#WWDC19

Advances in Collection View Layout

Complex layouts made simple

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Current state-of-the-art

A new approach

Demos

Advanced layouts

Current State-of-the-Art

UICollectionViewFlowLayout

In the beginning, there was flow

Useful for many common designs

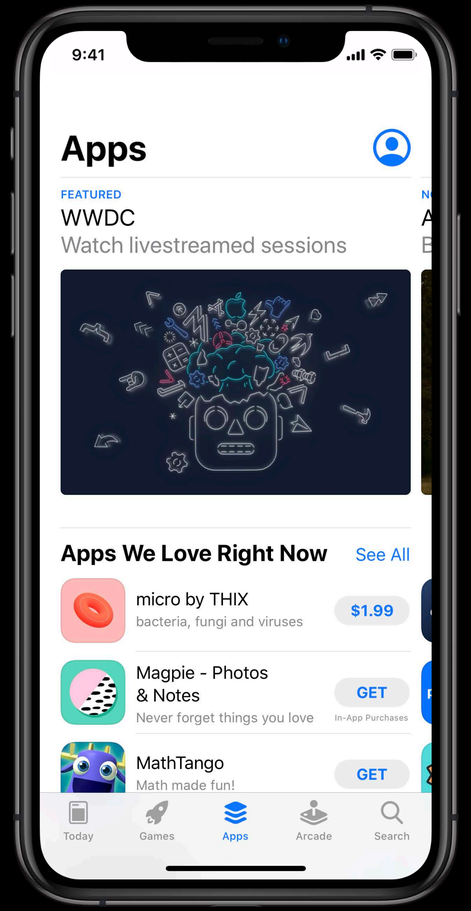
Line-based

What about today’s apps?

Today's App Designs

Complex

Custom layouts



Building Custom Layouts

Boilerplate code

Performance considerations

Supplementary and decoration view challenges

Self-sizing challenges

Compositional Layout

Compositional Layout

Composable

Flexible

Fast

Compositional Layout

Composing small layout groups together

Layout groups are line-based

Composition instead of subclassing

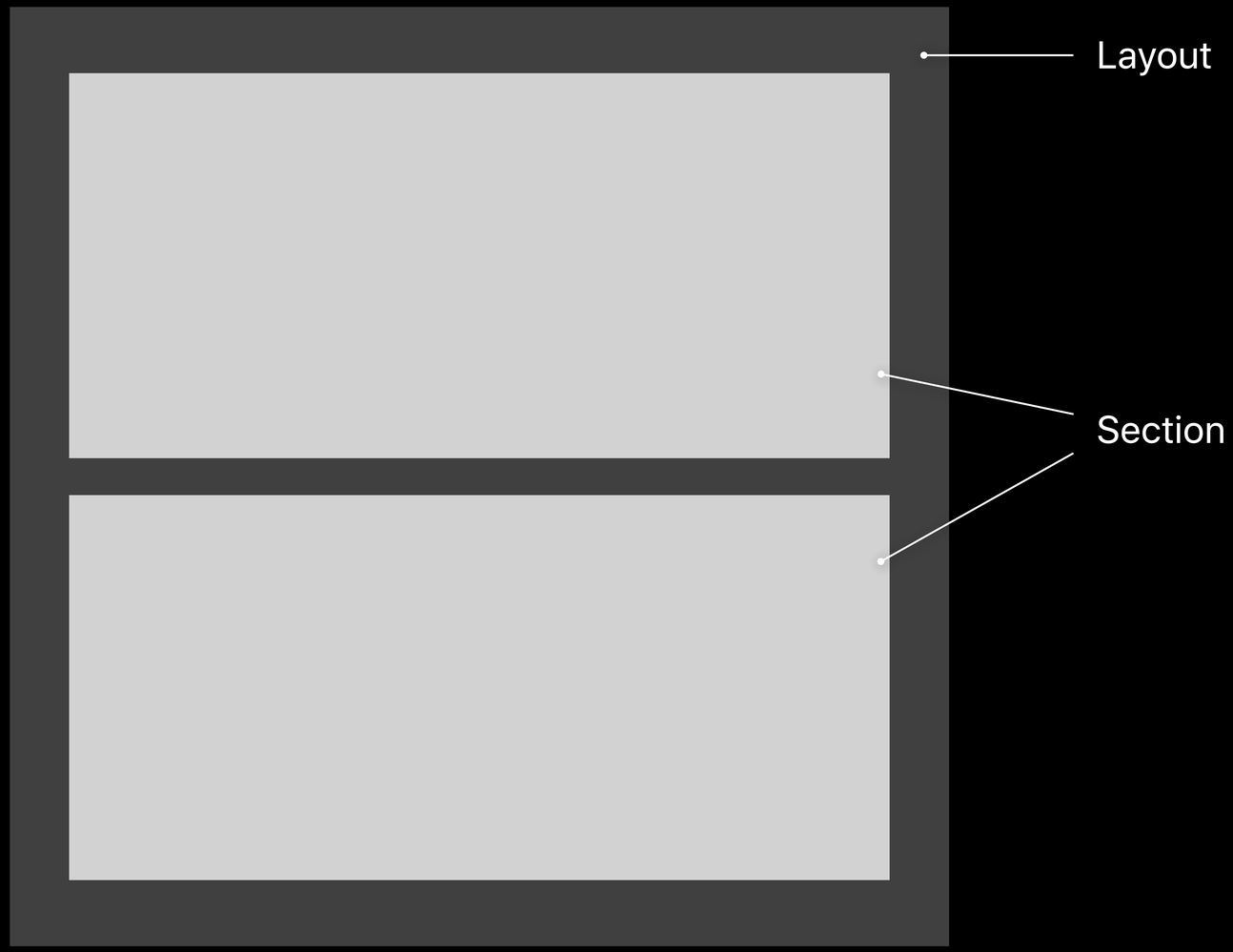
Show me some code already!

```
// Create a List by Specifying Three Core Components: Item, Group and Section

let size = NSCollectionLayoutSize(widthDimension: .fractionalWidth(1.0),
                                  heightDimension: .absolute(44.0))

let item = NSCollectionLayoutItem(layoutSize: size)

let group = NSCollectionLayoutGroup.horizontal(layoutSize: size, subitems: [item])

let section = NSCollectionLayoutSection(group: group)

let layout = UICollectionViewCompositionalLayout(section: section)
```

