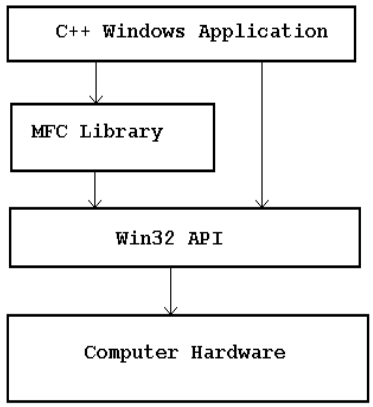
Windows Programming with MFC

MFC Programming

- MFC: The Microsoft Foundation Class Library
- Additional Notes:
  http://www.cs.binghamton.edu/~reckert/360/class14.htm
  http://www.cs.binghamton.edu/~reckert/360/class15.htm
  http://www.cs.binghamton.edu/~reckert/360/10.html

MFC

- The Microsoft Foundation Class (MFC) Library--
  - A Hierarchy of C++ classes designed to facilitate Windows programming
  - An alternative to using Win32 API functions
  - A Visual C++ Windows app can use either Win32 API, MFC, or both



The Relationship between Windows MFC and Win32 API Programming

Some Characteristics of MFC

- Offers convenience of REUSABLE CODE
  - Many tasks in Windows apps are provided by MFC
  - Programs can inherit and modify this functionality as needed
  - MFC handles many clerical details in Windows pgms
  - Functionality encapsulated in MFC Classes
- Produce smaller executables
- Can lead to faster program development
- MFC Programs must be written in C++ and require the use of classes
  - Programmer must have good grasp of OO concepts

Help on MFC Classes

- See Online Help (Index) on:

  "MFC"

  "Hierarchy"

  "Hierarchy Chart"

  "MFC Reference"
- On the Web:

  http://msdn.microsoft.com/en-us/library/d06h2x6e(VS.80).aspx

Base MFC Class

- ***CObject:*** At top of hierarchy ("Mother" of almost all MFC classes)
- Provides features like:
  - Serialization
  - Runtime class information
  - Diagnostic & Debugging support
  - Some important macros
- All its functionality is inherited by any classes derived from it

Some Important Derived Classes

- ***CFile***
- ***CDC***
- ***CGdiObject***
- ***CMenu***

- ***CCmdTarget:*** Encapsulates message passing process and is parent of:
  - ***CWnd***
    - Base class from which all windows are derived
    - Encapsulates many important windows functions and data members
    - Examples:
      - m_hWnd stores the window's handle
      - *Create(…)* creates a window
  - Most common subclasses:
    - ***CFrameWindow***
    - ***CView***
    - ***CDialog***

- ***CCmdTarget*** also parent of:
  - ***CWinThread:*** Defines a thread of execution and is the parent of:
    - ***CWinApp***
      - Encapsulates an MFC application
      - Controls following aspects of Windows programs:
        - Startup, initialization, execution, the message loop, shutdown
        - An application should have one CWinApp object
        - When instantiated, application begins to run
  - ***CDocument***

Primary task in writing an MFC program

- **To create/modify classes**
- **Most will be derived from MFC library classes**

