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CMSC436: Programming Handheld Systems

2D Graphics & Animation

Topics

2D Graphics

ImageView

Canvas

View Animation

Property Animation

Drawing 2D Graphics

Draw to a View

Simple graphics, little or no updating

Draw to a Canvas

More complex graphics, with regular updates

Drawable

Something that can be drawn, such as a bitmap, color, shape, etc.

Examples:

BitmapDrawable

ShapeDrawable

ColorDrawable

Drawing to Views

Can set Drawable objects on Views

Can do this via XML or programmatically

GraphicsBubble

Applications display a single ImageView

ImageView holds an image of a bubble

Graphics
BubbleXML



Graphics
BubbleProgram



ShapeDrawable

Used for drawing primitive shapes

Shape represented by a Shape class

PathShape - lines

RectShape - rectangles

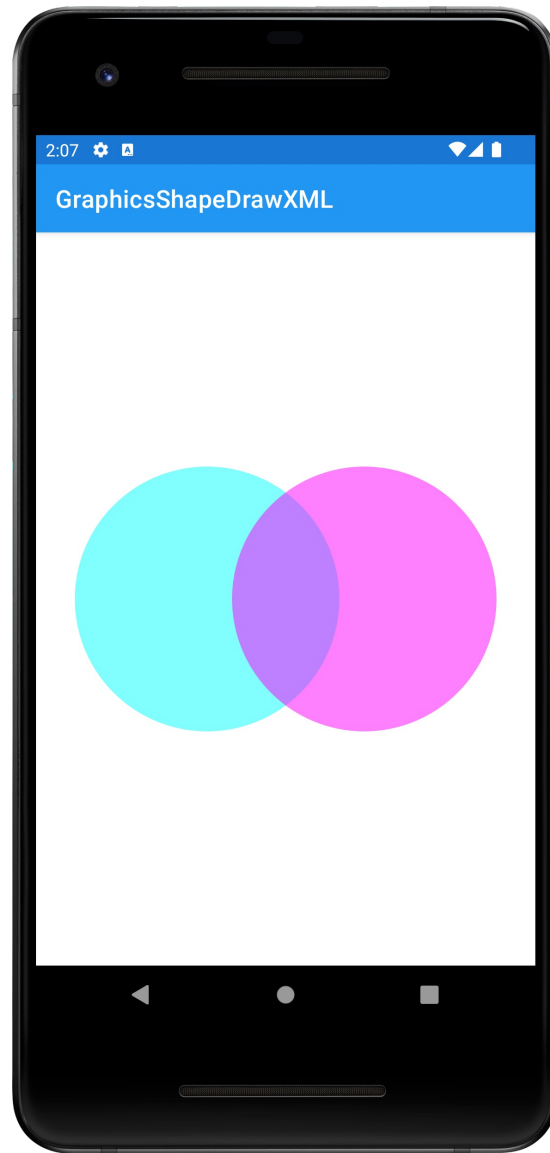
