Design Patterns to Simplify Mac Accessibility

Session 127

James Dempsey
Software Engineer, Cocoa Frameworks

These are confidential sessions—please refrain from streaming, blogging, or taking pictures

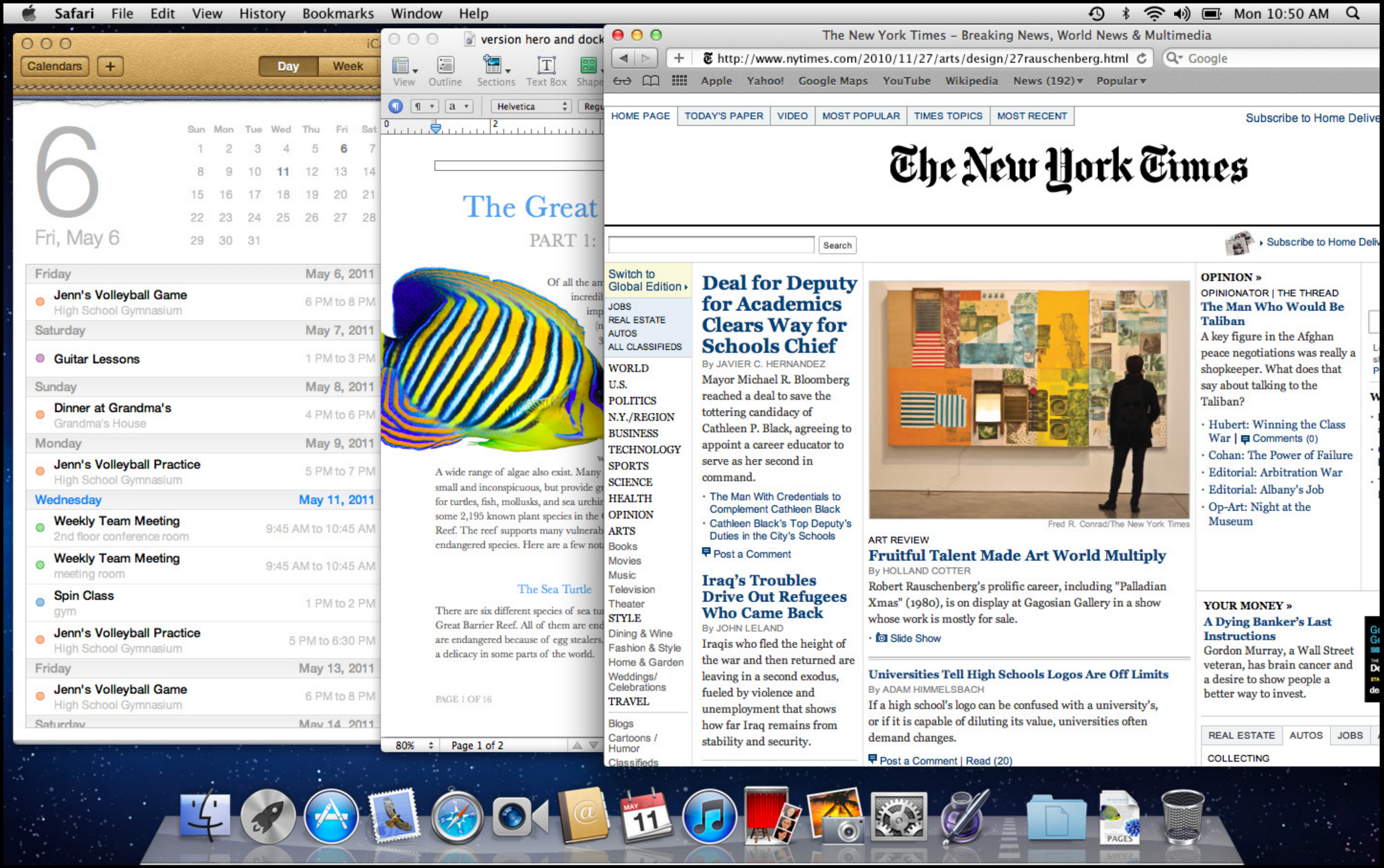
Agenda

Overview

Lion Update

Design Patterns

Graphical User Interface



6

Fri, May 6

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Friday May 6, 2011

Jenn's Volleyball Game 6 PM to 8 PM
High School Gymnasium

Saturday May 7, 2011

Guitar Lessons 1 PM to 3 PM

Sunday May 8, 2011

Dinner at Grandma's 4 PM to 6 PM
Grandma's House

Monday May 9, 2011

Jenn's Volleyball Practice 5 PM to 7 PM
High School Gymnasium

Wednesday May 11, 2011

Weekly Team Meeting 9:45 AM to 10:45 AM
2nd floor conference room

Weekly Team Meeting 9:45 AM to 10:45 AM
meeting room

Spin Class 1 PM to 2 PM
gym

Jenn's Volleyball Practice 5 PM to 6:30 PM
High School Gymnasium

Friday May 13, 2011

Jenn's Volleyball Game 6 PM to 8 PM
High School Gymnasium

Saturday May 14, 2011

The Great

PART 1:

Of all the am
incredib
imp
(n
3

A wide range of algae also exist. Many
small and inconspicuous, but provide g
for turtles, fish, mollusks, and sea urchi
some 2,195 known plant species in the
Reef. The reef supports many vulnerab
endangered species. Here are a few not

The Sea Turtle

There are six different species of sea tu
Great Barrier Reef. All of them are end
are endangered because of egg stealers
a delicacy in some parts of the world.

PAGE 1 OF 16

The New York Times

Deal for Deputy for Academics Clears Way for Schools Chief

By JAVIER C. HERNANDEZ

Mayor Michael R. Bloomberg reached a deal to save the tottering candidacy of Cathleen P. Black, agreeing to appoint a career educator to serve as her second in command.

- The Man With Credentials to Complement Cathleen Black
- Cathleen Black's Top Deputy's Duties in the City's Schools

Post a Comment

Iraq's Troubles Drive Out Refugees Who Came Back

By JOHN LELAND

Iraqis who fled the height of the war and then returned are leaving in a second exodus, fueled by violence and unemployment that shows how far Iraq remains from stability and security.

Fred R. Conrad/The New York Times

ART REVIEW

Fruitful Talent Made Art World Multiply

By HOLLAND COTTER

Robert Rauschenberg's prolific career, including "Palladian Xmas" (1980), is on display at Gagosian Gallery in a show whose work is mostly for sale.

- Slide Show

Universities Tell High Schools Logos Are Off Limits

By ADAM HIMMELSBACH

If a high school's logo can be confused with a university's, or if it is capable of diluting its value, universities often demand changes.

Post a Comment | Read (20)

OPINION »

OPINIONATOR | THE THREAD

The Man Who Would Be Taliban

A key figure in the Afghan peace negotiations was really a shopkeeper. What does that say about talking to the Taliban?

- Hubert: Winning the Class War | Comments (0)
- Cohan: The Power of Failure
- Editorial: Arbitration War
- Editorial: Albany's Job
- Op-Art: Night at the Museum

YOUR MONEY »

A Dying Banker's Last Instructions

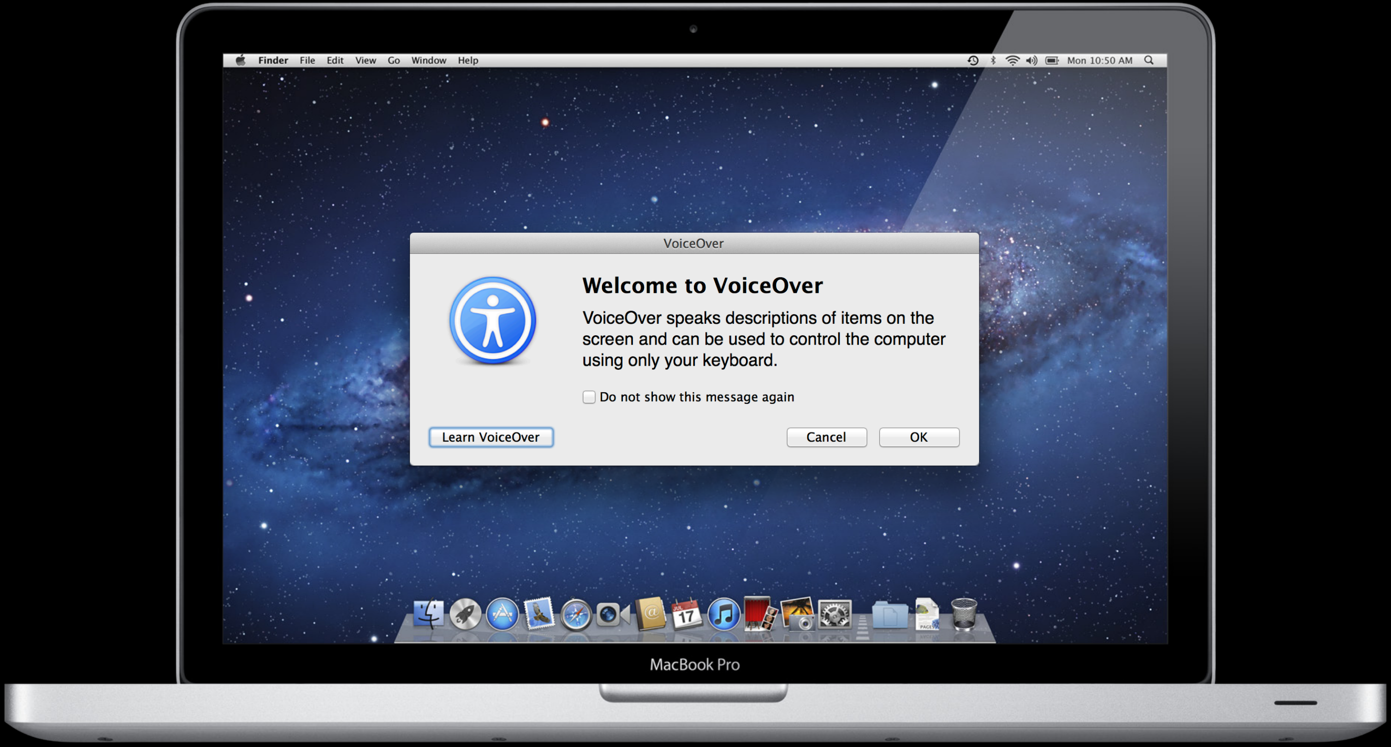
Gordon Murray, a Wall Street veteran, has brain cancer and a desire to show people a better way to invest.

VoiceOver

iPad
9:41 AM
Messages
Monday
6
Calendar
Notes
Reminders
Maps
YouTube
Videos
Contacts
Game Center
iTunes
App Store
Newsstand
FaceTime
Camera
Photo Booth
Settings
Safari
Mail
Photos
Music
tv

Finder File Edit View Go Window Help
Mon 10:50 AM
MacBook Pro

[redacted]



Welcome to VoiceOver

VoiceOver speaks descriptions of items on the screen and can be used to control the computer using only your keyboard.

