Objects and Object-oriented Programming (OOP)

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Computer Programming for Mechanical Engineers

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Reminder: Midterm Exam April 6

California State University Northridge

Outline

- Basics of object-oriented programming: objects, properties, and methods
- Important objects in Excel
- Collections of Objects
- Help from Object Browser
- Object variables
- Relative and absolute references
- Offset Property

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Background

- We have used statements like the following in previous VBA coding
  - Range("D6").Value Value Property
  - Cells(6,4).Value Value Property
  - Range("R12").NumberFormat Property
  - Range("B6:D12").ClearContents Method
- These are examples of object-oriented programming (OOP)
  - We are interested in using OOP to control Excel worksheets from VBA

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Basic Ideas

- Concept of object and property and object method
  - <Object>.<property> can be read or write
  - <Object>.<method> for actions with object
- Can have properties that are also objects
  - <Object>.<propertyObject>.<object>
  - <Object>.<propertyObject>.<method>
  - E.g. Range("A1").Font.Size

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Object-Oriented Programming

- OOP uses "objects" which have properties and methods
- A range is an object which has properties (e.g. Value and NumberFormat)
  - It also has methods like ClearContents
- In OOP we use constructs like Object.Property and Object.Method
- We have properties that we can read, write, or do both

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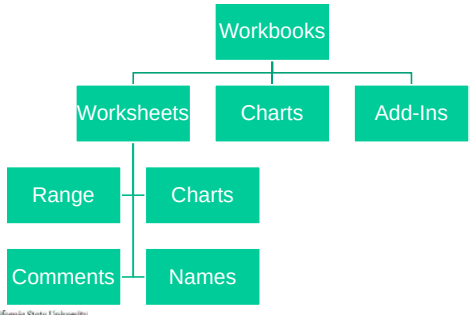
Simplified Excel Object Hierarchy



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Object Shorthand

- When we write a statement like Range("A6").Value = 12 we change the value of cell A6 on the current worksheet, known as the ActiveSheet
- When we want to work with multiple sheets (e.g., to copy data from one worksheet to another) we need to explicitly state the worksheet to which we are referring

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Examples

- For multiple worksheets, we can use a fuller reference as follows
  - Worksheets("<sheetName>").Range().Value
- Copy data from one worksheet to another with a command like the following:

  Worksheets("Sheet1").Range("B3:C6").Value =Worksheets("Sheet2").Range("A1:B4").Value
- Can also refer to worksheets by numerical index: Worksheets(k)

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Object Variables

- Can declare variables to refer to objects
  - Used to simplify code with repeated references to one object

```
Dim rng As Range
Set rng = Worksheets("Sheet3").Cells(5,12)
If rng.Value < 0 Then rng.Value = -rng.Value
Set rng = Nothing  'Clear object variable
```

  - Notice use of Set for setting object variables to a value and clearing object variables at end of code

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Worksheet Object Variable

- Useful approach for referring to different worksheets several times in VBA code

```
Dim sht1 As Worksheet
Dim sht2 As Worksheet
Set sht1 = Worksheets("Sheet1")
Set sht2 = Worksheets("Sheet2")
sht2.Range("B3:C6").Value = _
sht1.Range("A1:B4").Value
Set sht1 = Nothing
Set sht2 = Nothing
```

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Example: Find Last Row

- VBA code to find the last row with data in a selected column on a worksheet

```
Function getLastRow(sheetName As String, _
                    column As Long) As Long
    Dim sht As Worksheet
    Set sht = Worksheets(sheetName)
    getLastRow = sht.Cells(sht.Rows.Count, _
                 sht.column).End(xlUp).Row
    Set sht = Nothing
End Function
```

- Example: =getLastRow("Sheet1",5) returns number of last row with data in column E of Sheet1

How does this code work?

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How does this code work?

- Cells(<row>,<column>) refers to a range by row and column number

```
sht.Cells(sht.Rows.Count, sht.column)
```

  - Here we use the object variable, sht, to refer to a particular worksheet
  - The entry "Rows.Count" gives the last row in the worksheet = 1,048,576

```
sht.Cells(sht.Ro…, sht.col…).End(xlUp)
```

  - The End(xlUp) method finds the first row above the current row (here 1,048,576) that is not blank

```
sht.Cells(sht.R…,sht.c…).End(xlUp).Row
```

