	vbYes	Yes button
7	vbNo	No button

4.2.3 Example

You can use the following code to display a message box with icon and button.

```
Sub MsgBoxDemo()

    Dim ReturnValue As VbMsgBoxResult


    ReturnValue = MsgBox("Hello World", vbOKCancel + vbExclamation, "New Title")

    Worksheets(1).Range("A1").Value = ReturnValue

End Sub
```



4.3 The InputBox( ) Function

An InputBox( ) is a function that displays an input box where the user can enter a value or a message in the form of text. The format is:

myMessage = InputBox(Prompt, Title, default_text, x-position, y-position)

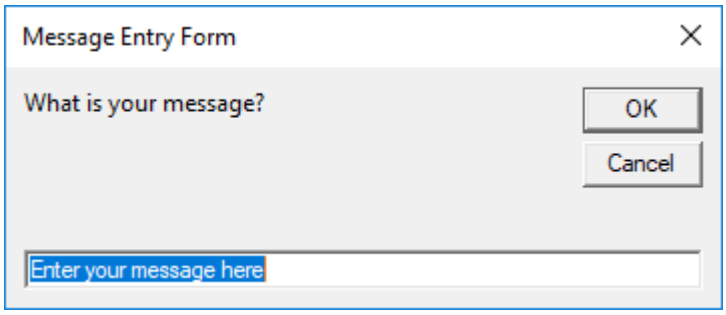
myMessage is a variant data type but typically it is declared as a string, which accepts the message input by the users. The arguments are explained as follows:

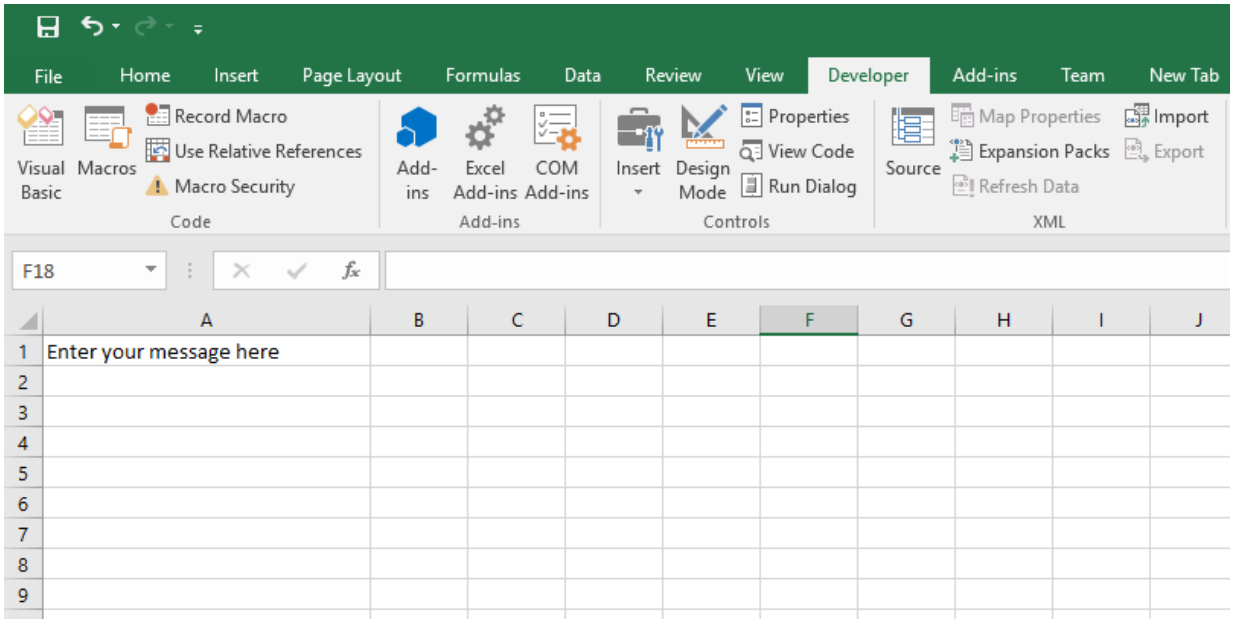
- Prompt – The message displayed in the inputbox.
- Title – The title of the Input Box.
- Default_text – The default text that appears in the input field where users can use it as his intended input or he may change it to another message.
- x-position and y-position –The position or the coordinates of the input box.

4.3.1 Example

You can use the following code to obtain user input

```
Sub InputBoxDemo()

    Dim UserInput As String


    UserInput = InputBox("What is your message?", "Message Entry Form", _
                         "Enter your message here", 500, 700)

    Worksheets(1).Range("A1").Value = UserInput

End Sub
```





5. Programming Variables

5.1 Variables

5.1.1 Declare and Assign Variables

In computer programming, you use a variable to store things in memory, so that you can retrieve them later for manipulation. Variables have a name and a data type. In VBA you can declare and set up your variable with key word **Dim**.

```
Dim MyNumber As Integer
```

This code sets up a variable with the name MyNumber. The type of variable is an integer. The Dim keyword goes at the start, and tells the programme to set up a variable of this name and type. However, there's nothing stored inside of the MyNumber variable. VBA has just allocated the memory at this point. To store something inside of a variable, you use the equal sign (=), also known as the assignment operator. To store a value of 10, say, inside of the variable called MyNumber, you do it like this:

```
MyNumber = 10
```

The above line reads, "Assign a value of 10 to the variable called MyNumber". So the name of your variable comes first, then the equal sign. After the equal sign you type the value that you want to store inside of your variable.

5.1.2 Common Data Type

Data Type	Symbol	Length	Detail
Integer	%	2	-32,768 to 32767
Long	&	4	-2,147,483,648 to 2,147,483,647
Currency	@	8	-922,337,203,685,477.5808 to 922,337,203,685,477.5807
Single	!	4	-3.402823E38 to 1.401298E45
Double	#	8	-1.79769313486232E308 to -4.94065645841247E-324, 4.94065645841247E-324 to 1.79769313486232E308
String	$		Varies according to the number of characters (1 per character)
Byte		2	Whole number between 0 and 255.
Date		8	1 January 1000 to 31 December 9999
Boolean		2	True or False

5.1.3 Variable Names

You can call your variable anything you like with the following guideline:

- Cannot start a variable name with a number
- Cannot have spaces in your variable names, or full stops (periods)
- Cannot use any of the following characters: !, %, ?, #, $
- Variable name must be less than 255 characters

Examples of valid and invalid variable names:

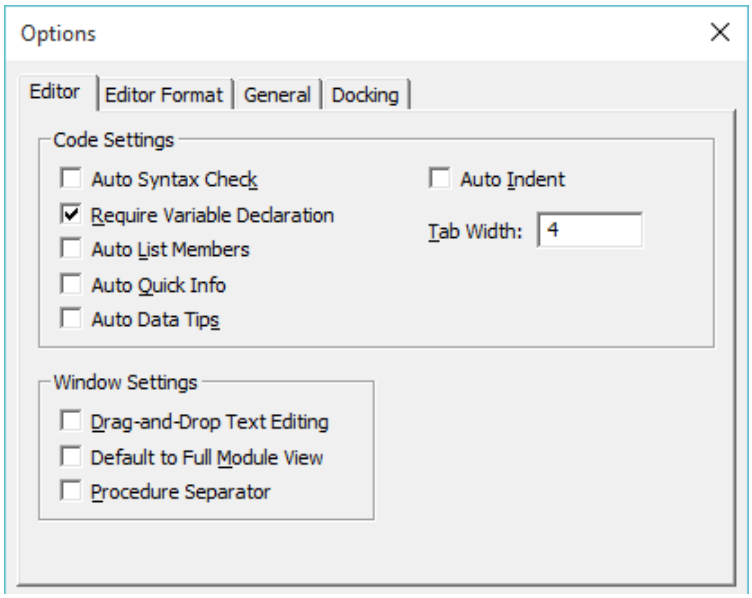
Valid Name	Invalid Name
My_Car	My.Car *(. is not acceptable)*
ThisYear	1NewBoy *(Cannot start with number)*
Long_Name_Can_beUSE	He&HisFather *(& is not acceptable)*
Group88	Student ID *(Spacing not allowed)*

5.2 Option Explicit

The use of Option Explicit is to help us to track errors in the usage of variable names within a program code. Option Explicit forces the programmer to declare all the variables using the Dim keyword. When Option Explicit is included in the program code, we have to declare all variables with the Dim keyword. Any variable not declared or wrongly typed will cause the program to popup the "Variable not defined" error message. We have to correct the error before the program can continue to run.

5.2.1 By Configuration

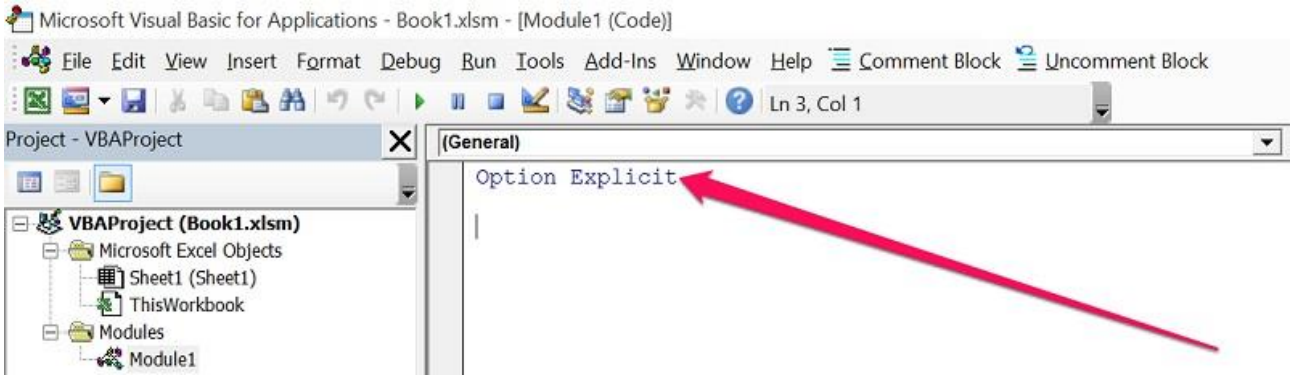
Select **Tools ➔ Options** and make sure the "Require Variable Declaration" is checked. Selecting this check box will automatically add the statement Option Explicit to any new modules (not existing ones). This ensures that a program will not run if it contains any variables that have not been explicitly declared.



5.2.2 By Programming

Whenever the Option Explicit statement is found within a module, you're prevented from executing VBA code containing undeclared variables. The Option Explicit statement just needs to be used once per module. In other words:

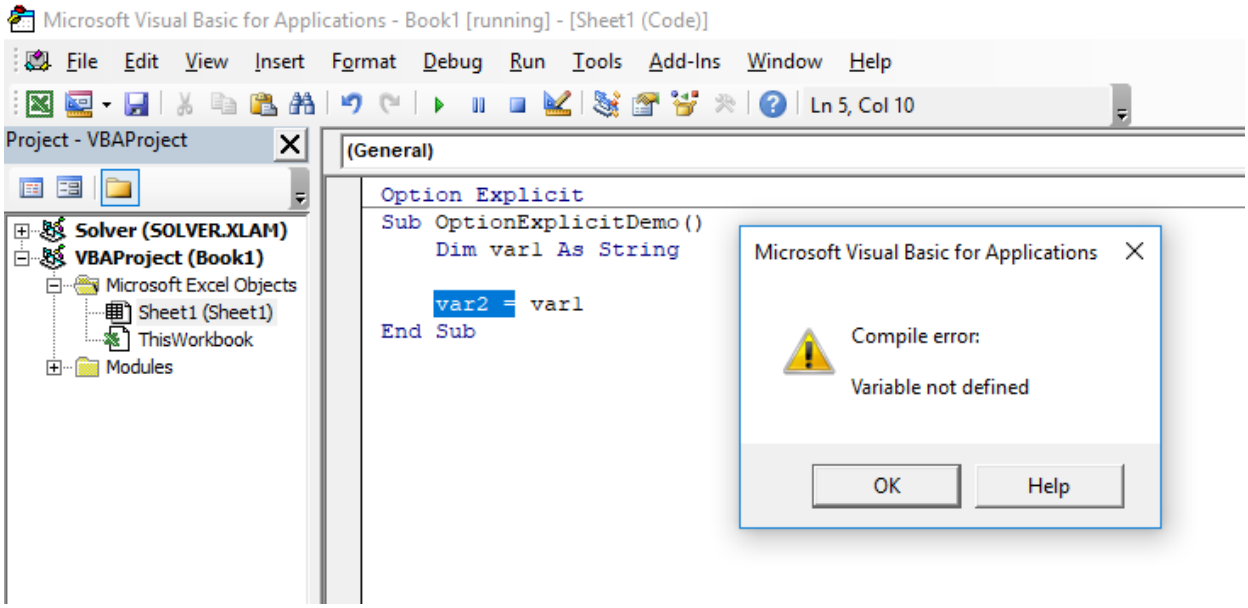
- You only include 1 Option Explicit statement per module.
- If you're working on a particular VBA project that contains more than 1 module, you must have 1 Option Explicit statement in each module.



5.2.2.1 Example

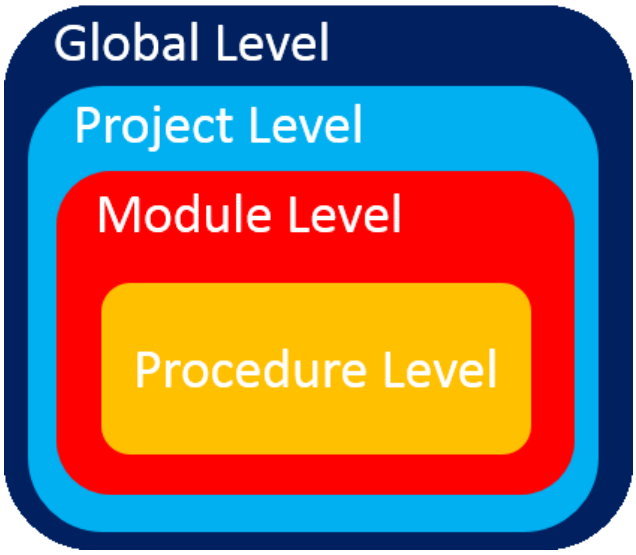
Compile Error will be prompted if variable haven't decelerated before use under Option Explicit.

```
Option Explicit


Sub OptionExplicitDemo()

    Dim var1 As String

    var2 = var1

End Sub
```