□ Do not show this message again

MacBook Pro
MacBook Air
MacBook Pro

Accessibility Benefits

- Provide everyone a great user experience
- Automated user interface scripting
  - Internal testing
  - Power users
  - Development tools
- Section 508: Sales into government and education accounts

Provide everyone a great user experience

VoiceOver

Framework
and Tools

Your Application

Lion Update

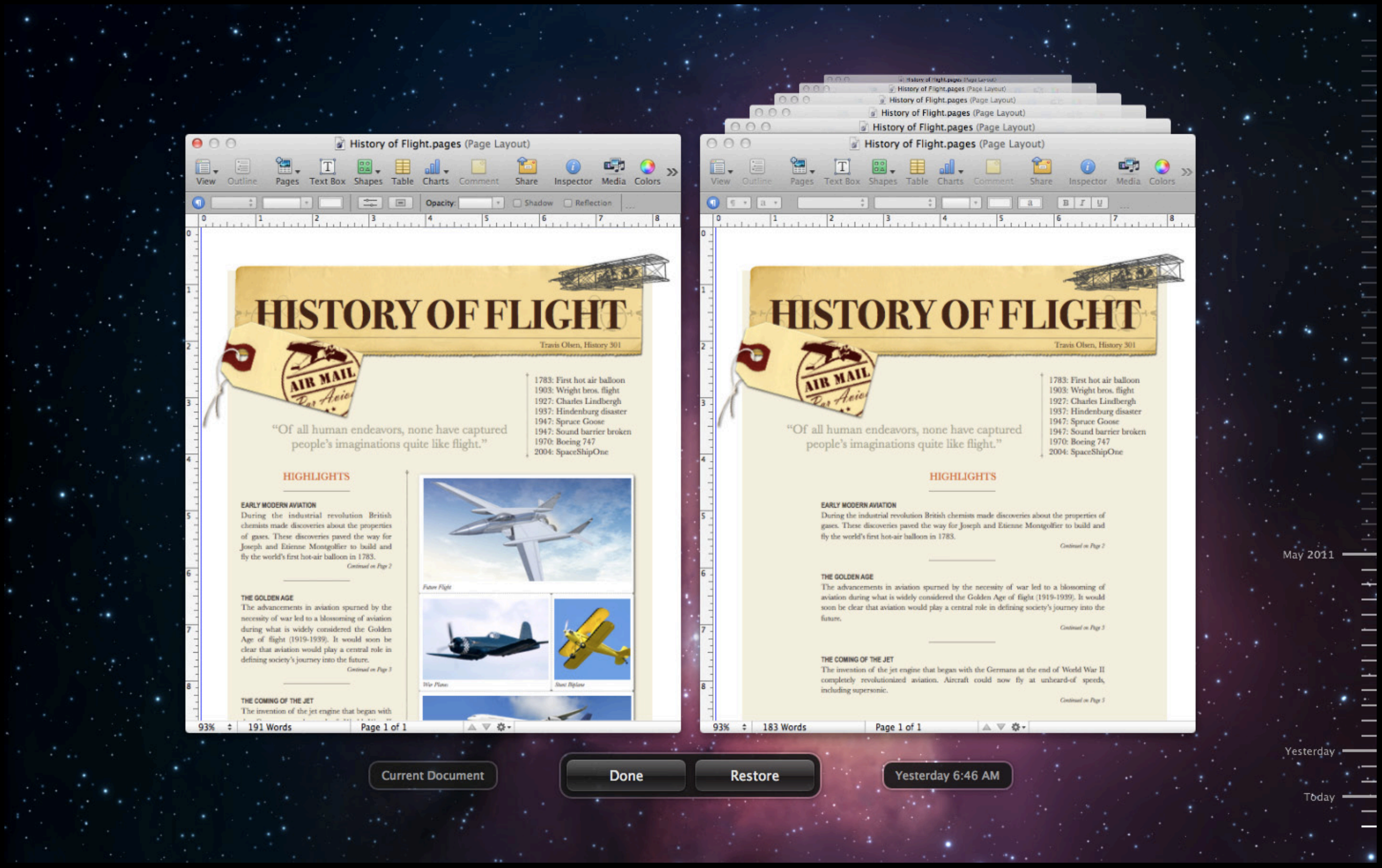
Lion Technologies

New

- New user features accessible
- New framework features give you more for free
- New Accessibility Inspector

Versions

New



HISTORY OF FLIGHT

Travis Olsen, History 301

AIR MAIL

“Of all human endeavors, none have captured people’s imaginations quite like flight.”

1783: First hot air balloon
1903: Wright bros. flight
1927: Charles Lindbergh
1937: Hindenburg disaster
1947: Spruce Goose
1947: Sound barrier broken
1970: Boeing 747
2004: SpaceShipOne

HIGHLIGHTS

EARLY MODERN AVIATION

During the industrial revolution British chemists made discoveries about the properties of gases. These discoveries paved the way for Joseph and Etienne Montgolfier to build and fly the world’s first hot-air balloon in 1783.

Continued on Page 2

THE GOLDEN AGE

The advancements in aviation spurned by the necessity of war led to a blossoming of aviation during what is widely considered the Golden Age of flight (1919-1939). It would soon be clear that aviation would play a central role in defining society’s journey into the future.

Continued on Page 3

THE COMING OF THE JET

The invention of the jet engine that began with

Future Flight

War Planes

Stunt Biplane

93% 191 Words Page 1 of 1

HISTORY OF FLIGHT

Travis Olsen, History 301

AIR MAIL

“Of all human endeavors, none have captured people’s imaginations quite like flight.”

1783: First hot air balloon
1903: Wright bros. flight
1927: Charles Lindbergh
1937: Hindenburg disaster
1947: Spruce Goose
1947: Sound barrier broken
1970: Boeing 747
2004: SpaceShipOne

HIGHLIGHTS

EARLY MODERN AVIATION

During the industrial revolution British chemists made discoveries about the properties of gases. These discoveries paved the way for Joseph and Etienne Montgolfier to build and fly the world’s first hot-air balloon in 1783.

Continued on Page 2

THE GOLDEN AGE

The advancements in aviation spurned by the necessity of war led to a blossoming of aviation during what is widely considered the Golden Age of flight (1919-1939). It would soon be clear that aviation would play a central role in defining society’s journey into the future.

Continued on Page 3

THE COMING OF THE JET

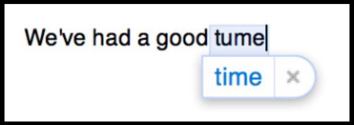
The invention of the jet engine that began with the Germans at the end of World War II completely revolutionized aviation. Aircraft could now fly at unheard-of speeds, including supersonic.

Continued on Page 5

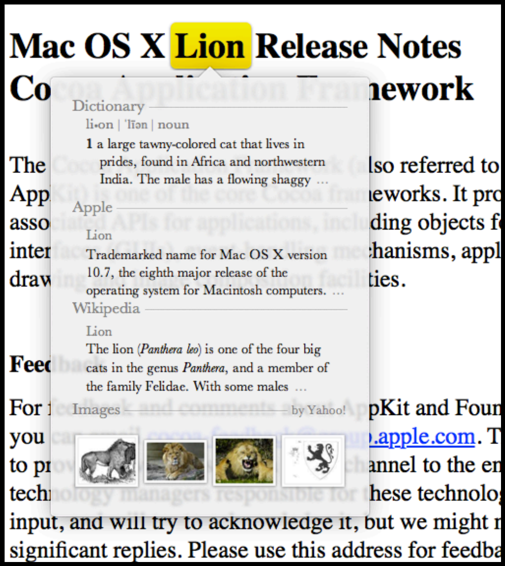
93% 183 Words Page 1 of 1

Autocorrect and Look Up

New



We've had a good tume



Mac OS X Lion Release Notes

Cocoa Application Framework

Dictionary

li·on | ˈlīən | noun

1 a large tawny-colored cat that lives in prides, found in Africa and northwestern India. The male has a flowing shaggy …

Apple

Lion

Trademarked name for Mac OS X version 10.7, the eighth major release of the operating system for Macintosh computers. …

Wikipedia

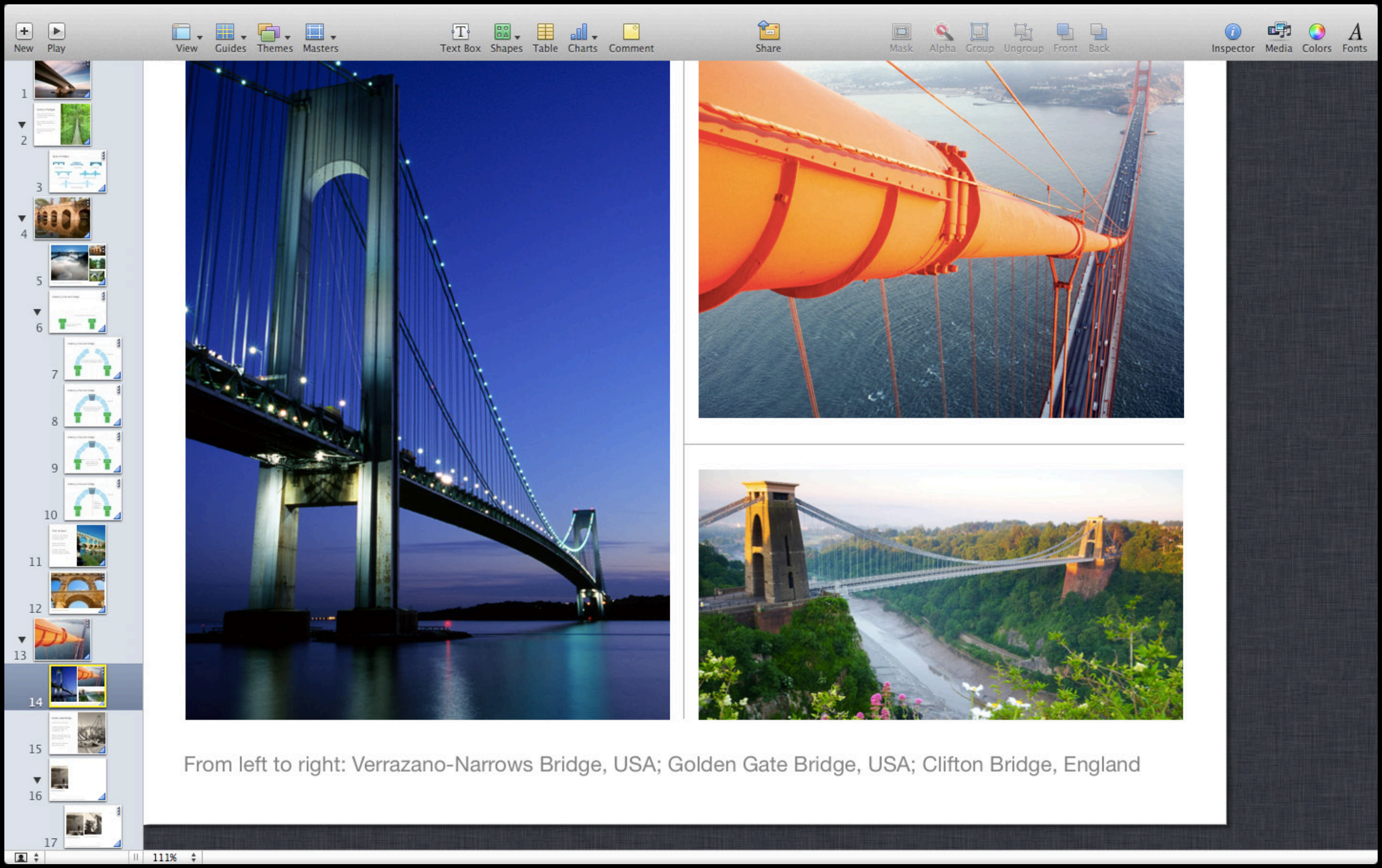
Lion

The lion (*Panthera leo*) is one of the four big cats in the genus *Panthera*, and a member of the family Felidae. With some males …

Images by Yahoo!

Full Screen

New



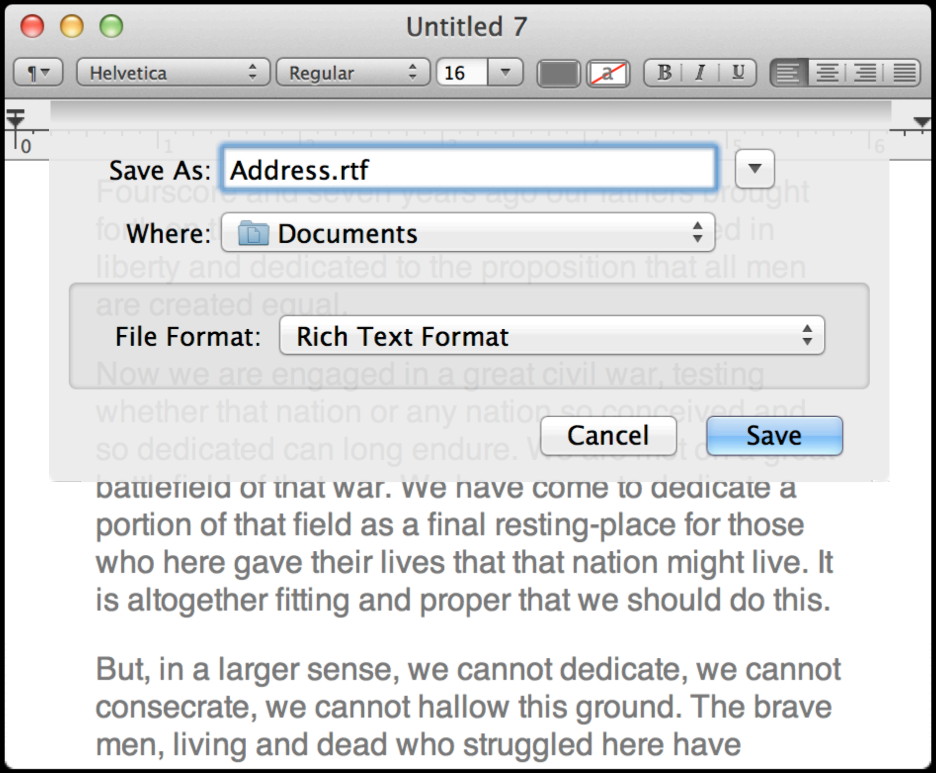
From left to right: Verrazano-Narrows Bridge, USA; Golden Gate Bridge, USA; Clifton Bridge, England

