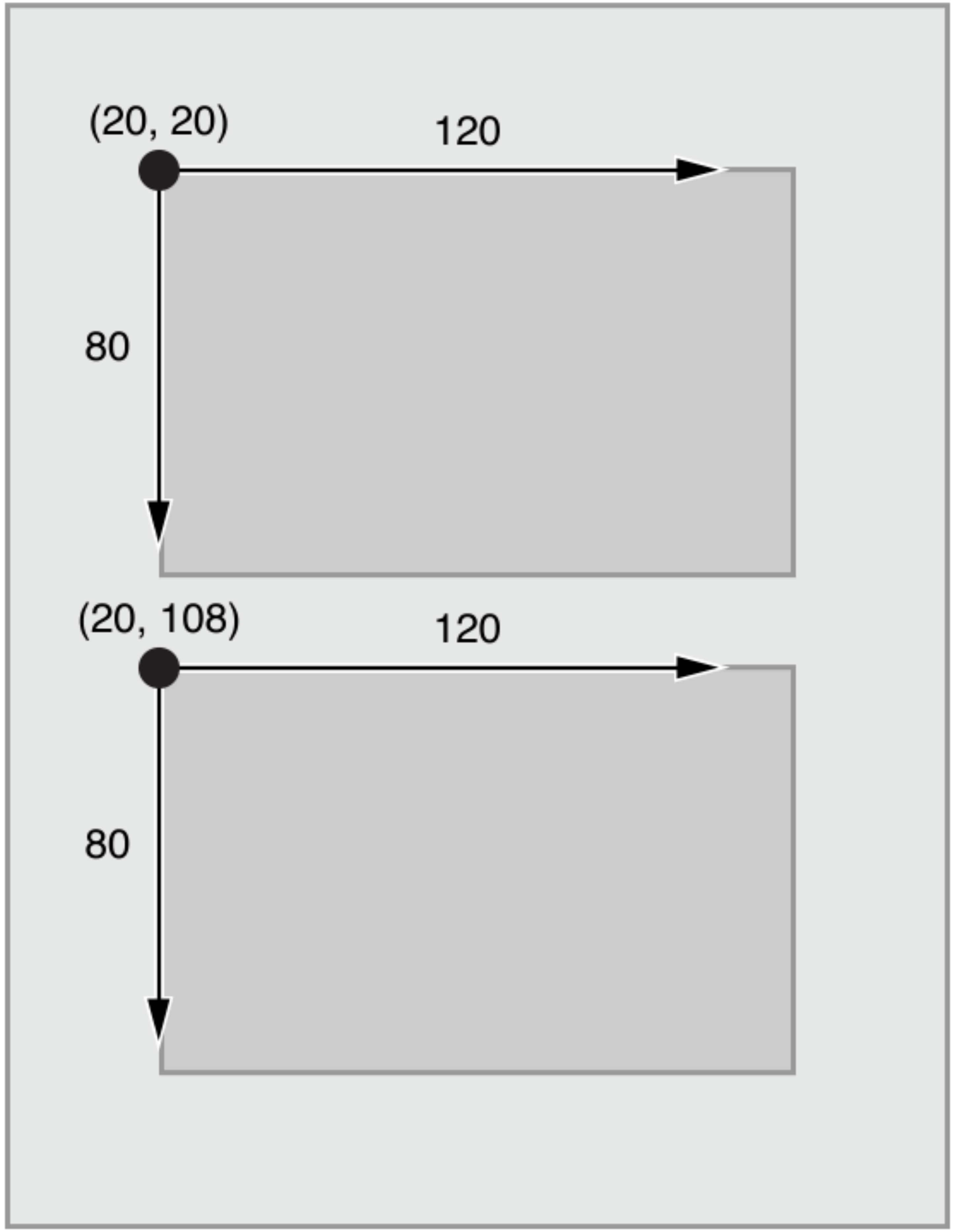
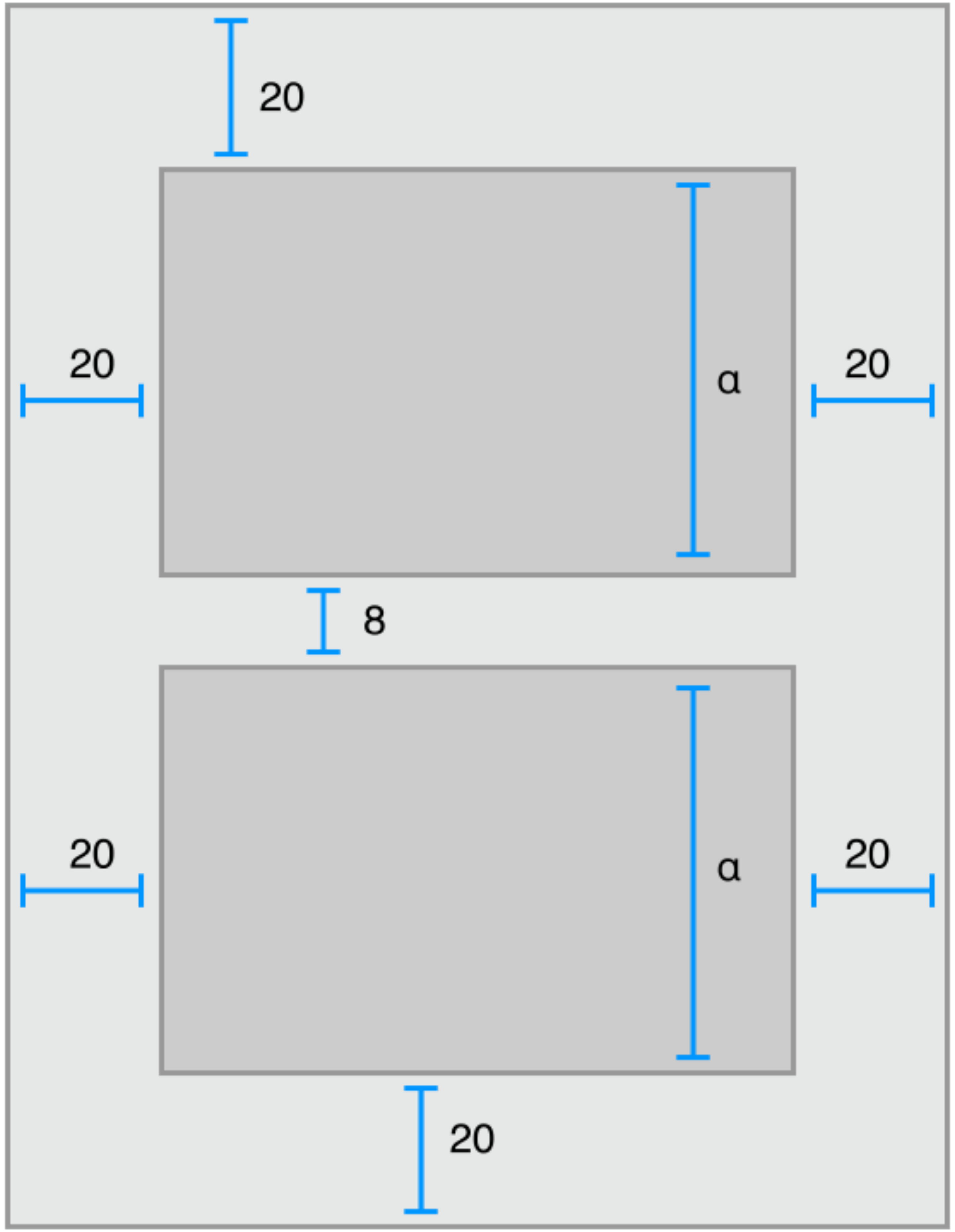
AutoLayout

