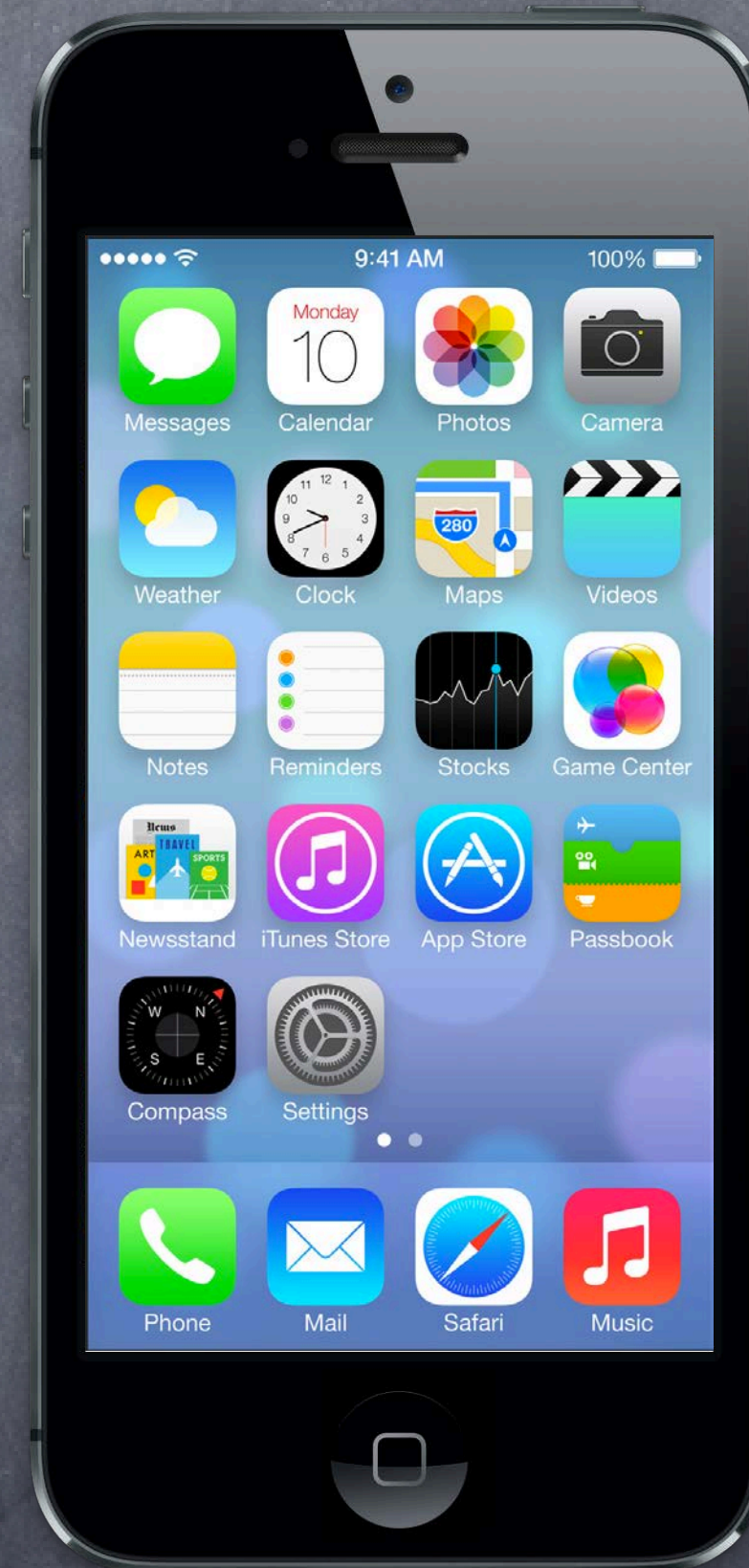


Stanford CS193p

Developing Applications for iOS
Fall 2013-14



Today

- 👁 Views

How to draw custom stuff on screen.

- 👁 Gestures

How to react to user's touch gestures.

- 👁 Demo

SuperCard

Views

- A view (i.e. `UIView` subclass) represents a rectangular area

Defines a coordinate space

- Draws and handles events in that rectangle

- Hierarchical

A view has only one superview – `(UIView *)superview`

But can have many (or zero) subviews – `(NSArray *)subviews`

Subview order (in `subviews` array) matters: those later in the array are on top of those earlier

A view can clip its subviews to its bounds or not (switch for this in Xcode, or method in `UIView`).