MFC Class Member Functions

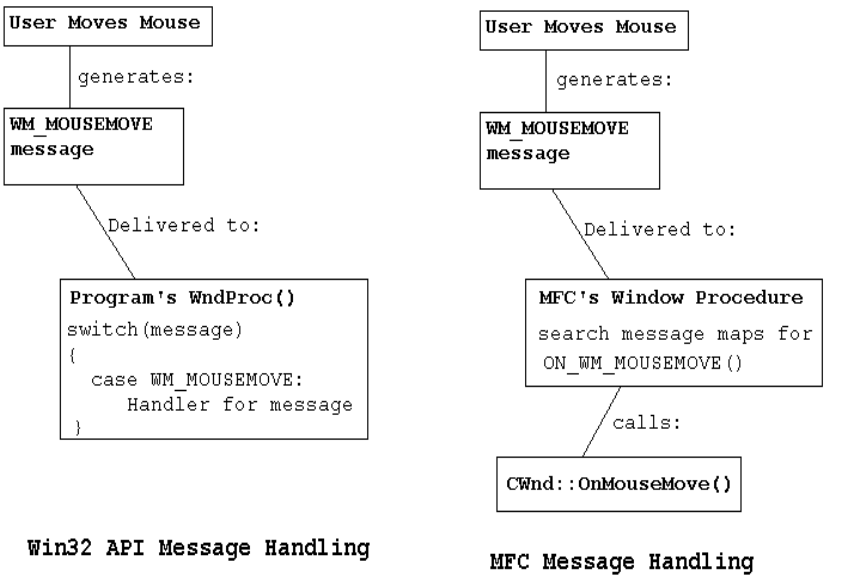
- Most functions called by an application will be members of an MFC class
- Examples:
  - *ShowWindow()*--a member of CWnd class
  - *TextOut()*--a member of CDC
  - *LoadBitmap()*--a member of CBitmap
- Applications can also call API functions directly
  - Use “global scope resolution” operator ::
    - Example ::UpdateWindow(hWnd);

MFC Global Functions

- Not members of any MFC class
- Independent of or span MFC class hierarchy
- Example:
  - *AfxMessageBox()*

Message Processing under MFC

- API mechanism: switch/case statement in app's WndProc
- Under MFC, WndProc is buried in MFC framework
- Message handling mechanism: "**Message Maps**"
  - lookup tables the MFC WndProc searches
- A Message Map contains:
  - A Message number
  - A Pointer to a message-processing function
    - These are members of CWnd
    - You override the ones you want your app to respond to
    - Like virtual functions
  - "Message-mapping macros" set these up



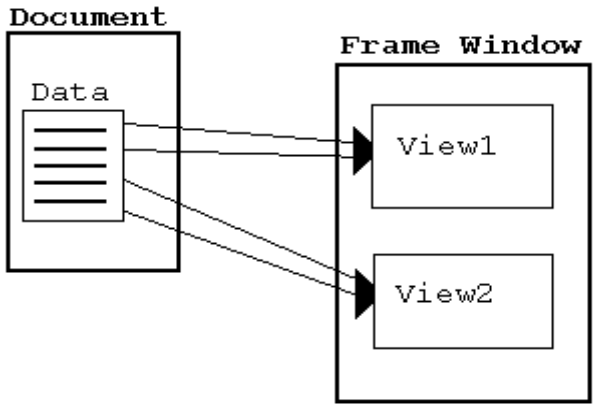
MFC Windows Programming (App/Window Approach)

- Simplest MFC programs must contain two classes derived from the hierarchy:
  - 1. An application class derived from ***CWinApp***
    - Defines the application
    - provides the message loop
  - 2. A window class usually derived from ***CWnd*** or ***CFrameWnd***
    - Defines the application's main window
- To use these & other MFC classes you must have: #include <Afxwin.h> in the .cpp file

MFC Windows Programming (Document/View Approach)

- Frequently need to have different views of same data
- Doc/View approach achieves this separation:
  - Encapsulates data in a *CDocument* class object
  - Encapsulates data display mechanism & user interaction in a *CView* class object

Relationship between Documents, Views, and Windows



Documents, Views, & Frames

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
- Lots of initialization code
- 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
- 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.