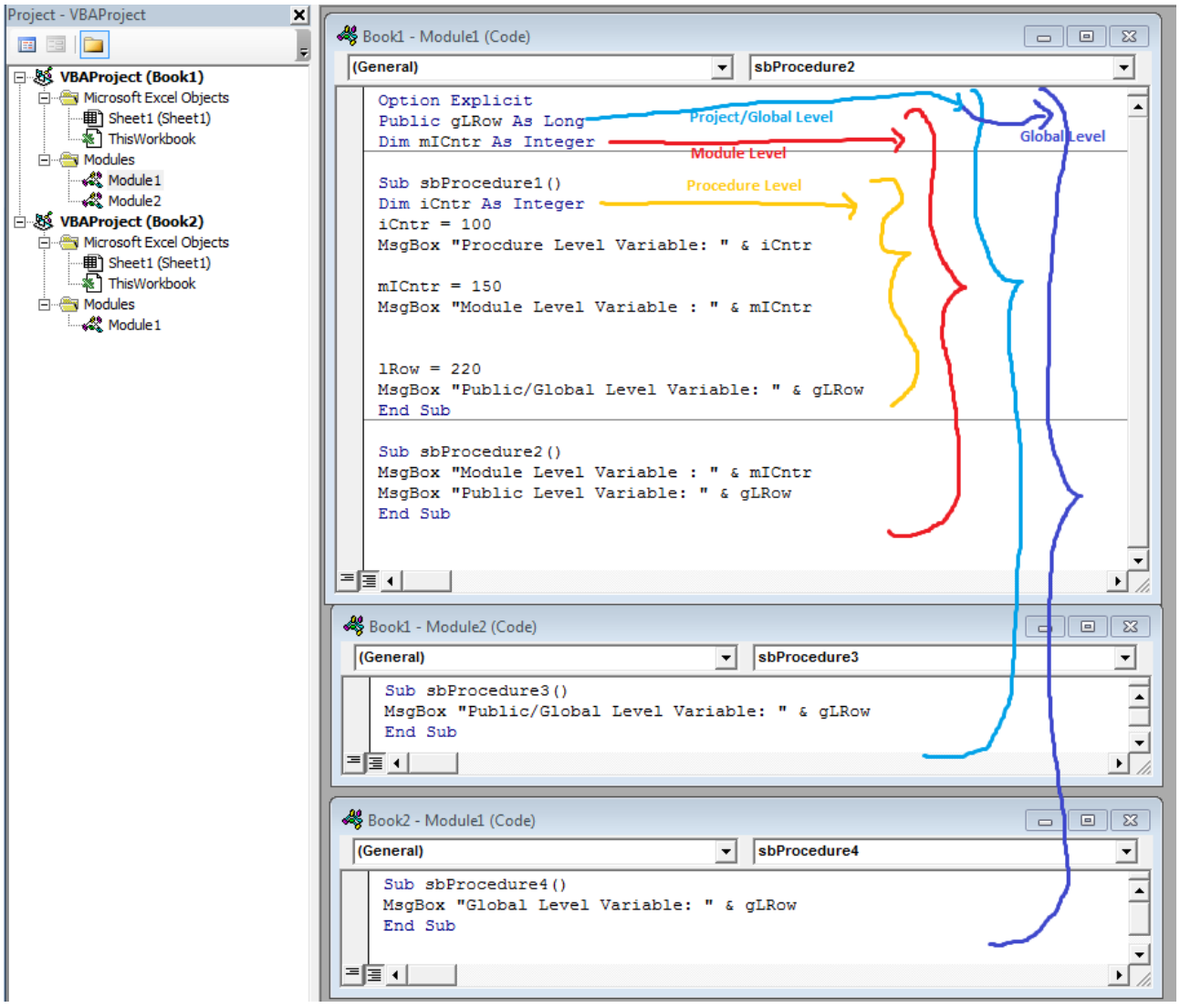


5.3 Variable Scope

The scope of a variable in Excel VBA determines where that variable may be used. You determine the scope of a variable when you declare it. There are four levels of Scope:



Here is the Pictorial Representation of the Scope of the Variables



5.3.1 Procedure-Level Scope

A local or procedure level variable is declared inside an individual procedure or function and is not visible outside that subroutine. Local variables can only be used in the procedure in which they are declared in. When the procedure or function ends the variable is automatically removed and the memory is released. You can use the Dim, Static or Private statement within a subroutine or function. The most common way to declare a local variable is to use the Dim statement between the Sub and End Sub statements. One of the great advantages of local variables is that we can use the same name in different subroutines without any conflicts.

5.3.2 Module-Level Scope

All Procedure-Level variables are accessible only within the Module in which they are declared. These are variables that are declared outside the Procedure itself at the very top of any Module. Its value is retained unless the Workbook closes or an End Statement is used.

5.3.3 Project-Level Scope

We set Project -Level Scope to the variables if we want to make the public variable to be accessed only in the project in which they are declared and not outside of this project. To set this option we need to add “Option Private Module” statement at the top of the declaration area.

5.3.4 Global-Level Scope

All Global-Level variables are accessible in anywhere in the Project (.i.e; in any Module, User Form, Classes) within the Workbook in which they are declared. And also accessible to outside of this project or workbook. These are variables that are declared using ‘Public’ keyword at the very top of any Public Module.

6. Arithmetic Operation

6.1 Overview

When you store numbers inside of variables, one of the things you can do with them is mathematical calculations. The arithmetic precedence is as follow:

Operator	Operation	Precedence number
^	exponentiation (raises a number to a power)	1
–	negation	2
*, /	multiplication and division	3
\	integer division	4
Mod	modulus	5
+, –	addition and subtraction	6

6.2 Addition

In programing languages, the addition sign is the plus (+).

```
Sub Add_Numbers( )
     Dim Number_1 As Integer
     Dim Number_2 As Integer

     Number_1 = 10
     Number_2 = 20

     Worksheets(1).Range("A1").Value = "Addition Answer"
     Worksheets(1).Range("B1").Value = Number_1 + Number_2
End Sub
```

6.3 Subtraction

In the VBA programming language, the minus sign (-) is used to subtract one value from another. Again, you can use actual values, values stored in variables, or a combination of the two.

```
Sub Subtract_Numbers( )
     Dim Number_1 As Integer
     Dim Number_2 As Integer

     Number_1 = 10
     Number_2 = 20

     Worksheets(1).Range("A2").Value = "Subtract Answer"
     Worksheets(1).Range("B2").Value = Number_1 - Number_2
End Sub
```

6.4 Multiplication

In programing languages, the multiplication sign is the asterisk (*). So if you want to multiply 10 by 5 in VBA you could do it like this:

```
Sub Multiply_Numbers( )
     Dim Number_1 As Integer
     Dim Number_2 As Integer

     Number_1 = 10
     Number_2 = 5

     Worksheets(1).Range("A3").Value = "Multiplication Answer"
     Worksheets(1).Range("B3").Value = Number_1 * Number_2
End Sub
```

6.5 Division

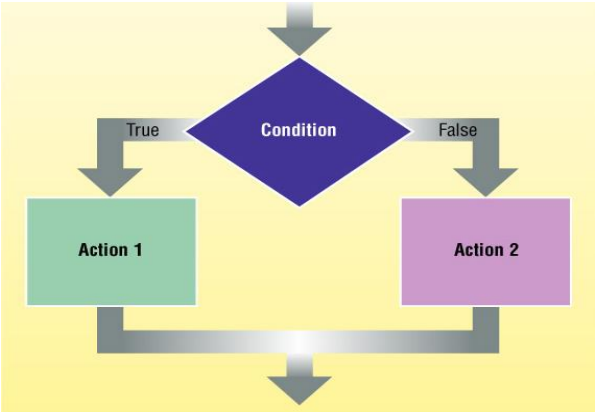
The symbol to use when you want to divide numbers is the forward slash (/).

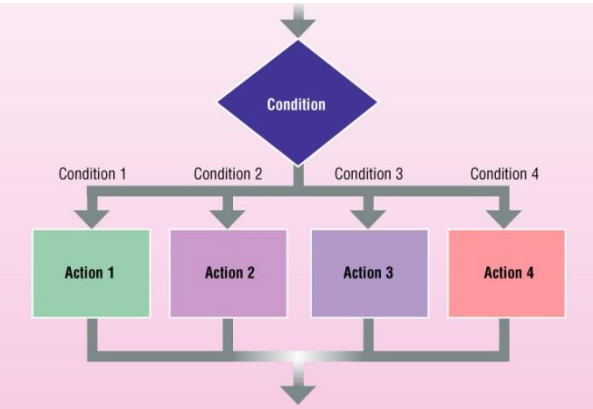
```
Sub Divide_Numbers( )
     Dim Number_1 As Integer
     Dim Number_2 As Integer

     Number_1 = 10
     Number_2 = 5

     Worksheets(1).Range("A4").Value = "Division Answer"
     Worksheets(1).Range("B4").Value = Number_1 / Number_2
End Sub
```

7. The Selection Structure

7.1 Overview

Also called the decision structure, makes a decision and then takes appropriate action based on that decision.





7.2 If Statement

To effectively control the program flow, we shall use the If...Then...Else statement together with the conditional operators and logical operators. The general format for the statement is as follows:

```
If condition1 Then
    Statement1
ElseIf condition2 Then
    Statement2
Else
    Statement3
End If
```

* Any If...Then...Else statement must end with End If. Sometime it is not necessary to use Else.

7.2.1 Relational Operators

	Relational Operator	Meaning	Example	Resulting Condition
1	=	Equal to	8 = 8	True
2	<>	Not equal to	6 <> 6	False
3	>	Greater than	7 > 9	False
4	<	Less than	4 < 6	True
5	>=	Greater than or equal to	3 >= 3	True
6	<=	Less than or equal to	7 <= 5	False

7.2.2 Logical Operators

Logical Operator	Order
Not	Highest Precedence
And	Next Precedence
Or	Last Precedence

7.2.3 Order of Operation

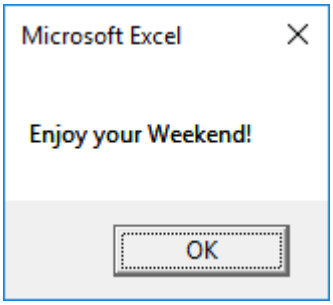
The order of operations for evaluating Boolean expressions is:

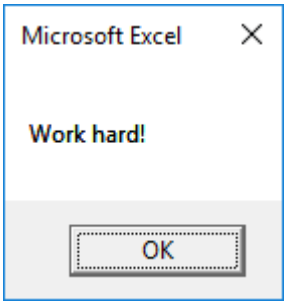
1. Arithmetic Operators
   - Parenthesis
   - Exponentiation
   - Division and multiplication
   - Addition and subtraction
2. Relational Operators
3. Logical Operators
   - Not
   - And
   - Or

7.2.4 Example

```
Sub IfThenElseDemo( )
   If Weekday(Now(), 2) = 6 Or Weekday(Now(), 2) = 7 Then
       MsgBox ("Enjoy your Weekend!")
    Else
       MsgBox ("Work hard!")
    End If
End Sub
```

The program will prompt up “Enjoy your weekend!” on Saturday and Sunday, and display “Work hard!” on other days.





7.3 Select Case.....End Select

Normally it is sufficient to use the conditional statement If....Then....Else for multiple options or selections programs. However, if there are too many different cases, the If...Then...Else structure could become too bulky and difficult to debug if problems arise. Fortunately, Visual Basic provides another way to handle complex multiple choice cases, that is, the Select Case.....End Select decision structure. The general format of a Select Case...End Select structure is as follow:

```
Select Case variable
    Case Value1
        Statement1
    Case Value2 To Value3
        Statement2
    Case Else
        Statement3
End Select
```

7.3.1 Check Single Value

The simple select case scenario is checking for single value. In the below example, the code asks the user to enter any number between 1 and 5, and then shows a message box with the number the user entered.

```
Sub CheckNumber1()
    Dim UserInput As Integer

    ' Capture user input
    UserInput = InputBox("Please enter a number between 1 and 5")

    Select Case UserInput
        Case 1
            MsgBox "You entered 1"
        Case 2
            MsgBox "You entered 2"
        Case 3
            MsgBox "You entered 3"
        Case 4
            MsgBox "You entered 4"
        Case 5
            MsgBox "You entered 5"
    End Select
End Sub
```

7.3.2 With Multiple Tests

You're not limited to testing a single value against your expression. You can test multiple values by separating them with commas

```
Sub CheckNumber2()
    Dim UserInput As Integer

    ' Capture user input
    UserInput = InputBox("Please enter a number between 1 and 5")

    Select Case UserInput
        Case 1, 3, 5
            MsgBox "You entered odd number"
        Case 2, 4
            MsgBox "You entered even number"
    End Select
End Sub
```

7.3.3 Using TO Keyword to Define Boundaries

The “To” keyword can be used in Case statement for defining the boundaries of range to test for expression test. In that case, the first value must be less than or equal to the second value.

```
Sub CheckNumber3()
    Dim UserInput As Integer

    ' Capture user input
    UserInput = InputBox("Please enter a number between 1 and 5")

    Select Case UserInput
        Case 1 To 3
            MsgBox "You entered 1-3"
        Case 4 To 5
            MsgBox "You entered 4-5"
    End Select
End Sub
```

7.3.4 Using IS Condition

You can use an IS condition with the Select Case construct to check for the value of numbers. You may use 'Is' keyword with the comparison operator like =, >=, <= etc.

```
Sub CheckNumber4()
    Dim UserInput As Integer

    ' Capture user input
    UserInput = InputBox("Please enter a number between 1 and 5")

    Select Case UserInput
        Case Is < 3
            MsgBox "You entered a number less than 3"
        Case Is >= 3
            MsgBox "You entered a number larger or equal to 3"
    End Select
End Sub
```

7.3.5 Using Case Else to Catch All

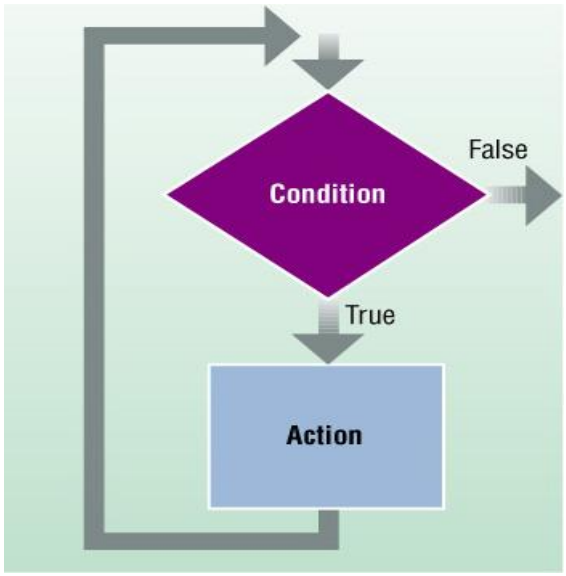
Instead of the second case with a condition, you can also use Case Else. Case Else acts as a catch-all and anything which doesn't fall into any of the previous cases is treated by the Case Else.

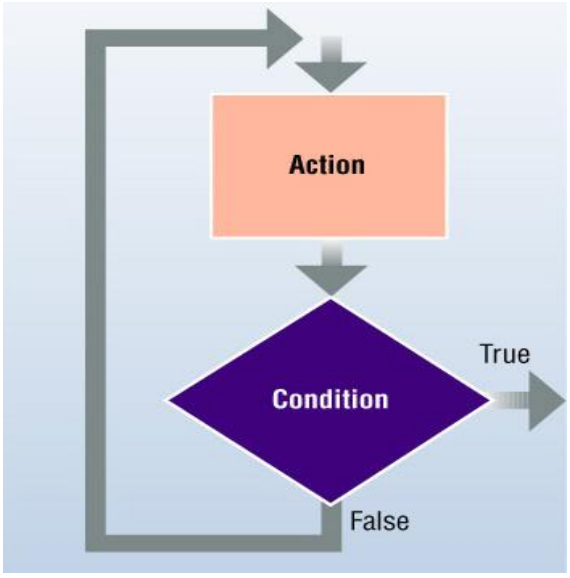
```
Sub CheckNumber5()
    Dim UserInput As Integer

    ' Capture user input
    UserInput = InputBox("Please enter a number between 1 and 5")

    Select Case UserInput
        Case Is <= 5
            MsgBox "You entered a correct number"
        Case Else
            MsgBox "You entered a number outside range"
    End Select
End Sub
```

8. The Iteration Structure

8.1 Overview

Directs computer to repeat one or more instructions until some condition is met. Also referred to as a Loop, Repeating or Iteration





8.2 Do……Loop

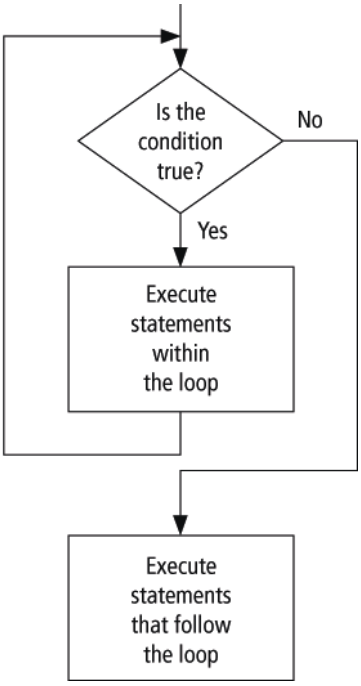
There are four ways you can use the Do Loop as shown below:

Type of Loop	Explanation	Example
Do While … Loop	The Do While ... Loop evaluates the condition, and if the condition is true, then it evaluates the statements following the condition. When it has finished doing this, it evaluates the condition again and if the condition is true, it evaluates the statements again. It continues repeating this process until the condition is false.	**Do While** *condition* *statements* **Loop**
Do Until ... Loop	The Do Until ... Loop is similar to the Do While ... Loop except it keeps evaluating the statements until the condition is true rather than while it is true.	**Do Until** *condition* *statements* **Loop**
Do ... Loop While	The Do ... Loop While evaluates the statements only once. It then evaluates the condition, and if the condition is true, evaluates the statements again. This process continues until the condition is false.	**Do** *statements* **Loop While** *condition*
Do ... Loop Until	Similar to Do ... Loop While except that it evaluates the statements until the condition is true.	**Do** *statements* **Loop Until** *condition*

8.2.1 Pre Test Loops

A loop is one of the most important structures in programming. Used to repeat a sequence of statements a number of times. The Do loop repeats a sequence of statements either as long as or until a certain condition is true.

```
Do While condition is true
   Processing step(s)
Loop
```



Consider the following example:

```
Dim intScore As Integer = 0
Do While intScore < 5
    intScore += 1
Loop
```

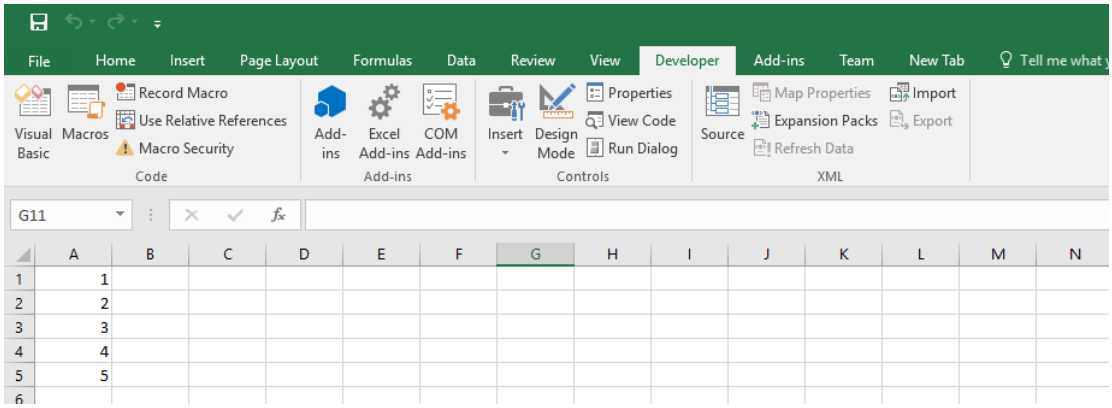
We find that the condition is checked 6 times and 5 execution in the loop.