- `UIWindow`

The `UIView` at the top of the view hierarchy

Only have one `UIWindow` (generally) in an iOS application

It's all about views, not windows

Views

- The hierarchy is most often constructed in Xcode graphically
Even custom views are often added to the view hierarchy using Xcode (more on this later).
- But it can be done in code as well
 - `(void)addSubview:(UIView *)aView; // sent to aView's (soon to be) superview`
 - `(void)removeFromSuperview; // sent to the view that is being removed`
- The top of this hierarchy for your MVC is the @property **view!**
`UIViewController's @property (strong, nonatomic) UIView *view`
It is critical to understand what this very simple @property is!
This is the view whose bounds will be changed when autorotation happens, for example.
This is the view you would programmatically add subviews to.
All your MVC's View's UIView's eventually have this view as their parent (it's at the top).
It is automatically hooked up for you when you drag out a View Controller in Xcode.

Initializing a UIView

- Yes, you might want to override UIView's designated initializer
More common than overriding UIViewController's designated initializer (but still rare).
- But you will also want to set up stuff in `awakeFromNib`
This is because `initWithFrame:` is NOT called for a UIView coming out of a storyboard!
But `awakeFromNib` is. Same as we talked about with UIViewController.
It's called "awakeFromNib" for historical reasons.
- Typical code ...

```
- (void)setup { ... }  
- (void)awakeFromNib { [self setup]; }  
- (id)initWithFrame:(CGRect)aRect  
{  
    self = [super initWithFrame:aRect];  
    [self setup];  
    return self;  
}
```

View Coordinates

- **CGFloat**

Just a floating point number (depends on 64-bit or not), but we always use it for graphics.

- **CGPoint**

C struct with two **CGFloats** in it: **x** and **y**.

```
CGPoint p = CGPointMake(34.5, 22.0);  
p.x += 20; // move right by 20 points
```

- **CGSize**

C struct with two **CGFloats** in it: **width** and **height**.

```
CGSize s = CGSizeMake(100.0, 200.0);  
s.height += 50; // make the size 50 points taller
```

- **CGRect**

C struct with a **CGPoint** **origin** and a **CGSize** **size**.

```
CGRect aRect = CGRectMake(45.0, 75.5, 300, 500);  
aRect.size.height += 45; // make the rectangle 45 points taller  
aRect.origin.x += 30; // move the rectangle to the right 30 points
```

(0,0)

increasing x

Coordinates

◦ (400, 35)

- Origin of a view's coordinate system is upper left

- Units are "points" (not pixels)

Usually you don't care about how many pixels per point are on the screen you're drawing on. Fonts and arcs and such automatically adjust to use higher resolution.

However, if you are drawing something detailed (like a graph), you might want to know.

There is a `UIView` property which will tell you:

```
@property CGFloat contentScaleFactor; // returns pixels per point on the screen this view is on.
```

This property is not `readonly`, but you should basically pretend that it is for this course.

- Views have 3 properties related to their location and size

```
@property CGRect bounds; // your view's internal drawing space's origin and size
```

The `bounds` property is what you use inside your view's own implementation.

It is up to your implementation as to how to interpret the meaning of `bounds.origin`.

```
@property CGPoint center; // the center of your view in your Superview's coordinate space
```

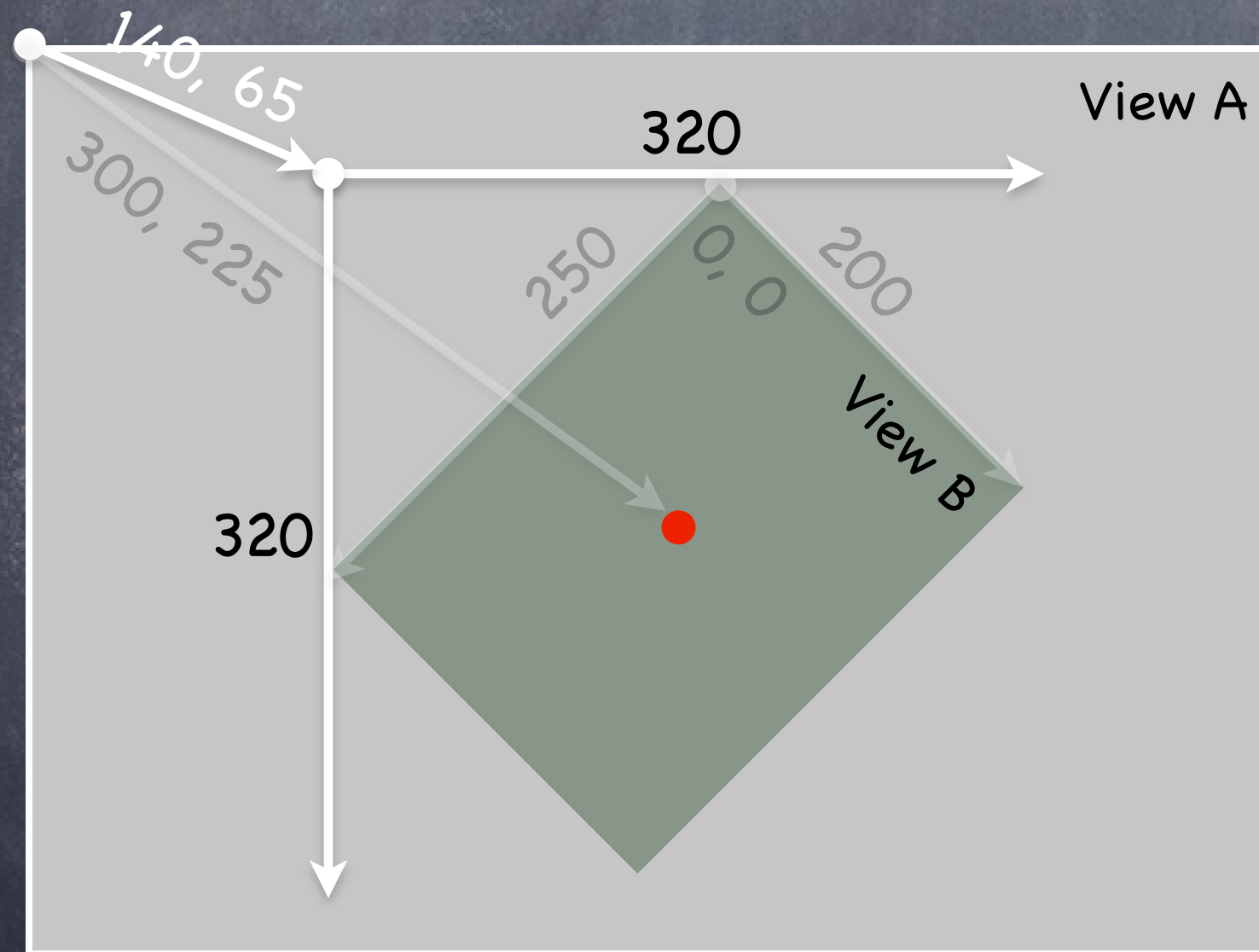
```
@property CGRect frame; // a rectangle in your Superview's coordinate space which entirely  
// contains your view's bounds.size
```