Other Visual Studio Wizards

- Dialog boxes that assist in generating code
  - Generate skeleton message handler functions
    - Set up the message map
  - Connect resources & user-generated events to program response code
  - Insert code into appropriate places in program
    - Code then can then be customized by hand
  - Create new classes or derive classes from MFC base classes
  - Add new member variables/functions to classes
- In .NET many wizards 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 CSketch***View*** class

Sketching Requirements

- Each time mouse moves:
  - If left mouse button is down:
    - 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

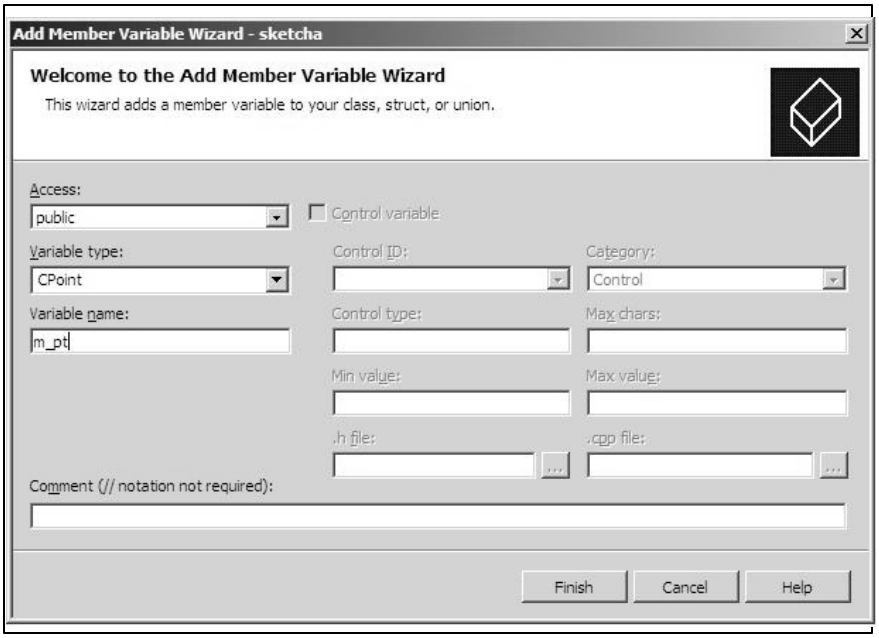
Variables

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

Steps in Preparing SKETCH

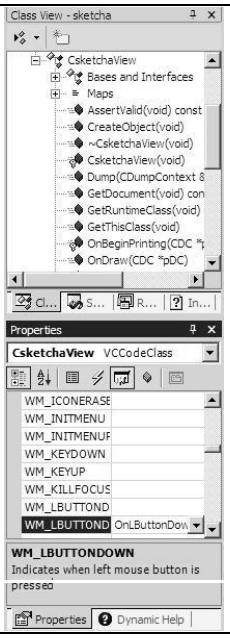
1. "File" / "New" / "Project"
   - Project Type: "Visual C++ Projects"
   - Template: "MFC Application"
   - Enter name: Sketch
2. In "Welcome to MFC Application Wizard"
   - Application type: "Single Document" Application
   - Take defaults for all other screens
3. Build Application --> Full-fledged SDI App with empty window and no functionality

4. Add member variables to CSketchView
   - Can do manually in .h file
   - Easier to:
     - Select Class View pane
     - Click on SketchView class
       - Note member functions & variables
     - Right click on CSketchView class
       - Choose "Add / Variable"
         - Launches "Add Member Variable Wizard"
       - Variable Type: enter CPoint
       - Name: m_pt
       - Access: Public (default)
         - Note after "Finish" that it's been added to the .h file
     - Repeat for other variables (or add directly in .h file):
       - CPoint m_ptold
       - bool m_butdn
       - COLORREF m_color
       - CDC* pDC



5. 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 down arrow and “<Add> OnLButtonDown”
     - 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);
}
```

6. Initialize variables in CSketchView constructor

- Double click on CSketchView constructor
  - CSketchView(void) in Class View
- After "TODO…", Add code:

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

7. Changing Window's Properties
   - Use window's SetWindowXxxxx() functions
     - In CWinApp-derived class before window is shown and updated
   - Example: Changing the default window title

