

# Cocoa Autolayout

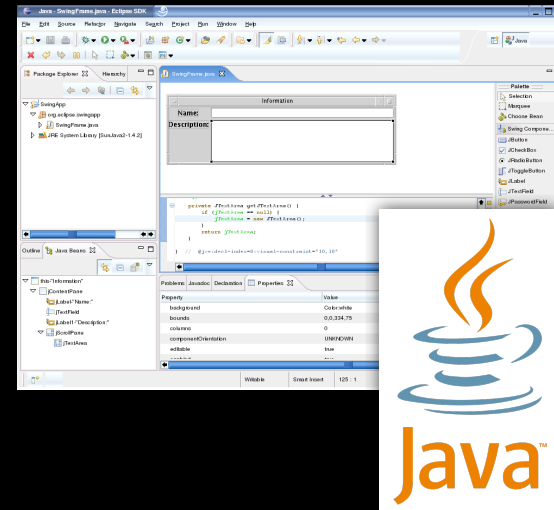
Session 103

**Ken Ferry**

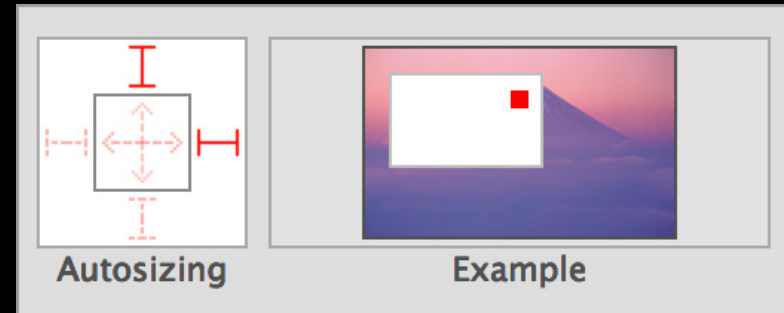
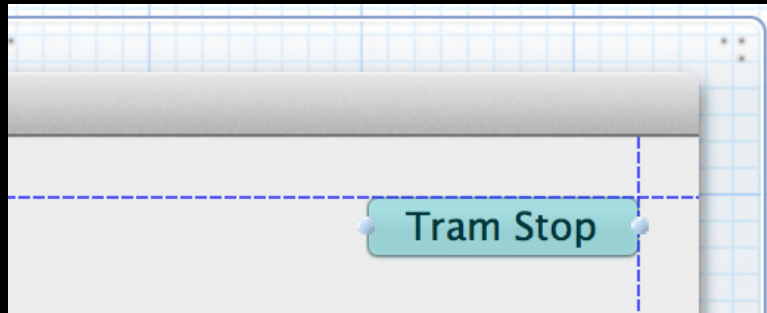
Cocoa Frameworks

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

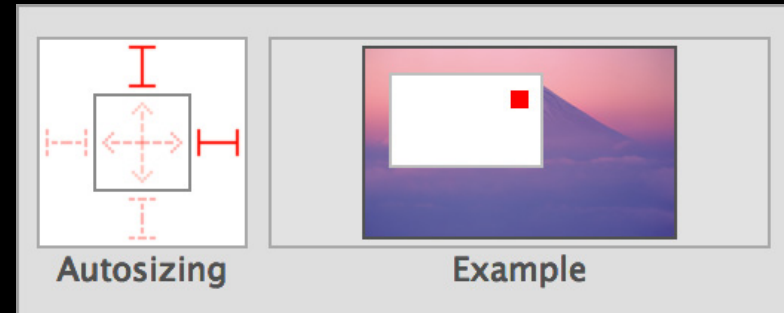
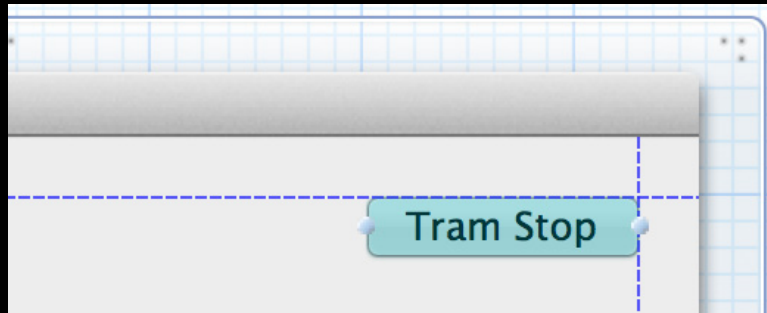
# Layout



