

# Recording in Progress

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# **CMSC436: Programming Handheld Systems**

# **Android Development Environment**

# The Android Platform

A multi-layered software stack for building and running mobile applications

# The Android Development Environment

Starts with knowledge of the Android platform

Your workbench for writing Android applications

See:

<https://developer.android.com/studio/intro/>

# Today's Topics

Downloading Android SDK

Using the Android Studio IDE

Using the Android emulator

Debugging Android applications

Other tools

# Prerequisites

## Supported Operating Systems:

Microsoft Windows 8/10 (64-bit)

Mac OS X 10.14 (Mojave) or higher

Any 64-bit Linux that supports Gnome, KDE, Unity DE

# General Prerequisites

8GB RAM min

8GB memory for Android SDK, emulator system images, and caches

1280 x 800 min screen resolution

# Getting Started

Download & install Android Studio

See: <https://developer.android.com/studio/>

# Android Studio

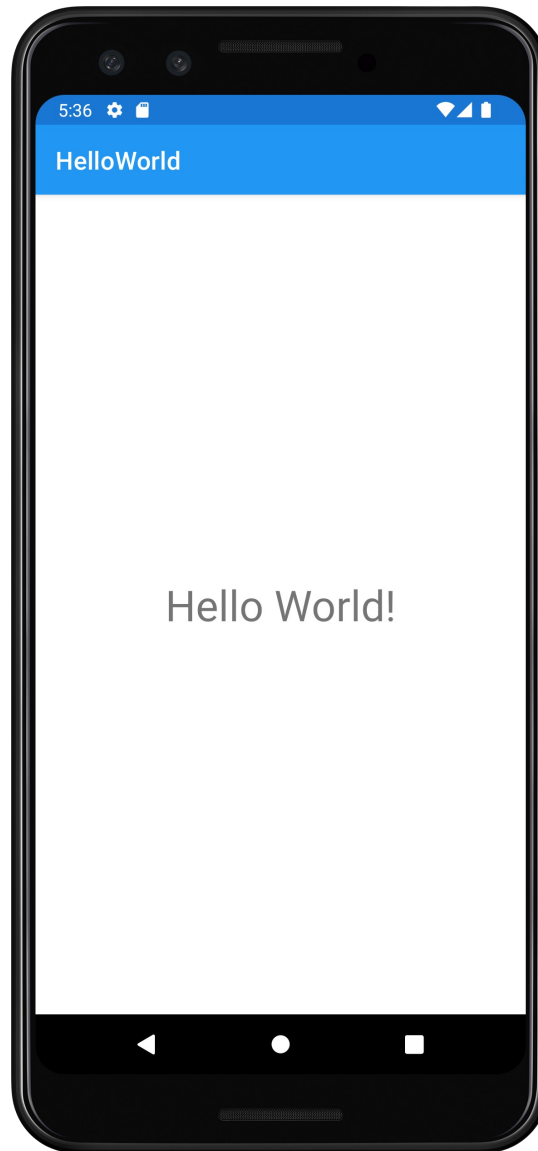
Android platform

Android Studio IDE

Key development tools

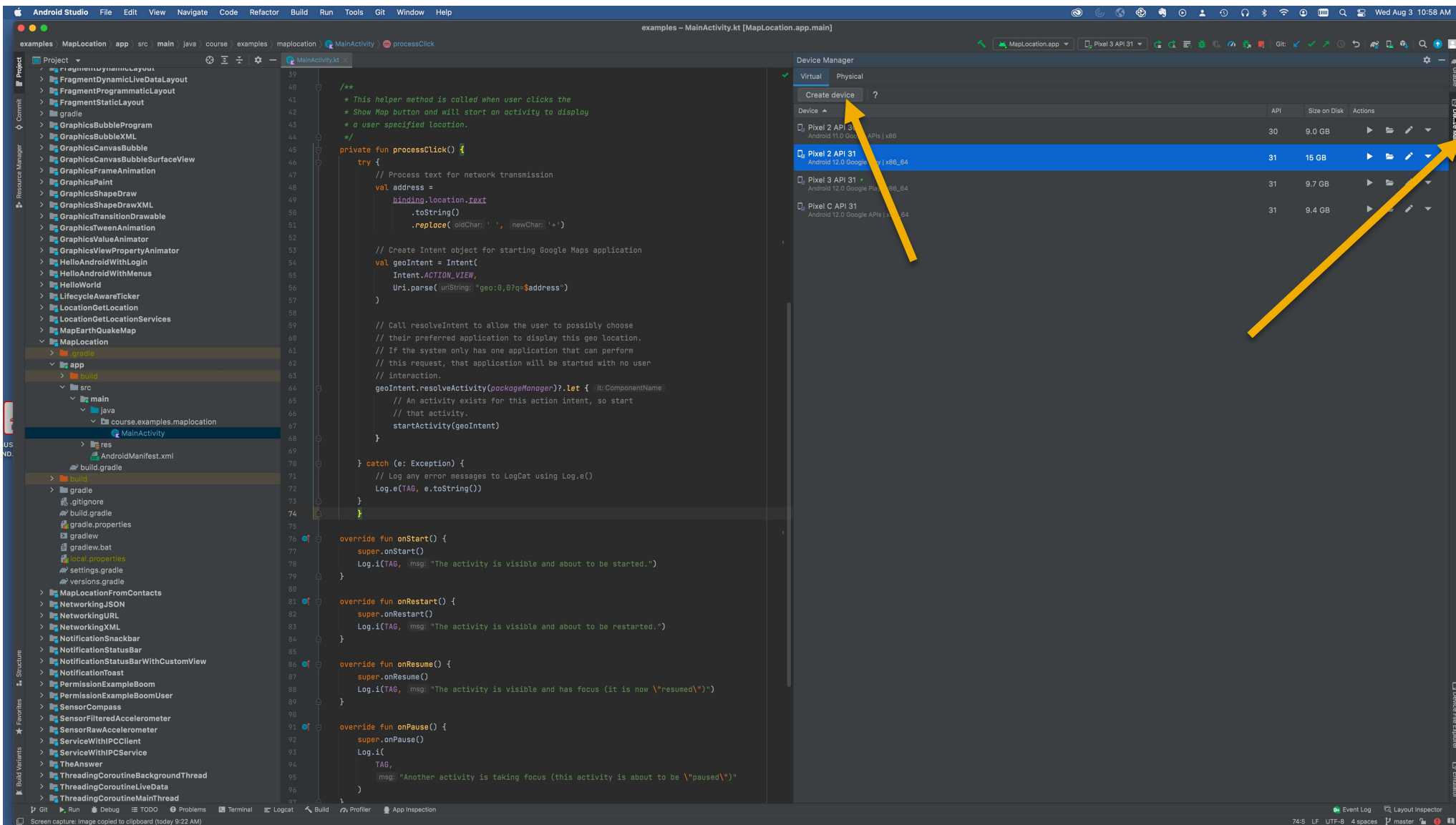
System image for emulator

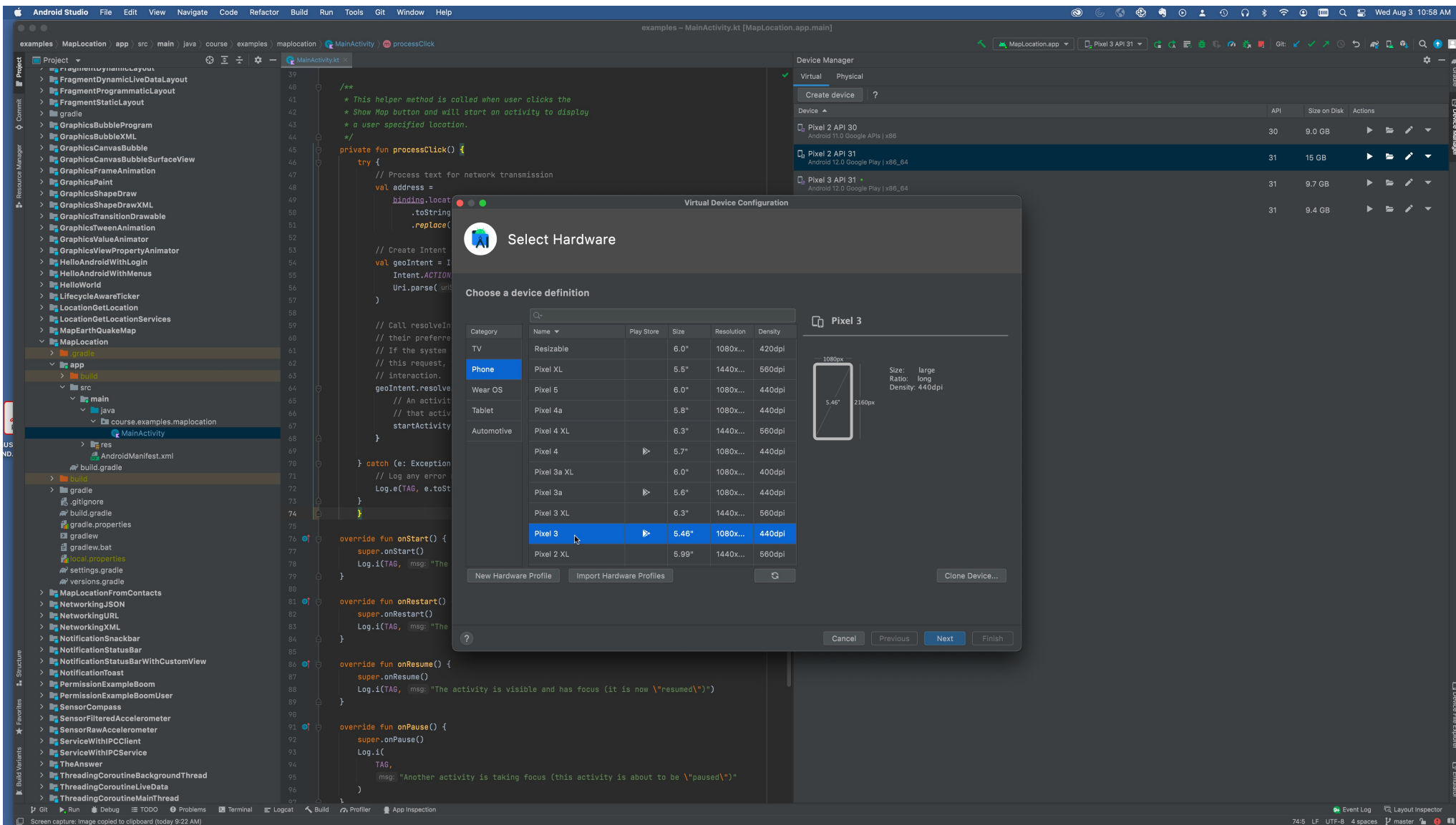
HelloWorld



# The Android Emulator

Runs virtual devices





# The Android Emulator

## Pros

- Doesn't require an actual phone

- Hardware is reconfigurable

- Changes are non-destructive

# The Android Emulator

## Cons

- Slower than an actual device

- Some features unavailable

  - e.g., no support for NFC, SD card insert/eject, etc.

- Performance / user experience can be misleading

# Advanced Features

Can emulate many different device/user characteristics, such as:

- Network speed/latencies

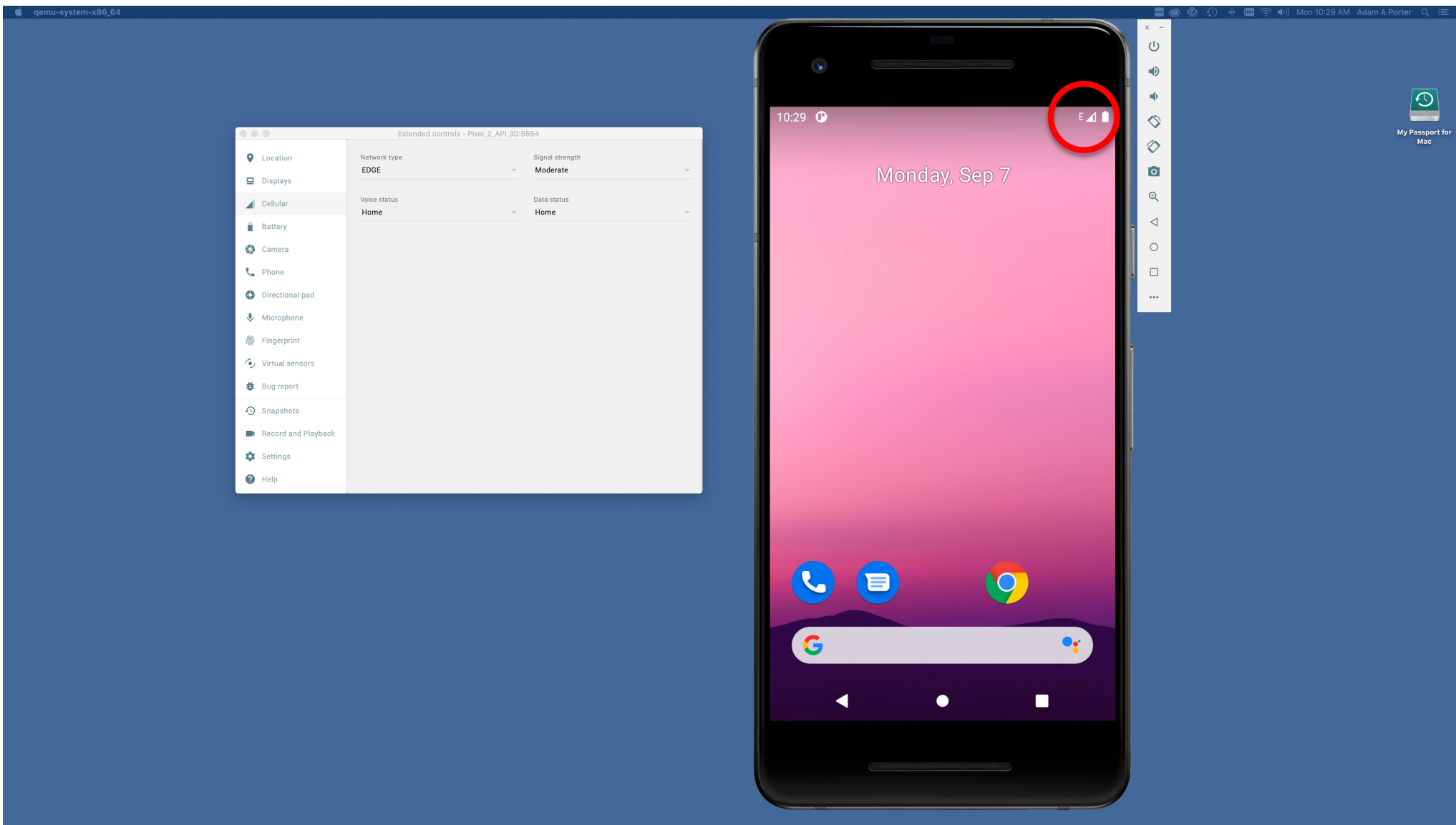
- Battery power

- Location coordinates

- Sensor readings

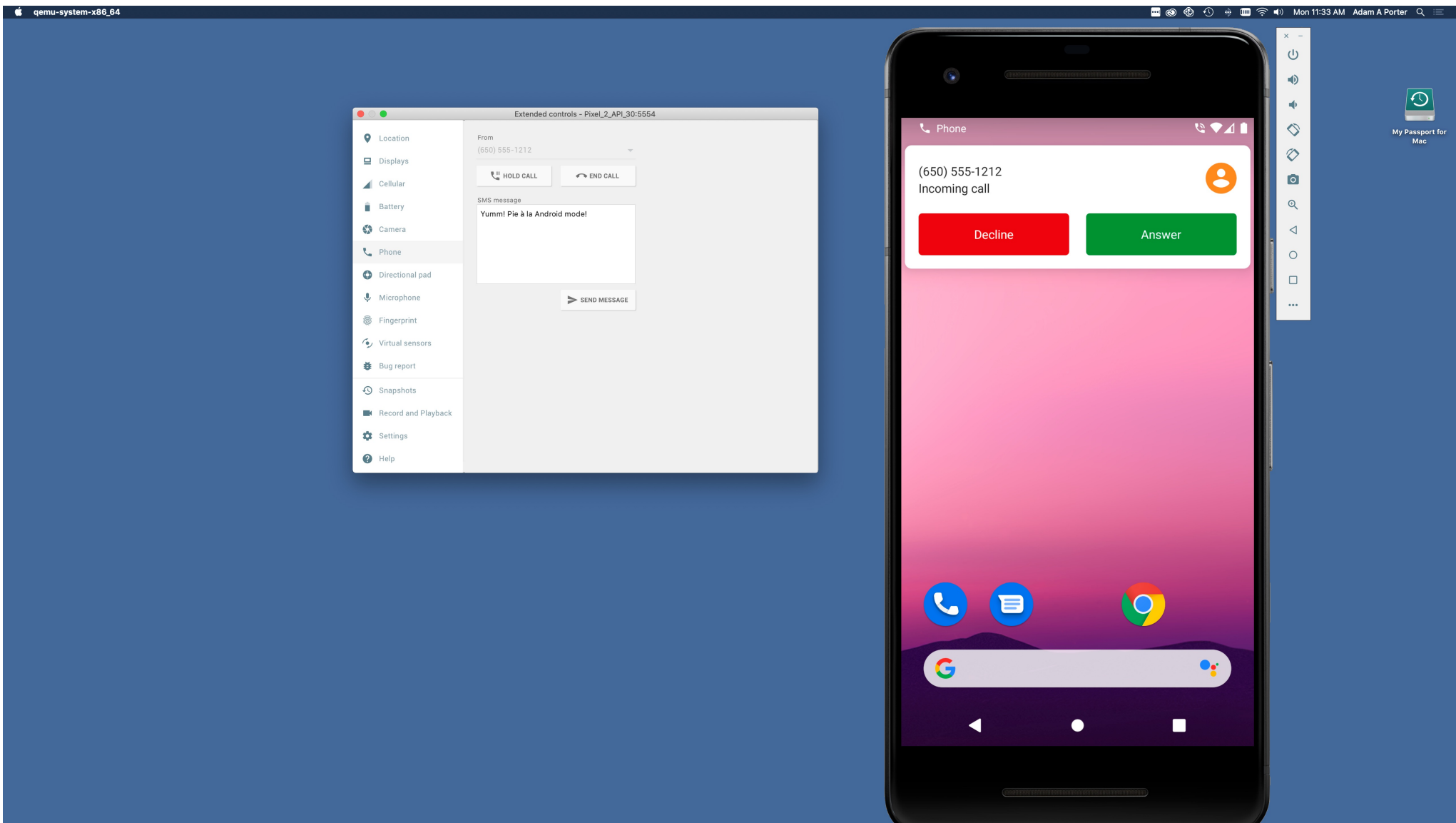
# Advanced Features

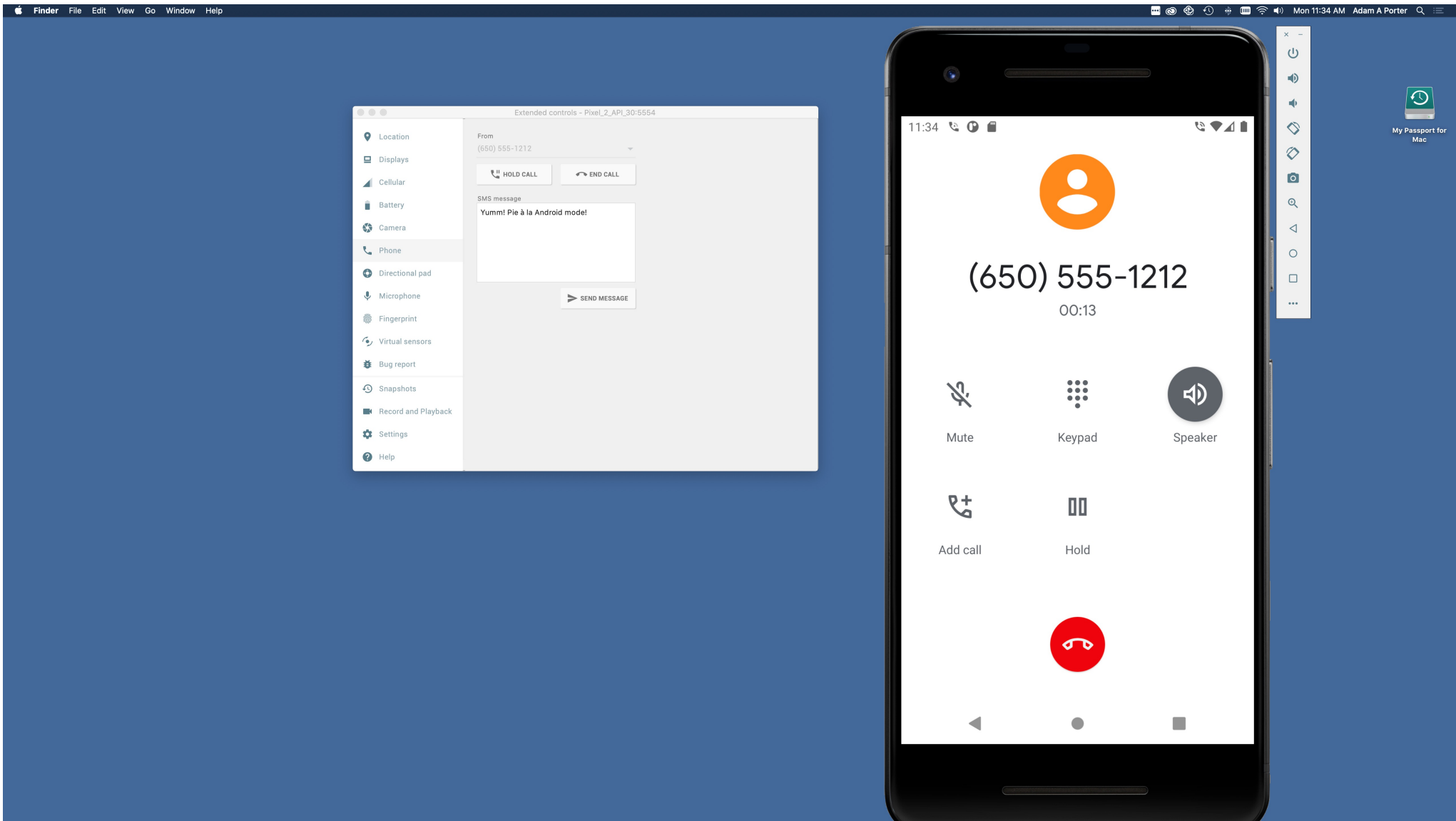
