Java on mobile devices

Building native apps for Android and iOS in Java

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Spot the difference

The early years (1992 – 2002)

- Oak
- PersonalJava
- Java 2 Platform, Micro Edition (J2ME) and the K Virtual Machine for heavily resource-constrained devices

JavaFX Mobile

- Based upon JavaFX 1.x (JavaFX Script)
- Aimed at, among others, Android and Windows Mobile
- Demoed on Android at JavaOne 2008; general availability: February 2009
- Should be available on mobile devices through cooperation with device manufacturer

Mobile Java on the decline

- „Java's not worth building in [to the phone].
  Nobody uses Java anymore.
  It's this big heavyweight ball and chain.“
  (Steve Jobs in 2007)

- March 2008 Sun announces that JavaME would be available on the iPhone. That never happned

- With the rise of smartphones, the relevance of Java ME shrank

- As of today, no official Java version/distribution for iOS

Java 9

- In September 2015 Oracle suggested a new project:
  Mobile: JDK Ports to Modern Mobile Platforms

- Features:
  - JDK 9 based port (Headless)
  - Support at minimum the equivalent of JDK 8 compact2 profile (in module form)
  - iOS x64 and arm64 (arm64 will be provided via Zero interpreter)
  - Android x86 and arm (arm will be provided via Zero interpreter)
  - Windows 10 tablet apps (side loaded)
  - JavaLauncher helper interface to simplify the process of including Java in Mobile applications
  - Sample HelloWorld applications and/or project templates for each platform

- Apparently no installation bundles for end users on iOS and Android

Why use Java on mobile devices?

- Android and iOS divide the market of mobile platforms up between themselves
  - Gigantic potential user base
  - Microsoft heavily invested in buying Xamarin (other eco system, same story)
- Android uses Java anyway, so why content oneself with half of the cake?
- Java is still most used programming language
  - Huge amount of skilled developers
  - Widespread knowledge
  - Why learn yet another language?

A couple of options

- J2ObjC
- Gluon Mobile
- MobiDevelop's RoboVM Fork and BugVM (both based upon RoboVM)
- Multi-OS Engine
- ADF Mobile / Mobile Application Framework
- DukeScript
- JUniversal
- ...

- What parts of Java are used? Language, libraries, tool chain
- What target artefact is produced?
- What runtime environment is needed?
- What kind of app can be developed?

Advantages of building native applications

- Easily distribute in app stores
- Deep integration in the platform and eco system
- (Native user interfaces)
  - Even deeper integration
  - Less code reuse

- (In theory) not distinguishable from „real“ native apps

RoboVM (discontinued)

- Swedish startup (founded 2013)
- Goal: native Android and iOS apps in Java with native ui
- JVM bytecode is translated into machine language using LLVM
- Class library based on Android class library with additional bindings for all iOS apis
- RoboVM Studio: IDE based on IntelliJ IDEA; supports source level debugging

- October 2015: Xamarin buys RoboVM
- February 2016: Microsoft announces plans to by Xamarin
- April 2016: Microsoft announces to wind down RoboVM

Gluon

- Commercial sibling of JavaFXPorts
- Native apps for Android and iOS (as well as desktop and embedded)
- JavaFX for the user interface
- For iOS, currently relies on open source parts of RoboVM
- On Android, currently compiles and links against Androids native runtime

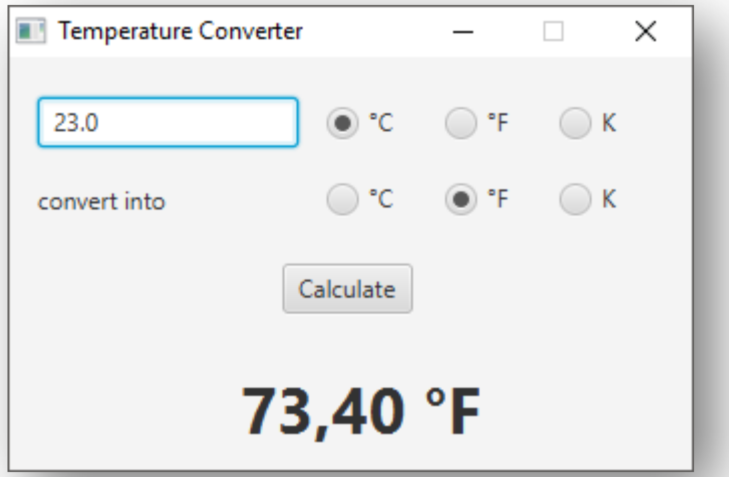
- Gluon has announced Gluon VM, which will be based upon Java 9