# Springs and Struts



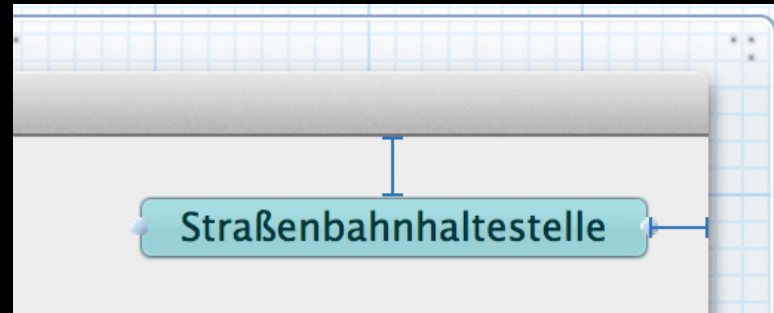
# Spring and Struts



# Autolayout



# Autolayout



# Benefits

- Reduced need for in-code layout—IB goes further
- Improved in-code layout
- Design flexibility
- Localization
- Resolution independence

# Agenda

Basics

Runtime

Layering

Debugging

Transition



# Demo

Interface Builder: Simplicity and expressiveness

**Kevin Cathey**  
Interface Builder

**Guide -> NSLayoutConstraint**

$$y = m \cdot x + b$$

$$\text{view1.attr1} = m \cdot \text{view2.attr2} + b$$

$\text{view1.attr1} = m \cdot \text{view2.attr2} + b$



$\text{acceptButton.left} = \text{cancelButton.right} + 12$

view1.attr1  $\stackrel{V}{=} \stackrel{V}{m \cdot \text{view2.attr2} + b}$   
@ priority

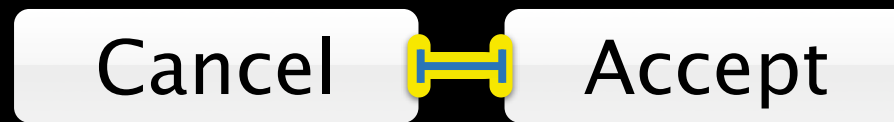
```
[NSLayoutConstraint constraintWithItem:  
    attribute:  
    relatedBy:  
    toItem:  
    attribute:  
    multiplier:  
    constant: ]
```

```
[NSLayoutConstraint constraintWithItem:acceptButton  
attribute:NSLayoutAttributeLeft  
relatedBy:NSLayoutRelationEquals  
 toItem:cancelButton  
attribute:NSLayoutAttributeRight  
multiplier:1.0  
constant:12]
```





# ASCII Art!





[cancelButton] – [acceptButton]

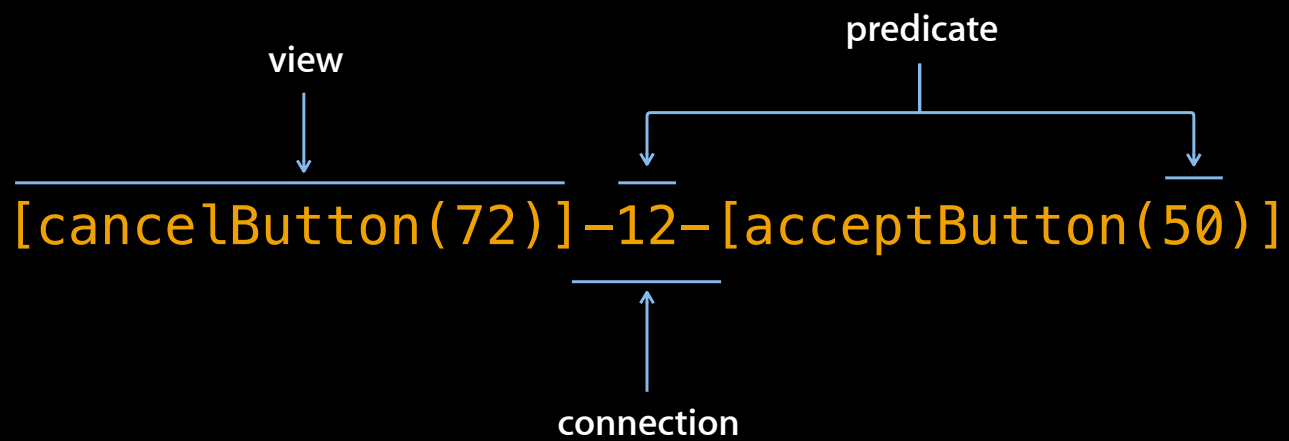
```
[NSLayoutConstraint constraintsWithVisualFormat:  
    @"[cancelButton]-[acceptButton]"  
    options:0 metrics:nil views:viewsDictionary];
```