Ex: Change network speeds



# Advanced Features

Ex: Emulate incoming phone calls & SMS messages





# Advanced Features

Many more options

See:

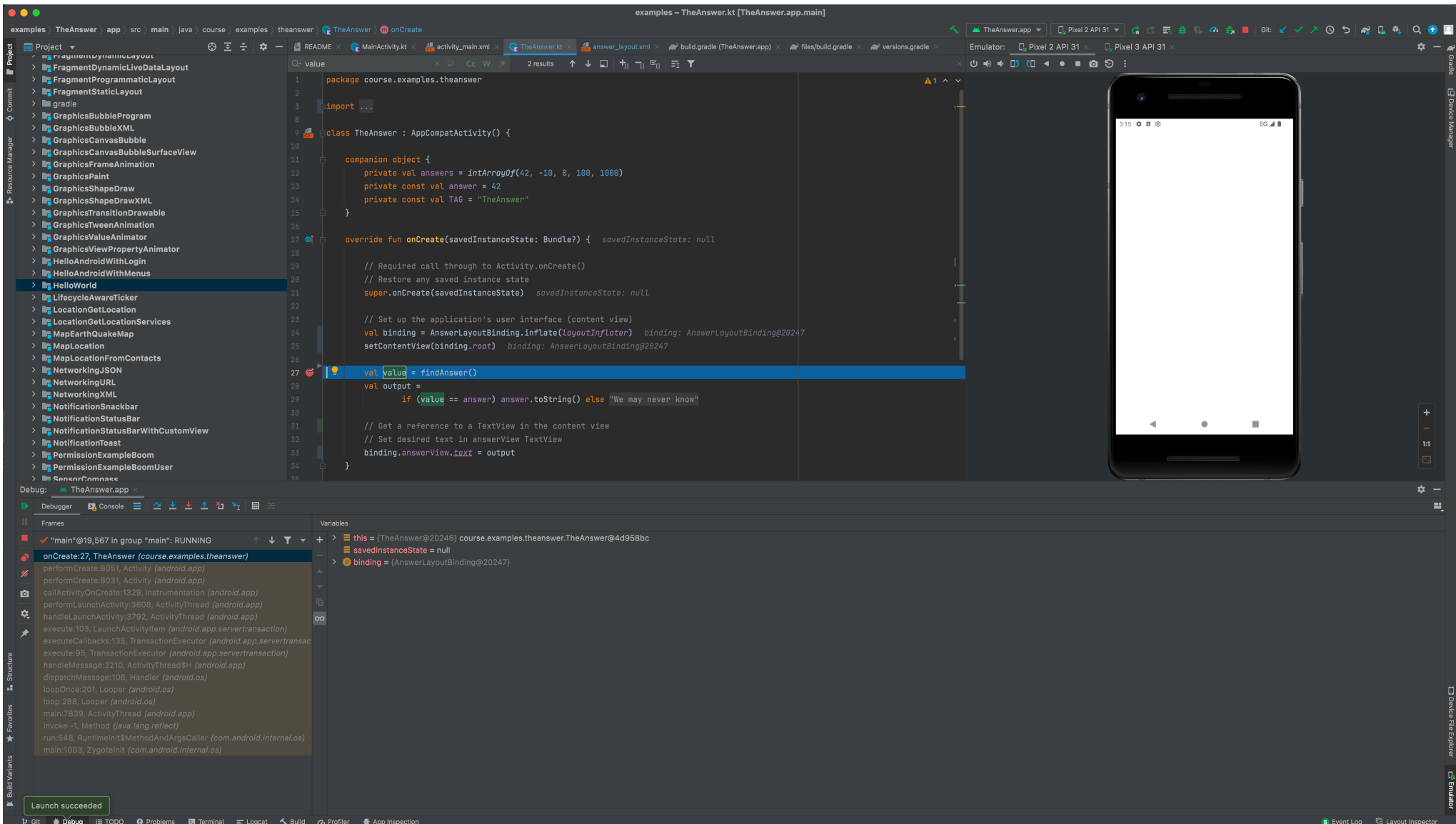
<https://developer.android.com/studio/run/emulator.html>