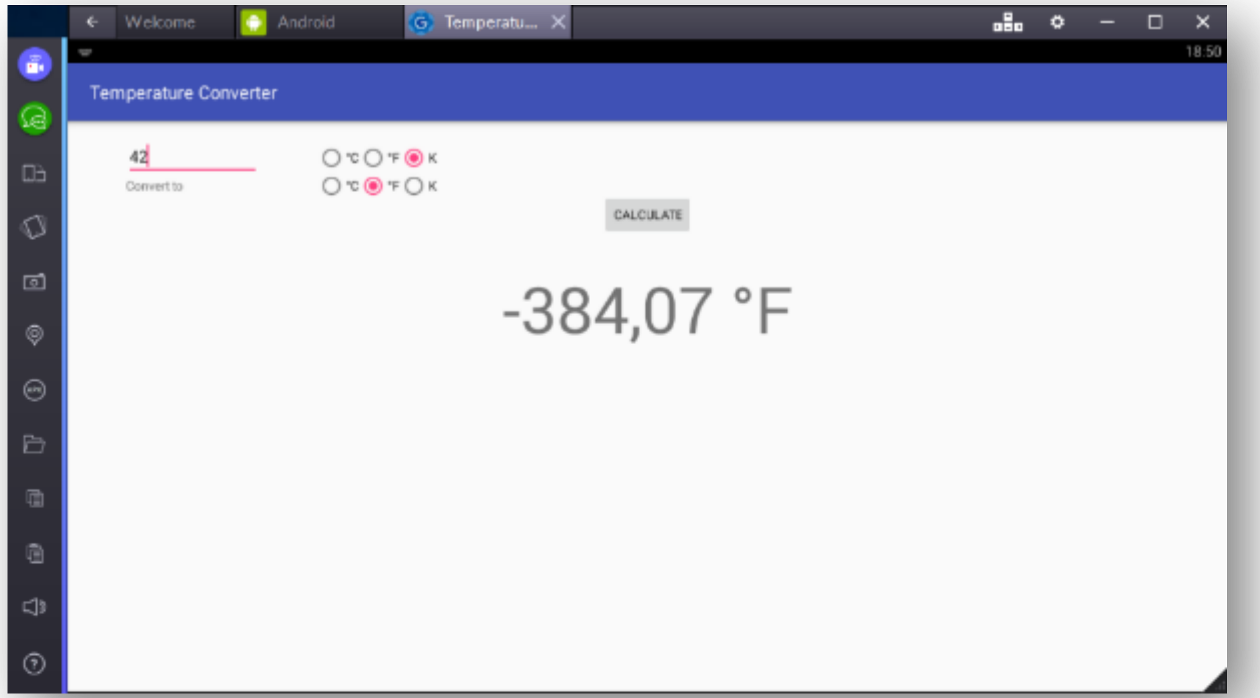
Multi-OS Engine

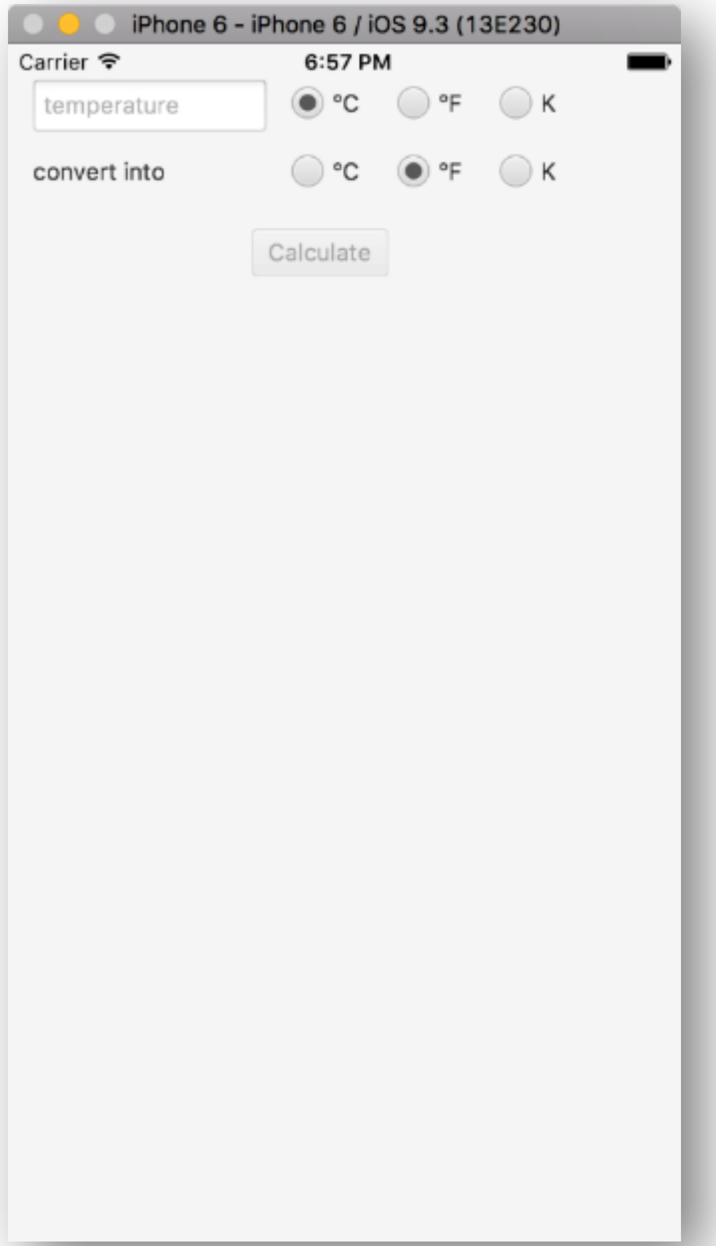
- Mobile apps for iOS and Android with native performance and native look and feel
- Develop on Macs or on Windows using remote build
- Plugins for Android Studio, IntelliJ IDEA and Eclipse