OvalShape - ovals & rings

GraphicsShapeDraw

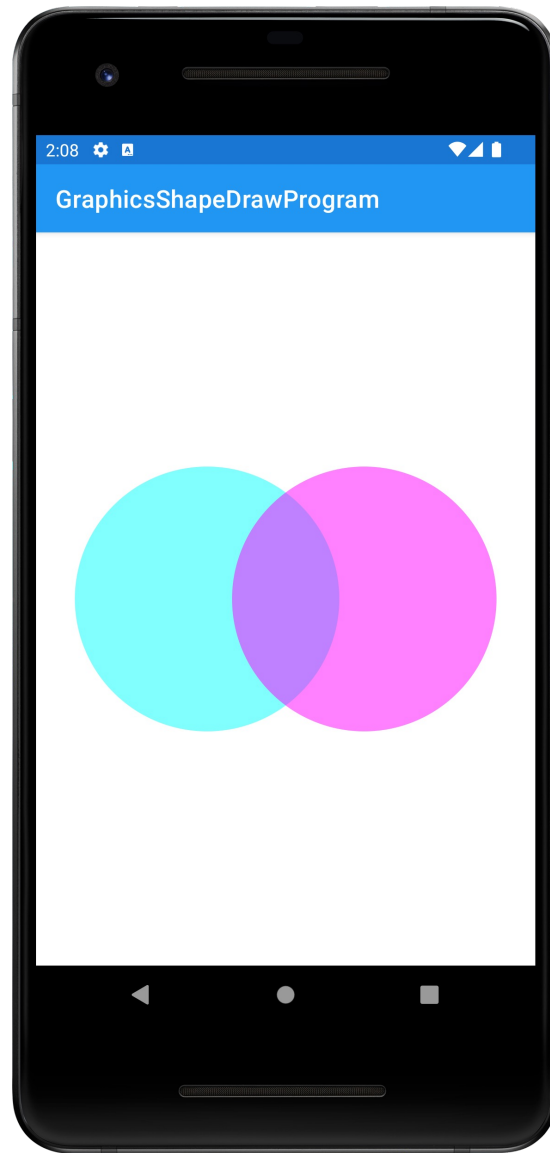
Applications display two Shapes within a RelativeLayout

The two shapes are partially overlapping and semi-transparent

Graphics
ShapeDrawXML



Graphics ShapeDrawProgram



Drawing with a Canvas

A Bitmap (a matrix of Pixels)

A Canvas for drawing to the underlying Bitmap

A drawing primitive (e.g., Rect, Path, Text, Bitmap)

A Paint object (for setting drawing colors & styles)

Drawing Primitives

Canvas supports multiple drawing methods

`drawText()`

`drawPoints()`

`drawColor()`

`drawOval()`

`drawBitmap()`

Paint

Specifies style parameters for drawing, e.g.,

`setStrokeWidth()`

`setTextSize()`

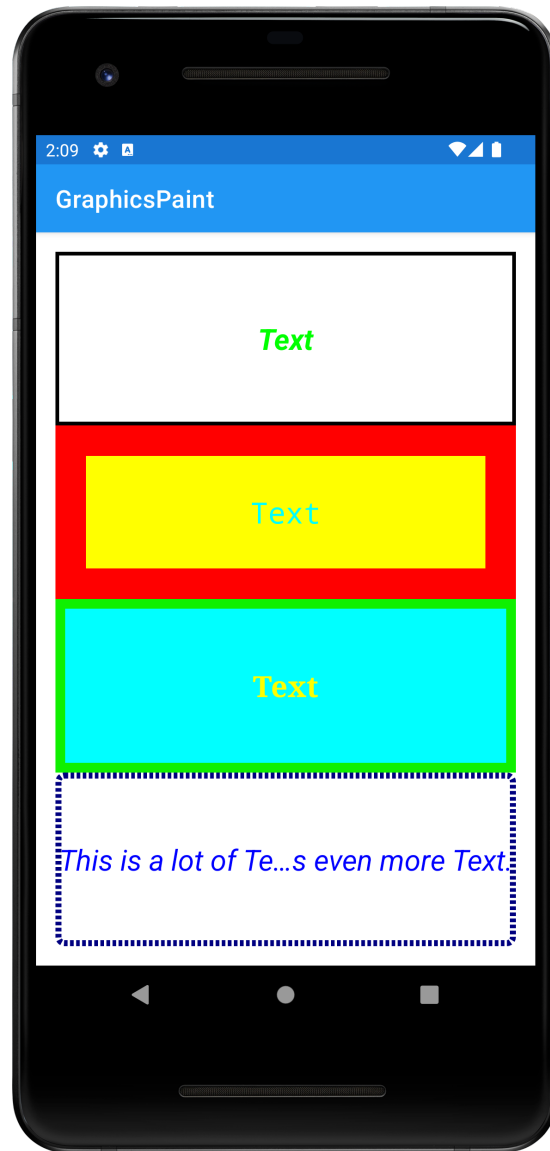
`setColor()`

`setAntiAlias()`

GraphicsPaint

Application draws several boxes holding text, using different paint settings each time