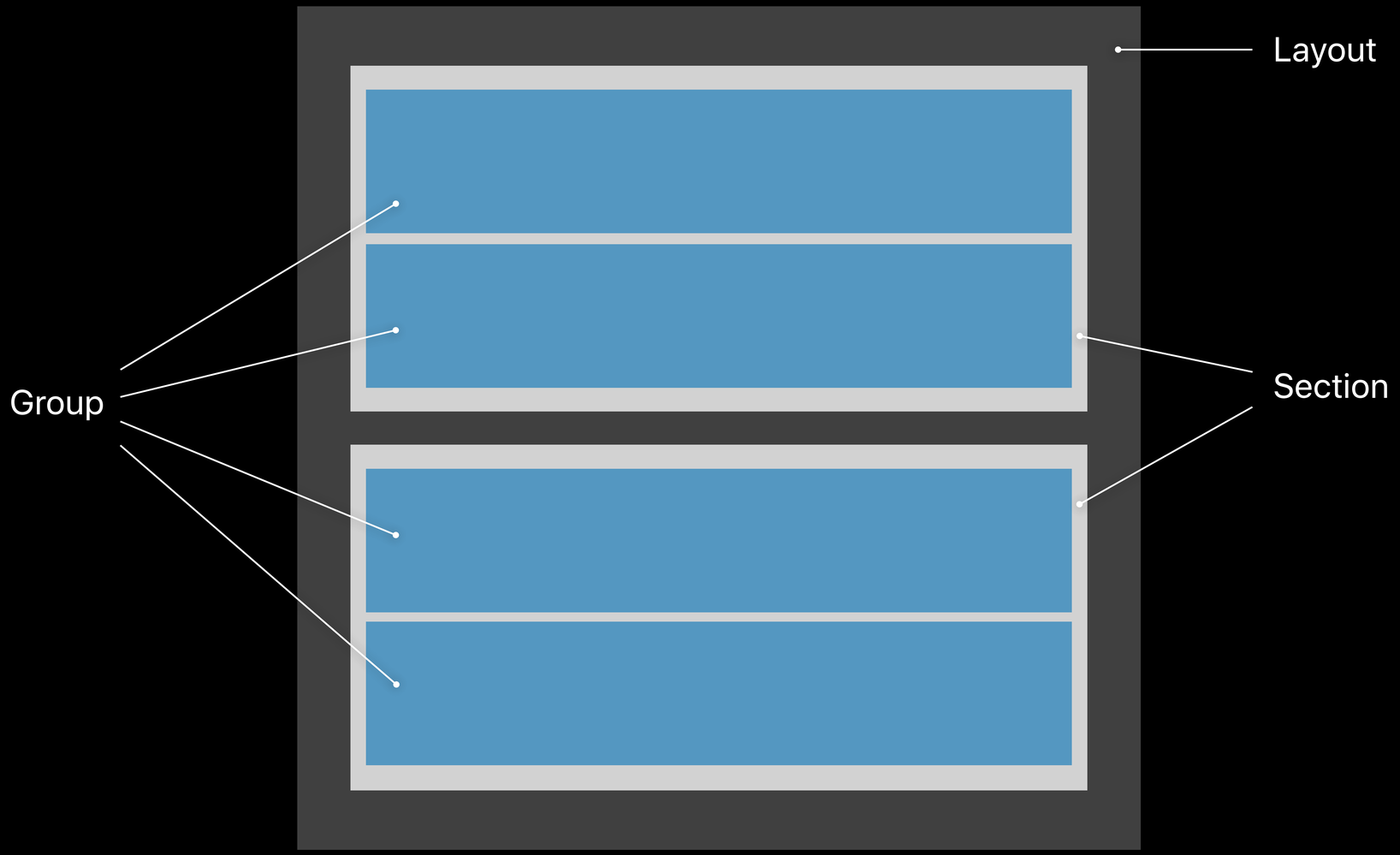
Item > Group > Section > Layout

Item > Group > Section > Layout

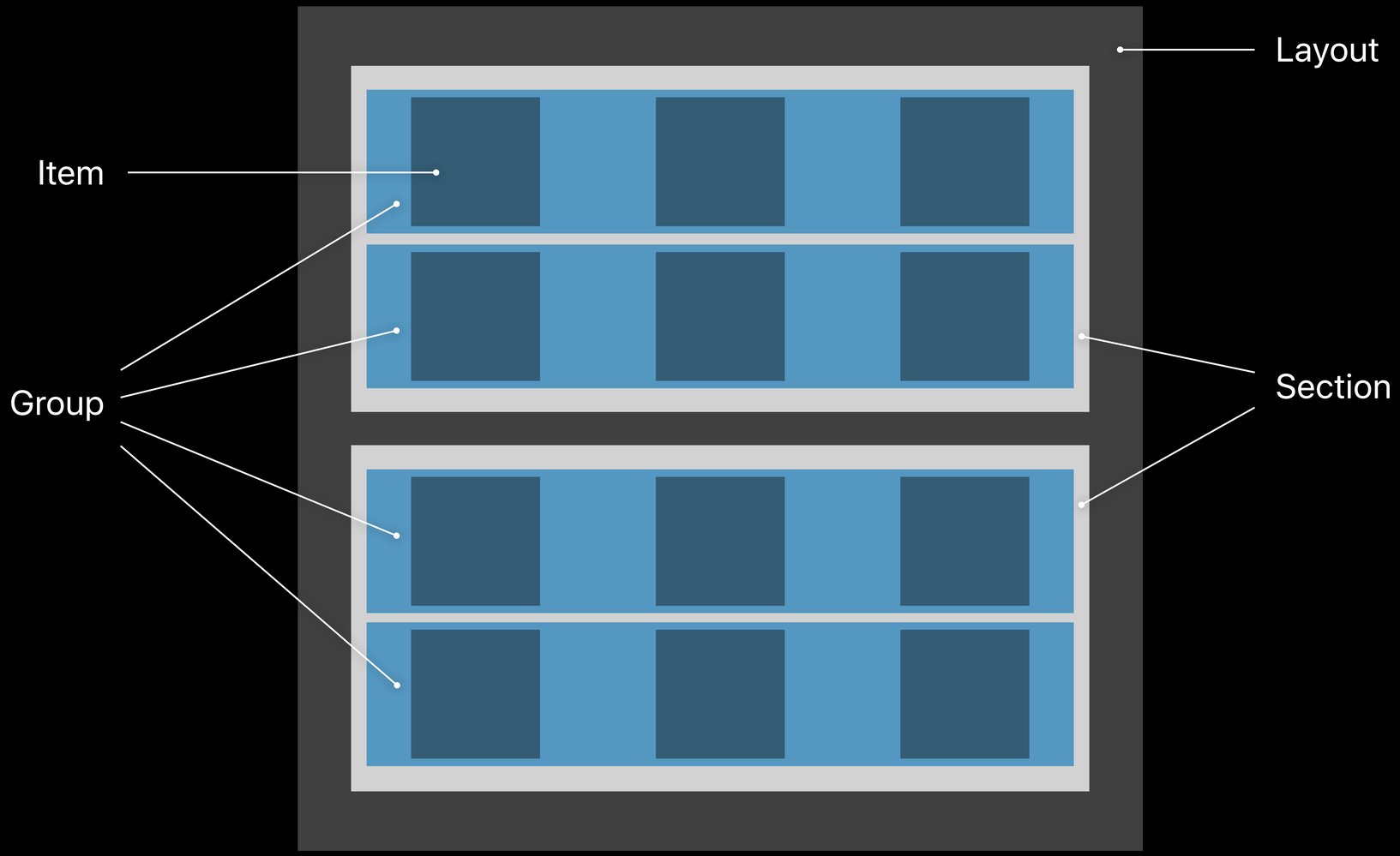
Item > Group > Section > Layout



Item > Group > Section > Layout



Item > Group > Section > Layout



Core Concepts

NSCollectionLayoutSize

NSCollectionLayoutItem

NSCollectionLayoutGroup

NSCollectionLayoutSection

NSCollectionLayoutSize

Everything has an explicit size

Size = Width + Height dimension

```
class NSCollectionLayoutSize {
    init(widthDimension: NSCollectionLayoutDimension,
         heightDimension: NSCollectionLayoutDimension)
