

Efficiency of Bubble and Shell Sorts

Array Elements	Bubble Sort Comparisons	Shell Sort Comparisons
5	10	17
10	45	57
15	105	115
20	190	192
25	300	302
30	435	364
50	1225	926
100	4950	2638
500	124,750	22,517
1000	499,500	58,460



• Efficiency of Sequential and Binary Search

Array Elements	Sequential Search Comparisons	Binary Search Comparisons
2000	1000 (Average)	11 (At most)



• Sequential Files

 Create a text file: Imports System.IO Dim sw As StreamWriter = File.CreateText(filespec) sw.WriteLine(datum) sw.Close()



Add items to a file: Imports System.IO
Dim sw As StreamWriter = File.AppendText(filespec)
sw.WriteLine(datum)
sw.Close()

 Open a file: Imports System.IO
 Dim sr As StreamReader = File.OpenText(filespec)
 sr.ReadLine()
 sr.Close()



Delete a file: Imports System.IO File.Delete(filespec)

 Move a file (change the filespec of a file) Imports System.IO
 File.Move(oldfilespec, newfilespec)

 Check existence of a file: Imports System.IO
 File.Exists(filespec)

• Declaring HashTable

• Dim MyHash As New Hashtable

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• Adding an element to the HashTable

- {hash table object}.Add(Key as Object, value as Object)
- Ex: MyHash.Add("George", 45)

• Accessing an element

{hash table object}.Item({key})

Ex: MyArray.Item("George")

• Searching for an element

• {hash table object}.Contains({key})

Ex: MyArray.Contains("George")

WEEK 9 – CHAPTER 9

CHAPTER 9 – ADDITIONAL CONTROLS AND OBJECTS

- 9.1 List Boxes, Combo Boxes, and the File-Opening Control
- 9.2 Seven Elementary Controls
- 9.3 Four Additional Objects
- 9.4 Graphics

THE LIST BOX CONTROL



THE LIST BOX CONTROL

- Items can be placed into the list at design time or run time
- The **Sorted** property allows items in the list to be sorted automatically
- If the Sorted property is set to True, then the following will place an item into the list in order and assign the index of its position to *num*:

num = lstBox.Items.Add(str)

USEFUL PROPERTIES OF THE LIST BOX

• The total number of items in a list box is given by

lstBox.Items.Count

• *Note:* Each item in lstBox is identified by an index number from 0 to lstBox.Items.Count – 1

- The index number of the currently highlighted item is given by:
 - lstBox.SelectedIndex

MORE LIST BOX PROPERTIES

olstBox.Items() is the list of items in the list box

• The value of the item with an index of *n* is: lstBox.Items(n)

• The data type of the elements in the lstBox.Items() array is Object. To display the first element of lstBox.Items in a text box:

txtBox.Text =

CStr(lstBox.Items(0))

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CURRENTLY HIGHLIGHTED ITEM IN A LIST BOXES

The currently highlighted item can be obtained as:

lstBox.Items(lstBox.SelectedIndex)

or

lstBox.Text

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REMOVING ITEMS FROM A LIST BOX

• To delete an item at a given location: lstBox.Items.RemoveAt(n)

• To delete the first occurrence of an item: lstBox.Items.Remove(str)

• To remove everything from a list box: lstBox.Items.Clear()

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LIST BOX EVENTS

Three main types of events with list boxes:

- 1. Click the user clicks on an item in the list box
- 2. SelectedIndexChanged the user clicks on an item or uses the arrow keys to select it
- 3. DoubleClick the user double-clicks on an item

All three events are triggered when the user doubleclicks on an item.

EXAMPLE 1: FORM



EXAMPLE 1: CODE

```
item = InputBox("Item to Add:")
```

```
lstOxys.Items.Add(item)
```

End Sub

```
Private Sub lstOxys_DoubleClick(...) _______
Handles lstOxys.DoubleClick
lstOxys.Items.RemoveAt(lstOxys.SelectedIndex)
txtSelected.Clear()
End Sub
```

FILLING A LIST BOX AT DESIGN TIME

• Click on the listbox.

