Programmation Android

I. Introduction

Plan

Application mobile

wikipédia

Caractéristiques

- Cible : **appareil électronique mobile** (smartphone, tablette, etc.)
- **Contexte logiciel** :
  - **non connecté** : agenda, baladeur, ...
  - **localisé** : navigation **GPS**, travaux géolocalisés (e.g. photographie)
  - **connecté** : tout **Internet**... avec un contexte mobile !
  - ...
- **Contexte matériel** :
  - **ressources plus faibles** : CPU / RAM / DD / ROM
  - $\Rightarrow$ la **consommation** des ressources doit être **minimale**
  - $\Rightarrow$ **Résolutions d'affichage hétéroclites** $\Rightarrow$ **GUI adaptative**
  - ...

Application mobile

Principaux OS

- **Android** (Google) : Linux, version 8.1 (décembre 2017)
- **BlackBerry** OS, **QNX** : Unix (arrêté en 2015)
- **iOS** (Apple) noyau hybride XNU : Mach(libre) + BSD (Unix)
- **Ubuntu Touch** (Canonical) : Linux (arrêté en avril 2017)
- **Windows 10 mobile** (Microsoft) (arrêté en octobre 2017)
- **Tizen** (*Linux Foundation*), supporté par Samsung (montres connectées)
- **Firefox OS** (Mozilla Corporation) : Linux (arrêté en 2015)
- ▸ plus d'information

Android

Origine

- Initialement un OS pour appareil photo
- Acheté par Google en 2005
- ▸ Wikipédia