  - The final "Row" returns the number of the row

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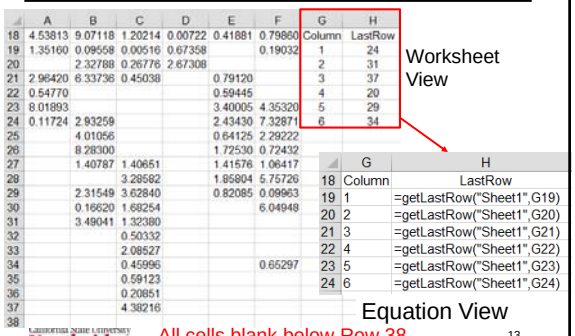
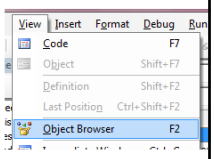
LastRow Example



Object Browser

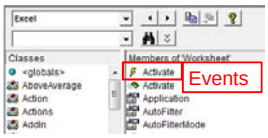
- Shows all objects and methods
- Access from VB Editor
- Press F2 or select Object Browser from View menu



Objects

Methods

Properties

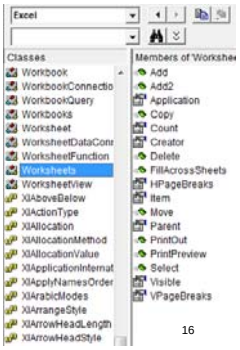


Collections

- Some objects represent collections of individual objects
  - Worksheet is an object that is a single worksheet
  - Worksheets is an object that represents the collection of all worksheets in a workbook
  - What do you think Workbooks is?
  - Workbooks is a collection of all open workbooks

Object Browser Example

- Select Excel from top pulldown menu
- Select desired object from Classes menu
- Right-click desired class member
- Select Help from resulting right- click menu



Worksheets.Count Help

Worksheets.Count Property (Excel)

Office 2013 and later | Other Versions

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Returns a **Long** value that represents the number of objects in the collection.

Syntax

expression .**Count**

expression A variable that represents a **Worksheets** object.

Use of Macro Recorder

- Macro recorder can show how to write VBA code to perform certain functions
- Code may not be most efficient
  - Generates code that selects a cell and then works with the selection
- Code may also do more than you want
  - Example: changing one aspect of a font will produce code that sets all other font properties to their default values

Code Generated for Font Size

```
With Selection.Font
    .Name = "Arial"
    .Size = 12
    .Strikethrough = False
    .Superscript = False
    .Subscript = False
    .OutlineFont = False
    .Shadow = False
    .Underline = xlUnderlineStyleNone
    .ThemeColor = xlThemeColorLight1
    .TintAndShade = 0
    .ThemeFont = xlThemeFontNone
End With
```

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With-End With Structure

- Used to simplify setting of several properties of same object
- Used on previous slide for setting properties of selected font
- General form

```
With <object>
   .<property1> = <value1>
   .<propertyN> = <valueN>
End With
```

Multiple statements allowed here

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Necessary Font Size Code

- Any one of the following are equivalent statements are required to set font (assumes `Selection` is cells C3:F12)
- `Selection.Font.Size = 12`
- `Range("C3:F12").Font.Size = 12`
- `Range("C3","F12").Font.Size _ = 12`
- `Range(Cells(3,3),Cells(12,6) _ ).Font.Size = 12`

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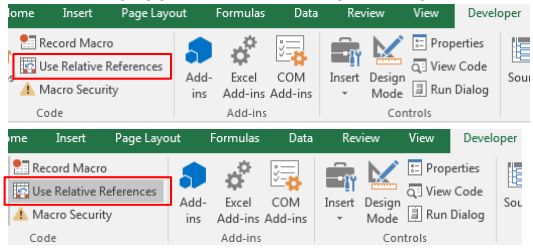
Relative/Absolute References

Developer tab with Relative References not selected (top) and selected (bottom)



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Absolute Reference Macro

```
Sub Macro1()
' Macro1 Macro
    Range("J69").Select
    Selection.Copy
    Range("K74").Select
    ActiveSheet.Paste
End Sub
```

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Combined Copy/Paste

- Can add paste destination as argument of copy function

```
Sub Macro2()
' Macro2 Macro
    Range("J69").Copy _
                  Range("K74")
End Sub
```

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Relative Reference Macro

```
Sub Macro3()
' Macro3 Macro
  'Range("J69").Select (equivalent)
    Application.CutCopyMode = False
    Selection.Copy
    ActiveCell.Offset(5, 1) _
                .Range("A1").Select
    ActiveSheet.Paste
End Sub
```

