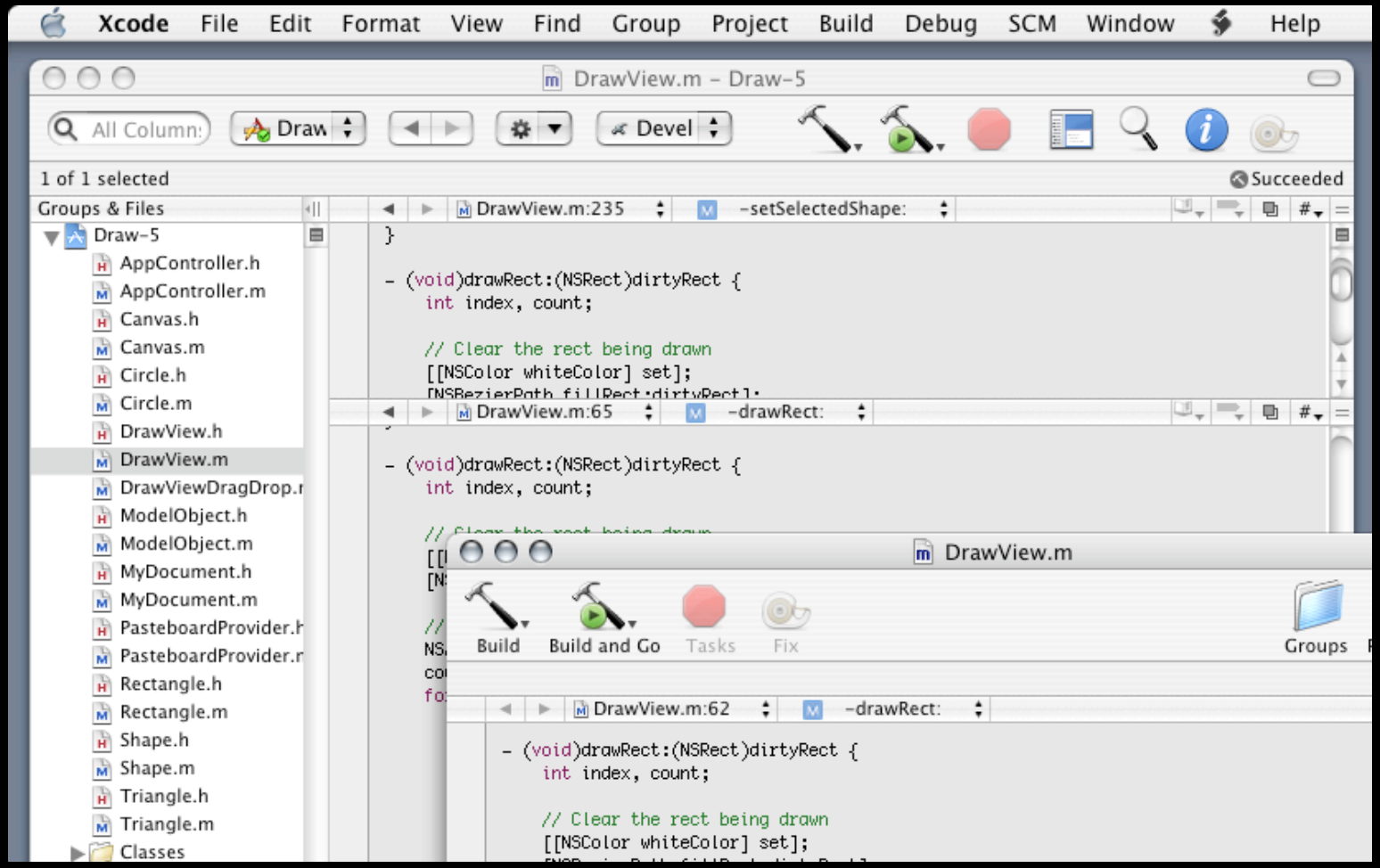
CS193E
Lecture 17

Multiple Document Windows
OpenGL & Cocoa

Multiple Views onto a Model

Xcode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DrawView.m – Draw-5
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Draw-5
AppController.h
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Canvas.h
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DrawView.h
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ModelObject.h
ModelObject.m
MyDocument.h
MyDocument.m
PasteboardProvider.h
PasteboardProvider.r
Rectangle.h
Rectangle.m
