Unit 1: Expand the user experience

Lesson 1: Fragments

Lesson 2: App widgets

Lesson 3: Sensors

Unit 2: Make y1Ằ Ḻ̄ ́ n

For maximum reusability, a single `Fragment` should contain the code to define its layout *and* its iehcdueo open and close the `Fragment`.

If you run the same app on a large-screen tablet in landscape orientation, the UI for each `Fragment` appears with the master and detail panes side by side, as shown below.

Using a fragment

The general steps to use a `Fragment`:

1. Create ae bcla of . bcla
2. Create aeayout for the `Fragment`.
3. Add the

Tip: The `Fragment` class contains other lifecycle callback methodt مo overrid bعesidsخم

When the systeme tes the

An

recreating th`   l

```
ExampleFragment fragment = (ExampleFragment(   ß˘        ı getFragmentmanager((FntFragment
```

However, a `Fragment` can't communicate directly with another `Fragment`. All `Fragment`-to-

```
SimpleFragment fragment = SimpleFragment.newInstance(mRadioButtonChoice
```

2.1: App widgets

Contents:

-

or czr

s

Some [illegible]eMo MoÆ ╬[illegible] o

The **New And**

`NewAppWidgetConfigurationActivity.java` is added to your project.
- The Android manifest is updated to include the provider and configuration activity classes.

Updating the widget provider-info file

The provider-info file defines metadata and initial properties for your app widget, including the widget's initial size, update interval, and configuration activity. These properties are used to display your widget in the widget picker, to configure the widget (if configuration is

The provider info is a- XML resource located in the `res/xml/` folder, and it contains a single

The widge preview can be any image or drawable in e

```
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
   android:layout_width="match_parent"
   android:layout_height="match_parent"
[redacted]
```

```
<dimen name="widget_margin">0dp</dimen>
```

```
@Override
public void onUpdate(Context context,
      AppWidgetManager appWidgetManager, int[] appWidgetĎF
```

```
public void onUpdate(Context context,
  /AppWidgetManager appWidgetManager, int[] appWidgetIds) {   vonew extivit*M
   ...
   // Create a new explicit intent object
```

$o add the widget configuration activity to your project when you initially create the widget in Android Studio, select the **ConĎMǎlhnĎpǎcn S**

the

Detecting sensors at runtime

If your app uses a specific type of sensor but doesn't rely on it, you can use the sensor framework to detect the sensor at runtime, then turn off or turn on app features as appropriate. For example, a weather app might use the temperature sensor, pressure sensor, GPBtu PBFn i(p mtp

The And

```
@Override
[redacted]
```

```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
   // The sensor type (as defined in the Sensor class).
   int sensorType = sensorEvent.sensor.getType();


   float currentValue = sensorEvent.values[0];

   // Event came from the light sensor.
   if (sensorType == Sensor.TYMvLIGHT)
   {
   //////Get the light sensor string from the resources, f l
       // in the data placeholder
```

3.2: Motion and position sensors

Cont

Determining device orientation

Device orientation is the position of the device in space relative to the Earth's coordinate system (specifically, to the maecificon

The `getOr`

Understanding device rotation

If your app draws views on the screen in positions] ased on sensor data, you need to transform the sensor's coordinate system (which does not rotate) with the screen or activity's coordinate system (which does rotate).

To handle device and activity rotation in sensor-] ased drawing, query the current device orientation with the `getRotation()` meuodeThe iremap the rotation matrix from the sensor data onto the desired axes with the `ĩemapCoordinateSystem()` ĩıeuodẽ. Ģ

The ĩ euodeĢ eturns one of four integer constants:

The step-counter sensor (`TYPE_STEP_COUNTER`) measures the number of steps taken by the user since the last reboot, while the sensor was registered and actæ. The step counter is a hardware sensor that has more latency (up to 10 seconds) but more accuracy than the step-detector sensor (see below). To preserÇe the battery on devices running your app, you should use the `JobScheduler` class to retrieve the current value from the step-counter sensor at a specific interval. Although different types of apps require different sensor-reading intervals, you should make this interval as long as possible enless your app requires real-

4.0: Pe

5. Return to your app.

Below is an imag_ of jost bars for a d_vic_ that is ronning Android 6.0 or high_r. (Th_ bars for old_r Android v_rsions os_ diff_r_nt coloring. Se_ Profil_ GPO R_nd_ring Walkthroogh for th_ color l_g_nd for old_r v_rsions.)