}
```

NSCollectionLayoutDimension

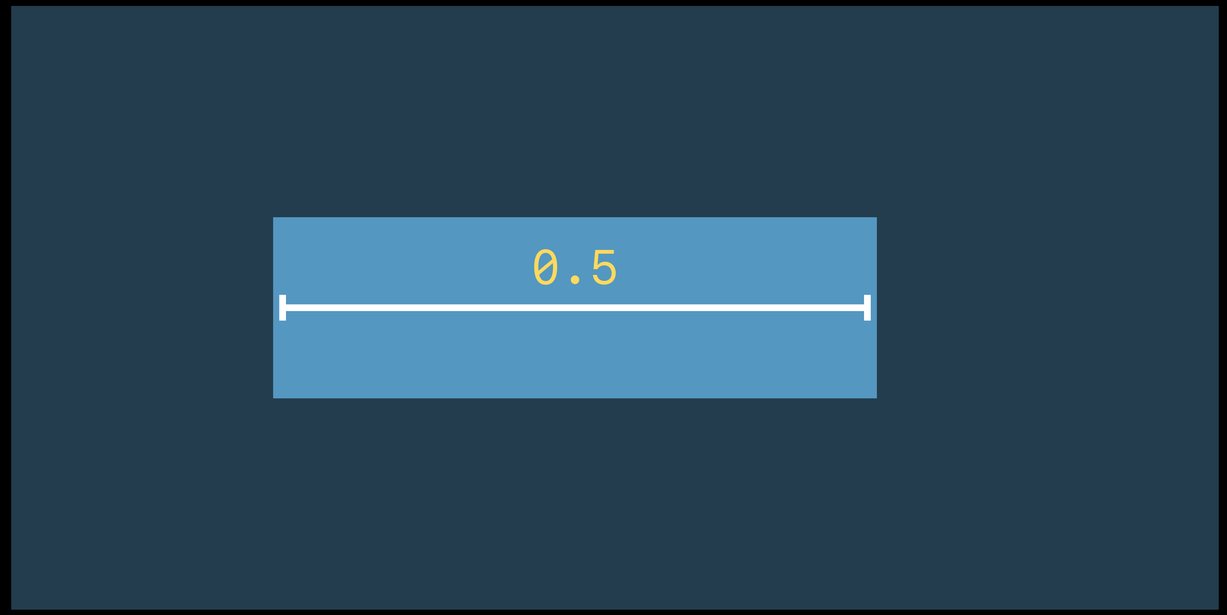
Axis independent

Four ways to define

```
class NSCollectionLayoutDimension {
    class func fractionalWidth(_ fractionalWidth: CGFloat) -> Self
    class func fractionalHeight(_ fractionalHeight: CGFloat) -> Self
    class func absolute(_ absoluteDimension: CGFloat) -> Self
    class func estimated(_ estimatedDimension: CGFloat) -> Self
}
```

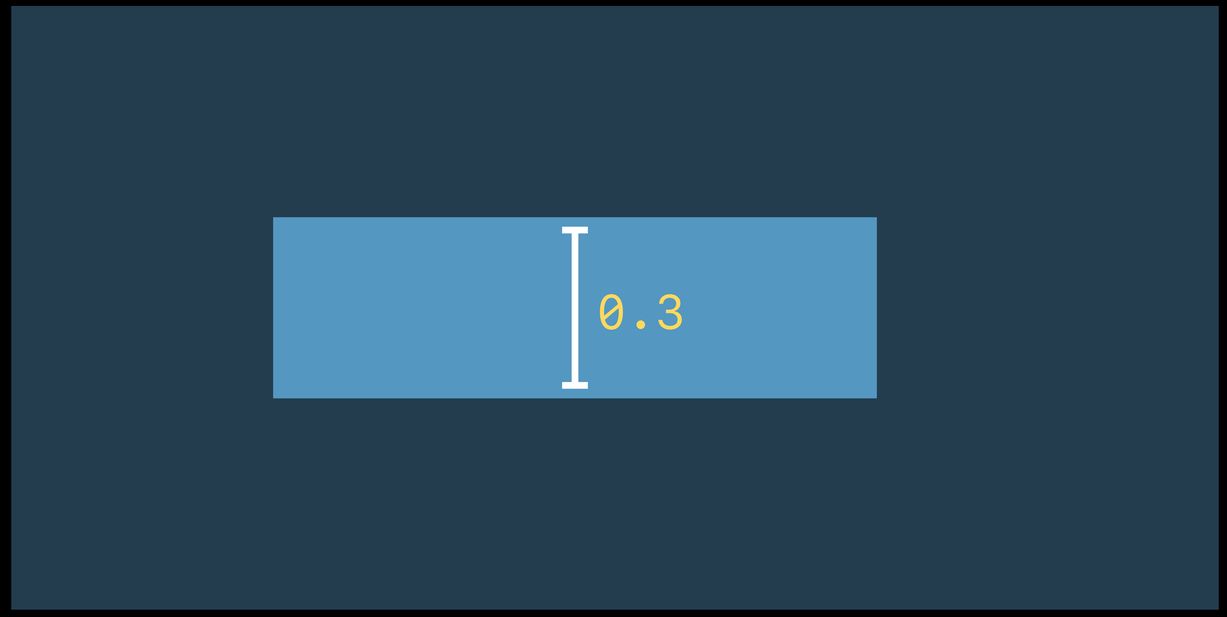
NSCollectionLayoutDimension

```
let widthDimension = NSCollectionLayoutDimension.fractionalWidth(0.5)
```