Graphics Paint



Drawing with a Canvas

Can draw to generic Views, or to SurfaceViews

Drawing to Views

Use when updates are infrequent

Create a custom View class

System provides the Canvas for the View when it calls the View's `onDraw()` method

Drawing to SurfaceViews

Use when updates are frequent

Create a custom SurfaceView

Provide secondary thread for drawing

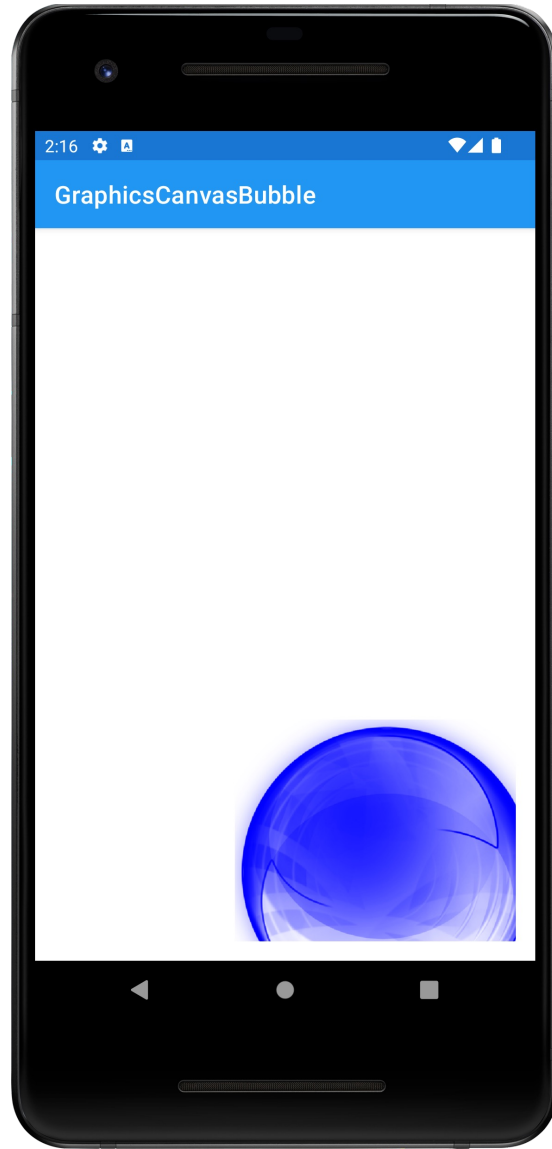
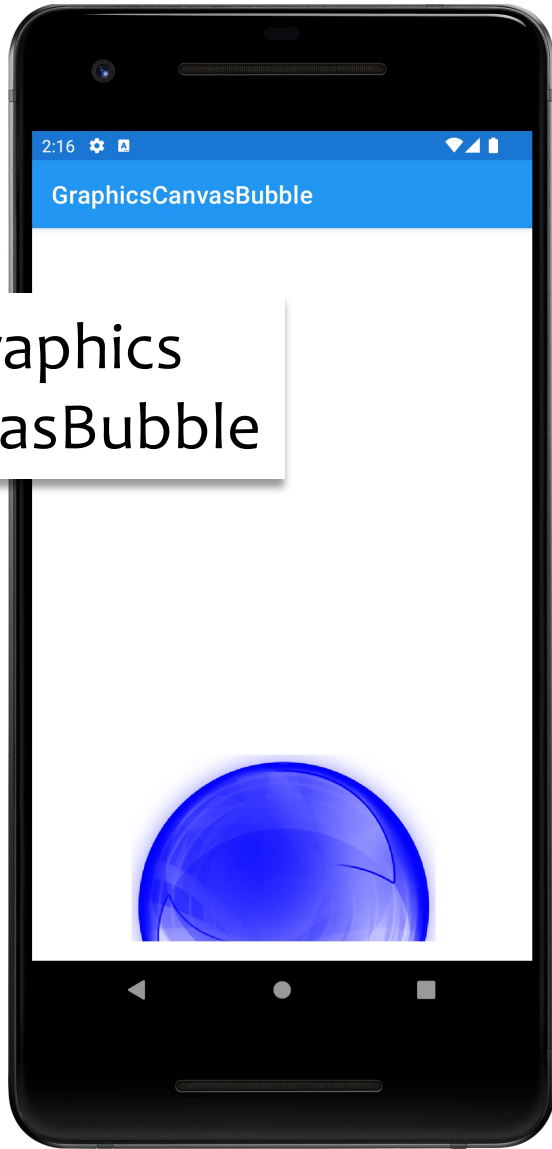
Application provides its own Canvas and has greater control over drawing