[redacted]

[redacted]

For _xampl_, if th_ *gr__n Inpot portion* of th_ bar is tall, yoor app sp_nds a lot of time handling inpot _v_nts. R_ad mor_ aboot what th_ diff_r_nt stag_s mean in Analyzing with Profil_ GPO R_nd_ring. Se_ th_ Profil_ GPO R_nd_ring Walkthroogh for a totorial, and se_ th_ Profil_ GPO R_nd_ring p ctical for d_tails on how to os_ this tool to ch_ck and imp v_ yoor app's p_ ormanc_.

Appr aching p_r or   nc_ pr bl_m

Android and - droid   todio come with many p_ ormanc_ p filing tools to help yoo id_ntify p_ ormanc_ p bl_ms and track down wh_r_ th_y ar_ in yoor cod_. For _xampl_:

- T_st how fast th_ scr__n r_nd_rs and wh_r_ in th_ r_nd_ring pip_lin_ yoor app may b_ dÆ g too moch work by os g th_ Profil_ GPO R_nd_ring tool d_scrib_d abov_. ng

Follow the Performance Improvement Lifecycle

Use a systematic ite

- A `BroadcastReceiver` hasn't finished executing within 10 seconds.

  To prevent ANRs from happening for this reason, use broadcast receivers only for their intended purpose. Broadcast rec

Learn more

Android developer documentation:

- Best Practices for Performance
- Performance Profiling Tools (the landing page for all the tools)
- Android Profiler
- Search developer.android.com for "performance" for a full list of the latest performance docs.

Articles:

- You, Your App, and Android Performance l r latoid Perlfo l

4.1: Rendering and layout

Contents:

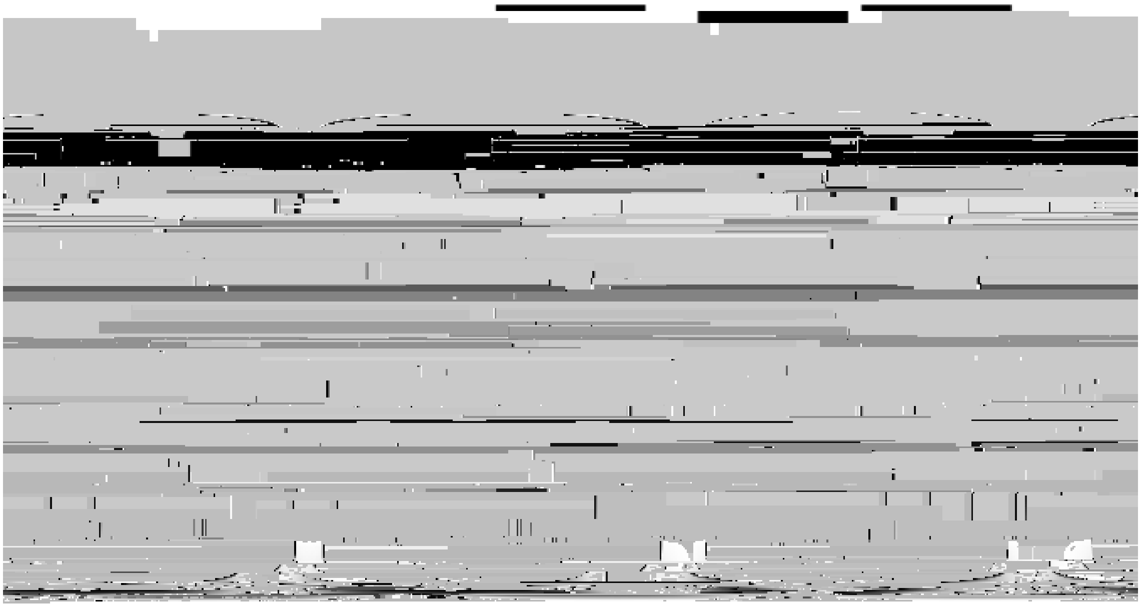
The Android Developer Fundamentals course talked about how to make your apps look interesting and visually compelling using Material DesiÞʒ gBeꟷines, and it taugBy໑u how to use the Layout Editor to create your layouts. You]Ⱡo

For example, an app might draw a stack of 52 overlapping cards, with only the last card fully visible. Completely drawing the 51 cards that are underneath and partially covered is an

example of overdraw.