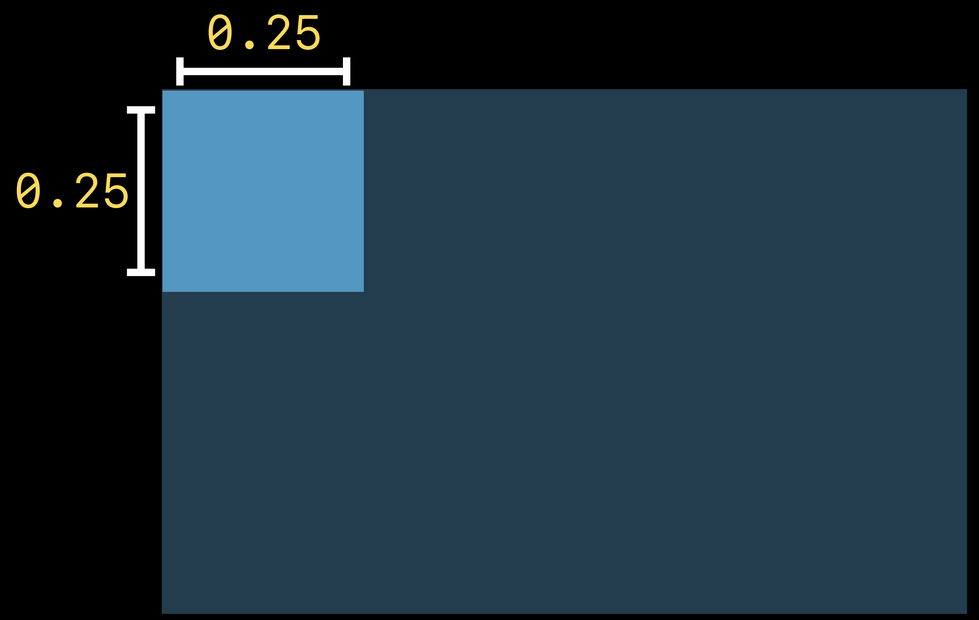
NSCollectionLayoutDimension

```
let heightDimension = NSCollectionLayoutDimension.fractionalHeight(0.3)
```



NSCollectionLayoutDimension

```
let size = NSCollectionLayoutDimension(widthDimension: .fractionalWidth(0.25),
                                       heightDimension: .fractionalWidth(0.25))
```



NSCollectionLayoutDimension

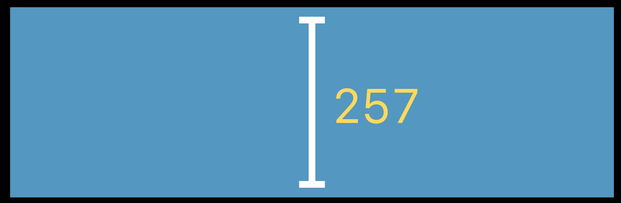
```
let heightDimension = NSCollectionLayoutDimension.absolute(200)
```

NSCollectionLayoutDimension

```
let heightDimension = NSCollectionLayoutDimension.estimated(200)
```

NSCollectionLayoutDimension

```
let heightDimension = NSCollectionLayoutDimension.estimated(200)
```



NSCollectionLayoutItem

Cell or Supplementary

```
class NSCollectionLayoutItem {
   convenience init(layoutSize: NSCollectionLayoutSize)
   var contentInsets: NSDirectionalEdgeInsets
}
```

NSCollectionLayoutGroup

Basic unit of layout

Three forms: Horizontal, vertical, and custom

```
class NSCollectionLayoutGroup: NSCollectionLayoutItem {
    class func horizontal(layoutSize: NSCollectionLayoutSize,
                          subitems: [NSCollectionLayoutItem]) -> Self
    class func vertical(layoutSize: NSCollectionLayoutSize,
                          subitems: [NSCollectionLayoutItem]) -> Self
    class func custom(layoutSize: NSCollectionLayoutSize,
                      itemProvider: NSCollectionLayoutGroupCustomItemProvider) -> Self
}
```

NSCollectionLayoutSection

Section’s layout

Additional cool features

```
class NSCollectionLayoutSection {
    convenience init(layoutGroup: NSCollectionLayoutGroup)
    var contentInsets: NSDirectionalEdgeInsets
}
```

UICollectionViewCompositionalLayout
NSCollectionViewCompositionalLayout

Same API for iOS, tvOS, and macOS

Repeating

Per-section

```
class UICollectionViewCompositionalLayout: UICollectionViewLayout {
    init(section: NSCollectionLayoutSection)
    init(sectionProvider: @escaping SectionProvider)
}
```

Demo

Show me some more code already!