increasing y

Coordinates

- Use **frame** and **center** to position the view in the hierarchy

These are used by superviews, never inside your **UIView** subclass's implementation. You might think **frame.size** is always equal to **bounds.size**, but you'd be wrong ...



Because views can be rotated (and scaled and translated too).

View B's **bounds** = $((0,0), (200,250))$

View B's **frame** = $((140,65), (320,320))$

View B's **center** = $(300,225)$

View B's middle in its own coordinate space is $(\text{bound.size.width}/2 + \text{bounds.origin.x}, \text{bounds.size.height}/2 + \text{bounds.origin.y})$ which is $(100,125)$ in this case.

Views are rarely rotated, but don't misuse **frame** or **center** by assuming that.

Creating Views

- Most often you create views in Xcode

Of course, Xcode's palette knows nothing about a custom view class you might create. So you drag out a generic `UIView` from the palette and use the Identity Inspector to change the class of the `UIView` to your custom class (demo of this later).

- How do you create a `UIView` in code (i.e. not in Xcode)?

Just use `alloc` and `initWithFrame:` (`UIView`'s designated initializer).
Can also use `init` (frame will be `CGRectZero`).

- Example

```
CGRect labelRect = CGRectMake(20, 20, 50, 30);
UILabel *label = [[UILabel alloc] initWithFrame:labelRect];
label.text = @"Hello!";
[self.view addSubview:label]; // Note self.view!
```



Custom Views

- When would I want to create my own `UIView` subclass?

I want to do some custom drawing on screen.

I need to handle touch events in a special way (i.e. different than a button or slider does)

We'll talk about handling touch events in a bit. First we'll focus on drawing.

- Drawing is easy ... create a `UIView` subclass & override 1 method

- `(void)drawRect:(CGRect)aRect;`

You can optimize by not drawing outside of `aRect` if you want (but not required).

- **NEVER** call `drawRect:!!` EVER! Or else!

Instead, let iOS know that your view's visual is out of date with one of these `UIView` methods:

- `(void)setNeedsDisplay;`

- `(void)setNeedsDisplayInRect:(CGRect)aRect;`

It will then set everything up and call `drawRect:` for you at an appropriate time.

Obviously, the second version will call your `drawRect:` with only rectangles that need updates.

Custom Views

- So how do I implement my `drawRect:`?
 - Use the Core Graphics framework directly (a C API, not object-oriented).
 - Or we can use the object-oriented `UIBezierPath` class (we'll do it this way).
- Core Graphics Concepts
 - Get a context to draw into (iOS will prepare one each time your `drawRect:` is called)
 - Create paths (out of lines, arcs, etc.)
 - Set colors, fonts, textures, linewidths, linecaps, etc.
 - Stroke or fill the above-created paths
- `UIBezierPath`
 - Do all of the above, but capture it with an object.
 - Then ask the object to stroke or fill what you've created.

Context

- The context determines where your drawing goes

Screen (the only one we're going to talk about today)

Offscreen Bitmap

PDF

Printer

- For normal drawing, UIKit sets up the current context for you

But it is only valid during that particular call to `drawRect:`.