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• Select the Items property of the list box.

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FILLING A LIST BOX AT DESIGN TIME

 Click on the ellipsis button on the right side of the Settings box. (A window titled String Collection Editor will be displayed.)

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FILLING A LIST BOX AT DESIGN TIME

- Type in the first item, and press Enter.
- Repeat Step 3 for each of the other items. 0
- When you are finished entering items, click on the OK button. 0

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USING AN ARRAY TO FILL A LIST BOX

The statement **lstBox.DataSource** = **arrayName** fills the list box with the elements of the array.

THE COMBO BOX CONTROL

- A list box combined with a text box
- The user has the option of filling the text box by selecting from a list or typing directly into the list box.
- Essentially same properties, events, and methods as a list box

- Form1	
Test test1 test2	
test3	
Test test1 test2	
	Button 1

9.2 SEVEN ELEMENTARY CONTROLS

- The Group Box Control
- The Check Box Control
- The Radio Button Control
- The Timer Control
- The Picture Box Control
- Scroll Bar Controls

THE GROUP BOX CONTROL

- Group boxes are passive objects used to group other objects together
- When you drag a group box, the attached controls follow as a unit
- To attach a control to a group box, create the group box, then drag the control you want to attach into the group box

GROUP BOX EXAMPLE

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THE CHECK BOX CONTROL

• Consists of a small square and a caption

- Presents the user with a Yes/No choice
- During run time, clicking on the check box toggles the appearance of a check mark
- Checked property is *True* when the check box is *checked* and *False* when it is *not*
- *CheckedChanged* event is triggered when the user clicks on the check box

EXAMPLE 1: FORM

🖳 Benefits Menu 📃 💷 🎫
Prescription Drug Plan (\$12.51)
Dental Plan (\$9.68)
Vision Plan (\$1.50)
Medical Plan (\$25.25)
Total monthly payment:

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EXAMPLE 1: CODE

Private Sub Tally(...) Handles chkDrugs.CheckedChanged, chkDental.CheckedChanged, chkVision.CheckedChanged, chkMedical.CheckChanged Dim sum As Double = 0If chkDrugs.Checked Then X 🖳 Benefits Menu sum += 12.51Prescription Drug Plan (\$12.51) End Tf If chkDental.Checked Then Dental Plan (\$9.68) sum += 9.68Vision Plan (\$1.50) End If Medical Plan (\$25.25) If chkVision.Checked Then sum += 1.5Total monthly payment: \$39.26 End If If chkMedical.Checked Then sum += 25.25End If txtTotal.Text = FormatCurrency(sum)

End Sub

THE RADIO BUTTON CONTROL

- Consists of a small circle with a caption (that is set by the Text property)
- Normally several radio buttons are attached to a group box
- Gives the user a single choice from several options
- Clicking on one radio button removes the selection from another

RADIO BUTTON PROPERTIES

• To determine if the button is on or off

radButton.Checked

has value True if button in on

• To turn a radio button on

radButton.Checked = True

EXAMPLE 2: FORM

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EXAMPLE 2: CODE

Private Sub btnVote_Click(...) Handles
 btnVote.Click

If radCandidate1.Checked Then
 txtVote.Text = "You voted for Kennedy."
ElseIf radCandidate2.Checked Then
 txtVote.Text = "You voted for Nixon."
Else
 txtVote.Text = "You voted for neither."

End If

End Sub

🖳 Vote for One						
President Kenr Nixo	nedy n					
Cast V	/ote					
You voted for	Kennedy.					