# Debugger

Tool for examining the internal state of a running application

TheAnswer





# Development Tools

Android Studio provides numerous tools for monitoring application behaviors

# Example Tools

Device File Explorer

Logcat

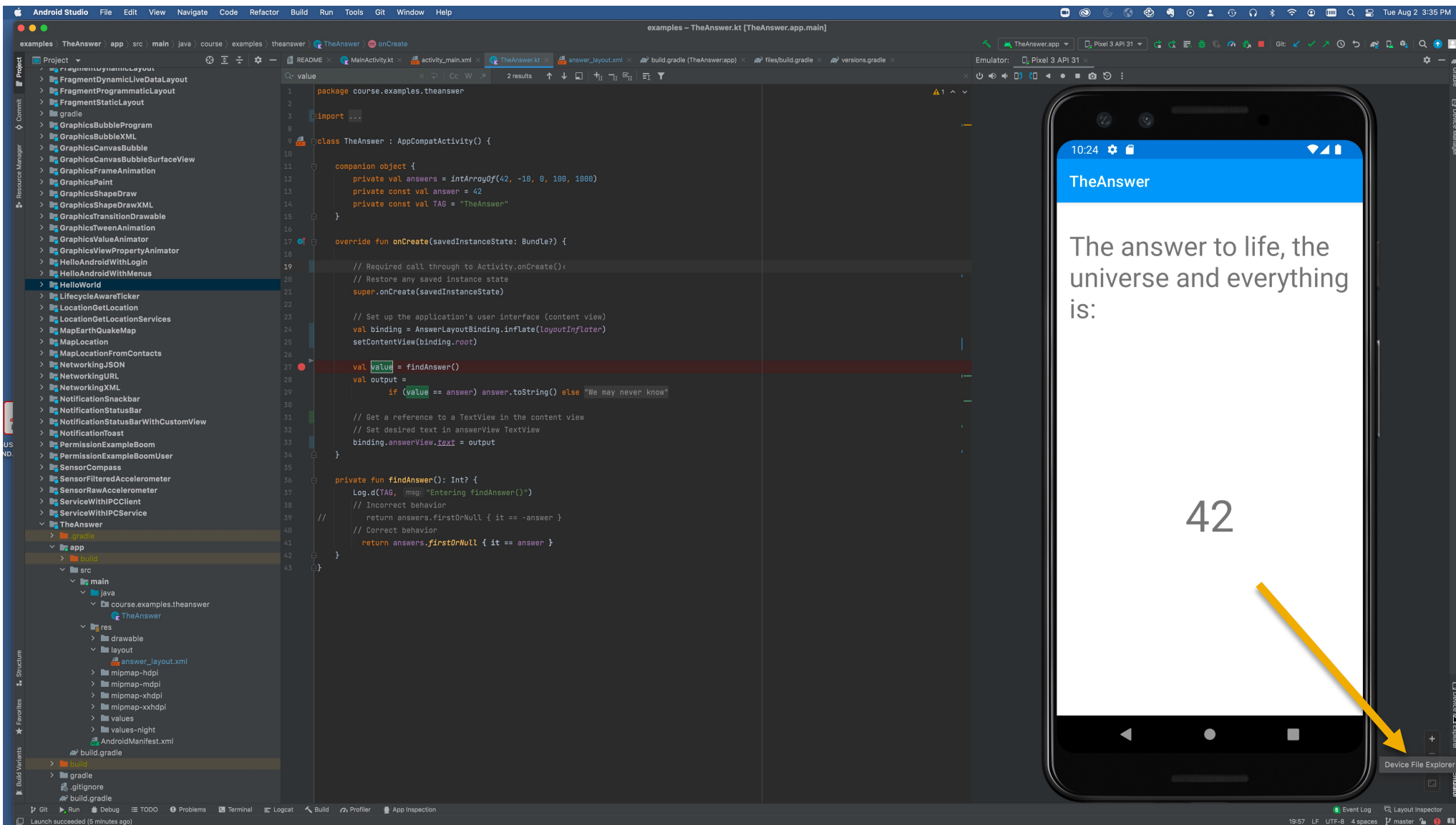
Layout Inspector

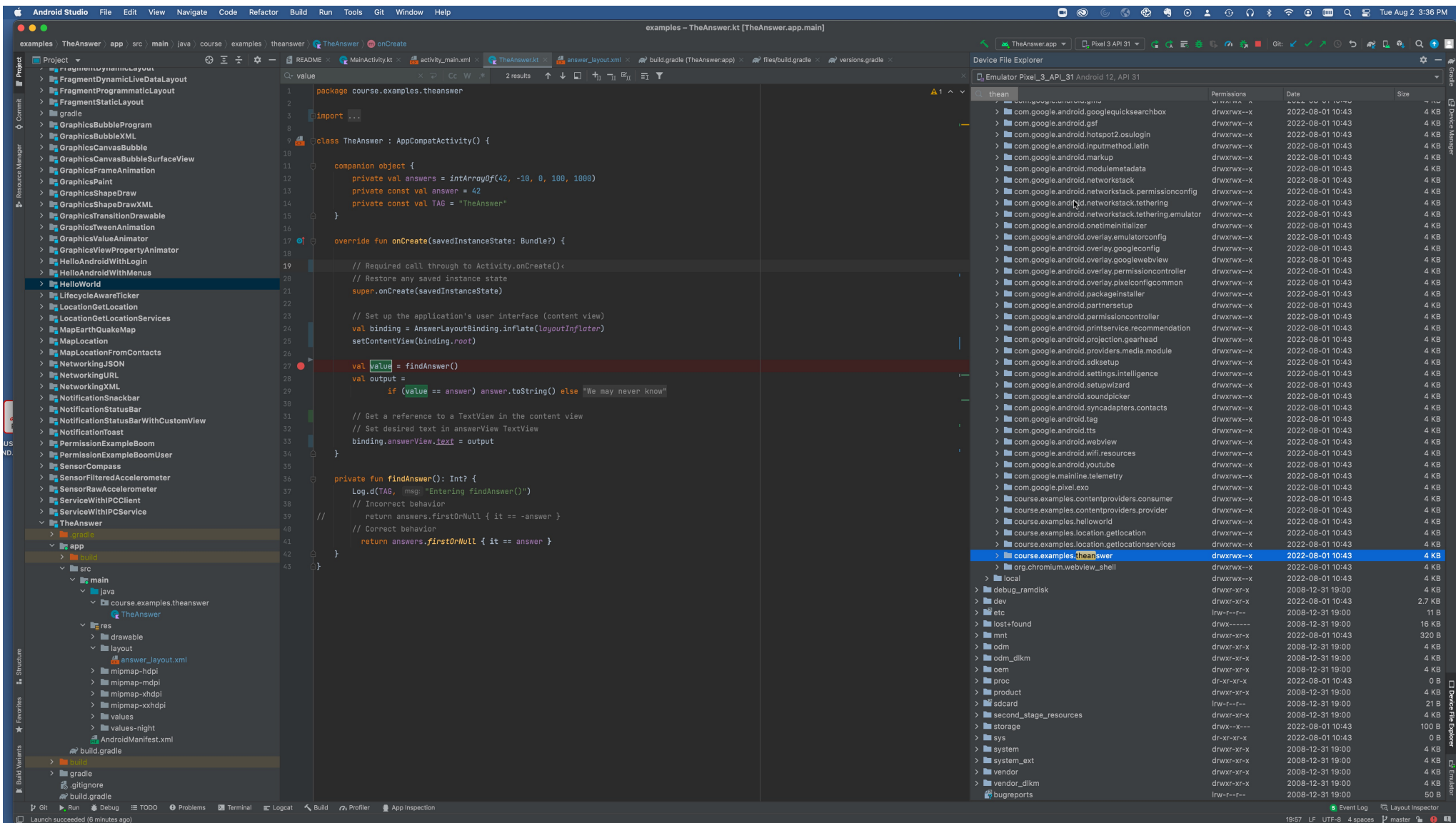
CPU Profiler

# Device File Explorer

View, copy, and delete files on your device

Often used to examine and verify file creation and transfer





# Logcat

Write and review log messages

Apps use Log class to write messages to log

Developer can search and filter log messages

examples HelloWorld

Project

- fragmentDynamicLiveLayout
- fragmentDynamicLiveDataLayout
- fragmentProgrammaticLayout
- fragmentStaticLayout
- gradle
- GraphicsBubbleProgram
- GraphicsBubbleXML
- GraphicsCanvasBubble
- GraphicsCanvasBubbleSurfaceView
- GraphicsFrameAnimation
- GraphicsPaint
- GraphicsShapeDraw
- GraphicsShapeDrawXML
- GraphicsTransitionDrawable
- GraphicsTweenAnimation
- GraphicsValueAnimator
- GraphicsViewPropertyAnimator
- HelloAndroidWithLogin
- HelloAndroidWithMenus
- HelloWorld**
- LifecycleAwareTicker
- LocationGetLocation
- LocationGetLocationServices
- MapEarthOvalMap
- MapLocation
- MapLocationFromContacts
- NetworkingJSON
- NetworkingURL
- NetworkingXML
- NotificationSnackbar
- NotificationStatusBar
- NotificationStatusBarWithCustomView
- NotificationToast
- PermissionExampleBoom
- PermissionExampleBoomUser
- SensorCompass
- SensorFilteredAccelerometer
- SensorRawAccelerometer
- ServiceWithPCLClient
- ServiceWithPCLService
- TheAnswer
- app
- build
- src

README

MainActivity.kt

activity\_main.xml

TheAnswer.kt

answer\_layout.xml

build.gradle (TheAnswerapp)

files/build.gradle

versions.gradle

Emulator: Pixel 2 API 31

Emulator: Pixel 3 API 31

```
1 package course.examples.theanswer
2
3 import ...
4
5 class TheAnswer : AppCompatActivity() {
6
7     companion object {
8         private val answers = intArrayOf(42, -10, 0, 100, 1000)
9         private const val answer = 42