A new one is set up for you each time `drawRect:` is called.

So never cache the current graphics context in `drawRect:` to use later!

- How to get this magic context?

`UIBezierPath` draws into the current context, so you don't need to get it if using that.

But if you're calling Core Graphics C functions directly, you'll need it (it's an argument to them).

Call the following C function inside your `drawRect:` method to get the current graphics context ...

```
CGContextRef context = UIGraphicsGetCurrentContext();
```

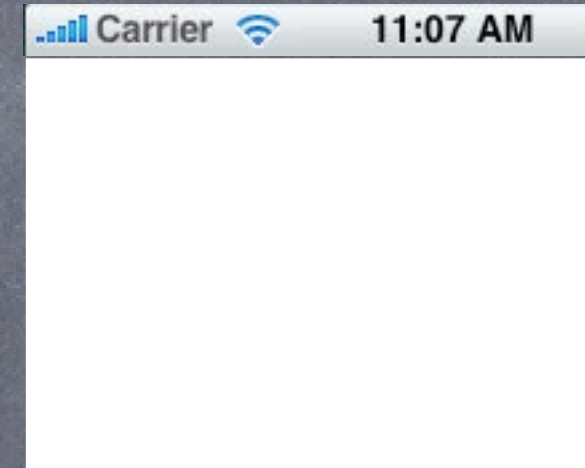
Define a Path

- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

```
[path moveToPoint:CGPointMake(75, 10)];
```



Define a Path

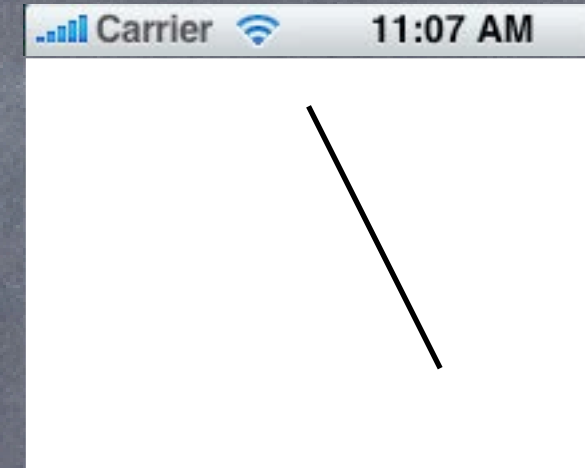
- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

```
[path moveToPoint:CGPointMake(75, 10)];
```

```
[path addLineToPoint:CGPointMake(160, 150)];
```



Define a Path

- Begin the path

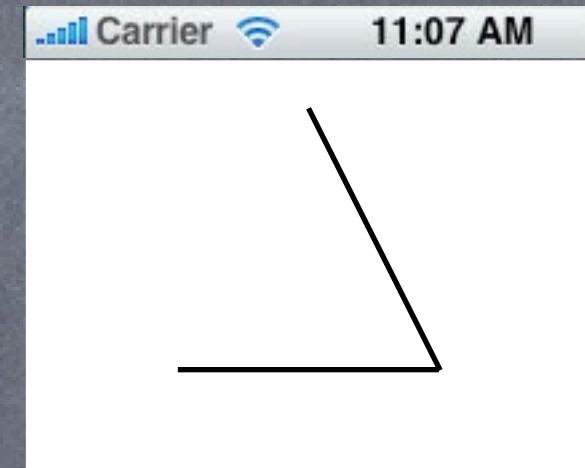
```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

```
[path moveToPoint:CGPointMake(75, 10)];
```

```
[path addLineToPoint:CGPointMake(160, 150)];
```

```
[path addLineToPoint:CGPointMake(10, 150)];
```



Define a Path

- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

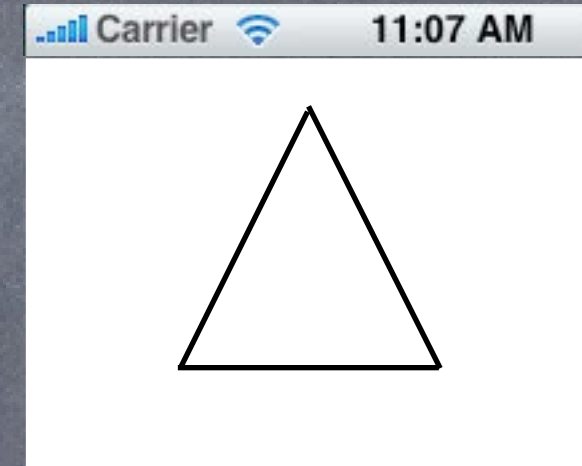
```
[path moveToPoint:CGPointMake(75, 10)];
```

```
[path addLineToPoint:CGPointMake(160, 150)];
```

```
[path addLineToPoint:CGPointMake(10, 150)];
```

- Close the path (connects the last point back to the first)