Loop Iteration	Value of intScore	Result of Condition Tested
1	intScore = 0	True
2	intScore = 1	True
3	intScore = 2	True
4	intScore = 3	True
5	intScore = 4	True
6	intScore = 5	False

8.2.1.1 Do While Loop Example

Five times is executed in the Do While Loop.

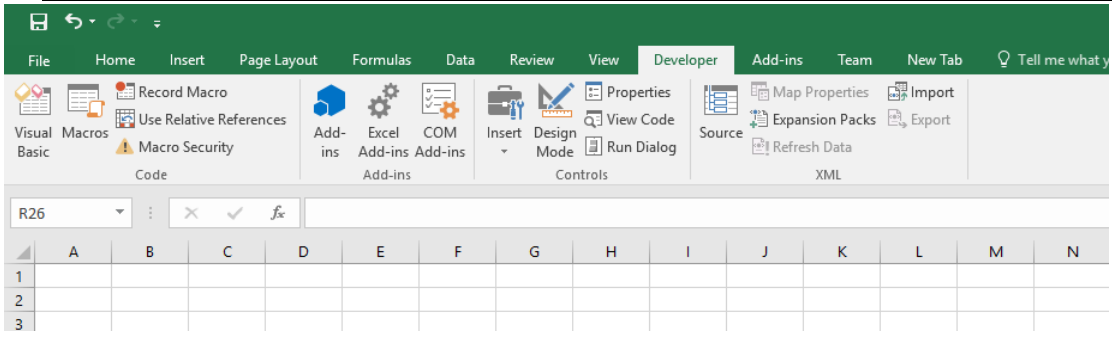
```
Sub DoWhileLoop( )

    Dim counter As Integer


    counter = 0

    Do While counter < 5

        counter = counter + 1

        Cells(counter, 1).Value = counter

    Loop

End Sub
```



8.2.1.2 Do Until Loop Example

No execution in Do Until Loop because the condition is match when enter.

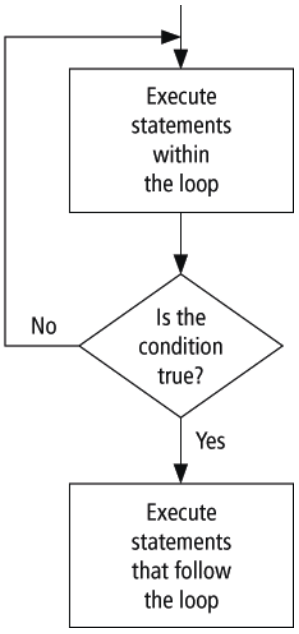
```
Sub DoUntilLoop( )

    Dim counter As Integer


    counter = 0

    Do Until counter < 5

        counter = counter + 1

        Cells(counter, 1).Value = counter

    Loop

End Sub
```



8.2.2 Post Test Loop

A Do statement precedes the sequence of statements, and a Loop statement follows the sequence of statements. The condition, preceded by either the word "While" or the word "Until", follows the word "Do" or the word "Loop". Be careful to avoid infinite loops – loops that never end. VB allows for the use of either the While keyword or the Until keyword at the top or the bottom of a loop.

```
Do
  statement(s)
Loop Until condition is true
```



Consider the following example:

```
22          Dim intScore As Integer = 0
23          Do
24              intScore = intScore + 1
25          Loop While intScore < 5
```

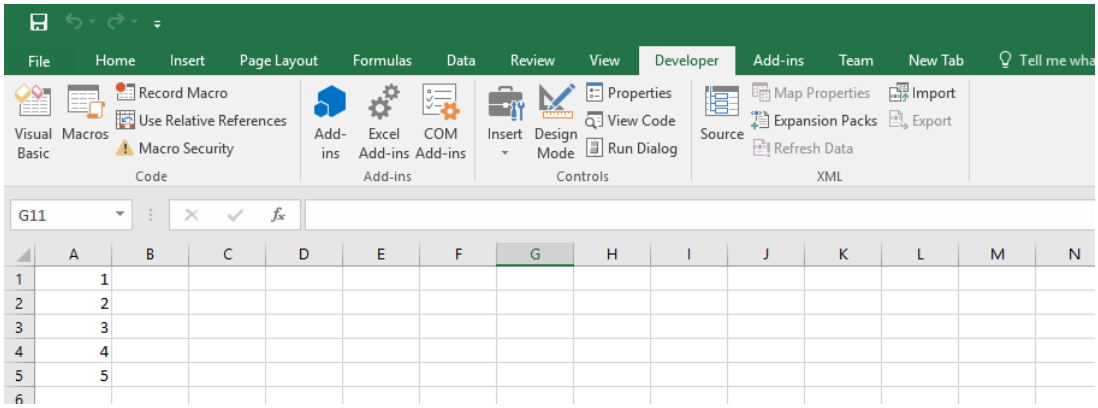
We find that the condition is executed 5 times in the loop.

Loop Iteration	Value of intScore at Start of the Loop	Value of intScore When Checked	Result of Condition Tested
1	intScore = 0	intScore = 1	True
2	intScore = 1	intScore = 2	True
3	intScore = 2	intScore = 3	True
4	intScore = 3	intScore = 4	True
5	intScore = 4	intScore = 5	False

8.2.2.1 Do Loop While Example

Five times is executed in the Do Loop While.

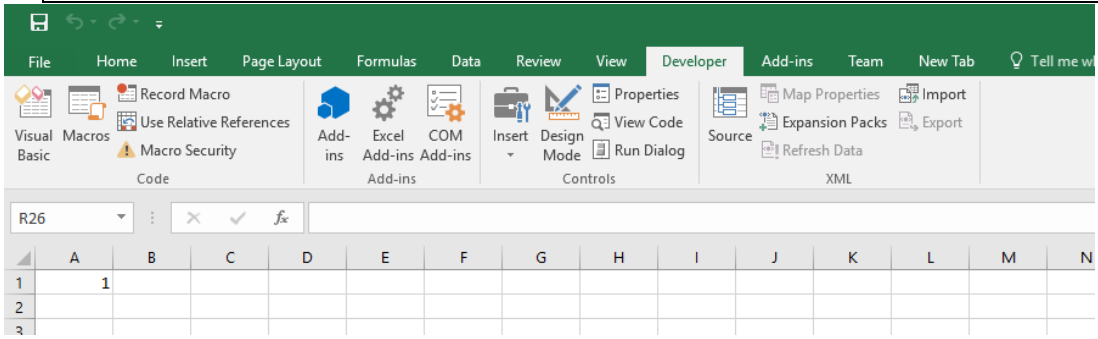
```
Sub DoLoopWhile( )

    Dim counter As Integer


    counter = 0

    Do

        Cells(counter, 1).Value = counter

        counter = counter + 1

    Loop While counter < 5

End Sub
```



8.2.2.2 Do Loop Until Example

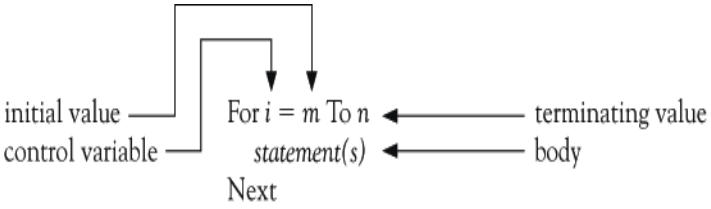
One times is executed in the Do Loop Until.

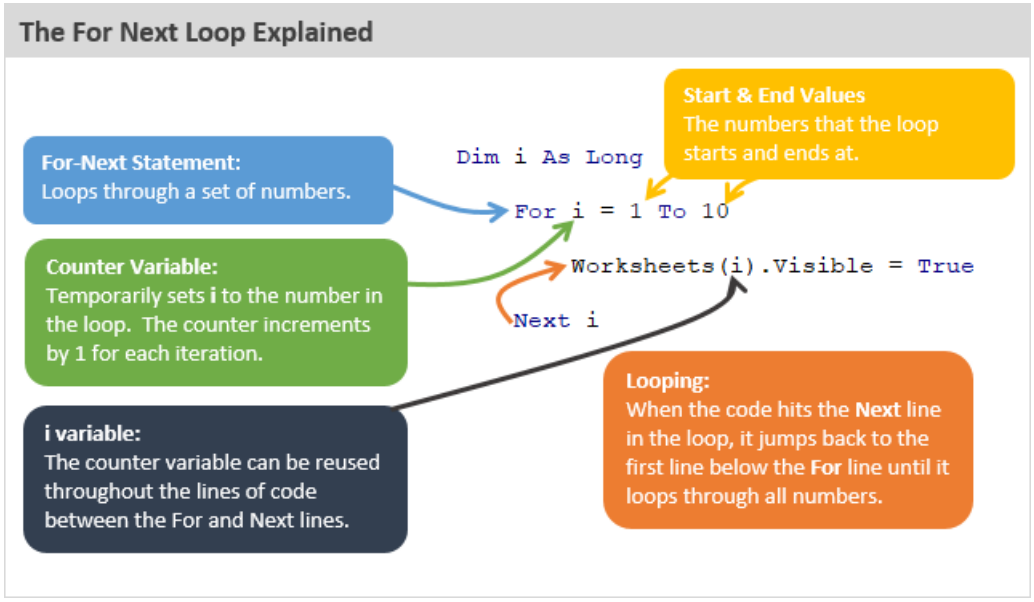
```
Sub DoLoopUntil()

    Dim counter As Integer


    counter = 0

    Do

        counter = counter + 1

        Cells(counter, 1).Value = counter

    Loop Until counter < 5

End Sub
```



8.3 For……Next Loop

You can use a For...Next loop when a section of code is to be executed an exact number of times. For…Next loops enable you to evaluate a sequence of statements multiple times. For and Next statements must be paired and a counter is used to control the loop





8.3.1 Single Loop

The simplest implementation of the FOR loop is to use the FOR...NEXT statement to create a single loop. This will allow you to repeat VBA code a fixed number of times.

Consider the following example:

```
For intNumber = 1 To 4
    'Body of loop
Next
```

Loop Iteration	Value of intNumber	Process
1	`intNumber = 1`	Executes the code inside the loop
2	`intNumber = 2`	Executes the code inside the loop
3	`intNumber = 3`	Executes the code inside the loop
4	`intNumber = 4`	Executes the code inside the loop
5 (exits the loop)	`intNumber = 5`	The control variable value exceeds the ending value, so the application exits the For...Next loop. This means the statement(s) following the Next command are executed.

8.3.1.1 Example: Add First 10 Number

Below is the code that will add the first 10 positive integers using a For Next loop. It will then display a message box showing the sum of these numbers. In this code, the value of Total is set to 0 before getting into the For Next loop. Once it gets into the loop, it holds the total value after every loop. So after the first loop, when counter is 1, 'Total' value becomes 1, and after the second loop it becomes 3 (1+2), and so on. And finally, when the loop ends, 'Total' variable has the sum of the first 10 positive integers.

```
Sub AddNumbers()
    Dim Total As Integer    ' Variable for Total
    Dim i As Integer        ' Variable for Looping

    ' Initialize the Total
    Total = 0

    ' Calculate the total from 1 to 10
    For i = 1 To 10
        Total = Total + i
    Next i

    ' Display the Total
    MsgBox (Total)
End Sub
```

8.3.2 Stepping

By default, the FOR loop will increment its loop counter by 1, but this can be customized. You can use STEP increment to change the value used to increment the counter. The FOR loop can be increment can be either positive or negative values. When you increment by a negative value, you need the starting number to be the higher value and the ending number to be the lower value, since the FOR loop will be counting down.

8.3.2.1 Example: Add Odd Number between 1 to 10

To sum the odd positive integers between 1 to 10 (i.e, 1, 3, 5, 7 and 9), you need a similar code with a condition to only consider the even numbers and ignore the odd numbers. When you use 'Step 2', it tells the code to increment the count value by 2 every time the loop is run. So the count value starts from 1 and then becomes 3, 5, 7, 9 as the looping occurs.

```
Sub AddEvenNumbers()
    Dim Total As Integer    ' Variable for Total
    Dim i As Integer        ' Variable for Looping

    ' Initialize the Total
    Total = 0
```

```
    ' Calculate the total from 1 to 10 (Odd Number only)
    For i = 1 To 10 Step 2
        Total = Total + i
    Next i

    ' Display the Total
    MsgBox (Total)
End Sub
```

8.3.3 Double Loop

To be able to fill up a range of values across rows and columns, we can use the nested loops, or loops inside loops.

In this example, when i=1, the value of j will iterate from 1 to 5 before it goes to the next value of i, where j will iterate from I to 5 again. The loops will end when i=10 and j=5. In the process, it sums up the corresponding values of i and j.

```
Sub FoxNextLoop()
    Dim i, j As Integer     ' Variable for looping

    For i = 1 To 10
        For j = 1 To 5
            Cells(i, j).Value = i & j
        Next j
    Next i
End Sub
```

The concept can be illustrated in the table below:

j / i	1	2	3	4	5
1	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
2	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
3	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
4	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)
5	(5, 1)	(5, 2)	(5, 3)	(5, 4)	(5, 5)
6	(6, 1)	(6, 2)	(6, 3)	(6, 4)	(6, 5)
7	(7, 1)	(7, 2)	(7, 3)	(7, 4)	(7, 5)
8	(8, 1)	(8, 2)	(8, 3)	(8, 4)	(8, 5)
9	(9, 1)	(9, 2)	(9, 3)	(9, 4)	(9, 5)
10	(10, 1)	(10, 2)	(10, 3)	(10, 4)	(10, 5)

8.3.4 The For Each Loop

The For Each loop is similar to the For ... Next loop but, instead of running through a set of values for a variable, the For Each loop runs through every object within a set of objects.