Sandboxing

New

Sandboxing

New



Save As: Address.rtf

Where: Documents

File Format: Rich Text Format

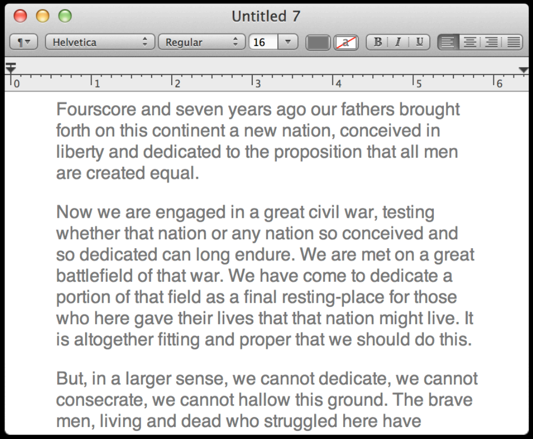
Fourscore and seven years ago our fathers brought fo on th ed in liberty and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation or any nation so conceived and so dedicated can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead who struggled here have

Sandboxing

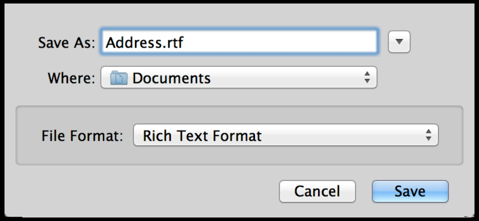
New



Fourscore and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation or any nation so conceived and so dedicated can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead who struggled here have



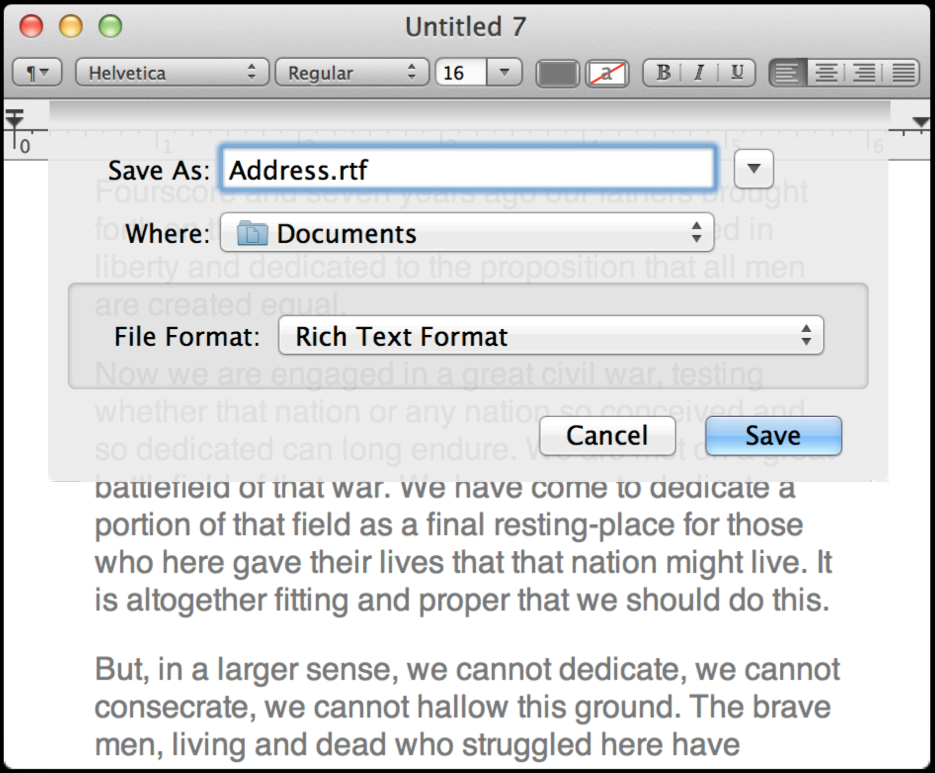
Save As: Address.rtf

Where: Documents

File Format: Rich Text Format

Sandboxing

New



Save As: Address.rtf

Where: Documents

File Format: Rich Text Format

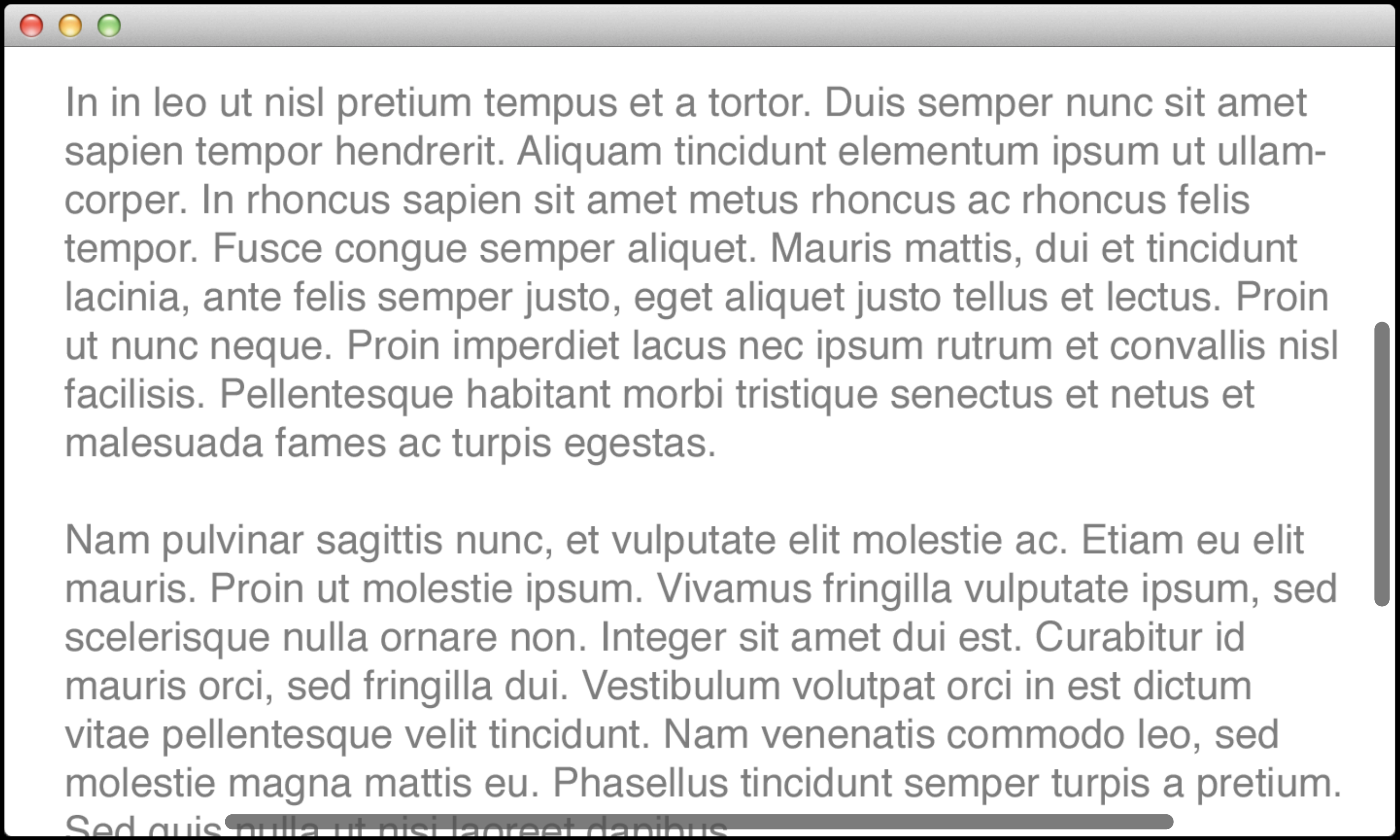
Fourscore and seven years ago our fathers brought forth on th… ed in liberty and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation or any nation so conceived and so dedicated can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead who struggled here have

Overlay Scrollers

New

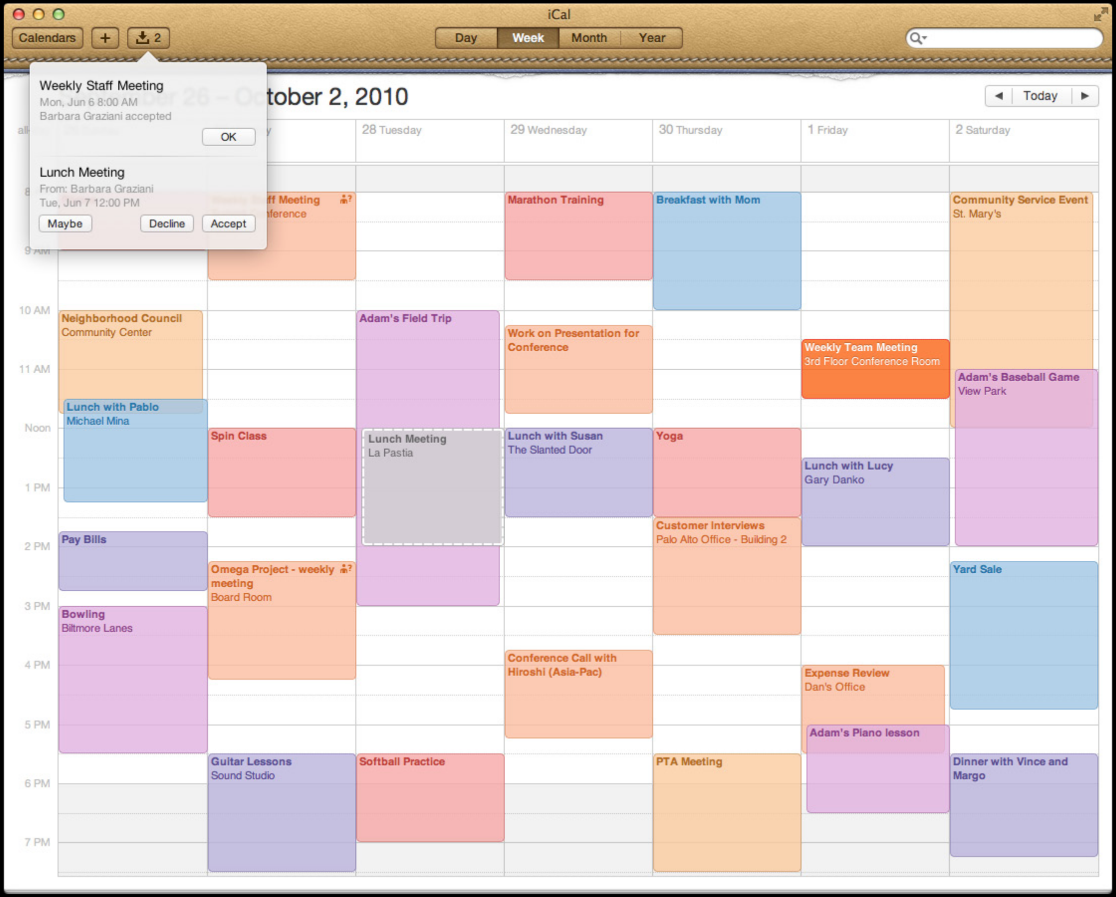


In in leo ut nisl pretium tempus et a tortor. Duis semper nunc sit amet sapien tempor hendrerit. Aliquam tincidunt elementum ipsum ut ullamcorper. In rhoncus sapien sit amet metus rhoncus ac rhoncus felis tempor. Fusce congue semper aliquet. Mauris mattis, dui et tincidunt lacinia, ante felis semper justo, eget aliquet justo tellus et lectus. Proin ut nunc neque. Proin imperdiet lacus nec ipsum rutrum et convallis nisl facilisis. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

Nam pulvinar sagittis nunc, et vulputate elit molestie ac. Etiam eu elit mauris. Proin ut molestie ipsum. Vivamus fringilla vulputate ipsum, sed scelerisque nulla ornare non. Integer sit amet dui est. Curabitur id mauris orci, sed fringilla dui. Vestibulum volutpat orci in est dictum vitae pellentesque velit tincidunt. Nam venenatis commodo leo, sed molestie magna mattis eu. Phasellus tincidunt semper turpis a pretium. Sed quis nulla ut nisi laoreet dapibus