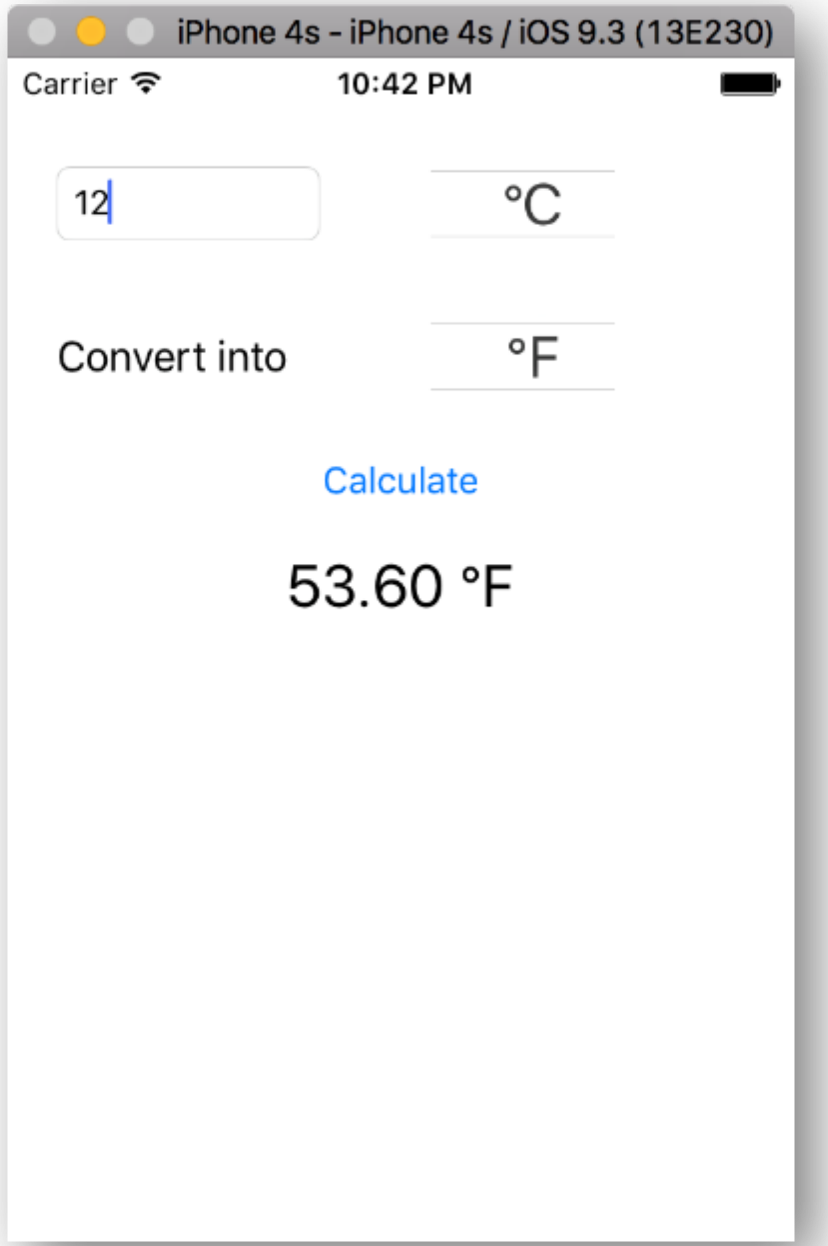
- Has been available as a technology preview; end of June 2016 Intel announced to open source Multi-OS Engine under the Apache License, Version 2.0
- Migeran is project lead and core developer
- Based upon Android Art Runtime environment and class libraries
- Java-Objective-C-bridge „Nat/J“ provides access to any Objective-C code

