MONASH University

FIT5046 (Mobile and Distributed Computing Systems)

Lab 1 – Android Introduction

This lab is an introduction to Android and provides the basic lessons for installing Android, setting up the environment and emulator, and running the Hello World application.

Task 1 – Installation and setting up the environment

1- Download Android Studio Electric Eel https://developer.android.com/studio

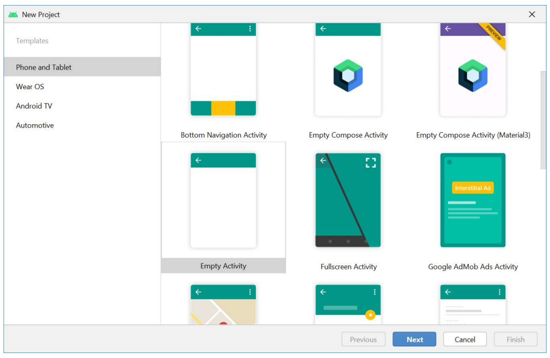
> **Note:** the lab activities and lectures are updated in January using the latest stable version of **Android Studio Electric Eel- 2022.1.1**. If you use any other version, there could be differences in the code that you need to address. Therefore, we strongly recommend you to install exactly the same version used for our lab exercises.

2- During the installation, you need to follow the setup wizard and choose the directory, the standard installation (not custom), select the dark/Dracula (default) or white background/theme, accept the license agreements for SDK and Intel x86 emulator, and then wait for the system to install all the files (SDK patches and x86_64 system image files).

3- After installation is complete, you can run/open Android studio.

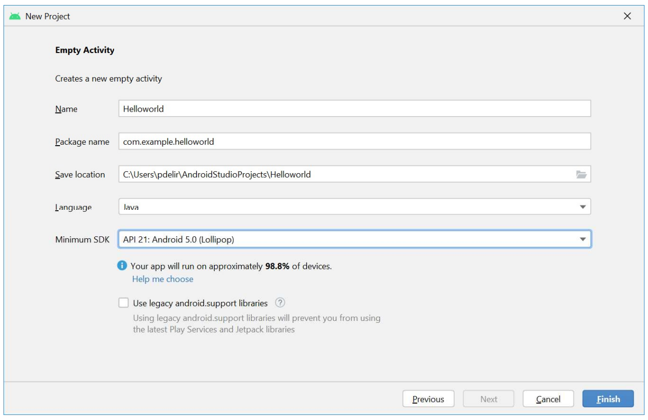
Task 2 – Create and Run HelloWorld

4- Select a New Project, and then select **Empty Activity** as below.



5- In the next window, give the project a name (HelloWorld).

6- Change the language from Kotlin to Java. Keep the minimum SDK as it is and click on Finish. It could take some time to install some remaining software and gradle files, and the system could ask for giving permissions.



Empty Activity

Creates a new empty activity

Name	Helloworld
Package name	com.example.helloworld
Save location	C:\Users\pdelir\AndroidStudioProjects\Helloworld
Language	Java
Minimum SDK	API 21: Android 5.0 (Lollipop)

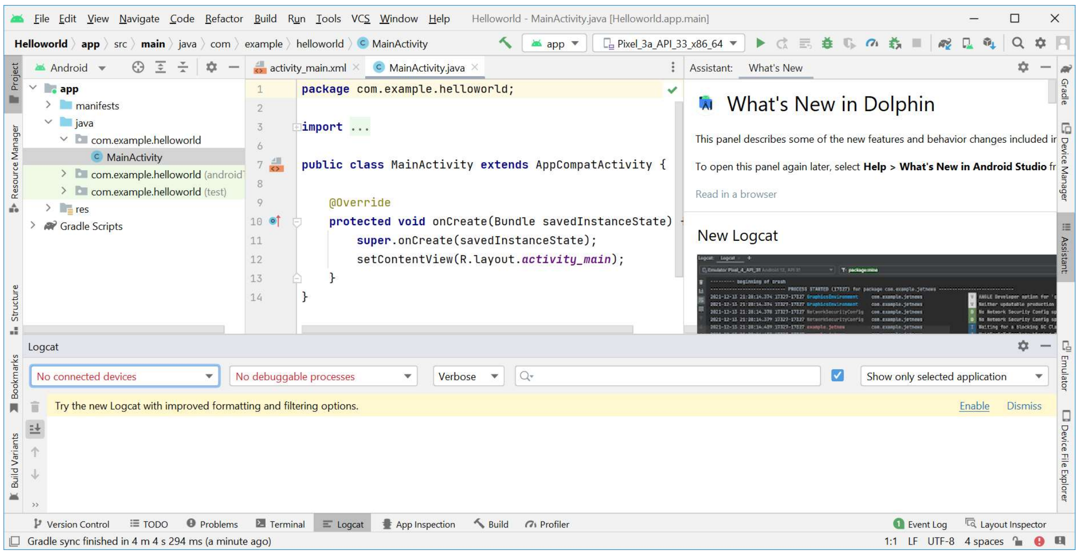
Your app will run on approximately **98.8%** of devices.
Help me choose

Use legacy android.support libraries
Using legacy android.support libraries will prevent you from using the latest Play Services and Jetpack libraries

7- After all files are installed, you should see a screen similar to the one shown below.

8- Click on Logcat at the bottom of the screen and then click on Enable.

