MFC Windows Programming: Document/View Approach

- More detailed notes at:

  http://www.cs.binghamton.edu/~reckert/360/class15.htm

MFC Windows Programming: Document/View Approach

- App/Window approach creates application and window objects
- Mirrors Win32 API program organization
- Main difference--MFC automates & masks details
- But data & rendering of data are intertwined
- Frequently, data members exist in window class
  - Example in MSGNEW.CPP: Output string defined in window-based class
    - But output string is data
    - Really has nothing to do with window it's being displayed in

- Conceptually data is different from rendering of data
- In an App/Window they are mixed together in same window class
- Frequently need to have different views of same data
  - (e.g., displaying data in a window or on a printer)
- So it would be good to separate data and data presentation

Doc/View Achieves Separation of Data and Data Presentation

- Encapsulates data in a ***CDocument*** class object
- Encapsulates data display mechanism and user interaction with it in a ***CView*** class object
- Classes derived from ***CDocument***
  - Should handle anything affecting an application's data
- Classes derived from ***CView***
  - Should handle display of data and user interactions with that display

Other Classes are Still Needed

- Still need to create ***CFrameWnd*** and ***CWinApp*** classes
- But their roles are reduced

Documents

- **Document**
  - Contain any forms of data associated with the application (pure data)
  - Not limited to text
  - Could be anything
    - game data, graphical data, etc.

Document Interfaces

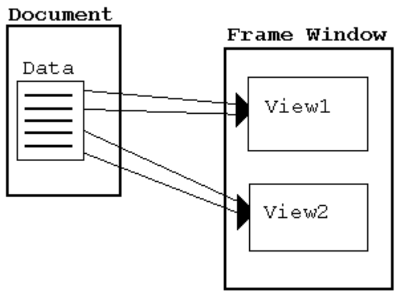
- **Single Document interface** (**SDI**) application
  - Program that deals with one document at a time
  - All our programs to date have been **SDI** apps
- **Multiple Document Interface** (**MDI**) application
  - Program organized to handle multiple documents simultaneously
  - More than one document can be displayed in a window at the same time
  - Example of an **MDI** application: Microsoft Word

Views

- A rendering of a document; a physical representation of the data
- Provides mechanism for displaying data stored in a document
- Defines how data is to be displayed in a window
- Defines how the user can interact with it

Frame Window

- Window in which a view of a document is displayed
- A document can have multiple views associated with it
  - different ways of looking at the same data
- But a view has only one document associated with it

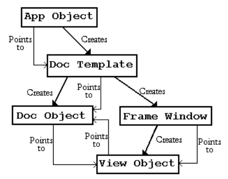


Documents, Views, & Frames

MFC Template Class Object

- Handles coordination between documents, views, and frame windows
- In general:
  - Application object creates a template...
  - which coordinates display of document's data…
  - in a view…
  - inside a frame window

Template/Document/View/Window



Relationship between Application, Document Template, Document, Frame Window, & View in a Document/View Approach MFC Program.

Serialization

- ✍ Provides for storage/retrieval of document data
- ✍ Usually to/from a disk file
- ✍ ***CDocument*** class has serialization built into it
  - – So in DOCUMENT/VIEW apps, saving/storing data is straightforward

Dynamic Creation

- ✍ In Doc/View approach, objects are dynamic
- ✍ Doc/View program is run
  - – Its frame window, document, and view are created dynamically
  - – Doc/View objects synthesized from file data
  - – Need to be created at load time
  - – To allow for dynamic creation, use dynamic creation macros
    - • in classes derived from ***CFrameWnd, CDocument***, and ***CView***)

Dynamic Creation Macros

- ✍ ***DECLARE_DYNCREATE(class_name)***
  - – in declaration (.h file)
- ✍ ***IMPLEMENT_DYNCREATE(class_name, parent_class_name)***
  - – (in .cpp file)
- ✍ ***After IMPLEMENT_DYNCREATE()*** macro is invoked:
  - – Class is enabled for dynamic creation
  - – Now a template can be created

Document/View Programs

- ✍ Almost always have at least four classes derived from:
  - – ***CFrameWnd***
  - – ***CDocument***
  - – ***CView***
  - – ***CWinApp***
- ✍ Usually put into separate declaration (.h) and implementation (.cpp) files
- ✍ Because of template and dynamic creation, there's lots of initialization
- ✍ Could be done by hand, but nobody does it that way

Microsoft Developer Studio AppWizard and ClassWizard Tools

AppWizard

- ✍ Tool that generates a Doc/View MFC program framework automatically
- ✍ Can be built on and customized by programmer
- ✍ Fast, efficient way of producing Windows Apps
- ✍ Performs required initialization automatically
- ✍ Creates functional ***CFrameWnd, CView, CDocument, CWinApp*** classes
- ✍ After AppWizard does it's thing:
  - – Application can be built and run
  - – Full-fledged window with all common menu items, tools, etc.