Start your engines









- https://github.com/tkuenneth/TemperatureConverter

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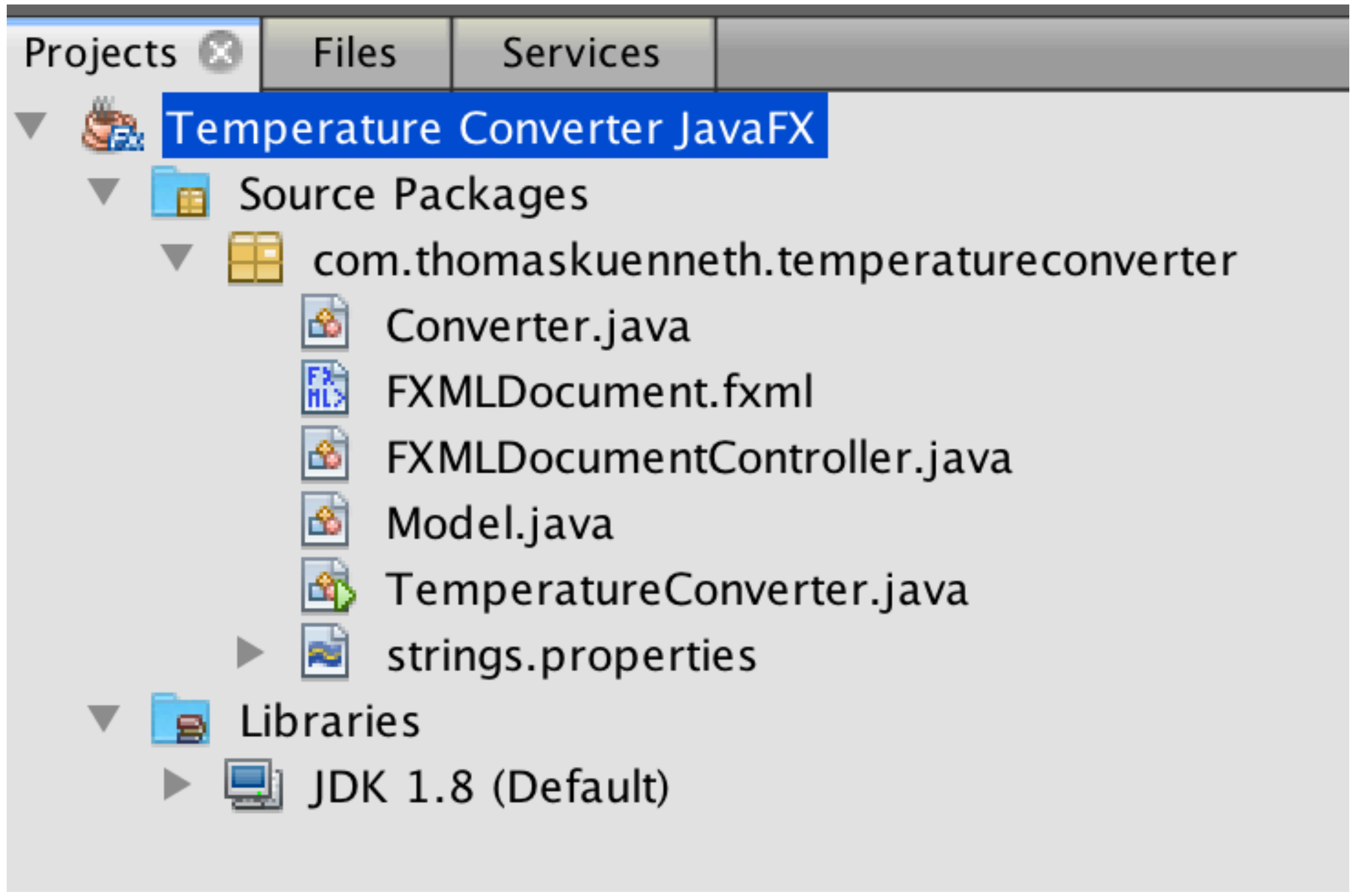
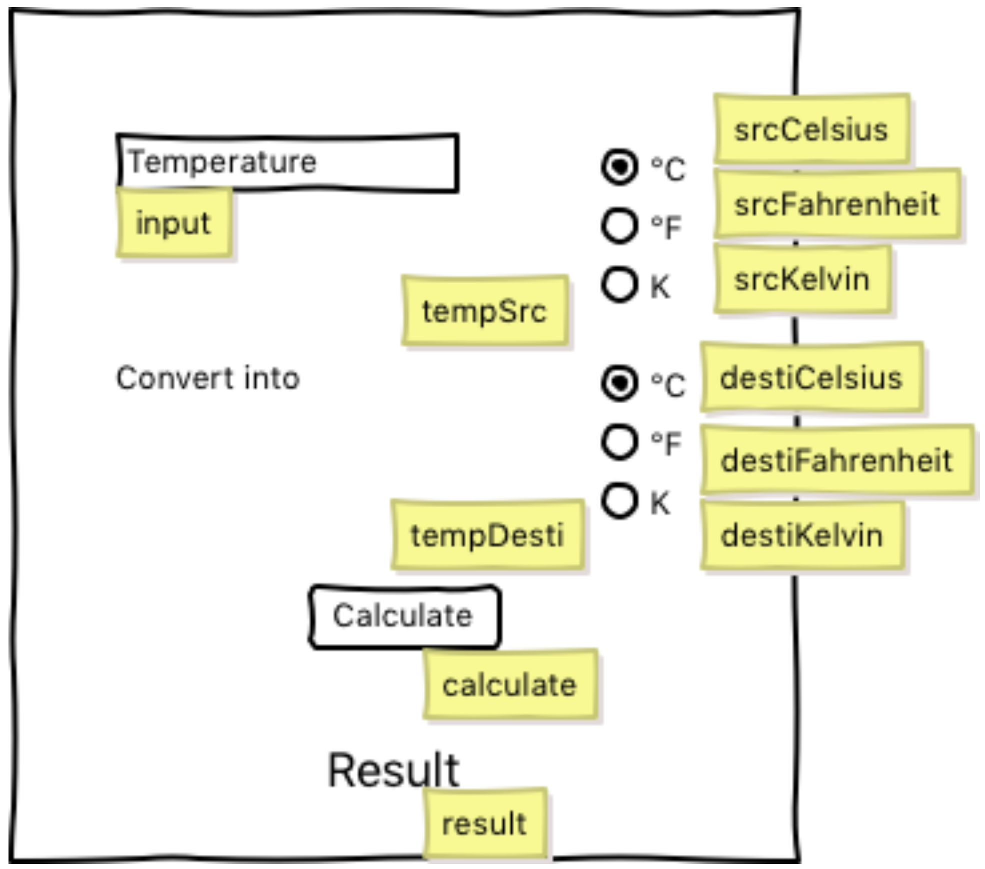
A glimpse at the JavaFX app