9- You can restart Android Studio because you enabled Logcat.



```
package com.example.helloworld;

import ...

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

What's New in Dolphin

This panel describes some of the new features and behavior changes included i

To open this panel again later, select **Help > What's New in Android Studio** fr

Read in a browser

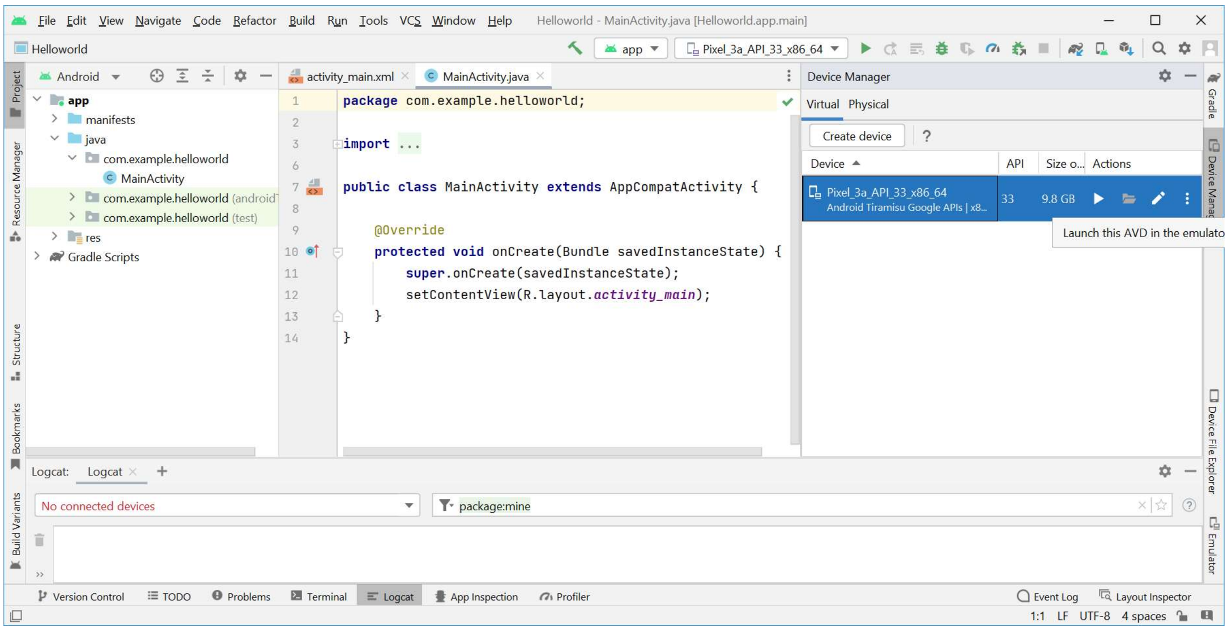
New Logcat

Try the new Logcat with improved formatting and filtering options.

Gradle sync finished in 4 m 4 s 294 ms (a minute ago)

1:1 LF UTF-8 4 spaces

10- On the right-hand side menu bar, select Device Manager. If there is no device, click on Create Device, select a device and then install its system image (try to use Tiramisu version API 33). After it is installed, you can run it by clicking on the play icon as shown below. (if it didn't display the play icon, create a second device).



```
package com.example.helloworld;

import ...

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

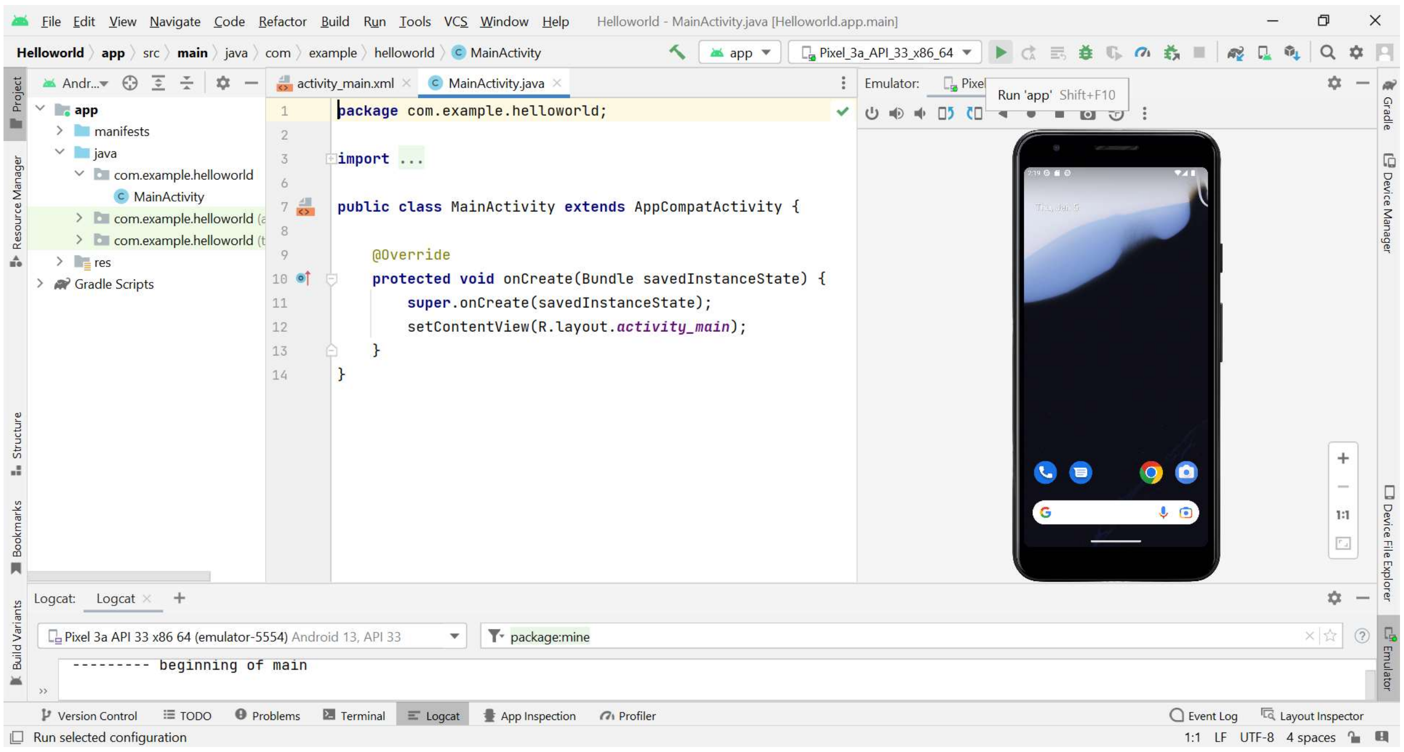
Device	API	Size o...	Actions
Pixel_3a_API_33_x86_64 Android Tiramisu Google APIs | x8...	33	9.8 GB	

Launch this AVD in the emulato

package:mine

1:1 LF UTF-8 4 spaces

11- You can run the Hello application, by clicking Run at the top menu.