Problem to solve:

Laying out views when there are changes in:

```
- Screen size
- Rotations
- Subview content
- Internationalization
- Dynamic Type
- Size class
```


(20, 20)
120
80
(20, 108)
120
80


20
20
a
20
8
20
a
20
20

The logic used to design a set of constraints to create specific behaviors is very different from the logic used to write procedural or object-oriented code.[1]

[1] Understanding Auto Layout. developer.apple.com.

Let's back up a bit...

$$\begin{cases} x + y + z = 0 \\ 2x - 4y + 9z = 10 \\ -x + y - 2z = -3 \end{cases}$$

"...the constraint-based system"

"...the ~~constraint~~ equation-based system"

AutoLayout is just an equation system where the variables are the view's frames

Equation == Constraint

A constraint is just an equation that expresses on an axis either:

- The distance between two sibling views
- The size of a view

If we think about it:

```
view.leadingAnchor.constraint(
  equalTo: superView.leadingAnchor,
  constant: 10
)
```

Can be translated to[2]:

$$view.left == superView.left + 10$$

[2] Cartography.

How many equations do we need?

Each view has to have a defined `frame`, which means:

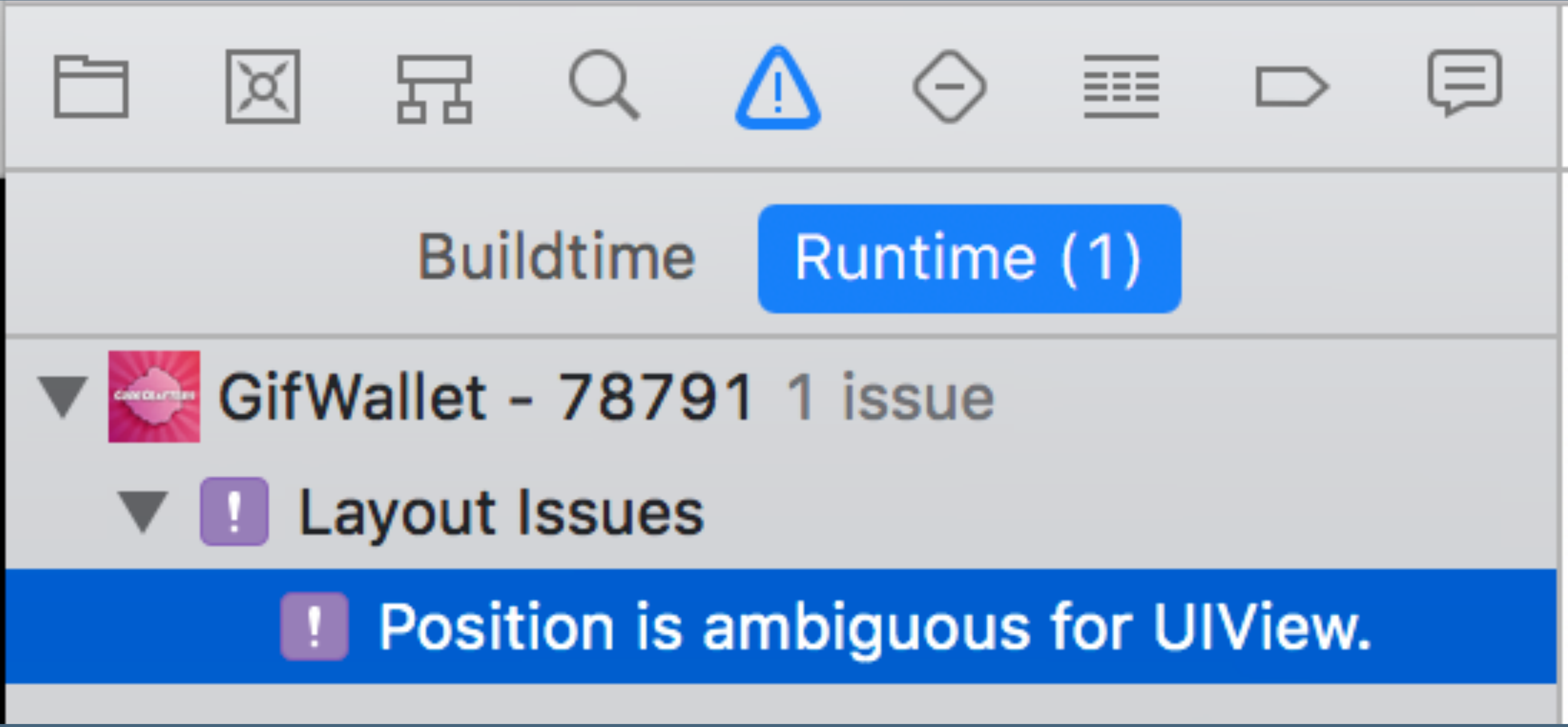
— *origin*: `x`, `y`

— *size*: `width`, `height`

You add enough constraints until the layout system can solve all 4 variables for every view.