```
m_pMainWnd->SetWindowTextW(
        TEXT("Sketching Application"));
```

   - There are many other SetWindowXxxxx() functions that can be used to change other properties of the window

8. Build and run the application

Menus and Command Messages

- User clicks on menu item
- WM_COMMAND message is sent
- ID_XXX identifies which menu item (its ID)
- No predefined handlers
  - We write the OnXxx() handler function
  - Must be declared in .h file and defined in .cpp file
- Event handler wizard facilitates this

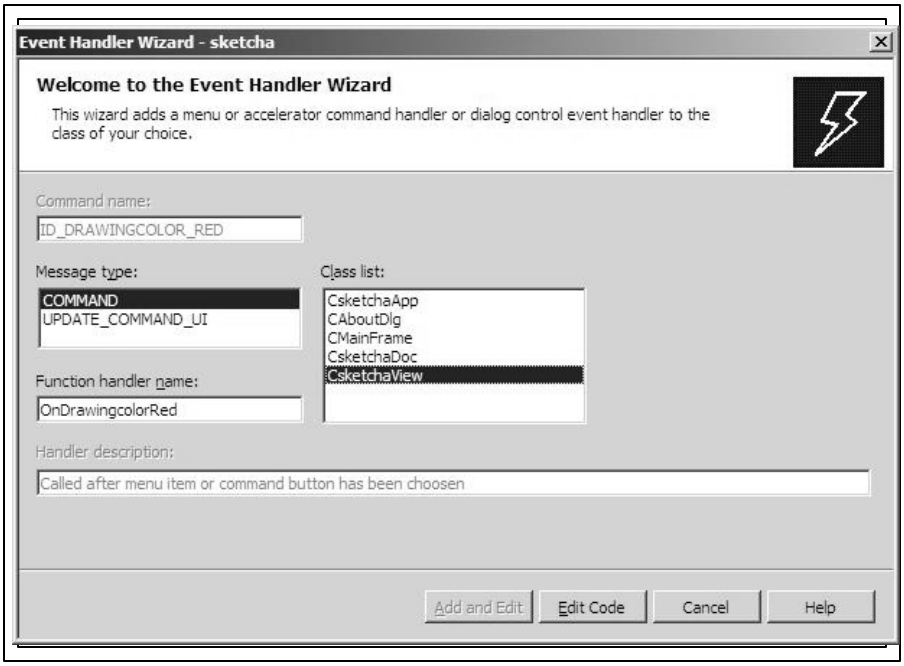
Adding Color and Clear Menu Items to SKETCH App

- Resource View (sketch.rc folder)
  - Double click Menu folder
  - Double click IDR_MAINFRAME menu
  - Add: “Drawing Color” popup menu item with items:
    - “Red”, ID_DRAWING_COLOR_RED (default ID)
    - “Blue”, ID_DRAWINGCOLOR_BLUE
    - “Green”, ID_DRAWINGCOLOR_GREEN
    - “Black”, ID_DRAWINGCOLOR_BLACK
  - Add another main menu item:
    - “Clear Screen”, ID_CLEARSCREEN
      - Set Popup property to False

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:

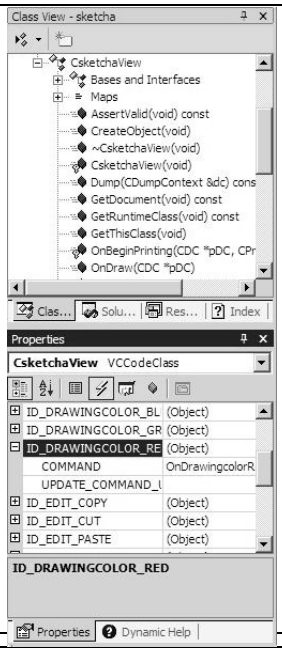
    m_color = RGB(255,0,0);



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”
- Click “<Add> 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();

Destroying the Window

- Just need to call *DestroyWindow()*
  - Do this in the CMainFrame class – usually in response to a “Quit” menu item

Build and Run the Application