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Offset Property

- Form: <range specification>. _ Offset(<rowOffset>,<columnOffset>)
- **rowOffset** is an integer that is negative, zero or positive for **rows** above, the same as, or lower than the specified range row
- **columnOffset** is an integer that is negative, zero or positive for **columns** to the left of, the same as, or to the right of the specified range column

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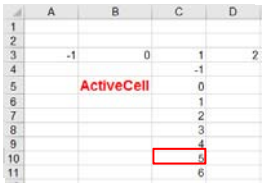
Offset Command Illustrated

- VBA code with offset property

```
ActiveCell.Offset(5, 1) _
    .Range("A1").Select
```

- What is selected cell?
- Cell C10
- Why is this selected cell?
- It is 5 rows down and 1 column to the right of the Active Cell



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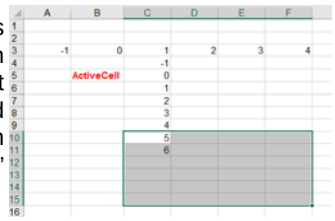
Offset Command with Select

- Revised VBA code with offset

```
ActiveCell.Offset(5, 1) _
    .Range("A1:D6").Select
```

Offset cell 5 rows down and 1 column to left is upper-left cell "A1" in selected 6-row, 4-column range, "C10:F15"



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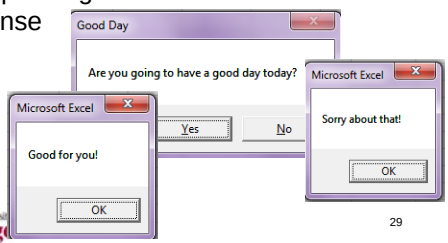
Functions as Subs

- Functions may be used as subs if the return value is not needed
- Example msgBox Function with Yes/No response



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Message Box Code

```
response = MsgBox("Are you going to" _
           & "have a good day today?", _
             vbYesNo, "Good Day")
If response = vbYes Then
    MsgBox ("Good for you!")
Else
    MsgBox ("Sorry about that!")
End If
```

MsgBox can return a value

MsgBox does not have to return a value

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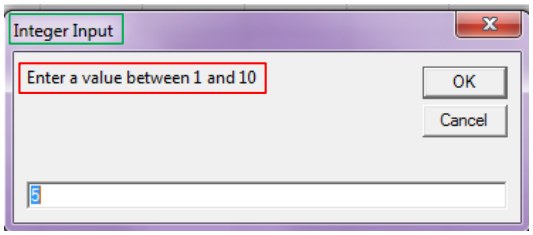
Input Box




```
y = InputBox("Enter a value between" _
    & "1 and 10", "Integer Input", 5)
```

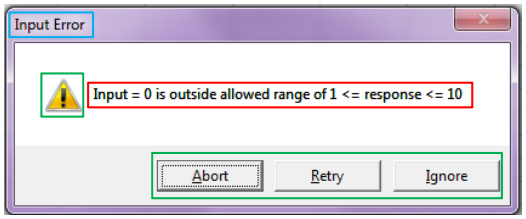
Called "prompt" on next slide

Overall Input Box Code

```
Do
  y = InputBox(prompt,"Integer Input", yMean)
  If y >= yMin And y <= yMax Then Exit Do
  response = MsgBox("Input out of range", _
           vbAbortRetryIgnore, "Input Error")
  If response = vbAbort Then
     MsgBox "Program will halt" : Exit Sub
  ElseIf response = vbIgnore Then
     Exit Do
  End If
Loop
```

Note: infinite loop requires Exit Do statement(s) somewhere

Error Message




```
response = MsgBox("Input = " & y & " is" _
 "outside allowed range of 1 <= response" _
 " <= 10",vbAbortRetryIgnore+vbExclamation, _
 "Input Error")
```


More on Argument Lists

- Some argument lists have optional arguments
  - These optional arguments have default values which need not be entered by user
- Some methods have a very large number of arguments many of which are optional
- It is possible to specify only the arguments you want to a function

Example: Add a worksheet

- Here is the method and its parameters
  - Worksheets.Add(<before>,<after>, <count>,<type>)
  - All these arguments are optional
  - Worksheets.Add(,,2,) to add two worksheets
    - When <before> and <after> are both omitted, the new worksheet is added before the active worksheet
    - Could also use Worksheets.Add(count:=2)

Example: Add a worksheet II

- Worksheets.Add(<before>,<after>, <count>,<type>)
  - Worksheets.Add(,,2,)
  - Worksheets.Add(count:=2)
- This := method for specifying only some optional parameters is a general one
- Worksheets.add returns an optional object variable referring to the new work-sheet, e.g., wks = worksheets.add()