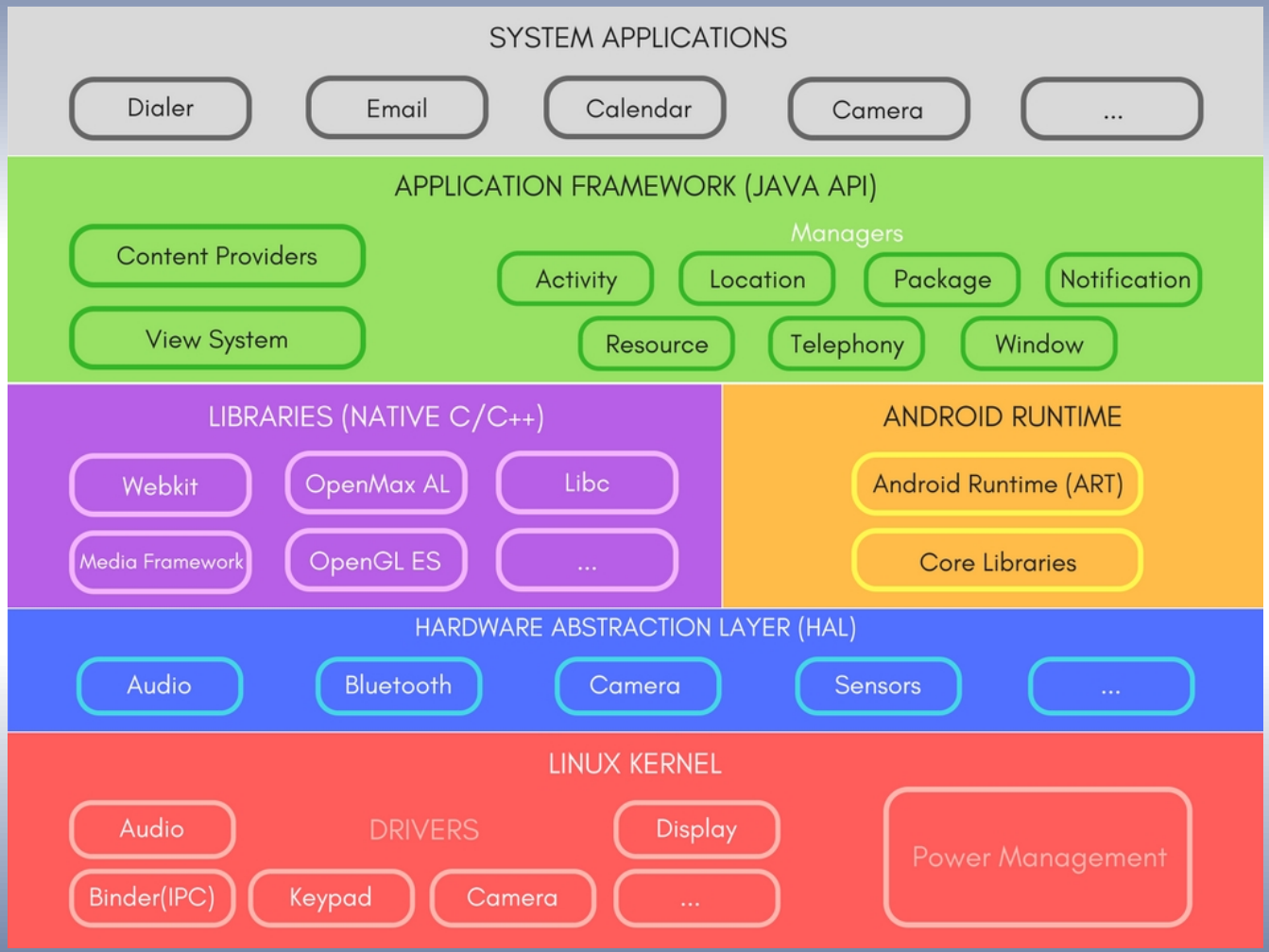
Diffusion

Google I/O, mai 2017

Répartition des différentes versions (accès au Play Store)