Popovers

New



Weekly Staff Meeting
Mon, Jun 6 8:00 AM
Barbara Graziani accepted

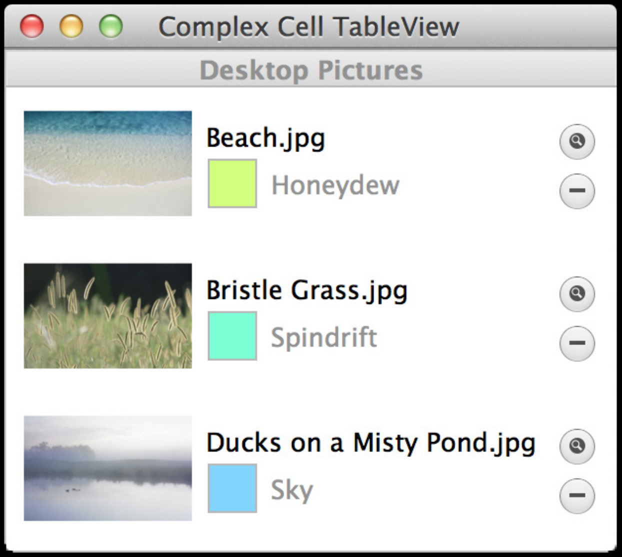
OK

Lunch Meeting
From: Barbara Graziani
Tue, Jun 7 12:00 PM

Maybe Decline Accept

View-based Table Views

New



Complex Cell TableView

Desktop Pictures

Beach.jpg
Honeydew

Bristle Grass.jpg
Spindrift

Ducks on a Misty Pond.jpg
Sky

- Use for complex table cells
- Connect the textField outlet to the primary text field
  - NSTableCellView has built-in outlet
  - Add outlet to custom views used as table cell views
- Use the table row insert / move / remove methods where appropriate

Identifiers

New

- NSUserInterfaceItemIdentification protocol

```
-(NSString *) identifier
- (void) setIdentifier:(NSString *)id
```

- Implemented by NSWindow, NSView, NSCell and others
- Set in Interface Builder or in code
- Reported to accessibility clients as AXIdentifier
- Particularly useful for automated UI testing

Accessibility Inspector

New

- Redesigned, simplified user interface
- Retained functionality of previous version
- Added new navigation features

Demo

Accessibility Inspector

Lion Technologies

- New user features accessible
- New framework features give you more for free
- New Accessibility Inspector
- Check AppKit release notes for more details

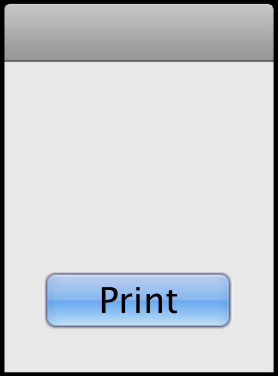
Design Patterns to Simplify Mac Accessibility

Design Patterns

For simplifying Mac accessibility

- Implied versus explicit information
- Approaches for building a custom view
- Accessibility client needs drive requirements
- Requirements drive a short list of things to consider

Print



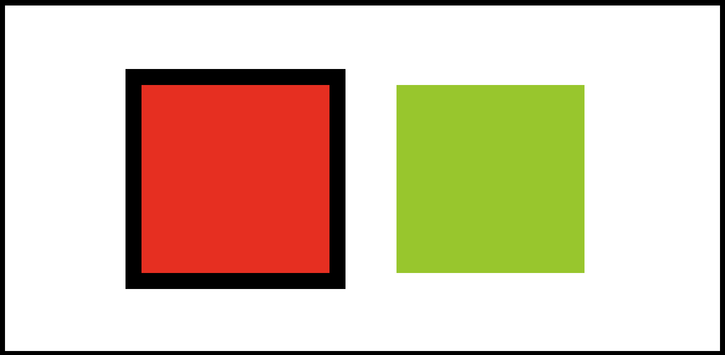
Attribute Name	Attribute Value
AXRole	“AXButton”
AXRoleDescription	“button”
AXParent	window UI element
AXWindow	window UI element
AXTopLevelUIElement	window UI element
AXEnabled	YES
AXFocused	NO
AXTitle	“Print”
AXPosition	(1084, 227)
AXSize	32 x 23

Actions
AXPress

A Simple Custom View

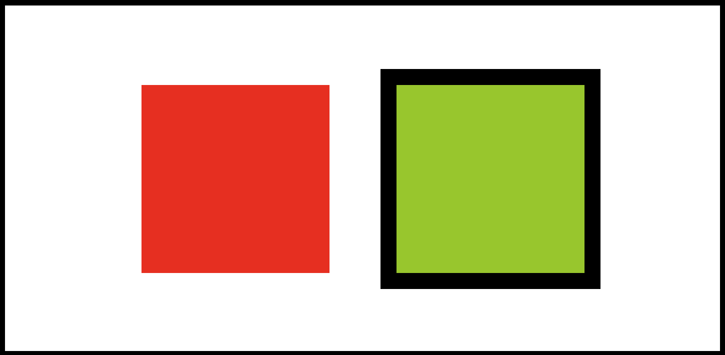
A Simple Custom View

Click to select



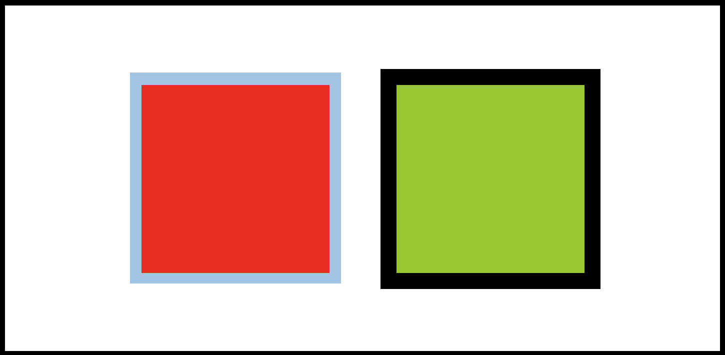
A Simple Custom View

Click to select



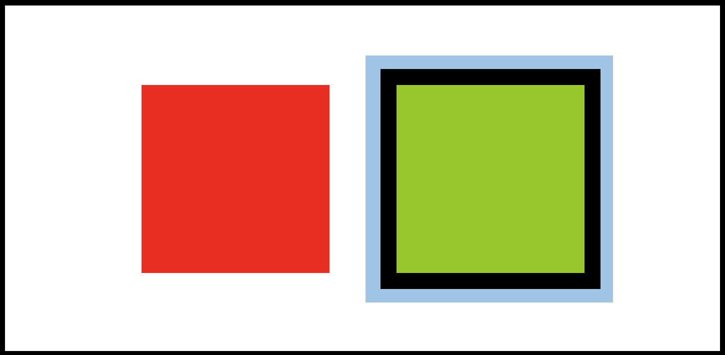
A Simple Custom View

Handles full keyboard navigation



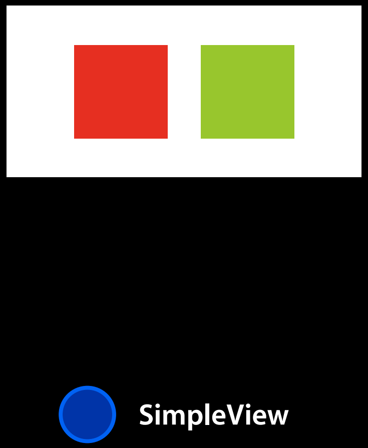
A Simple Custom View

Handles full keyboard navigation



Approach 1

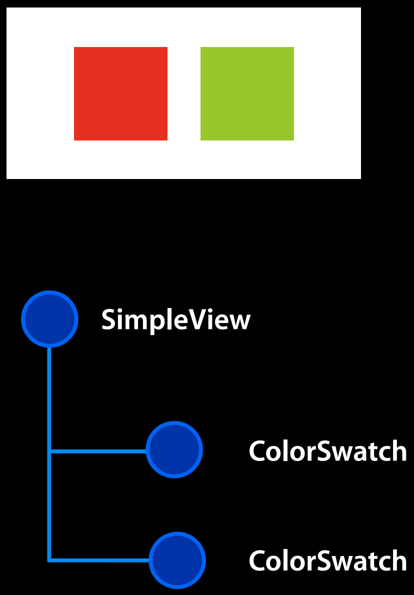
View handles everything



- Drawing
  - Draw background, then draw each square
- Event handling
  - Calculate which color was hit based on the mouse location

Approach 2

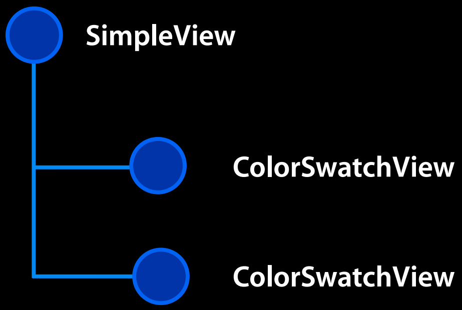
Objects used for substructure



- Drawing
  - Subelements know their own bounds
  - Draw background, then tell each swatch to draw itself
- Event Handling
  - Hit test each color swatch object

Approach 3

Compose three custom views



SimpleView

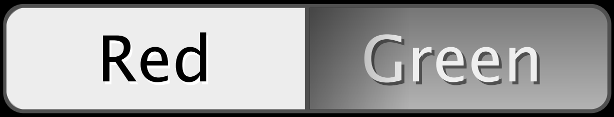
ColorSwatchView

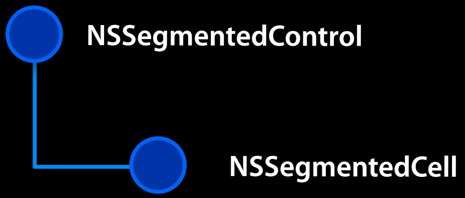
ColorSwatchView

- Many things already handled
  - Hit testing
  - Keyboard focus
  - Basic accessibility support

Approach 4

Use framework classes where possible

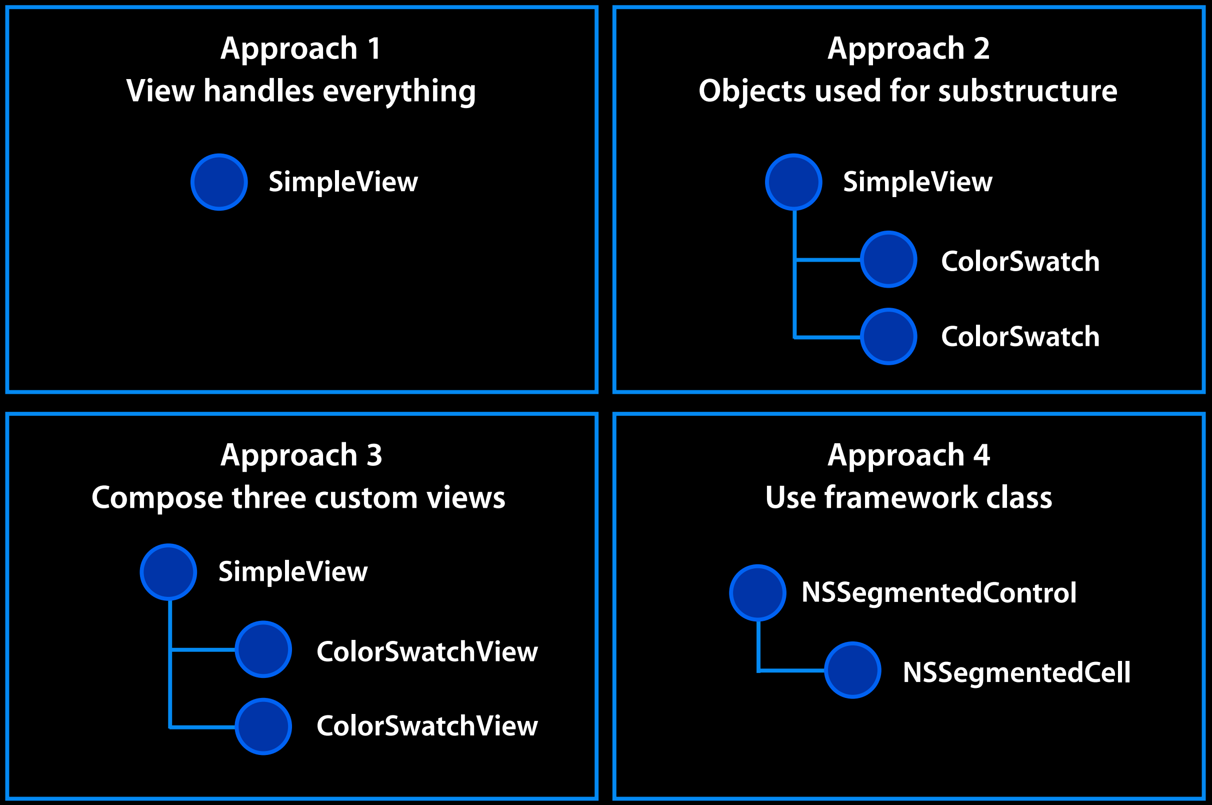



NSSegmentedControl

NSSegmentedCell

- The custom view is essentially reinventing NSSegmentedControl
- Easiest path to accessible user interfaces