Shape.h
Shape.m
Triangle.h
Triangle.m
Classes
DrawView.m:235
-setSelectedShape:
}
- (void)drawRect:(NSRect)dirtyRect {
int index, count;
// Clear the rect being drawn
[[NSColor whiteColor] set];
DrawView.m:65
-drawRect:
- (void)drawRect:(NSRect)dirtyRect {
int index, count;
DrawView.m
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Tasks
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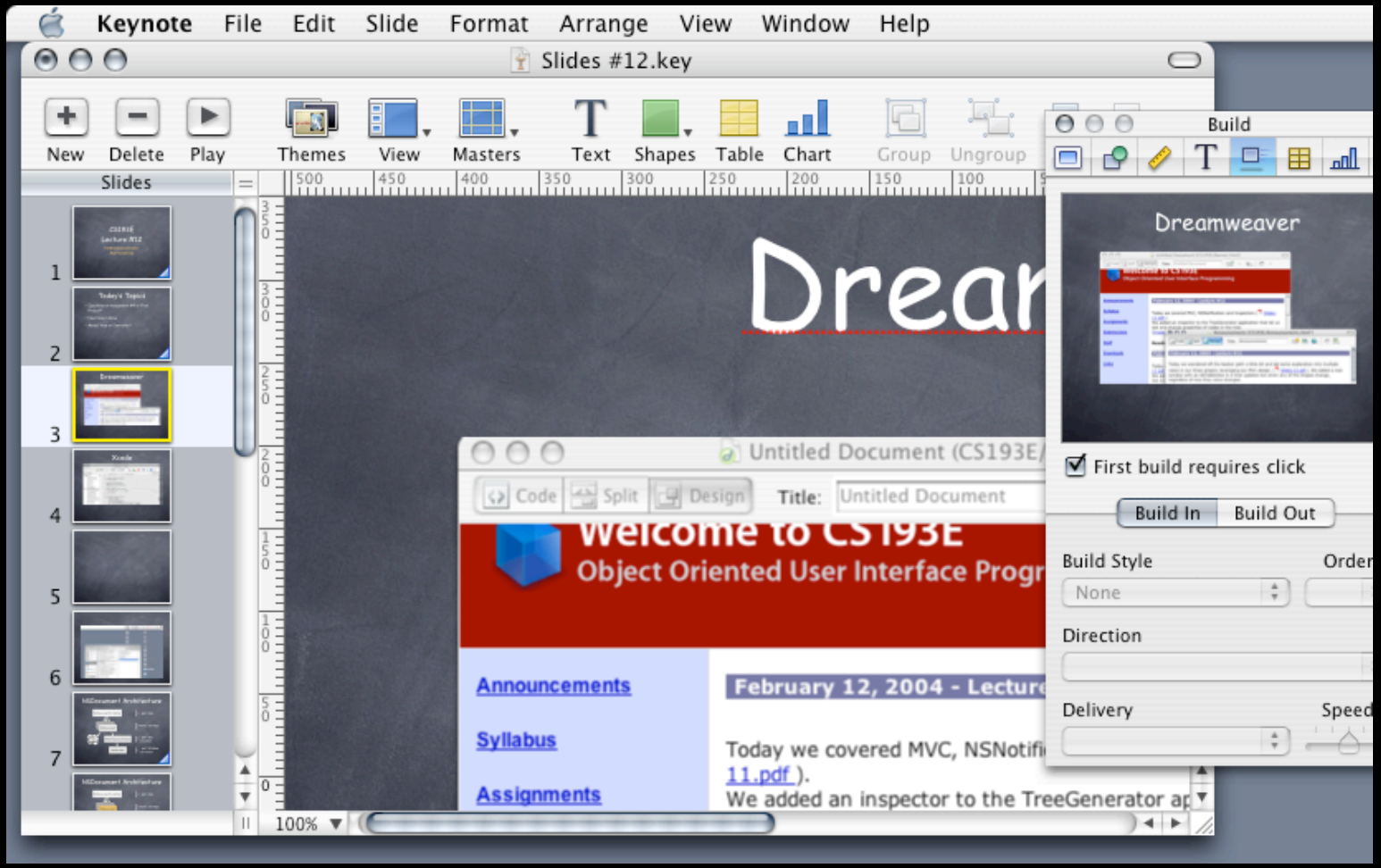
Groups
DrawView.m:62
-drawRect:
- (void)drawRect:(NSRect)dirtyRect {
int index, count;
// Clear the rect being drawn
[[NSColor whiteColor] set];