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THE TIMER CONTROL

- Invisible during run time
- Triggers an event after a specified period of time
- The Interval property specifies the time period measured in milliseconds
- To begin timing, set the Enabled property to True
- To stop timing, set the Enabled property to False
- The event triggered each time Timer1.Interval elapses is called Timer1.Tick

EXAMPLE 3: FORM

🖳 Stopwatch 👝 💷 💌	
Start	
Seconds:	— txtSeconds
Stop	

OBJECT	PROPERTY	SETTING
tmrWatch	Interval	100
	Enabled	False

EXAMPLE 3: CODE

```
Private Sub btnStart_Click(...) Handles
btnStart.Click
  txtSeconds.Text = "0" 'Reset watch
  tmrWatch.Enabled = True
End Sub
```

```
Private Sub btnStop_Click(...) Handles
    btnStop.Click
    tmrWatch.Enabled = False
End Sub
```

🖳 Stopwatch 💼 🔳 💌			
Start			
Seconds:			
Stop			

```
Private Sub tmrWatch_Tick(...) Handles
  tmrWatch.Tick
   txtSeconds.Text = CStr((CDbl(txtSeconds.Text)
   + 0.1))
End Sub
```

PIXELS

- The graphics unit of measurement is called a **pixel**.
- To get a feel for pixel measurement, place a picture box on a form and look at the picture box's *Size* property
 - The two numbers in the setting give the width and height of the picture box in pixels





COORDINATES IN A PICTURE BOX





THE PICTURE BOX CONTROL

• Designed to hold drawings and pictures

• To draw a blue rectangle inside the picture box with the upper left hand corner having coordinates (*x*, *y*), width *w*, and height *h*:

picBox.CreateGraphics.

DrawRectangle (Pens.Blue, x, y, w, h)

THE PICTURE BOX CONTROL

• To draw a blue circle with diameter *d*:

opicBox.CreateGraphics. DrawEllipse(Pens.Blue, x, y, d, d)

• The numbers *x* and *y* give the coordinates of the upper-left corner of a rectangle having the circle inscribed in it.

PICTURE BOX CONTAINING A RED CIRCLE



picBox.CreateGraphics. DrawEllipse(Pens.Red, 35, 35, 70, 70)

PICTURE BOX PROPERTIES

- A picture can be placed in a picture box control with the **Image** property
- Ο.
- Prior to setting the Image property, set the *SizeMode* property
 - *AutoSize* will cause the picture box control to be resized to fit the picture
 - *StretchImage* will cause the picture to be resized to fit the picture box control

PICTURE BOX AT RUN TIME

• A picture also can be assigned to a picture box control at run time:

picBox.Image = Image.FromFile(filespec)

• The SizeMode property can be altered at run time with a statement such as

picBox.SizeMode =
PictureBoxSizeMode.AutoSize

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THE HORIZONTAL AND VERTICAL SCROLL BARS



SCROLL BAR BEHAVIOR

- When the user clicks on one of the arrow buttons, the scroll box moves a small amount toward that button
- When the user clicks between the scroll box and one of the arrow buttons, the scroll box moves a large amount toward that button

• The user can also move the scroll box by dragging it.

SCROLL BAR PROPERTIES

• The main properties of a scroll bar control are

- Minimum
- Maximum
- Value
- SmallChange,
- LargeChange

• hsbBar.Value, a number between hsbBar.Minimum and hsbBar.Maximum, gives the location of the scroll box

SCROLL BAR NOTES

- The setting for the Minimum property must be less than the setting for the Maximum property
- The Minimum property determines the values for the left and top arrow buttons
- The Maximum property determines the values for the right and bottom arrow buttons

• The Scroll event is triggered whenever any part of the scroll bar is clicked

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9.3 FOUR ADDITIONAL OBJECTS

- The Clipboard Object
- The Random Class
- The MainMenu Control
- Multiple Forms

THE CLIPBOARD OBJECT

- Used to copy information from one place to another
- Maintained by Windows, so it can even be used with programs outside Visual Basic
- A portion of memory that has no properties or events

USING THE CLIPBOARD OBJECT

• To place something in the Clipboard: Clipboard.SetText(str)

oTo get something out of the Clipboard:
 str = Clipboard.GetText

To delete the contents of the Clipboard: Clipboard.SetText("")

THE RANDOM CLASS

- A random number generator declared with the statement:
 - Dim randomNum As New Random()
- If m and n are whole numbers and m < n then the following generates a whole number between m and n (including m, but excluding n)</p>
 randomNum.Next(m, n)