GraphicsCanvasBubble

This application draws to custom View

It has an internal Thread that periodically wakes up and causes the View to move and to be redrawn

Graphics
CanvasBubble



Canvas with SurfaceView

Used for more high-performance drawing outside the UI thread

SurfaceView

SurfaceView manages a low-level drawing area called a Surface

The Surface represent a drawing area within the View hierarchy

Defining a Custom SurfaceView

Subclass SurfaceView & implement
SurfaceHolder.Callback

SurfaceHolder.Callback declares lifecycle
methods that are called when the Surface
changes

Using a SurfaceView

Two steps

Set up SurfaceView

Draw to SurfaceView

Setup

Use SurfaceView's holder property to acquire reference to Surface

Setup

Register for callbacks with SurfaceHolder's
addCallback()

surfaceCreate()

surfaceChanged()

surfaceDestroyed()

Setup

SurfaceView does not provide its own Thread for drawing operations

Create the Thread on which drawing operations will execute

Drawing

Acquire lock on Canvas

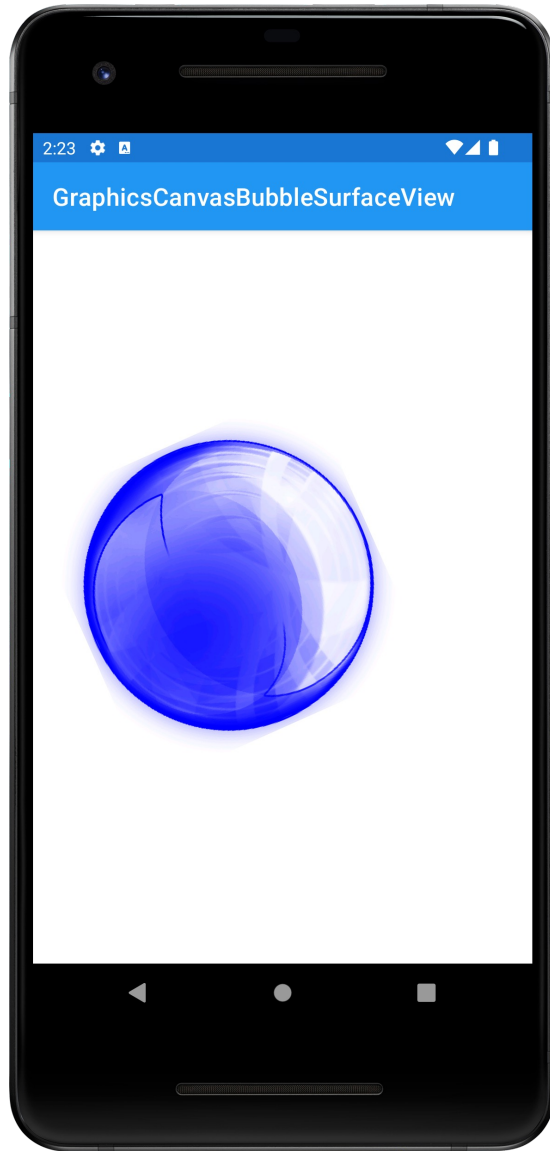
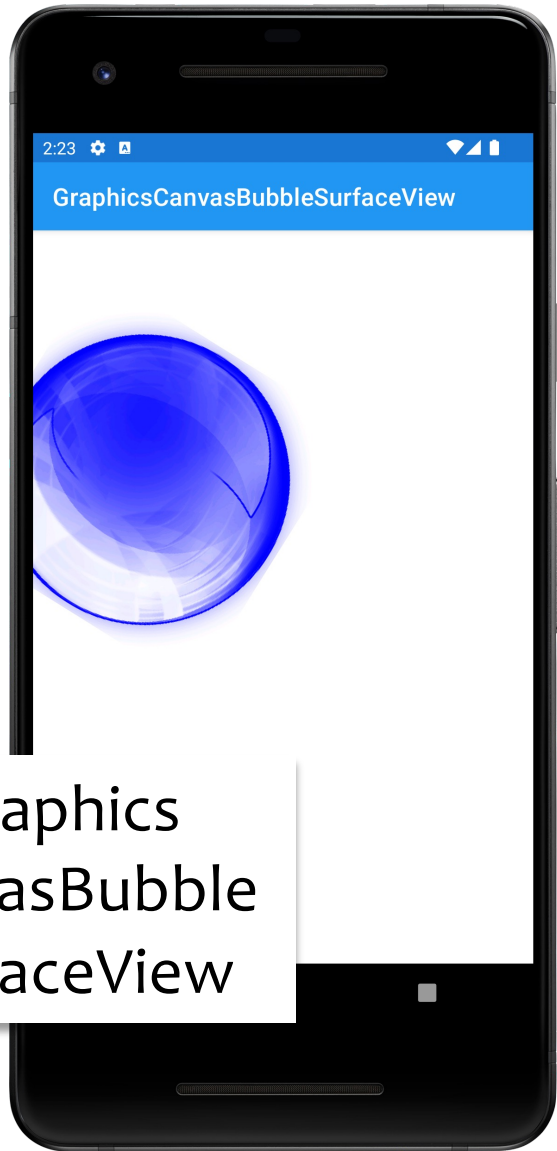
```
SurfaceHolder.lockCanvas()
```

Draw

```
Canvas.drawBitmap()
```

Unlock Canvas

```
SurfaceHolder.unlockCanvasAndPost()
```

Graphics
CanvasBubble
SurfaceView

View Animation

Changing View properties over a period of time

Properties include:

Size

Position

Transparency

Orientation

View Animation Classes

TransitionDrawable

AnimationDrawable

Animation

TransitionDrawable

A 2-layer Drawable

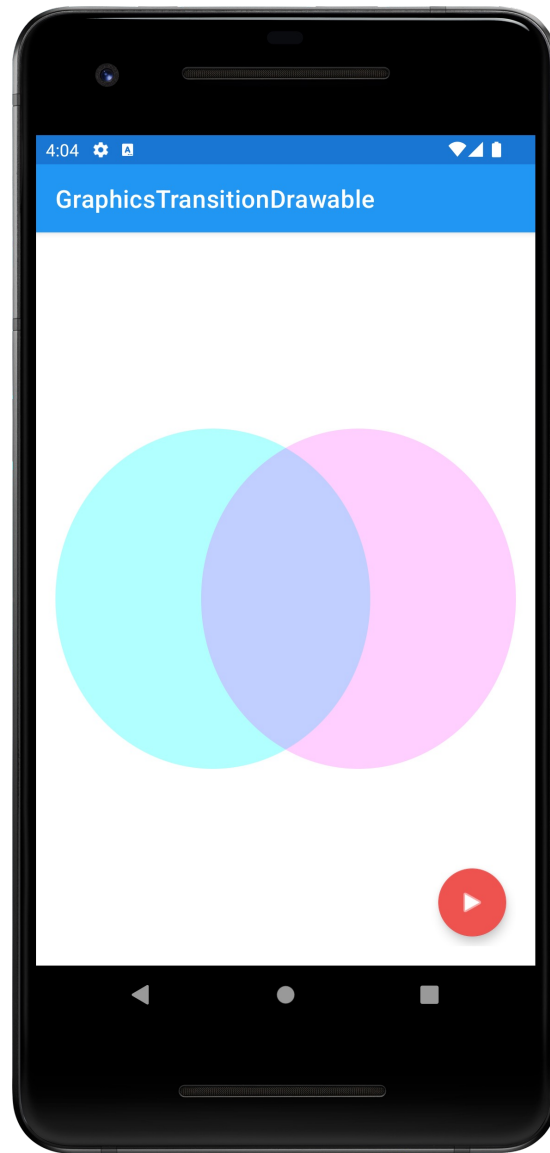
Can fade between 1st & 2nd layers

GraphicsTransitionDrawable

This application uses the same shapes as the GraphicsShapeDraw applications

Shows Cyan shape then fades to Magenta shape

Graphics TransitionDrawable



AnimationDrawable

Animates a series of Drawables

Each Drawable is shown for a specific amount of time

GraphicsFrameAnimation

Uses an Animation Drawable to present a frame-by-frame animation



Graphics
FrameAnimation

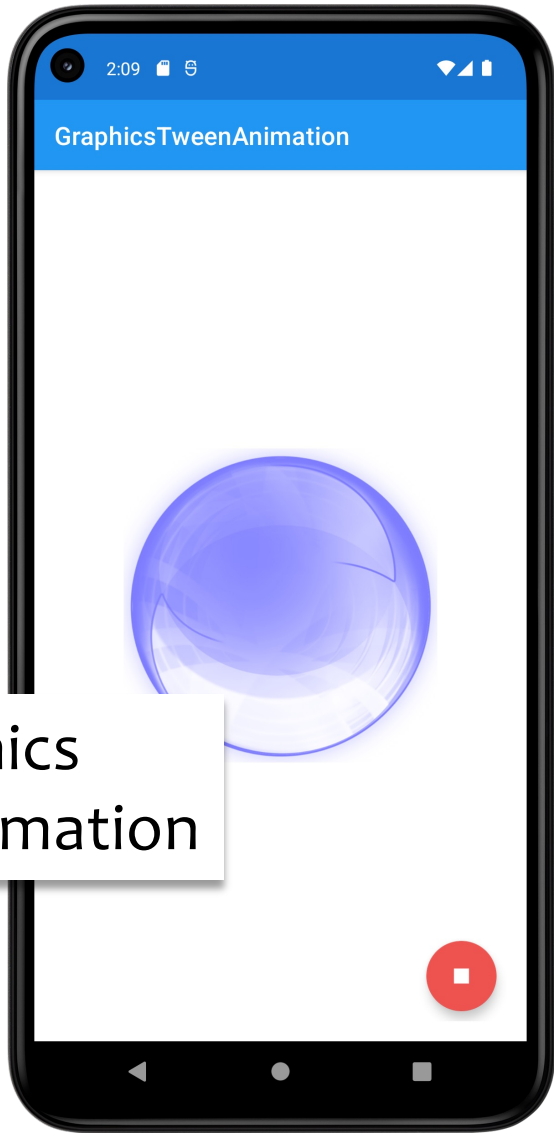
Animation

A series of transformations applied to the content of a View

Can manipulate animation timing to give effect of sequential or simultaneous changes

