

CS193P - Lecture 14

iPhone Application Development

Touch Events & Multi-Touch

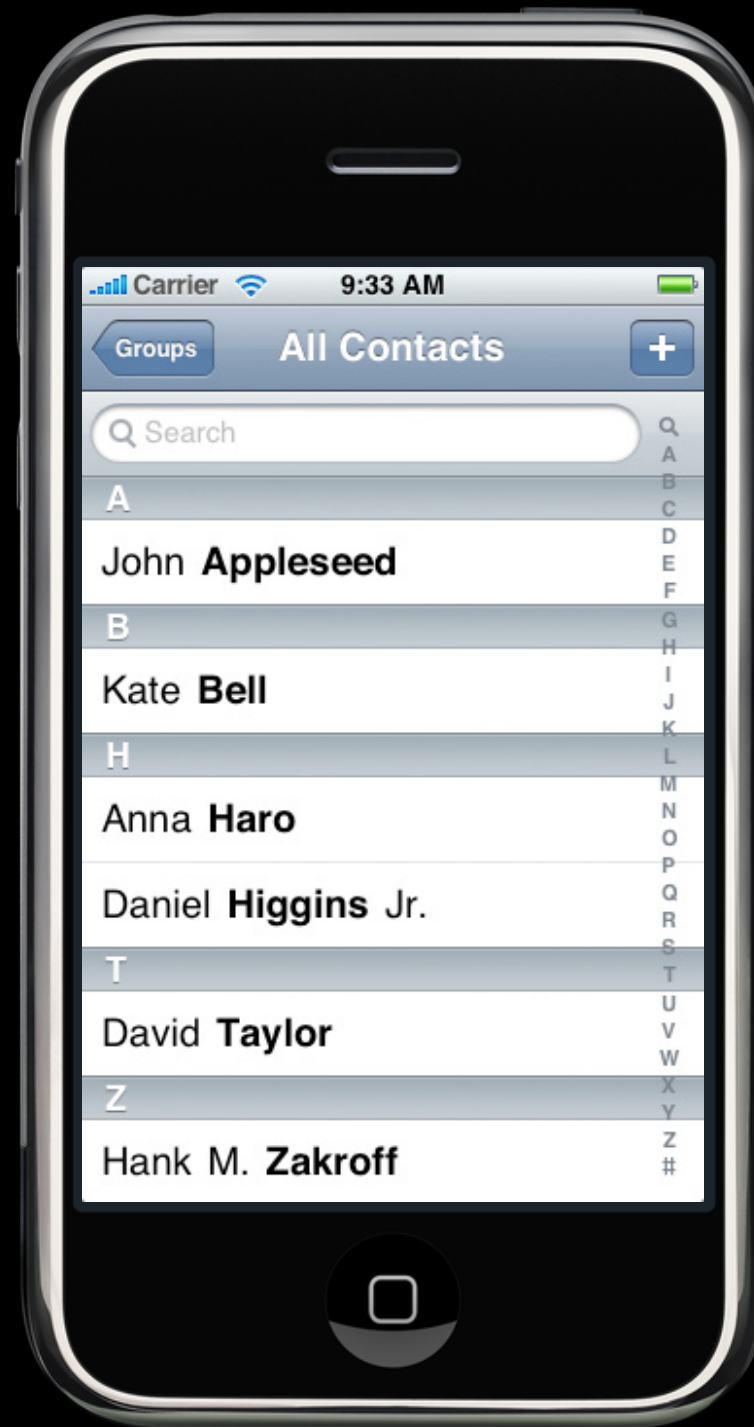
Announcements

- Paparazzi 4 due next Friday 2/26 at 11:59PM
- Final project proposals due yesterday

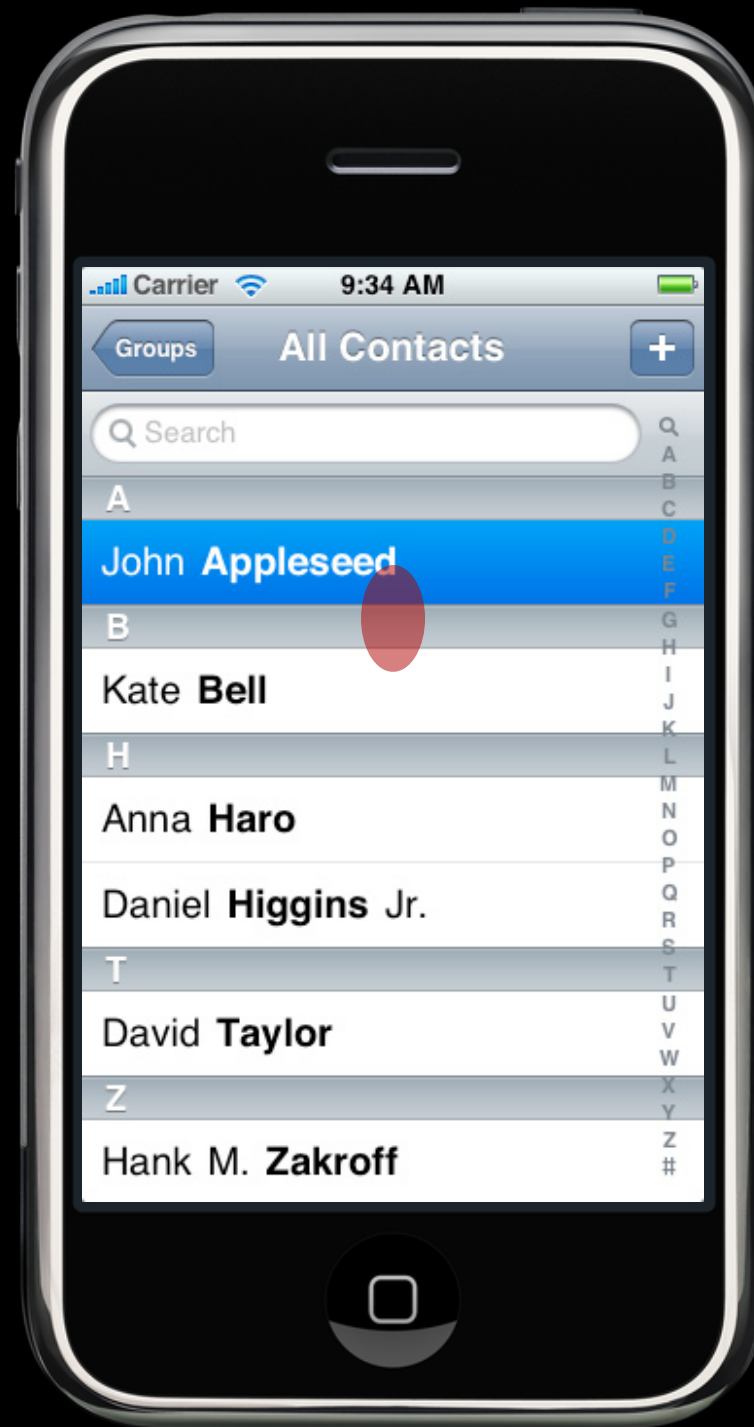
Jason Beaver, Apple Touch Events & Multi-Touch

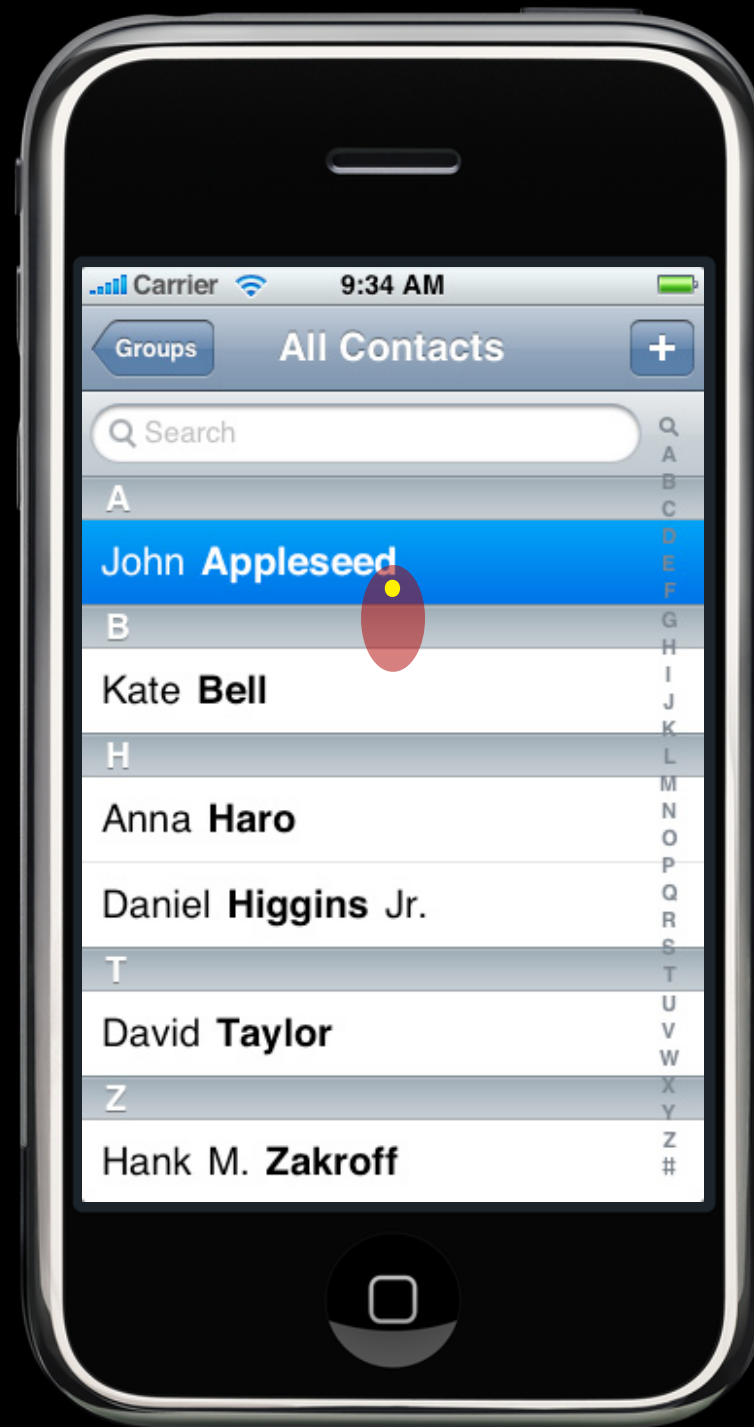












Today's Topics

Today's Topics

- Touch Sequences
- Touch and Event Objects
- Touch Delivery
- Single Touch
- Multiple Touches
- Multiple Views
- Touch Routing
- UIControl Objects

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Single Touch Sequence



Single Touch Sequence



Single Touch Sequence



Single Touch Sequence



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UITouch

UITouch

Represents a single finger

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Represents a single finger

@property(nonatomic,readonly) NSTimeInterval	timestamp;
@property(nonatomic,readonly) UITouchPhase	phase;
@property(nonatomic,readonly) NSUInteger	tapCount;

UITouch

Represents a single finger

```
@property(nonatomic,readonly) NSTimeInterval    timestamp;  
@property(nonatomic,readonly) UITouchPhase        phase;  
@property(nonatomic,readonly) NSUInteger          tapCount;  
  
@property(nonatomic,readonly,retain) UIWindow     *window;  
@property(nonatomic,readonly,retain) UIView       *view;
```

UITouch

Represents a single finger

```
@property(nonatomic,readonly) NSTimeInterval    timestamp;  
@property(nonatomic,readonly) UITouchPhase        phase;  
@property(nonatomic,readonly) NSUInteger          tapCount;  
  
@property(nonatomic,readonly,retain) UIWindow      *window;  
@property(nonatomic,readonly,retain) UIView        *view;  
  
- (CGPoint)locationInView:(UIView *)view;  
- (CGPoint)previousLocationInView:(UIView *)view;
```

UIEvent

UIEvent

A container for one or more touches

UIEvent

A container for one or more touches

```
@property(nonatomic,readonly) NSTimeInterval timestamp;
```

UIEvent

A container for one or more touches

```
@property(n nonatomic, readonly) NSTimeInterval timestamp;
```

- (NSSet *)allTouches;
- (NSSet *)touchesForWindow:(UIWindow *)window;
- (NSSet *)touchesForView:(UIView *)view;