```
[path closePath]; // not strictly required but triangle won't have all 3 sides otherwise
```



Define a Path

- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

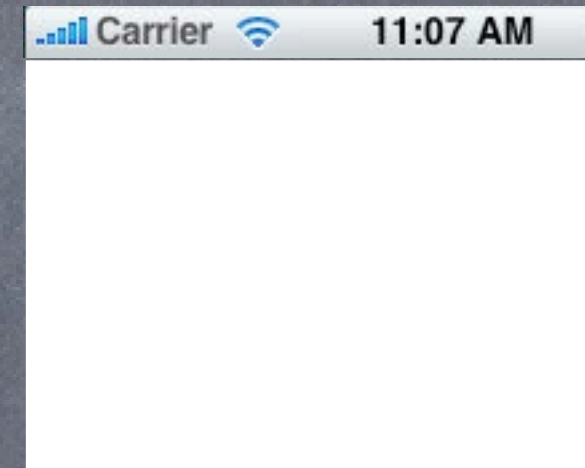
```
[path moveToPoint:CGPointMake(75, 10)];  
[path addLineToPoint:CGPointMake(160, 150)];  
[path addLineToPoint:CGPointMake(10, 150)];
```

- Close the path (connects the last point back to the first)

```
[path closePath]; // not strictly required but triangle won't have all 3 sides otherwise
```

- Now that the path has been created, we can stroke/fill it

Actually, nothing has been drawn yet, we've just created the UIBezierPath.



Define a Path

- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

```
[path moveToPoint:CGPointMake(75, 10)];  
[path addLineToPoint:CGPointMake(160, 150)];  
[path addLineToPoint:CGPointMake(10, 150)];
```

- Close the path (connects the last point back to the first)

```
[path closePath]; // not strictly required but triangle won't have all 3 sides otherwise
```

- Now that the path has been created, we can stroke/fill it

Actually, nothing has been drawn yet, we've just created the UIBezierPath.

```
[[UIColor greenColor] setFill];  
[[UIColor redColor] setStroke];
```



Define a Path

- Begin the path

```
UIBezierPath *path = [[UIBezierPath alloc] init];
```

- Move around, add lines or arcs to the path

```
[path moveToPoint:CGPointMake(75, 10)];  
[path addLineToPoint:CGPointMake(160, 150)];  
[path addLineToPoint:CGPointMake(10, 150)];
```

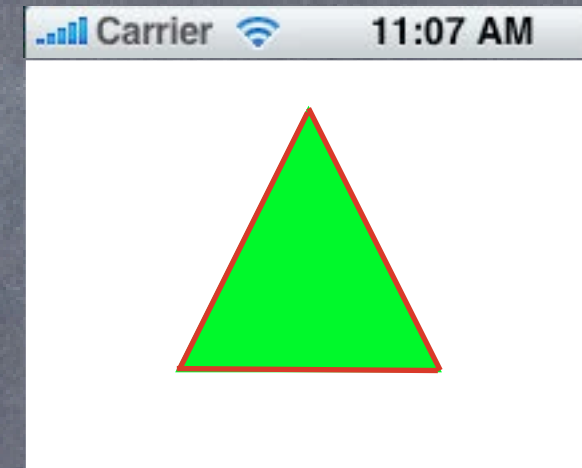
- Close the path (connects the last point back to the first)

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[path closePath]; // not strictly required but triangle won't have all 3 sides otherwise
```

- Now that the path has been created, we can stroke/fill it

Actually, nothing has been drawn yet, we've just created the UIBezierPath.

```
[[UIColor greenColor] setFill];  
[[UIColor redColor] setStroke];  
[path fill]; [path stroke];
```



Graphics State

- Can also set graphics state

e.g. `path.lineWidth = 2.0;` // line width in points (not pixels)

- And draw rounded rects, ovals, etc.

```
UIBezierPath *roundedRect = [UIBezierPath bezierPathWithRoundedRect:(CGRect)bounds  
                                                                    cornerRadius:(CGFloat)radius];
```

Note: the “casts” in the arguments are just to let you know the types (i.e. they’re not required).

```
UIBezierPath *oval = [UIBezierPath bezierPathWithOvalInRect:(CGRect)bounds];  
[roundedRect stroke];  
[oval fill];
```

- You can use a UIBezierPath to “clip” your drawing

```
[roundedRect addClip]; // this would clip all drawing to be inside the roundedRect
```

Graphics State

• Drawing with transparency in `UIView`

You know that `UIColors` can have `alpha`.

This is how you can draw with transparency in your `drawRect:`.

`UIView` also has a `backgroundColor` property which can be set to transparent values.

Be sure to set `@property BOOL opaque` to `NO` in a view which is partially transparent.

If you don't, results are unpredictable (this is a performance optimization property, by the way).

`UIView`'s `@property CGFloat alpha` can make the entire view partially transparent.

(you might use this to your advantage in your homework to show a "disabled" custom view)

View Transparency

- What happens when views overlap?