▸ Statistiques

Architecture globale

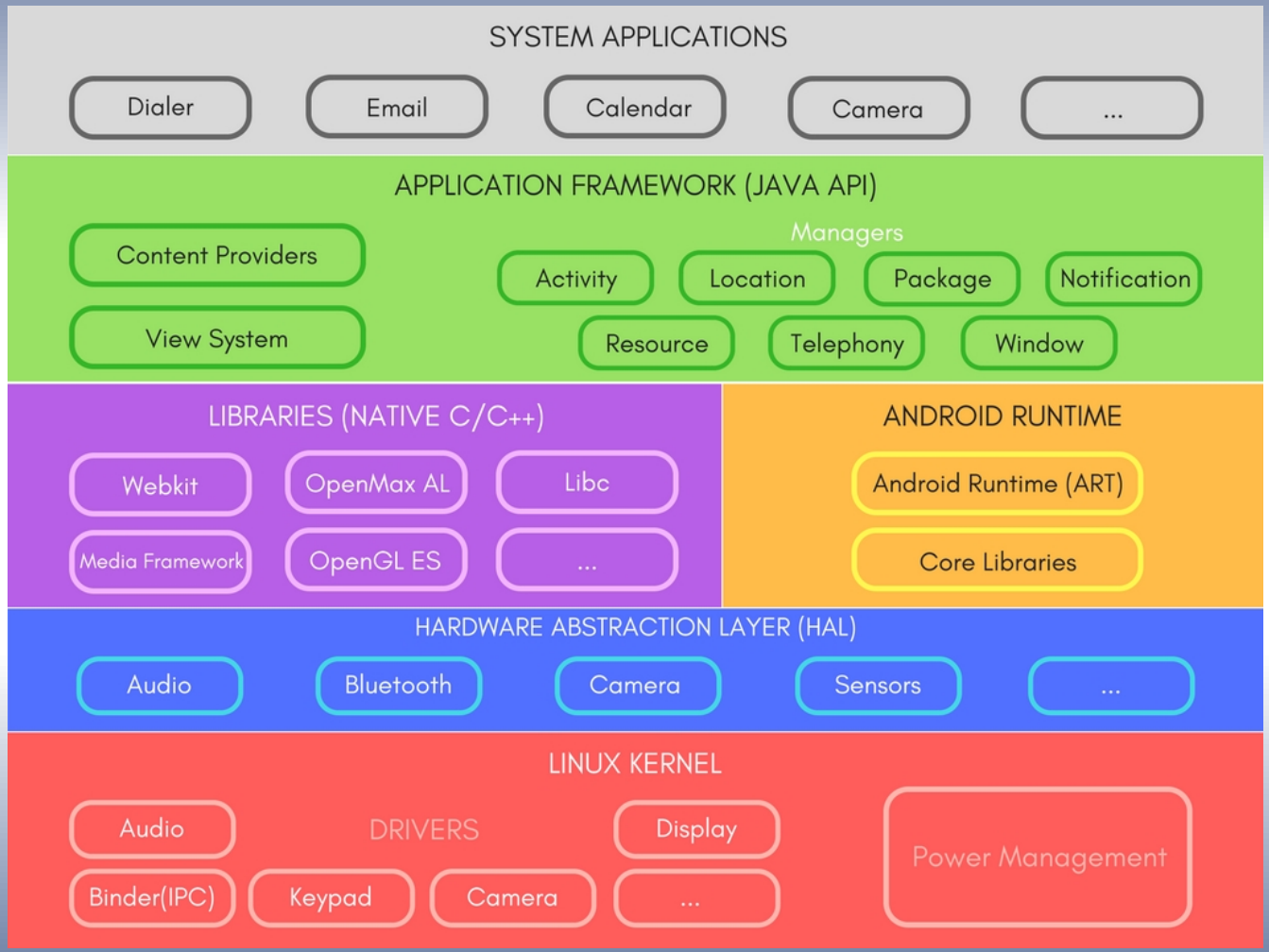


Libraries

Librairies C/C++ libres ⇒

- **Surface Manager** : affichage 2D/3D
- **Media Framework** : codecs basés sur librairie OpenCORE
- **SQLite** : moteur de base de données relationelle
- **OpenGL|ES** : implémentation OpenGL pour l'embarqué
- **FreeType** : rendu bitmap de polices vectorielles
- **WebKit** : moteur de rendu de pages Web
- **SGL** : moteur graphique 2D
- **SSL** : communications réseaux sécurisées