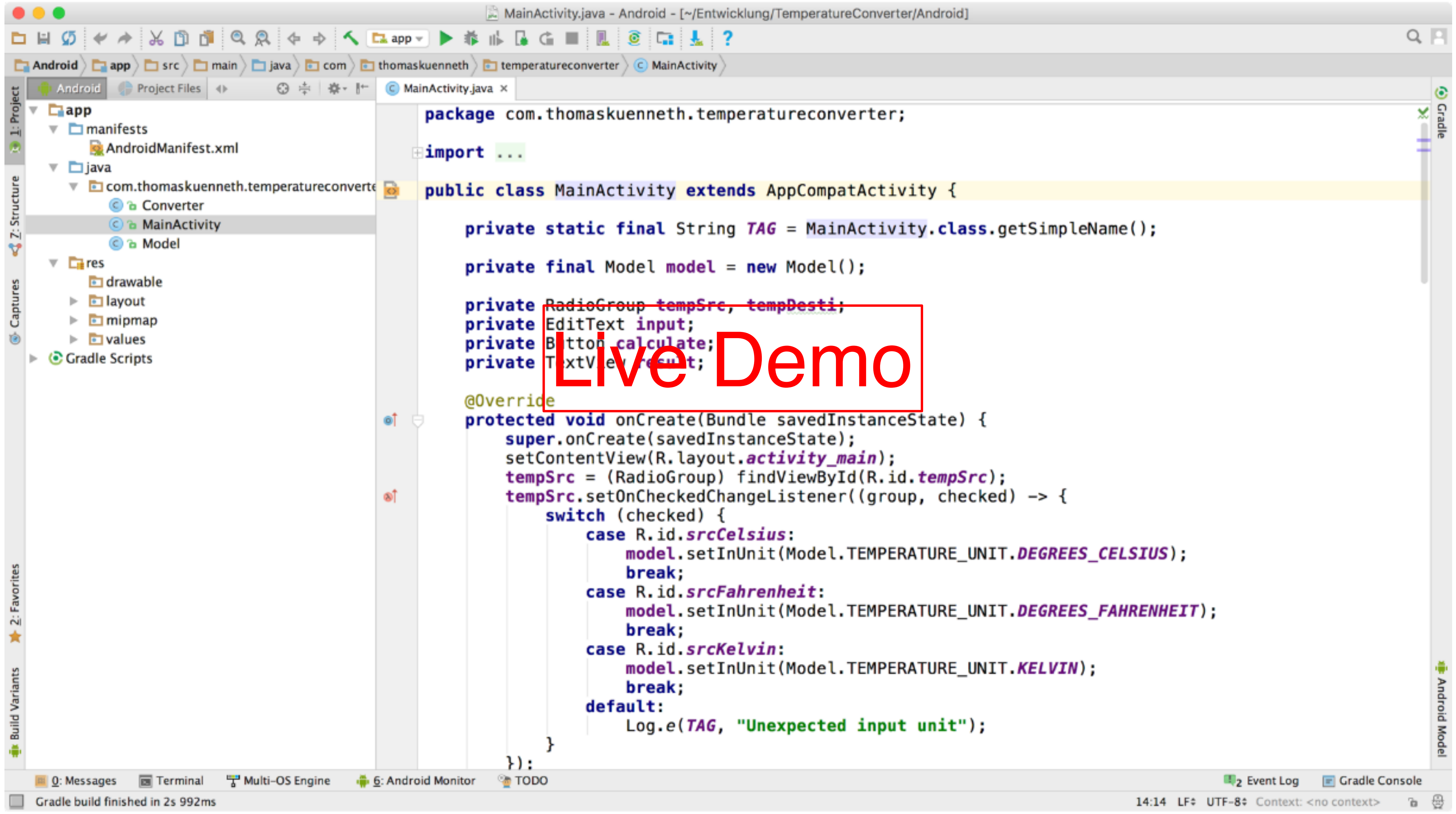


Projects | Files | Services

- Temperature Converter JavaFX
  - Source Packages
    - com.thomaskuenneth.temperatureconverter
      - Converter.java
      - FXMLDocument.fxml
      - FXMLDocumentController.java
      - Model.java
      - TemperatureConverter.java
      - strings.properties
  - Libraries
    - JDK 1.8 (Default)



Build a „pure Android“ app from scratch


MainActivity.java - Android - [~/Entwicklung/TemperatureConverter/Android]
Android > app > src > main > java > com > thomaskuenneth > temperatureconverter > MainActivity
app
manifests
AndroidManifest.xml
java
com.thomaskuenneth.temperatureconverte
Converter
MainActivity
Model
res
drawable
layout
mipmap
values
Gradle Scripts
0: Messages
Terminal
Multi-OS Engine
6: Android Monitor
TODO
Event Log
Gradle Console
Gradle build finished in 2s 992ms
Live Demo

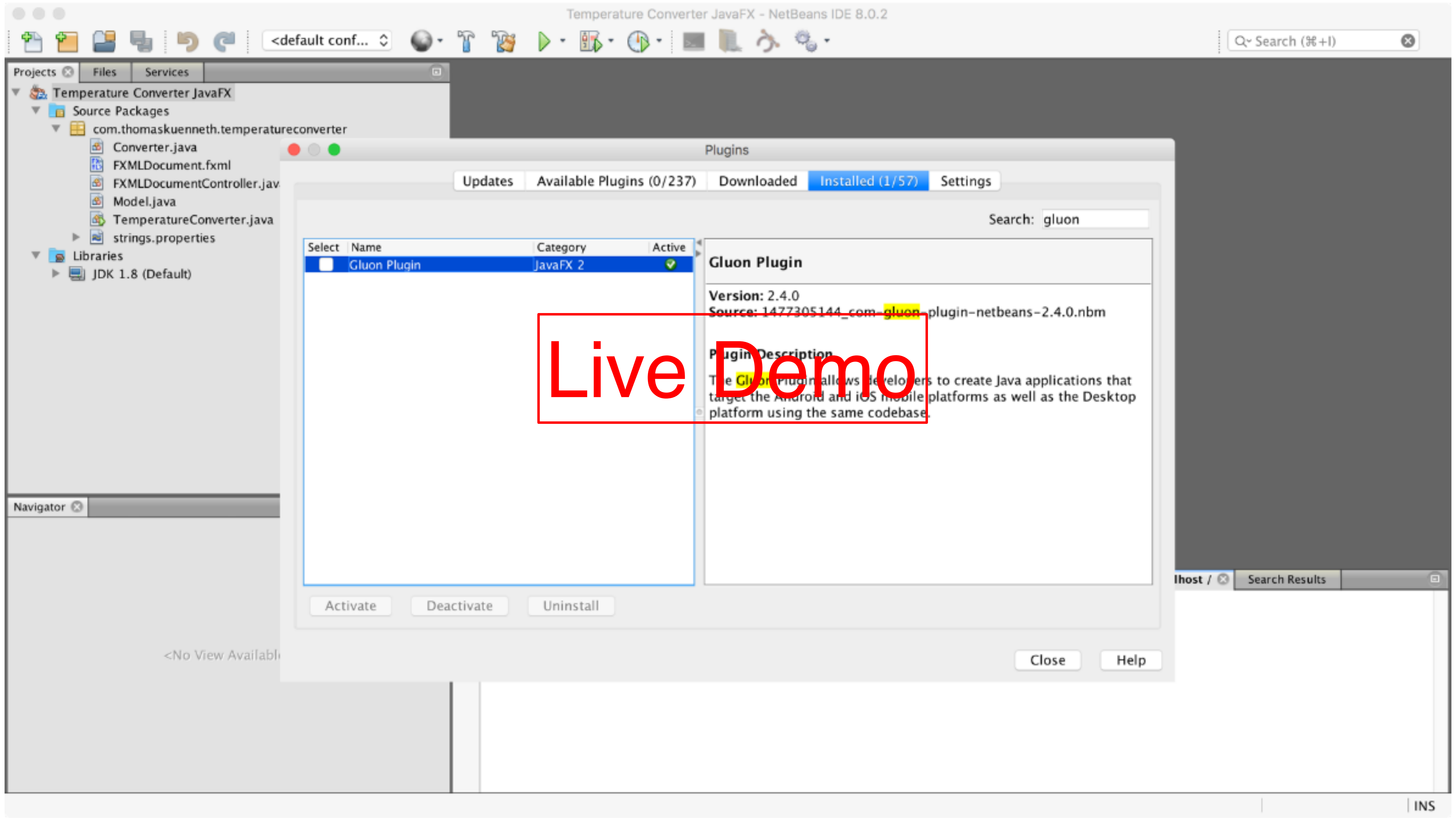
```
package com.thomaskuenneth.temperatureconverter;

import ...

public class MainActivity extends AppCompatActivity {

    private static final String TAG = MainActivity.class.getSimpleName();

    private final Model model = new Model();

    private RadioGroup tempSrc, tempDesti;
    private EditText input;
    private Button calculate;
    private TextView result;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        tempSrc = (RadioGroup) findViewById(R.id.tempSrc);
        tempSrc.setOnCheckedChangeListener((group, checked) -> {
            switch (checked) {
                case R.id.srcCelsius:
                    model.setInUnit(Model.TEMPERATURE_UNIT.DEGREES_CELSIUS);
                    break;
                case R.id.srcFahrenheit:
                    model.setInUnit(Model.TEMPERATURE_UNIT.DEGREES_FAHRENHEIT);
                    break;
                case R.id.srcKelvin:
                    model.setInUnit(Model.TEMPERATURE_UNIT.KELVIN);
                    break;
                default:
                    Log.e(TAG, "Unexpected input unit");
            }
        });
```