$$\begin{cases} x + y + z = 0 \\ 2x - 4y + 9z = 10 \\ -x + y - 2z = -3 \end{cases}$$

$$\begin{cases} x + y + z = 0 \\ 2x - 4y + 9z = 10 \end{cases}$$



GifWallet - 78791 1 issue

Layout Issues

Position is ambiguous for UIView.

$$\begin{cases} x + y + z = 0 \\ 2x - 4y + 9z = 10 \\ -x + y - 2z = -3 \\ 5x - 2y + z = 5 \end{cases}$$

```
Unable to simultaneously satisfy constraints
    Probably at least one of the constraints in the
    following list is one you don't want.

Will attempt to recover by breaking constraint
<NSLayoutConstraint:0x698e70 UIView: 0x698e43.width == 30   (active)>
```

How to add constraints (responsibly):

1. A `UIView` should provide constraints for it's subviews positions
2. A `UIView` should provide it's size:
   - Using width and height constraints
   - Using `intrinsicContentSize`

How to create constraints:

```swift
let widthConstraint = redView.widthAnchor.constraint(equalToConstant: 30)
let heightConstraint = redView.heightAnchor.constraint(equalToConstant: 30)
```

And then:

```swift
NSLayoutConstraint.activate([
  widthConstraint,
  heightConstraint
])
```

What happens next?

Layout cycle

Adding a constraint will indirectly call `setNeedsLayout` to a view, triggering a layout pass where the layout system will:

1. Finds the top-most view (normally the `UIWindow`'s root view controller)
2. Resolve the top-most view hierarhy using the window size.
   — Positions and sizes for the top-most view's subviews will be resolved.
3. The layout system will recursively resolve the subviews hierarcy based on the size of all the subviews.

Layout cycle: customization

The layout system will call:

`-viewWillLayoutSubviews` on `UIViewController`

`-layoutSubviews` on `UIView`

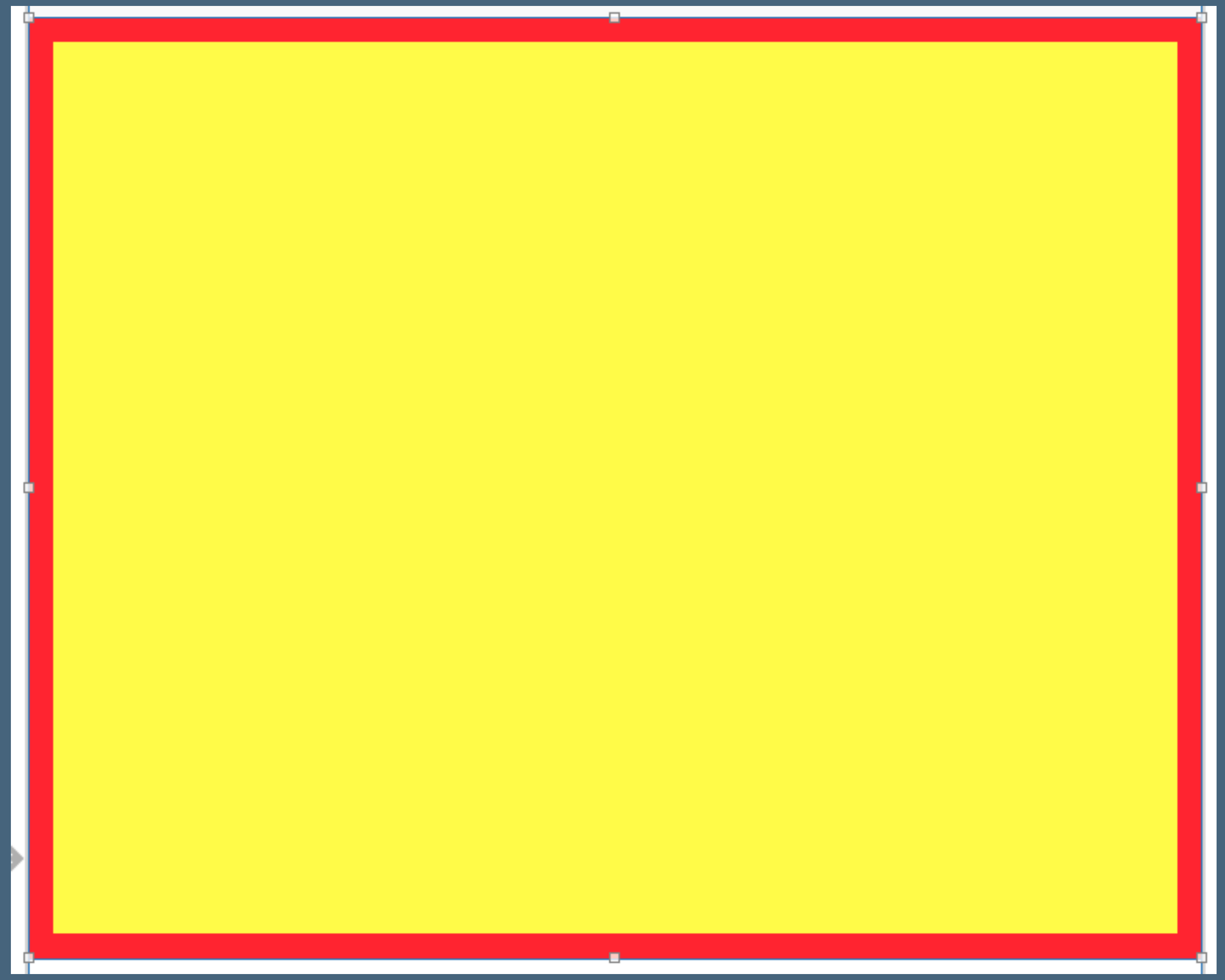
The resolved frame for the current view will be passed as an argument for customization.