As mentioned before, `subviews` list order determines who's in front

Lower ones (earlier in `subviews` array) can "show through" transparent views on top of them

- Default drawing is opaque

Transparency is not cheap (performance-wise)

- Also, you can hide a view completely by setting `hidden` property

```
@property (nonatomic) BOOL hidden;
```

```
myView.hidden = YES; // view will not be on screen and will not handle events
```

This is not as uncommon as you might think

On a small screen, keeping it de-cluttered by hiding currently unusable views make sense.

Also this can be used to swap two (or more) views in and out depending on state.

Graphics State

- Special considerations for defining drawing “subroutines”

What if you wanted to have a utility method that draws something?

You don't want that utility method to mess up the graphics state of the calling method.

Use save and restore context functions.

```
- (void)drawGreenCircle:(CGContextRef)ctx {
    CGContextSaveGState(ctx);
    [[UIColor greenColor] setFill];
    // draw my circle
    CGContextRestoreGState(ctx);
}

- (void)drawRect:(CGRect)aRect {
    CGContextRef context = UIGraphicsGetCurrentContext();
    [[UIColor redColor] setFill];
    // do some stuff
    [self drawGreenCircle:context];
    // do more stuff and expect fill color to be red
}
```

Drawing Text

- We can use a `UILabel` as a subview to draw text in our view
But there are certainly occasions where we want to draw text in our `drawRect:`.

- To draw in `drawRect:`, use `NSAttributedString`

```
NSAttributedString *text = ...;
```

```
[text drawAtPoint:(CGPoint)p]; // NSAttributedString instance method added by UIKit
```

How much space will a piece of text will take up when drawn?

```
CGSize textSize = [text size]; // another UIKit NSAttributedString instance method
```

You might be disturbed that there are drawing methods in Foundation (a non-UI framework!).

These `NSAttributedString` methods are defined in UIKit via a mechanism called categories.

(so are the names of the attributes that define UI stuff (e.g. `NSFontAttributeName`)).

Categories are an Objective-C way to add methods to an existing class without subclassing.

We'll cover how (and when) to use this a bit later in this course.

Drawing Images

- `UIImageView` is like `UILabel` for images
But again, occasionally you want to draw an image in your `drawRect:`.
- Create a `UIImage` object from a file in your Resources folder

```
UIImage *image = [UIImage imageNamed:@"foo.jpg"]; // you did this in Matchismo
```
- Or create one from a named file or from raw data
(of course, we haven't talked about the file system yet, but ...)

```
UIImage *image = [[UIImage alloc] initWithContentsOfFile:(NSString *)fullPath];  
UIImage *image = [[UIImage alloc] initWithData:(NSData *)imageData];
```
- Or you can even create one by drawing with `CGContext` functions

```
UIGraphicsBeginImageContext(CGSize);  
// draw with CGContext functions  
UIImage *myImage = UIGraphicsGetImageFromCurrentContext();  
UIGraphicsEndImageContext();
```

Drawing Images

- Now blast the `UIImage`'s bits into the current graphics context

```
UIImage *image = ...;
[image drawAtPoint:(CGPoint)p];           // p is upper left corner of the image
[image drawInRect:(CGRect)r];             // scales the image to fit in r
[image drawAsPatternInRect:(CGRect)patRect]; // tiles the image into patRect
```

- Aside: You can get a PNG or JPG data representation of `UIImage`

```
NSData *jpgData = UIImageJPEGRepresentation((UIImage *)myImage, (CGFloat)quality);
NSData *pngData = UIImagePNGRepresentation((UIImage *)myImage);
```

Redraw on bounds change?

- By default, when your UIView's bounds change, there is no redraw. Instead, the "bits" of your view will be stretched or squished or moved.

- Often this is not what you want ...

Luckily, there is a UIView @property to control this! It can be set in Xcode.

```
@property (nonatomic) UIViewContentMode contentMode;
```

These content modes move the bits of your drawing to that location ...

```
UIViewContentMode{Left,Right,Top,Right,BottomLeft,BottomRight,TopLeft,TopRight}
```

These content modes stretch the bits of your drawing ...

```
UIViewContentModeScale{ToFill,AspectFill,AspectFit} // bit stretching/shrinking
```

This content mode calls drawRect: to redraw everything when the bounds changes ...

```
UIViewContentModeRedraw // it is quite often that this is what you want
```

Default is `UIViewContentModeScaleToFill` (stretch the bits to fill the bounds)

UIGestureRecognizer

- We've seen how to draw in our UIView, how do we get touches?
We can get notified of the raw touch events (touch down, moved, up).
Or we can react to certain, predefined "gestures." This latter is the way to go.
- Gestures are recognized by the class **UIGestureRecognizer**
This class is "abstract." We only actually use "concrete subclasses" of it.
- There are two sides to using a gesture recognizer
 1. Adding a gesture recognizer to a UIView to ask it to recognize that gesture.
 2. Providing the implementation of a method to "handle" that gesture when it happens.
- Usually #1 is done by a Controller
Though occasionally a UIView will do it to itself if it just doesn't make sense without that gesture.
- Usually #2 is provided by the UIView itself
But it would not be unreasonable for the Controller to do it.
Or for the Controller to decide it wants to handle a gesture differently than the view does.