EXAMPLE 1

num3 = randomNum.Next(0, 10)

txtNumbers.Text = num1 & " " & num2 & " " & num3 End Sub

EXAMPLE 1: OUTPUT

Select Winning Numbers	🖳 DC Lottery	
Select Winning Numbers		
893	Select Winning Numbers	
	893	

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THE MENUSTRIP CONTROL

Used to create menus like the following:



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MENU EVENTS

- Each menu item responds to the Click event
- Click event is triggered by
 - the mouse
 - Alt + access key
 - Shortcut key

MULTIPLE FORMS

- Visual Basic programs can contain more than one form
- To add the new form, select Add Windows Form from the Project menu, to invoke the Add New Items dialog box.

ADD NEW ITEMS DIALOG BOX

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ADD NEW ITEMS DIALOG BOX

- Select Windows Form from the Installed Templates pane
- Optionally type in a name
- Press the Add button

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SOLUTION EXPLORER

 Both forms will be accessible through Solution Explorer



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VARIABLES AND MULTIPLE FORMS

- Variables declared in the Declarations section of a form with Public, instead of Dim, will be available to all forms in the program
- When a Public variable is used in another form, it is referred to by an expression such as

secondForm.variableName



🖳 Income	- • •	EXAMPLE 3			
Name:					
Total Income:					
Dete	emine Total Income	txtTotIncome			
FRMINCOME FRMSOURCES					
		Sources of Income 📃 🗖 💌			
		Wages:			
		Interest Income:			
		Dividend Income:			
		Compute Total Income			
Forr	nBorderStyle p	oroperty set to FixedDialog 68			

EXAMPLE 3: FRMINCOME'S CODE

Private Sub btnDetermine_Click(...) Handles_
 btnDetermine.Click

'Instantiate the second form Dim secondForm As New frmSources()

secondForm.ShowDialog() 'Show the second 'form and wait until it closes. Then 'execute the rest of the code in this 'procedure.

txtTotIncome.Text =
 FormatCurrency(secondForm.sum)
End Sub

EXAMPLE 3: FRMSOURCE'S CODE

Public sum As Double 'Holds the sum of the 'text boxes' values

'Store total into the Public variable sum sum = CDbl(txtWages.Text) + CDbl(txtIntIncome.Text) + CDbl(txtDivIncome.Text)

'Close the form as it is not needed anymore
Me.Close()
To
End Sub

9.4 GRAPHICS

- Graphics Objects
- Lines, Rectangles, Circles, and Sectors
- Pie Charts
- Bar Charts
- Animation

GRAPHICS OBJECTS

• Our objective is to draw bar charts and pie charts in a picture box

• A statement of the form

Dim gr As Graphics =
picBox.CreateGraphics

declares *gr* to be a Graphics object for the picture box picBox
PIXELS

• The graphics unit of measurement is called a **pixel**

• To get a feel for pixel measurement, place a picture box on a form and look at the picture box's Size property. The two numbers in the setting give the width and height in pixels.

COORDINATES IN A PICTURE BOX

• Each point in a picture box is identified by a pair of coordinates, (x, y).



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DISPLAY TEXT IN PICTURE BOX

```
Dim gr As Graphics =
picBox.CreateGraphics
gr.DrawString(string, Me.Font, ______
Brushes.Color, x, y)
```

• Displays *string* in the picture box. The upper-left corner of the text has coordinates (x, y), the font used is the Form's font, and the color of the text is specified by *color*

• Note: IntelliSense will provide a list of colors

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DISPLAY TEXT

Dim gr As Graphics = picBox.CreateGraphics Dim strVar As String = "Hello" gr.DrawString(strVar, Me.Font, Brushes.Blue, 4, 30) gr.DrawString("World", Me.Font, Brushes.Red, 35, 50)



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DRAW A LINE IN A PICTURE BOX

Dim gr As Graphics = picBox.CreateGraphics gr.DrawLine(Pens.Color, x1, y1, x2, y2)