File Edit View Navigate Code Refactor Build Run Tools VCS Window Help
Helloworld - MainActivity.java [Helloworld.app.main]
Helloworld app src main java com example helloworld MainActivity
app
Pixel_3a_API_33_x86_64
Run 'app' Shift+F10
activity_main.xml
MainActivity.java
Emulator:
app
manifests
java
com.example.helloworld
MainActivity
res
Gradle Scripts
Logcat: Logcat
Version Control TODO Problems Terminal Logcat App Inspection Profiler
Event Log Layout Inspector
Run selected configuration
1:1 LF UTF-8 4 spaces

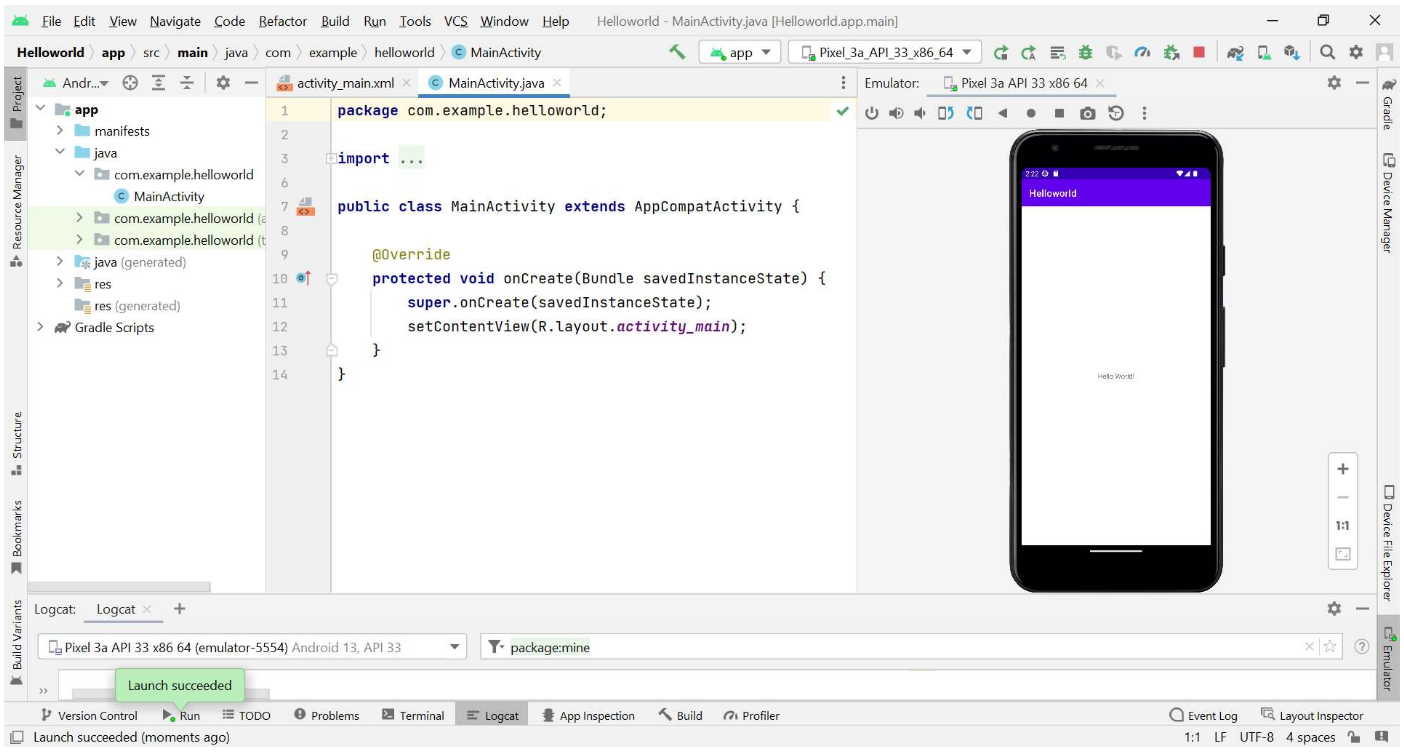
```
package com.example.helloworld;

import ...

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

Pixel 3a API 33 x86 64 (emulator-5554) Android 13, API 33

package:mine

```
--------- beginning of main
```

12- After you run the Hello application, you will see the Hello World message in the emulator as shown below. We will explain all the files and code for running this simple application in the lecture.


File Edit View Navigate Code Refactor Build Run Tools VCS Window Help
Helloworld - MainActivity.java [Helloworld.app.main]
Helloworld app src main java com example helloworld MainActivity
app
Pixel_3a_API_33_x86_64
activity_main.xml
MainActivity.java
Emulator: Pixel 3a API 33 x86 64
app
manifests
java
com.example.helloworld
MainActivity
java (generated)
res
res (generated)
Gradle Scripts
Helloworld
Hello World!
Logcat: Logcat
Version Control Run TODO Problems Terminal Logcat App Inspection Build Profiler
Event Log Layout Inspector
1:1 LF UTF-8 4 spaces

```
package com.example.helloworld;

import ...