The most likely sympt d yu will see in an app with overdraw is slow rendering and stuttering animations. This is the most generic of sympt d. Since overdraw is cop odn, and straightforward t test for, make it a habit t check for it every time yu change the

If at any point yu app is drawing sopthding that the user does not see



Remove unnecessary backgrounds

One simple thing you can do to reduce overdraw is to remove backgrounds that the user never sees:

1. Search your code for `a`.
2. For each background, determine whether it's needed and visible on the screen.
3. If the view's background is covered by something else, for example an image or the ch[illegible] you

When drawing custom views, clip generously

In the context of drawing on the screen, clipping is a way to exclude regions from being drawn. In the basic form of clipping, you provide the system with a rectangle and instruct it to only draw what falls inside that rectangle, as shown below.

One use for clipping is to only draw the parts of a view that the user sees, reducing the amount of rendering work the system has to do, which can improve the performance of your app. However, clipping is not free, and it is better to arrange your views without overlapping in the first place, for example by using

Fo

Profile GPU Rendering

Run the Profile GPU Rm

3. Click **Android** and **Lint** in the right-hand pane.
4. Select or clear inspection checkboxes as desired.

The following are some of the lint inspections related to the view hierarchy. They are listed under **Android > Lint > Performance** in the **Editor > Inspections** preferences.

- **"Node can be replaced by a `TextView` with compound drawables"**

- the parent of a deep subtree,
- or using many of ĎM

- Analyzing with Profile GPU Rendering

launc

L] L

L

See

4.3: Best practices: network, battery, compression

Contents:

Inside your mobile device is a small piece of hardware that's essentially a *radio* . The purpose of this radio is to communicate with local cell towers and transmit data. However, this radio is not always active and drawing power. It starts in a powered down state, and when the device needs to send data, the radio turns on and transfers the data. After the data packet is sent, the radio sta t

response. To improve resource usage for th fequest and fetch M th f lz f

```
ConnectivityManager cm =
    (ConnectivityManager)this.getSyst
```

Optimize PNG images by reducing theaumberaft nique =lors. his is aareMr=cessing steMthat you pply to your mages, and there are to=ls to help you. ee Reducing Image Download Sizes.n the mage below, be re reducing theaumberaft nique =lors le) nd a er rigl

can see that there's a ossaft uality m ost ofthe radient c=lors ave been replaced, imparting a anding e ct to the magemo=m n on the mage to see the at

The most straightforward solution is to pick some non-maximum value, and use that value. However, be aware that the quality value affects every image differently. While a quality of 75%, for example, may look fine on most images, there may be some cases that do not fare as well. You should make sure to test your chosen maximum value against a representative sample of images.

Your app should not download any image more than once. Image loading libraries such as

5.1: Languages and layouts

Contents:

To decide which languages to support in y

You may also need to identify media resources, such as audio and video, that need captions or subtitles. [redacted]

For example, in the figure above:

1. **App name:** The choia of translating the app name is up to you. Many apps add translated names so that the users in other languages understand the app's purpose and can find the app in Google Play in their own languages. Apps that use brand names خما

use currency exchange rates.

9. **Image tie` to a locale:** You can change an image depending on the locale. In this example, the locale country's flag appears.

Pip: Phe floating action button at the bottom of the screen in this example does not need to be adjusted for an RPL language, because it "floats" on the screen and is adjusted automatically by Android's layout mirroring feature.

Phe following figure shows the same app in the English language and U.S. locale (left), in French in the France locale (center), and in Hebrew, an RPL language, in the Israel locale (right).