- **libc** : dérivé de la librairie C (BSD) pour l'embarqué (Bionic libc)

Architecture : Application Framework



Application framework 1/2

Modules $\Rightarrow$

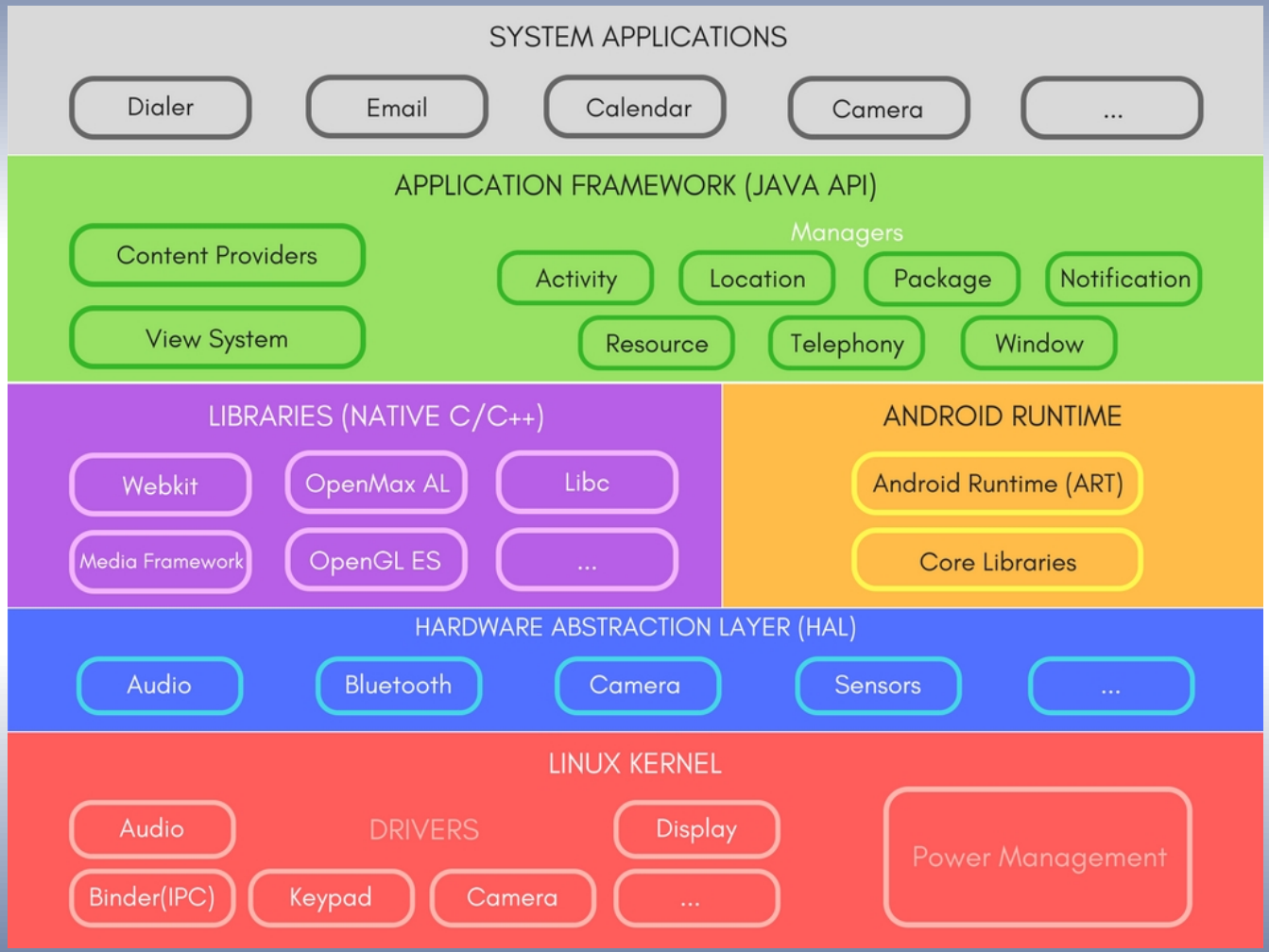
- **Content Providers** : gestion de l'accès aux données (appli et autres applis)
- **View System** : gestion des composants graphiques et des événements utilisateurs liés
- **Activity Manager** : cycle de vie et navigation entre applications
- **Location Manager** : accès aux fonctions de localisation