[cancelButton] – [acceptButton]

[cancelButton ]- -[acceptButton ]

[cancelButton(72)]-12-[acceptButton(50)]





# Visual Format Language

Standard Space	[button]-[textField]
Inequality, Priority	[wideView(>=60@700)]
Connection to Superview	-5-[contentView]-5-
Vertical Layout	V:[topView]-10-[bottomView]
Flush Views, Equal Widths	[redBox][yellowBox(==redBox)]
Multiple Predicates	[flexibleView(>=30,<=80)]
Combination	-[Find]-[FindNext]-[FindField(>=20)]-

[button]-[textField]

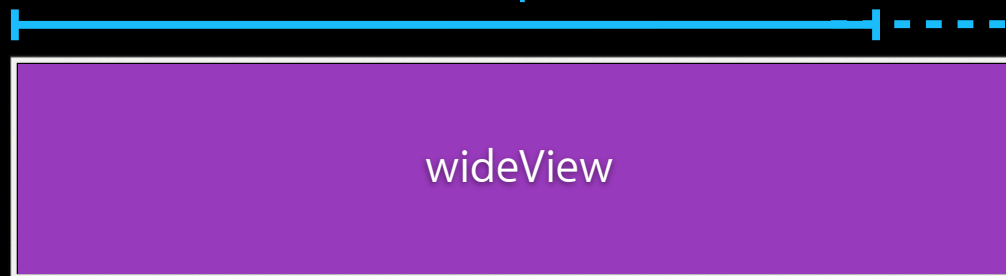


# Visual Format Language

Standard Space	[button]-[textField]
Inequality, Priority	[wideView(>=60@700)]
Connection to Superview	-5-[contentView]-5-
Vertical Layout	V:[topView]-10-[bottomView]
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Multiple Predicates	[flexibleView(>=30,<=80)]
Combination	-[Find]-[FindNext]-[FindField(>=20)]-

[wideView(>=60@700)]

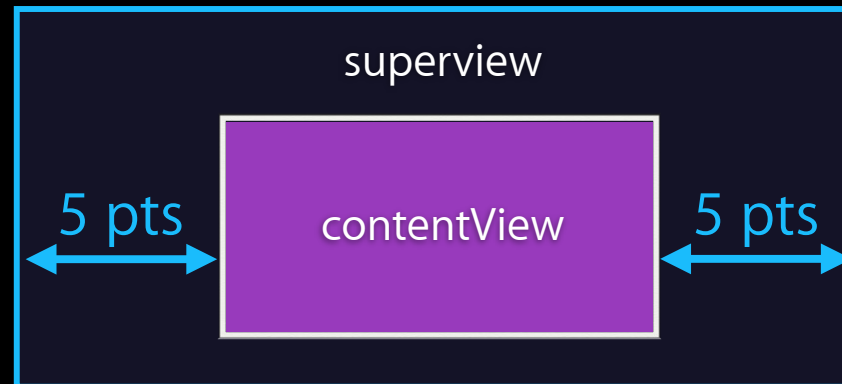
60 pts



# Visual Format Language

Standard Space	[button]-[textField]
Inequality, Priority	[wideView(>=60@700)]
Connection to Superview	-5-[contentView]-5-
Vertical Layout	V:[topView]-10-[bottomView]
Flush Views, Equal Widths	[redBox][yellowBox(==redBox)]
Multiple Predicates	[flexibleView(>=30,<=80)]
Combination	--[Find]-[FindNext]-[FindField(>=20)]-