Comparing Approaches



Approach 1
View handles everything

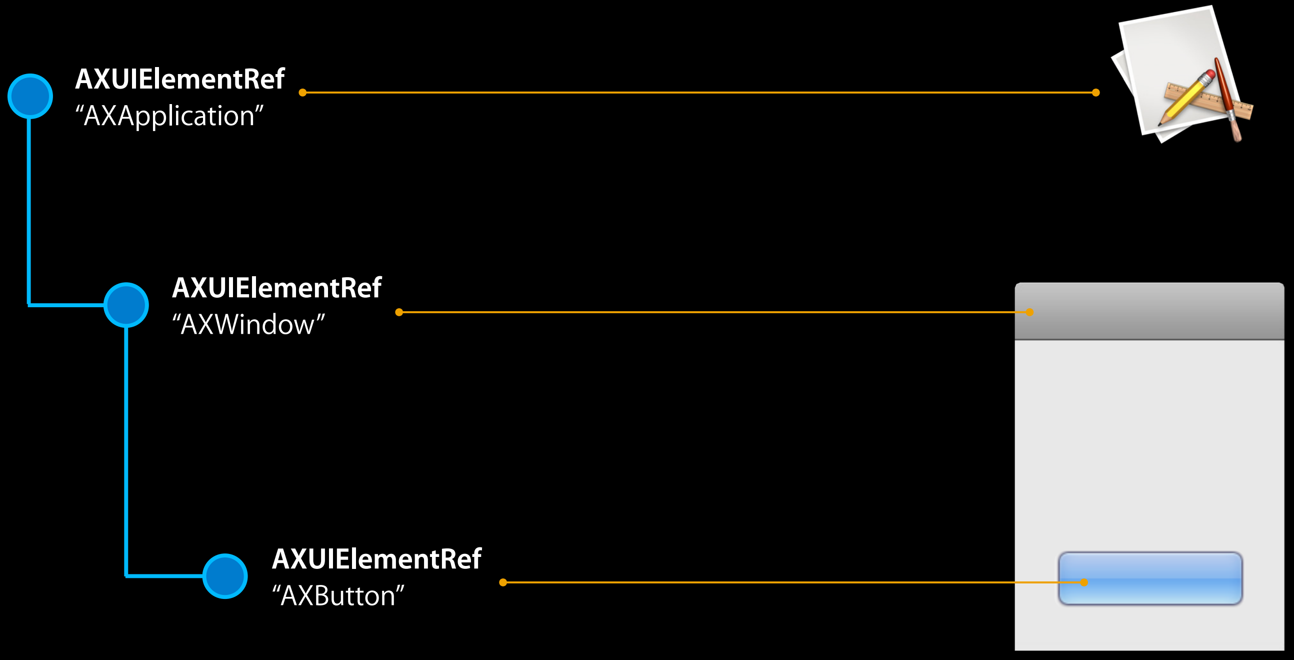
Approach 2
Objects used for substructure

Approach 3
Compose three custom views

Approach 4
Use framework class

Apps Vend a Hierarchy of UI Elements

Each node in tree represents a UI element



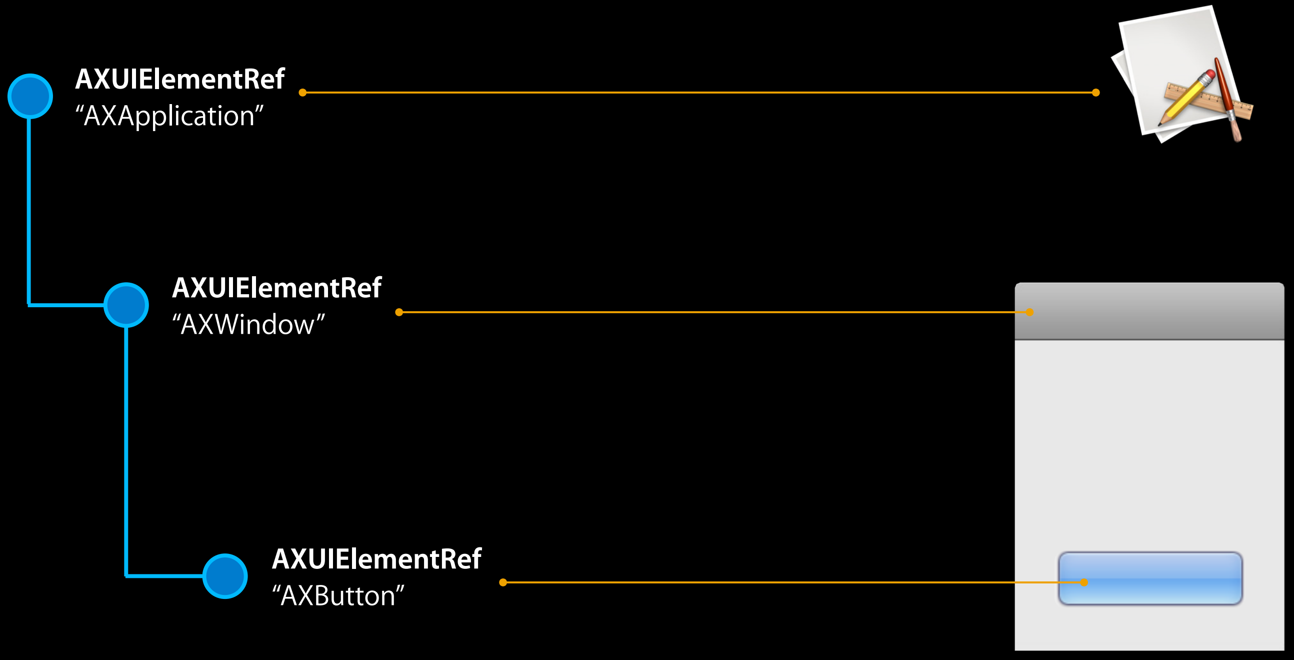
AXUIElementRef
"AXApplication"

AXUIElementRef
"AXWindow"

AXUIElementRef
"AXButton"

Apps Vend a Hierarchy of UI Elements

A node can support attributes, actions, and notifications



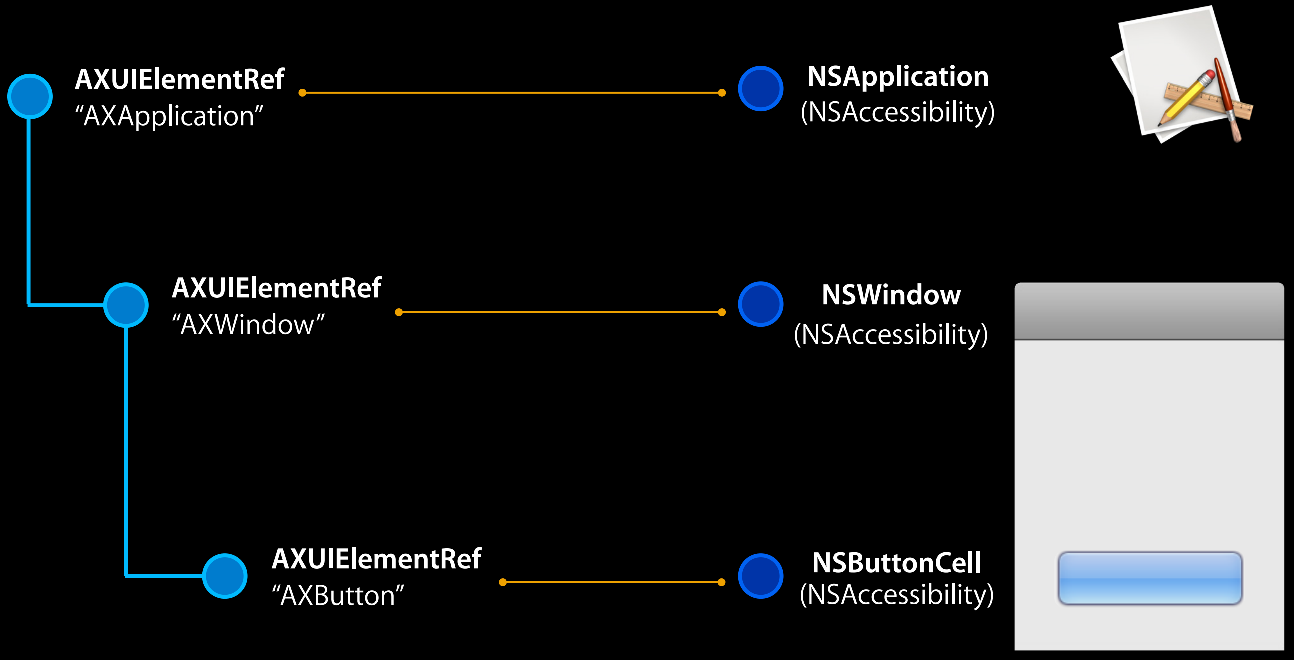
AXUIElementRef
“AXApplication”

AXUIElementRef
“AXWindow”

AXUIElementRef
“AXButton”

Each Node Represents an Object

Each object implements the NSAccessibility protocol



NSAccessibility Protocol

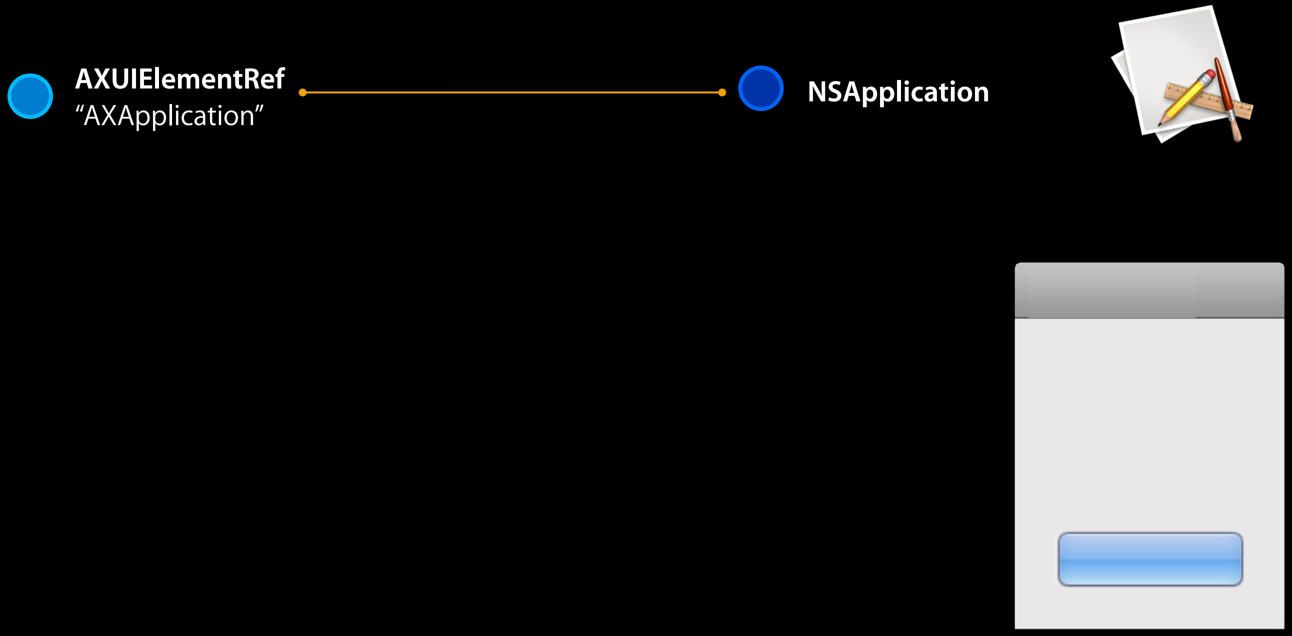
```
- (NSArray *)accessibilityAttributeNames;

- (id)accessibilityAttributeValue:(NSString *)attribute;

- (BOOL)accessibilityIsAttributeSettable:(NSString *)attribute;

- (void)accessibilitySetValue:(id)value
                 forAttribute:(NSString *)attribute;


- (NSArray *)accessibilityParameterizedAttributeNames;

- (void)accessibilityAttributeValue:(id)attribute
                 forParameter:(id)parameter;
```

NSAccessibility Protocol

```
- (NSArray *)accessibilityActionNames;

- (NSString *)accessibilityActionDescription:(NSString *)action;

- (void) accessibilityPerformAction:(NSString *)action;


- (id)accessibilityHitTest:(NSPoint)point;

- (id)accessibilityFocusedUIElement;

- (BOOL)accessibilityIsIgnored;


NSAccessibilityPostNotification(id element, NSString *notification)
```