Example: Count the number of Worksheet

8.3.4.1 Example: Find all worksheet

For example, the following code shows the For Each loop used to list every Worksheet in the current Excel Workbook:

```
Sub FindWorksheet()
    Dim ws As Worksheet     ' Declare a Worksheet object

    ' Loop through all worksheets
    For Each ws In Worksheets
        MsgBox "Found Worksheet: " & ws.Name
    Next ws
End Sub
```

8.3.5 The Exit For Statement

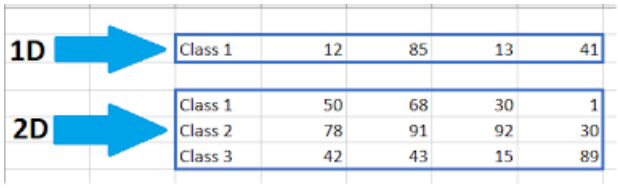
If, you want to exit a 'For' Loop early, you can use the Exit For statement. This statement causes VBA to jump out of the loop and continue with the next line of code outside of the loop. For example, when searching for a particular value in an array, you could use a loop to check each entry of the array. However, once you have found the value you are looking for, there is no need to continue searching, so you exit the loop early.

```
Sub FindDay()
    Dim i As Integer    ' Variable for looping

    ' Loop through 1 to 31
    For i = 1 To 31
        ' Compare counter and Day
        If i = Day(Now()) Then
            Exit For
        End If
    Next i

    ' Display the number for stop
    MsgBox ("Stop at " & i)
End Sub
```

9. Array

9.1 Overview

A VBA array is a type of variable. It is used to store lists of data of the same type. An example would be storing a list of countries or a list of weekly totals.



9.1.1 Declare Array

An array is a way to store more than one value under the same name. The only difference between declaring a variable to be an array and declaring an ordinary variable is the round brackets after the variable name. An array looks like this when it is declared:

```
Dim MyArray(5) As String
```

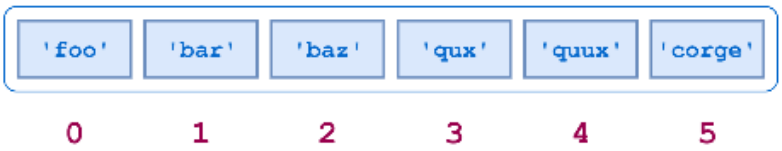
The variable name is MyArray. A pair of round brackets follows the variable name. VBA takes this to mean that you want to set up an array. The number of values you want to store using your variable name is typed between the round brackets. However, one important point to bear in mind is that the first position in the array is 0. So the above array can actually hold 6 values, 0 to 5.

9.1.2 Assign Value to Array

To place a value in an array position you do it like this:

```
MyArray(0) = "Foo"
MyArray(1) = "bar"
MyArray(2) = "baz"
MyArray(3) = "quz"
MyArray(4) = "quux"
MyArray(5) = "corge"
```

The array position 0 has a value of “foo”, array position 1 has a value of “bar”, and so on.



To get back a value from array, it's just like any other variable: put it on the right of an equal sign:

```
Dim MyVariable As String


MyVariable = MyArray(1)
```

Notice that you still need the round brackets with a position number between them. The line above will store whatever value is at position 1 in the array into the variable to the left of the equal sign.

9.2 Type of Arrays

There are two types of arrays in VBA

- Static – an array of fixed size.
- Dynamic – an array where the size is set at run time.

9.2.1 Static Array

The size is specified when you declare a static array. The problem with this is that you can never be sure in advance the size you need. Each time you run the VBA program you may have different size requirements. If you do not use all the array locations then the resources are being wasted. If you need more locations you can use ReDim but this is essentially creating a new static array.

A static array is declared as follows:

```
' Create an static array with locations 0,1,2,3
Dim StaticArray1(0 To 3) As String


' Create an static array with locations 0,1,2,3
Dim StaticArray2(3) As String
```

9.2.2 Dynamic Array

The dynamic array is not allocated until you use the ReDim statement. The advantage is you can wait until you know the number of items before setting the array size. With a static array you have to give the size up front. To give an example. Imagine you were reading worksheets of student marks. With a dynamic array you can count the students on the worksheet and set an array to that size. With a static array you must set the size to the largest possible number of students.

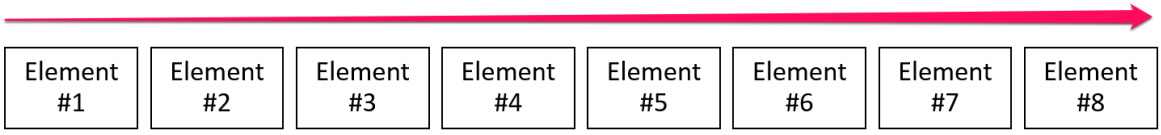
A dynamic array is declared as follows:

```
' Create an dynamic array
Dim DynamicArray1() As String


' Create array with locations 0,1,2,3
ReDim StaticArray2(0 To 3)
```

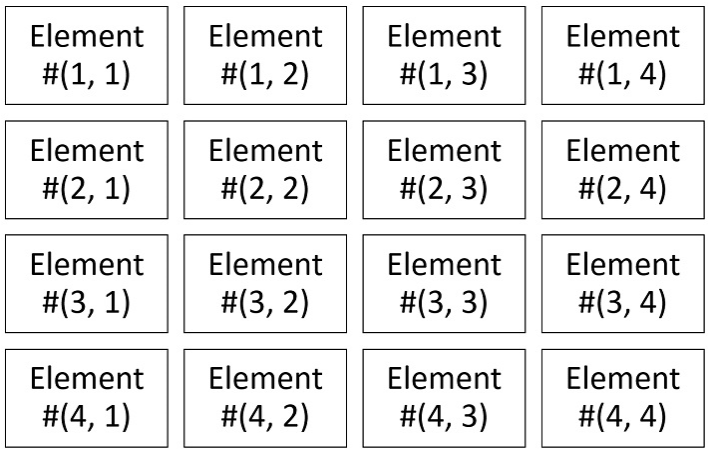
9.3 Multi-Dimension Array

Arrays are not just limited to a single dimension, however, they can have a maximum of 60 dimensions. In practice you'll usually work with (maximum) 2 or 3 dimensional arrays. Two-dimensional arrays are the most commonly used ones.

In order to understand what a dimension is, let's take a look at the simplest case: a one-dimensional array. One-dimensional arrays can be visualized as a single line of items. The following image shows an illustration of an 8-element one-dimensional array.



If you add an additional dimension, you have a two-dimensional array. You can think of such an array as a grid where the elements are arranged in rows and columns. The following image illustrates a two-dimensional array with 16 elements organized in 4 rows and 4 columns.



A multi-dimensional array is also declared using the Dim statement, and the assignment is the same as one dimensional array.

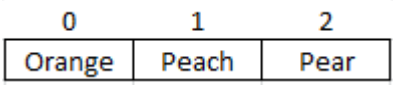
```
' Create a 2-dimensional array
Dim MultiArray(1, 2) As String


' Assign values to 2-dimensional array
MultiArray(0, 0) = "00"
MultiArray(0, 1) = "01"
MultiArray(0, 2) = "02"
MultiArray(1, 0) = "10"
MultiArray(1, 1) = "11"
MultiArray(1, 2) = "12"
```

9.4 Using the Array and Split function

You can use the Array function to populate an array with a list of items. You must declare the array as a type Variant. The following code shows you how to use this function.

```
' Create a Variant
Dim arr1 As Variant


' Create an array by populate a list of items
arr1 = Array("Orange", "Peach", "Pear")
```

The array created by the Array Function will start at index zero unless you use Option Base 1 at the top of your module. Then it will start at index one. In programming it is generally considered poor practice to have your actual data in the code. However sometimes it is useful when you need to test some code quickly.



The Split function is used to split a string into an array based on a delimiter. A delimiter is a character such as a comma or space that separates the items. The Split function is normally used when you read from a comma separated file or another source that provides a list of items separated by the same character.

```
' Declare a string and list of items
Dim s As String
s = "Red, Yellow, Green, Blue"

' Split the list into array
Dim arr() As String
arr = Split(s, ",")
```

This statement split the string s into array as follow:

0	1	2	3
Red	Yellow	Green	Blue

9.5 Using Erase Function

The Erase function can be used on arrays but performs differently depending on the array type.

- For a static Array the Erase function resets all the values to the default. If the array is of integers, then all the values are set to zero. If the array is of strings, then all the strings are set to “” and so on.
- For a Dynamic Array the Erase function DeAllocates memory. That is, it deletes the array. If you want to use it again you must use ReDim to Allocate memory.

In the following example, we use Erase after setting the values. When the value are printed out they will all be zero.

```
' Declare an array
Dim SampleArray(2) As String

' Assign value to array
SimpleArray(1) = '1'
SimpleArray(2) = '2'

' Erase all content
Erase SimpleArray

' Print the content
For i = 1 to 2
    MsgBox(SimpeArray(i))
Next i
```

9.6 ReDim with Preserve

If we use ReDim on an existing array, then the array and its contents will be deleted. In the following example, the second ReDim statement will create a completely new array. The original array and its contents will be deleted.

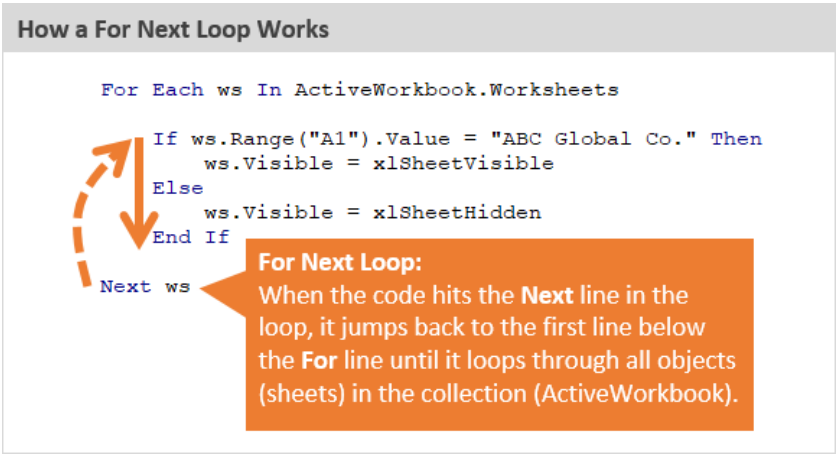
```
' Declare an array
Dim SampleArray(2) As String


' Assign value to array
SimpleArray(1) = '1'


' Erase all content
ReDim SimpleArray(5)


' Print the content
MsgBox(SimpeArray(1))
```

If we want to extend the size of an array without losing the contents, we can use the Preserve keyword.

```
' Declare an array
Dim SampleArray(2) As String


' Assign value to array
SimpleArray(1) = '1'


' Erase all content
ReDim Preserve SimpleArray(5)


' Print the content
MsgBox(SimpeArray(1))
```

9.7 Using the For Each Loop

Using a For Each is neater to use when reading from an array.



```
' Declare an array
Dim SampleArray(2) As String


' Assign value to array
SimpleArray(0) = '0'
SimpleArray(1) = '1'
SimpleArray(2) = '1'


' Loop all item in Array
For Each item In SampleArray
     ' Print the content
     MsgBox(SimpeArray(1))
Next item
```

9.8 Array Methods

There are various inbuilt functions which help the developers to handle arrays effectively. All the methods that are used in conjunction with arrays are listed below.

Function	Description
LBound	Returns an integer that corresponds to the smallest subscript of the given arrays
UBound	Returns an integer that corresponds to the largest subscript of the given arrays.
Split	Returns an array that contains a specified number of values. Split based on a delimiter.
Join	Returns a string that contains a specified number of substrings in an array. This is an exact opposite function of Split Method
Filter	Returns a zero based array that contains a subset of a string array based on a specific filter criteria.
IsArray	Returns a boolean value that indicates whether or not the input variable is an array.
Erase	Recovers the allocated memory for the array variables.

10. Sub Procedure and Function

10.1 Overview

A procedure is a block of code that performs certain tasks. We have actually learned about VBA procedures in our previous chapters, but all of them are event procedures. Event procedures are VBA programs that are associated with VBA objects such as command buttons, checkboxes, and radio buttons. However, we can also create procedures that are independent from the event procedures. They are normally called into the event procedures to perform certain tasks. There are two types of the aforementioned procedures, namely Functions and Sub Procedures.

10.2 Sub Procedure

10.2.1 Defining Procedure

A sub procedure is an assignment that is carried but does not give back a result. To create a sub procedure, start with the Sub keyword followed by a name. The name of a procedure is always followed by parentheses. At the end of the sub procedure, you must type End Sub. Therefore, the primary formula to create a sub procedure is:

```
Sub ProcedureName( arguments )
    Statements
End Sub
```

The name of a procedure should follow the same rules we learned to name the variables. Moreover, you should following the best practice:

- If the procedure performs an action that can be represented with a verb, you can use that verb to name it. Here are examples: show, display
- To make the name of a procedure stand, you should start it in uppercase. Examples are Show, Play, Dispose, Close
- You should use explicit names that identify the purpose of the procedure. If a procedure would be used as a result of another procedure or a control's event, reflect it on the name of the sub procedure. Examples would be: afterupdate, longbefore.
- If the name of a procedure is a combination of words, you should start each word in uppercase. An example is AfterUpdate

In the body of the procedure, you carry the assignment of the procedure. It is also said that you define the procedure or you implement the procedure.

10.2.2 Calling Procedure

Once you have a procedure, whether you created it or it is part of the Visual Basic language, you can use it. Using a procedure is also referred to as calling it. Before calling a procedure, you should first locate the section of code in which you want to use it. To call a simple procedure, type its name. Besides using the name of a procedure to call it, you can also precede it with the **Call** keyword.

```
Sub main()
    Call Format_Centered_And_Sized( arg1, arg2, ... )
End Sub
```

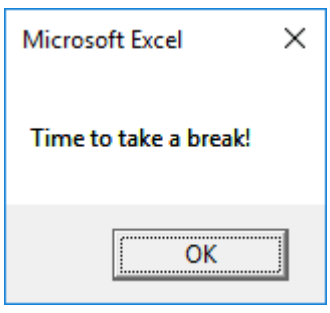
10.2.3 Procedures and Access Levels

Like a variable access, the access to a procedure can be controlled by an access level. A procedure can be made private or public. To specify the access level of a procedure, precede it with the Private or the Public keyword. The rules that were applied to global variables are the same:

Private	• If a procedure is made private, it can be called by other procedures of the same module. Procedures of outside modules cannot access such a procedure. • Also, when a procedure is private, its name does not appear in the Macros dialog box
Public	• A procedure created as public can be called by procedures of the same module and by procedures of other modules. • Also, if a procedure was created as public, when you access the Macros dialog box, its name appears and you can run it from there

10.2.4 Example

```
Sub ProcedureDemo()
    Call CreateBeep (2)
    Call PopupMessage
End Sub

Sub CreateBeep(NumberOfSound)
    Dim counter As Integer

    For counter = 1 To NumberOfSound
        Beep
    Next counter
End Sub

Sub PopupMessage()
    MsgBox "Time to take a break!"
End Sub
```



10.3 Functions

10.3.1 Overview

Like a sub procedure, a function is used to perform an assignment. The main difference between a sub procedure and a function is that, after carrying its assignment, a function gives back a result. We also say that a function "returns a value". There are two types of Excel VBA functions; the built-in functions and the user defined functions. We can use built-in functions in Excel for automatic calculations.

Some of the Excel VBA built-in functions are Sum, Average, Min, Max, Mode, Median and more. However, built-in functions can only perform some basic calculations, for more complex calculations, user-defined functions are often required. User-defined functions are procedures created independently from the event procedures. A Function can receive arguments passed to it from the event procedure and then return a value in the function name. It is usually used to perform certain calculations.