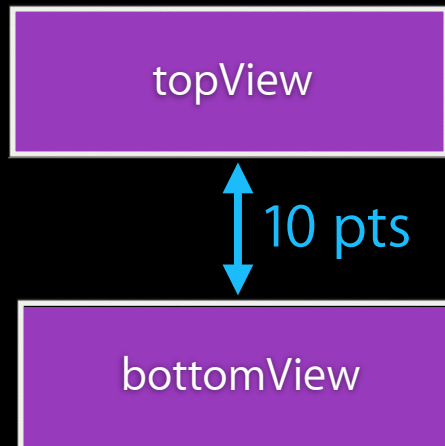
|-5-[contentView]-5-|



# Visual Format Language

Standard Space	[button]-[textField]
Inequality, Priority	[wideView(>=60@700)]
Connection to Superview	-5-[contentView]-5-
Vertical Layout	V:[topView]-10-[bottomView]
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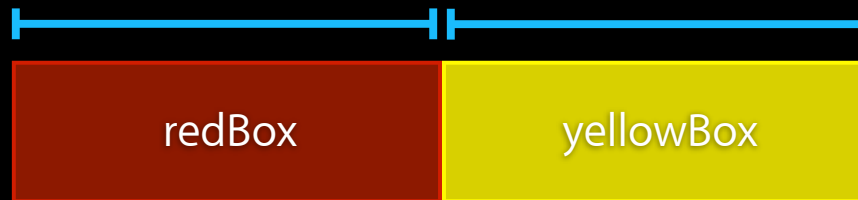
V:[topView]-10-[bottomView]



# Visual Format Language

Standard Space	[button]-[textField]
Inequality, Priority	[wideView(>=60@700)]
Connection to Superview	-5-[contentView]-5-
Vertical Layout	V:[topView]-10-[bottomView]
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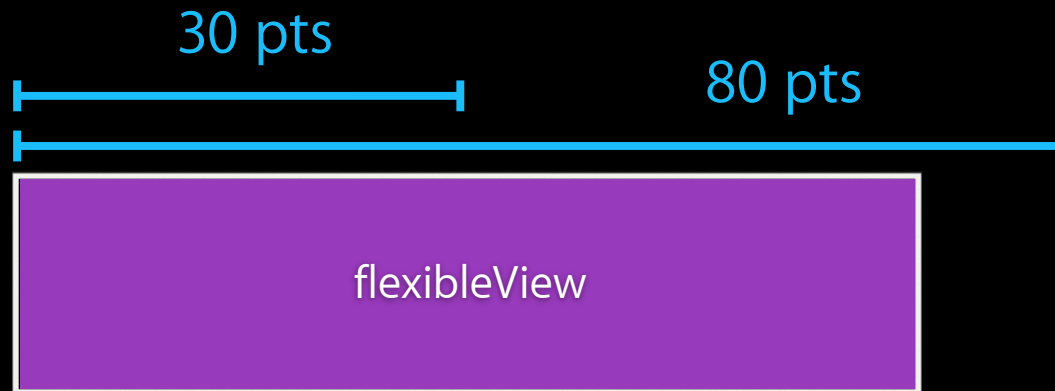
[redBox][yellowBox(==redBox)]



# Visual Format Language

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[flexibleView(>=30,<=80)]



# Visual Format Language

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Multiple Predicates	[flexibleView(>=30,<=80)]
Combination	- [Find]-[FindNext]-[FindField(>=20)]-

|- [Find]-[FindNext]-[FindField(>=20)]-|





```
[NSLayoutConstraint constraintsWithVisualFormat:  
    @"[cancelButton]-[acceptButton]"  
    options:0 metrics:nil views:viewsDictionary];
```

```
(gdb) po viewsDictionary
{
    acceptButton = "<NSButton: 0x4004c8660>";
    cancelButton = "<NSButton: 0x4004a9ec0>";
}
```