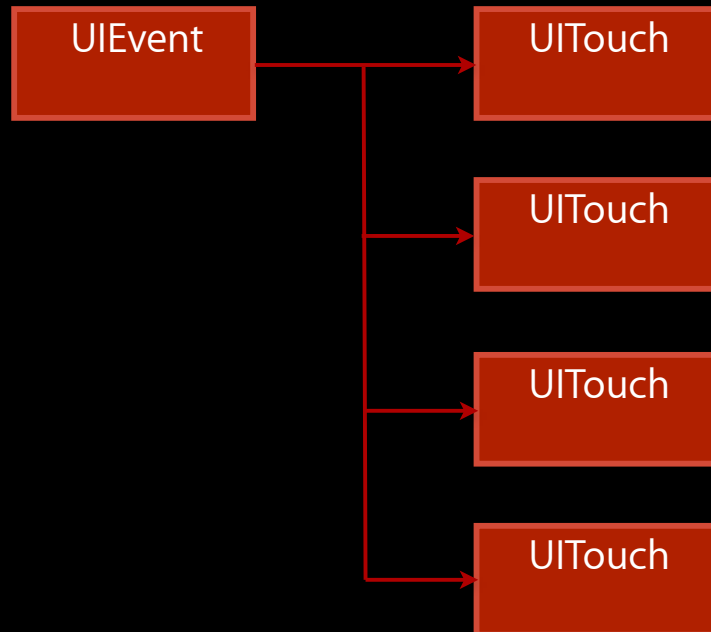
UIEvent

UIEvent

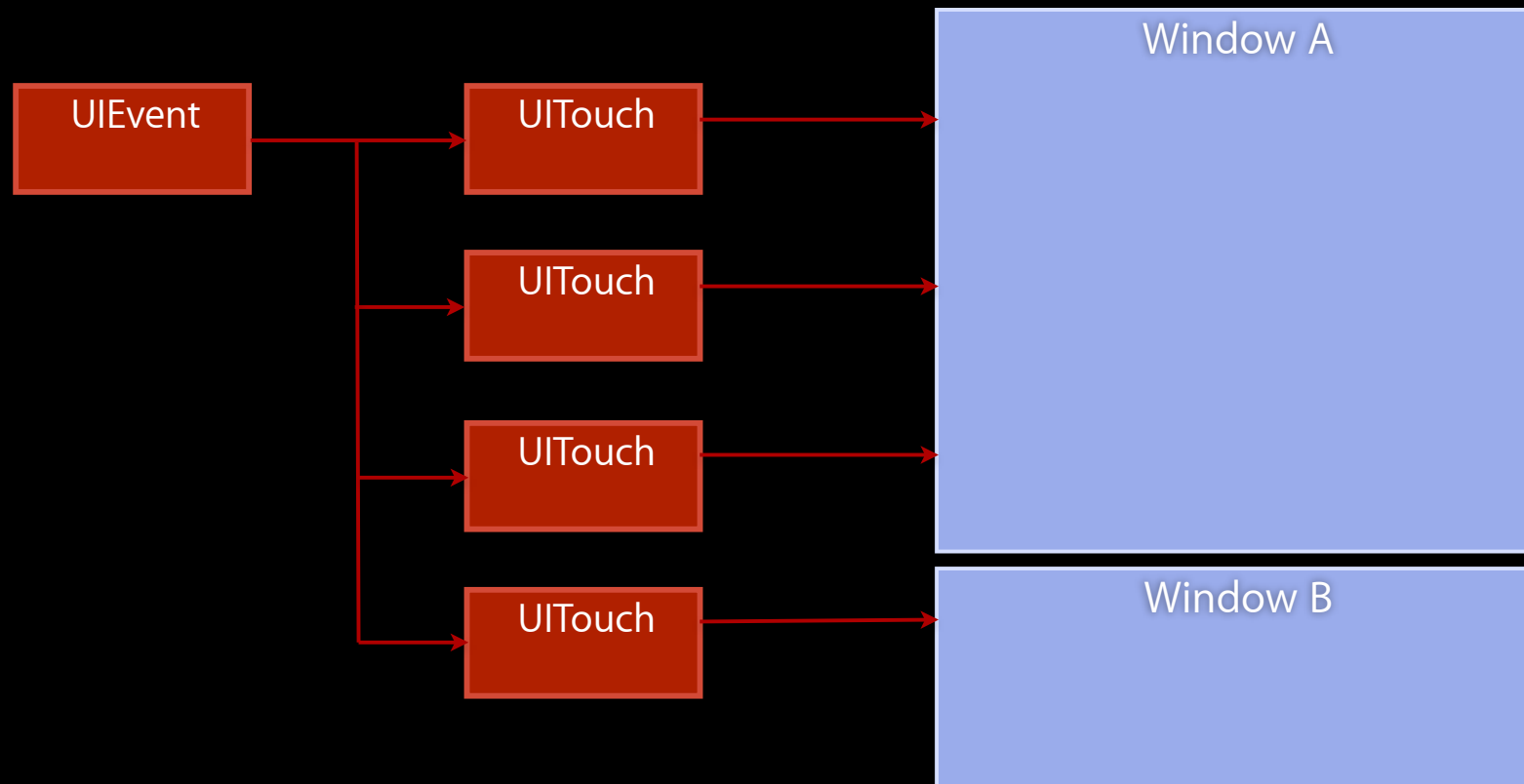


UIEvent

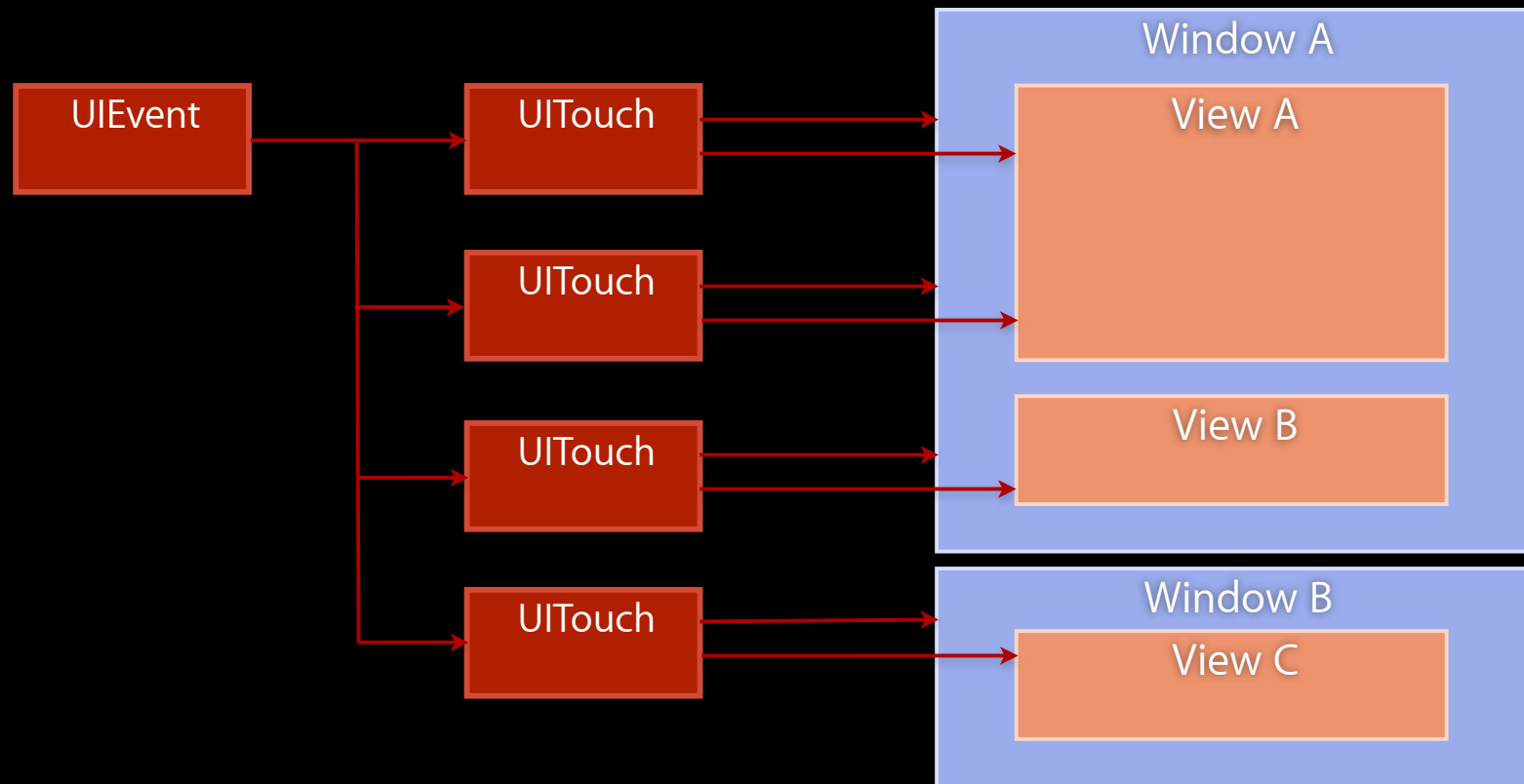
UIEvent



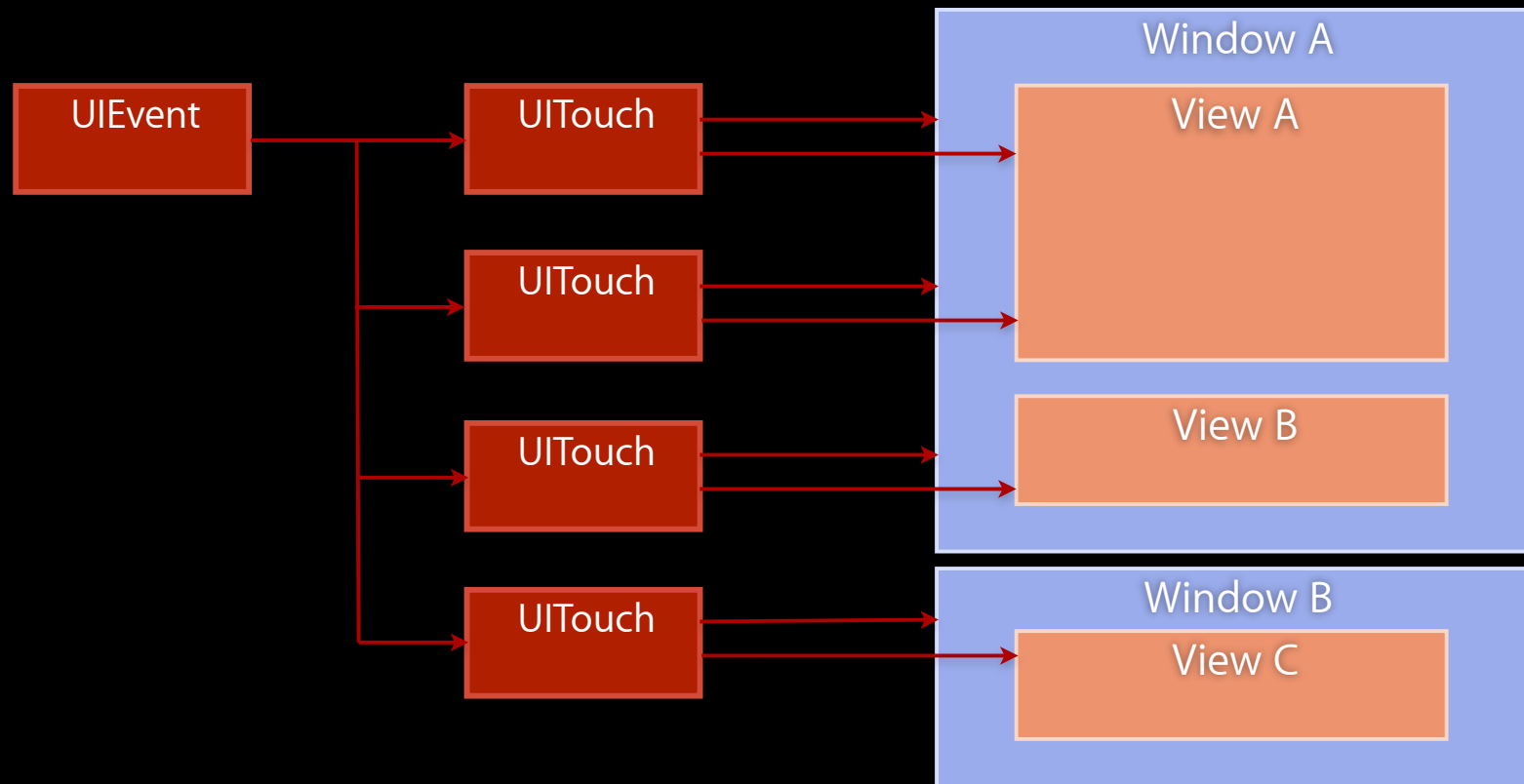
UIEvent



UIEvent

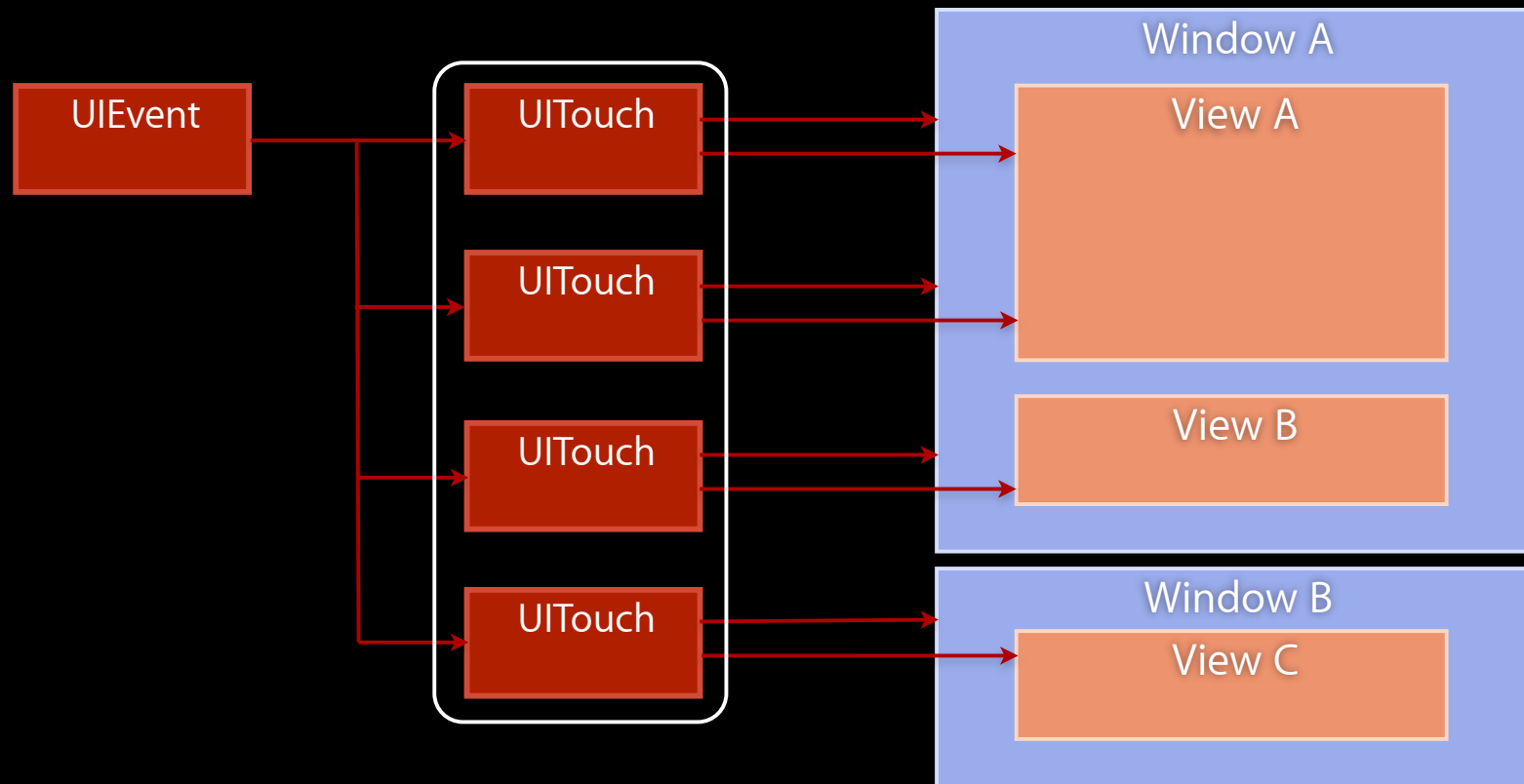


UIEvent



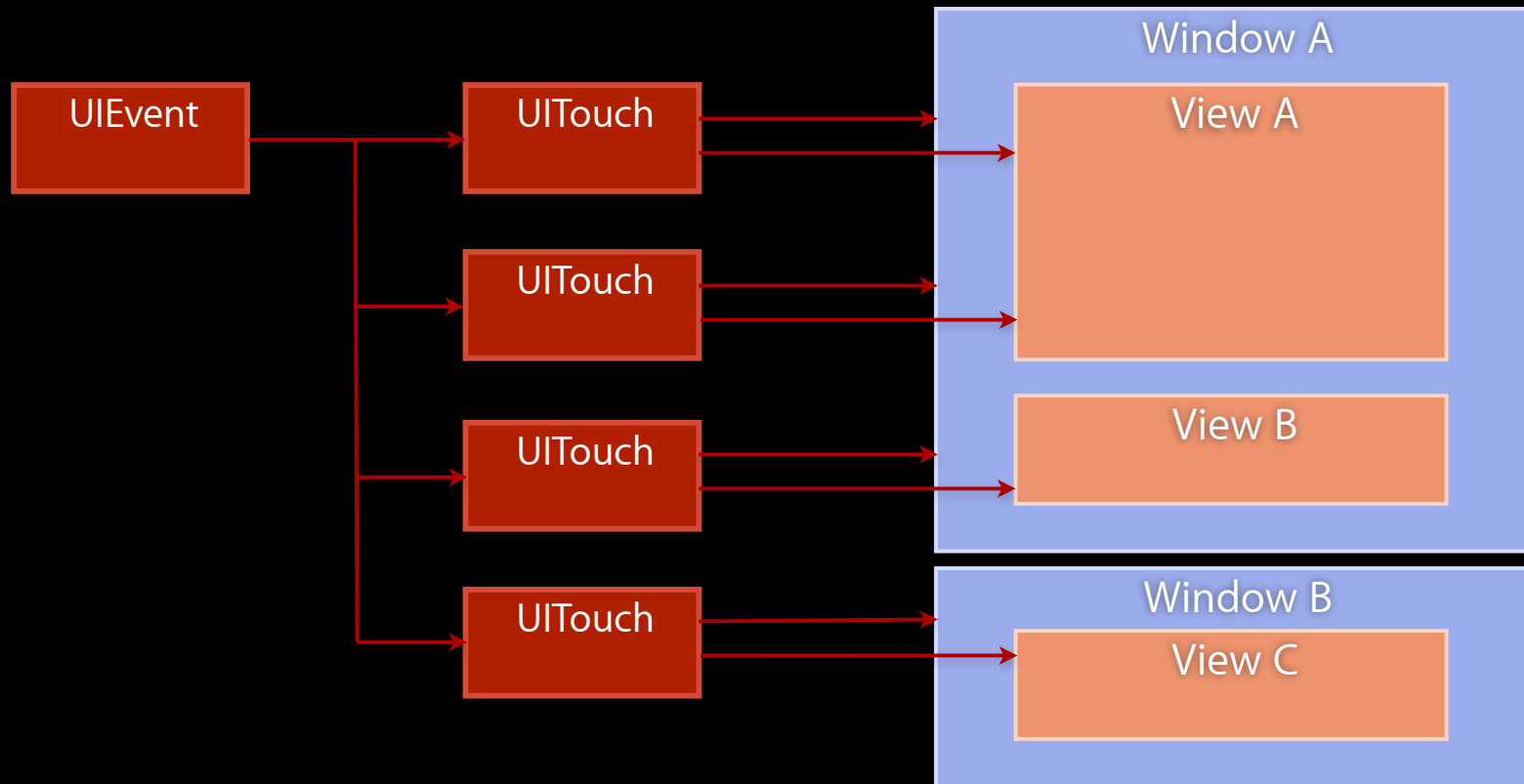
- (NSSet *)allTouches;