10        private const val TAG = "TheAnswer"
11    }
12
13    override fun onCreate(savedInstanceState: Bundle?) {
14
15        // Required call through to Activity.onCreate()
16        // Restore any saved instance state
17        super.onCreate(savedInstanceState)
18
19        // Set up the application's user interface (content view)
20        val binding = AnswerLayoutBinding.inflate(layoutInflater)
21        setContentView(binding.root)
22
23        val value = findAnswer()
24        val output =
25            if (value == answer) answer.toString() else "We may never know"
26
27        // Get a reference to a TextView in the content view
28        // Set desired text in answerView TextView
29        binding.answerView.text = output
30
31        private fun findAnswer(): Int? {
32            Log.d(TAG, "msg: Entering findAnswer()")
33            // Incorrect behavior
34            return answers.firstOrNull { it == -answer }
35            // Correct behavior
36            return answers.firstOrNull { it == answer }
37        }
38    }
39}
```

Logcat

Emulator Pixel\_3\_API\_31 Android

course.examples.theanswer (1817)

Verbose

2022-08-01 22:09:32.082 18170-18170/course.examples.theanswer D/TheAnswer: Entering findAnswer()

2022-08-01 22:09:32.065 18170-18198/course.examples.theanswer D/HostConnection: createUnique: call

2022-08-01 22:09:32.066 18170-18198/course.examples.theanswer D/HostConnection: HostConnection::get() New Host Connection established 0x71203fe03590, tid 18198

2022-08-01 22:09:32.076 18170-18198/course.examples.theanswer D/HostConnection: HostComposition ext ANDROID\_EMU\_CHECKSUM\_HELPER\_v1 ANDROID\_EMU\_native\_sync\_v2 ANDROID\_EMU\_native\_sync\_v3 ANDROID\_EMU\_native\_sync\_v4 ANDROID\_EMU\_dma\_v1 ANDROID\_EMU\_direct\_mem ANDROID\_EMU\_host\_composition\_v1 ANDROID\_EMU\_host\_composition\_v2

2022-08-01 22:09:32.079 18170-18198/course.examples.theanswer W/OpenGLES: Failed to choose config with EGL\_SWAP\_BEHAVIOR\_PRESERVED, retrying without...