Prerequisites for Android apps

- Android Studio
- Android SDK
- Android Emulator or real device

- To some extent know how to use these tools

Building the app using Gluon



Search: gluon

Select	Name	Category	Active
☐	Gluon Plugin	JavaFX 2	✓

Gluon Plugin

Version: 2.4.0
Source: 1477305144_com-gluon-plugin-netbeans-2.4.0.nbm

Plugin Description

The Gluon Plugin allows developers to create Java applications that target the Android and iOS mobile platforms as well as the Desktop platform using the same codebase.

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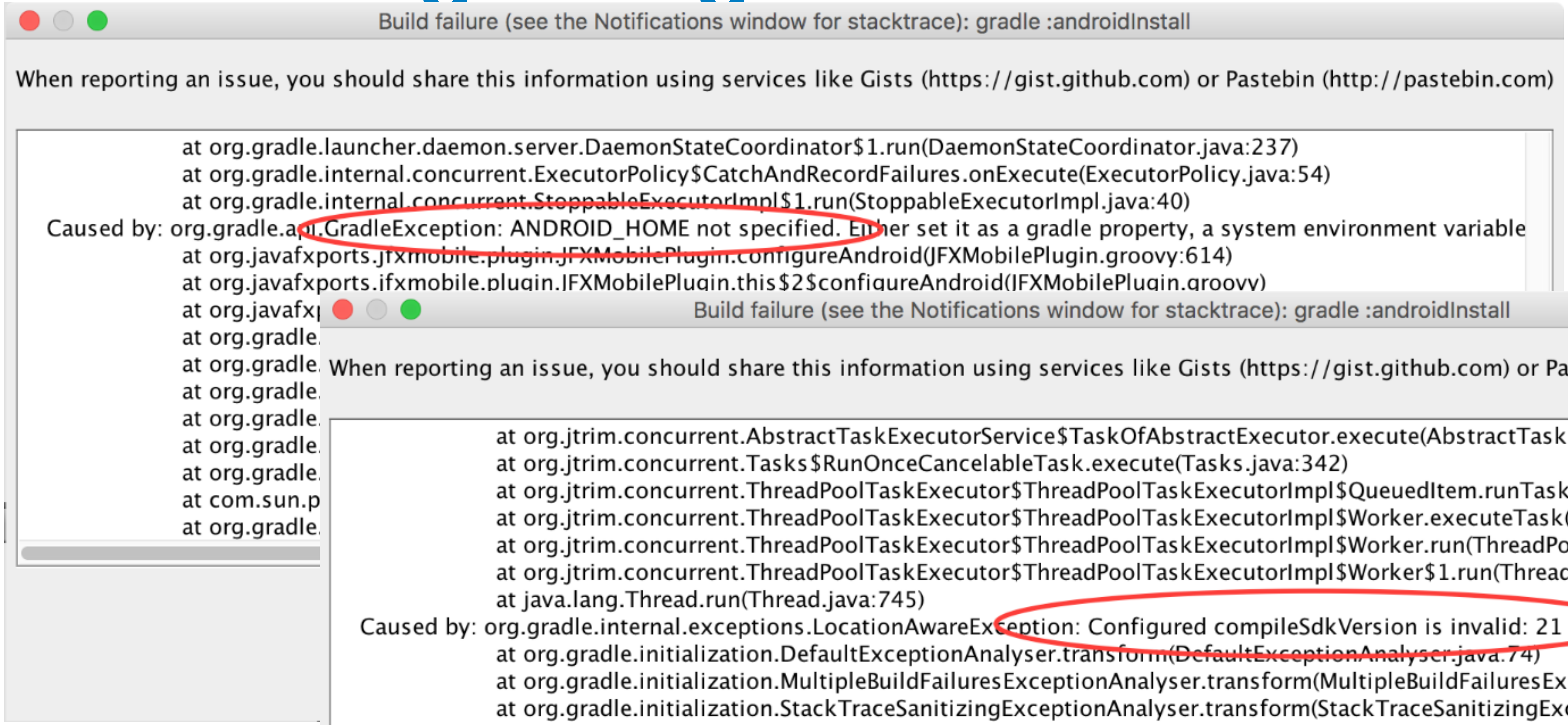
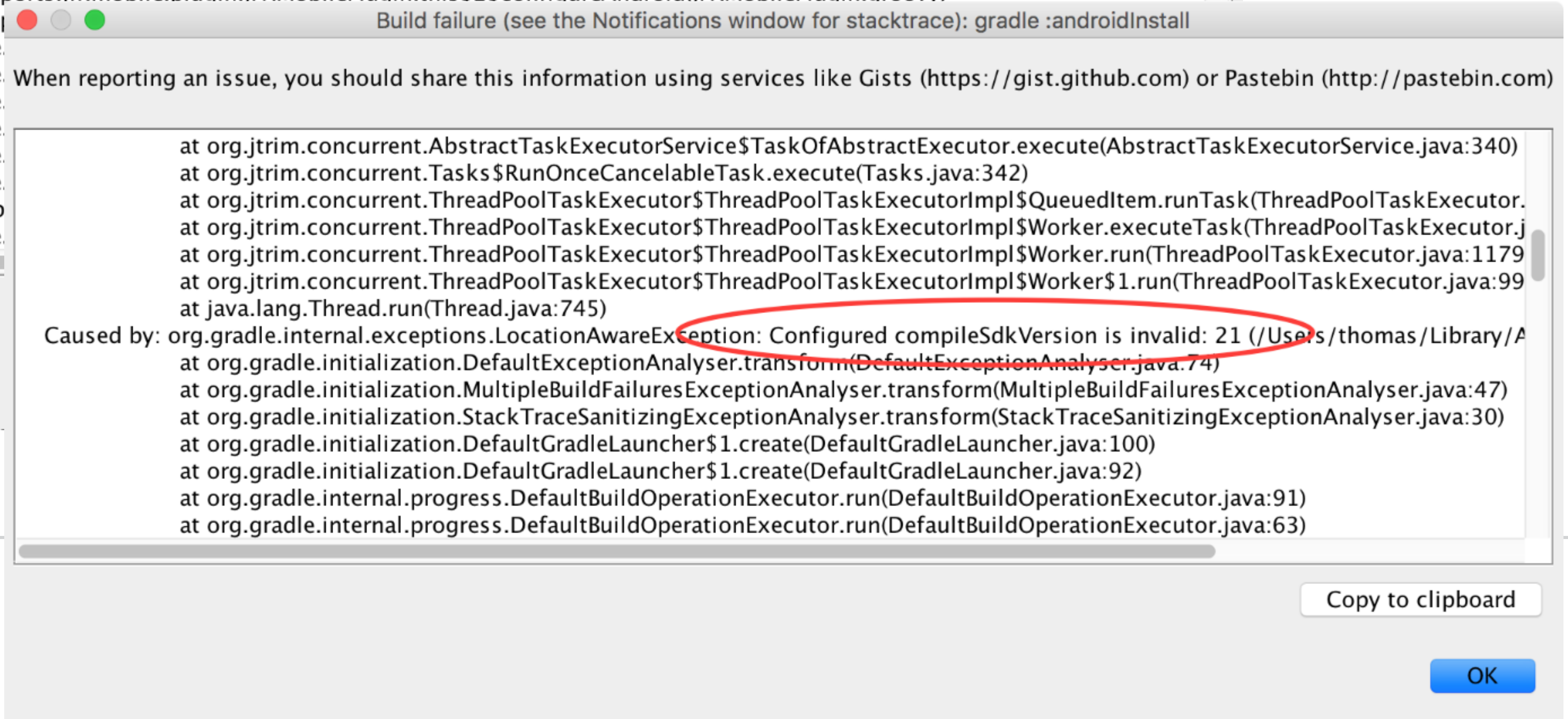
Errors regarding Android SDK