# Agenda

Basics

Runtime

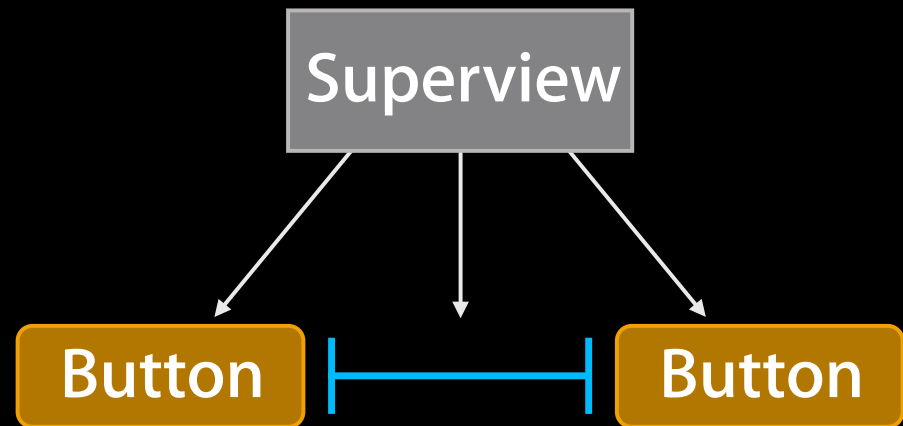
Layering

Debugging

Transition

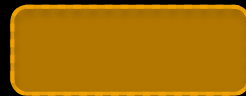
# Constraints at Runtime

```
-[NSView addConstraint:]  
-[NSView removeConstraint:]
```



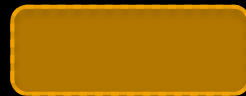
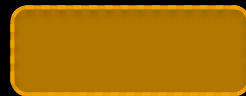
# Phases of Display

Display



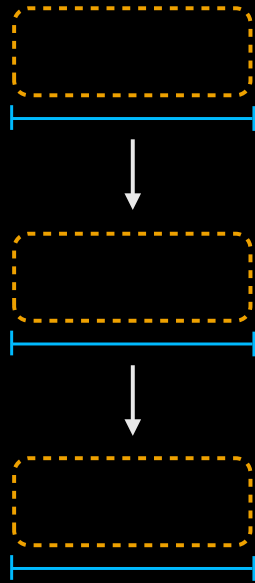
# Phases of Display

Display

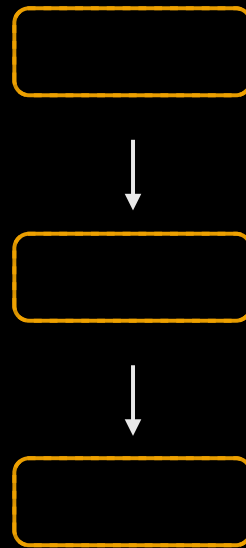


# Phases of Display

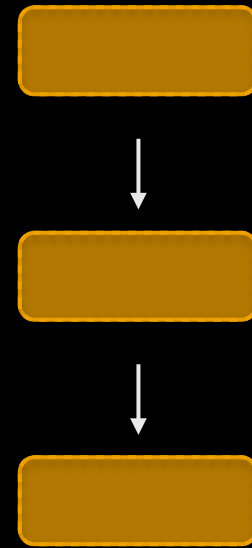
Update Constraints



Layout



Display



# Phases of Display

## Update Constraints

```
-[NSWindow  
updateConstraintsIfNeeded]  
-[NSView  
updateConstraintsForSubtreeIfNeeded]  
-[NSView updateConstraints]  
-[NSView  
needsUpdateConstraints]  
-[NSView  
setNeedsUpdateConstraints:]
```

## Layout

```
-[NSWindow layoutIfNeeded]  
-[NSView layoutSubtreeIfNeeded]  
-[NSView layout]  
-[NSView needsLayout]  
-[NSView setNeedsLayout:]
```

## Display

```
-[NSWindow displayIfNeeded]  
-[NSView displayIfNeeded]  
-[NSView drawRect:]  
-[NSView needsDisplay]  
-[NSView setNeedsDisplay:]
```



# Layout Phase

Calls `-[NSView setFrame:]`

- Code should modify constraints, not frames

# Mutation and Animation

```
NS_CLASS_AVAILABLE(10_7, NA)
@interface NSLayoutConstraint : NSObject <NSAnimatablePropertyContainer>
{
```

```
[NSAnimationContext beginGrouping];
[[NSAnimationContext currentContext] setDuration:1.0];
[[constraint animator] setConstant:800];
[NSAnimationContext endGrouping];
```

# Agenda

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Basics

Runtime

Layering

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Debugging

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Transition

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# View vs Controller Responsibilities

## Reworking the layering

- setFrame: is monolithic
  - If view state changes, layout never updates
- Controller layer has to know a lot about visual design of views