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

Pixel 3a API 33 x86 64 (emulator-5554) Android 13, API 33

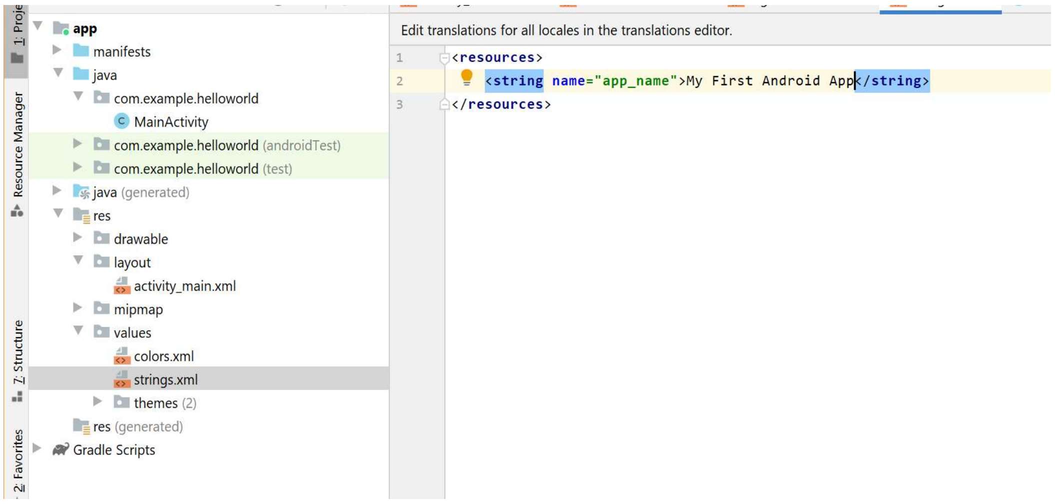
package:mine

Launch succeeded

Launch succeeded (moments ago)

Task 3- Change the app’s title

13- To change the Android application’s title, you need to open the **strings.xml** file under the res/values folder (as shown in the screenshot below) and change the value of the app_name to “My First Android App”. Re-run the project.



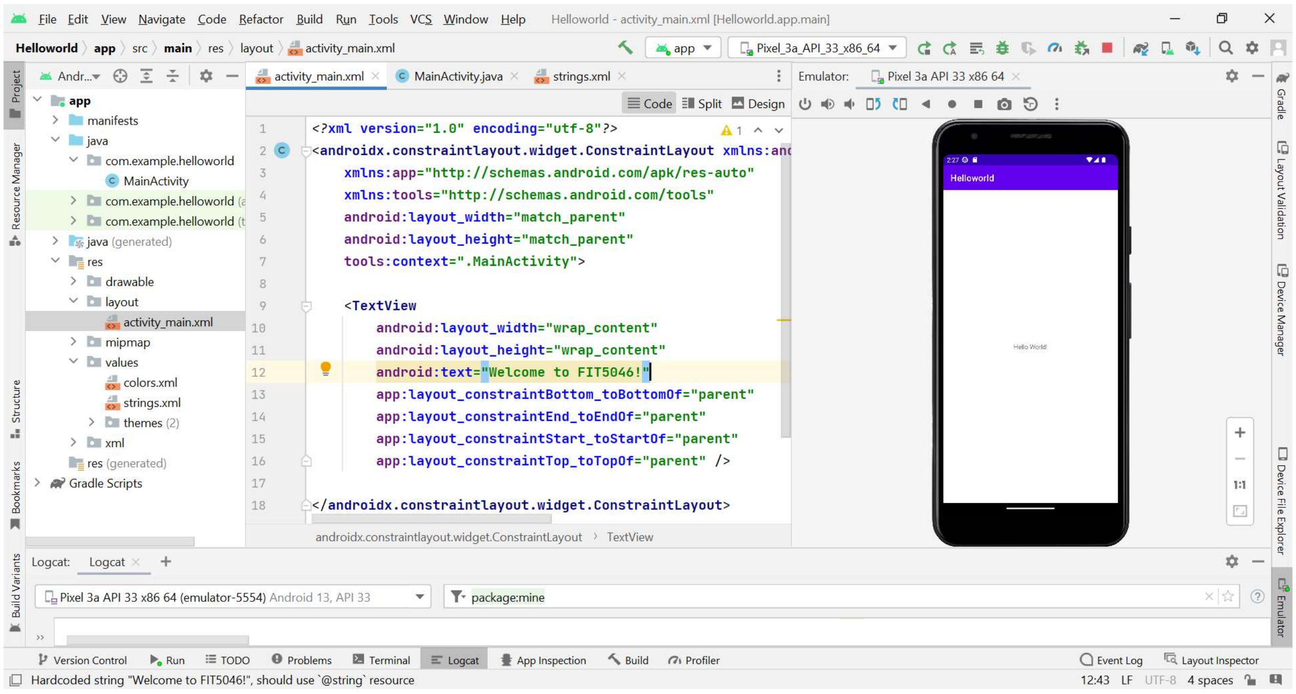
Edit translations for all locales in the translations editor.

```xml
<resources>
    <string name="app_name">My First Android App</string>
</resources>
```

Task 4 – change the message

14- Open the **activity_main.xml** under res/layout and in the middle window, Click on Code to see the XML code. You can always **switch between Design and Code or display both**.

15- In the Code view, find and change the “hello world” to “Welcome to FIT5046” as the value of android:text for the TextView widget.