Keynote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Untitled Document (CS193E/
Code Split Design Title: Untitled Document
Welcome to CS193E
Object Oriented User Interface Progr
Announcements
Syllabus
Assignments
February 12, 2004 - Lecture
Today we covered MVC, NSNotifi
11.pdf).
We added an inspector to the TreeGenerator ap
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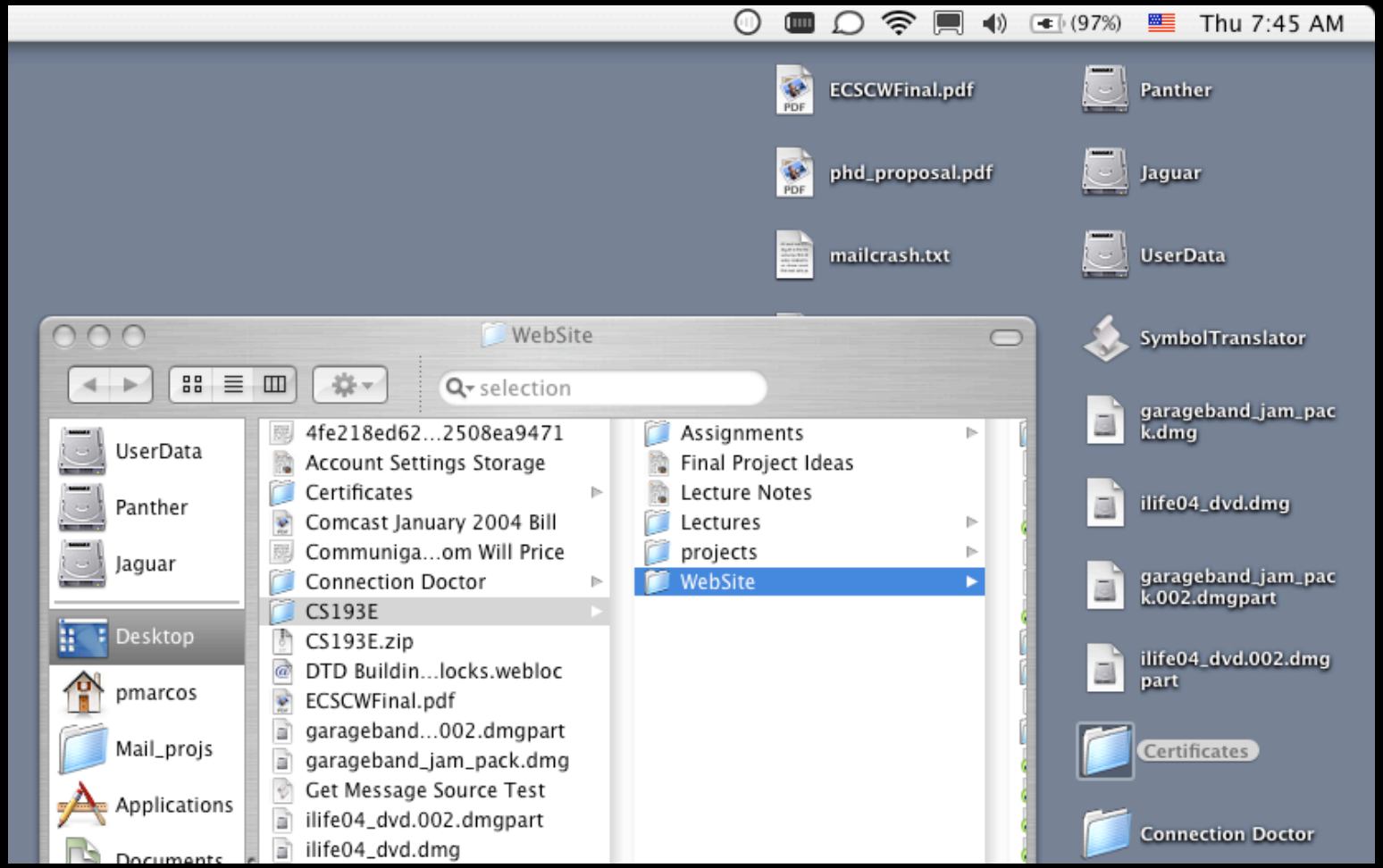
Finder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Final Project Ideas
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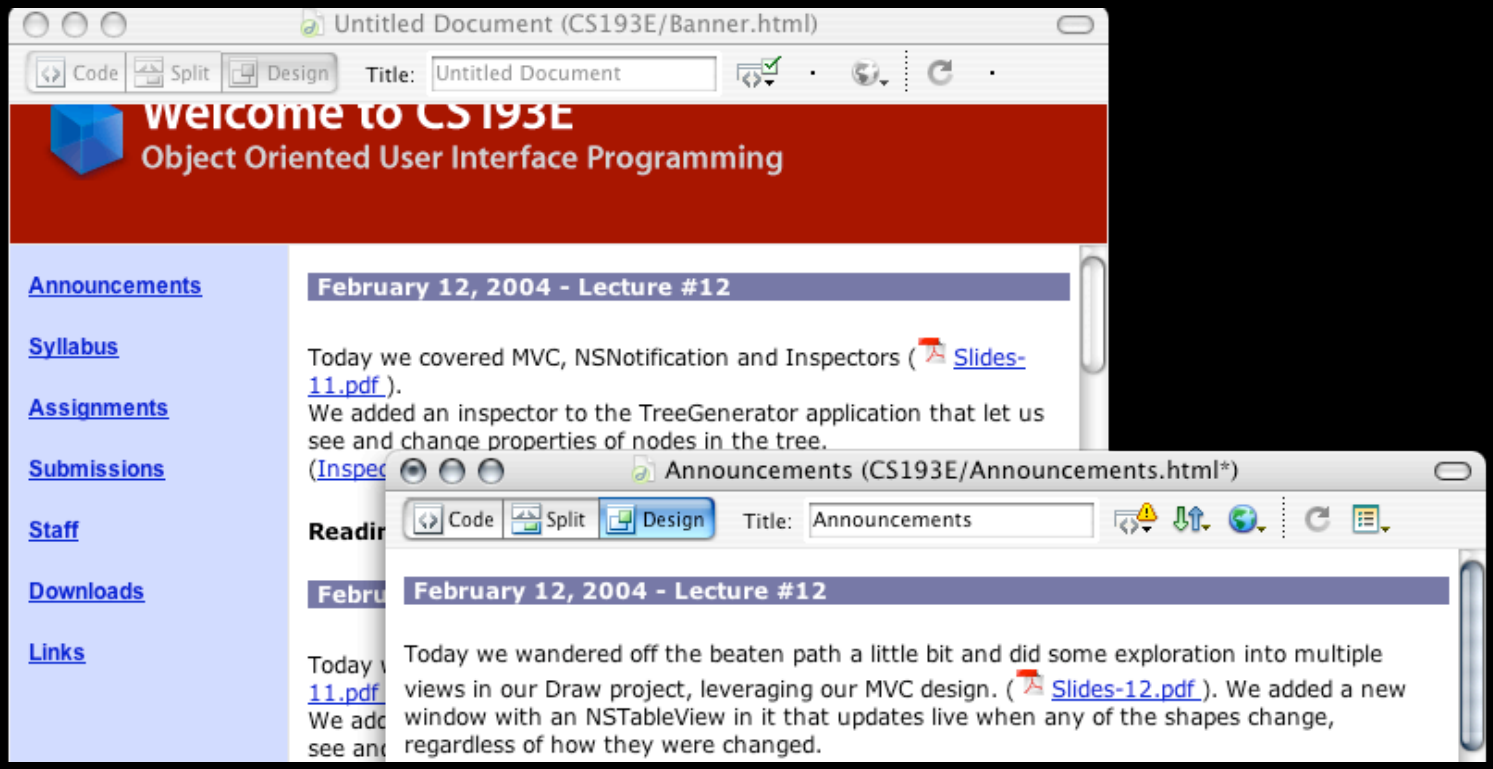
Dreamweaver