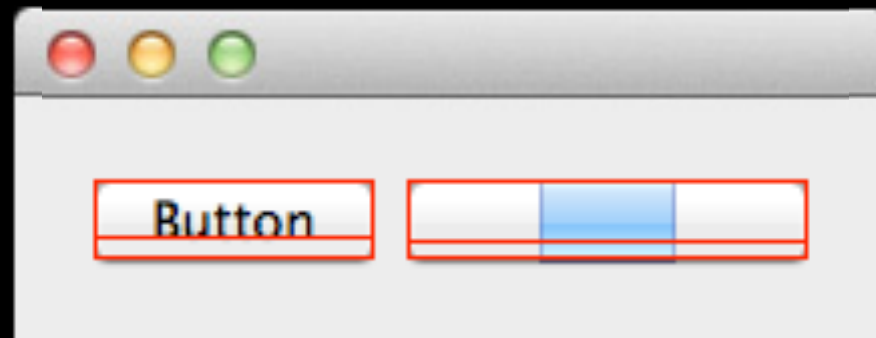
# Baselines

- NSView:

```
-(CGFloat)baselineOffsetFromBottom;
```

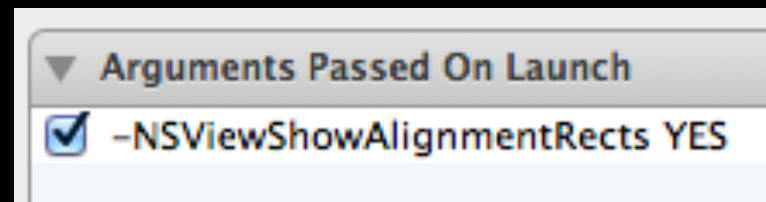
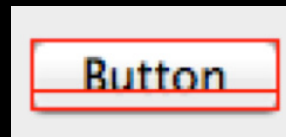


# Alignment Rect



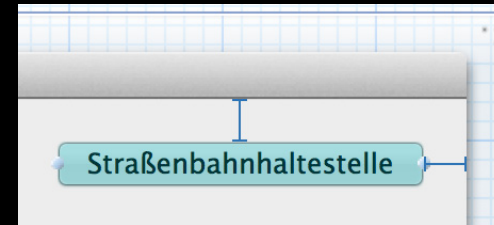
# Alignment Rect

- `NSView`:
  - `(NSEdgeInsets)alignmentRectInsets;`



# Intrinsic Content Size

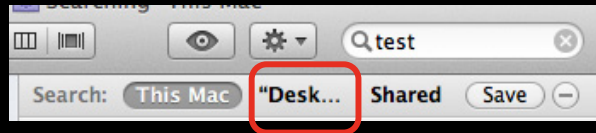
- Intrinsic Content Size declares size of content
  - Invalidate when attributes change
- Inverts classic Cocoa sizeToFit
  - Greatly reduces burden on controller layer
  - Lets view layer vary independently
  - Makes work done in Interface Builder go further





# Intrinsic Content Size

- External controller knows more about importance



```
-setContentCompressionResistancePriority:forOrientation:  
-setContentHuggingPriority:forOrientation:
```

# Intrinsic Content Size vs Fitting Size

Intrinsic Content Size	Fitting Size
Override	Call
Feeds data into layout system	Takes data out of layout system

# Agenda

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Basics

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Runtime

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Layering

---

Debugging

---

Transition

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# Demo

Working with Autolayout in code

**Ken Ferry**

Cocoa Frameworks

# Debugging

- Find bad view frame

```
-NSShowAllViews YES
```

```
-[NSView _subtreeDescription]
```

- Bad view frame -> bad constraint

```
-[NSView constraintsAffectingLayout:forOrientation:]
```

```
-[NSWindow visualizeConstraints:]
```

- Bad constraint -> bad code

- Instruments template, "Cocoa Layout"

# Debugging

The screenshot shows the Xcode Instruments interface. The top bar includes controls for recording, target selection (FindPanelLayout), inspection range (00:00:19), and view options. The main area displays a timeline with a 'Stack Depth' graph. Below the timeline is the 'Event List' for 'Cocoa Layout', which contains the following data:

#	Caller	Constraint	Constant	Event
0	+ [N...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(480)]>	480	Created
1	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(480@500)] priority:500>	480	Added To Window
2	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(651@500)] priority:500>	651	Constant Modified
3	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(675@500)] priority:500>	675	Constant Modified
4	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(651@500)] priority:500>	651	Constant Modified
5	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(675@500)] priority:500>	675	Constant Modified
6	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(687@500)] priority:500>	687	Constant Modified
7	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(675@500)] priority:500>	675	Constant Modified
8	- [NS...	<NSLayoutConstraint:0x7f85a4920ef0 H:[NSThemeFrame:0x7f85a2c47950'FindPanelLayout'(687@500)] priority:500>	687	Constant Modified

The right-hand pane shows the 'Stack Trace' for the selected event, listing the following frames from bottom to top:

- [NSThemeFrame mouseDown:]
- [NSTitledFrame mouseDown:]
- [NSWindow(NSWindowResizing)\_f...
- [NSWindow(NSWindowResizing)\_f...
- [NSTitledFrame \_validFrameForRe...
- [NSWindow(NSConstraintBasedLay...
- [NSLayoutConstraint \_setSymbolic...