UIEvent



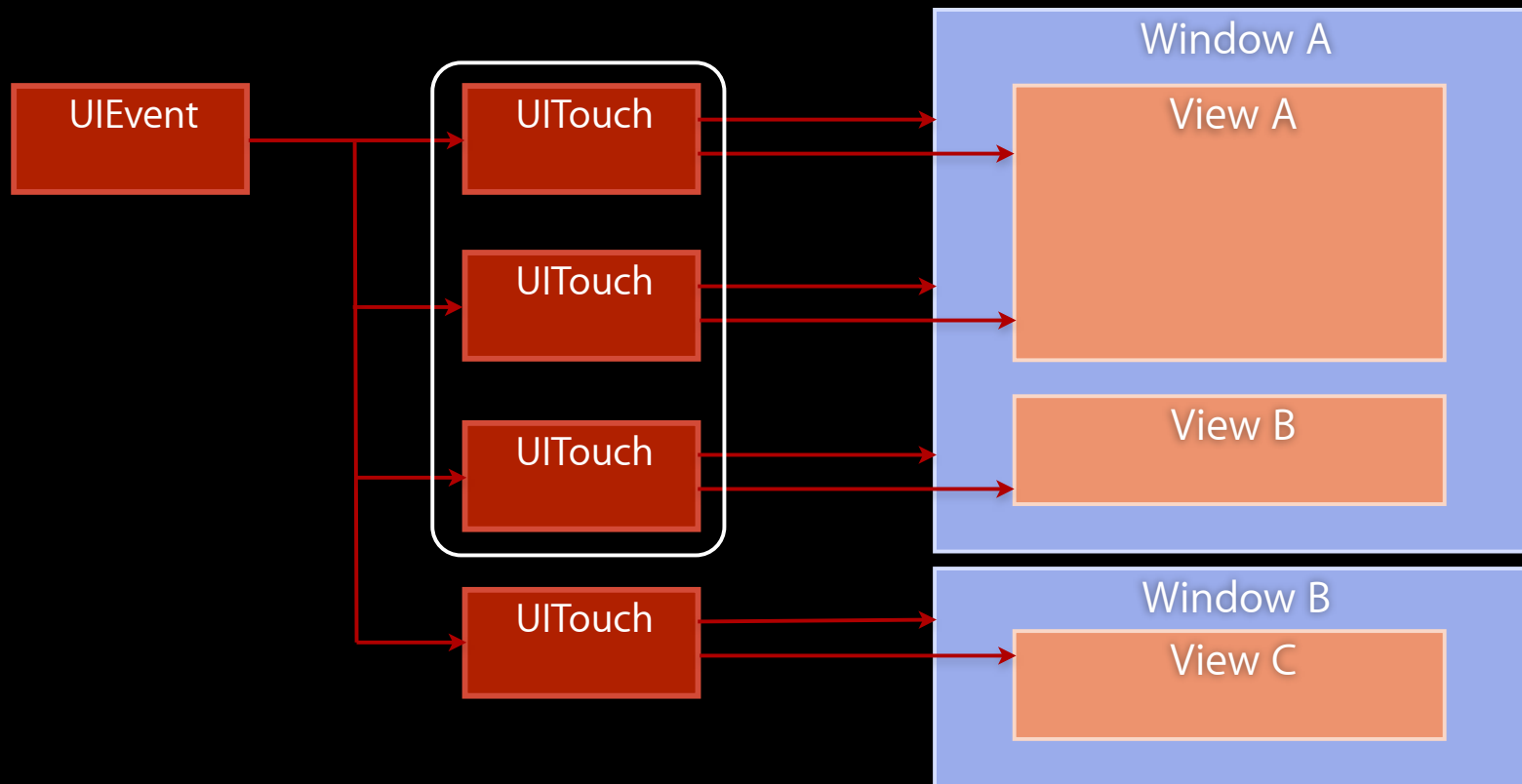
- (NSSet *)allTouches;

UIEvent



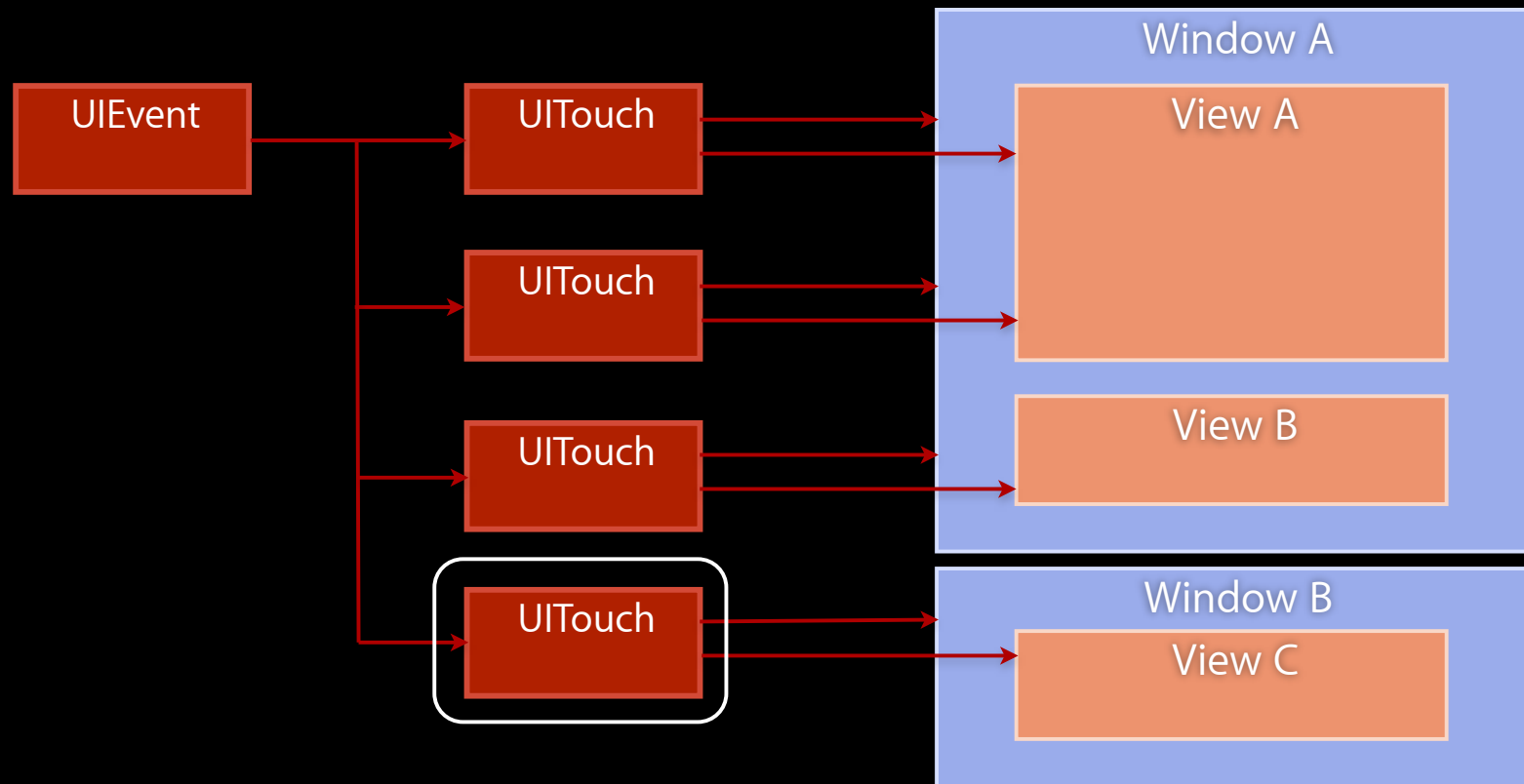
- (NSSet *)touchesForWindow:(UIWindow *)window;

UIEvent



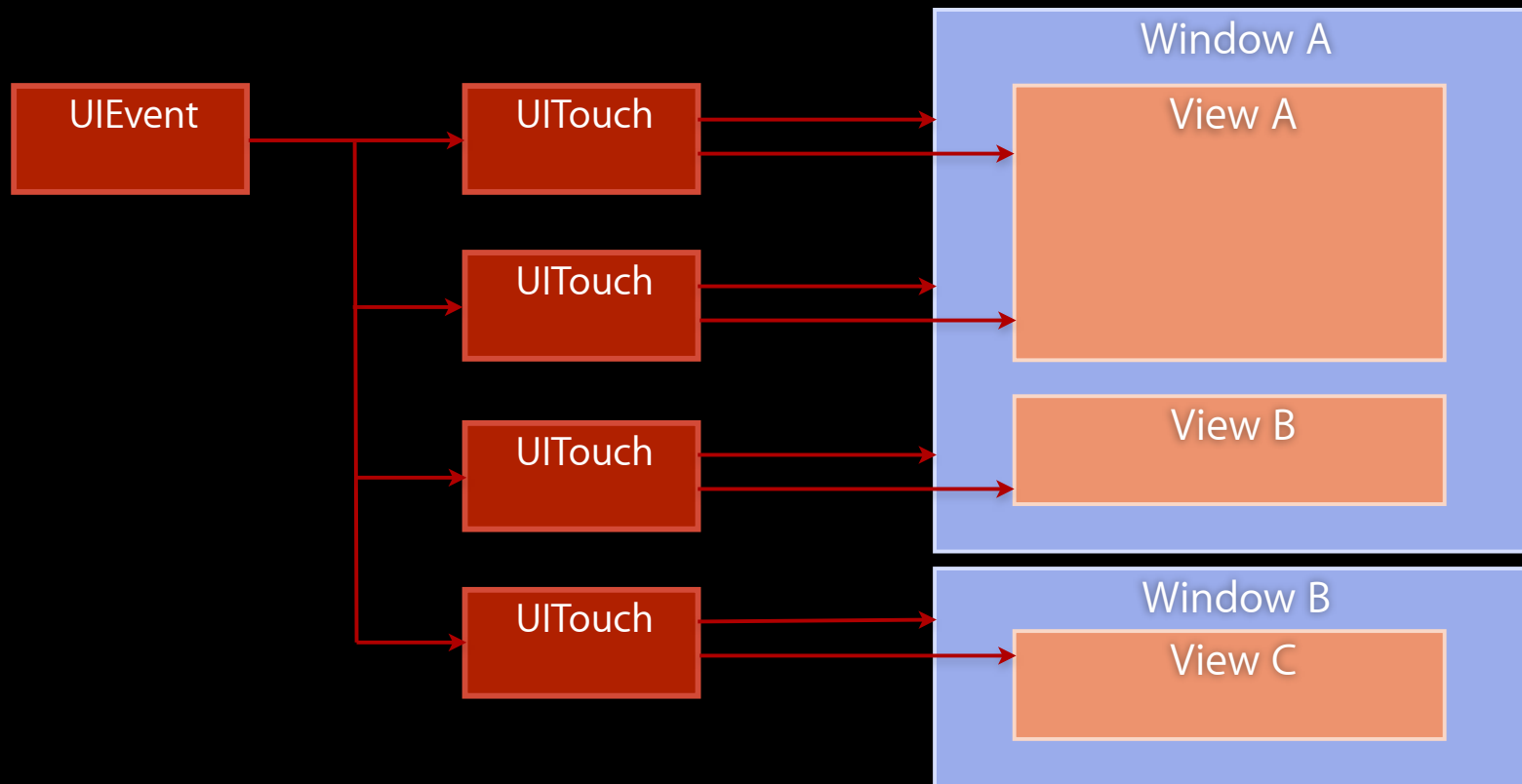
- (NSSet *)touchesForWindow:(UIWindow *)window;

UIEvent



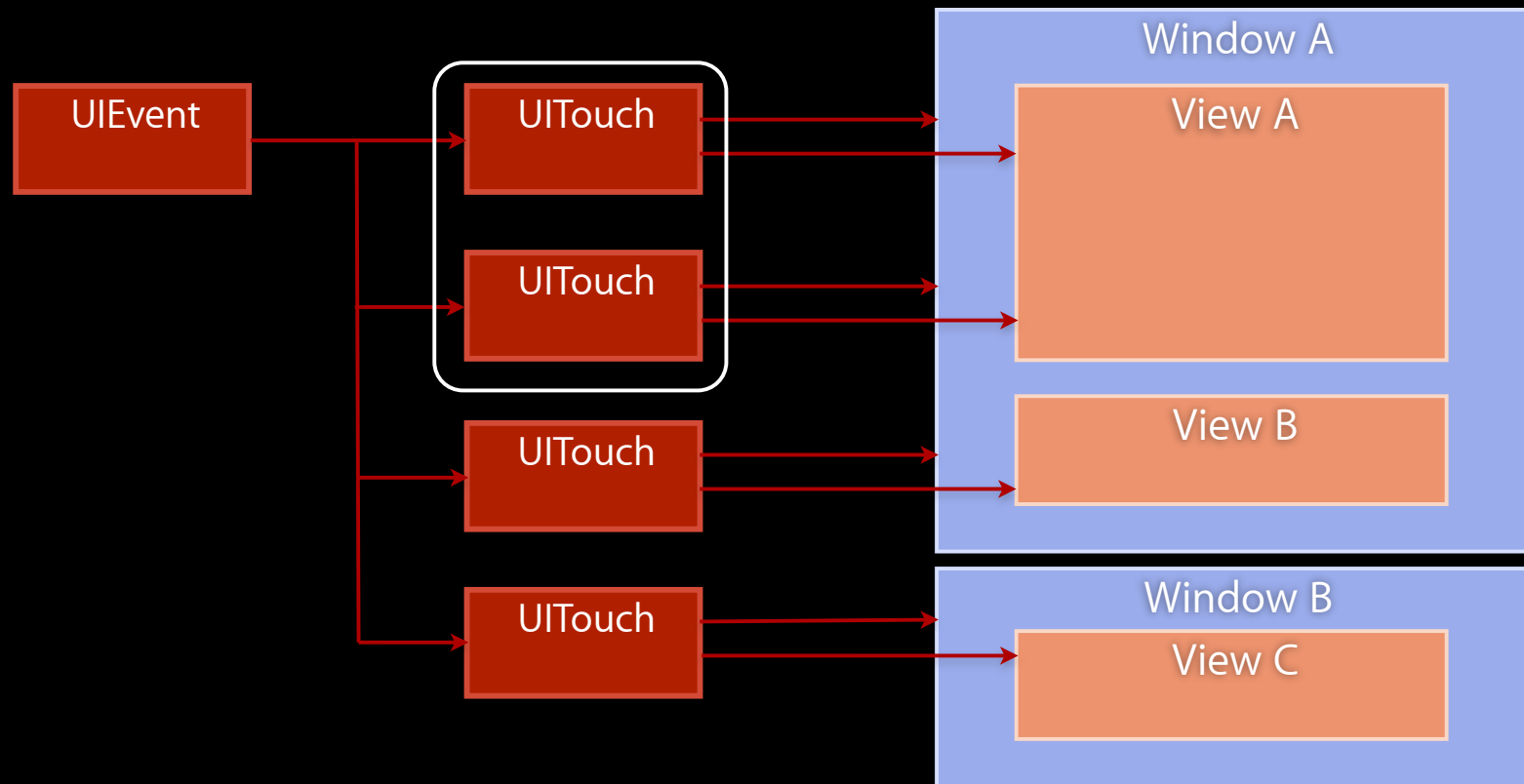
- (NSSet *)touchesForWindow:(UIWindow *)window;