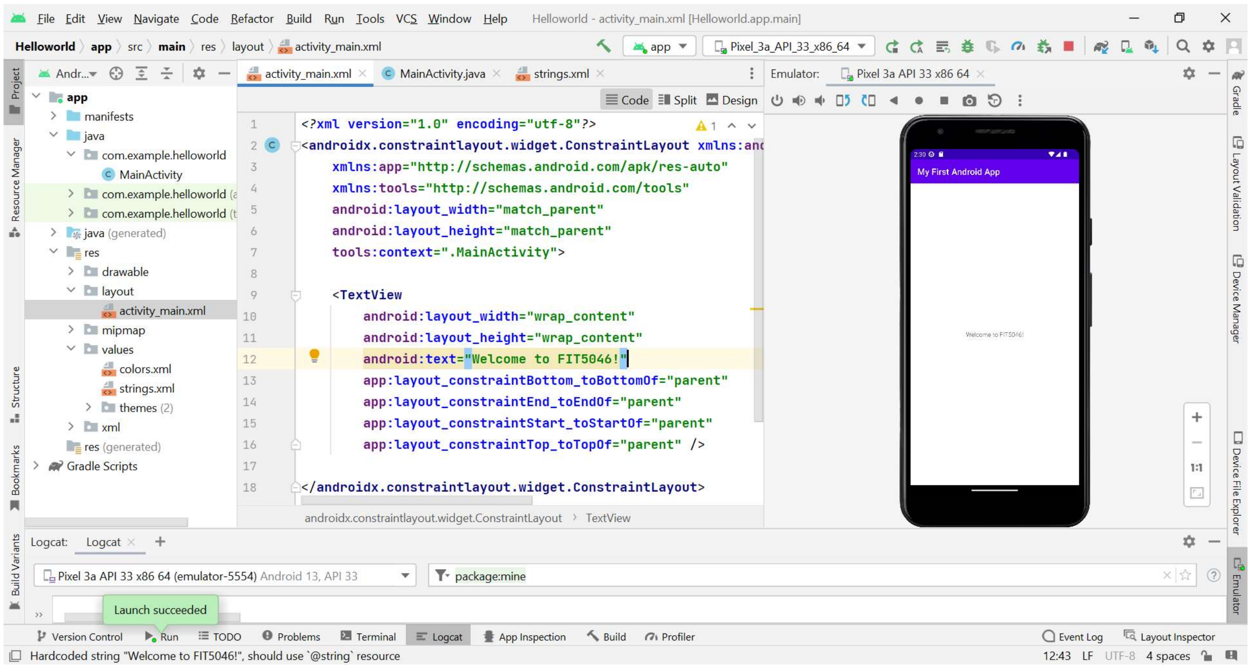
```xml
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout xmlns:and
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    tools:context=".MainActivity">

    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Welcome to FIT5046!"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent" />

</androidx.constraintlayout.widget.ConstraintLayout>
```

androidx.constraintlayout.widget.ConstraintLayout › TextView

Hardcoded string "Welcome to FIT5046!", should use `@string` resource

12:43 LF UTF-8 4 spaces

16- Re-run the application and check the new application name and the message.



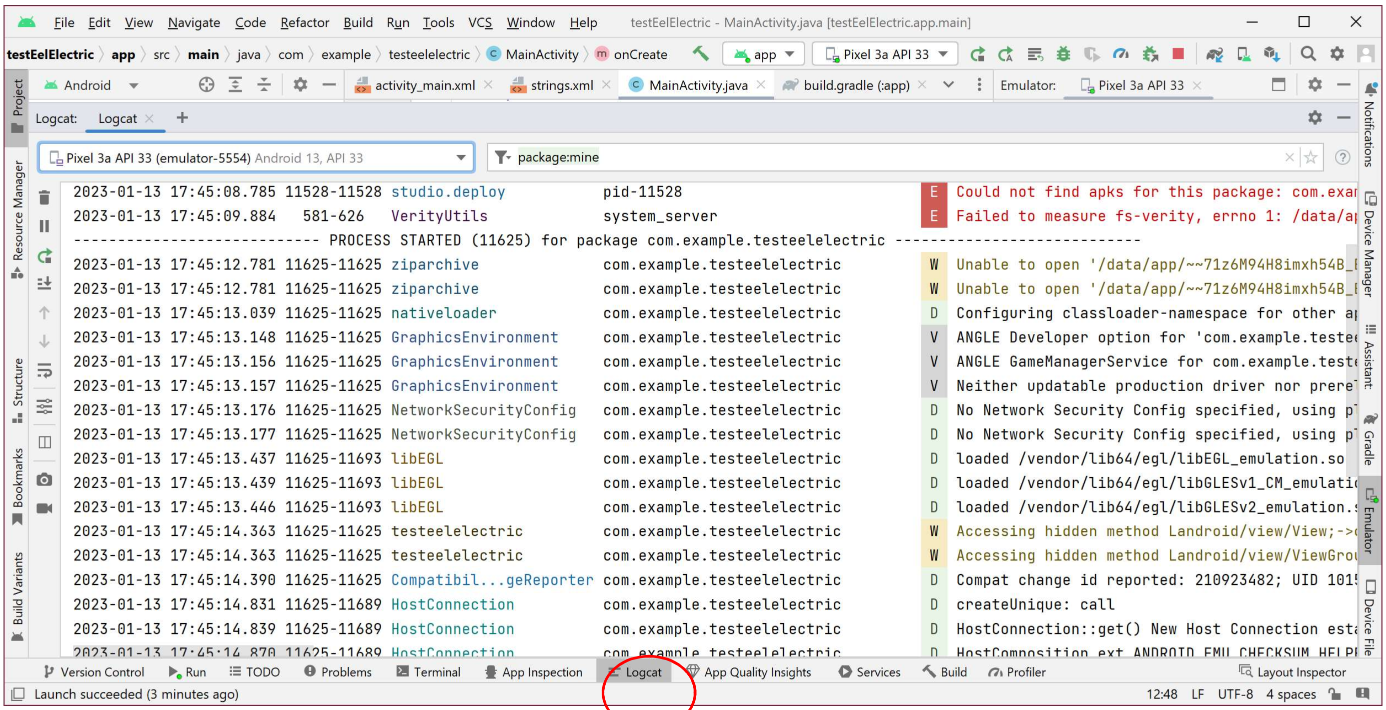
```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout xmlns:and
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    tools:context=".MainActivity">

    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Welcome to FIT5046!"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent" />

</androidx.constraintlayout.widget.ConstraintLayout>
```

My First Android App
Welcome to FIT5046!
Launch succeeded
Hardcoded string "Welcome to FIT5046!", should use `@string` resource

Task 5 – Debugging

5.1 Using Logcat

17- The Logcat can help you debug your app and find the errors by displaying logs from your device in real time. It displays each entry with a priority of FATAL, ERROR, WARNING, INFO, DEBUG, or VERBOSE.