UIGestureRecognizer

• Adding a gesture recognizer to a `UIView` from a Controller

– `(void)setPannableView:(UIView *)pannableView // maybe this is a setter in a Controller`

```
{
```

```
    pannableView = pannableView;
```

```
    UIPanGestureRecognizer *pangr =
```

```
        [[UIPanGestureRecognizer alloc] initWithTarget:pannableView action:@selector(pan:)];
```

```
    [pannableView addGestureRecognizer:pangr];
```

```
}
```

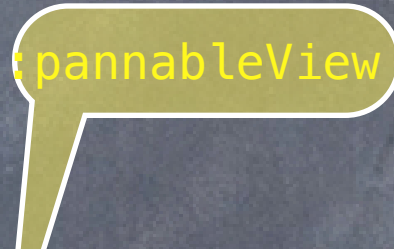
This is a concrete subclass of `UIGestureRecognizer` that recognizes “panning” (moving something around with your finger).

There are, of course, other concrete subclasses (for swipe, pinch, tap, etc.).

UIGestureRecognizer

• Adding a gesture recognizer to a `UIView` from a Controller

```
- (void)setPannableView:(UIView *)pannableView // maybe this is a setter in a Controller
{
    _pannableView = pannableView;
    UIPanGestureRecognizer *pangr =
        [[UIPanGestureRecognizer alloc] initWithTarget:pannableView action:@selector(pan:)];
    [pannableView addGestureRecognizer:pangr];
}
```



Note that we are specifying the view itself as the target to handle a pan gesture when it is recognized.

Thus the view will be both the recognizer and the handler of the gesture.

The `UIView` does not have to handle the gesture. It could be, for example, the Controller that handles it.

The View would generally handle gestures to modify how the View is drawn.

The Controller would have to handle gestures that modified the Model.

UIGestureRecognizer

• Adding a gesture recognizer to a `UIView` from a Controller

```
- (void)setPannableView:(UIView *)pannableView // maybe this is a setter in a Controller
{
    _pannableView = pannableView;
    UIPanGestureRecognizer *pangr =
        [[UIPanGestureRecognizer alloc] initWithTarget:pannableView action:@selector(pan:)];
    [pannableView addGestureRecognizer:pangr];
}
```



This is the action method that will be sent to the target (the `pannableView`) during the handling of the recognition of this gesture.

This version of the action message takes one argument (which is the `UIGestureRecognizer` that sends the action), but there is another version that takes no arguments if you'd prefer.

We'll look at the implementation of this method in a moment.

UIGestureRecognizer

• Adding a gesture recognizer to a `UIView` from a Controller

```
- (void)setPannableView:(UIView *)pannableView // maybe this is a setter in a Controller
{
    _pannableView = pannableView;
    UIPanGestureRecognizer *pangr =
        [[UIPanGestureRecognizer alloc] initWithTarget:pannableView action:@selector(pan:)];
    [pannableView addGestureRecognizer:pangr];
}
```

If we don't do this, then even though the `pannableView` implements `pan:`, it would never get called because we would have never added this gesture recognizer to the view's list of gestures that it recognizes.

Think of this as "turning the handling of this gesture on."

UIGestureRecognizer

• Adding a gesture recognizer to a `UIView` from a Controller

```
- (void)setPannableView:(UIView *)pannableView // maybe this is a setter in a Controller
{
    _pannableView = pannableView;
    UIPanGestureRecognizer *pangr =
        [[UIPanGestureRecognizer alloc] initWithTarget:pannableView action:@selector(pan:)];
    [pannableView addGestureRecognizer:pangr];
}
```

Only `UIView` instances can recognize a gesture (because `UIViews` handle all touch input).

But any object can tell a `UIView` to recognize a gesture (by adding a recognizer to the `UIView`).

And any object can handle the recognition of a gesture (by being the target of the gesture's action).