Advanced Layouts

NSCollectionLayoutSupplementaryItem

Badges

Headers

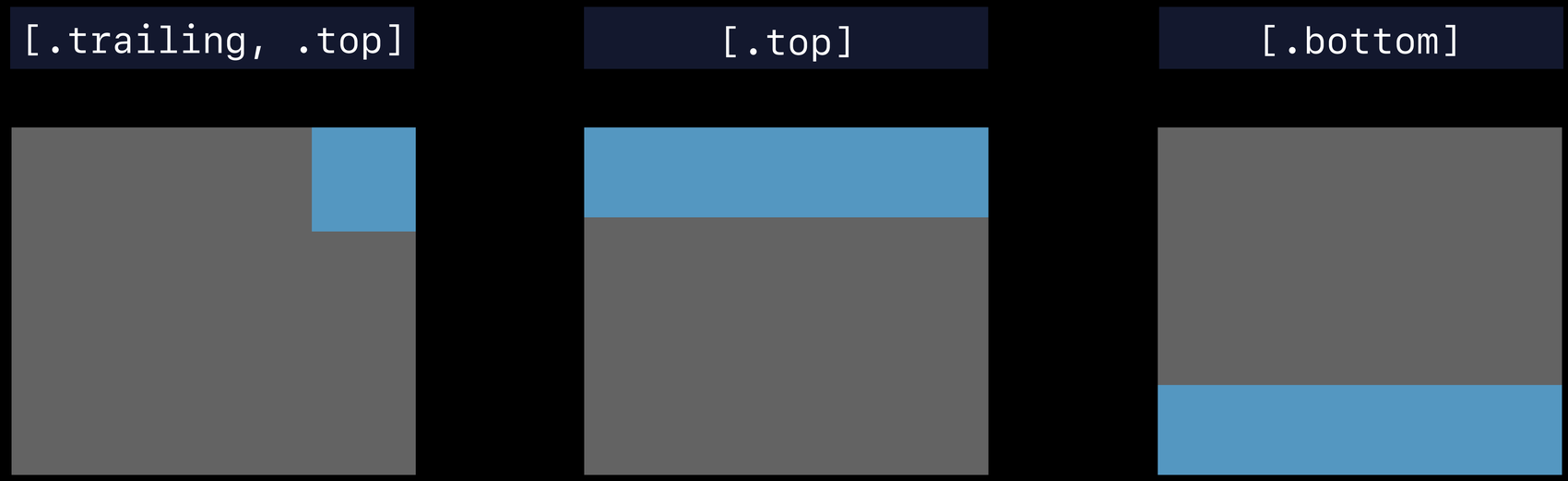
Footers

NSCollectionLayoutSupplementaryItem

Simplifies using supplementaries

Anchored to item or group

NSCollectionLayoutAnchor



Defines position relative to the host geometry

```
// NSCollectionLayoutAnchor

let badgeAnchor = NSCollectionLayoutAnchor(edges: [.top, .trailing],
                                           fractionalOffset: CGPoint(x: 0.3, y: -0.3))

let badgeSize = NSCollectionLayoutSize(widthDimension: .absolute(20),
                                       heightDimension: .absolute(20))

let badge = NSCollectionLayoutSupplementaryItem(layoutSize: badgeSize,
                                                elementKind: "badge",
                                                containerAnchor: badgeAnchor)

let item = NSCollectionLayoutItem(layoutSize: itemSize, supplementaryItems: [badge])
```

What About Headers and Footers?

Boundary supplementary item

Section or entire layout

Pinning

```
// NSCollectionLayoutBoundarySupplementaryItem

let header = NSCollectionLayoutBoundarySupplementaryItem(layoutSize: headerSize,
                                                         elementKind: "header",
                                                         alignment: .top)

let footer = NSCollectionLayoutBoundarySupplementaryItem(layoutSize: footerSize,
                                                         elementKind: "footer",
                                                         alignment: .bottom)

header.pinToVisibleBounds = true
section.boundarySupplementaryItems = [header, footer]
```

```swift
// Section Background Decoration Views

let background = NSCollectionLayoutDecorationItem.background(elementKind: "background")
section.decorationItems = [background]

// Register Our Decoration View with the Layout
layout.register(MyCoolDecorationView.self, forDecorationViewOfKind: "background")
```

Estimated Self-Sizing

Fast

Per-axis

Supplementary items

Dynamic text

```
// Estimated Self-Sizing

let headerSize = NSCollectionLayoutSize(widthDimension: .fractionalWidth(1.0),
                                        heightDimension: .estimated(44.0))

let header = NSCollectionLayoutBoundarySupplementaryItem(layoutSize: headerSize,
                                                         elementKind: "header",
                                                         alignment: .top)
header.pinToVisibleBounds = true
section.boundarySupplementaryItems = [header, footer]
```

Nested NSCollectionLayoutGroup

NSCollectionLayoutGroup is-a NSCollectionLayoutItem

No limit to nesting depth

Unlocks new designs

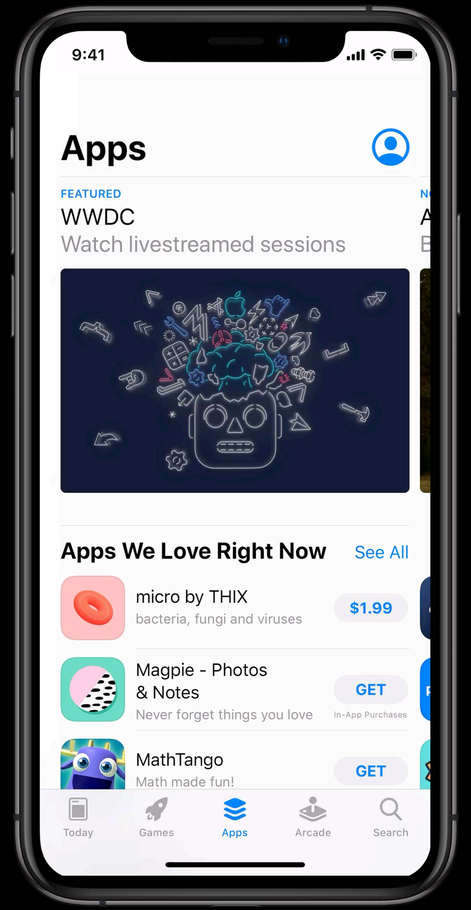
```
// Nested NSCollectionLayoutGroup

let leadingItem = NSCollectionLayoutItem(layoutSize: leadingItemSize)

let trailingItem = NSCollectionLayoutItem(layoutSize: trailingItemSize)

let trailingGroup = NSCollectionLayoutGroup.vertical(layoutSize: trailingGroupSize)
                                                     subitem: trailingItem,
                                                     count: 2)

let containerGroup = NSCollectionLayoutGroup.horizontal(layoutSize: containerGroupSize,
                                                        subitems: [leadingItem,
                                                                   trailingGroup])
```

Nested CollectionViews

Challenging

Lots of bookkeeping

Common pattern



Nested CollectionViews

Challenging

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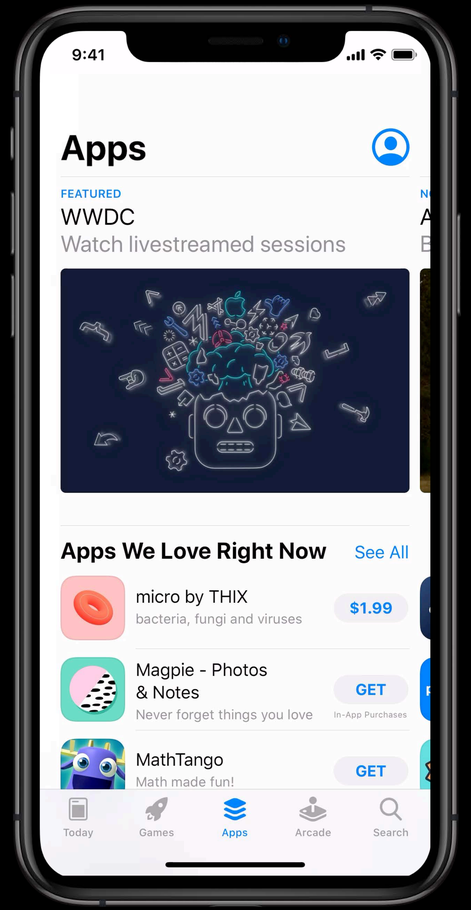
Common pattern



```
// Orthogonal Scrolling Sections

section.orthogonalScrollingBehavior = .continuous
```

```
// Orthogonal Scrolling Sections

enum UICollectionLayoutSectionOrthogonalScrollingBehavior: Int {
    case none
    case continuous
    case continuousGroupLeadingBoundary
    case paging
    case groupPaging
    case groupPagingCentered
}
```