TreeGenerator 3D

NSDocument Architecture

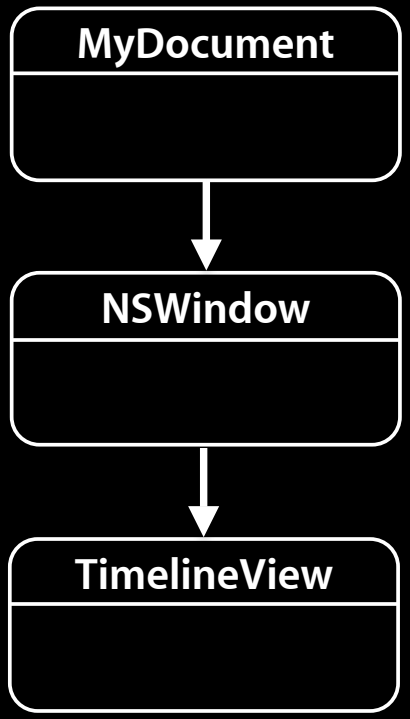
- Supports two approaches:
  - Simple, single window document
  - More complex multi-window document
- We've used the simple model so far
- Today we'll see how to extend it to support multiple windows for a single document

Planning Ahead

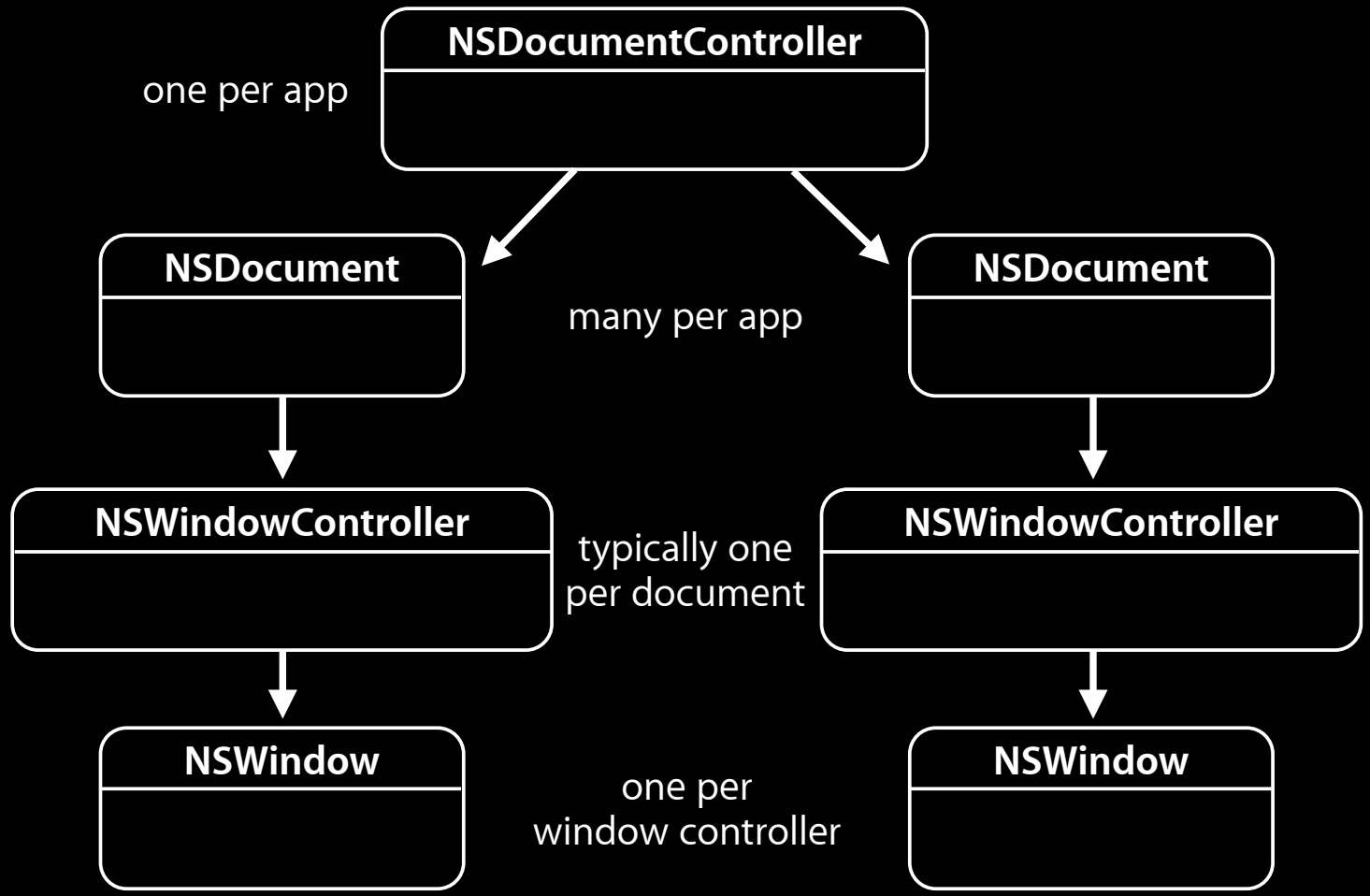
- Make sure your model is isolated
  - Write a command line tool
  - Write a separate test app
  - Can you do it without linking against AppKit framework?
- Make a diagram of your object relationships
- Keep your Model separated!