10.3.2 Defining Function

To create a function, you use the **Function** keyword followed by a name and parentheses. Unlike a sub procedure, because a function returns a value, you must specify the type of value the function will produce. To give this information, on the right side of the closing parenthesis, you can type the **As** keyword, followed by a data type. To indicate where a function stops, type **End Function**. Based on this, the minimum syntax used to create a function is:

```
Function FunctionName( parameter ) As DataType
    Statements
End Function
```

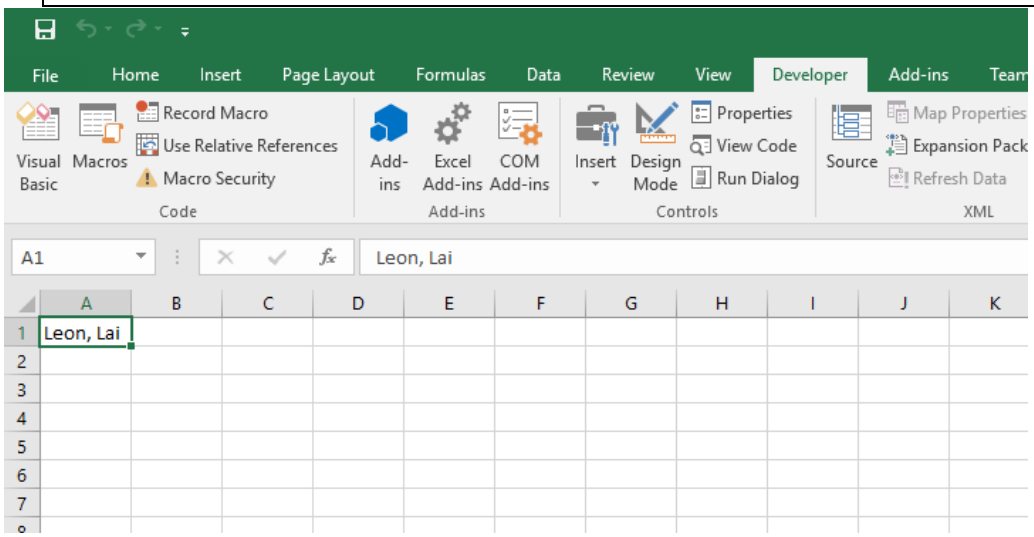
10.3.3 Using a Type Character

As done with variables, you can also use a type character as the return type of a function and omit the As DataType expression. The type character is typed on the right side of the function name and before the opening parenthesis. An example would be GetFullName$(). As with the variables, you must use the appropriate type character for the function:

Type Character	The function must return
$	A string
%	An integral value between -32768 and 32767
&	An integer of small or large scale
!	A decimal number with single precision -3.402823E38 to 1.401298E45
#	A decimal number with double precision -1.79769313486232E308 to -4.94065645841247E-324, 4.94065645841247E-324 to 1.79769313486232E308
@	A monetary value (Currency)

10.3.4 Example

```
Sub FunctionDemo()
    Dim FullName$

    FullName = GetFullName()
    ActiveCell.FormulaR1C1 = FullName
End Sub

Function GetFullName$()
    Dim FirstName, LastName As String

    FirstName = "Leon"
    LastName = "Lai"

    GetFullName = FirstName & ", " & LastName
End Function
```



10.4 Passing Parameters to Function/Procedure

10.4.1 Overview

When an external value is to be used by a procedure to perform an action, it is passed to the procedure by variables. These variables which are passed to a procedure are called arguments. An argument is the value supplied by the calling code to a procedure when it is called. When the set of parentheses, after the procedure name in the Sub or Function declaration statement, is empty, it is a case when the procedure does not receive arguments. However, when arguments are passed to a procedure from other procedures, then these are listed or declared between the parentheses.

10.4.2 Argument Data Types

It is usual to declare a data type for arguments passed to a procedure and if not specified, the default data type is variant

```
Function CalculationTotal(Quantity as Integer, Price as Double) as Double
    CalculationTotal = Quantity * Price
End Function
```

10.4.3 Passing Arguments by Value

When you pass an argument by value in a procedure, only a copy of a variable is passed and any change in the value of the variable in the current procedure will not affect or change the variable in its original location because the variable itself is not accessed. To pass an argument by value, use the **ByVal** keyword before the argument to its left.

```
Function ByValFunction(ByVal i As Integer) As Long
     'Passing an argument by value in a procedure using the ByVal keyword
     i = 5
     number = i
End Function


Sub ByValDemo()
     'value of the variable n is set to 0 when it is declared:
     Dim n As Integer

     'the message returned is 5.
     'the number function is called here which assigns value to the variable n.
     'Because the variable was passed by value in the function, any change in the
     'value of the variable is only in the current function and after the function
     'ends the value of the variable n will revert to the value when it was
     'declared where it was set to 0. If the variable had been passed by reference
     'in the function, then the variable n would have permanently assumed the new
     'assigned value.
     MsgBox ByValFunction(n)

     'message returned is 0, because after the number function ends the value of
     'the variable n reverts to the value when it was declared where it was set
     'to 0
     MsgBox n
End Sub
```

10.4.4 Passing Arguments by Reference

When you pass an argument by reference in a procedure, the variable itself is accessed by the procedure in its location or address in memory. The value of the variable is changed permanently by the procedure in this case. To pass an argument by reference, use the **ByRef** keyword before the argument to its left. Passing arguments by reference is also the default in VBA, unless you explicitly specify to pass an argument by value.

```
Function ByRefFunction(ByVal i As Integer) As Long
    'Passing an argument by reference in a procedure using the ByRef keyword
    i = 5
    number = i
End Function

Sub ByRefDemo()
    'value of the variable n is set to 0 when it is declared:
    Dim n As Integer

    'message returned is 5 because calling the number1 function, assigns value to
    'the variable n
    MsgBox ByRefFunction(n)

    'message returned is 5, because the variable has been passed by reference in
    'the number1 function, and the variable n has permanently assumed the new
    'assigned value by calling the number1 function in the preceding line of code
    MsgBox n
End Sub
```

10.4.5 Optional Arguments

Arguments can be specified as Optional by using the Optional keyword before the argument to its left. When you specify an argument as Optional, all other arguments following that argument to its right must also be specified as Optional. Note that specifying the Optional keyword makes an argument optional otherwise the argument will be required.

The Optional argument should be (though not necessary) declared as Variant data type to enable use of the IsMissing function which works only when used with variables declared as Variant data type. The IsMissing function is used to determine whether the optional argument was passed in the procedure or not and then you can adjust your code accordingly without returning an error. If the Optional argument is not declared as Variant in which case the IsMissing function will not work, the Optional argument will be assigned the default value for its data type which is 0 for numeric data type variables (viz. Integer, Double, etc) and Nothing (a null reference) for String or Object data type variables.

```
Sub OptionalVariable(Optional firstName As String, Optional secondName As String)
    'The declaration of the sub-procedure contains two arguments,
    'both specified as Optional.
    ActiveSheet.Range("A1") = firstName
    ActiveSheet.Range("B1") = secondName
End Sub

Sub OptionDemo()
    Dim strName1 As String
    Dim strName2 As String

    strName1 = InputBox("Enter First Name")
    strName2 = InputBox("Enter Second Name")

    Call OptionalVariable(strName1, strName2)
End Sub
```

10.4.6 Pass an Arbitrary or Indefinite Number of Arguments - Parameter Arrays (ParamArray)

By using the ParamArray keyword you will be allowed to pass an arbitrary number of arguments to the procedure so that the procedure will accept an indefinite number of arguments or no argument at all. Use a ParamArray when you are not sure of the precise number of arguments to pass in a procedure at the time you define it. It might be convenient to create an optional array (ie. a ParamArray) than going through the hassle of declaring a large number of optional arguments, and then using the IsMissing function with each of them.

A procedure uses information in the form of variables, constants & expressions to perform actions whenever it is called. The procedure's declaration defines a parameter which allows the calling code (code which calls the procedure) to pass an argument or value to that parameter so that every time the procedure is called the calling code may pass a different argument to the same parameter. A Parameter is declared like a variable by specifying its name and data type. By declaring a parameter array, a procedure can accept an array of values for a parameter. A parameter array is so defined by using the ParamArray keyword.

Only one ParamArray can be defined in a procedure and it is always the last parameter in the parameter list. A ParamArray is an optional parameter and it can be the only optional parameter in a procedure and all parameters preceding it must be required. ParamArray should be declared as an array of Variant data type. Irrespective of the Option Base setting for the module, LBound of a ParamArray will always be 0 ie. index values for the array will start from 0. ByVal, ByRef or Optional keywrods cannot be used with ParamArray.

Define a procedure to accept an indefinite number of arguments or values ie. a parameter array: Use the ParamArray keyword to precede the parameter name, which must be the last parameter in the procedure declaration. An empty pair of parentheses should follow the parameter array name to be declared as a Variant data type with the customary As clause. Do not specify a default value after the As clause.

To access a parameter array's value: use the UBound function to determine the array length which will give you the number of elements or index values in the array. In the procedure code you can access a parameter array's value by typing the array name followed by an index value (which should be between 0 and UBound value) in parantheses

```
Sub addNums(ParamArray numbers() As Variant)
    'a procedure declaration that allows to pass an arbitrary number of arguments
    'to the procedure using a ParamArray parameter.
    Dim lSum As Long
    Dim i As Long

    'LBound of a ParamArray is always 0. Each element of the ParamArray is added
    'here:
    For i = LBound(numbers) To UBound(numbers)
        lSum = lSum + numbers(i)
    Next i

    MsgBox lSum
End Sub

Sub getAddNums()
    'you can pass an arbitrary or indefinite number of arguments in a procedure
    'using ParamArray:
    Call addNums(22, 25, 30, 40, 55)
End Sub
```

11. Common Build-in Functions

11.1 Mathematical Functions

The Excel Math Functions perform many of the common mathematical calculations, including basic arithmetic, conditional sums & products, exponents & logarithms, and the trigonometric ratios

11.1.1 Abs

In Excel VBA, the Abs function returns the absolute value (positive value) of a given number. The syntax is **Abs(** ***Number*** **)**.

- E.g. Abs(-20) returns the value 20;
  Abs(20) returns the value 20.

11.1.2 Sqr

If supplied with numeric value, the Sqr function returns the square root of that value.

- E.g. Sqr(4) returns the value 2

11.1.3 Rnd

The Rnd function returns a random value between 0 and 1.Rnd is very useful when we deal with the concept of chance and probability. The syntax is: **Rnd**.

- E.g. Int(Rnd() * 10) return the value between 0 and 1.

11.2 Rounding Function

Unlike formatting options that change only the display value, rounding functions alter the actual value in a cell. Below you will find a list of functions specially designed for performing different types of rounding in Excel.

11.2.1 Round

Round is the function that rounds up a number to a certain number of decimal places. The Format is **Round (** ***n*****,** ***m*** **)** which means to round a number n to m decimal places.

- E.g. Round (1.234, 2) = 1.23
  Round (56.789, 2) = 56.79
  Round (-1.234, 2) = -1.23
  Round (-56.789, 2) = -56.79

11.2.2 RoundUp

RoundUp is the function round the number upward to the specified number of digits. The Format is **RoundUp (** ***n*****,** ***m*** **)** which means to round upward a number n to m decimal places.

- E.g. RoundUp (1.234, 2) = 1.24
  RoundUp (56.789, 2) = 56.79
  RoundUp (-1.234, 2) = -1.24
  RoundUp (-56.789, 2) = -56.79

11.2.3 RoundDown

RoundDown is the function that round the number downward to the specified number of digits. The Format is **RoundDown (*n*, *m*)** which means to round downward a number n to m decimal places.

- E.g. RoundDown (1.234, 2) = 1.23
  RoundDown (56.789, 2) = 56.78
  RoundDown (-1.234, 2) = -1.23
  RoundDown (-56.789, 2) = -56.78

11.2.4 Int

Int is the function that converts a number into an integer by truncating its decimal part and the resulting integer is the largest integer that is smaller than the number. The syntax is **Int(*Number*)**.

- E.g. Int(2.4) return 2;
  Int(0.1) return 0;
  Int(-0.1) return -1;
  Int(-2.4) return -3

11.2.5 Fix

Fix and Int are the same if the number is a positive number as both truncate the decimal part of the number and return an integer. However, when the number is negative, it will return the smallest integer that is larger than the number. The syntax is: **Fix(*number*)**.

- E.g. Fix(2.4) return 2;
  Fix(0.1) return 0;
  Fix(-0.1) return 0;
  Fix(-2.4) return -2

11.3 String Handling Functions

Excel VBA handles strings similar to the stand-alone Visual Basic program. All the string handling functions in Visual Basic such as Left, Right, Instr, Mid and Len can be used in Excel VBA. Some of the common string handling functions are listed and explained below:

11.3.1 InStr

InStr is a function that looks for the position of a substring in a phrase.
The syntax is **Instr(*String*, *Phase*)**.

- E.g. InStr("Visual Basic","ual") will find the substring "ual" from "Visual Basic" and then return its position; in this case, it is 4th from the left.

11.3.2 Left

Left is a function that extracts characters from a phrase, starting from the left. The syntax is **Left(*String*, *Length*)**.

- E.g. Left("Phrase", 4) return “Phra” because four characters are extracted from the phrase, starting from the leftmost position.

11.3.3 Right

Right is a function that extracts characters from a phrase, starting from the Right. The syntax is **Right(** ***String*****,** ***Length*** **)**.

- E.g. Right("Phrase", 3) return "ase" because 3 characters are extracted from the phrase, starting from the rightmost position.

11.3.4 Mid

Mid is a function that extracts a substring from a phrase, starting from the position specified by the second parameter in the bracket. The syntax is **Mid(** ***String*****,** ***Position*****,** ***Length*** **)**.

- E.g. Mid("Phrase", 2, 3) return "hra" because a substring of three characters are extracted from the phrase, starting from the 2nd position from the left.

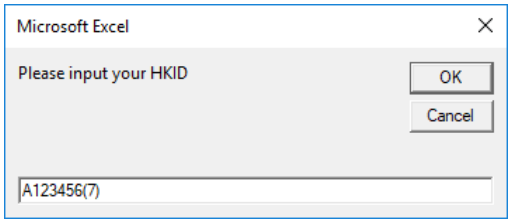
11.3.5 Len

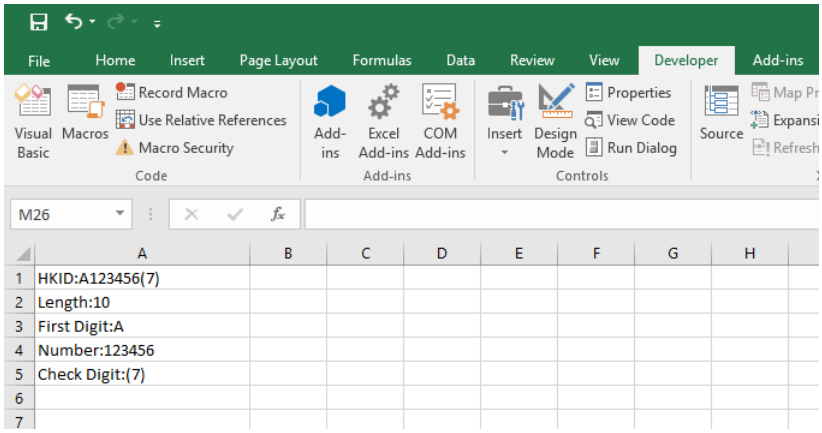
Len is a function that returns the length of a phrase. The syntax is **Len(** ***String*** **)**

- E.g. Len("Phase") return the value of 5.

11.3.6 Example

```
Sub StringDemo( )

    Dim UserInput As String


    UserInput = InputBox("Please input your HKID")

    Worksheets(1).Range("A1").Value = "HKID:" & UserInput

    Worksheets(1).Range("A2").Value = "Length:" & Len(UserInput)

    Worksheets(1).Range("A3").Value = "First Digit:" & Left(UserInput, 1)

    Worksheets(1).Range("A4").Value = "Number:" & Mid(UserInput, 2, 6)

    Worksheets(1).Range("A5").Value = "Check Digit:" & Right(UserInput, 3)

End Sub
```





11.4 Date and Time Functions

Excel VBA can be programmed to handle Date and Time, adding extra capabilities to time and date handling by MS Excel. We can use various built-in date and time handling functions to program Excel VBA date and time manipulating programs.