Don't call `setNeedsLayout` during these methods.

Demo

Layout Guides

Defines a rectangular region where layout can occurr safely in their owning view's coordinate system.



Layout Guides

```swift
let layoutGuide: UILayoutGuide = ...
let constraints = [
    label.leadingAnchor.constraint(equalTo: layoutGuide.leadingAnchor),
    label.trailingAnchor.constraint(equalTo: layoutGuide.trailingAnchor),
    label.topAnchor.constraint(equalTo: layoutGuide.topAnchor),
    label.bottomAnchor.constraint(equalTo: layoutGuide.bottomAnchor)
]
NSLayoutConstraint.activate(constraints)
```

Layout Guides

There are three types:

- Margin.
- SafeArea.
- Custom.

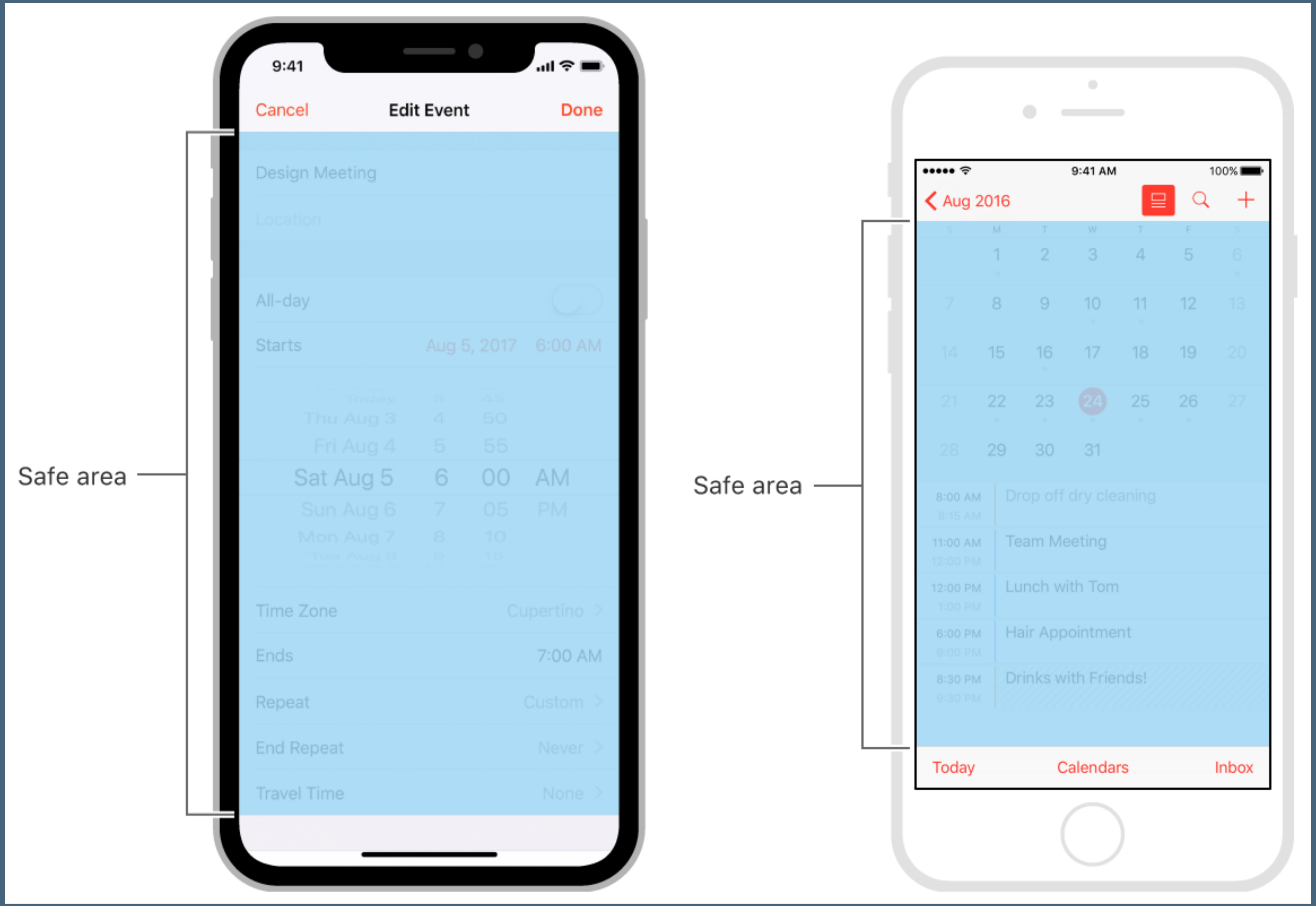
Layout Margins Guides

Every `UIView` has one to reflect the `layoutMargins` property.

```
self.layoutMargins = UIEdgeInsets(top: 5, left: 5, bottom: 5, right: 5)
let constraints = [
    label.leadingAnchor.constraint(equalTo: self.layoutMarginsGuide.leadingAnchor),
    label.trailingAnchor.constraint(equalTo: self.layoutMarginsGuide.trailingAnchor),
    label.topAnchor.constraint(equalTo: self.layoutMarginsGuide.topAnchor),
    label.bottomAnchor.constraint(equalTo: self.layoutMarginsGuide.bottomAnchor)
]
NSLayoutConstraint.activate(constraints)
```

Note: you can't modify a `UIViewController`'s view's margins.