ClassWizard

- Facilitates message handling in a framework-based MFC application
- A tool that connects resources & user-generated events to program response code
- Writes C++ skeleton routines to handle messages
- Inserts code into appropriate places in program
- Code then can then be customized by hand
- Can be used to create new classes or derive classes from MFC base classes
- Add new member variables/functions to classes
- In .NET many "class wizards" are available through Properties window

SKETCH Application

- Example of Using AppWizard and ClassWizard
- User can use mouse as a drawing pencil
  Left mouse button down:
  - lines in window follow mouse motion
- Left mouse button up:
  - sketching stops
- User clicks "Clear" menu item
  - window client area is erased

- Sketch data (points) won't be saved
  - So leave document (***CSketchDoc)*** class created by AppWizard alone
- Base functionality of application (***CSketchApp)*** and frame window (***CMainFrame)*** classes are adequate
  - Leave them alone
- Use ClassWizard to add sketching to ***CView*** class

Sketching Requirements

- If left mouse button is down:
  - Each time mouse moves:
    - Get a DC
    - Create a pen of drawing color
    - Select pen into DC
    - Move to old point
    - Draw a line to the new point
    - Make current point the old point
    - Select pen out of DC

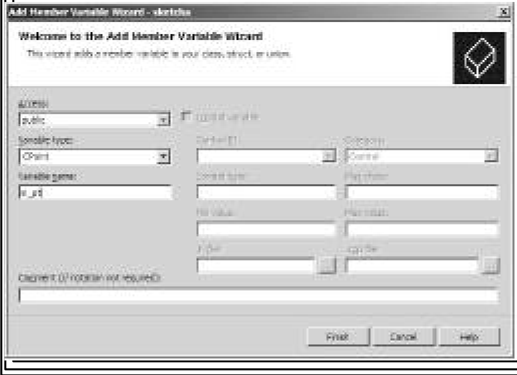
Variables

- BOOLEAN m_butdn
- CPoint m_pt, m_ptold
- COLORREF m_color
- CDC* pDC

Steps in Preparing SKETCH

- 1. "File / New / Project"
  - Project Type: "Visual C++ Projects"
  - Template: "MFC Application"
  - Enter name: Sketch
- 2. In "Welcome to MFC Application Wizard"
  - Choose "Single Document" Application Type
- 3. Build App --> Full-fledged SDI App with empty window and no functionality
- 4. Add member variables to CSketchView
  - Can do manually in .h file

- 4. Easier to:
  - Select Class View pane in Properties window
  - Select and expand (+) SketchView class
    - Note member functions & variables
  - Right click on CSketchView class
    - Choose "Add / Variable"
      - Launches "Member Variable Wizard" Dialog Box
    - Variable Type: enter CPoint
    - Name: m_pt
    - Access: Public (default)
  - Repeat for other variables:
    - CPoint m_ptold
    - bool m_butdn
    - COLORREF m_color
    - CDC* pDC


Add Member Variable Wizard - sketch

Welcome to the Add Member Variable Wizard

This wizard adds a member variable to your class, struct, or union.

Access: public

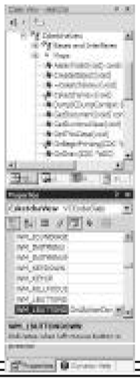
Variable type: CPoint

Variable name: m_pt

Comment (// notation not required):

- 4. Add message handler functions:
  - Select CSketchView in Class View
  - Select "Messages" icon in Properties window
    - Results in a list of WM_ messages
  - Scroll to WM_LBUTTONDOWN & select it
  - Add the handler by clicking on "<Add> OnLButtonDown" in resulting combo box
    - Note that the function is added in the edit window and the cursor is positioned over it:
      - After "TODO…" enter following code:

```
m_butdn = TRUE;
m_ptold = point;
```