Build failure (see the Notifications window for stacktrace): gradle :androidInstall

When reporting an issue, you should share this information using services like Gists (https://gist.github.com) or Pastebin (http://pastebin.com)

```
        at org.gradle.launcher.daemon.server.DaemonStateCoordinator$1.run(DaemonStateCoordinator.java:237)
        at org.gradle.internal.concurrent.ExecutorPolicy$CatchAndRecordFailures.onExecute(ExecutorPolicy.java:54)
        at org.gradle.internal.concurrent.StoppableExecutorImpl$1.run(StoppableExecutorImpl.java:40)
Caused by: org.gradle.api.GradleException: ANDROID_HOME not specified. Either set it as a gradle property, a system environment variable
        at org.javafxports.jfxmobile.plugin.JFXMobilePlugin.configureAndroid(JFXMobilePlugin.groovy:614)
        at org.javafxports.jfxmobile.plugin.JFXMobilePlugin.this$2$configureAndroid(JFXMobilePlugin.groovy)
        at org.javafx
        at org.gradle.
        at org.gradle.
        at org.gradle.
        at org.gradle.
        at org.gradle.
        at org.gradle.
        at com.sun.p
        at org.gradle.
```


Build failure (see the Notifications window for stacktrace): gradle :androidInstall

When reporting an issue, you should share this information using services like Gists (https://gist.github.com) or Pastebin (http://pastebin.com)

```
        at org.jtrim.concurrent.AbstractTaskExecutorService$TaskOfAbstractExecutor.execute(AbstractTaskExecutorService.java:340)
        at org.jtrim.concurrent.Tasks$RunOnceCancelableTask.execute(Tasks.java:342)
        at org.jtrim.concurrent.ThreadPoolTaskExecutor$ThreadPoolTaskExecutorImpl$QueuedItem.runTask(ThreadPoolTaskExecutor.
        at org.jtrim.concurrent.ThreadPoolTaskExecutor$ThreadPoolTaskExecutorImpl$Worker.executeTask(ThreadPoolTaskExecutor.j
        at org.jtrim.concurrent.ThreadPoolTaskExecutor$ThreadPoolTaskExecutorImpl$Worker.run(ThreadPoolTaskExecutor.java:1179
        at org.jtrim.concurrent.ThreadPoolTaskExecutor$ThreadPoolTaskExecutorImpl$Worker$1.run(ThreadPoolTaskExecutor.java:99
        at java.lang.Thread.run(Thread.java:745)
Caused by: org.gradle.internal.exceptions.LocationAwareException: Configured compileSdkVersion is invalid: 21 (/Users/thomas/Library/A
        at org.gradle.initialization.DefaultExceptionAnalyser.transform(DefaultExceptionAnalyser.java:74)
        at org.gradle.initialization.MultipleBuildFailuresExceptionAnalyser.transform(MultipleBuildFailuresExceptionAnalyser.java:47)
        at org.gradle.initialization.StackTraceSanitizingExceptionAnalyser.transform(StackTraceSanitizingExceptionAnalyser.java:30)
        at org.gradle.initialization.DefaultGradleLauncher$1.create(DefaultGradleLauncher.java:100)
        at org.gradle.initialization.DefaultGradleLauncher$1.create(DefaultGradleLauncher.java:92)
        at org.gradle.internal.progress.DefaultBuildOperationExecutor.run(DefaultBuildOperationExecutor.java:91)
        at org.gradle.internal.progress.DefaultBuildOperationExecutor.run(DefaultBuildOperationExecutor.java:63)
```