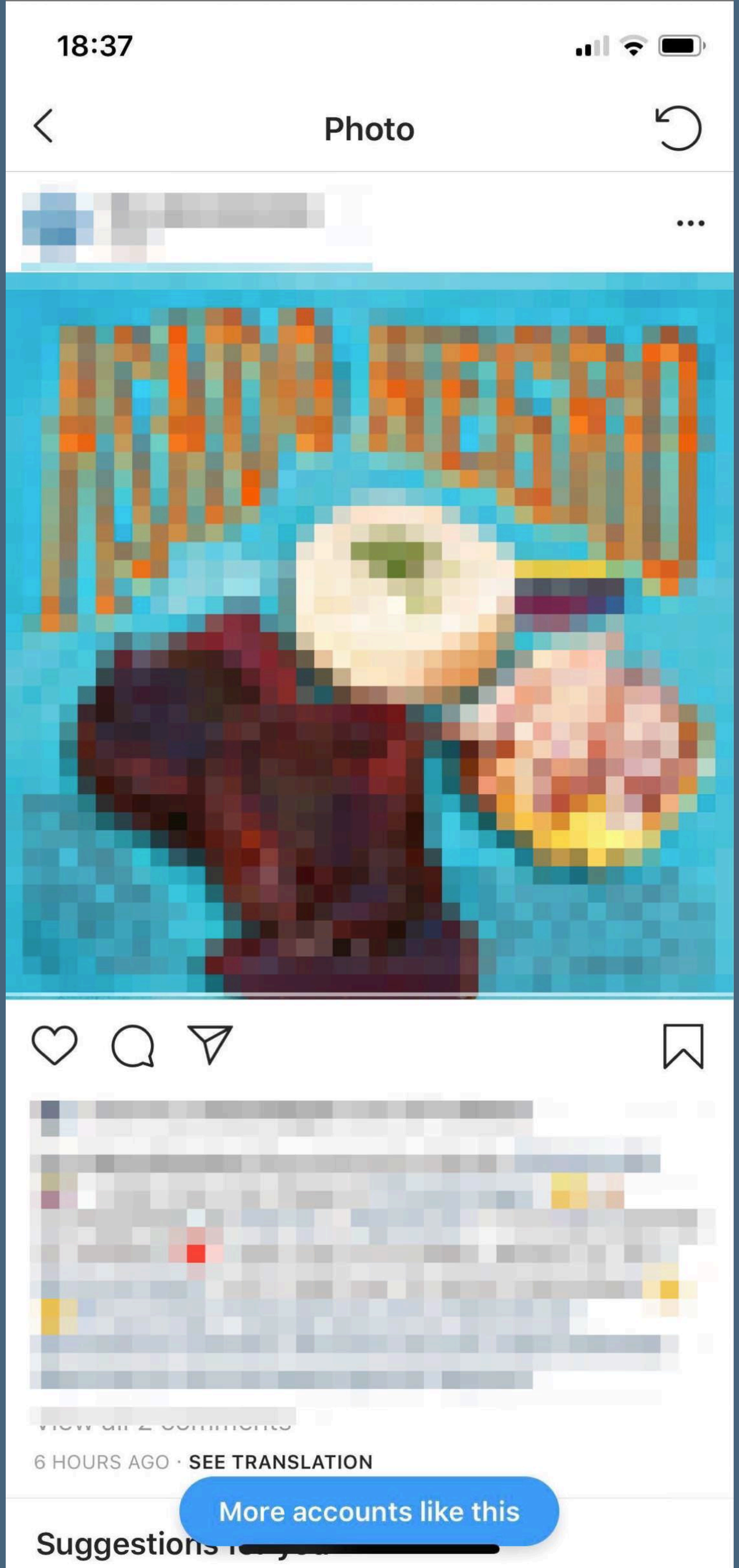
Safe Area Layout Guide



Safe Area Layout Guide

Prevents showing content underneath:
- `UINavigationBar`
- `UITabBar`
- `UIStatusBar`
- iPhone X home indicator.

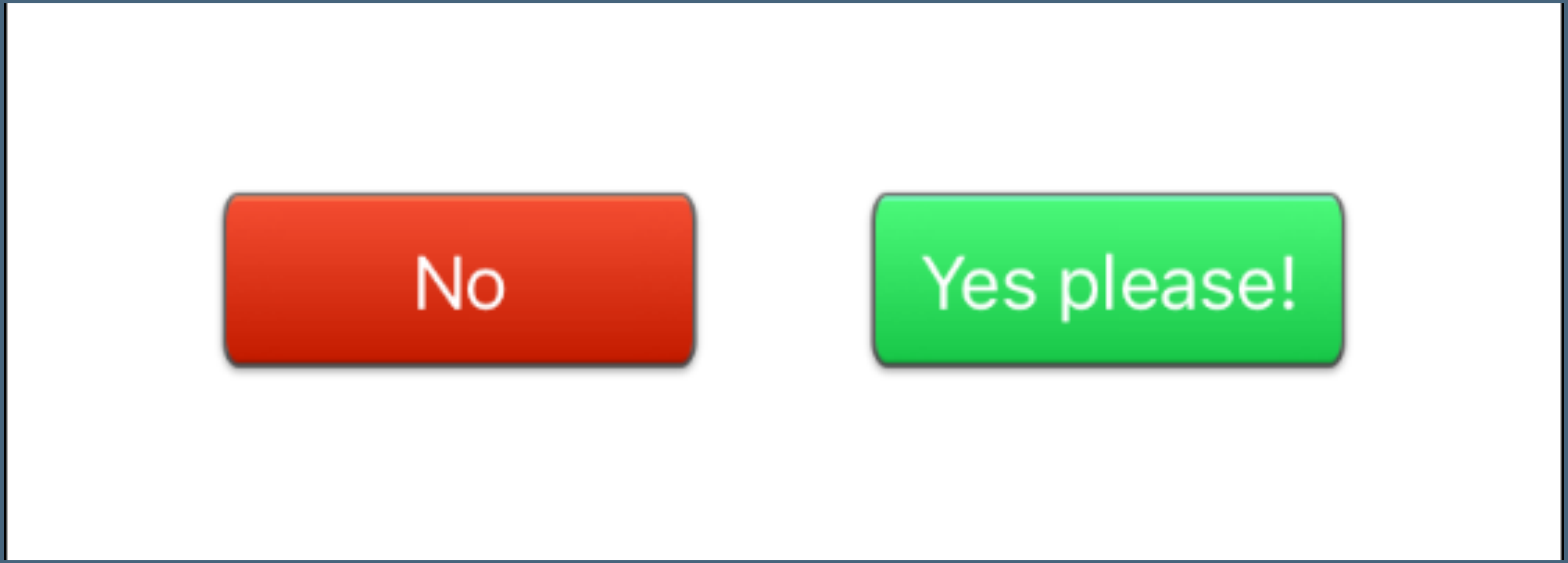
✅ Automatically set for us on `UIViewController`
👀 Can be modified with `additionalSafeAreaInsets`