GraphicsTweenAnimation

Application displays a single UIImageView and animates several of its properties



Graphics
TweenAnimation

Property Animation

Animation - Changing properties of an Object over a period of time

Property Animation Architecture

ValueAnimator – Timing engine

TimeInterpolator – defines how values change as a function of time

AnimatorUpdateListener – called back at every animation frame change

TypeEvaluator – Calculates a property's value at a given point in time

Property Animation Architecture

AnimatorSet – combines individual animations to create more complex animations

TimeInterpolator

Defines rate of change of an animation

Allows non-linear rates of changes

Examples include:

AccelerateInterpolator

AccelerateDecelerateInterpolator

AnticipateInterpolator

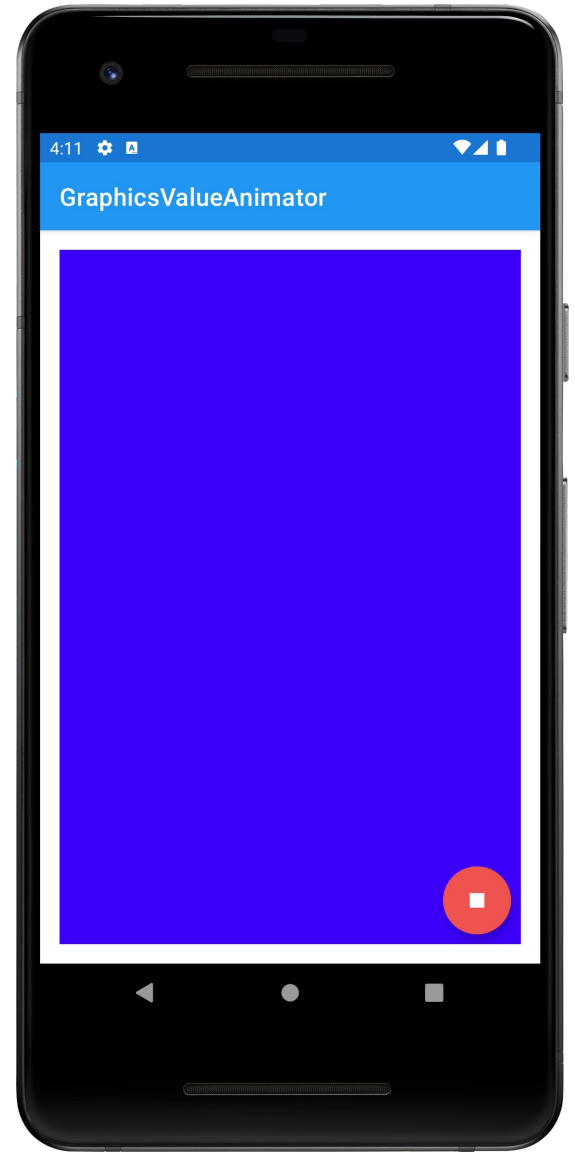
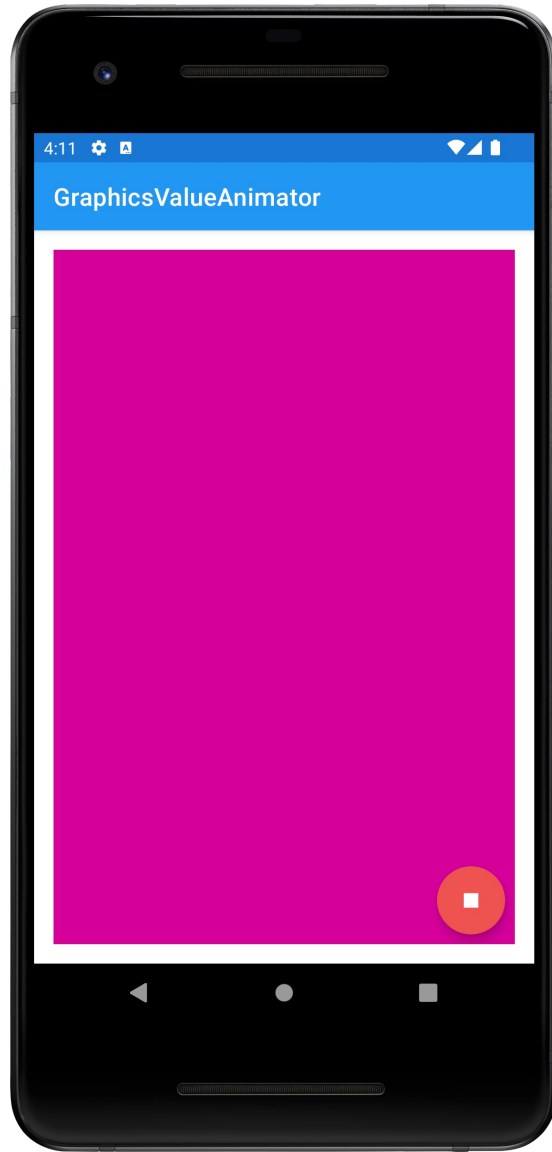
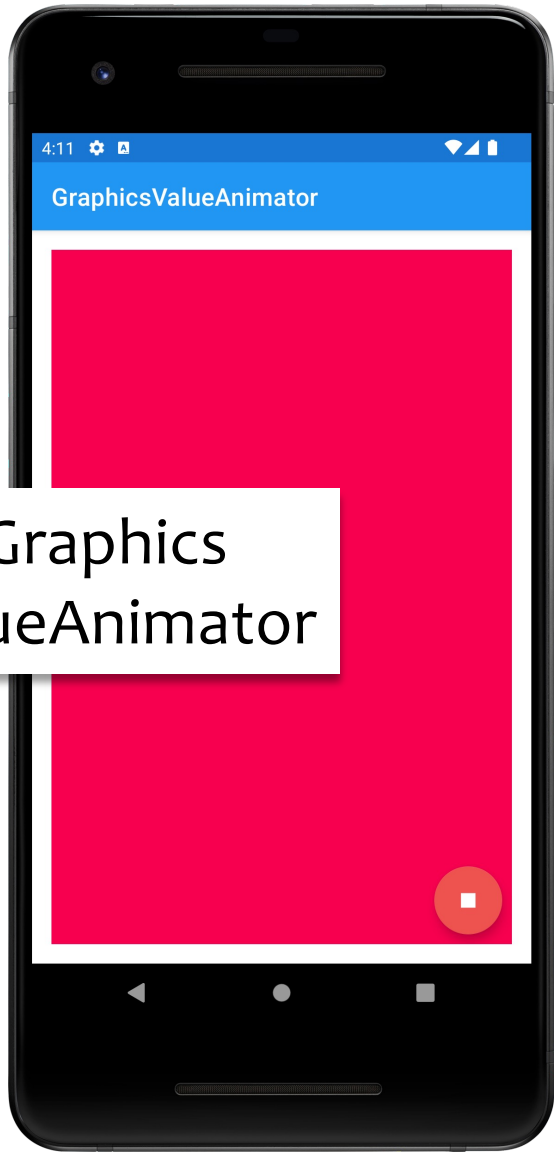
AnticipateOvershootInterpolator

BounceInterpolator

GraphicsValueAnimator

Uses a ValueAnimator to animate changing an ImageView's background color

Graphics
ValueAnimator



GraphicsViewPropertyAnimator

Same as the GraphicsTweenAnimation

Uses the ViewPropertyAnimator class, which is a simplified animator for Views



Graphics
ViewProperty
Animator

Next Time

MultiTouch & Gestures

Example Applications

GraphicsBubbleXML

GraphicsBubbleProgram

GraphicsShapeDrawXML

GraphicsShapeDraw

GraphicsPaint

GraphicsCanvasBubble

GraphicsCanvas

BubbleSurfaceView

GraphicsTransitionDrawable

GraphicsFrameAnimation

GraphicsTweenAnimation

GraphicsValueAnimator

GraphicsView

PropertyAnimator