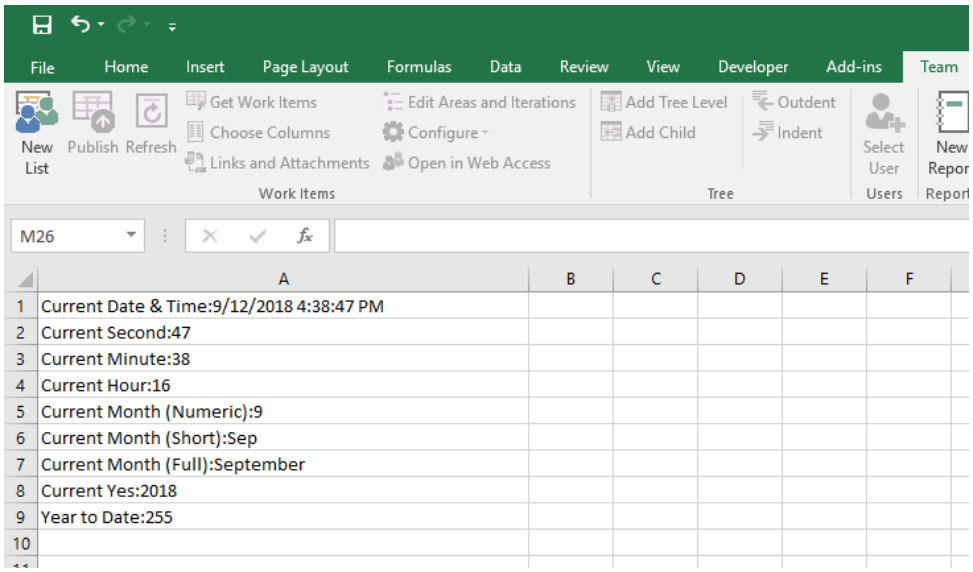
11.4.1 Now( )

The Now() function returns the current date and time according to your computer's regional settings. We can also use the Format function in addition to the function Now to customize the display of date and time using the syntax **Format(Now, "*style argument*")**. The usage of Now and Format functions are explained in the table below:

Formatting with various Style Arguments	Output
Format(Now, "s")	Current Time in seconds
Format(Now, "n")	Current Time in minutes
Format(Now, "h")	Current Time in hours
Format(Now, "m")	Current Month in numeric form
Format(Now, "mmm")	Current Month in short form
Format(Now, "mmmm")	Current Month in full name
Format(Now, "y")	Number of days to date in current year (YTD)
Format(Now, "yy")	Current Year

11.4.1.1 Example

```
Sub NowDemo()
    Worksheets(1).Range("A1").Value = "Current Date & Time:" & Now()
    Worksheets(1).Range("A2").Value = "Current Second:" & Format(Now, "s")
    Worksheets(1).Range("A3").Value = "Current Minute:" & Format(Now, "n")
    Worksheets(1).Range("A4").Value = "Current Hour:" & Format(Now, "h")
    Worksheets(1).Range("A5").Value = "Current Month (Numeric):" & Format(Now, "m")
    Worksheets(1).Range("A6").Value = "Current Month (Short):" & Format(Now, "mmm")
    Worksheets(1).Range("A7").Value = "Current Month (Full):" & Format(Now, "mmmm")
    Worksheets(1).Range("A8").Value = "Current Yes:" & Format(Now, "yyyy")
    Worksheets(1).Range("A9").Value = "Year to Date:" & Format(Now, "y")
End Sub
```



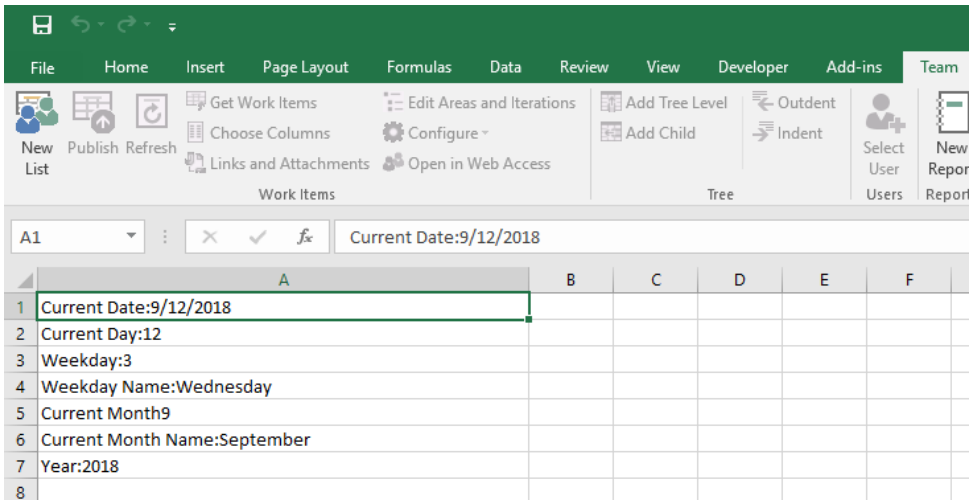
11.4.2 Date Manipulation Function

Date, Day, Weekday, WeekdayName, Month, MonthName and Year are the common used date functions. The usage of these functions is illustrated in the following table:

Function	Output
Date	Current Date
Time	Current Time
Year(Date)	Return the year in long form. E.g. Year("05/23/2016") returns the value 2016.
Month(Date)	Returns the month number in numeric form for a supplied date. E.g. Month("05/23/2016") returns the value 5.
Day(Date)	Return the day part of the current date E.g. Day("05/23/2016") returns the value 23.
Hour(Time)	Returns the Hour portion of a supplied time E.g. Hour("12:34:56") returns the value 12.
Minute(Time)	Returns the Minute portion of a supplied time E.g. Minute("12:34:56") returns the value 34.
Second(Time)	Returns the Second portion of a supplied time E.g. Second("12:34:56") returns the value 56.
Weekday(Date)	Weekday of the current week in numeric form
WeekdayName(Weekday(Date))	Weekday name of the current date
MonthName(Month(Date))	Full name of the current month

11.4.2.1 Example

```
Sub DateDemo()
    Worksheets(1).Range("A1").Value = "Current Date:" & Date
    Worksheets(1).Range("A2").Value = "Current Day:" & Day(Date)
    Worksheets(1).Range("A3").Value = "Weekday:" & Weekday(Date, 2)
    Worksheets(1).Range("A4").Value = "Weekday Name:" & WeekdayName(Weekday(Date))
    Worksheets(1).Range("A5").Value = "Current Month" & Month(Date)
    Worksheets(1).Range("A6").Value = "Current Month Name:" &
MonthName(Month(Date))
    Worksheets(1).Range("A7").Value = "Year:" & Year(Date)
End Sub
```



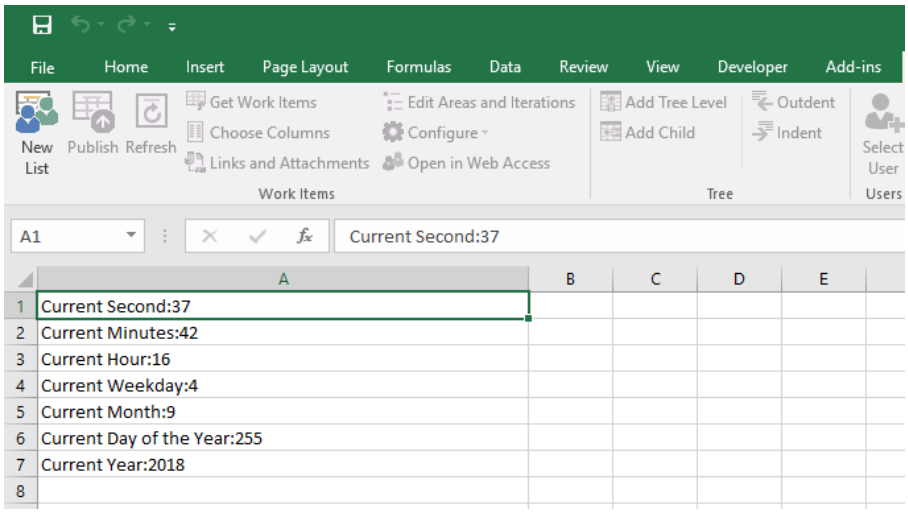
11.4.3 DatePart Function

The DatePart function is used together with the Now function to obtain part of date or time specified by the arguments. The DatePart function is generally written as **DatePart (*Part of date to be returned*, Now)**. Various expressions and the corresponding outputs are shown below:

Function	Output
DatePart("s", now)	Current Second
DatePart("n", now)	Current Minutes
DatePart("h", now)	Current Hour
DatePart("w", now)	Current Weekday
DatePart("m", now)	Current Month
DatePart("y", now)	Current Day of the Year (YTD)
DatePart("yyyy", now)	Current Year

11.4.3.1 Example

```
Sub DatePartDemo()
    Worksheets(1).Range("A1").Value = "Current Second:" & DatePart("s", Now)
    Worksheets(1).Range("A2").Value = "Current Minutes:" & DatePart("n", Now)
    Worksheets(1).Range("A3").Value = "Current Hour:" & DatePart("h", Now)
    Worksheets(1).Range("A4").Value = "Current Weekday:" & DatePart("w", Now)
    Worksheets(1).Range("A5").Value = "Current Month:" & DatePart("m", Now)
    Worksheets(1).Range("A6").Value = "Current Day of the Year:" & DatePart("y",
Now)
    Worksheets(1).Range("A7").Value = "Current Year:" & DatePart("yyyy", Now)
End Sub
```



11.4.4 Adding and Subtracting Dates

11.4.4.1 DateAdd Function

Dates can be added using the DateAdd function. The syntax of the DateAdd function is

DateAdd (*interval*, *value to be added*, *date*)

where interval is the part of date to be added. For example, DateAdd ("yyyy", 3, Now) means 3 years will be added to the current year. Similarly,

11.4.4.2 DateDiff Function

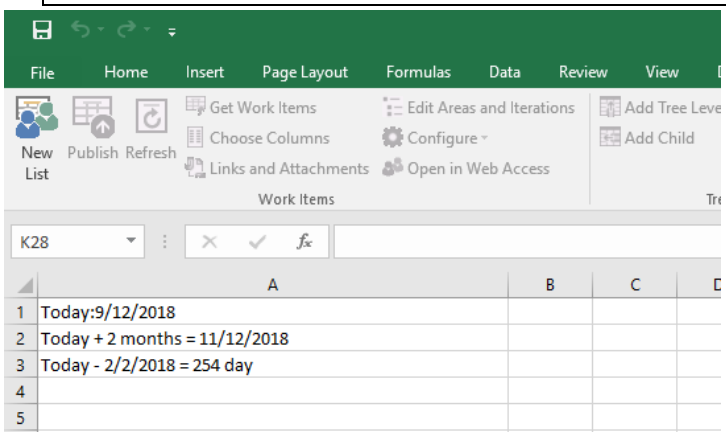
Dates can be subtracted using the DateDiff function. The syntax of the DateDiff function is

DateDiff (*interval*, *first date*, *second date*)

where interval is the part of date to be subtracted. For example, DateDiff ("yyyy", Now, "6/6/2012") means 3 years will be subtracted from the current year. Both the aforementioned functions use the argument "s" for second, "n" for minute, "h" for hour, "d" for day, "w" for week, “m” for month and "yyyy" for year.

11.4.4.3 Example

```
Sub DateDifferent()

    Worksheets(1).Range("A1").Value = "Today:" & Date

    Worksheets(1).Range("A2").Value = "Today + 2 months = " & DateAdd("m", 2, Date)

    Worksheets(1).Range("A3").Value = "Today - 2/2/2018 = " & _

                                      DateDiff("d", "1/1/2018", Date) & " day"

End Sub
```



11.5 Checking Function

11.5.1 IsDate

Returns True if a supplied value is a date, and False otherwise.

- E.g. IsDate("01/01/2016") returns the value True;
  IsDate(100) returns the value False.

11.5.2 IsNumeric

Returns True if a supplied value can be evaluated as a number, or False otherwise.

- E.g. IsNumeric(1234) return the value True
  IsNumeric(-567) return the value True
  IsNumeric(“Hello”) return the value False

12. Excel Objects

12.1 Overview

The term Excel Objects (collectively referred to as the Excel Object Model) refers to the entities that make up an Excel workbook, such as Worksheets, Rows, Columns, Cell Ranges, and the Excel Workbook itself. Each object in Excel has a number of Properties, which are stored as a part of that object.

For example, an Excel Worksheet's properties include the Worksheet's Name, Protection, Visible Property, Scroll Area, etc. Therefore, if during the execution of a macro, we wanted to hide an Excel worksheet, we could do this by accessing the Worksheet object, and altering the 'Visible' property.

Excel VBA has a special type of object, called a Collection. As the name suggests, a Collection refers to a group (or collection) of Excel objects. For example, the Rows collection is an object containing all the rows of a Worksheet.

The main Excel Objects can all be accessed (directly or indirectly) from the Workbooks object, which is a collection of all the currently open Workbooks. Each Workbook object contains the Sheets object (consisting of all the Worksheets and Chart sheets in the Workbook), and in turn, each Worksheet object contains a Rows object (consisting of all Rows in the Worksheet) and a Columns object (consisting of all Columns in the Worksheet), etc.

Object Type	Description
Application	• The current Excel Application.
Workbooks	• The Workbooks object is a collection of all of the open Excel Workbooks in the current Excel Application. • An individual Workbook can be extracted from the Workbooks object by using an individual Workbook index number or name (i.e. Workbooks(1) or Workbooks("Book1")).
Workbook	• A Workbook object can be accessed from the Workbooks Collection by using a Workbook index number or a Workbook name (e.g. Workbooks(1) or Workbooks("Book1")). You can also use 'ActiveWorkbook' to access the current active Workbook. • From the Workbook object, you can access the Sheets object, which is a collection of all the Sheets (Worksheets and Chart Sheets) in the Workbook, and you can also access the Worksheets object, which is a collection of all the Worksheets in the Workbook.
Sheets	• The Sheets object is a collection of all the Sheets in a Workbook. These Sheets can be Worksheets or Charts. An individual Sheet can be extracted from the Sheets object by using an individual Sheet index number or name (i.e. Sheets(1) or Sheets("Sheet1")).

Worksheets	• The WorkSheets object is a collection of all the WorkSheets in a Workbook (i.e. all the Sheets, except the Charts). An individual Worksheet can be extracted from the Worksheets object by using an individual Worksheet index number or name (i.e. Worksheets(1) or Worksheets("Wksheet1")).
Worksheet	• A Worksheet object can be accessed from the Sheets or the Worksheets object by using a Sheet or Worksheet index number or a Sheet or Worksheet name (e.g. Sheets(1), Worksheets(1), Sheets("Sheet1") or Worksheets("Wksheet1")). You can also use 'ActiveSheet' to access the current active Sheet. • From the Worksheet object, you can access the Rows and Columns objects, which are collections of Range objects relating to the Rows and Columns of the Worksheet. You can also access an individual cell or any Range of contiguous cells on the Worksheet.
Rows	• The Rows object is a collection of all the Rows of a Worksheet. A Range object consisting of an individual Worksheet row can be accessed by using an index number (i.e. Rows(1))
Columns	• The Columns object is a collection of all the Columns of a Worksheet. A Range object consisting of an individual Worksheet column can be accessed by using an index number (i.e. Columns(1))
Range	• The Range object represents any number of contiguous cells on a Worksheet. This can be just one cell or it can be all the cells on the Worksheet. • A range consisting of just one cell can be returned from a Worksheet, using the Cells property (i.e. Worksheet.Cells(1,1)). • Alternatively, a range can be referenced by specifying either a cell range or a start and end cell (e.g. Worksheet.Range("A1:B10") OR Worksheet.Range("A1", "B10") OR Worksheet.Range(Cells(1,1), Cells(10,2))). • Note that if the second cell reference is omitted from the Range (e.g. Worksheet.Range("A1") OR Worksheet.Range(Cells(1,1)), this will return a range that consists of only one cell.

12.1.1 Access Object

To access Excel objects via 'parent' objects. For example, a range of cells may be referenced by the expression:

Workbooks("*WB1*").Worksheets("*WS1*").Range("*A1:B10*")

12.1.2 Assigning an Object to a Variable

Another point to note, when working with Excel objects is that, when an object is being assigned to a variable in your VBA code, you must use the Set keyword as follows:

```
Dim DataWb As Workbook
Set DataWb = Workbooks("Data.xlsx")
```

12.1.3 The Active Object

At any one time, Excel will have an Active Workbook, which is the workbook that is currently selected. Similarly, there will be an Active Worksheet and an Active Range, etc.