Timeline Architecture

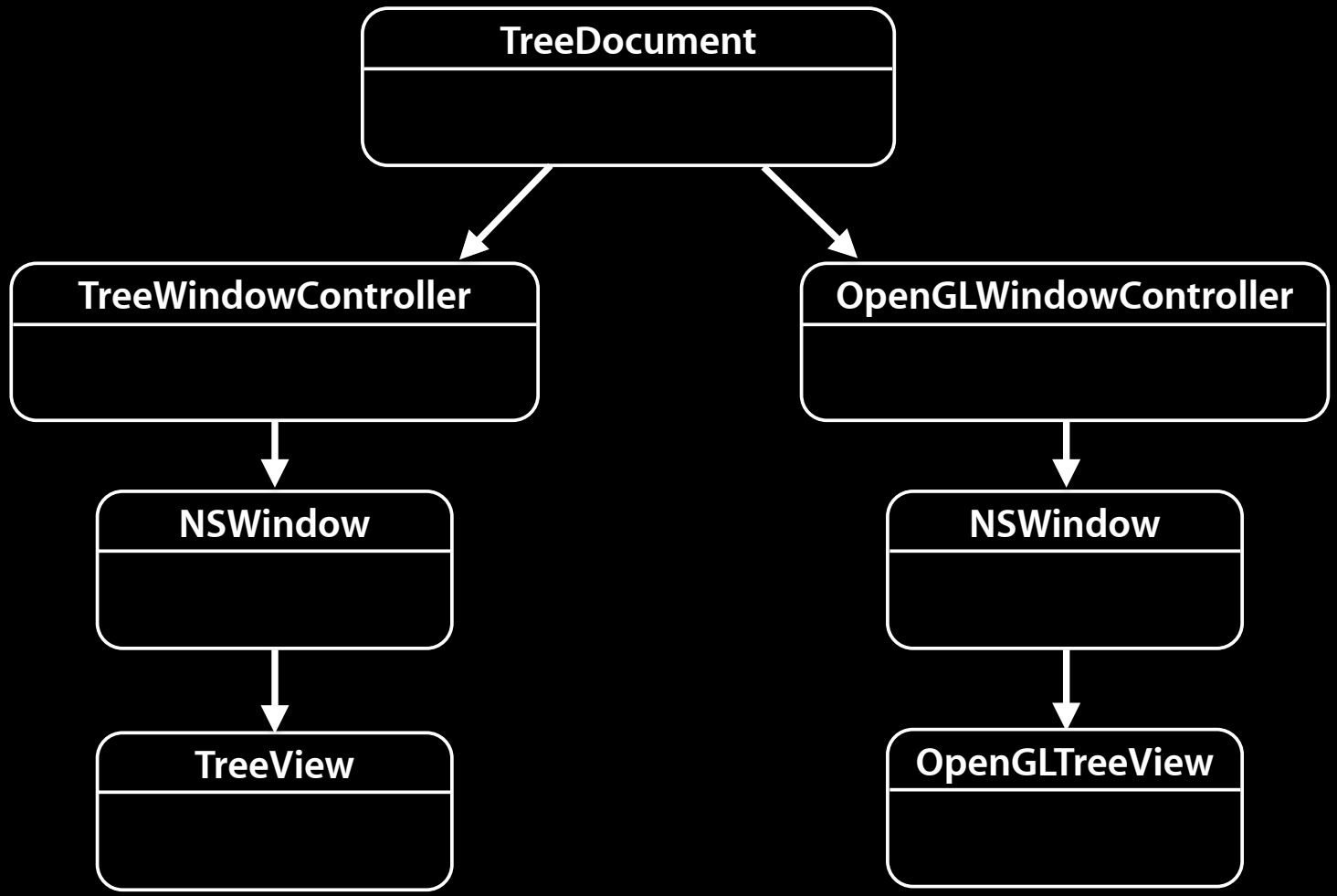
- Simple NSDocument case
- Single window
- NSDocument creates a default window controller and we don't really have to think about it