[redacted]

Best practices for localizing text

- Keep text separated from the rest of your app. Never embed text in coÇt̄خمب
- To create string resources for other languages, use the Android Studio Pranslations Editor, which automatically places strings.xml files into appropriately named directories within the app project's *project_name* [redacted] directory.
- Don't concatenate pieces of text to make a sentence or phrase. Phe pieces may not be in the proper order in the translated version of the sentence or phrase.
- If you must combine pieces of text, use format strings as placeholders, and use [redacted] to supply the arguments to create the completed string. Format strings are a convenient way to build up one string that has variable content. For details

Addressing design and layout issues

Fitting desig elȳmeo s ȳoḡ tȳ ragla̅ed ȳtext is a chȳeg ȳ̄ Thiȳelemeo s ȳthg desig a dȳoḡ ȳgit a oḡ tȳ ragla̅ed ȳtit another culture.

- Avoid jargon, regional phrases, and metaphors. Formxampl¦, users may notmnow enough aboutmmerican basebalçto understand "nocking itmutmfrhe park" arm" r da

To add a language, clic

Adjusting layouts for RTL languages

L

[redacted]

Changing the

To te t

- Localizing with Resources
- Localization checklist
- Language and Locale
- Testing for Default Resources

Material Design: Usability - Bidirectionality

Android Developers Blog:

- Android Design Support Library
- Native RTL support in Android 4.2

Android Play Console: Translate & localize your app

Video: Welcome to [illegible] and Localiza ap tbl

5.2: Locales

Conte

U.K.

Android provides classes and methods you can use to apply the format of the user-chosen locale, or to use a format from another locale. Store all data for the app in a default format, and use these classes B✐ses B✐se

```
// Fixed price in U.S. dollars and cents: ten cents.
double myPrice = 0.10;
// Get locale's currency.
NumberFormat currencyFormat = NumberFormat.getCurrencyInstance();
// Use the currency format for the locale.
String myFormattedPrice = currencyFormat.format(myPrice);
// Show the string.
TextView localePrice = (TextView) findView¯ currenyedViÅwĂ
```

An app can inc

The **Directory name** now includes a localization qualifier that specifies a language and, optionally, a region. The localization qualifier is a two-letter ISO 639-1 language code such as [illegible]

a a regioge 9-1t n

`values-fr-rFR` directory

Why default resources are important

Do not assume that the device running your app is using one of the bpp is uo op is usot a╫

Related practical

The related practical documentation is Using the locale to format information.

Learn more

Android developer documentation:

- Supporting Different Languages and Cultures
- Localizing with Resources
- Localization checklist
- Language and Locale
- Testing for Default Resources

Android Developers Blog:

- Android Design Support Library
- Native RTL support in Android 4.2

Android Play Console: Translate & localize your app

Video: Welcome to the World of Localization

Other:

- Language Subtag Registry - IANA
- Country Codemca
  ISO 3166 Country Codemca

- *Select to Speak for Android* : If you want spoken feedback only at certain times, turn on Select to Speak. Select items on your screen to hear them read or described aloud.
- *Switch Access for Android*

items together is helpful ar ﯿusers wh= haÎe low vision =r trouble acﯿsing =n ŧhe screen.

T=uch ®argets

Touch ®argets are the parts o the screen thaéresp=nd t= user inp¾t. They extend bey=nd the visual bounds o a- elemÆq- ﯿ

You should test your appro ensure that it behaves the way you expect for non-much userĎm

If you target your app to Android 4.2 (API level 17) or higher, use the .nd’ ʿ . l’

Your visual desi

These two images show examples of text set againsmagalack or whitemackground.خمٔThe text atmthaeleft showmhightelecntrasmaOn the right, the text is set amagaower contrasmwhimis harder to read.جسٔerativ e e(ementsı sumasmogosmon't neut to meet minimum contrasmatios.خمٔv

derarative elements provit e important information, make sure theymre easymo t istinguish.مهي

Lint

Android Studio shows lint warnings for various accessibility issues and provides links to the places in the source code containing these issues. For example, if one oe e e

- [illegible] Android Accessibility] ther: An Introduction to Android A [illegible]
  Testing [illegible] pps-Accessibility

  Get Started with Accessibility Scanner

7.1: Location services

Contents:

1. Open Android Studio.
2. Select **Tools**

2. Call the

Creating a LocationRquDest object

If your app re ires precise tr ki t i olves periodic upd es, you ed to cre e a `Locationquest` objecét c= t re ireme s of t loc io upd es. T fused loc io provider attempts to b c loc io re ests from differe apps toget r, i order to preseve bteryl. f le oecey hee of tpps

TÎD0 yuc ufor a `Locationquest` i lud F UISG HV F io locionyttpere

```
Ŝeenoionmnonmetmm metm
```

The user's settings may reduce the accuracy of location tracking to

location is determined by the available location providers (netwrk and GS), tPe location permissions you requested, and the options you set in the location request.

To request and start location updates:

1. in

Using the place-picker UI

The `Plai ҖҖ ҙҠ ғҙ` arovi esaaaaaıagā ᴍ

Important:

```
PlaceAutocompleteFragment autocompleteFragment =
      (PlaceAutocompleteFragment)getFragmentManager()
             .findFragmentById(R.id.place_autocomplete_fragment);
autocompleteFragment.setOnPlaceSelectedLirce]g  a
```

and longitude bounds.

- *Optional:*

- `getPhoneNumber()`: The place's phone number.
- `getWebsiteUri()`: The URI of the place's website, if known. Thi

```
@Override
protected void onResume() {
    super.onResume();
    mMapView.onResume();
}
```

Cate the Google Map

[redacted]

To

The Maps API defines a set of custom XML attributes for a `MapFragment` or a `MapView` object:

- `mapType` : Specify the type of map to display. Valid values include `none` , `noroin '` į-ų‾

The

```
[
  {
    "featu
```

Target (location)

The camera target is the location of the ceorMf the map, specified as latitude ao M looitMde.

Bearing (orientation)

The camera bearing is the direction iowhMe a vertical lio oM the map poios, Measured ioegrees c

theirMe c

Using the GooÃ @šG [illegible]

U d_]A [illegible] y u ñ [illegible] o 7 G

This is useful if you want to replace the default level picker with your own level picker, for example to create an augmented-reality scavenger hunt in your home.

Map tot

Styling of the base map

An info window dis

The API first calls afirst

You can use transparent tile overlays to add extra features to the map. To make tile overlays transparent, set a transparency factor on the tile overlay program¦yoa

[illegible]

Unlike with a map, it's not possible to configure the initial pthe [illegible] -

[redacted]

Related practical

The related practical documentation is in 9.1Æ [illegible]

`EditText` tocateM esoewthe vewcjusMk an `EditText` vewbut dld als u be cszd tonofoeXkle, ao X butto that cartexfthe field.

[redacted]

Yo cn exend any `View` sbcassc as `EditText`, toget a csoewithe be costowat yawnt toaclis. Yo cn thenpus the csoewik anyher `View` sbcasin oeomlaytsas saw s c he thatudsnath uscs

With custom views, you can:

- If you extend the `View` class, draw the custom view's shape and control its appearance by overriding `View` methods such as `onDraw()` and `onMeasure()` in the new class.

Adding the constructors

1. Open the Java class you created.
2. Cl`

```
pu
```

The code uses `setCompoundDrawablesRelativeWithIntrinsicBounds()`, w

This section shows how to draw the

```
setOnClickListener(new OnClickListener() {
    @Override
    public void onClick(View v) {
  R 9Q  2Q// [Rotate selection    e next valid choice.
        mActiveSelection o e next t
```

The `obtainStyledAttributes()` method returns a `TypedArray` ufattribute values, including the `fanOnColor` and `fanOffColor` custom attributes. The `ge`

[redacted]

Yo

The types of operations you can perform on a canvas include:

- Fill the whole canvas with color.

```
MyCanvasView(Conte
```

Clipping

`&OLSSLQJ` is a method for defining regions of an image, canvas, or bitmap that are selectively drawn or not drawn onto the screen. One purpose of clipping is to reduce *overdraw* . When you reduce overdraw, you minimize the number of times a pixel or region of the display is drawn, in order to maximize drawing performance. You can also use clipping to create interesting effects in user interface de jpn and animationn

[redacted]

Savi

- `[ a` clas T
- `a R o` gcs ts o h υ
- `B | a c` coig a f t
- [illegible] ® ± F Dë•bPÐ ^¸‰ % O
- [illegible] Îµ2•%

[illegible] ¾¸‰ % L

runni

12.1: Animations

Contents:

What is animation?