UIEvent



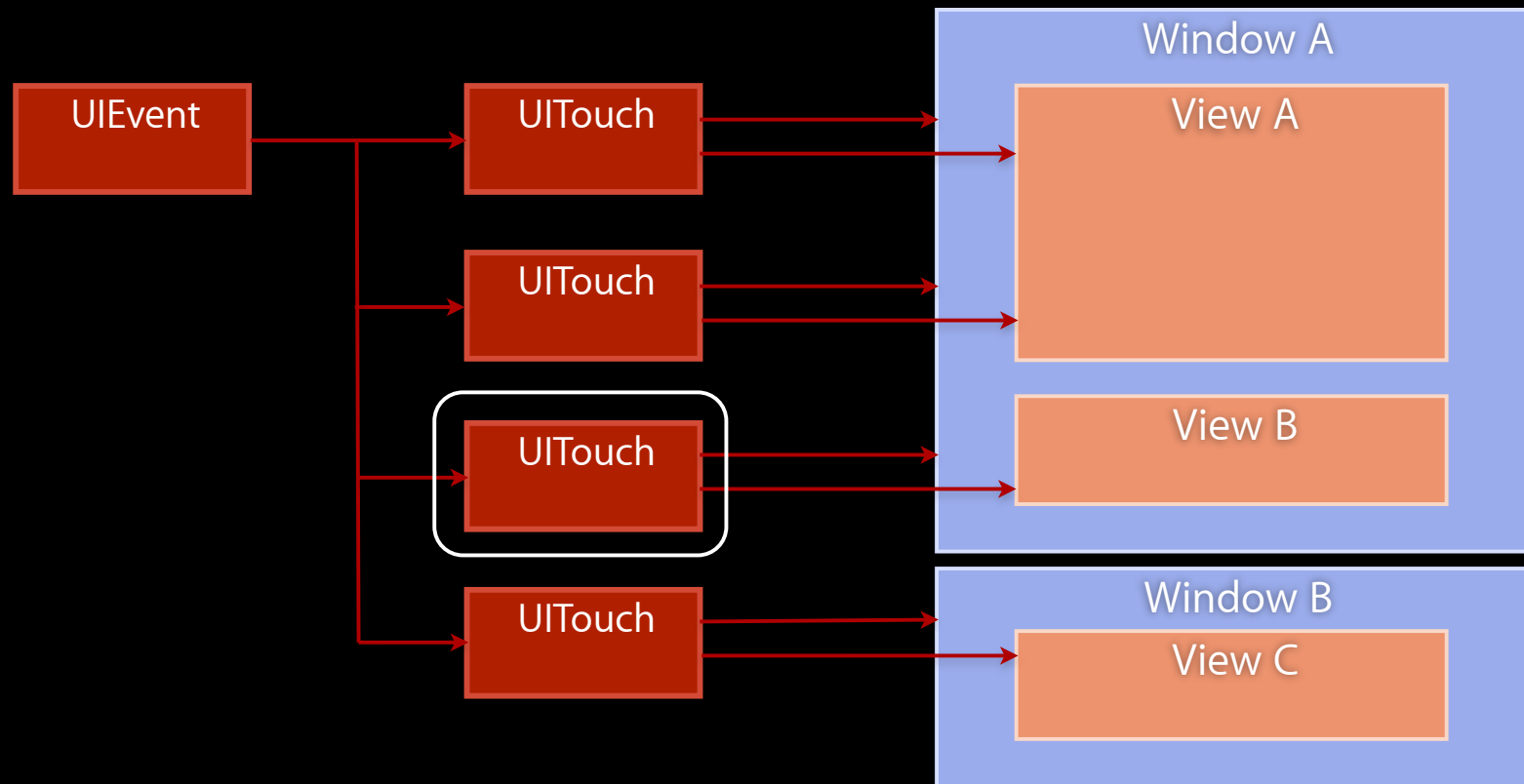
- (NSSet *)touchesForView:(UIView *)view;

UIEvent



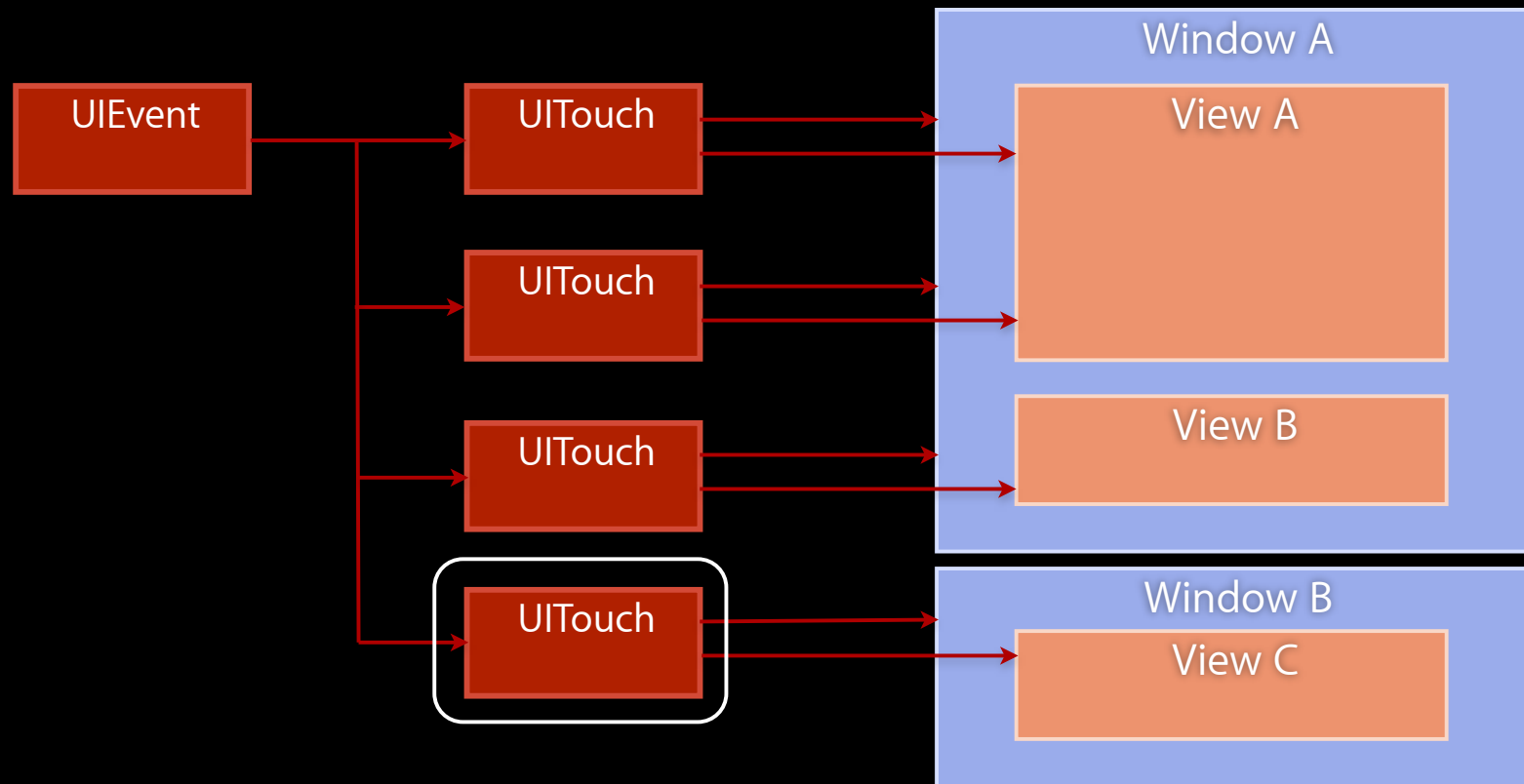
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Receiving Touches

Receiving Touches

UIResponder

Receiving Touches

UIResponder

- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event;

Receiving Touches

UIResponder

- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesMoved:(NSSet *)touches withEvent:(UIEvent *)event;

Receiving Touches

UIResponder

- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesMoved:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesEnded:(NSSet *)touches withEvent:(UIEvent *)event;

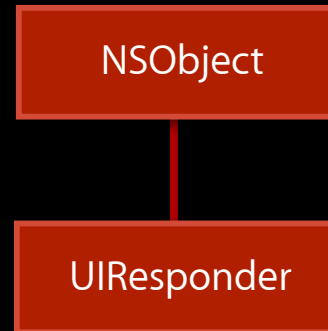
Receiving Touches

UIResponder

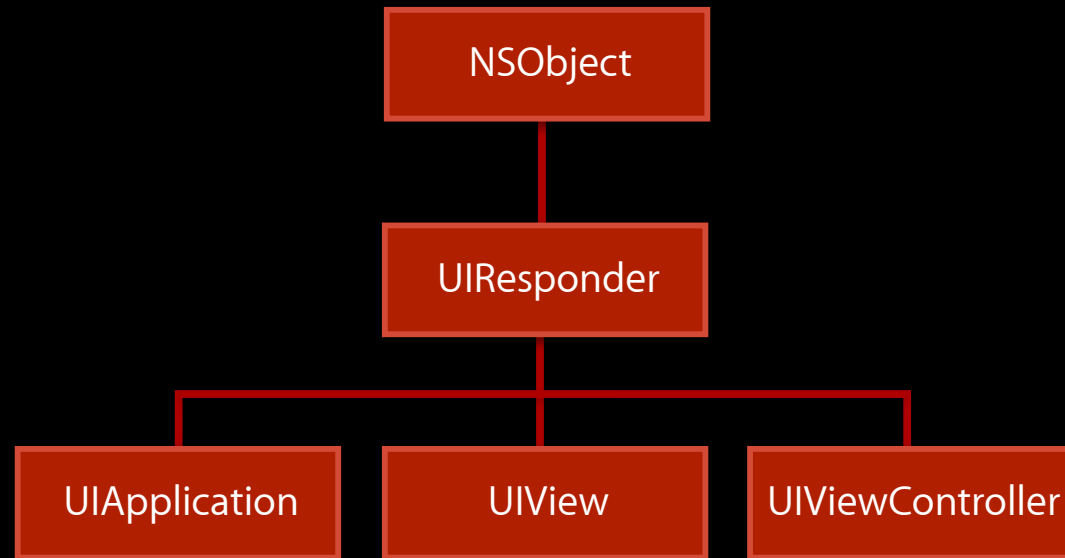
- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesMoved:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesEnded:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;

UIResponder

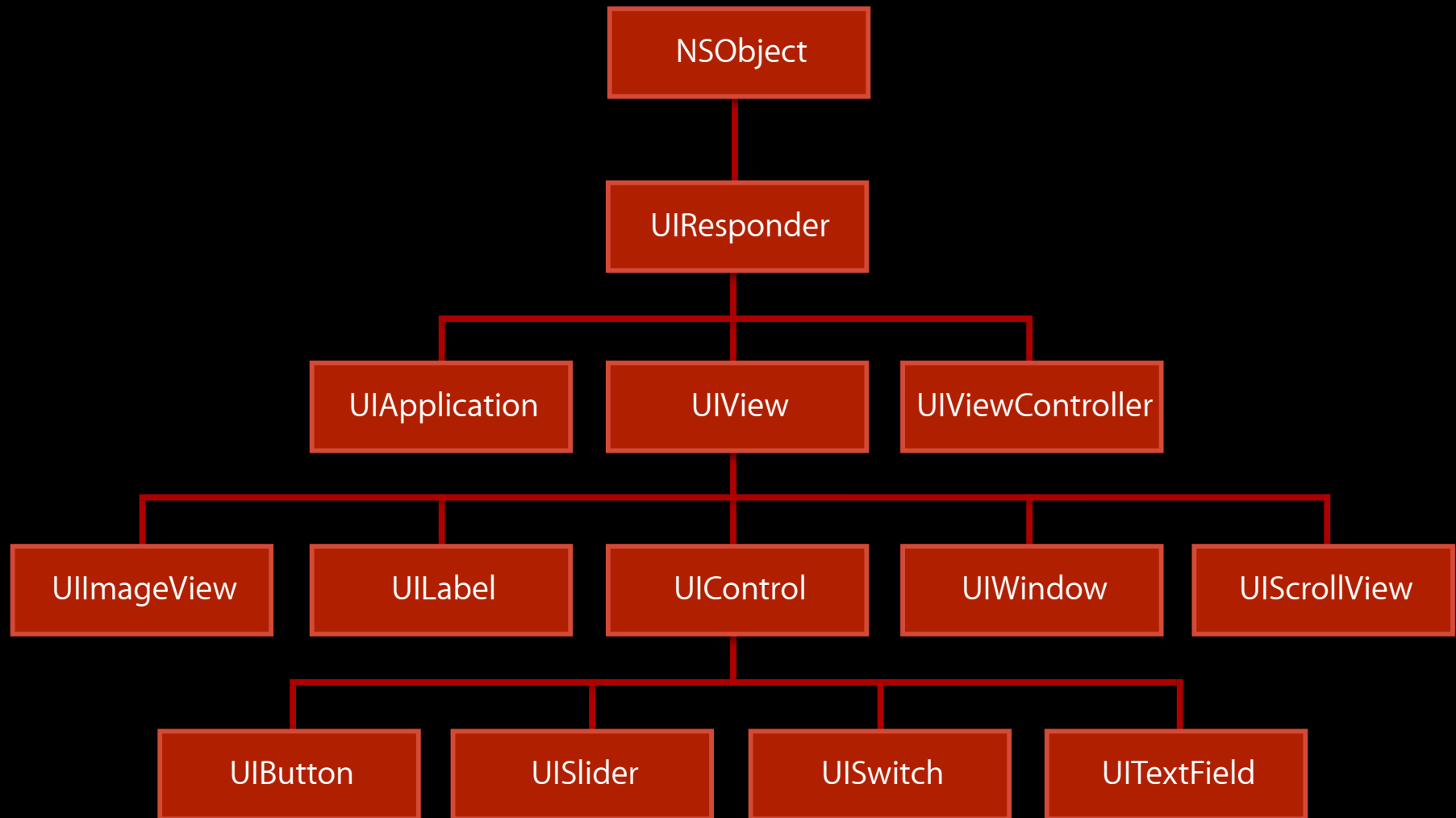
UIResponder



UIResponder



UIResponder



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Single Touch Sequence



Single Touch Sequence

UITouch 0x123

Phase: Began
Location: 160, 120



`touchesBegan:withEvent:`

Single Touch Sequence

UITouch 0x123

Phase: Moved

Location: 160, 160



`touchesMoved:withEvent:`

Single Touch Sequence

UITouch 0x123

Phase: Moved

Location: 160, 200



`touchesMoved:withEvent:`

Single Touch Sequence

UITouch 0x123

Phase: Moved

Location: 160, 240



`touchesMoved:withEvent:`

Single Touch Sequence

UITouch 0x123

Phase: Ended

Location: 160, 240



`touchesEnded:withEvent:`

Touch Cancellation



Touch Cancellation

UITouch 0x123

Phase: Began

Location: 160, 120



```
touchesBegan:(NSSet*)touches withEvent:(UIEvent*)event
```