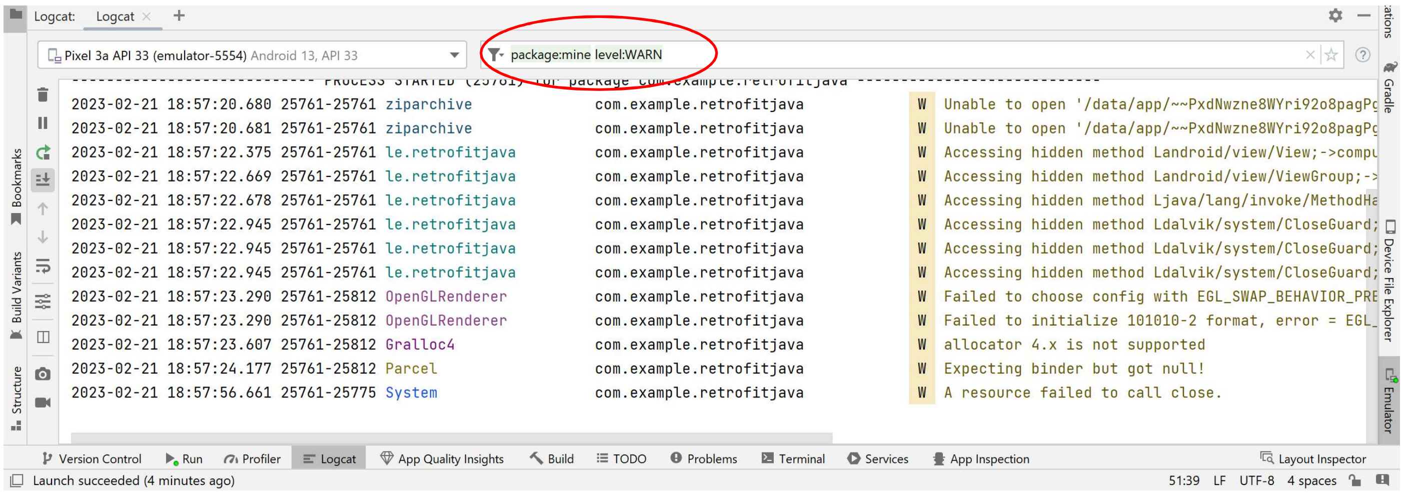
```
2023-01-13 17:45:08.785 11528-11528 studio.deploy          pid-11528                  E  Could not find apks for this package: com.exa
2023-01-13 17:45:09.884   581-626   VerityUtils            system_server              E  Failed to measure fs-verity, errno 1: /data/a
---------------------------- PROCESS STARTED (11625) for package com.example.testeelectric ----------------------------
2023-01-13 17:45:12.781 11625-11625 ziparchive             com.example.testeelectric  W  Unable to open '/data/app/~~71z6M94H8imxh54B_
2023-01-13 17:45:12.781 11625-11625 ziparchive             com.example.testeelectric  W  Unable to open '/data/app/~~71z6M94H8imxh54B_
2023-01-13 17:45:13.039 11625-11625 nativeloader           com.example.testeelectric  D  Configuring classloader-namespace for other a
2023-01-13 17:45:13.148 11625-11625 GraphicsEnvironment    com.example.testeelectric  V  ANGLE Developer option for 'com.example.teste
2023-01-13 17:45:13.156 11625-11625 GraphicsEnvironment    com.example.testeelectric  V  ANGLE GameManagerService for com.example.test
2023-01-13 17:45:13.157 11625-11625 GraphicsEnvironment    com.example.testeelectric  V  Neither updatable production driver nor prere
2023-01-13 17:45:13.176 11625-11625 NetworkSecurityConfig  com.example.testeelectric  D  No Network Security Config specified, using p
2023-01-13 17:45:13.177 11625-11625 NetworkSecurityConfig  com.example.testeelectric  D  No Network Security Config specified, using p
2023-01-13 17:45:13.437 11625-11693 libEGL                 com.example.testeelectric  D  loaded /vendor/lib64/egl/libEGL_emulation.so
2023-01-13 17:45:13.439 11625-11693 libEGL                 com.example.testeelectric  D  loaded /vendor/lib64/egl/libGLESv1_CM_emulati
2023-01-13 17:45:13.446 11625-11693 libEGL                 com.example.testeelectric  D  loaded /vendor/lib64/egl/libGLESv2_emulation.
2023-01-13 17:45:14.363 11625-11625 testeelectric          com.example.testeelectric  W  Accessing hidden method Landroid/view/View;->
2023-01-13 17:45:14.363 11625-11625 testeelectric          com.example.testeelectric  W  Accessing hidden method Landroid/view/ViewGro
2023-01-13 17:45:14.390 11625-11625 Compatibil...geReporter com.example.testeelectric D  Compat change id reported: 210923482; UID 101
2023-01-13 17:45:14.831 11625-11689 HostConnection         com.example.testeelectric  D  createUnique: call
2023-01-13 17:45:14.839 11625-11689 HostConnection         com.example.testeelectric  D  HostConnection::get() New Host Connection est
2023-01-13 17:45:14.870 11625-11689 HostConnection         com.example.testeelectric  D  HostComposition ext ANDROID_EMU_CHECKSUM_HELPE
```

Pixel 3a API 33 (emulator-5554) Android 13, API 33
package:mine
Logcat
Launch succeeded (3 minutes ago)

You can display messages within your code by adding messages to Log:

An example: `Log.i("Error ","Response failed");`

Then in the Logcat window you can filter messages based on any of these levels (F, E, W, I, D or V) by adding the level after package:mine, as shown below.