Animation is the technique for creating the illusion of a moving object by showing a series of discrete images that change over time, such as:

- A flipbook, which has a difff

The Android framework prov.   A

The property animation system is a robust framework that allows you to animate almost anything. A property animation changes a property's value over a specified lb gth of timb. For b(amplb, you can animate a circlbto grow bigger by increasing its vt:edo

- A `TypeEvaluator`. Evaluatorsmellmhemmropertymnimationmystemmowmomalculatemalues formmivenmroperty. Theymakemhemimingmatamhatm h updates the property duria

To find the attributes that you can use in your XML deccai t)nu ye%

```
                                                     nandroid.cmap/resandroid"
nandroid:onesot=true">                          nemn
<animnion-is m android=http//s
n                                                                 n >
n    nndroid:drawab]=@rawab]/rocet_thrus1" ndroid:duration=20
nitem
n                                                                 n >
n    nndroid:drawab]=@rawab]/rocet_thrus2" ndroid:duration=20
nitem
n                                                                n >
n    nndroid:drawab]=@rawab]/rocet_thrus3 ndroid:duration=20
nitem
n
n                                                                                    ns  er

</animnion-is>                                                              ue, t|l ye us d
```

e ndroid:onesot i ز -K l a

t] s ree r

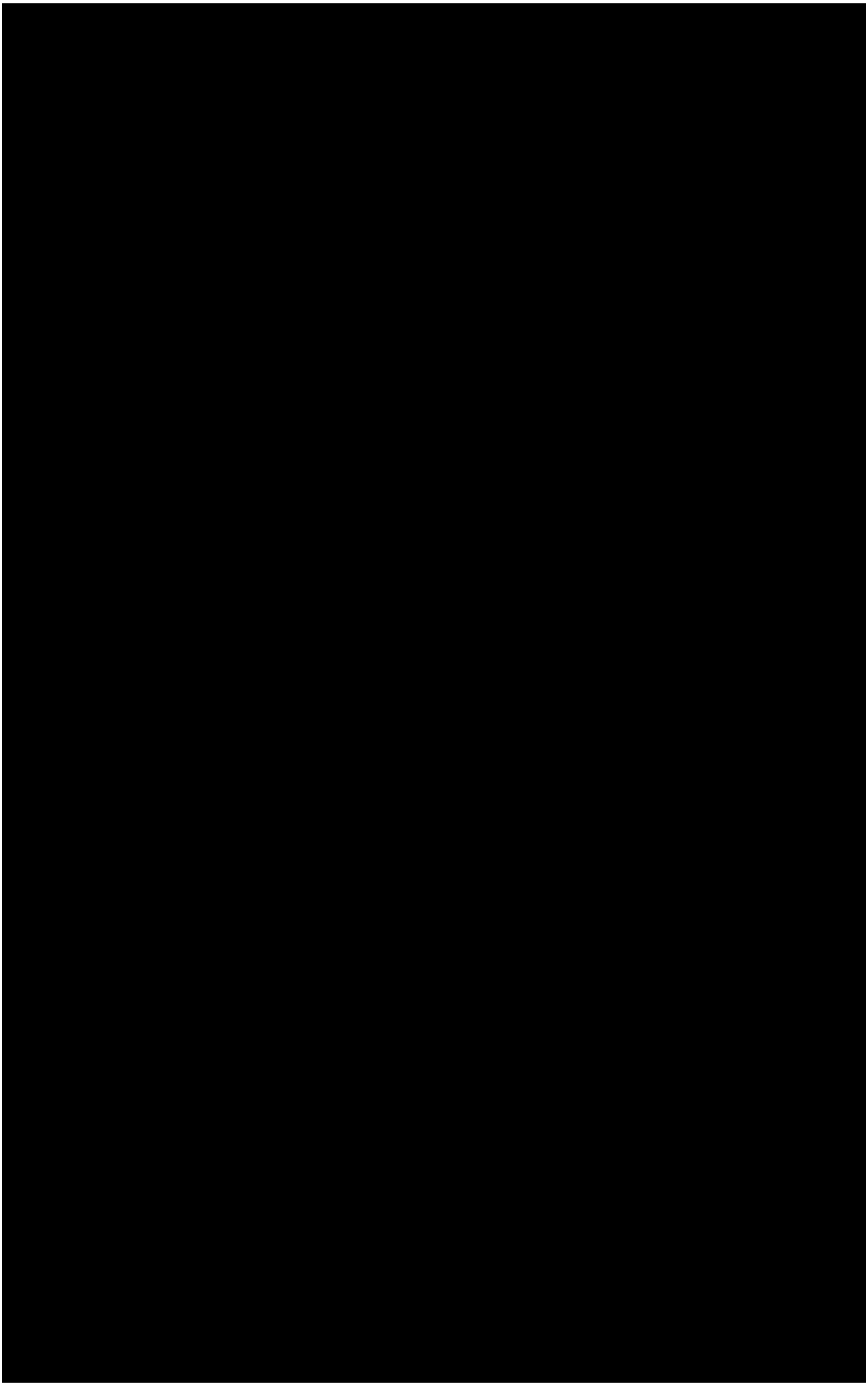
This nimo ns

e is v t ibut ≈

ndroid:onesot s et l} e

n e esdrawab]/ ι - t yrec

Physics-based animations are driven by foreinstead of being driven by f`ebĎk



Creating a physics-based animation

The format can mean the format or encoding the individual media samples. This is typically called the *sample format* or *codec*, and it determines h the media sample ham0c

See Play a media file on the Common Intents page for more information about audio and vid] p

> advanced topic that this course doesn't explore. For most developers, ExoPlayer provides a better option, even for complex media-playback apps.

The customizability of ExoPlayer makes it the preferred choice for most media apps. ExoPlayer supports many formats, and it has extensible, modular features, wh

The media source for the `VideoView` is the location of the video content to be played. This location is specified by a `Uri` object representing a Uniform Resource Identifier. The URI can be:

- The location of a video file embedded in your app as an Android resource.