Touch Cancellation

UITouch 0x123

Phase: Moved

Location: 160, 160



```
touchesMoved:(NSSet*)touches withEvent:(UIEvent*)event
```


Touch Cancellation

UITouch 0x123

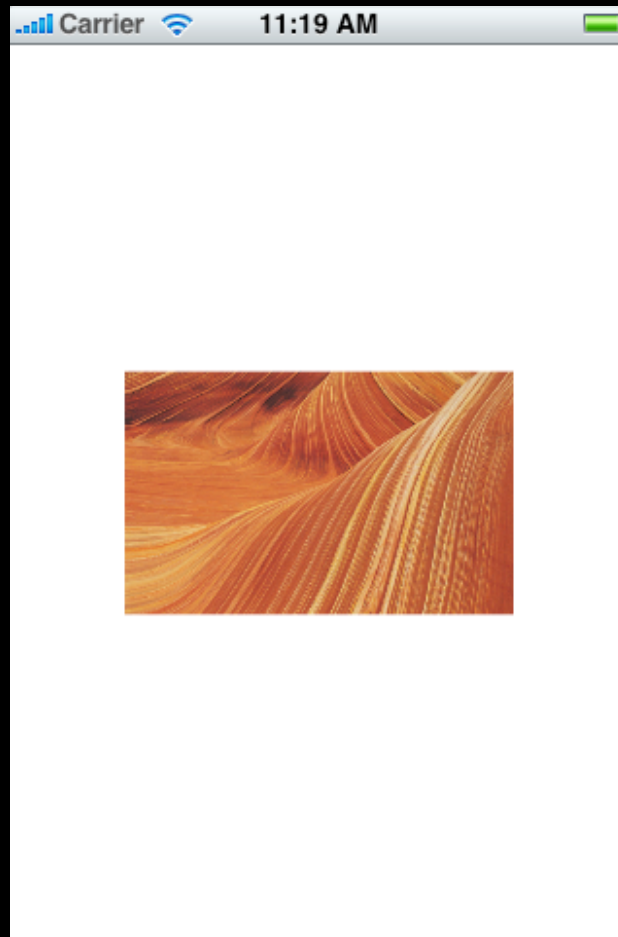
Phase: Cancelled
Location: 160, 240



```
touchesCancelled:(NSSet*)touches withEvent:(UIEvent*)event
```

Single Touch Demo

Single Touch Demo



Demo

Single Touch

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Multiple Touches

Multiple Touches

UIView Property

```
BOOL multipleTouchEnabled;
```

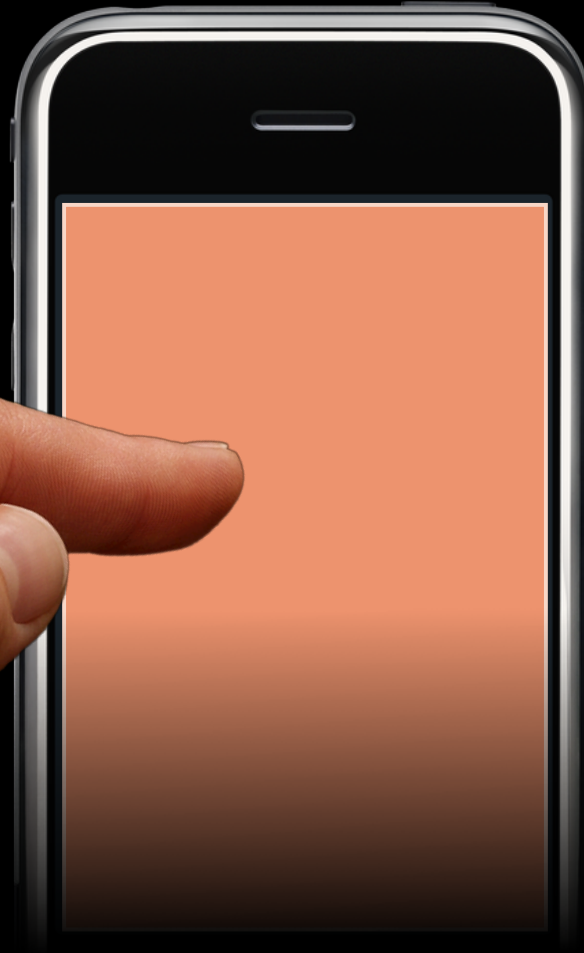
Multiple Touch Sequence



Multiple Touch Sequence

UITouch 0x123

Phase: Began
Location: 120, 200

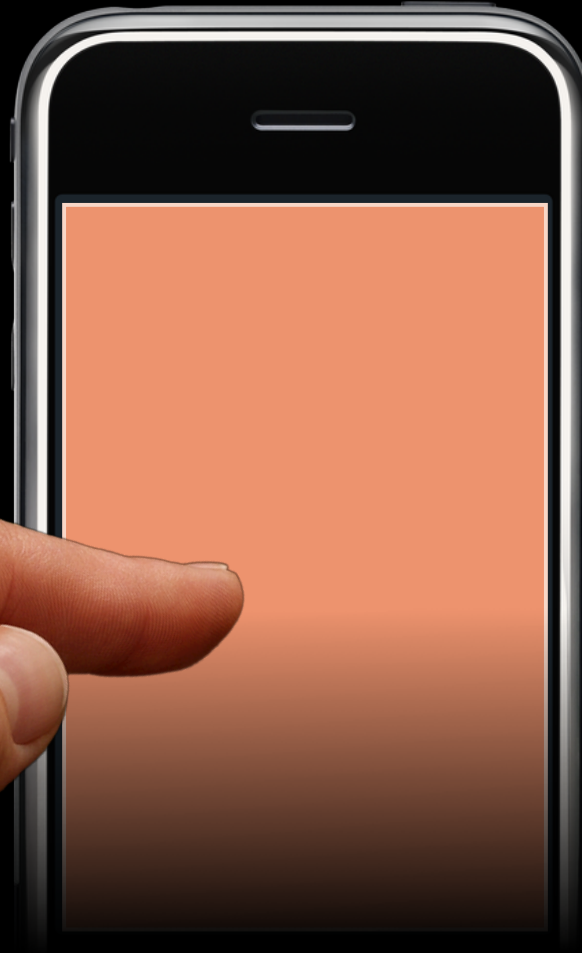


`touchesBegan:withEvent:`

Multiple Touch Sequence

UITouch 0x123

Phase: Moved
Location: 120, 240



`touchesMoved:withEvent:`

Multiple Touch Sequence

UITouch 0x123

Phase: Stationary
Location: 120, 240

UITouch 0xabc

Phase: Began
Location: 200, 200

`touchesBegan:withEvent:`

Multiple Touch Sequence

UITouch 0x123

Phase: Moved
Location: 120, 280

UITouch 0xabc

Phase: Moved
Location: 200, 240

`touchesMoved:withEvent:`

Multiple Touch Sequence

UITouch 0x123

Phase: Stationary
Location: 120, 280

UITouch 0xabc

Phase: Moved
Location: 200, 280

`touchesMoved:withEvent:`

Multiple Touch Sequence

UITouch 0x123

Phase: Ended
Location: 120, 280

UITouch 0xabc

Phase: Ended
Location: 200, 280

`touchesEnded:withEvent:`

Multiple Touches Demo

Multiple Touches Demo



Demo

Multiple Touches

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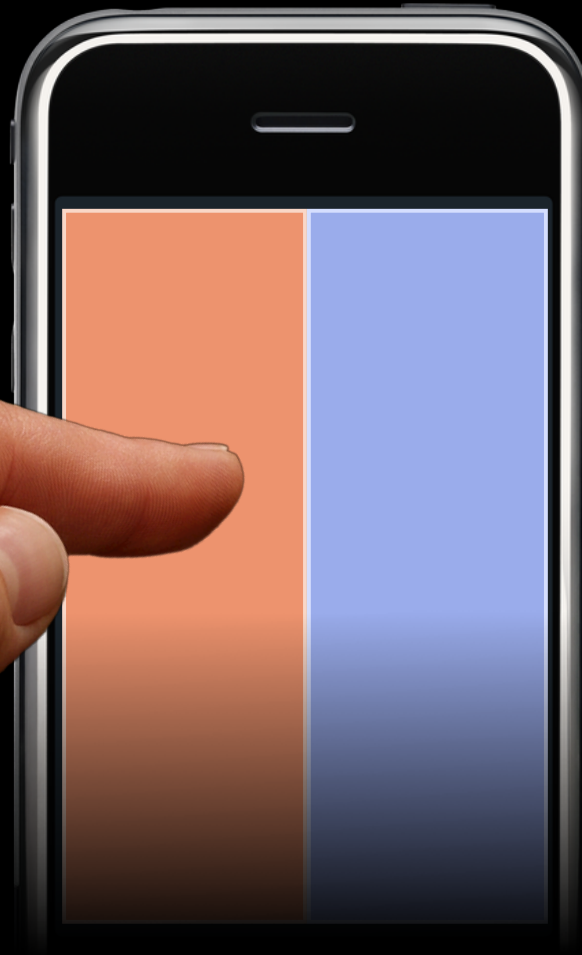
Multiple Views Touch Sequence



Multiple Views Touch Sequence

UITouch 0x123

Phase: Began
Location: 120, 200



`touchesBegan:`
`withEvent:`

Multiple Views Touch Sequence

UITouch 0x123

Phase: Moved
Location: 120, 240



touchesMoved:
withEvent:

Multiple Views Touch Sequence

UITouch 0x123

Phase: Stationary
Location: 120, 240

UITouch 0xabc

Phase: Began
Location: 200, 200

touchesBegan:
withEvent:

Multiple Views Touch Sequence

UITouch 0x123

Phase: Moved
Location: 120, 280

UITouch 0xabc

Phase: Moved
Location: 200, 240

touchesMoved: touchesMoved:
withEvent: withEvent:

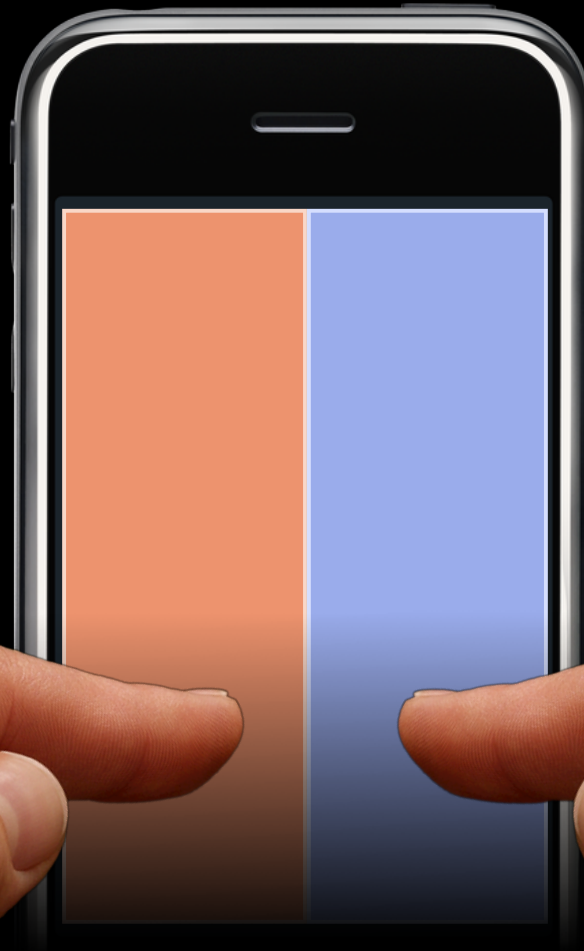
Multiple Views Touch Sequence

UITouch 0x123

Phase: Stationary
Location: 120, 280

UITouch 0xabc

Phase: Moved
Location: 200, 280



touchesMoved:
withEvent:

Multiple Views Touch Sequence

UITouch 0x123

Phase: Ended
Location: 120, 280



UITouch 0xabc

Phase: Ended
Location: 200, 280

touchesEnded: touchesEnded:
withEvent: withEvent:

Multiple Views

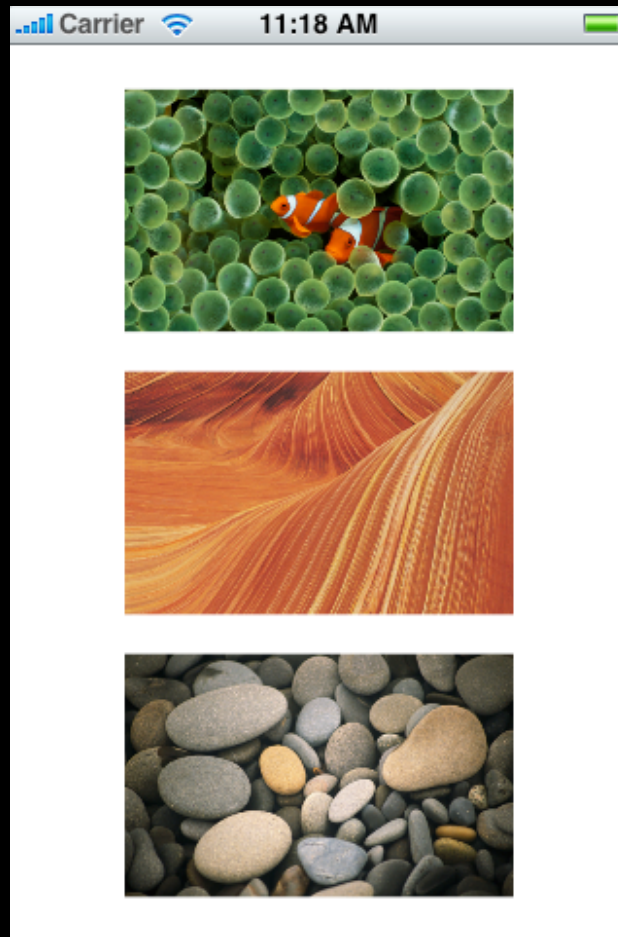
Multiple Views

UIView Property

```
BOOL exclusiveTouch;
```


Multiple Views Demo

Multiple Views Demo



Demo

Multiple Views

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Responder Chain



UIView

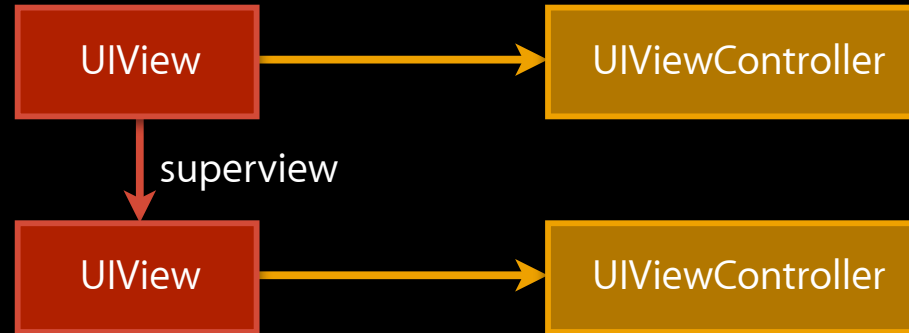
Responder Chain



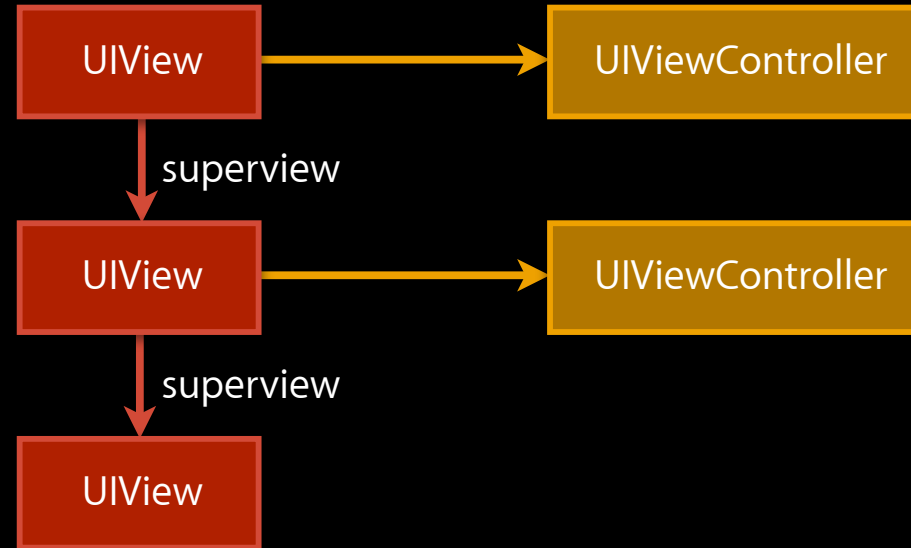
Responder Chain



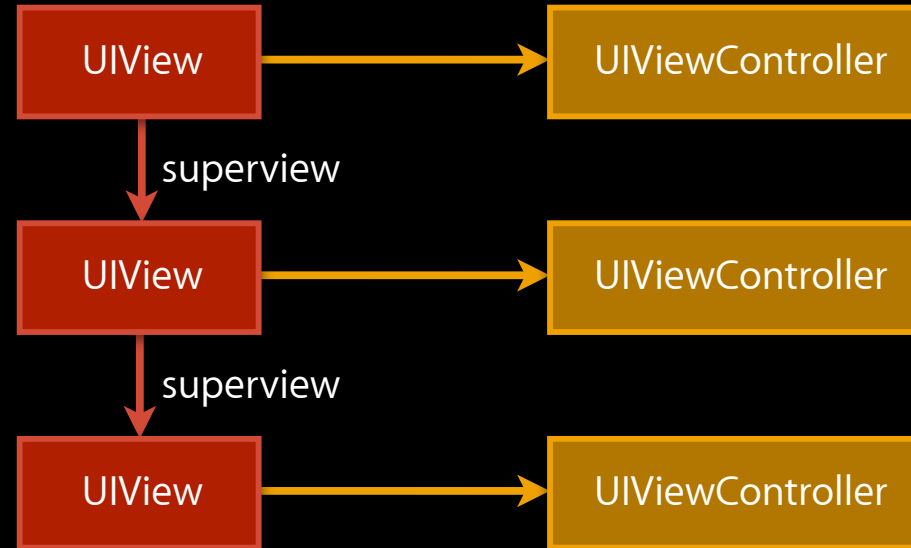
Responder Chain



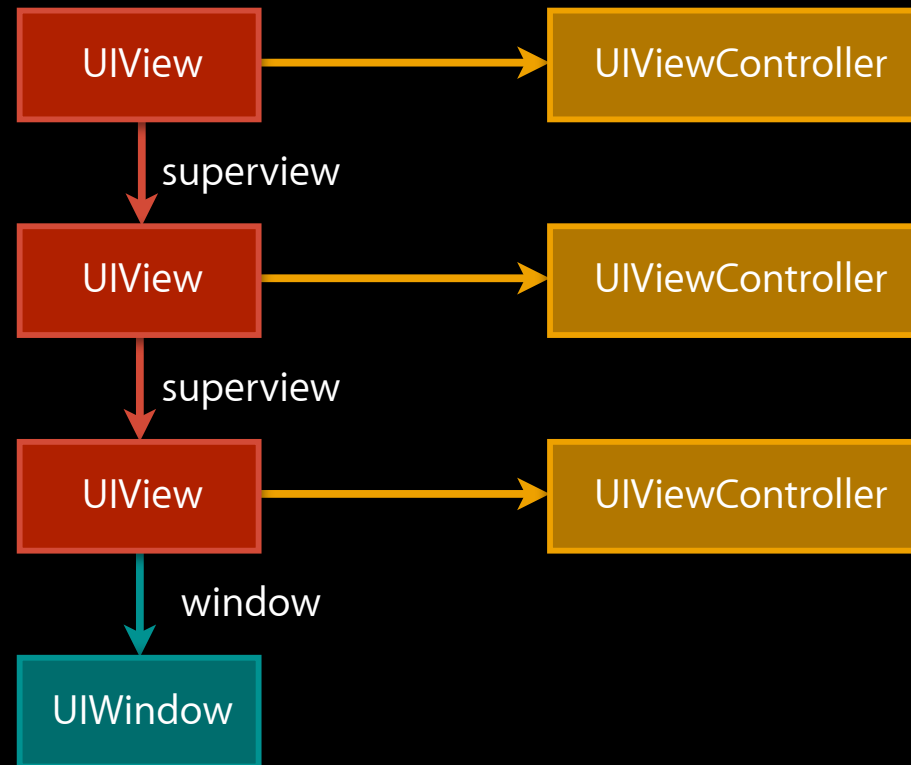
Responder Chain



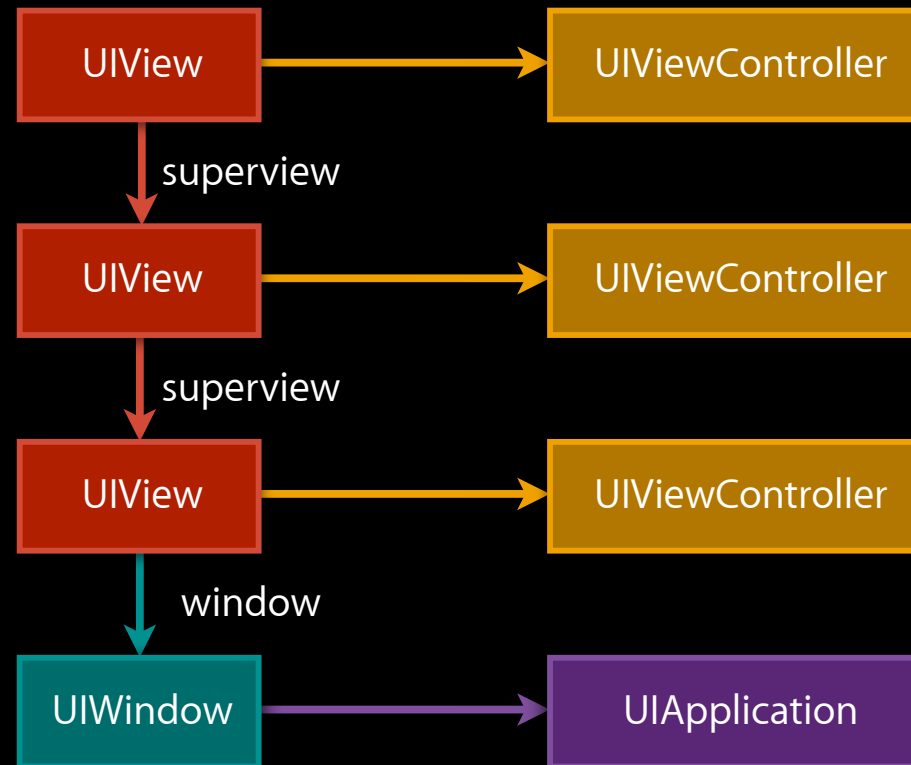