2022-08-01 22:09:32.080 18170-18198/course.examples.theanswer W/OpenGLES: Failed to initialize 101010-2 format, error = EGL\_SUCCESS

2022-08-01 22:09:32.081 18170-18198/course.examples.theanswer D/EGL\_emulation: eglCreateContext: 0x71203fe01b50: maj 3 min 0 rcv 3

2022-08-01 22:09:32.082 18170-18198/course.examples.theanswer D/EGL\_emulation: eglMakeCurrent: 0x71203fe01b50: ver 3 0 (tinfo 0x712256f3b080) (first time)

2022-08-01 22:09:32.094 18170-18198/course.examples.theanswer I/Gralloc4: mapper 4.x is not supported

2022-08-01 22:09:32.095 18170-18198/course.examples.theanswer D/HostConnection: createUnique: call

2022-08-01 22:09:32.095 18170-18198/course.examples.theanswer D/HostConnection: HostConnection::get() New Host Connection established 0x71203fe08990, tid 18198

2022-08-01 22:09:32.096 18170-18198/course.examples.theanswer D/goldfish-address-space: allocate: Ask for block of size 0x100

2022-08-01 22:09:32.096 18170-18198/course.examples.theanswer D/goldfish-address-space: allocate: ioctl allocate returned offset 0x3ffffe000 size 0x2000

2022-08-01 22:09:32.097 18170-18198/course.examples.theanswer W/Gralloc4: allocator 4.x is not supported

2022-08-01 22:09:32.103 18170-18198/course.examples.theanswer D/HostConnection: HostComposition ext ANDROID\_EMU\_CHECKSUM\_HELPER\_v1 ANDROID\_EMU\_native\_sync\_v2 ANDROID\_EMU\_native\_sync\_v3 ANDROID\_EMU\_native\_sync\_v4 ANDROID\_EMU\_dma\_v1 ANDROID\_EMU\_direct\_mem ANDROID\_EMU\_host\_composition\_v1 ANDROID\_EMU\_host\_composition\_v2

2022-08-01 22:09:32.909 18170-18181/course.examples.theanswer W/System: A resource failed to call close.

Launch succeeded (a minute ago)