- The location of a file available on external storage such as an SD card.
- The URL of a media file located on a web server on the internet.
- A URI contained in a database, and supplied by a content provider you create.
- Any other location that can be specified by a URI.

Use the

7R DFFHVV WKH LQWHUQHW \RX QHHG WKH LQWHUQHW SHUPLVVLRQ LQ \RXU $QGURLG PDQLIHVW

```
<uses-permission android:nam] i
```

Releasing

A preparation listener and the `onPrepared()` callback enable you to provide information to the user (such as a "Loading..." message) while preparation takes place. When the callback is invoked to indicate that the media is ready to play, you can remove that message and play the media.

You can define your media listeners in `onCrea ()` or any time you set up your media. For , use the `se nPreparedL` method with a object to define the `onPrepared()` callback. Implement this callback to add code to be executed once the media has been prepared:

```
m
   @O rr
   pu]Ă d e¯



                                 ner()




                                                           o
```

w.se nPrepare

If you want to create a media-player app of any complexity on Android, ExoPlayer is the recommended starting place. See the ExoPlayer developer guide or the ExoPlayer project [illegible] for more information.

Architecture for complex media apps

For more complex media player apps, including those whose main purpose is to play media, it is a best practice to ensure that your app plays well with the overall Android platform ecosystem. This practice is especially important for music-player apps, because users often expect music-player apps to play even when the app is not visible on screen, and users expect to control music-player apps from hardware devices such as headset buttons, or through Android Auto.

To integrate with the Android platform, the Android media APIs include a number of classes to abstract various aspects of media playback betm n your app and the system, including media sessions, media controllers, and media brom ers. You implement these classes in addition to and alongside of your app's transport controls and media player.

N te: The Android v4 support library includes "C mpat" versions of the classes described in this section, in the Media-C mpat support library [illegible] As with all Android apps, it is a best [illegible]

[redacted]

You create a single media session for your app usually at the same time you create the media player. The player is only called from the media session that controls it.