Responder Chain



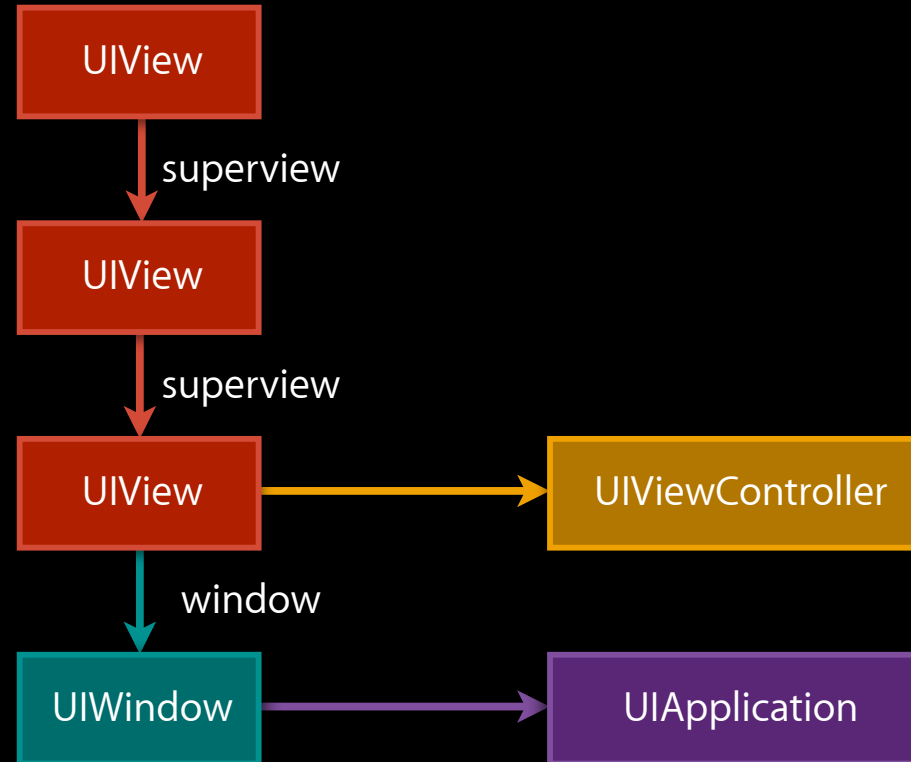
Responder Chain



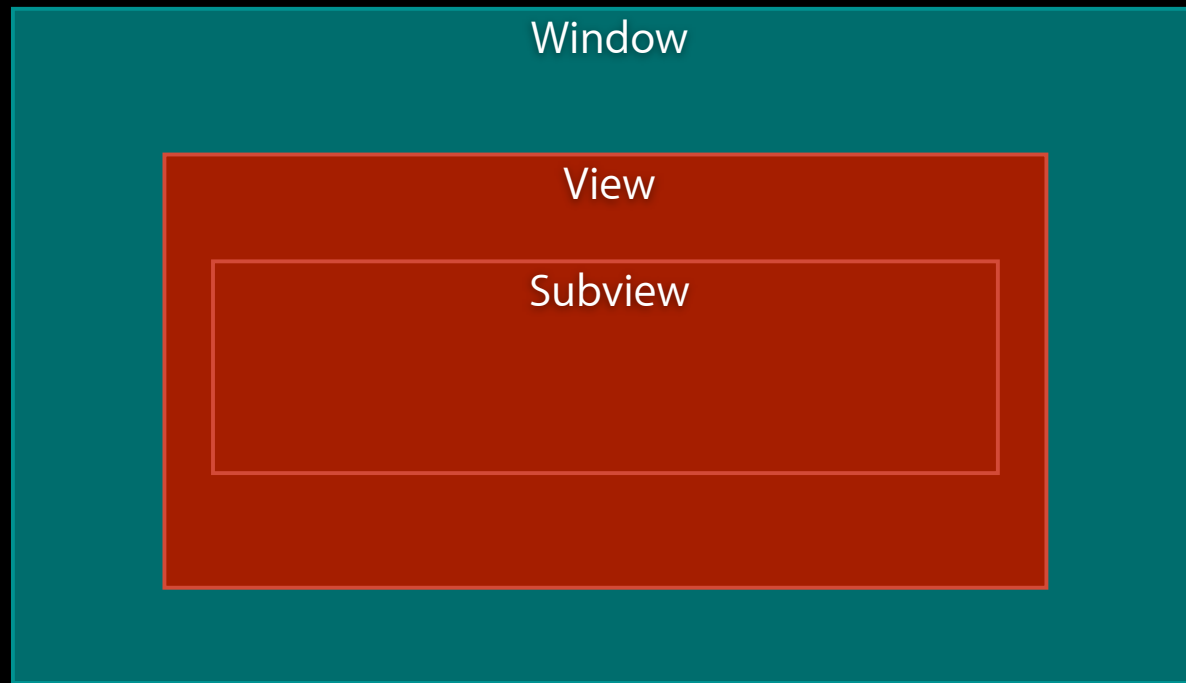
Responder Chain



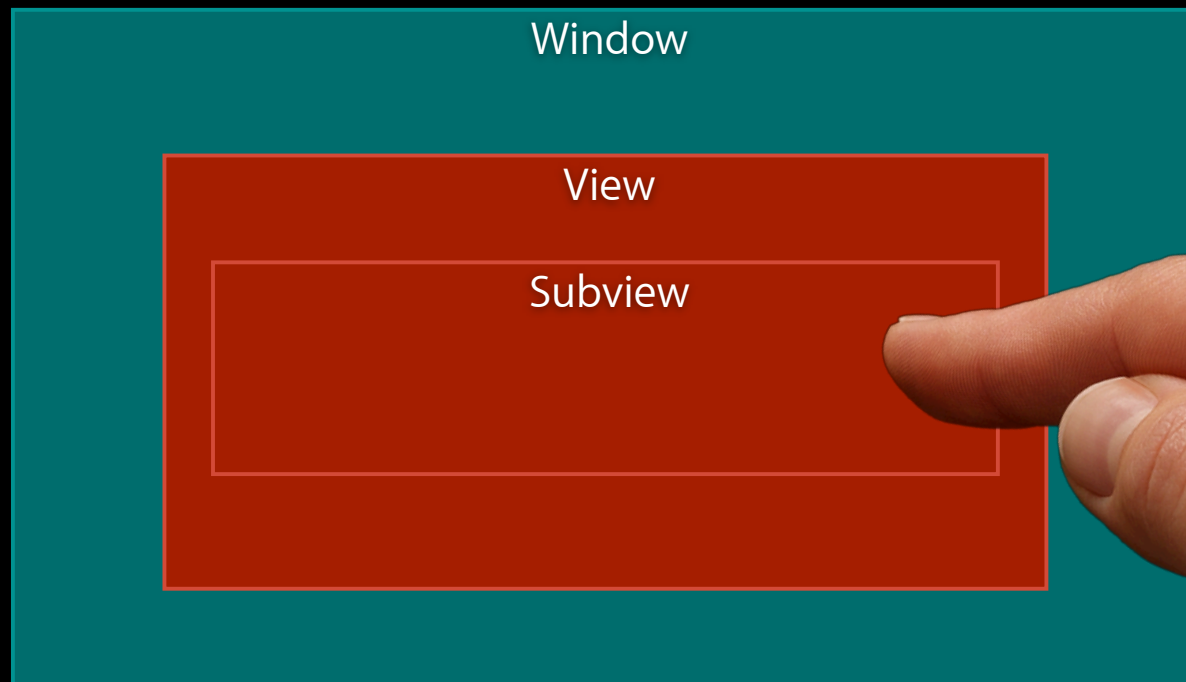
Responder Chain



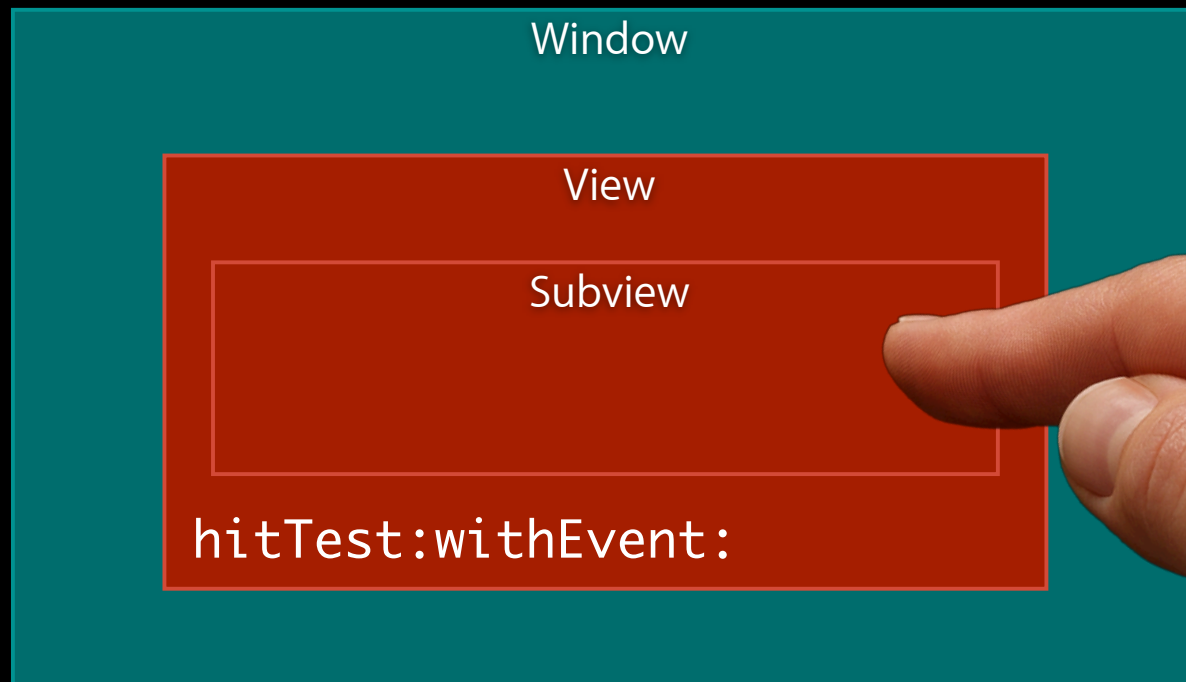
Hit Testing



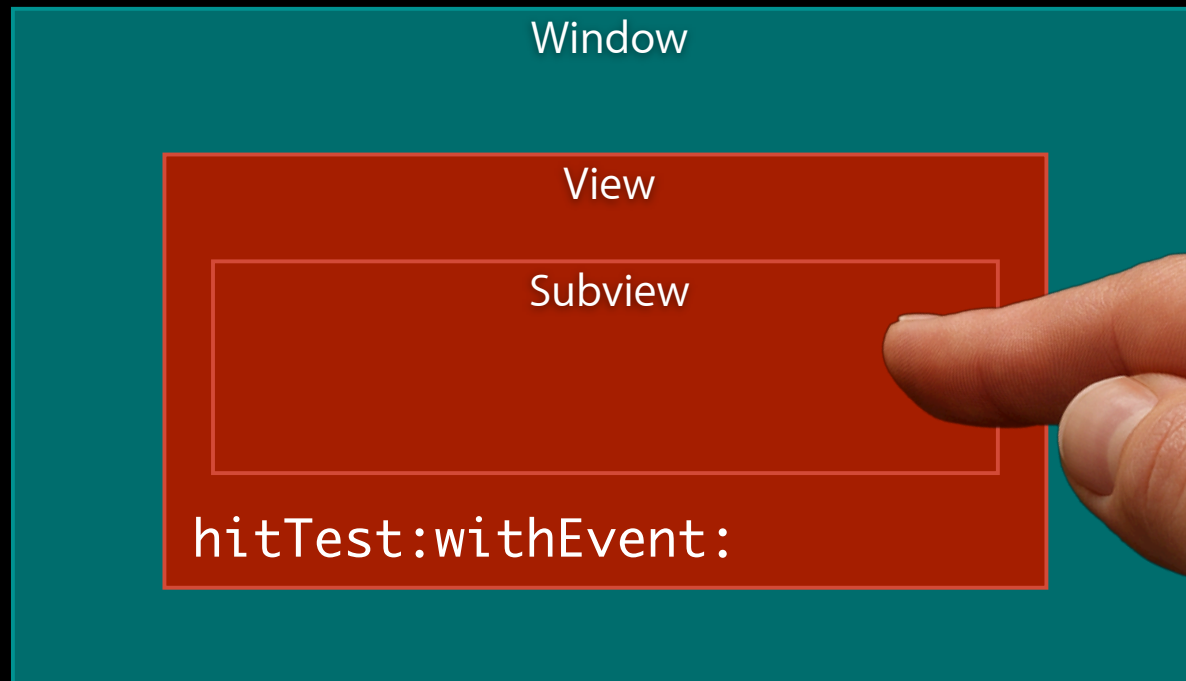
Hit Testing



Hit Testing

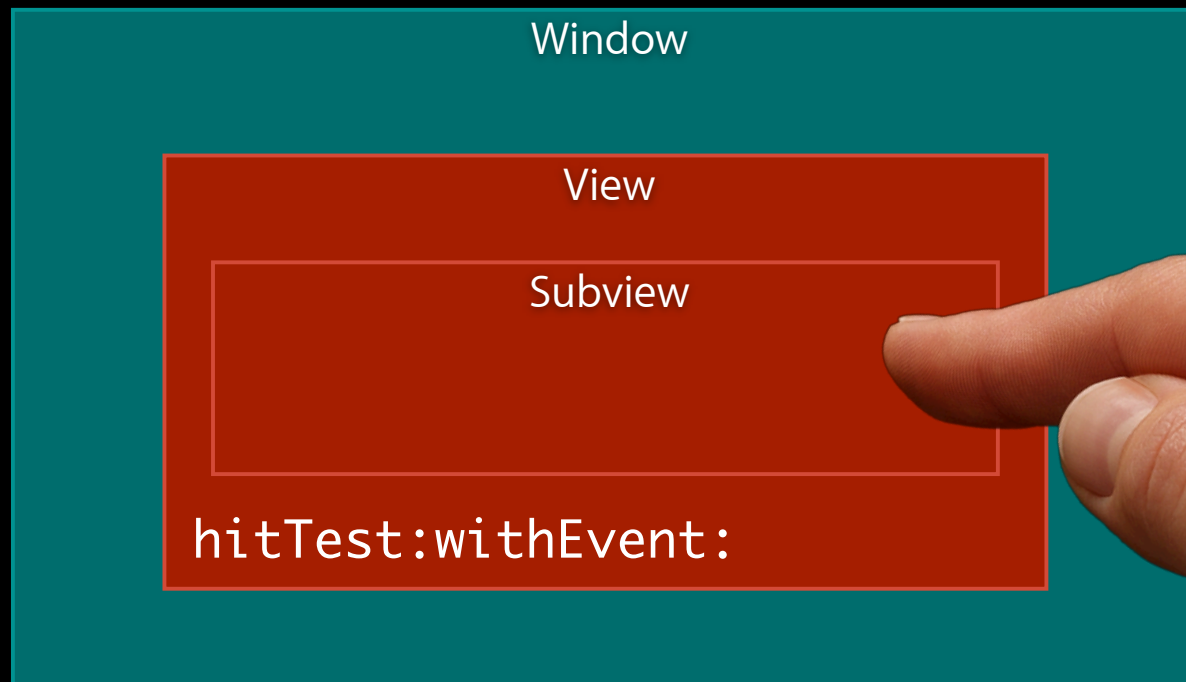


Hit Testing



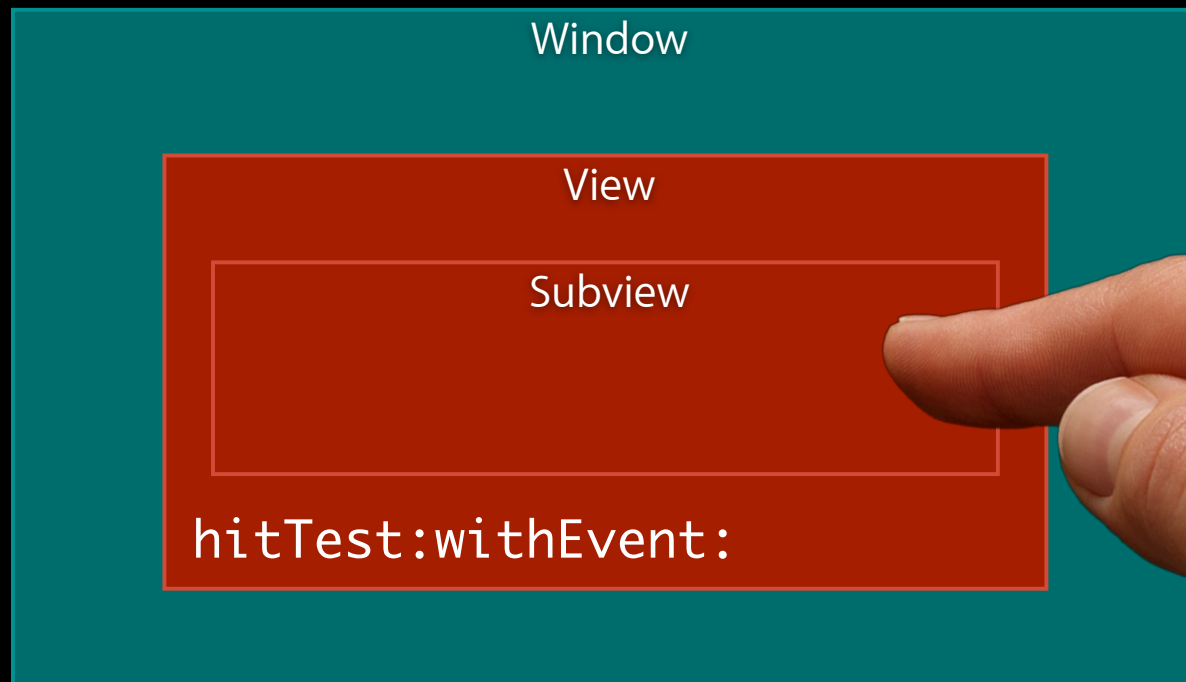
- `userInteractionEnabled`

Hit Testing



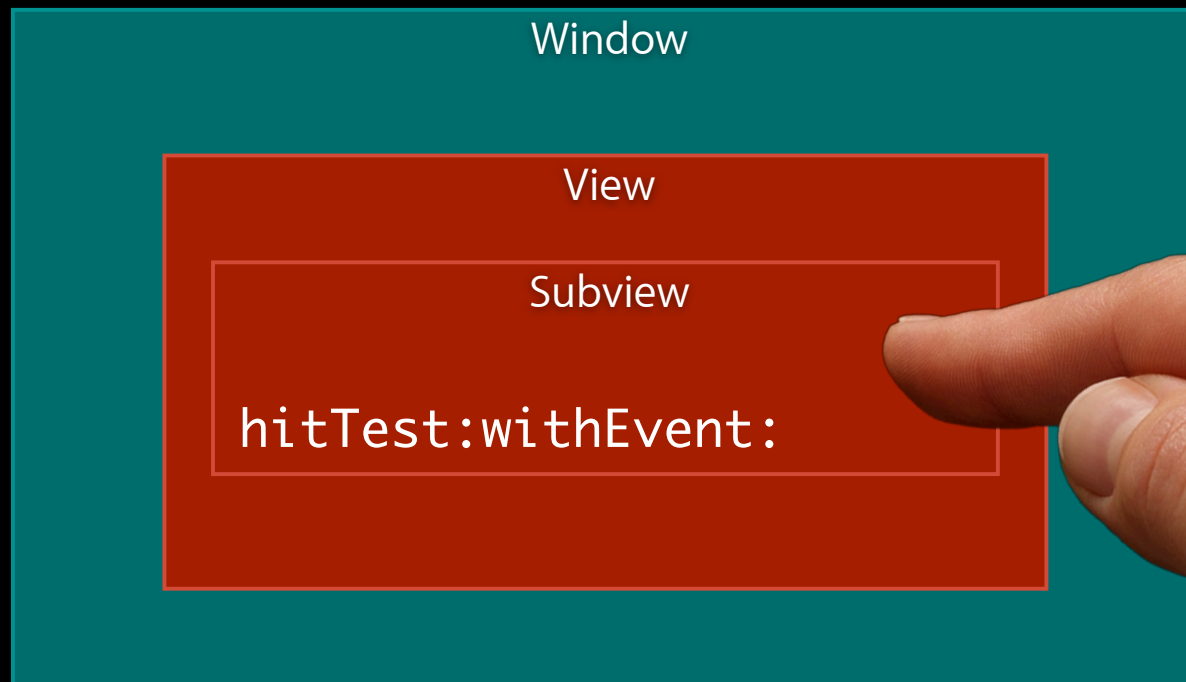
- `userInteractionEnabled`
- `hidden/alpha`