Easily fixed

- Set environment variable ANDROID_HOME to the Android SDK:
  export ANDROID_HOME=/Users/thomas/Library/Android/sdk/
- OR: put androidSdk=... in build.gradle

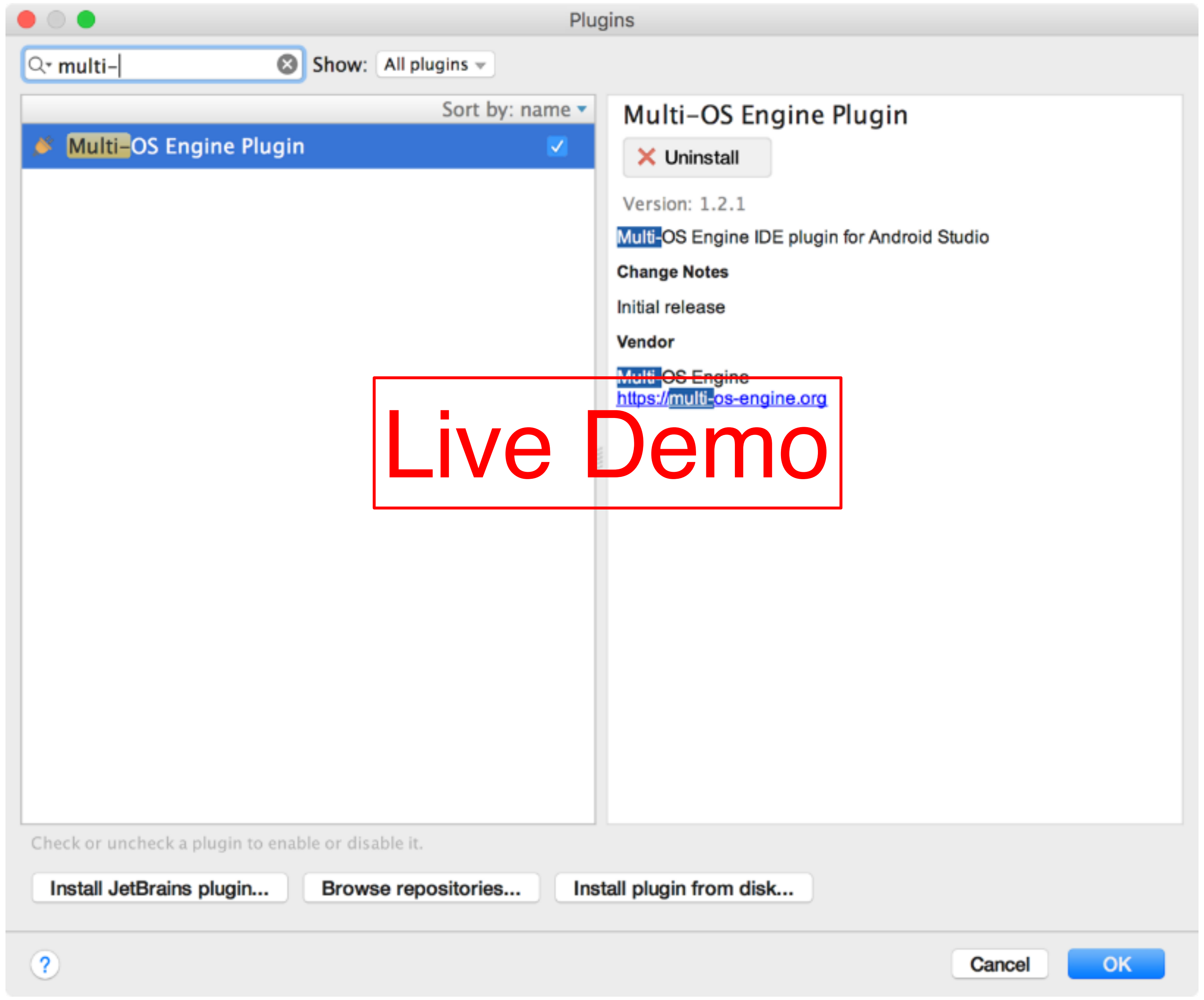
- Download appropriate Android platform
- OR: put compileSdkVersion=... in build.gradle

Prerequisites for iOS apps

- computer running macOS
- Xcode and Xcode commandline tools
- iOS Simulator or a real device

- To some extent know how to use thesm

Building the app with Multi-OS Engine



Multi-OS Engine Plugin

Multi-OS Engine Plugin

Version: 1.2.1

Multi-OS Engine IDE plugin for Android Studio

Change Notes

Initial release

Vendor

Multi-OS Engine
https://multi-os-engine.org

Check or uncheck a plugin to enable or disable it.

Live Demo

Wrap up

- Apps are truely native
- UI may be depending on the solution being used
- Heavy code-reuse possible
- Existing knowledge can be leveraged
- Fair amount of knowledge regarding native tools needed
- To build native ui, the underlying concepts must be mastered

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