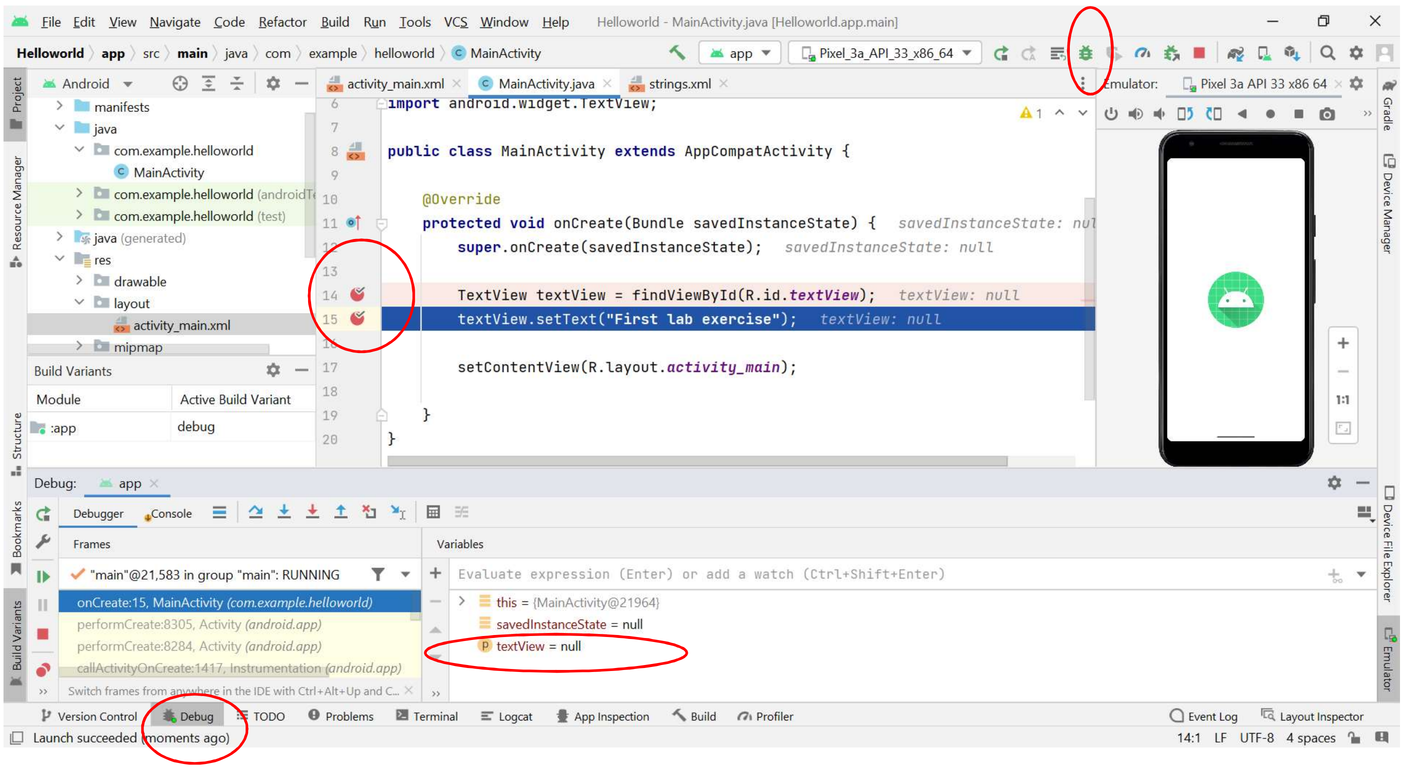
```
---------------------------- PROCESS STARTED (25761) for package com.example.retrofitjava ----------------------------
2023-02-21 18:57:20.680 25761-25761 ziparchive        com.example.retrofitjava        W  Unable to open '/data/app/~~PxdNwzne8WYri92o8pagPg
2023-02-21 18:57:20.681 25761-25761 ziparchive        com.example.retrofitjava        W  Unable to open '/data/app/~~PxdNwzne8WYri92o8pagPg
2023-02-21 18:57:22.375 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Landroid/view/View;->compu
2023-02-21 18:57:22.669 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Landroid/view/ViewGroup;->
2023-02-21 18:57:22.678 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Ljava/lang/invoke/MethodHa
2023-02-21 18:57:22.945 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Ldalvik/system/CloseGuard;
2023-02-21 18:57:22.945 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Ldalvik/system/CloseGuard;
2023-02-21 18:57:22.945 25761-25761 le.retrofitjava   com.example.retrofitjava        W  Accessing hidden method Ldalvik/system/CloseGuard;
2023-02-21 18:57:23.290 25761-25812 OpenGLRenderer    com.example.retrofitjava        W  Failed to choose config with EGL_SWAP_BEHAVIOR_PRE
2023-02-21 18:57:23.290 25761-25812 OpenGLRenderer    com.example.retrofitjava        W  Failed to initialize 101010-2 format, error = EGL_
2023-02-21 18:57:23.607 25761-25812 Gralloc4          com.example.retrofitjava        W  allocator 4.x is not supported
2023-02-21 18:57:24.177 25761-25812 Parcel            com.example.retrofitjava        W  Expecting binder but got null!
2023-02-21 18:57:56.661 25761-25775 System            com.example.retrofitjava        W  A resource failed to call close.
```

5.2 Using the Debug

18. When you have more complex code, it is very useful also to run Debug to better understand why an error happened and how to fix it. In the xml layout file, add the textView id as below.

```xml
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout xmlns:android="http://schemas.android.com/apk/res/android"
  xmlns:app="http://schemas.android.com/apk/res-auto"
  xmlns:tools="http://schemas.android.com/tools"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  tools:context=".MainActivity">

  <TextView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"

    android:id="@+id/textView"

    android:text="Welcome to FIT5046!"
    app:layout_constraintBottom_toBottomOf="parent"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toTopOf="parent" />

</androidx.constraintlayout.widget.ConstraintLayout>
```