UIGestureRecognizer

- How do we implement the target of a gesture recognizer?
Each concrete class provides some methods to help you do that.
- For example, UIPanGestureRecognizer provides 3 methods:
 - (CGPoint)translationInView:(UIView *)aView;
 - (CGPoint)velocityInView:(UIView *)aView;
 - (void)setTranslation:(CGPoint)translation inView:(UIView *)aView;
- Also, the base class, UIGestureRecognizer provides this @property:
`@property (readonly) UIGestureRecognizerState state;`
Gesture Recognizers sit around in the state **Possible** until they start to be recognized
Then they either go to **Recognized** (for discrete gestures like a tap)
Or they go to **Began** (for continuous gestures like a pan)
At any time, the state can change to **Failed** (so watch out for that)
If the gesture is continuous, it'll move on to the **Changed** and eventually the **Ended** state
Continuous can also go to **Cancelled** state (if the recognizer realizes it's not this gesture after all)

UIGestureRecognizer

- So, given these methods, what would `pan:` look like?

```
– (void)pan:(UIPanGestureRecognizer *)recognizer
```

```
{
```

```
    if ((recognizer.state == UIGestureRecognizerStateChanged) ||  
        (recognizer.state == UIGestureRecognizerStateEnded)) {
```

We're going to update our view every time the touch moves (and when the touch ends). This is "smooth panning."

```
    }
```

```
}
```

UIGestureRecognizer

- So, given these methods, what would **pan:** look like?

```
- (void)pan:(UIPanGestureRecognizer *)recognizer
{
    if ((recognizer.state == UIGestureRecognizerStateChanged) ||
        (recognizer.state == UIGestureRecognizerStateEnded)) {
        CGPoint translation = [recognizer translationInView:self];
    }
}
```

This is the cumulative distance this gesture has moved.

UIGestureRecognizer

- So, given these methods, what would **pan:** look like?

```
- (void)pan:(UIPanGestureRecognizer *)recognizer
{
    if ((recognizer.state == UIGestureRecognizerStateChanged) ||
        (recognizer.state == UIGestureRecognizerStateEnded)) {
        CGPoint translation = [recognizer translationInView:self];
        // move something in myself (I'm a UIView) by translation.x and translation.y
        // for example, if I were a graph and my origin was set by an @property called origin
        self.origin = CGPointMake(self.origin.x+translation.x, self.origin.y+translation.y);
    }
}
```

UIGestureRecognizer

- So, given these methods, what would **pan:** look like?

```
(void)pan:(UIPanGestureRecognizer *)recognizer
{
    if ((recognizer.state == UIGestureRecognizerStateChanged) ||
        (recognizer.state == UIGestureRecognizerStateEnded)) {
        CGPoint translation = [recognizer translationInView:self];
        // move something in myself (I'm a UIView) by translation.x and translation.y
        // for example, if I were a graph and my origin was set by an @property called origin
        self.origin = CGPointMake(self.origin.x+translation.x, self.origin.y+translation.y);
        [recognizer setTranslation:CGPointZero inView:self];
    }
}
```

Here we are resetting the cumulative distance to zero.

Now each time this is called, we'll get the "incremental" movement of the gesture (which is what we want). If we wanted the "cumulative" movement of the gesture, we would not include this line of code.

UIGestureRecognizer

- So, given these methods, what would **pan:** look like?

```
- (void)pan:(UIPanGestureRecognizer *)recognizer
{
    if ((recognizer.state == UIGestureRecognizerStateChanged) ||
        (recognizer.state == UIGestureRecognizerStateEnded)) {
        CGPoint translation = [recognizer translationInView:self];
        // move something in myself (I'm a UIView) by translation.x and translation.y
        // for example, if I were a graph and my origin was set by an @property called origin
        self.origin = CGPointMake(self.origin.x+translation.x, self.origin.y+translation.y);
        [recognizer setTranslation:CGPointZero inView:self];
    }
}
```

Other Concrete Gestures

- UIPinchGestureRecognizer

`@property CGFloat scale; // note that this is not readonly (can reset each movement)`

`@property (readonly) CGFloat velocity; // note that this is readonly; scale factor per second`

- UIRotationGestureRecognizer

`@property CGFloat rotation; // not readonly; in radians`

`@property (readonly) CGFloat velocity; // readonly; radians per second`

- UISwipeGestureRecognizer

This one you "set up" (w/the following) to find certain swipe types, then look for Recognized state

`@property UISwipeGestureRecognizerDirection direction; // what direction swipes you want`

`@property NSUInteger numberOfTouchesRequired; // two finger swipes? or just one finger? more?`

- UITapGestureRecognizer

Set up (w/the following) then look for Recognized state

`@property NSUInteger numberOfTapsRequired; // single tap or double tap or triple tap, etc.`

`@property NSUInteger numberOfTouchesRequired; // e.g., require two finger tap?`

Demo

- SuperCard

Let's make a lot better-looking playing card!

- What to watch for ...

Custom UIView with its own drawRect:

setNeedsDisplay

UIBezierPath

Clipping

Pushing and popping graphics context

Drawing text with NSAttributedString and images with UIImage

Document Outline and Size Inspector in Xcode

Gestures recognizers hooked up in Xcode vs. programmatically

Controller vs. View as gesture handler

Coming Up

- 👁️ **Friday**

Running on your device with the University Developer Program (Stanford Only).

- 👁️ **Homework**

Due a week from Monday.

Get started on first few Required Tasks immediately (i.e. replacing button with custom UIView).

- 👁️ **Next Week**

Animation

Autolayout