Case Study

App Store adoption

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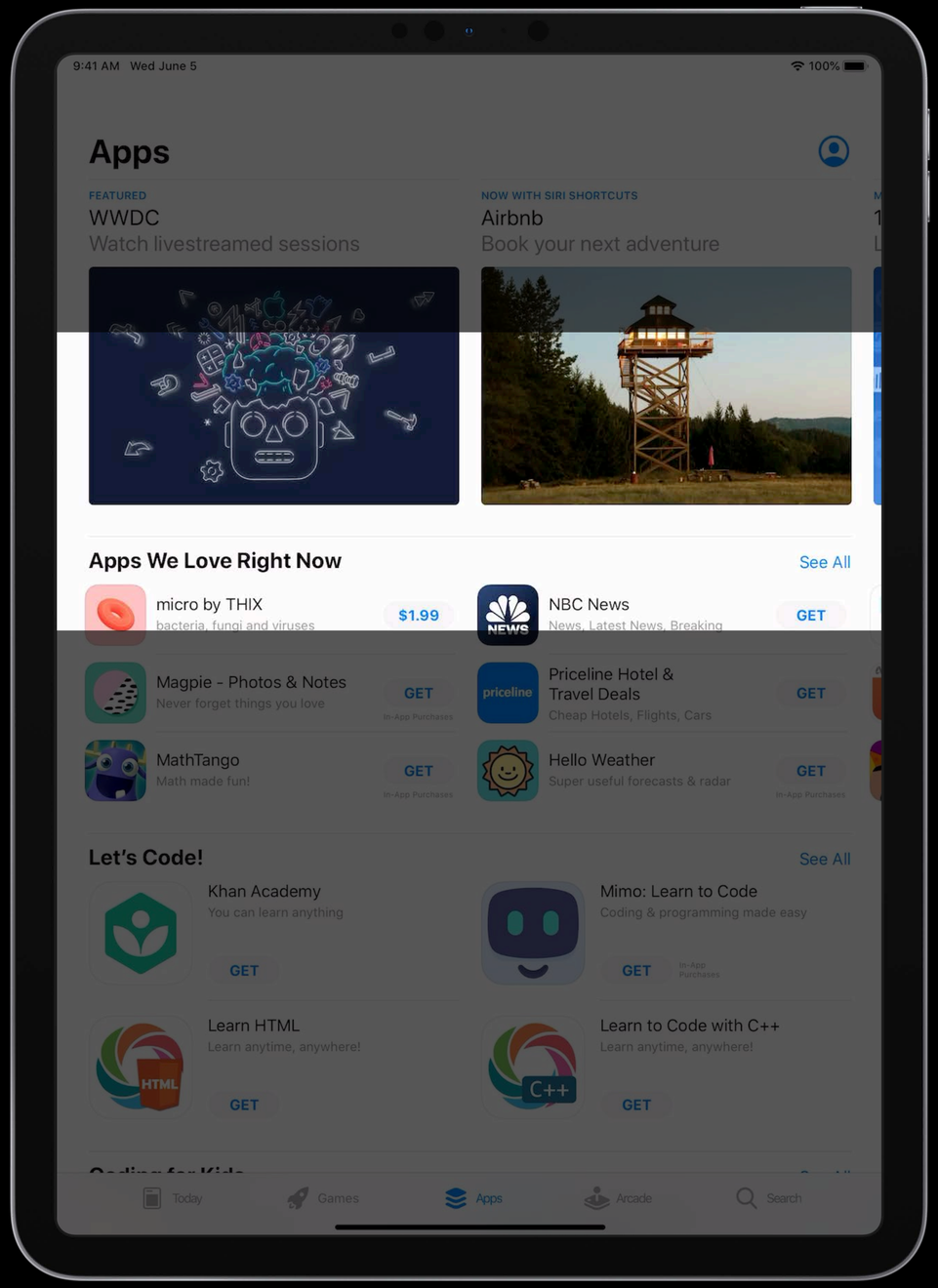
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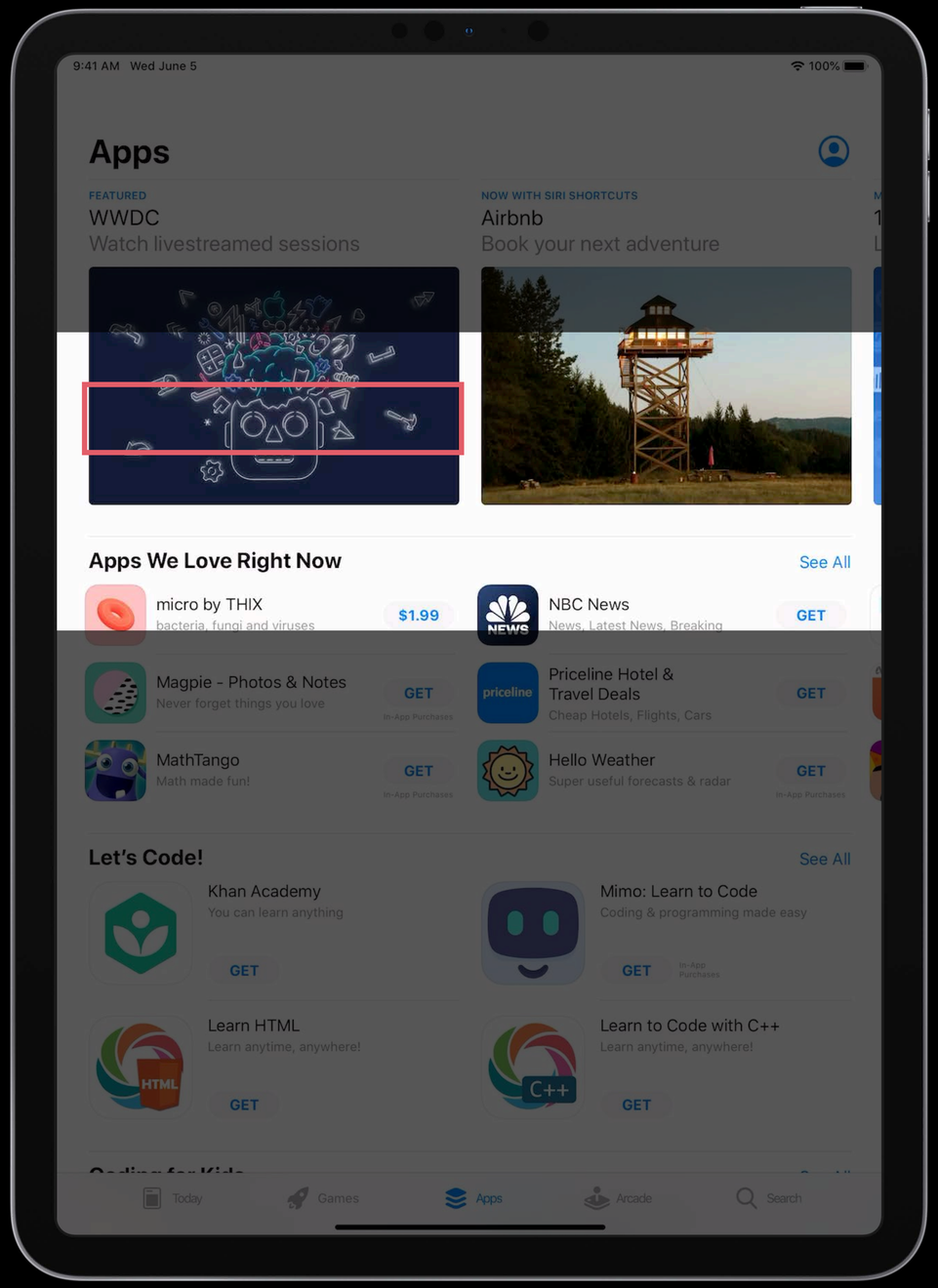
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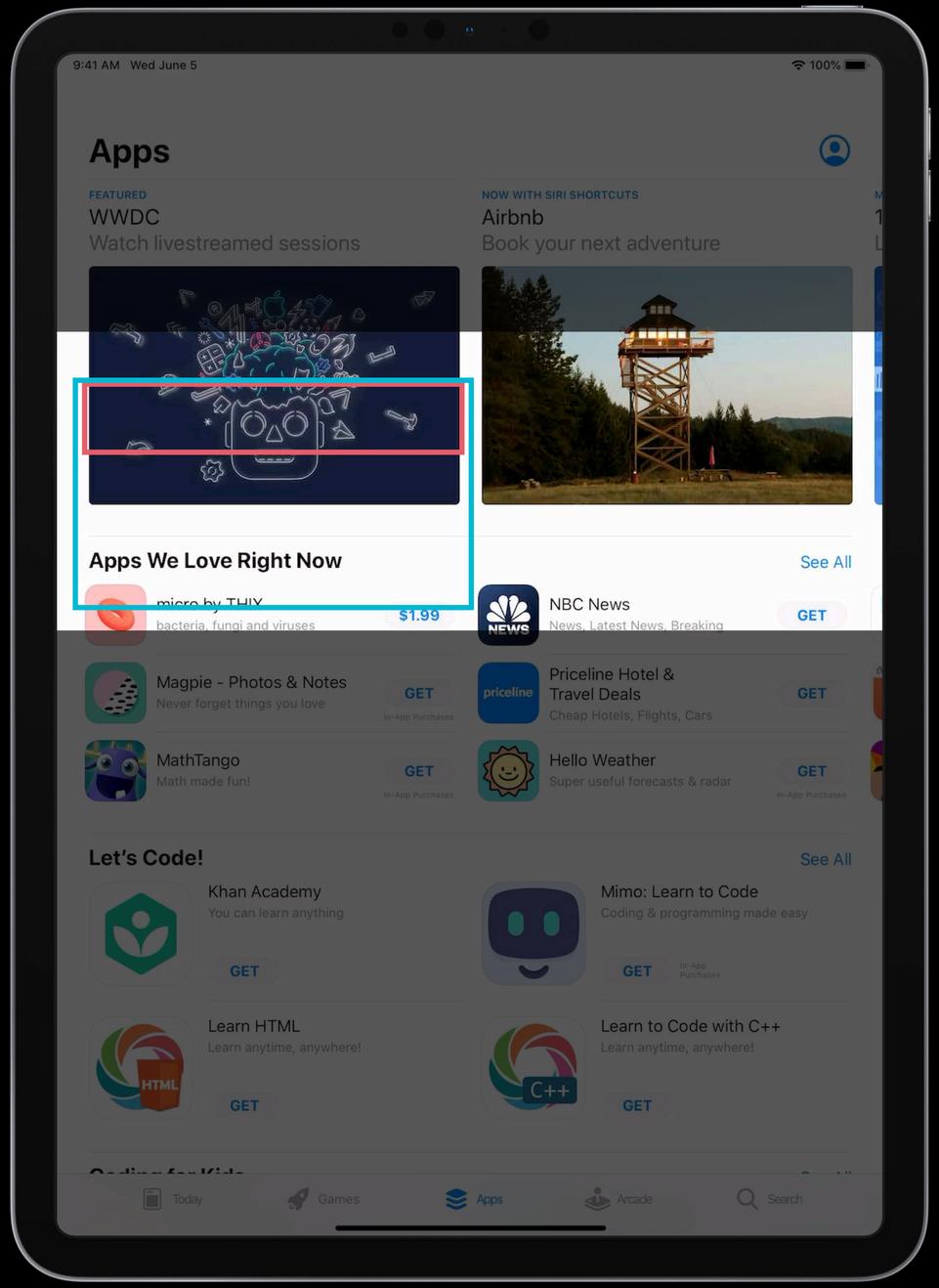