412 LF UTF-8 4 spaces master

Event Log

Layout Inspector

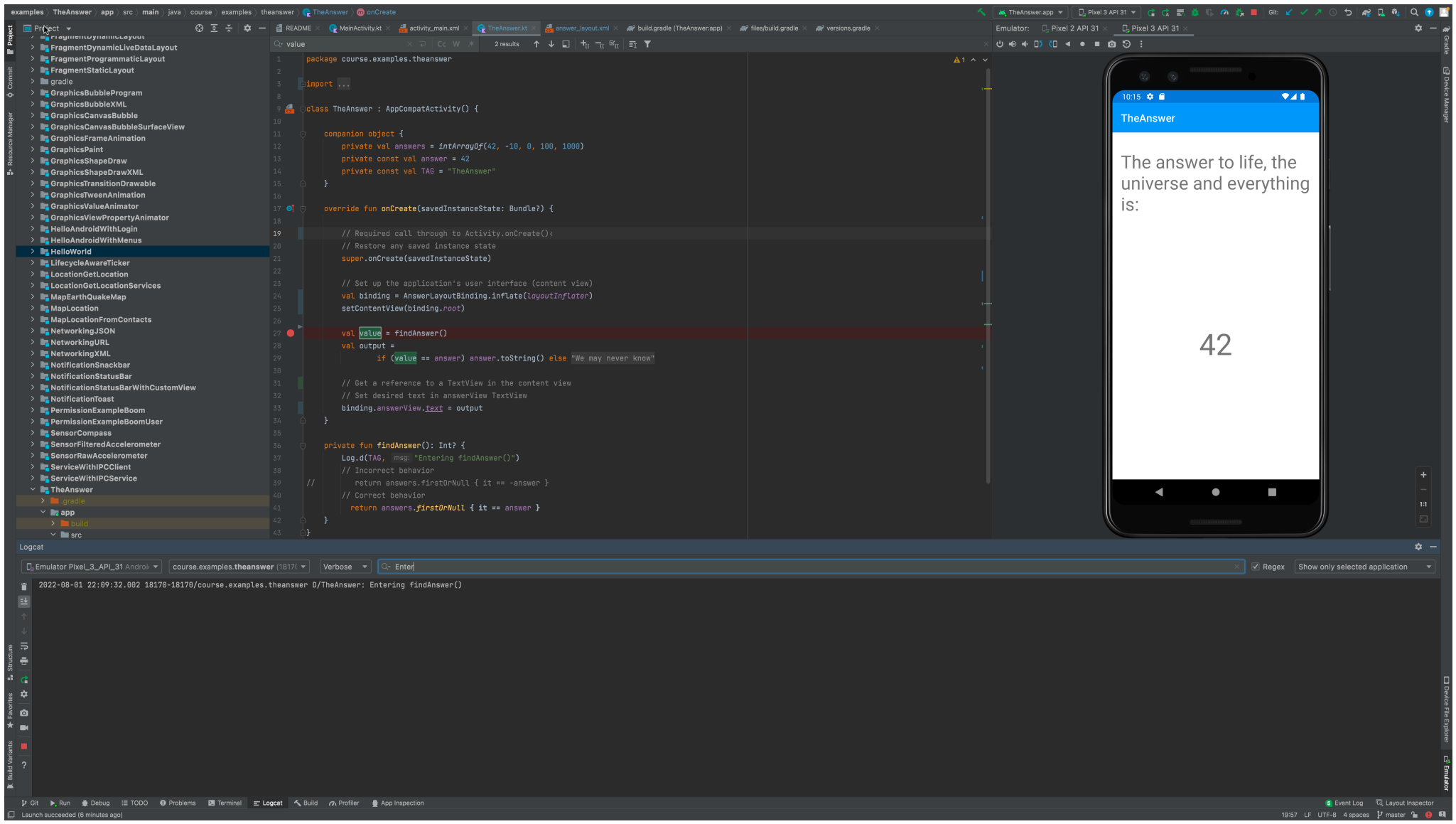
Device File Explorer

Emulator

TheAnswer

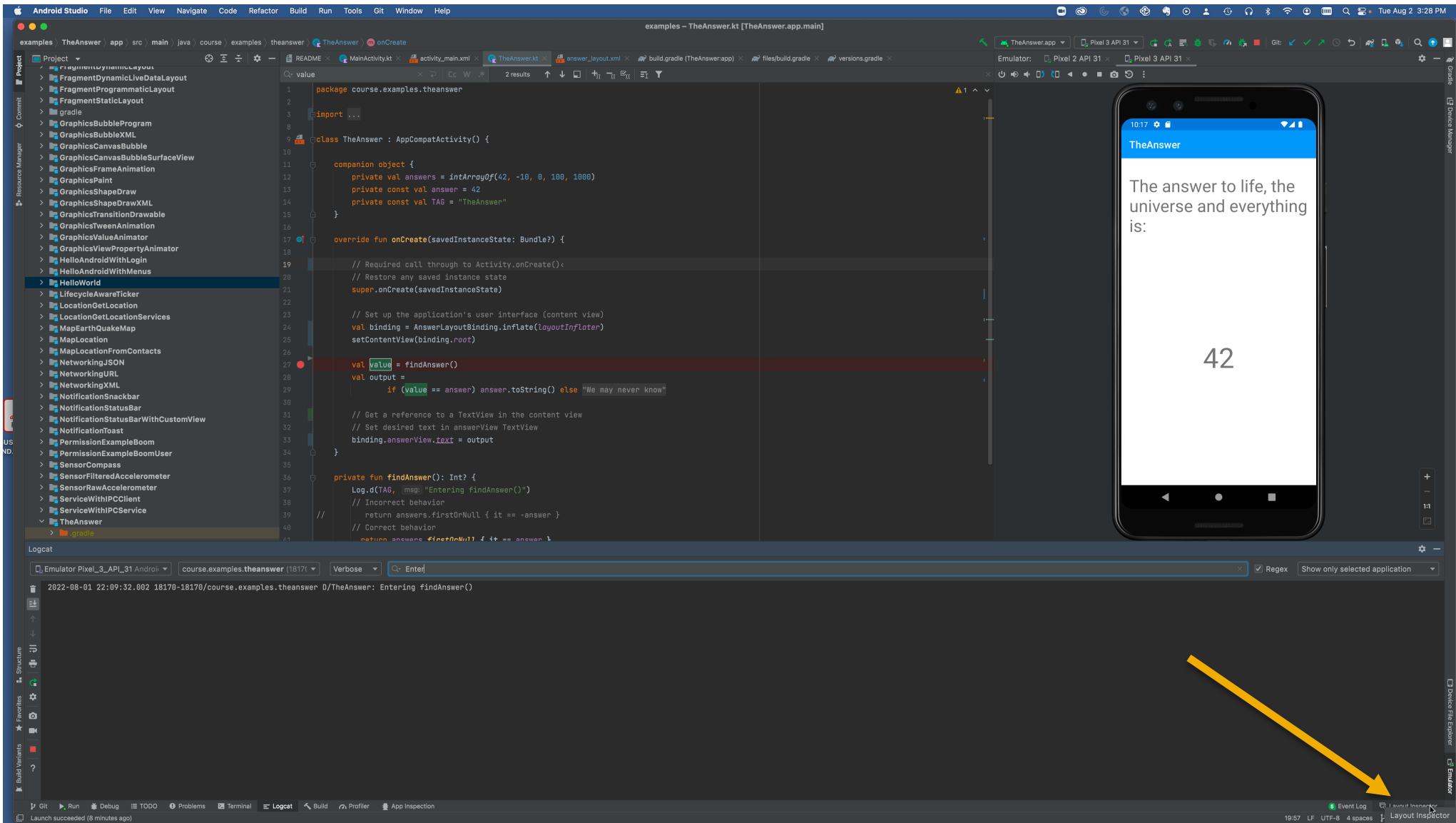
The answer to life, the universe and everything is:

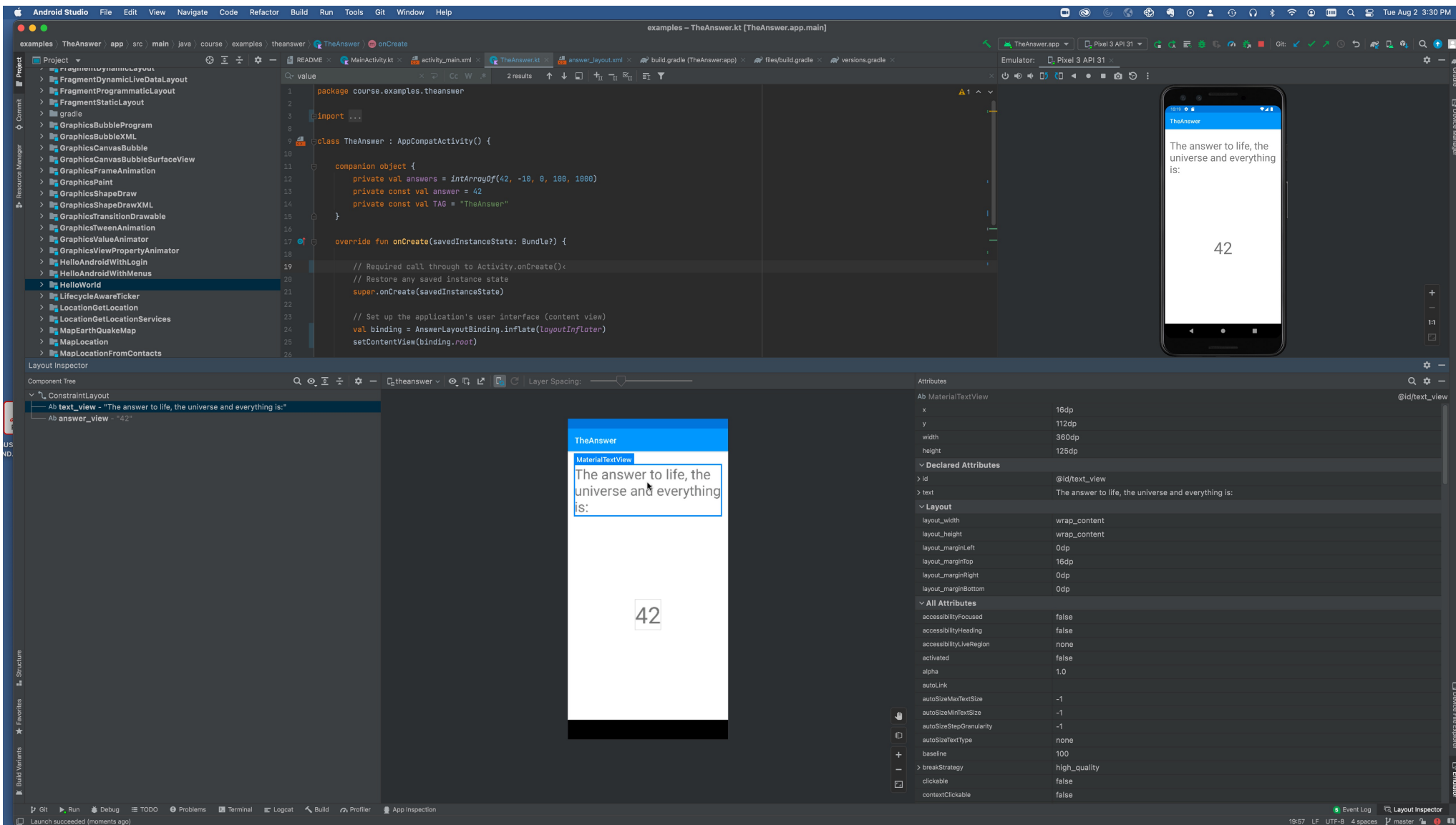
42



# Layout Inspector

Shows the runtime organization of the user interface





**Next**

Application Fundamentals

# Example Applications

HelloWorld

TheAnswer