Clients Can Access Root of Tree

Top-down navigation via AXChildren attribute

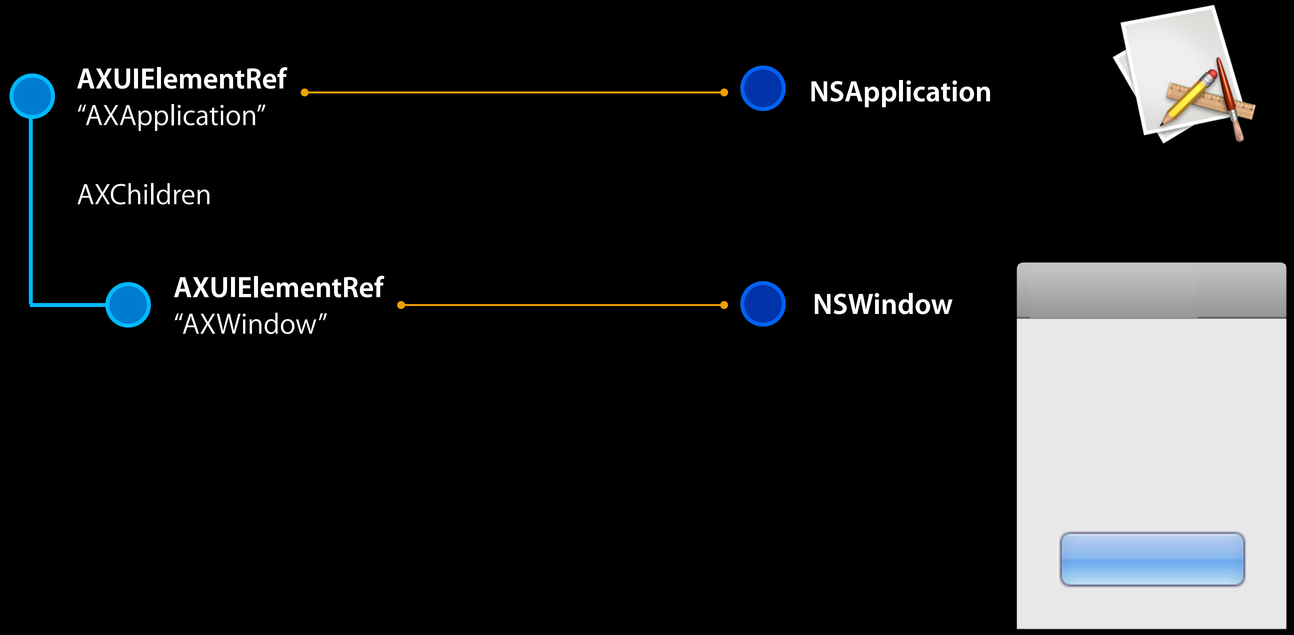


AXUIElementRef
“AXApplication”

NSApplication

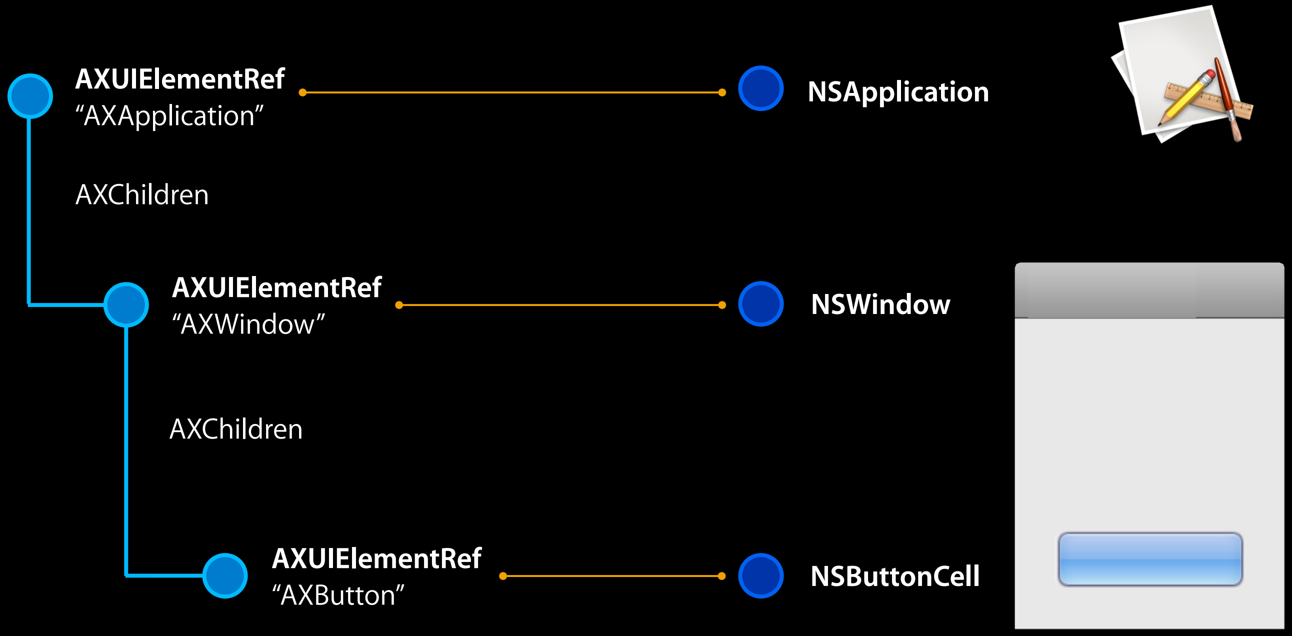
Clients Can Access Root of Tree

Top-down navigation via AXChildren attribute



Clients Can Access Root of Tree

Top-down navigation via AXChildren attribute

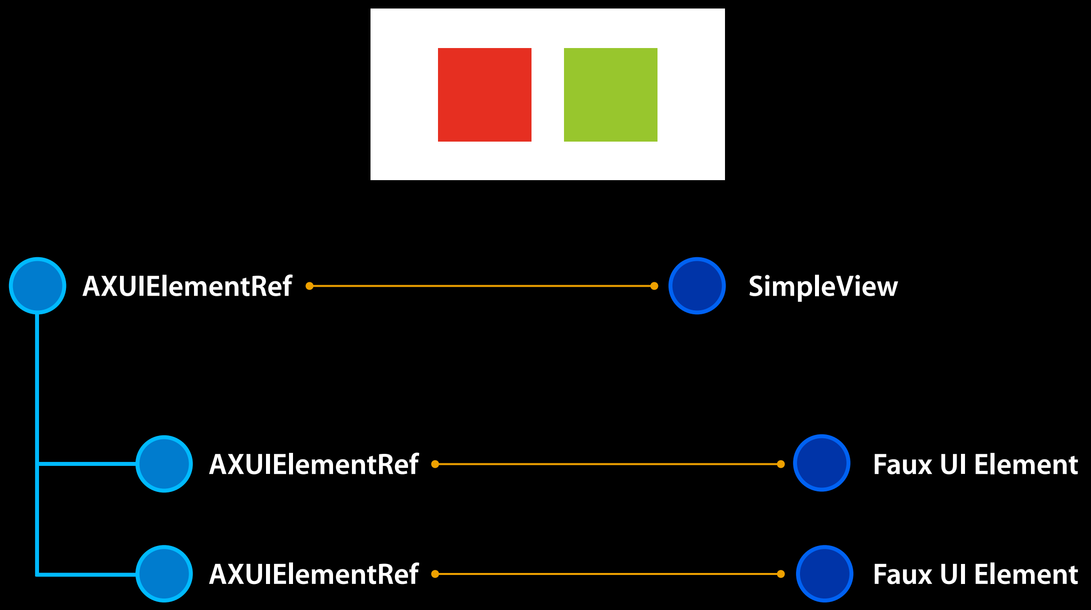


Things to Keep in Mind

- Every element needs a backing object
- Every element needs to know its children

Approach 1

View handles everything



AXUIElementRef

SimpleView

AXUIElementRef

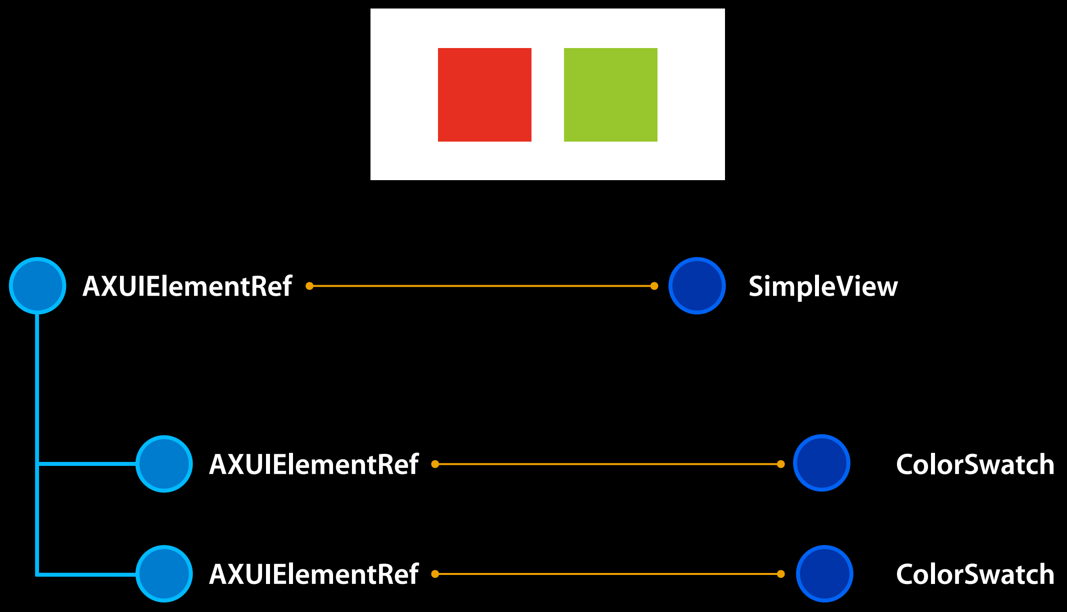
Faux UI Element

AXUIElementRef

Faux UI Element

Approach 2

Objects used for substructure



AXUIElementRef → SimpleView

AXUIElementRef → ColorSwatch

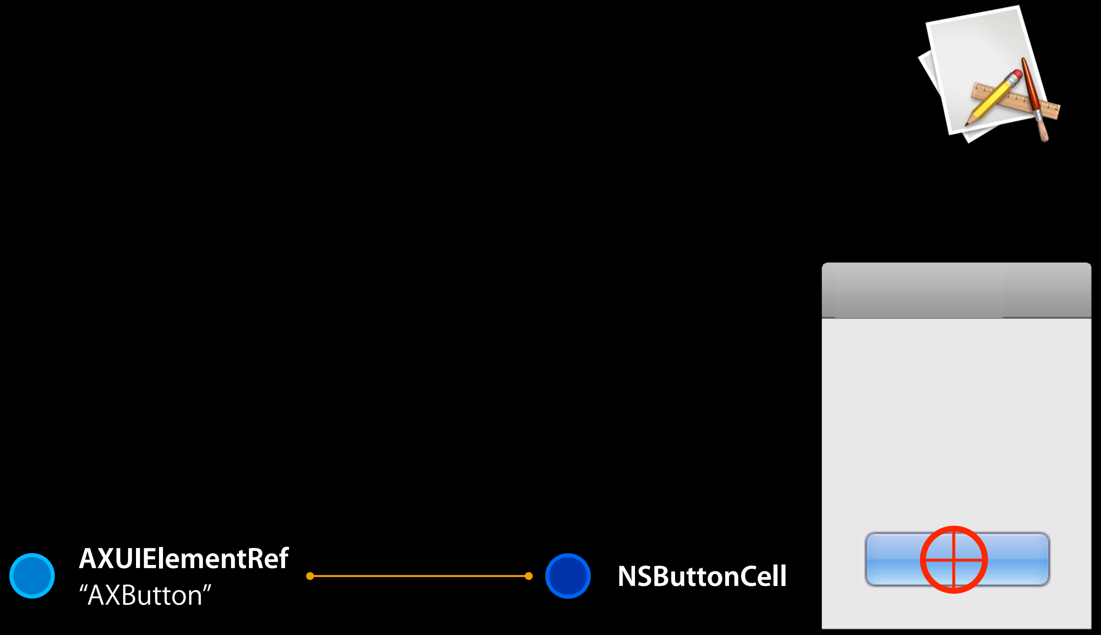
AXUIElementRef → ColorSwatch

Backing Object Design Choices

- Approach 1
  - Use ‘faux’ UI element objects
  - Create and return autoreleased objects to respond to accessibility requests
  - These objects are often ‘dumb’, relying on parent or ancestor for key pieces of information
- Approach 2
  - Accessibility structure matches subelement object structure