Document-based Architecture



Multiple Windows Per Document



Making The Switch

- Create NSWindowController subclass for existing window
- Update File's Owner class in nib file to be the window controller
- Relocate any outlets (and associated code) from your document to the window controller
- In the end, the window controller is now the "owner" of the nib

Making The Switch

- Relocate `windowNibName` from document to window controller.
- In your document, implement `makeWindowControllers` to set up default window controller
- Other window controllers can be added later using `addWindowController:`

Adding New Windows

- Create new NSWindowController subclass for new window
- Create nib file for new window, set File's Owner class to new window controller class
- Add code in your document subclass to create this new window controller
- Implement classes/views needed in your new window

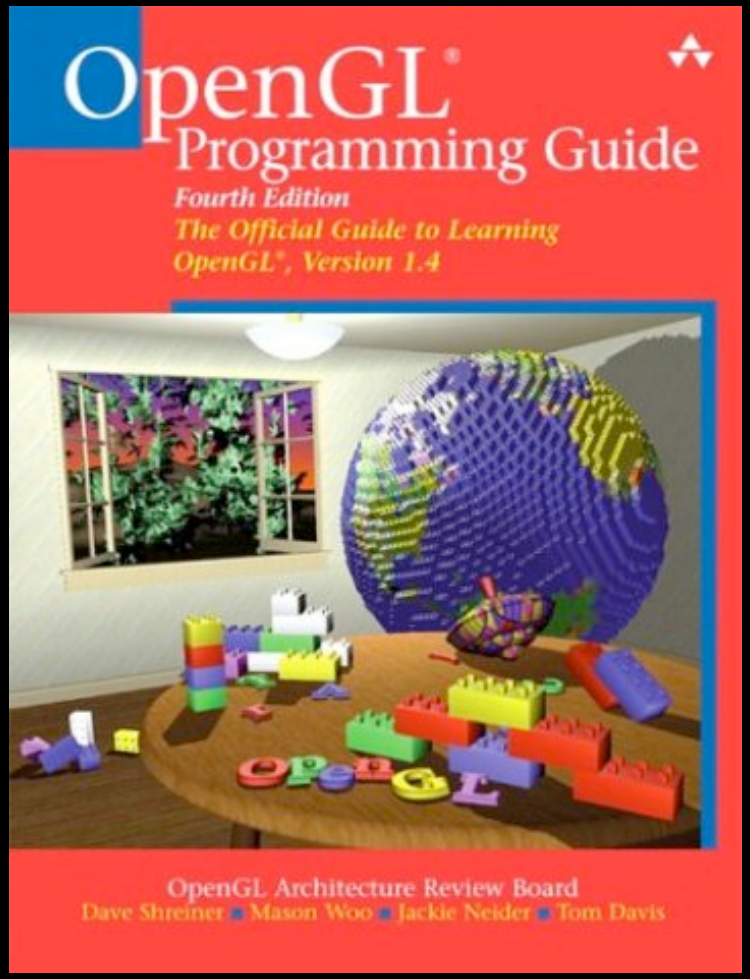
OpenGL

What is OpenGL?