Media

14.1 C: Architecture Components

Contents:

Recommended Architecture Components

To introduce the terminology, here is a short introduction to the Architecture Components and how they w

`LiveData` : A

You

to data across multiple components of your app can create explicit, rjpan

UI components just observe relevant data and don't stop or resume observation. `LiveData` is aware of vant data o

WKHQ XSGDWH WKH FDFKHG GDWD IRUH[DPSOH LQ WKH DGDSWHU DQG WKH DGDSWHU XSGDWHV ZKDWWKH XVHUVHHV

8VXDOO\ \RX REVHUYH GDWD LQ D `ViewModel` QRWGLUHFWO\ LQ WKH 5HSRVLWRU\ RU LQ 5RRP `ViewModel` LV GHVFULEHG LQ D ODWHU VHFWLRQ

7KH IROORZLQJ FRGH VKRZV KRZ WR DWWDFK DQ REVHUYHU WR `LiveData`

```
// Create the observer whid updates the UI.
final Observer<String> nameObserver = new Observer<String>() {
    @Override
    publi void on5anged(@Nullable final String newName) {
        // Update the UI, in thi dse, a TextView.
        mNameTextView.setText(newName);
```

6HH WKH `LiveData` `LiveData` RUZ DP@K Ð@F LV

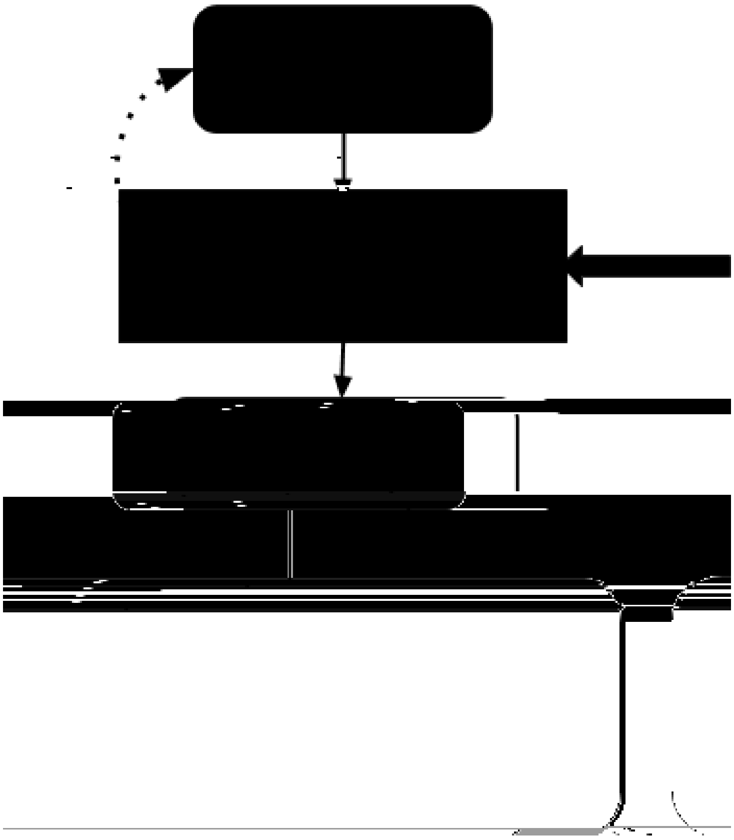
$UFKLWHFWXUH &RPSRQHQW /LYH'DP@DQG /LIHF\FOH ÙLGHR

Room dam8ase

5RRP LV D GDWDEDVH OD\KERQ WRS RI D 64/LØ%R%P DQ–V%D

Rep

the lifecycle library. For an intro$uctory guide to this topic, see the `ViewModel`



A `ViewModel` ho,ds your app's UI data in a lifecycle-conscious way that survives configuration changes. Separating your app's UI data from your

[illegible]

device is rotated. If you [illegible]ference to the `Activity` in the `ViewModel`, you end up with references that point to the destroyed [illegible]

```
mWordViewModel.getAllWords().observe(this, new Observer<List<Word>>() {
```

The `android.arch.lifecycle` package provides classes and interfaces that let you build
l

Paging library

The