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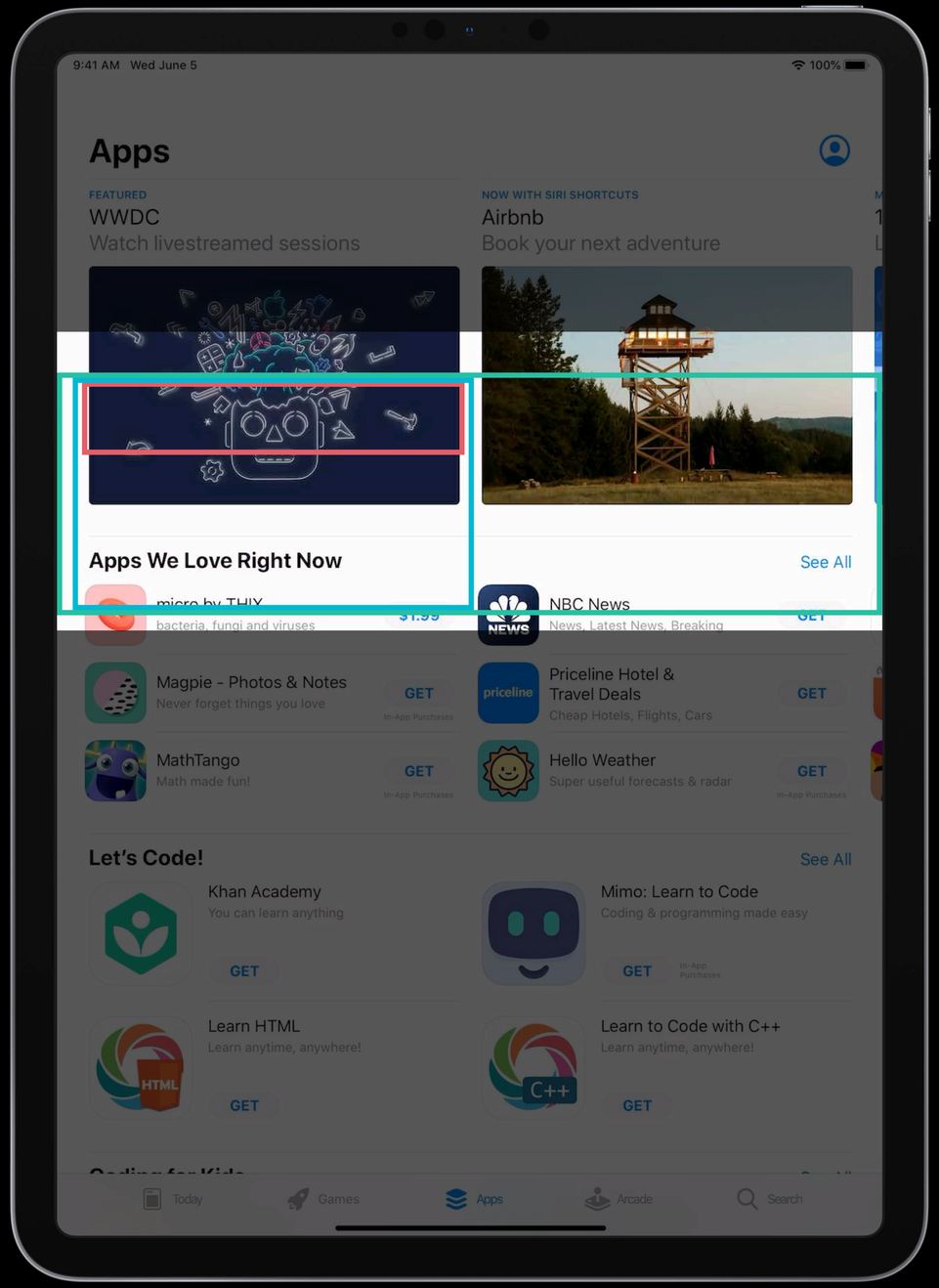
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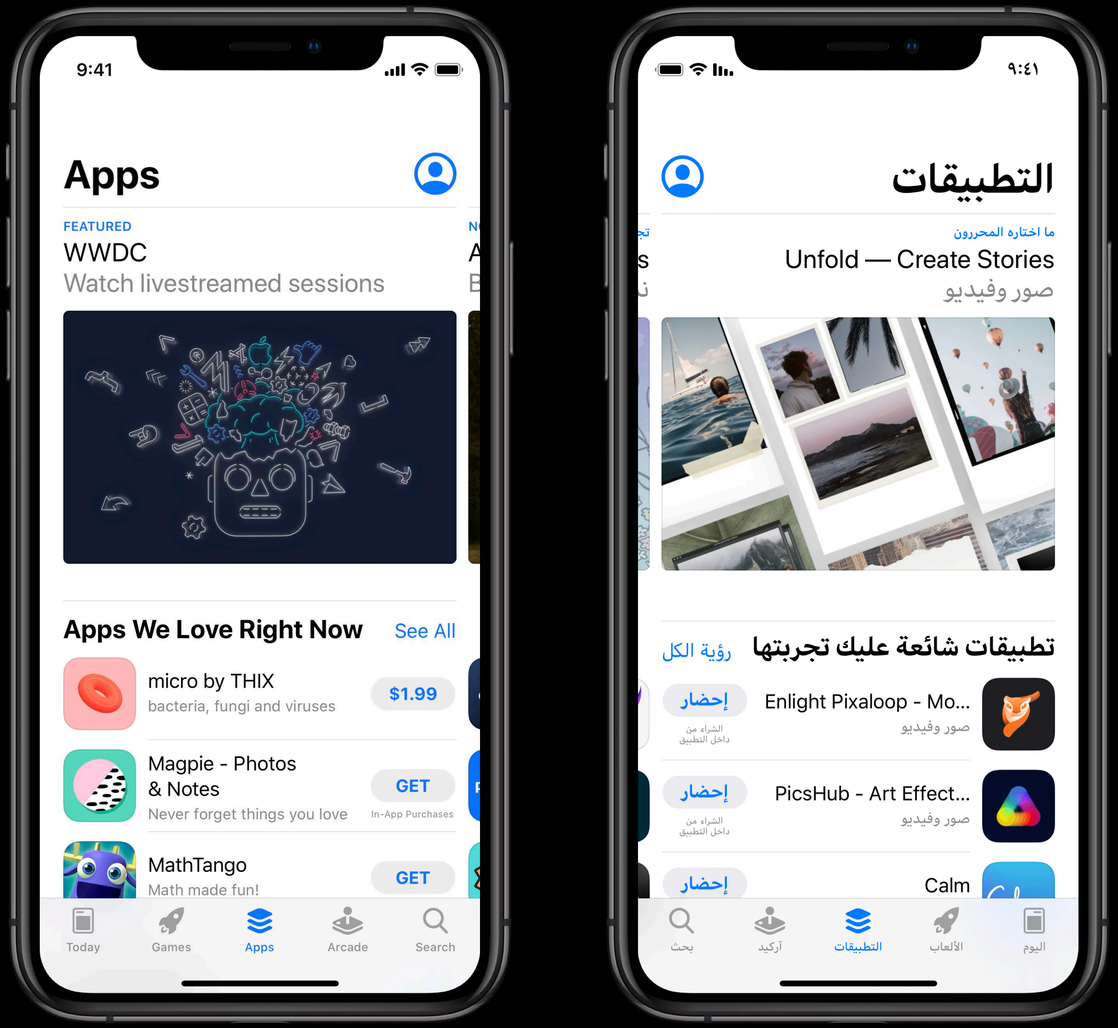

Compositional Layout on the App Store

No more horizontal collection views

Less code, easy to reason about

Demo

Compositional layout on macOS

Compositional Layout Has It All

iOS, tvOS, and macOS

Custom CollectionView layouts for a fraction of the work

Makes CollectionView much more versatile

Tighter UI iteration

More Information

developer.apple.com/wwdc19/215

Advances in UI Data Sources	Wednesday, 2:00
UIKit and Collection Lab	Thursday, 9:00


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