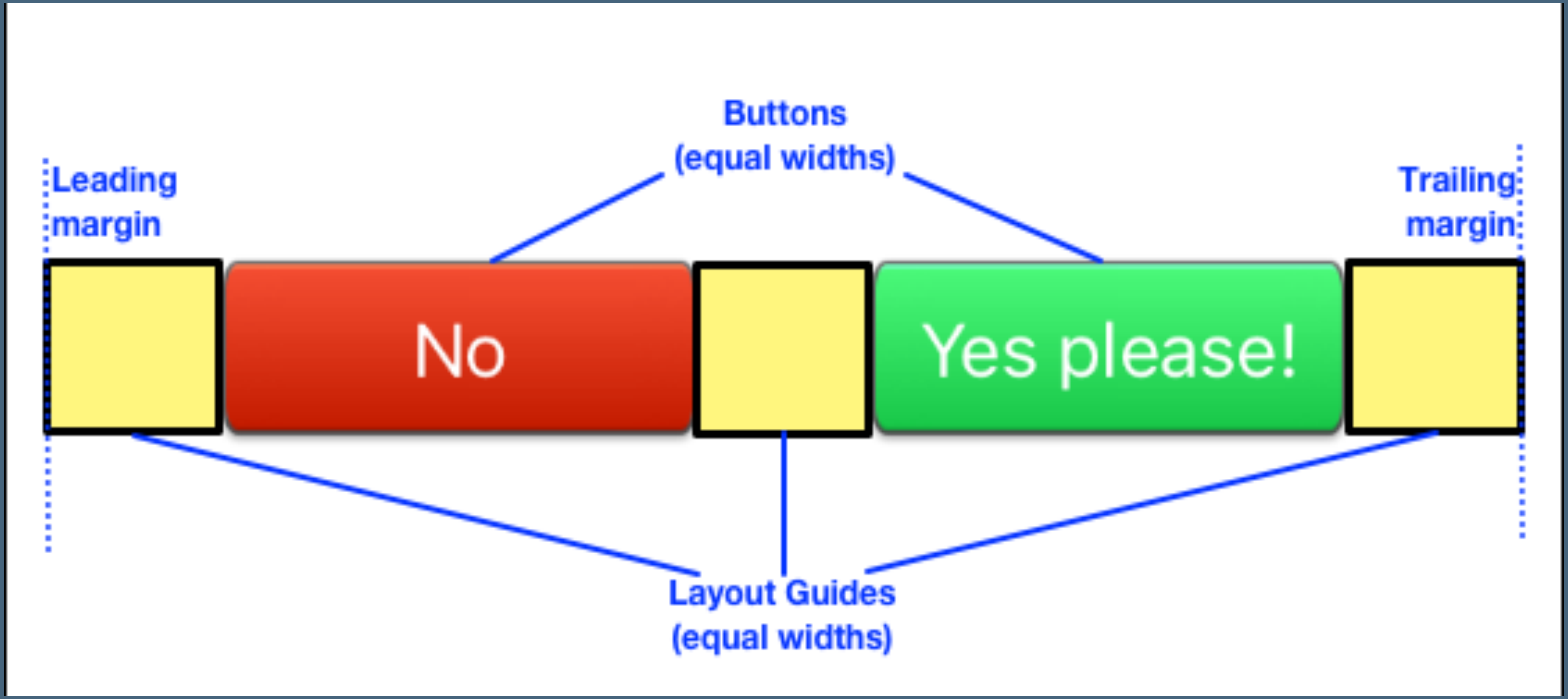
Safe Area Layout Guide

— All `UIControls` in your view must respect this

Custom guides:



Custom guides[3]:



[3] Goodbye Spacer Views Hello Layout Guides. useyourloaf.com.