Clients Can Access by Hit Testing

Bottom-up navigation via AXParent attribute

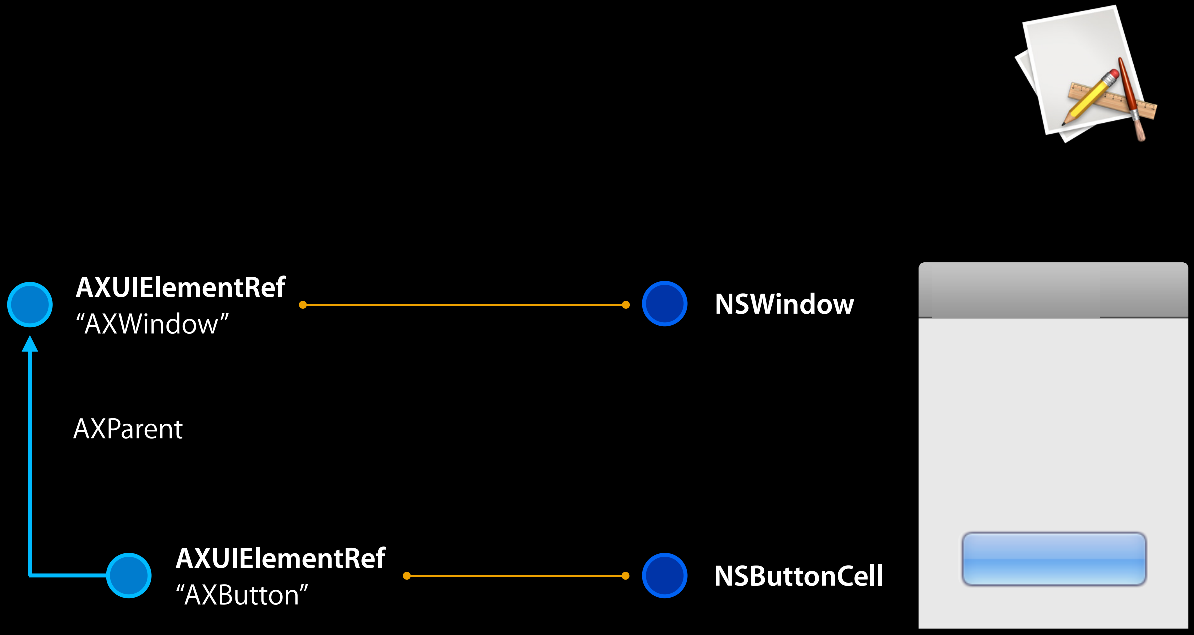


AXUIElementRef
“AXButton”

NSButtonCell

Clients Can Access by Hit Testing

Bottom-up navigation via AXParent attribute



AXUIElementRef
"AXWindow"

NSWindow

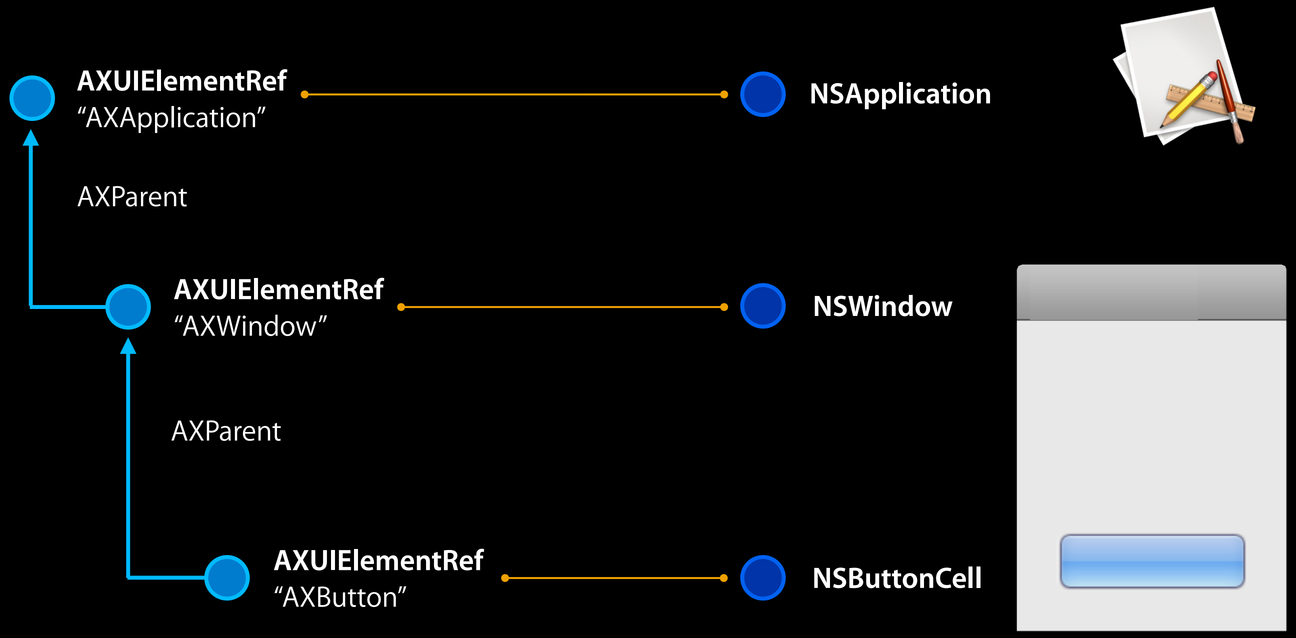
AXParent

AXUIElementRef
"AXButton"

NSButtonCell

Clients Can Access By Hit Testing

Bottom-up navigation via AXParent attribute



AXUIElementRef
“AXApplication”

NSApplication

AXParent

AXUIElementRef
“AXWindow”

NSWindow

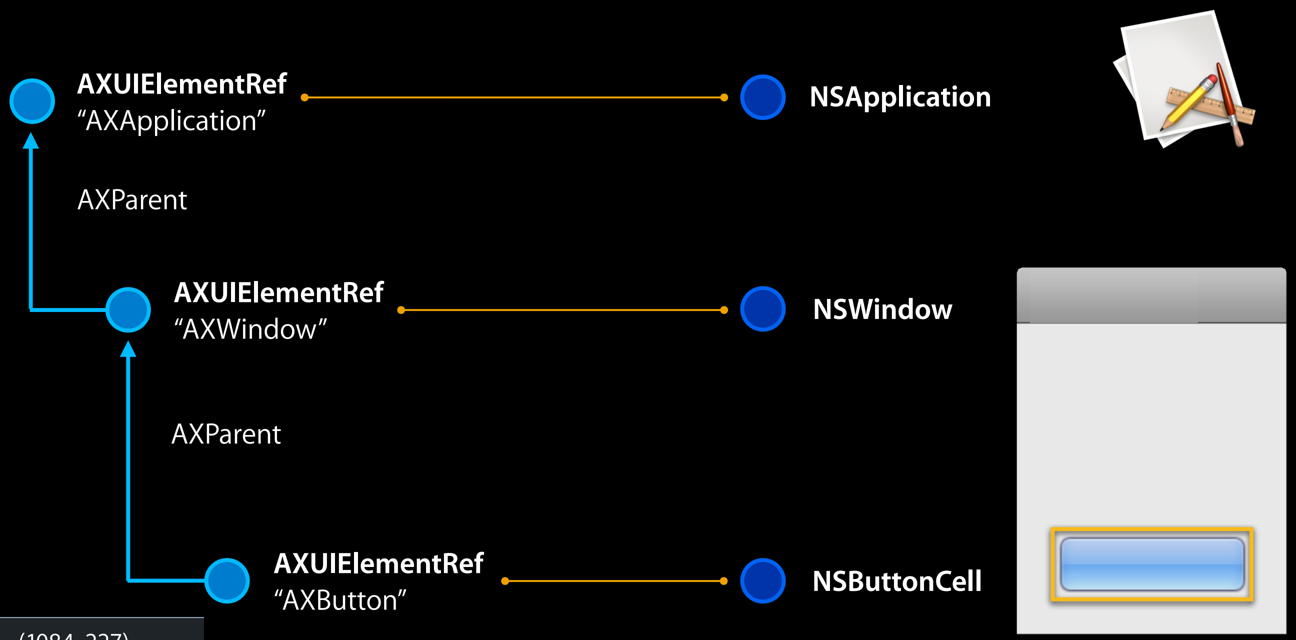
AXParent

AXUIElementRef
“AXButton”