The 'General' section of the extended detail shows the following information:

- walltimestamp: 9975647896
- Constraint: <NSLayoutC...riority:500>
- Constant: 687
- Event: Constant Modified
- Thread: 0x7c1df

# Agenda

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Basics

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Runtime

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Layering

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Debugging

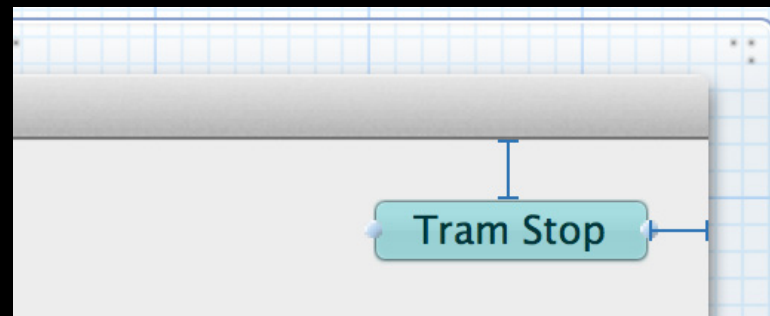
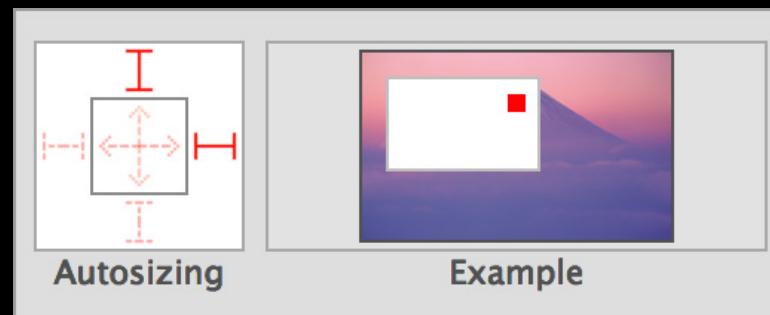
---

Transition

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# Transition

-[NSView translatesAutoresizingMaskMaskIntoConstraints]





# Transition

Autolayout activates lazily

Update Constraints



Layout



Display



# Transition

Autolayout activates lazily

Update Constraints



Layout



Display



# Transition

Autolayout activates lazily

---

Update Constraints

---



---

Layout

---



---

Display

---



# Review

- Reduced need for in-code layout
  - Constraints accommodate dynamic content
- Improved in-code layout
  - ASCII art, improved layering
- Design flexibility
  - Baselines, alignment rect, intrinsic content size
- Localization
  - Dynamic content, intrinsic content size
- Expressiveness
  - Peer to peer relationships, inequalities, priority

# More Information

## Bill Dudney

Cocoa Evangelist  
[dudney@apple.com](mailto:dudney@apple.com)

## Autolayout Documentation, Sample Code, and Release Notes

Log in and search for 'Autolayout' on Mac Dev Center

<https://developer.apple.com/library/prerelease/mac/search/?q=Autolayout>

## Programming With Constraints

The Cassowary Linear Arithmetic Constraint Solving Algorithm

<http://www.cs.washington.edu/research/constraints/cassowary/>

## Apple Developer Forums

<http://devforums.apple.com>

# Related Sessions

Using Interface Builder in Xcode

Pacific Heights  
Tuesday 2:00PM

# Labs

Cocoa Lab	App Frameworks Lab A Tuesday 2:00-6:00PM
Cocoa and Autolayout Lab	App Frameworks Lab A Wednesday 9:00-11:00AM
Cocoa, Full Screen, and Aqua Lab	App Frameworks Lab A Wednesday 2:00-6:00PM
Cocoa, Auto Save, File Coordination, and Resume Lab	App Frameworks Lab A Thursday 2:00-4:00PM