Demo

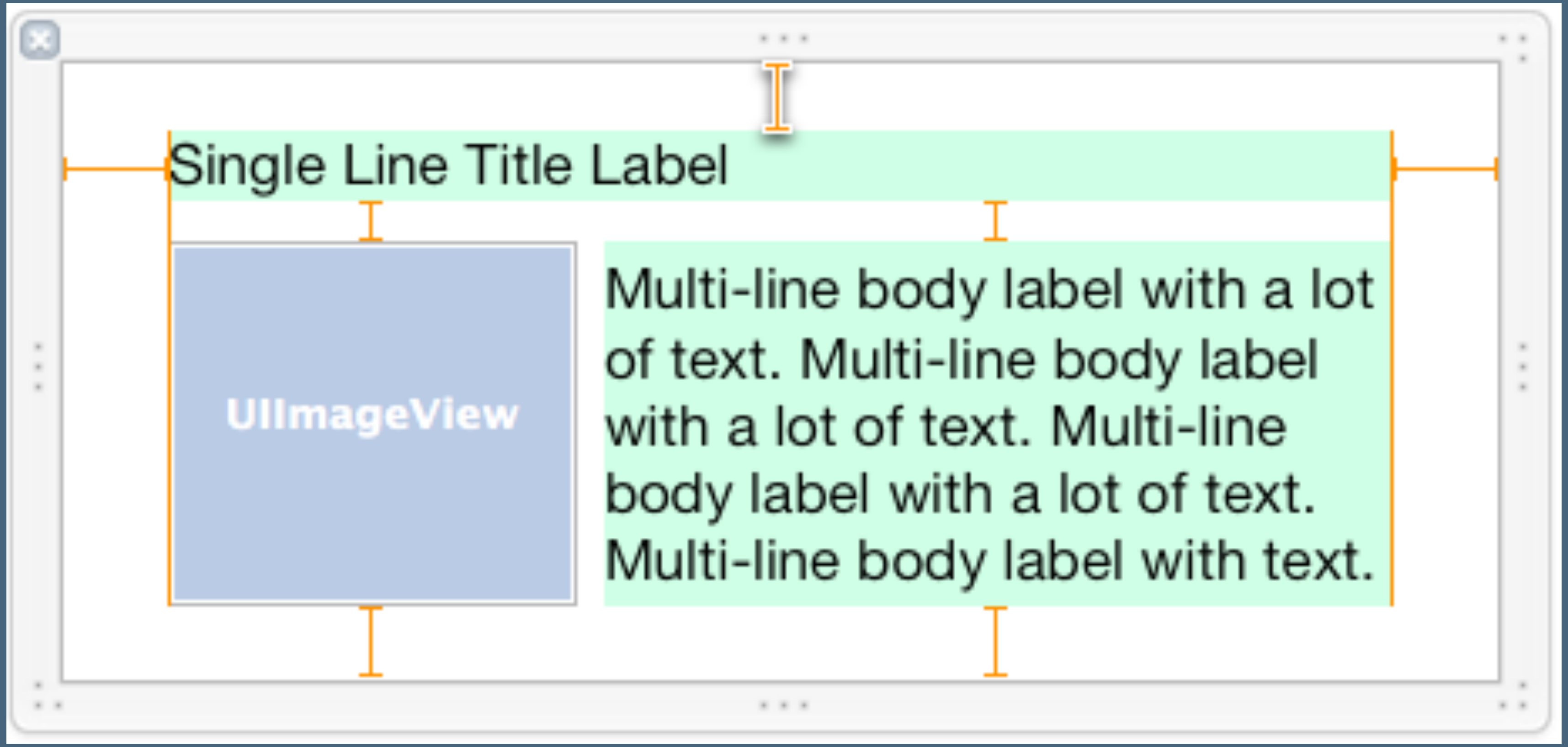
Best practices:

View layout

- From top to bottom on the view hierarchy.
- Create constraints and activate them all at once using `NSLayoutConstraint.activate()`.
- Don't create more constraints than you need.
- Rely on `intrinsicContentSize` for sizes when possible.

`intrinsicContentSize`

- Your custom view's should not override this method
  - Instead, create constraints that will make the system infer it for you.


Single Line Title Label
UIImageView
Multi-line body label with a lot of text. Multi-line body label with a lot of text. Multi-line body label with a lot of text. Multi-line body label with text.

`UILabel.intrinsicContentSize`

- ⛔ *Never* constraint the width/height
- ✅ Set `numberOfLines` to 0 and leading and trailing constraints instead of width.
- ☑️ Also, set `contentHuggingPriority` and `contentCompressionResistancePriority` appropiately.

`UIImageView.intrinsicContentSize`

- It will default to the image's size
- Create a constraint for:
  - The `aspectRatio`
  - The max allowed `aspectRatio`
  - The width or height.