NSButtonCell

Clients Can Access Size and Position

Returned in screen coorindates



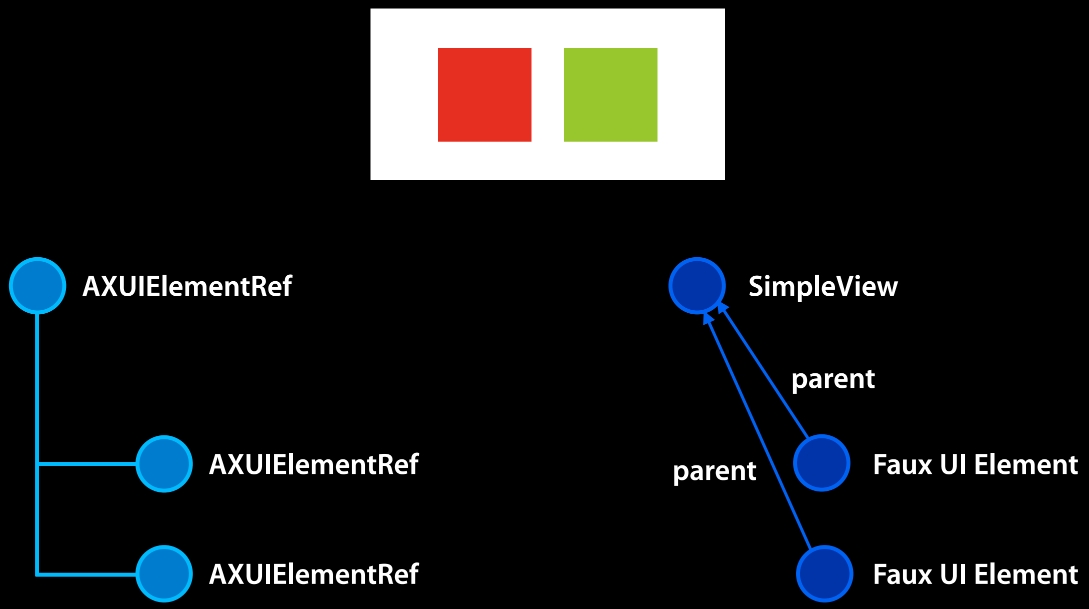
AXPosition	(1084, 227)
AXSize	32 x 23

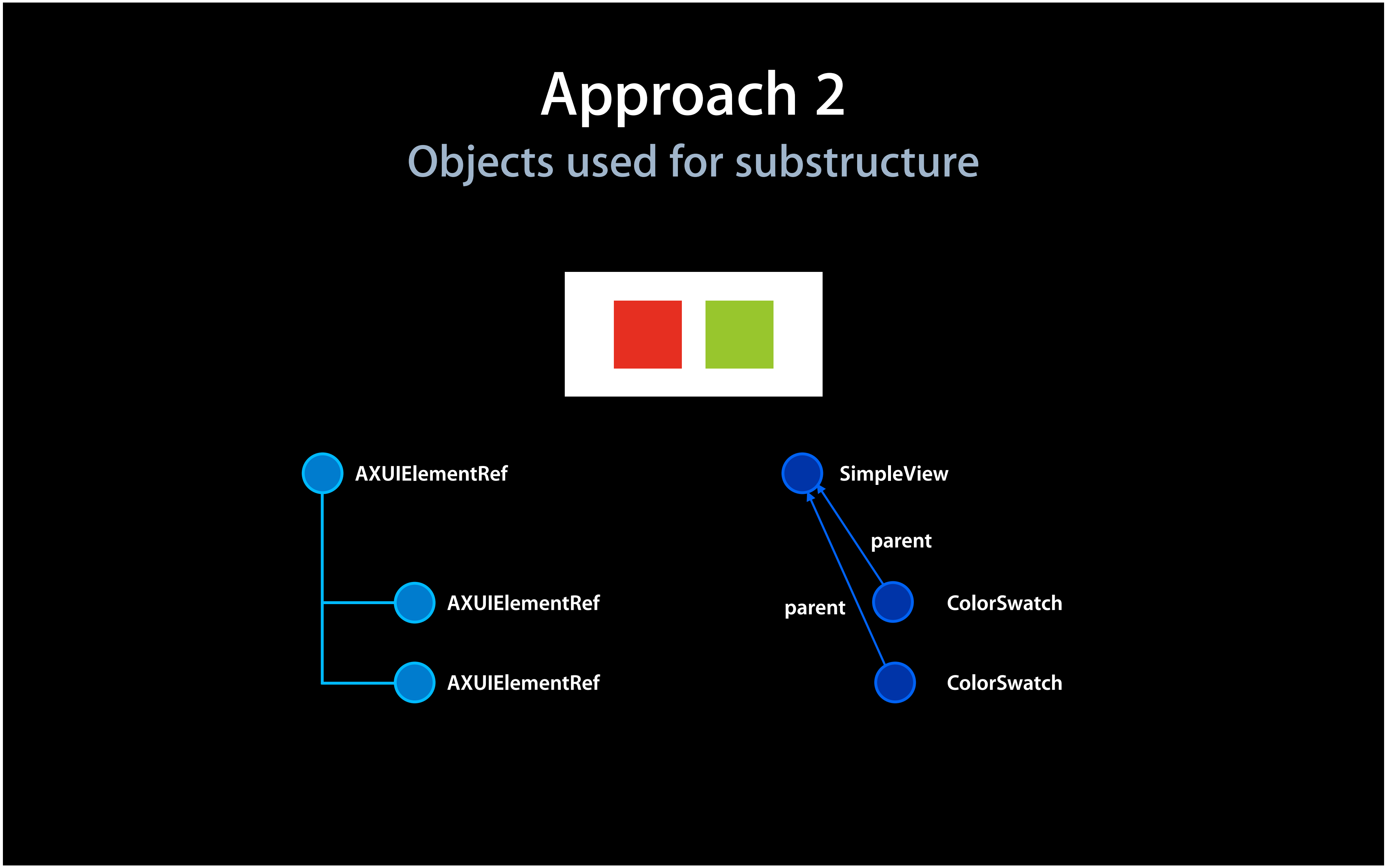
Things to Keep in Mind

- Every element needs a backing object
- Every element needs to know its children and its parent
- Every element needs to know its screen bounds

Approach 1

View handles everything





Approach 2

Objects used for substructure

Geometry Design Choices

- Approach 1
  - Factor subelement bounds into a method

```
– (NSRect)boundsOfSubelement:(NSInteger)partNumber
```

- Approach 2
  - Subelements know their own bounds
- Use the same mechanism for:
  - View drawing
  - Hit testing
  - Accessibility reporting of size and position
  - Accessibility hit testing

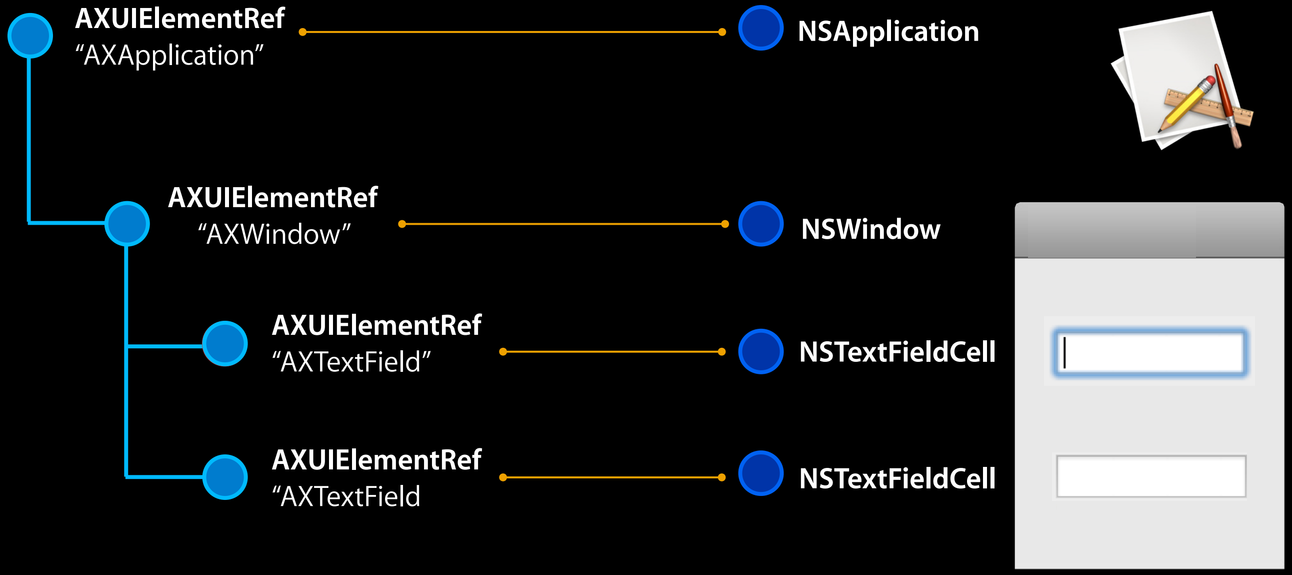
References Up The Hierarchy

Need to know parent and containing view

- These requirements exist regardless of approach taken
- An accessibility parent is always required
  - Designs sometimes do not include a parent backpointer
- Bounds are reported in screen coordinates
  - A UI element’s containing view is needed to convert local bounds

Clients Rely on Keyboard Focus

By notification and querying the application



AXUIElementRef
“AXApplication”

NSApplication

AXUIElementRef
“AXWindow”

NSWindow

AXUIElementRef
“AXTextField”

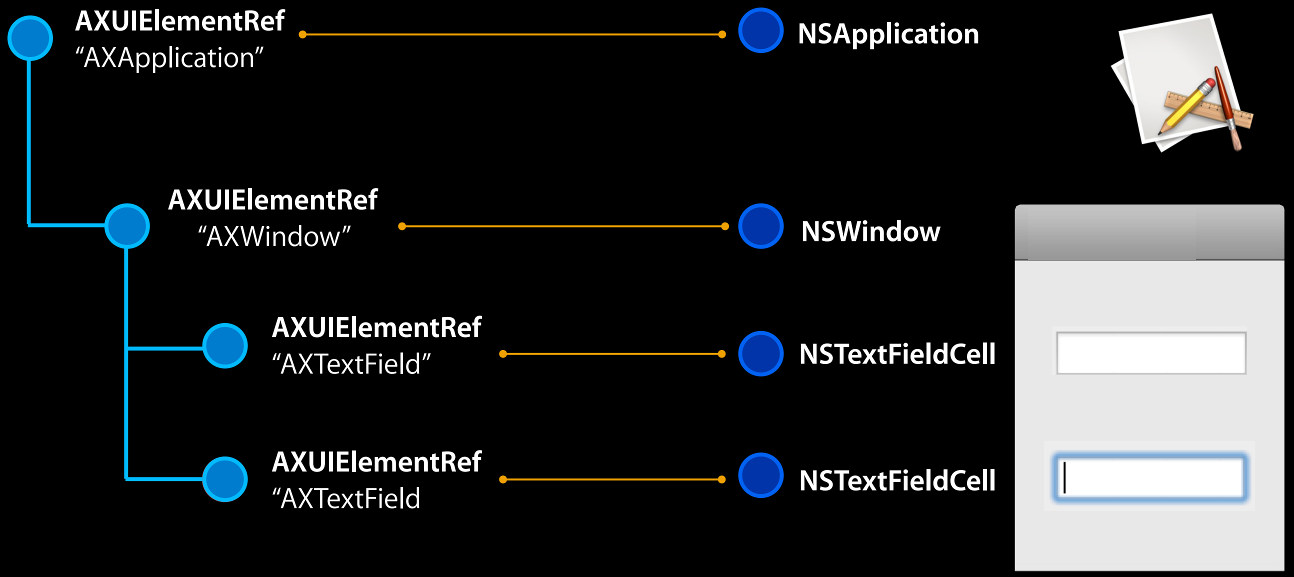
NSTextFieldCell

AXUIElementRef
“AXTextField

NSTextFieldCell

Clients Rely on Keyboard Focus

By notification and querying the application



Things to Keep in Mind

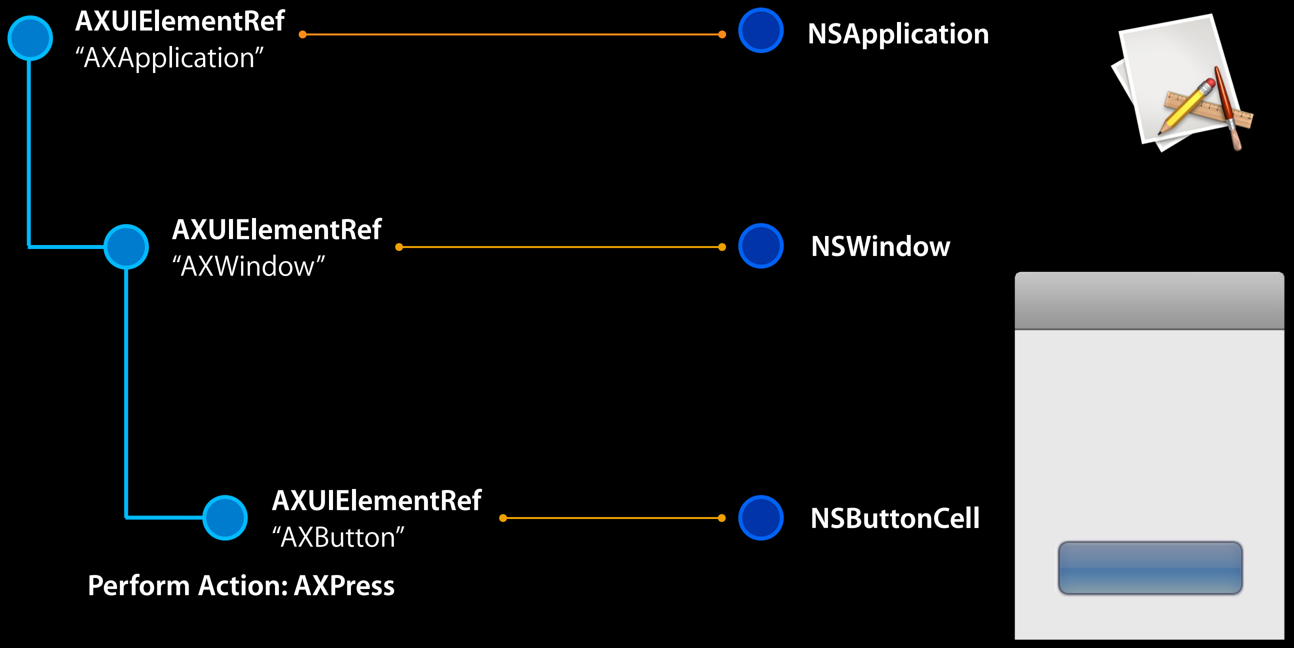
- Every element needs a backing object
- Every element needs to know its children and its parent
- Every element needs to know its rectangle
- Keyboard focus is incredibly important

Changes in Focus

- For views, focus follows the first responder automatically
- Focus for subelements of a view is done in your code
  - Send notification that focused UI element has changed
  - Send zoom rectangle update notification
- Best to have a single control point where focus change happens

Clients Can Interact with Your App

Performing actions and setting attribute values



AXUIElementRef
“AXApplication”

NSApplication

AXUIElementRef
“AXWindow”

NSWindow

AXUIElementRef
“AXButton”

NSButtonCell

Perform Action: AXPress

Things to Keep in Mind

- Every element needs a backing object
- Every element needs to know its children and its parent
- Every element needs to know its rectangle
- Keyboard focus is incredibly important
- Not all interaction has an NSEvent

Handling Actions and Setting Attributes

- Factor things like triggering behavior and changing selection into general methods
- Call the general methods from both event handling methods and accessibility actions and attribute setters

Review

- When possible use standard controls and views
- Keep a handful of things in mind when building custom views
  - Every element needs a backing object
  - Every element needs to know its children and its parent
  - Every element needs to know its rectangle
  - Keyboard focus is incredibly important
  - Not all interaction has an NSEvent

Resources

- Sample code
  - ImageMap
  - Dicey
  - Sketch+Accessibility
- Documentation
  - Accessibility Roles and Attributes Reference
  - Accessibility Programming Guidelines for Cocoa

More Information

Bill Dudney
Application Frameworks Evangelist
dudney@apple.com

Documentation
Mac OS X Dev Center
http://developer.apple.com/devcenter/mac

Apple Developer Forums
http://devforums.apple.com

Related Sessions

What’s New in Cocoa	Presidio Tuesday 10:15AM
View Based NSTableView Basic to Advanced	Nob Hill Thursday 10:15AM

Labs

Accessibility Lab	App Frameworks Lab D Thursday 4:30-6:00PM

WWDC2011