The current active Workbook or Sheet can be referred to, in your VBA code as ActiveWorkbook, or ActiveSheet, and the current active range can be accessed by referring to Selection.

If, in your VBA code, you refer to a worksheet, without referring to a specific workbook, Excel defaults to the current Active Workbook. Similarly, if you refer to a range, without referring to a specific workbook or worksheet, Excel defaults to the current Active Worksheet in the current Active Workbook.

Therefore, if you wish to refer to range A1:B10 on the current Active Worksheet, within the current Active Workbook, you can simply type:

Range("*A1:B10*")

If you wish to change the current Active Workbook, Worksheet, Range, etc, during the execution of your code, this can be done using the 'Activate' or 'Select' methods as follows:

```
Workbooks("Book1.xlsm").Activate

Worksheets("Data").Select

Range("A1", "B10").Select
```

12.1.4 Object Properties

VBA objects have related properties associated to them. For example, the Workbook object has the properties 'Name', 'RevisionNumber', 'Sheets', and many more. These properties can be accessed by referring to the object name followed a dot and then the property name. For example, the name of the current active Workbook can be accessed by referring to ActiveWorkbook.Name. Therefore, to assign the current active Workbook name to the variable wbName, we could use the following code:

Dim *wbName* As String

wbName **= ActiveWorkbook.Name**

Moreover, the Workbook object can be used to access a Worksheet using the command because the Worksheets collection is a property of the Workbook object

Workbooks("*WB1*").Worksheets("*WS1*")

Some object properties are read only, meaning that you cannot change their values. However, some of the properties can have values assigned to them. For example, if you wanted to change the name of the current active sheet to "my worksheet", this could be done by simply assigning the name "my worksheet" to the active sheet's 'Name' property, as follows:

ActiveSheet.Name = "*MyWorksheet*"

12.1.5 Object Methods

VBA objects also have methods that perform specific actions. Object methods are procedures that are associated to a specific object type. For example, the Workbook object has the methods 'Activate', 'Close', 'Save', and many more.

An Object Method can be called by referring to the object name followed a dot and then the method name. For example, the current active Workbook can be saved using the code:

ActiveWorkbook.Save

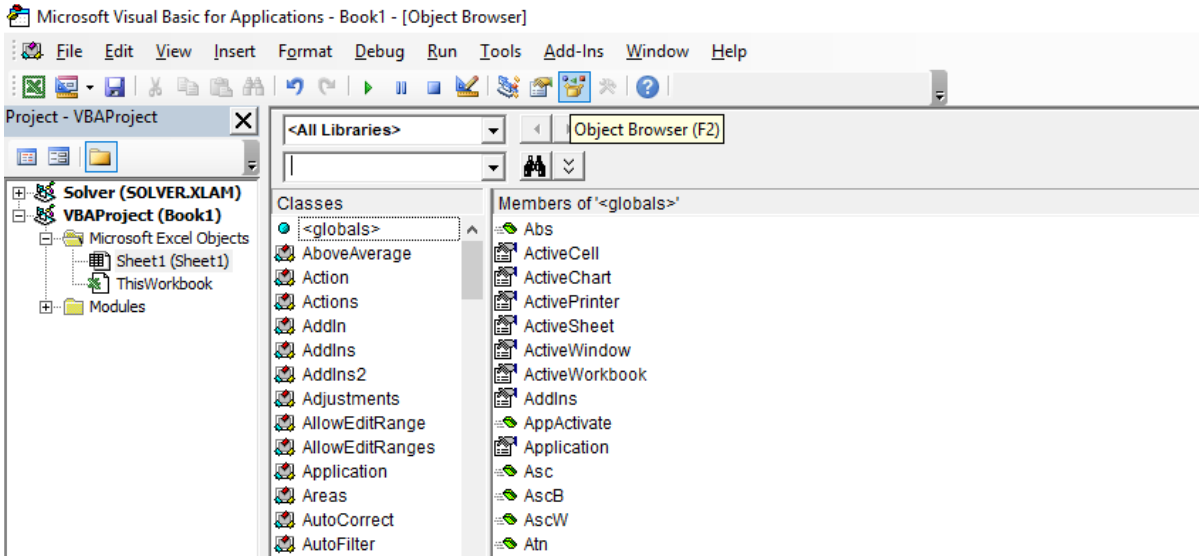
Like any other procedures, methods can have arguments that are supplied when the method is called. For example, the Workbook 'Close' method has three optional arguments which are used to provide information to the method such whether the Workbook is to be saved before closing, etc. The method arguments are supplied to the method by following the call to the method with the argument values, separated by commas. For example, if you wanted to save the current active workbook as a .csv file called "Book2", you would call the Workbook SaveAs method with the Filename argument set to "Book2" and the FileFormat argument set to xlCSV:

ActiveWorkbook.SaveAs "*Book2*", xlCSV

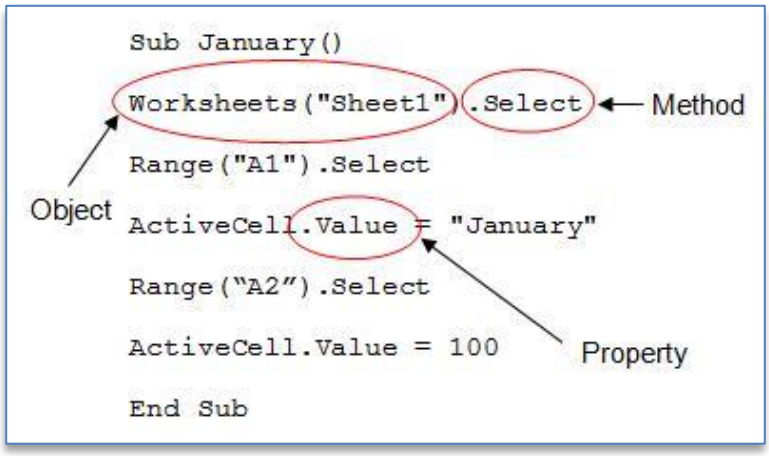
To make your code more readable, you can use named arguments when calling a method. In this case, you type the argument name followed by the assignment operator := and then the value. Therefore, the above call to the Workbook SaveAs method could be written as:

ActiveWorkbook.SaveAs Filename:="*Book2*", [FileFormat]:=xlCSV

A list of excel objects, with their properties and methods are provided in the Object Browser within the Visual Basic Editor. To display this, simply press [F2] from within the Visual Basic Editor.



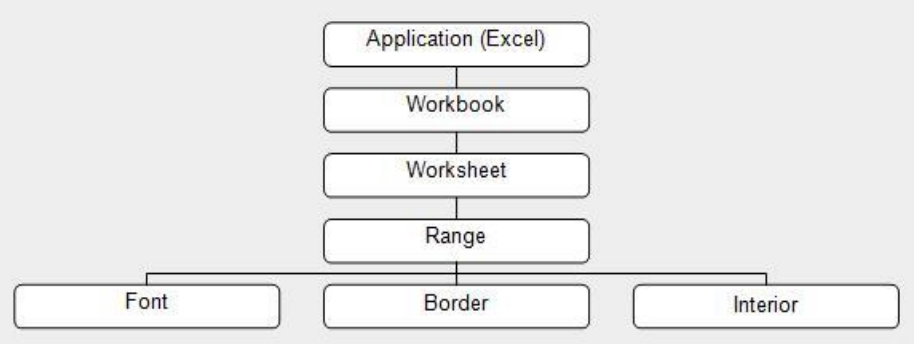
12.1.6 Example



12.2 Application Objects

The Application Object refers to the host application of Excel, and the entire Excel application is represented by it. As the top-level object it is unique and thus, seldom needs to be addressed in code; however, there are a few occasions when you must use the Application object's qualifier in code.

12.2.1 Application hierarchy



12.2.2 Object and Collection

Objects are the fundamental building blocks of Visual Basic. An object is a special type of variable that contains both data and codes. A collection is a group of objects of the same class. The most used Excel objects in VBA programming are Workbook, Worksheet, Sheet, and Range. For example, Workbooks is a collection of all Workbook objects. Worksheets is a collection of Worksheet objects. The Workbook object represents a workbook, the Worksheet object represents a worksheet, the Sheet object represents a worksheet or chartsheet, and the Range object represents a range of cells.

12.3 The Workbook Object

In the VBA language, a workbook is an object that belongs to a collection called Workbooks. Each workbook of the Workbooks collection is an object of type Workbook, which is a class. Each workbook of the Workbooks collection can be identified using the Item property. To programmatically refer to a workbook, access the Item property and pass either the index or the file name of the workbook to it. After referring to a workbook, if you want to perform an action on it, you must get a reference to it.

12.3.1 Creating a Workbook

A workbook is an object of type Workbook and it is part of the Workbooks collection. To support the ability to create a new workbook, the Workbooks collection is equipped with a method named Add. Its syntax is:

Workbooks.Add(***Template*** **) As Workbook**

You start with the Workbooks class, a period, and the Add method. This method takes only one argument but the argument is optional. This means that you can call the method without an argument and without parentheses.

When the method is called like this, a new workbook would be created and presented to you. After creating a workbook, you may want to change some of its characteristics. To prepare for this, notice that the Add( ) method returns a Workbook object. Therefore, when creating a workbook, get a

reference to it. To do this, assign the called method to a Workbook variable. After doing this, you can then use the new variable to change the properties of the workbook.

```
Sub AddWorkbook ( )
    Dim newWorkbook As Workbook
    Set newWorkbook = Workbooks.Add
End Sub
```

12.3.2 Saving Workbooks

12.3.2.1 Introduction

After working on a new workbook, you can save it. After programmatically creating a workbook, if you want to keep it when the user closes Microsoft Excel or when the computer shuts down, you must save it. You and the user have the option of using the Save As dialog box.

12.3.2.2 Saving a Workbook

To visually save a workbook, you can click Save or pressing [Ctrl] + [S]. If the document was saved already, it would be saved behind the scenes without doing anything else. To support the ability to programmatically save a workbook, the Workbook class is equipped with a method named Save. Its syntax is:

Workbook.Save( )

As you can see, this method takes no argument. If you click the Office Button and click Save or if you call the Workbook.Save() method on a work that was not saved yet, you would be prompted to provide a name to the workbook.

To save a workbook to a different location, you can click Save As and select from the presented options. You can also press [F12]. To assist you with programmatically saving a workbook, the Workbook class is equipped with a method named SaveAs. Its syntax is:

Workbook.SaveAs(*FileName*, *FileFormat*, *Password*, *WriteResPassword*,
**   *ReadOnlyRecommended*, *CreateBackup*, *AccessMode*,**
**   *ConflictResolution*, *AddToMru*, *TextCodepage*, *TextVisualLayout*,**
**   *Local*)**

The first argument is the only required one. It holds the name or path to the file. Therefore, you can provide only a name of the file with extension when you call it.

```
Sub SaveWorkbook( )
    Dim newWorkbook As Workbook
    Set newWorkbook = Workbooks.Add
    newWorkbook.SaveAs "C:\Temp\NewWorkbook.xlsx"
End Sub
```

If you provide only the name of a file when calling this method, the new workbook would be saved in the current directory or in My Documents. If you want, an alternative is to provide a complete path to the file.

12.3.3 Opening Workbooks

To support the ability to programmatically change the default folder, the Application class is equipped with a property named DefaultFilePath. Therefore, to programmatically specify the default folder, assign its string to the Application.DefaultFilePath property.

The ability to programmatically open a workbook is handled by the Workbooks collection. To support this, the Workbooks class is equipped with a method named Open. Its syntax is:

Workbooks.Open(***FileName*****,** ***UpdateLinks*****,** ***ReadOnly*****,** ***Format*****,** ***Password*****,**
WriteResPassword**,** ***IgnoreReadOnlyRecommended*****,** ***Origin*****,**
Delimiter**,** ***Editable*****,** ***Notify*****,** ***Converter*****,** ***AddToMru*****,** ***Local*****,**
CorruptLoad **)**

FileName is the only required argument. When calling this method, you must provide the name of the file or its path. This means that you can provide a file name with its extension. If you provide only the name of a file, Microsoft Excel would look for it in the current directory or in My Documents. If Microsoft Excel cannot file the file, you would receive an error.

```
Sub OpenWorkbook ( )
    Application.DefaultFilePath = "C:\Temp\"
    Workbooks.Open "NewWorkbook.xlsx"
End Sub
```

12.4 The Worksheet Object

In Microsoft Excel, a spreadsheet is called a worksheet. In the previous lesson, we introduced workbooks. Indeed, a workbook is a series of worksheets that are treated as a group. When Microsoft Excel starts, it creates a workbook. That workbook is equipped with three worksheets. If you do not need all of them, you can delete those that appear useless. You can also add new worksheets as you see fit.

12.4.1 Selecting a Worksheet

In some circumstances, you will need to perform a general action on a worksheet. Before doing this, you may need to select the contents of the whole worksheet first. To programmatically select a worksheet, access the Sheets collection, pass the name of the desired worksheet as string, and call Select. The syntax is:

Sheets(***Worksheet*** **).Select**

The worksheet that is selected and that you are currently working on is called the active worksheet. It is programmatically identified as the ActiveSheet object.

12.4.2 Creating a Worksheet

To programmatically create a new worksheet, you can specify whether you want it to precede or succeed an existing worksheet. To support creating a new worksheet, call the Add( ) method of the Worksheets or the Sheets collection. Its syntax is:

Workbook.Sheets.Add(***Before*****,** ***After*****,** ***Count*****,** ***Type*** **).**

If you want to create a new worksheet on the left side of any worksheet you want, you can first select that worksheet and call the Add( ) method. For example, suppose you have three worksheets named Sheet1, Sheet2, and Sheet3 from left to right and you want to insert a new worksheet between Sheet1 and Sheet2, you can use code as follows:

```
Sub AddWorkSheet( )
    Sheets("Sheet1").Select
    Sheets.Add
End Sub
```

12.4.3 Removing Worksheets

As your work progresses, you will decide how many worksheets you need for your particular workbook. Just as we learned to add worksheets, you can delete or remove the worksheets you do not need anymore. Since a worksheet is not a file, when you delete a worksheet, it is permanently gone. If one or more cells of the worksheet contain data, you will receive a confirmation message to decide. To programmatically remove a worksheet, call the Delete( ) method of its collection. When calling this method, pass the name of the worksheet you want to remove to the collection.

```
Sub DeleteWorkSheet( )
    Worksheets("Sheet3").Delete
End Sub
```

12.5 The Column Object

12.5.1 Selecting Column

To programmatically select a range of columns, in the parentheses of the Columns collection, enter the name of the first column on one end, followed by a colon ":", followed the name of the column that will be at the other end.

```
Sub SelectColumn( )
    Sheets("Sheet1").Select
    Columns("D:G").Select
End Sub
```

12.5.2 Adding New Column

To support the creation of columns, the Column class is equipped with a method named Insert. This method takes no argument. When calling it, you must specify the column that will succeed the new one.

```
Sub AddColumn( )
    Sheets("Sheet1").Select
    Columns(3).Insert
End Sub
```

12.5.3 Deleting Column

To provide the ability to delete a column, the Column class is equipped with a method named Delete. This method does not take an argument. To delete a column, use the Columns collection to specify the index or the name of the column that will be deleted. Then call the Delete method.

```
Sub DeleteColumn( )
     Sheets("Sheet1").Select
     Columns("D:F").Delete
End Sub
```

12.5.4 Selecting Column Width

To support column sizes, the Column class is equipped with a property named ColumnWidth. Therefore, to programmatically specify the width of a column, access it, then access its ColumnWidth property and assign the desired value to it.

```
Sub SetColumnWidth( )
     Sheets("Sheet1").Select
     Columns("C").ColumnWidth = 50
End Sub
```

12.5.5 Hiding and Revealing Column

To programmatically hide a column, first select it, then assign True to the Hidden property of the EntireColumn object of Selection. To unhide a hidden column, assign a False value to the Hidden property.

```
Sub HideColumn( )
     Sheets("Sheet1").Select
     Columns("F:F").Select
     Selection.EntireColumn.Hidden = True
End Sub
```

12.6 The Row Object

12.6.1 Selecting Row

To support row selection, the Row class is equipped with a method named Select. Therefore, to programmatically select a row, access a row from the Rows collection using the references we saw earlier. Then call the Select method. We also saw that you could refer to a row using the Range object. After accessing the row, call the Select method. Here is an example that selects Row 1 to 4:

```
Sub SelectRow( )
     Sheets("Sheet1").Select
     Rows("1:4").Select
End Sub
```

When a row has been selected, it is stored in an object called Selection. You can then use that object to apply an action to the row.