- Repeat process for WM_LBUTTONUP handler
  - Scroll to WM_LBUTTONUP
  - Click: "<Add> OnLButtonUp",
  - Edit Code by adding:

```
m_butdn = FALSE;
```

- Repeat for WM_MOUSEMOVE
  - Scroll to WM_MOUSEMOVE
  - Click: "<Add> OnMouseMove"
  - Edit by adding code:

```
if (m_butdn)
{
      pDC = GetDC();
      m_pt = point;
      CPen newPen (PS_SOLID, 1, m_color);
      CPen* pPenOld = pDC->SelectObject (&newPen);
      pDC->MoveTo (m_ptold);
      pDC->LineTo (m_pt);
      m_ptold = m_pt;
      pDC->SelectObject (pPenOld);
}
```

- 5. Initialize variables in CSketchView constructor
  - Double click on CSketchView constructor (in Class View)
  - After “TODO…”, Add code:

```
m_butdn = FALSE;
m_pt = m_ptold = CPoint(0,0);
m_color = RGB(0,0,0);
```

- 6. Build Project and Run

Menus and Command Messages

- User clicks on menu item
- WM_COMMAND message sent
- IDM_XXX identifies which menu item
- No predefined handlers
- So message mapping macro is different
- ON_COMMAND(IDM_XXX, OnXxx)
  - OnXxx() is the handler function
  - Must be declared in .h file and defined in .cpp file

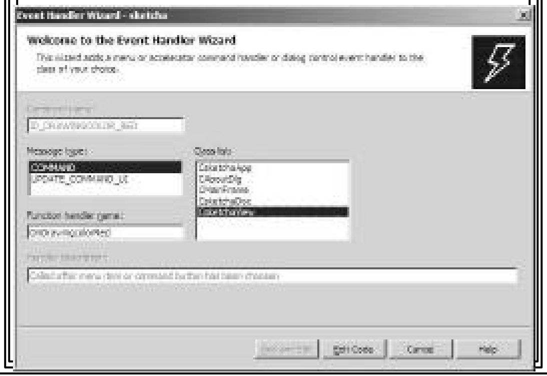
Adding Color and Clear Menu Items to SKETCH App

- Resource View (sketch.rc folder)
  - Double click Menu folder
  - Double click IDR_MAINFRAME menu
  - Add: “Drawing Color” popup menu item with items:
    - “Red” (ID_DRAWINGCOLOR_RED)
    - “Blue” (ID_DRAWINGCOLOR_BLUE)
    - “Green” (ID_DRAWINGCOLOR_GREEN)
    - “Black” (ID_DRAWINGCOLOR_BLACK)
  - Add another main menu item:
    - “Clear Screen” (ID_CLEAR)

Add Menu Item Command Handler Function

- One way: Use “Event Handler Wizard”
- In “Resource View” bring up menu editor
- Right click on “Red” menu item
- Select “Add Event Handler” ✍ “Event Handler Wizard” dialog box
  - Class list: CSketchView
  - Message type: COMMAND
  - Function handler name: accept default
    - OnDrawingColorRed
  - Click on “Add and edit”
  - After “TODO…” in editor enter following code:

```
m_color = RGB(255,0,0);
```


Event Handler Wizard - sketcha

Welcome to the Event Handler Wizard

This wizard adds a menu or accelerator command handler or dialog control event handler to the class of your choice.

Command name: ID_DRAWINGCOLOR_RED

Message type: COMMAND, UPDATE_COMMAND_UI

Class list: CSketchaApp, CAboutDlg, CMainFrame, CSketchaDoc, CSketchaView

Function handler name: OnDrawingColorRed

Handler description: Called after menu item or command button has been chosen

Another Method of Adding a Menu Item Command Handler

- In Class View Select CSketchView
- In Properties window select Events (lightning bolt) icon
- Scroll down to: ID_DRAWINGCOLOR_RED
- Select “Command”
- Accept “OnDrawingColorRed” handler
- Edit code by adding:
  m_color = RGB(255,0,0);

Repeat for ID_DRAWINGCOLOR_BLUE
  Code: m_color = RGB(0,0,255);

Repeat for ID_DRAWINGCOLOR_GREEN
  Code: m_color = RGB(0,255,0);

Repeat for ID_DRAWINGCOLOR_BLACK
  Code: m_color = RGB(0,0,0);

Repeat for ID_CLEAR
  Code: Invalidate();