19. For the purpose of debugging, we will move the textView code below before the setContentView() method.
    ```java
    TextView textView = findViewById(R.id.textView);
    textView.setText("First lab exercise");
    ```
20. The code for TextView should be after setContentView() because first the setContentView() method must be called to define the UI (based on an XML layout file), and then you can access views within that XML layout.
21. You can add breakpoints for each line of code as shown below by just clicking on the left-hand side of the code. This red dot shows the break points for debugging. If you have multiple breakpoints you can stop at each point and observe the state of the application as it is running.


```
import android.widget.TextView;

public class MainActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {   savedInstanceState: nul
        super.onCreate(savedInstanceState);   savedInstanceState: null

        TextView textView = findViewById(R.id.textView);   textView: null
        textView.setText("First lab exercise");   textView: null

        setContentView(R.layout.activity_main);

    }
}
```

```
Frames
"main"@21,583 in group "main": RUNNING
onCreate:15, MainActivity (com.example.helloworld)
performCreate:8305, Activity (android.app)
performCreate:8284, Activity (android.app)
callActivityOnCreate:1417, Instrumentation (android.app)

Variables
this = {MainActivity@21964}
savedInstanceState = null
textView = null
```

```
Launch succeeded (moments ago)
```

22. The Debugger window will appear as shown above. Debugger will show you the details and tell you that the value of the variable that is null and caused the error. First, the debugger stops at the first breakpoint. Click on the Debugger's **Step over button** at the top of the Debug window so it moves to the second breakpoint. Now you can see in the Debugger window below that the textView is null. The Debuger also shows some faded colour text beside each line of code that are useful.
23. The problem here can be fixed by moving the text view code after the setContentView() method. The setContentView() needs to be called first to set the activity content from a layout resource that is activity_main.xml and then inflate it by adding all top-level views to the activity.

The savedInstanceBundle is shown below as null and this is OK because there is no previous state of this activity saved in a bundle to be restored.

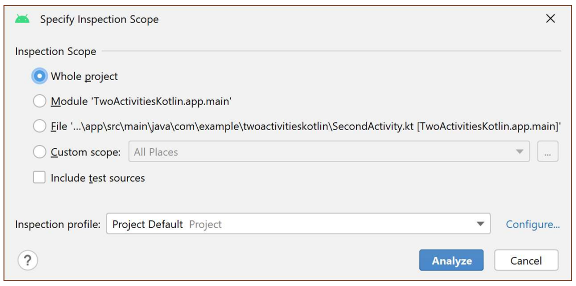
References:

https://developer.android.com/studio/debug

5.3 Using Lint

Lint is a scanning tool provided by Android Studio to check your code and provide messages/warnings for potential bugs or optimize your code in terms of correctness, security, performance, usability, accessibility, and internationalization

24. From the top menu, select Code > Inspect Code (uncheck Include test sources).


Specify Inspection Scope

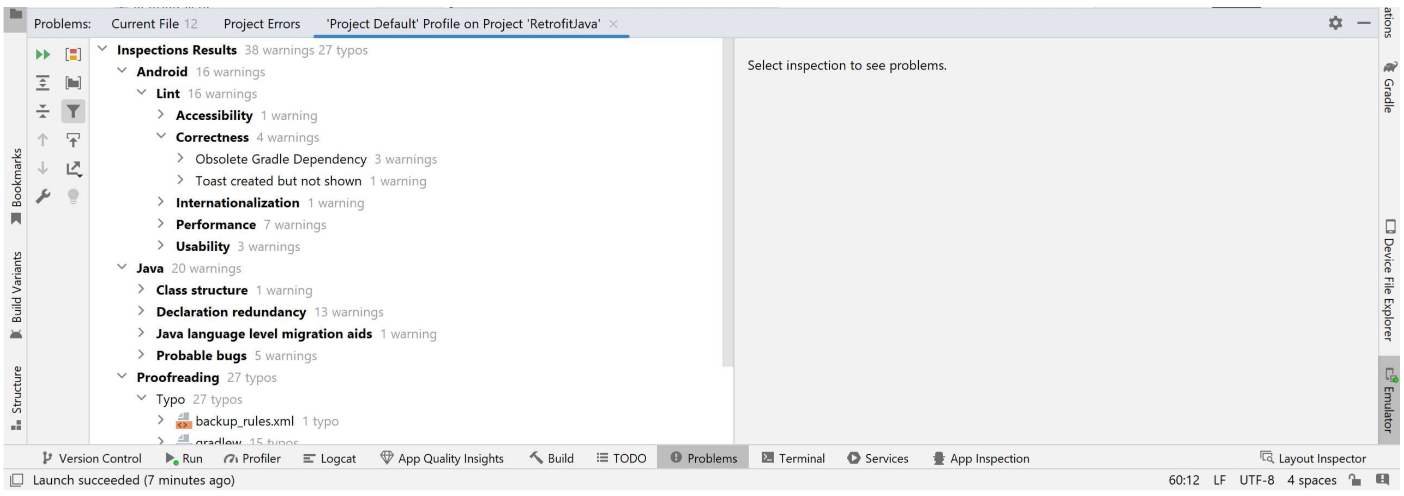
Inspection Scope

[✓ Whole project]
Module 'TwoActivitiesKotlin.app.main'
File '...\app\src\main\java\com\example\twoactivitieskotlin\SecondActivity.kt [TwoActivitiesKotlin.app.main]'
Custom scope: All Places
☐ Include test sources

Inspection profile: Project Default Project   Configure...

Analyze   Cancel

25. In the Inspection Results that appears, check the warnings for any useful information. Note that most of these are not causing any error, and aim to optimize the code. There are also some warnings that are not related to your written code (internal code), so you can ignore them.



Problems: Current File 12 Project Errors 'Project Default' Profile on Project 'RetrofitJava'

```
Inspections Results 38 warnings 27 typos
  Android 16 warnings
    Lint 16 warnings
      Accessibility 1 warning
      Correctness 4 warnings
        Obsolete Gradle Dependency 3 warnings
        Toast created but not shown 1 warning
      Internationalization 1 warning
      Performance 7 warnings
      Usability 3 warnings
  Java 20 warnings
    Class structure 1 warning
    Declaration redundancy 13 warnings
    Java language level migration aids 1 warning
    Probable bugs 5 warnings
  Proofreading 27 typos
    Typo 27 typos
      backup_rules.xml 1 typo
      gradlew 15 typos
```

Select inspection to see problems.

Launch succeeded (7 minutes ago) 60:12 LF UTF-8 4 spaces