Hit Testing



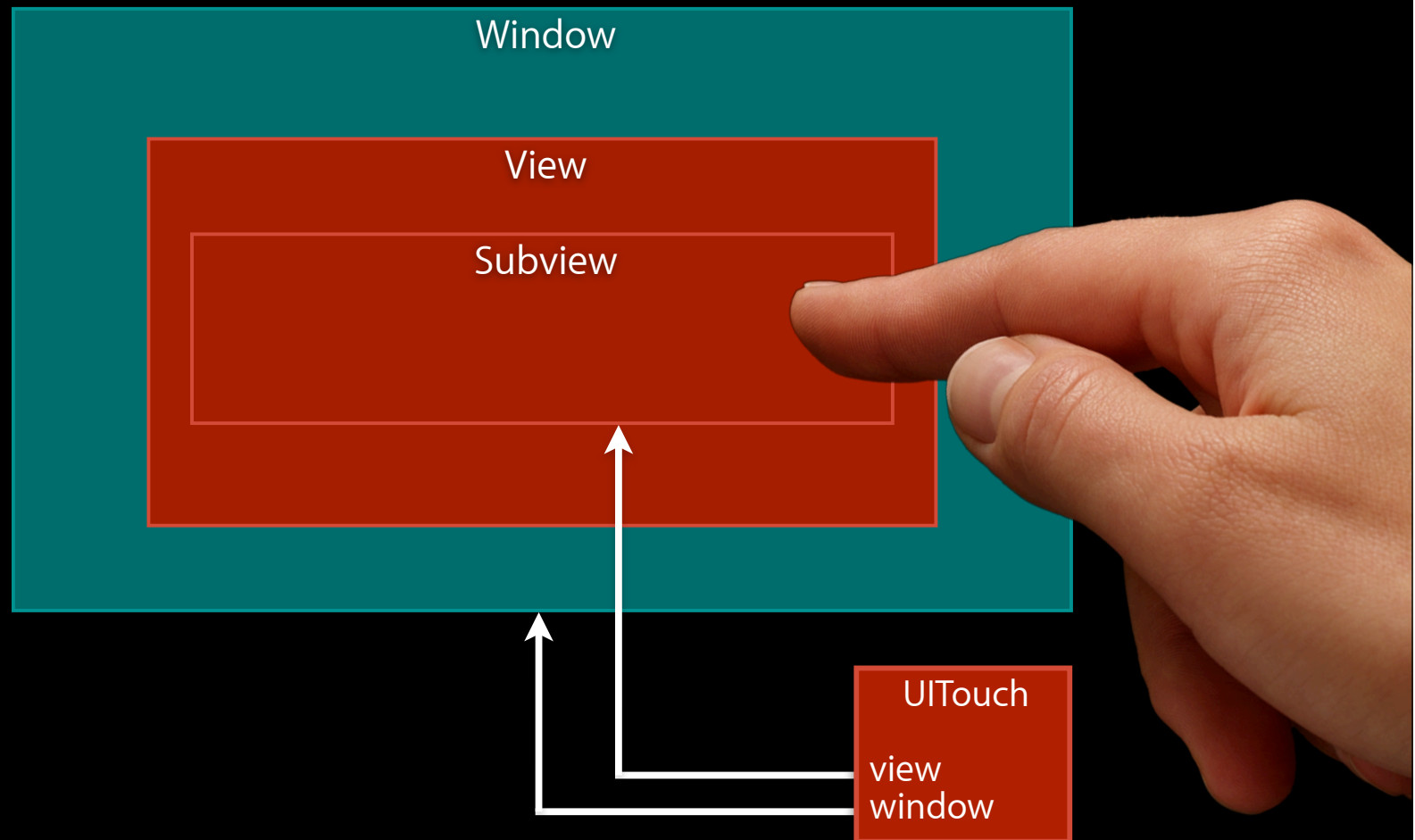
- `userInteractionEnabled`
- `hidden/alpha`
- `pointInside:withEvent:`

Hit Testing



- `userInteractionEnabled`
- `hidden/alpha`
- `pointInside:withEvent:`

Hit Testing



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UIControlEvents

UIControlEvents

UIControlEventTouchDown

UIControlEventTouchDownRepeat

UIControlEvents

UIControlEventTouchDown

UIControlEventTouchDownRepeat

UIControlEventTouchDragInside

UIControlEventTouchDragOutside

UIControlEvents

UIControlEventTouchDown
UIControlEventTouchDownRepeat
UIControlEventTouchDragInside
UIControlEventTouchDragOutside
UIControlEventTouchDragEnter
UIControlEventTouchDragExit

UIControlEvents

UIControlEventTouchDown
UIControlEventTouchDownRepeat
UIControlEventTouchDragInside
UIControlEventTouchDragOutside
UIControlEventTouchDragEnter
UIControlEventTouchDragExit
UIControlEventTouchUpInside
UIControlEventTouchUpOutside

UIControlEvents

UIControlEventTouchDown
UIControlEventTouchDownRepeat
UIControlEventTouchDragInside
UIControlEventTouchDragOutside
UIControlEventTouchDragEnter
UIControlEventTouchDragExit
UIControlEventTouchUpInside
UIControlEventTouchUpOutside
UIControlEventTouchCancel

Associating actions with UIControlEvents

Associating actions with UIControlEvents

```
- (void)addTarget:(id)target  
    action:(SEL)action  
    forControlEvents:(UIControlEvents)controlEvents;
```

Associating actions with UIControlEvents

```
- (void)addTarget:(id)target  
    action:(SEL)action  
    forControlEvents:(UIControlEvents)controlEvents;
```

Action Signatures

Associating actions with UIControlEvents

```
- (void)addTarget:(id)target  
    action:(SEL)action  
    forControlEvents:(UIControlEvents)controlEvents;
```

Action Signatures

```
- (void)performAction;
```


Associating actions with UIControlEvents

```
- (void)addTarget:(id)target  
    action:(SEL)action  
    forControlEvents:(UIControlEvents)controlEvents;
```

Action Signatures

```
- (void)performAction;  
- (void)performAction:(id)sender;
```

Associating actions with UIControlEvents

- (void)addTarget:(id)target
 action:(SEL)action
 forControlEvents:(UIControlEvents)controlEvents;

Action Signatures

- (void)performAction;
- (void)performAction:(id)sender;
- (void)performAction:(id)sender withEvent:(UIEvent *)event;

UIControl Touch Tracking

UIControl Touch Tracking

- (BOOL)beginTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;

UIControl Touch Tracking

- (BOOL)beginTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (BOOL)continueTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;

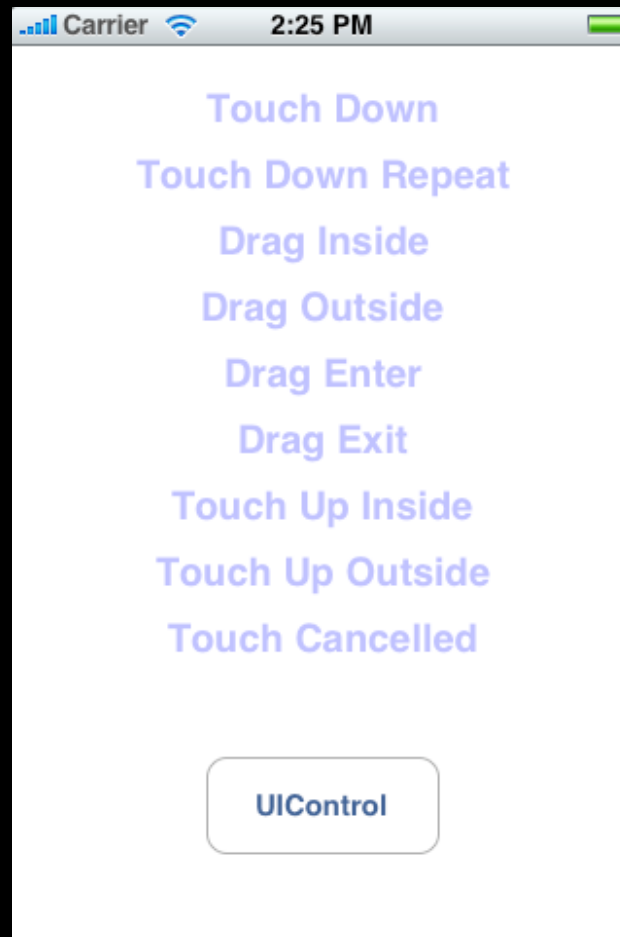
UIControl Touch Tracking

- (BOOL)beginTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (BOOL)continueTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (void)endTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;

UIControl Touch Tracking

- (BOOL)beginTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (BOOL)continueTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (void)endTrackingWithTouch:(UITouch *)touch
 withEvent:(UIEvent *)event;
- (void)cancelTrackingWithEvent:(UIEvent *)event;

UIControl Demo



Demo

UIControl

Best Practices

Handling Touch Events

The view returned by:

- (UIView *)hitTest:(CGPoint)point withEvent:(UIEvent *)event;

must handle **all** of the touch processing methods:

Handling Touch Events

The view returned by:

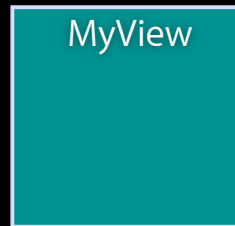
- (UIView *)hitTest:(CGPoint)point withEvent:(UIEvent *)event;

must handle **all** of the touch processing methods:

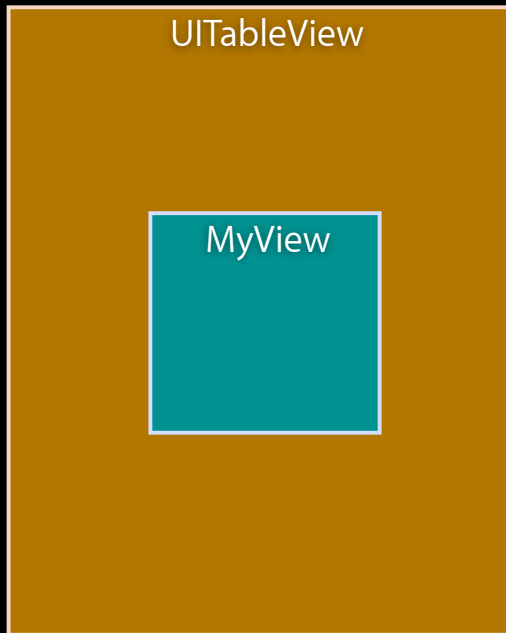
- (void)touchesBegan:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesMoved:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesEnded:(NSSet *)touches withEvent:(UIEvent *)event;
- (void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;

Subclassing UIView

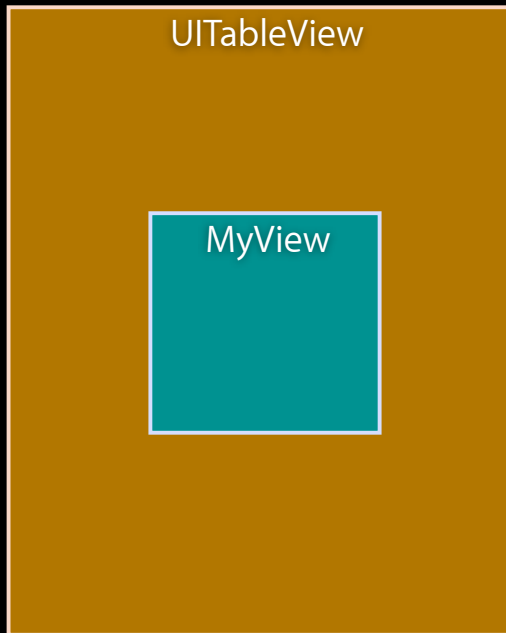
Subclassing UIView



Subclassing UIView



Subclassing UIView



- Subclasses of UIView must implement all touch processing methods and **must not** call super.

Subclassing Other UIKit Classes

Subclassing Other UIKit Classes



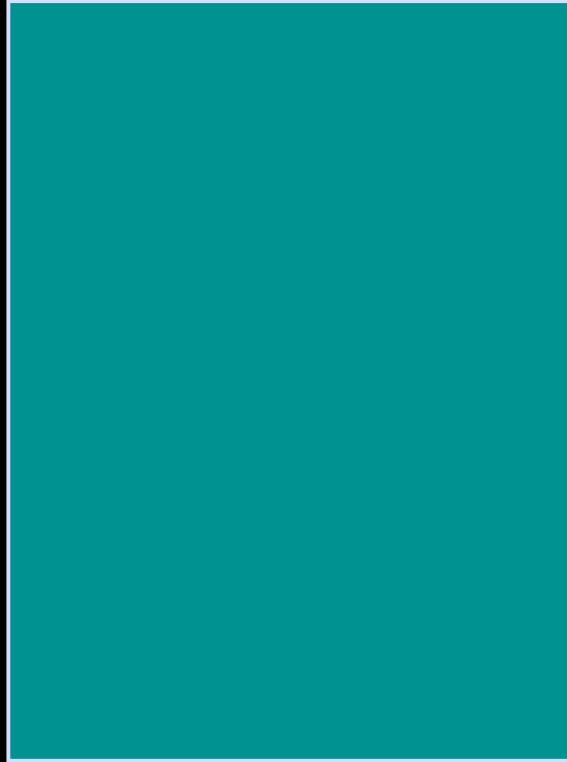
Subclassing Other UIKit Classes



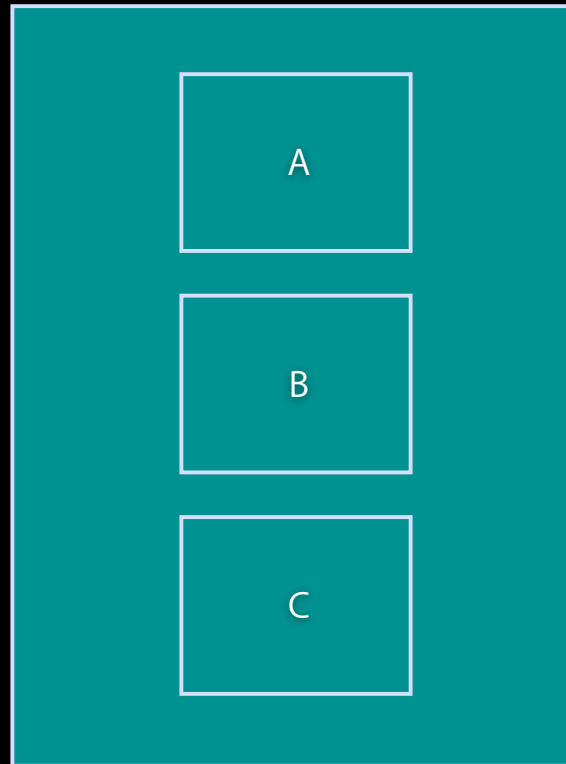
- Subclasses of any other UIKit class can implement any or all touch processing methods but **must** call super.

Touch Forwarding

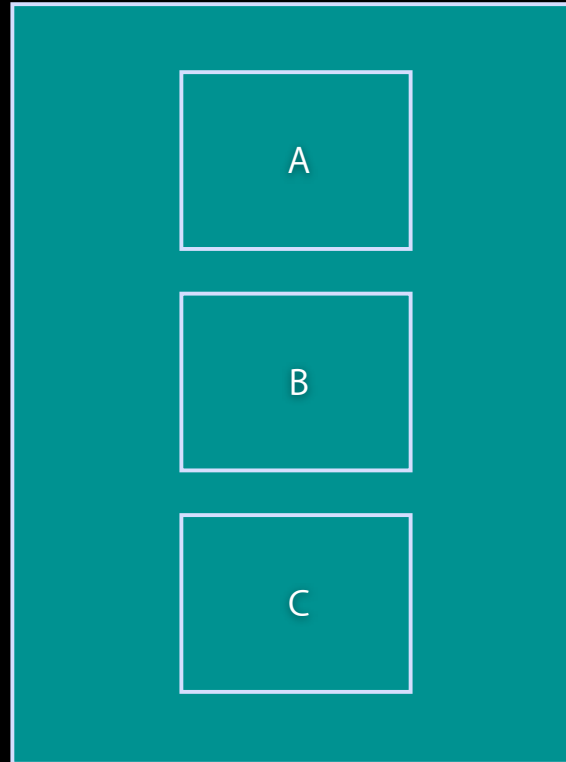
Touch Forwarding



Touch Forwarding



Touch Forwarding



- If you need to conditionally send touches to various views, all of the views involved need to be your own custom subclasses of UIView

Gotchas

Gotchas

Gotchas

- Failing to handle cancelled touches

Gotchas

- Failing to handle cancelled touches
 - `(void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;`

Gotchas

- Failing to handle cancelled touches
 - `(void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;`
- Forwarding touches to UIKit classes

Gotchas

- Failing to handle cancelled touches
 - `(void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;`
- Forwarding touches to UIKit classes
- Subclassing a UIKit class and conditionally calling super from the various touch processing methods

Gotchas

- Failing to handle cancelled touches
 - `(void)touchesCancelled:(NSSet *)touches withEvent:(UIEvent *)event;`
- Forwarding touches to UIKit classes
- Subclassing a UIKit class and conditionally calling super from the various touch processing methods
- Calling the wrong touch handler on your superclass

Summary

Summary

- Touch Sequences
- Touch and Event Objects
- Touch Delivery
- Single Touch
- Multiple Touches
- Multiple Views
- Touch Routing
- UIControl Objects

Questions?