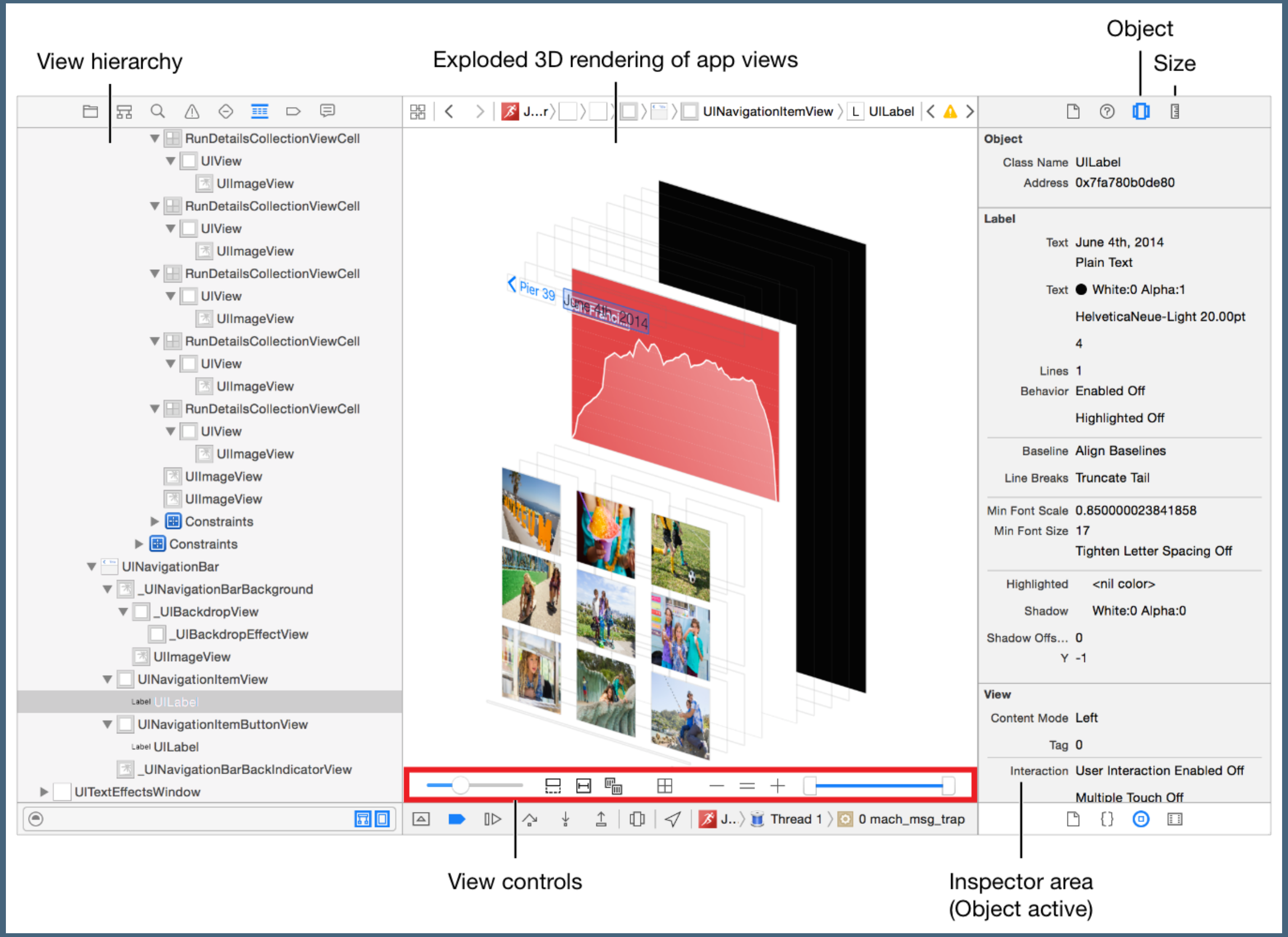
UIStackView

- Use `UIStackView` as much as possible.
- Remember that they don't have an `intrinsicContentSize`.
    - However, if the system can infer a width (vertical) or height (horizontal) for this stackView, then it uses the **fitting size** for this stackView:

```
let size: CGSize = stackView.systemLayoutSizeFitting(
    CGSize(width: 100, height: 0),
    withHorizontalFittingPriority: .required,
    verticalFittingPriority: .fittingSizeLevel
)
```

Debugging

— Xcode's Visual Hierarchy debugger is your friend.



```
▼ RunDetailsCollectionViewCell
  ▼ UIView
      UIImageView
▼ RunDetailsCollectionViewCell
  ▼ UIView
      UIImageView
▼ RunDetailsCollectionViewCell
  ▼ UIView
      UIImageView
▼ RunDetailsCollectionViewCell
  ▼ UIView
      UIImageView
▼ RunDetailsCollectionViewCell
  ▼ UIView
      UIImageView
  UIImageView
  UIImageView
▶ Constraints
▶ Constraints
▼ UINavigationBar
  ▼ _UINavigationBarBackground
    ▼ _UIBackdropView
        _UIBackdropEffectView
    UIImageView
  ▼ UINavigationItemView
      UILabel
  ▼ UINavigationItemButtonView
      UILabel
    _UINavigationBarBackIndicatorView
▶ UITextEffectsWindow
```

Object

Class Name	UILabel
Address	0x7fa780b0de80

Label

Text	June 4th, 2014
	Plain Text
Text	● White:0 Alpha:1
	HelveticaNeue-Light 20.00pt
	4
Lines	1
Behavior	Enabled Off
	Highlighted Off
Baseline	Align Baselines
Line Breaks	Truncate Tail
Min Font Scale	0.850000023841858
Min Font Size	17
	Tighten Letter Spacing Off
Highlighted	<nil color>
Shadow	White:0 Alpha:0
Shadow Offs...	0
Y	-1

View

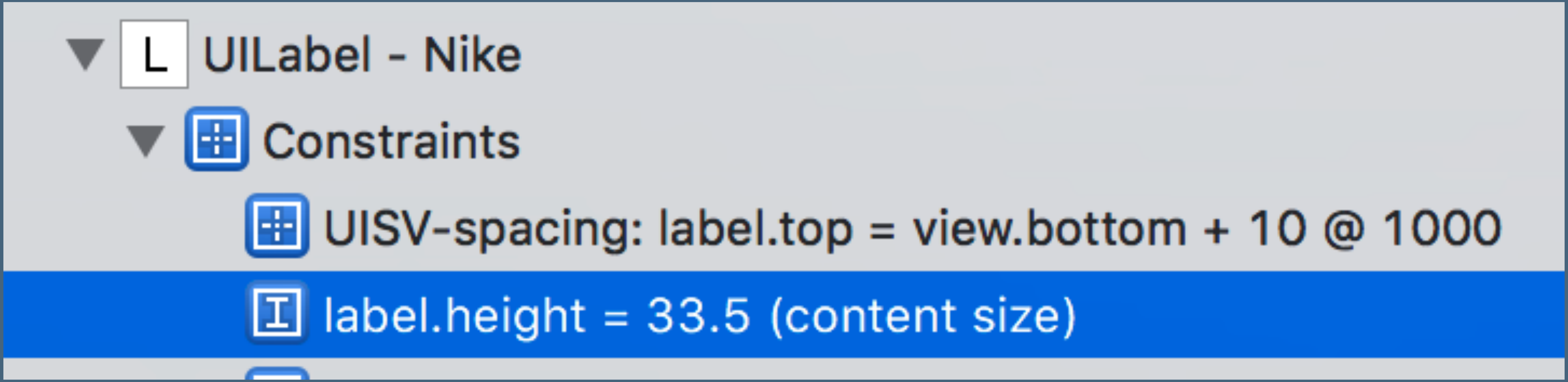
Content Mode	Left
Tag	0
Interaction	User Interaction Enabled Off
	Multiple Touch Off

Debugging

- Remember to turn of `translatesAutoresizingMaskIntoConstraints`.
- If a constraint is being broken by the engine, and the layout looks correct:
  - The engine did the right thing now, but this doesn't mean that it will do the same thing on other OS versions.
  - Set that constraint's priority lower to optimize the performance.

Debugging

— Content sizes are also represented in the layout engine



UILabel - Nike

Constraints

UISV-spacing: label.top = view.bottom + 10 @ 1000

label.height = 33.5 (content size)