- OpenGL is a software interface to graphics hardware
- Library of about 250 commands, platform and hardware independent
- The base library supports very minimal shape primitives: points, lines and polygons
- Higher level libraries add more rendering abilities and higher level operations (draw spheres, cylinders, teapots, etc)

OpenGL Reference

- "OpenGL Programming Guide" is the book to have
- Plenty of web sites with a ton of examples, easily migrated into Cocoa apps
- Several Cocoa examples on Apple's web site and with developer tools



OpenGL Extensions

- Other libraries add higher level constructs
  - GLU: GL Utility Library
    - Adds support for textures, additional shapes (spheres, cylinders, disks)
  - GLUT: GL Utility Toolkit
    - Adds UI level things like windows, menus, keyboard, mouse events, etc.

Naming Conventions

- Function names indicate what library function belongs to:
  - `glBegin(), glEnd(), glLight(), glPointSize()`
  - `gluBeginCurve(), glCylinder(), glSphere()`
  - `glutCreateWindow(), glutSetCursor()`
- Often indicate parameter types
  - `void glVertex2d(GLdouble x, GLdouble y);`
  - `void glVertex2i(GLint x, GLint y);`
  - `void glVertex4f(GLfloat x, GLfloat y, GLfloat z, GLfloat w);`

Naming Conventions

Parameter types

b	signed char (8-bit)
s	signed short (16-bit)
i	signed int (32-bit)
f	signed float (32-bit)
d	signed double (64-bit)
ub	unsigned char (8-bit)
us	unsigned short (16-bit)
ui	unsigned int (32-bit)

RedBook examples

- More documentation links available from:
  http://en.wikipedia.org/wiki/OpenGL
- Handy collection of examples from
  http://www.sgi.com/products/software/opengl/examples/redbook
- Built copies will be posted on the web site
- They work out of the box (mostly)
  - Had to change #include line and update makefile

Mac OS X & OpenGL

- OpenGL framework included on Mac OS X

```
#import <OpenGL/gl.h>
#import <GLUT/glut.h>
```

  - Don't forget to add frameworks in Xcode!!
- Quartz uses OpenGL for all the whizzy effects like the genie effect when minimizing, Exposé and cube rotations
- man pages for OpenGL functions as well as other OpenGL documentation

OpenGL Examples

Redbook Examples

OpenGL & Cocoa

2D Drawing

- Everything you've been doing up to this point
- NSView implements drawRect: where views do their drawing
- Cocoa handles the setup of the drawing context and flushing bits to the screen
- You draw using NSBezierPath, string drawing, NSImage compositing, etc

3D Drawing

- Conceptually not very different from 2D drawing
- NSOpenGLView does OpenGL context setup similar to how NSView handles setting up the 2D graphics context
- Instead of bezier paths, string drawing, etc. you make OpenGL client function calls to do drawing
- You have to explicitly flush the 3D pipeline to get bits on the screen, though

Cocoa OpenGL Classes

- NSOpenGLView - the Cocoa view that gets inserted into the view hierarchy, manages the OpenGL context
- NSOpenGLContext - ObjC representation of the OpenGL state variables
- NSOpenGLPixelFormat - specifies the buffer and various attributes for use by an NSOpenGLContext

Cocoa & OpenGL

- Cocoa provides an NSOpenGLView that manages the OpenGL context
- 3D equivalent of NSView
- Coordinate system differences:
  - Cocoa origin is in lower left corner of view
  - OpenGL origin is in center of view
  - OpenGL has a “z” coordinate, perpendicular to of the screen

Using NSOpenGLView

- Like using NSView, you create a custom subclass to implement your drawing
  - Either in Xcode or in IB
- In your nib you drag out an NSOpenGLView
- Change the class in the inspector to your custom subclass
- Just like NSViews...

Subclassing NSOpenGLView

- Required:
  - Implement `drawRect:` to do drawing
- Optional:
  - Implement `prepareOpenGL` to do initialization
  - Implement `reshape` to handle resizing

OpenGL & Cocoa Examples

OpenGLPolygon, OpenGLTeapot, & TreeGenerator

TreeGenerator Notes

- Includes a Camera class that encapsulates the view positioning
- OpenGLTreeView doesn't hold onto Tree directly, gets it from the document as needed

Quartz Composer Demo

Example Code

- Many examples ship with Xcode
- /Developer/Examples/OpenGL
  - Cocoa, GLUT, and Shader examples
- /Developer/Examples/QuartzComposer

Questions?