• draws a line in the specified color from (x1, y1) to (x2, y2)

DRAW A LINE

Dim gr As Graphics = picBox.CreateGraphics gr.DrawLine(Pens.Blue, 50, 20, 120, 75)



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DRAW A SOLID RECTANGLE IN A PICTURE BOX

Dim gr As Graphics = picBox.CreateGraphics
gr.FillRectangle(Brushes.Color, x, y, w, h)

• draws a solid rectangle of width *w* and height *h* in the color specified and having the point with coordinates (x, y) as its upper-left corner

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DRAW A SOLID RECTANGLE IN A PICTURE BOX

Dim gr As Graphics = picBox.CreateGraphics
gr.FillRectangle(Brushes.Blue, 50, 20, 70, 55)



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DRAW A SOLID ELLIPSE IN A PICTURE BOX

Dim gr As Graphics = picBox.CreateGraphics
gr.FillEllipse(Brushes.Color, x, y, w, h)

• draws a solid ellipse in the color specified inscribed in the rectangle described by the values *x*, *y*, *w*, and *h*

• Note: When *w* = *h*, the ellipse is a circle. This is the only type of ellipse we will consider

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DRAW A SOLID ELLIPSE

• The statement

gr.FillEllipse(Brushes.Color, a - r, b - r, 2 * r, 2 * r)

• draws a solid circle in the color specified with center (a, b) and radius *r*

• For example,

• Draws a solid blue circle of radius 40 and center (80, 50)

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A SECTOR OF A CIRCLE

A sector of a circle (shown below as upper-left sector) is specified by two angles, θ_1 (the start angle) and θ_2 (the sweep angle).



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DRAW A SECTOR

• The statement

gr.FillPie(Brushes.Color, a - r, b - r, _____ 2 * r, 2 * r, startAngle, sweepAngle)

- draws a solid sector of a circle with center (*a*, *b*), radius *r*, and having the specified startAngle and sweepAngle
- The color of the sector is determined by the value of *Color*

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BRUSHES, PENS, AND FONTS

- Variables can be used for brushes, pens, and fonts. For example, the statement
- gr.FillRectangle(Brushes.Blue,
 50,20,70,55)
- o can be replaced with
- Dim br As Brush = Brushes.Blue
- gr.FillRectangle(br, 50, 20, 70, 55)

FINANCING PUBLIC SCHOOLS DATA

	Amount (in billions)	Percent
Federal	\$33	8%
State	\$206	49%
Local	\$180	43%

FINANCING PUBLIC SCHOOLS PIE CHART



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CREATE THE PIE CHART

Dim gr As Graphics = picBox.CreateGraphics Dim percent() As Single = $\{.08, .49, .43\}$ Dim br() As Brush = {Brushes.Blue, Brushes.Red, Brushes.Tan} Dim sumOfSweepAngles As Single = 0 For i As Integer = 0 To 2gr.FillPie(br(i), 5, 5, 200, 200, sumOfSweepAngles, percent(i) * 360) sumOfSweepAngles += percent(i) * 360 Next

FINANCING PUBLIC SCHOOLS BAR CHART



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FINANCING PUBLIC SCHOOLS BAR CHART

- Suppose the *x*-axis is 110 pixels below the top of the picture box
- Let the unit for the rectangle heights be .5 pixels
- Then the top of a rectangle corresponding to the quantity q is 110 q/2 pixels from the top of the picture box

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CREATE THE BAR CHART

Dim gr As Graphics = picBox.CreateGraphics
Dim quantity() As Single = {33, 206, 180}
'Draw x-axis

gr.DrawLine(Pens.Black, 40, 110, 210, 110) 'Draw y-axis

ANIMATION

 Place an image into a picture box, and move the picture box a small distance with each tick of a Timer control



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MOVE BALL

• The following code moves the ball along a diagonal with each tick of the timer

Private Sub Timer1_Tick(...) Handles _____

Timer1.Tick
 picBall.Left += 1
 picBall.Top += 1
End Sub

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