12.6.2 Adding New Row

To provide the ability to add a new row, the Row class is equipped with a method named Insert. Therefore, to programmatically add a row, refer to the row that will be positioned below the new one and call the Insert method.

```
Sub AddRow( )
     Sheets("Sheet1").Select
     Rows(3).Insert
End Sub
```

12.6.3 Deleting Row

To support row removal, the Row class is equipped with a method named Delete that takes no argument. Based on this, to delete a row, access it using a reference as we saw earlier, and call the Delete method.

```
Sub DeleteRow( )
     Sheets("Sheet1").Select
     Rows(3).Delete
End Sub
```

12.6.4 Setting Row Height

To support the height of a row, the Row object is equipped with a property named RowHeight. Therefore, to programmatically specify the height of a row, access the row using a reference as we saw earlier, access its RowHeight property and assign the desired value to it.

```
Sub RowHeight( )
     Sheets("Sheet1").Select
     Rows(6).RowHeight = 25
End Sub
```

12.6.5 Hiding and Revealing Rows

To programmatically hide a row, first select. Then, access the Hidden property of the EntireRow object of Selection. To hide a group of rows, first select their range, then write Selection.EntireRow.Hidden = True.

```
Sub HiddenRow( )
     Sheets("Sheet1").Select
     Rows("6:6").Select
     Selection.EntireRow.Hidden = True
End Sub
```

12.7 The Cell Object

12.7.1 Selecting Cells

To programmatically identify a cell, you can identify a cell using the Range object. To do this, in the parentheses of the Range object, pass a string that contains the name of the cell.

```
Sub SelectCell( )
    Sheets("Sheet1").Select
    Range("D10").Select
End Sub
```

13. VBA Example

13.1 Unhide all Rows and Column

could be really helpful if you get a file from someone else and want to be sure there are no hidden rows/columns.

```
Sub UnhideRowsColumns()
    ' Unhide all Column
    Columns.EntireColumn.Hidden = False

    ' Unhide all Row
    Rows.EntireRow.Hidden = False
End Sub
```

13.2 Unmerge all Merged Cells

It's a common practice to merge cells to make it one. While it does the work, when cells are merged you will not be able to sort the data. In case you are working with a worksheet with merged cells, use the code below to unmerge all the merged cells at one go.

```
Sub UnmergeAllCells()
    ' Unmerge all cell in ActiveSheet
    ActiveSheet.Cells.UnMerge
End Sub
```

13.3 Highlight Blank Cells

While you can highlight blank cell with conditional formatting or using the Go to Special dialog box, if you have to do it quite often, it's better to use a macro. Once created, you can have this macro in the Quick Access Toolbar or save it in your personal macro workbook. In this code, the blank cells is highlighted in the yellow color, while other colors such as red, blue, cyan, etc can also be used.

```
Sub HighlightBlankCells()
    Dim Dataset as Range          ' Declare a range object

    ' Define the selected range
    Set SelectRange = Selection

    ' Set the blank cell to Yellow color in selected range
    SelectRange.SpecialCells(xlCellTypeBlanks).Interior.Color = vbYellow
End Sub
```

13.4 Highlight all Cells with Comments

Use the below code to highlight all the cells that have comments in it. In this case, vbBlue is used to give a blue color to the blank cells, you can change it to other colors if you want.

```
Sub HighlightCellsWithComments()
    ' Set the cell with comment to Blue  color
    ActiveSheet.Cells.SpecialCells(xlCellTypeComments).Interior.Color = vbBlue
End Sub
```

13.5 Change the Letter of Selected Cells to Upper Case

While Excel has the formulas to change the letter case of the text, it makes you do that in another set of cells. Use this code to instantly change the letter case of the text in the selected text. Note that in this case, UCase is used to make the text case upper, LCase can used for lower case.

```
Sub ChangeCase()
    Dim Rng As Range           ' Declare a range object

    ' Within the selected cells
    For Each Rng In Selection.Cells
        ' If no formula in the cell
        If Rng.HasFormula = False Then
            ' Convert the case
            Rng.Value = UCase(Rng.Value)
        End If
    Next Rng
End Sub
```

13.6 Convert all Formulas into Values

Use this code when you have a worksheet that contains a lot of formulas and you want to convert these formulas to values.

```
Sub ConvertToValues()
    ' For the area containing formula, formatting, value that has ever been used
    With ActiveSheet.UsedRange
        ' Convert to Value
        .Value = .Value
    End With
End Sub
```

13.7 Find all Worksheets within Workbook

This code is useful to examine the references to the Worksheets object (taken from the current active Workbook by default), and the reference to each individual Worksheet. Note that the Worksheet Name property is accessed, to display the name of each Worksheet.

```
Sub FindWorkSheet()
     Dim ws As Worksheet    ' Declare a worksheet object

    ' Loop all worksheets in Excel workbook
    For Each ws In Worksheets
        ' Popup a message to show the worksheet name
       MsgBox "Found: " & ws.Name
    Next ws
End Sub
```

13.8 Hide all Worksheets except Active Sheet

If you're working on a report or dashboard and you want to hide all the worksheet except the one that has the report/dashboard, you can use the following code.

```
Sub HideAllExceptActiveSheet()
     Dim ws As Worksheet    ' Declare a worksheet object

    ' Loop all worksheets in Excel workbook
     For Each ws In Worksheets
          ' If the worksheet name not equal to Active Worksheet name
          If ws.Name <> ActiveSheet.Name Then
               ' Hide the worksheet by set Visible = 0
               ws.Visible = xlSheetHidden
          End If
     Next ws
End Sub
```

13.9 Unhide all Worksheets

If you are working in a workbook that has multiple hidden sheets, you need to unhide these sheets one by one. This could take some time in case there are many hidden sheets.

```
Sub UnhideAllWoksheets()
    ' Declare a worksheet object
    Dim ws As Worksheet

   ' Loop all worksheets in Excel workbook
    For Each ws In Worksheets
        ' Unhide the worksheet
        ws.Visible = xlSheetVisible
    Next ws
End Sub
```

13.10 Sort Worksheets Alphabetically

If you have a workbook with many worksheets and you want to sort these alphabetically, this macro code can come in really handy. This could be the case if you have sheet names as years or employee names or product names.

```
Sub SortSheetsTabName()
   ' Declare wsCount to count the number of worksheet; i & j as looping counter
   Dim wsCount, i, j As Integer

   ' Count the number of worksheet
   wsCount = Sheets.Count

   ' Sort the worksheet by Bubble Sort
   For i = 1 To wsCount - 1
      For j = i + 1 To wsCount
         If Sheets(j).Name < Sheets(i).Name Then
            Sheets(j).Move before:=Sheets(i)
         End If
      Next j
   Next i
End Sub
```

13.11 Protect all Worksheets with Password

If you have a lot of worksheets in a workbook and you want to protect all the sheets, you can use this macro code. It allows you to specify the password within the code. You will need this password to unprotect the worksheet.

```
Sub ProtectAllSheets()
    Dim ws As Worksheet           ' Declare worksheet object
    Dim UserPassword As String    ' Declare password string

    UserPassword = InputBox("Please input the password")

   ' Loop all worksheets in Excel workbook
    For Each ws In Worksheets
        ' Protect the worksheet by specified password
        ws.Protect password:=UserPassword
    Next ws
End Sub
```

13.12 Unprotect all Worksheets with Password

If you have some or all of the worksheets protected, you can just use a slight modification of the code used to protect sheets to unprotect it. Note that the password needs to the same that has been used to lock the worksheets. If it's not, you will see an error

```
Sub UnprotectAllSheets()
    Dim ws As Worksheet           ' Declare worksheet object
    Dim UserPassword As String    ' Declare password string

    UserPassword = InputBox("Please input the password")

   ' Loop all worksheets in Excel workbook
    For Each ws In Worksheets
        ' Unprotect the worksheet by specified password
        ws.Unprotect password:=UserPassword
    Next ws
End Sub
```

13.13 Protect Cells with Formulas only

You may want to lock cells with formulas when you have a lot of calculations and you don't want to accidentally delete it or change it. Here is the code that will lock all the cells that have formulas, while all the other cells are not locked.

```
Sub LockCellsWithFormulas()
    With ActiveSheet
        .Unprotect                  ' Unprotect worksheet
        .Cells.Locked = False       ' Unlock all cell
        .Cells.SpecialCells(xlCellTypeFormulas).Locked = True ' Lock cell with
                                                              ' formula only
        .Protect AllowDeletingRows:=True    ' Protect only cells with formula
    End With
End Sub
```

13.14 Save Workbook with TimeStamp in Name

A lot of time, you may need to create versions of your work. These are quite helpful in long projects where you work with a file over time. A good practice is to save the file with timestamps. Using timestamps will allow you to go back to a certain file to see what changes were made or what data was used.

Here is the code that will automatically save the workbook in the specified folder and add a timestamp whenever it's saved. You need to specify the folder location where you want to save the file.

```
Sub SaveWorkbookWithTimeStamp()
    ' Declare a string to store the timestamp information
    Dim timestamp As String

    ' Generate the timestamp in "dd-mm-yyyy_hh-ss" format.
    timestamp = Format(Date, "dd-mm-yyyy") & "_" & Format(Time, "hh-ss")

   ' Save the file in specified path
    ThisWorkbook.SaveAs "C:\Temp\WorkbookName" & TimeStamp, _
                        FileFormat:=xlOpenXMLWorkbookMacroEnabled
End Sub
```

13.15 Save each Worksheet as Separate PDF

If you work with data for different years or divisions or products, you may have the need to save different worksheets as PDF files. While it could be a time-consuming process if done manually, VBA can really speed it up. Here is a VBA code that will save each worksheet as a separate PDF. In the below code, I have specified the address of the folder location in which I want to save the PDF. Also, each PDF will get the same name as that of the worksheet. Note that this code works for worksheets with figure only (worksheet without data or chart sheets will cause error).

```
Sub SaveWorkshetAsPDF()
    Dim ws As Worksheet           ' Declare worksheet object

   ' Loop all worksheets in Excel workbook
    For Each ws In Worksheets
        ' Save each worksheet to PDF format
        ws.ExportAsFixedFormat xlTypePDF, "C:\Temp\DemoPDF" & ws.Name & ".pdf"
    Next ws
End Sub
```

13.16 Highlight Cells with Misspelled Words

Excel doesn't have a spell check as it has in Word or PowerPoint. While you can run the spell check by hitting the [F7] key, there is no visual cue when there is a spelling mistake. Use this code to instantly highlight all the cells that have a spelling mistake in it.

```
Sub HighlightMisspelledCells()
    Dim Rng As Range

    ' For the area containing formula, formatting, value that has ever been used
    For Each Rng In ActiveSheet.UsedRange
        If Not Application.CheckSpelling(word:= Rng.Text) Then
            ' Mark in red color if fail for spelling check
            Rng.Interior.Color = vbRed
        End If
    Next cl
End Sub
```

13.17 Refresh all Pivot Tables in the Workbook

If you have more than one Pivot Table in the workbook, you can use this code to refresh all these Pivot tables at once.

```
Sub RefreshAllPivotTables()
    Dim PT As PivotTable     ' Declare a Pivot Table object

    ' Refresh all Pivot Table in Active Worksheet
    For Each PT In ActiveSheet.PivotTables
        PT.RefreshTable
    Next PT
End Sub
```

13.18 How to Sort Data by Multiple Columns

Suppose you have a dataset as shown. Below is the code that will sort the data based on multiple columns. Note that here I have specified to first sort based on column A and then column B.

	A	B	C
1	**State**	**Store**	**Sales**
2	MI	Store 3	2075
3	NY	Store 4	1164
4	AZ	Store 1	2269
5	MI	Store 4	4179
6	MI	Store 1	3626
7	NY	Store 2	1103
8	NY	Store 1	1243
9	NY	Store 3	3230
10	AZ	Store 2	1768
11	MI	Store 2	1389
12	AZ	Store 3	4116
13	AZ	Store 4	5259

```
Sub SortMultipleColumns()
    With ActiveSheet.Sort
        .SortFields.Add Key:=Range("A1"), Order:=xlAscending
        .SortFields.Add Key:=Range("B1"), Order:=xlAscending
        .SetRange Range("A1:C13")
        .Header = xlYes
        .Apply
    End With
End Sub
```

13.19 Get Only the Numeric Part from a String in Excel

If you want extract only the numeric part or only the text part from a string, you can then use this VBA function in the worksheet (just like regular Excel functions) and it will extract only the numeric or text part from the string. You need place in code in a module, and then you can use the function *GetNumeric* in the worksheet. This function will take only one argument, which is the cell reference of the cell from which you want to get the numeric part.

```
Function GetNumeric(CellRef As String)
    Dim StringLength As Integer   ' Declare an integer for String Length

    ' Get the String length
    StringLength = Len(CellRef)

    ' Remove numeric part from the string
    For i = 1 To StringLength
        If IsNumeric(Mid(CellRef, i, 1)) Then
            Result = Result & Mid(CellRef, i, 1)
        End If
    Next i

    GetNumeric = Result
End Function
```

13.20 Get Only the Text Part from a String in Excel

Similarly, below is the function that will get you only the text part from a string in Excel:

```
Function GetText(CellRef As String)
    Dim StringLength As Integer' Declare an integer for String Length

    ' Get the String length
    StringLength = Len(CellRef)

    ' Remove numeric part from the string
    For i = 1 To StringLength
        If Not (IsNumeric(Mid(CellRef, i, 1))) Then
            Result = Result & Mid(CellRef, i, 1)
        End If
    Next i

    GetText = Result
End Function
```

13.21 Copy between Workbook

The following section of VBA code has been included to illustrate how you can access Worksheets and Ranges from other Workbooks and how the current Excel Objects are accessed by default if no specific object is referenced. This example also illustrates the use of the Set keyword to assign an Excel object to a variable. The code also shows the PasteSpecial method being called for the Range object. This method sets the 'Paste' argument to the value 'xlPasteValues'.

```
Sub CopyWorkSheet()
    Dim TargetWB As Workbook

    Set TargetWB = ActiveWorkbook
    Workbooks.Open("C:\Temp\Demo.xlsx")
    ActiveWorkbook.Sheets("Sheet1").Range("A2:A10").Copy
    TargetWB.Sheets("Sheet1").Range("A1").PasteSpecial Paste:=xlPasteValues
End Sub
```

13.22 Get the Table Size

There are certain situations where we perform some tasks by finding last used Column and Row with data in a worksheet. We can count the number of columns using in the active sheet from there we can come back in particular row to get the exact column with data. We can use Column property to get last used Column. Besides, we can also count the number of rows in the active sheet from there we can come back in particular row to get the exact number of rows with data. We can use Row property to get last used Row.

```
Sub GetTableSize()
    Dim Last_Column, Last_Row As Integer

    With ActiveSheet
      Last_Column = .Cells(1, .Columns.Count).End(xlToLeft).Column
      Last_Row = .Cells(.Rows.Count, "A").End(xlUp).Row
    End With

    MsgBox "No of Column = " & Last_Column & Chr(13) & "No of Row =" & Last_Row
End Sub
```

13.23 Processing on non-empty Cells

The following section of VBA code shows how the Columns (collection) object can be accessed from the Worksheet object. It is also seen that, when a cell or cell range on the current active Worksheet is accessed, the reference to the Worksheet can be omitted. Again the code provides an illustration of the use of the Set keyword to assign a Range object to the variable 'Col'. The code also includes an example of how to access and change the Range object's Value property.

```
Sub ProcessCell()
    Dim i As Integer
    Dim Col As Range
    Dim dVal As Double

    Set Col = Sheets("Sheet1").Columns("A")

    i = 1
    Do Until IsEmpty(Col.Cells(i))
        dVal = Col.Cells(i).Value * 3 - 1
        Cells(i, 2).Value = dVal
        i = i + 1
    Loop
End Sub
```