Application framework 2/2

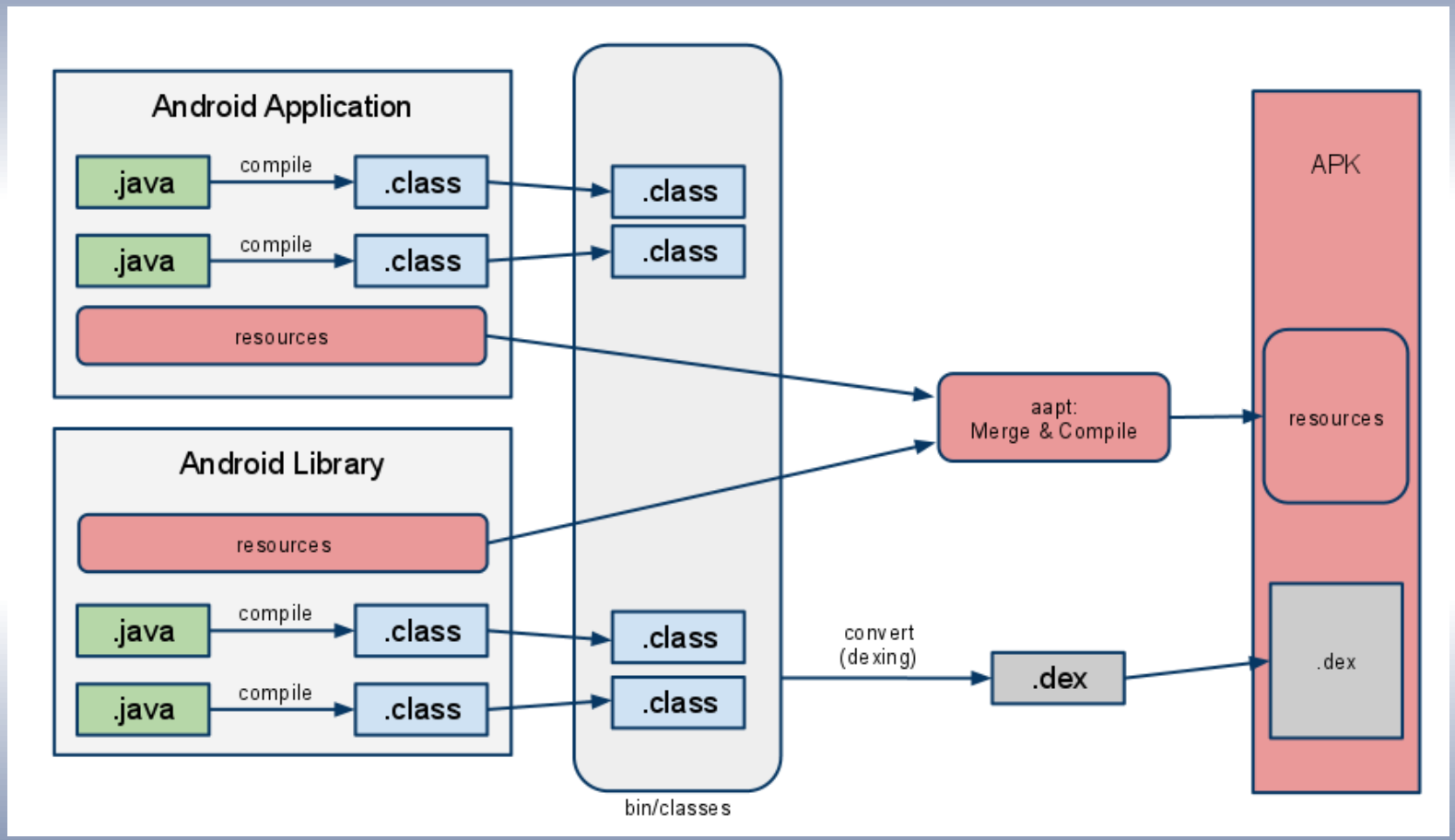
Modules ⇒

- **Package Manager** : accès aux API tierces installées
- **Notification Manager** : gestion du système de notifications
- **Resource Manager** : gestion des ressources (images, définition des layouts, etc.)
- **Telephony Manager** : accès aux services de téléphonie
- **Window Manager** : gestion GUI (z-ordered, mise en page, etc.)

Architecture : Android Runtime



Construction d'un APK



Prérequis

Créer une application Android :

Connaissances Techniques

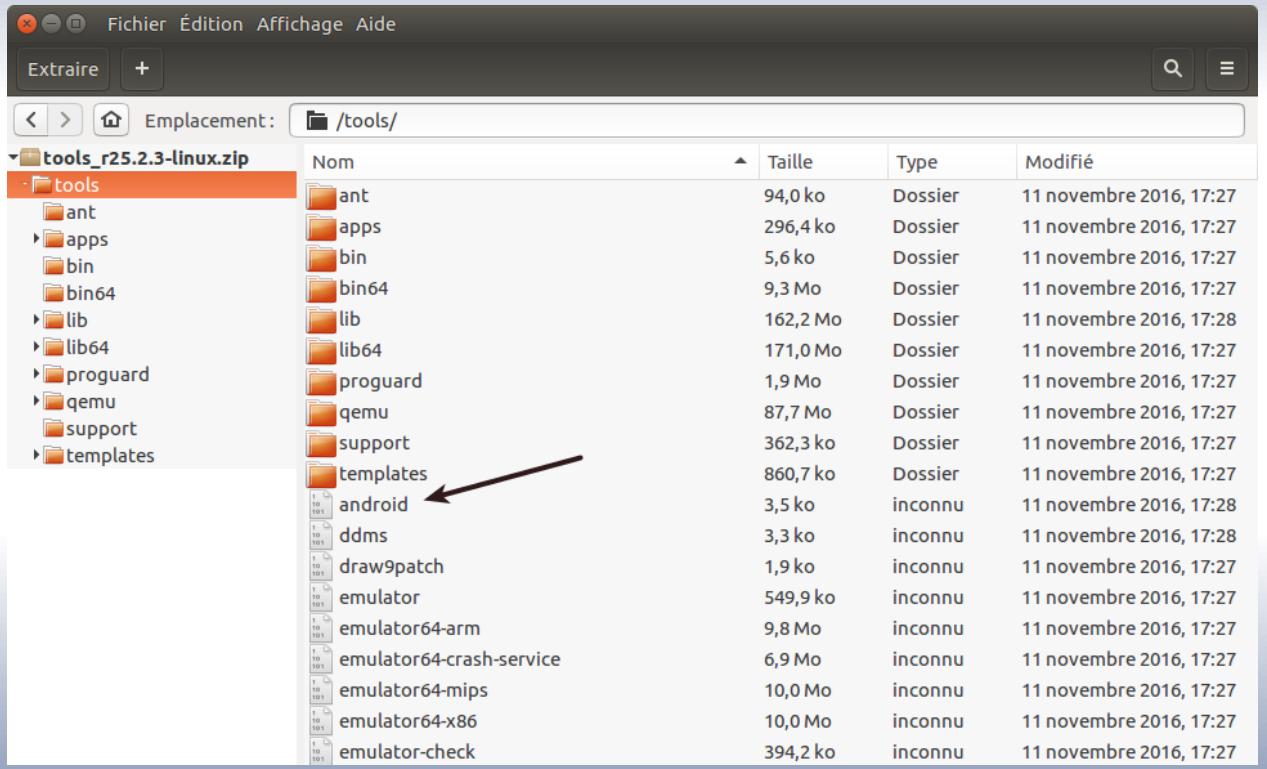
- Android (runtime + framework) $\Rightarrow$ **POO + Java**

Outils logiciels

- **Java Runtime Environment (JRE) pour exécuter les outils Android**
- **Android SDK** ▸ téléchargement
- **Android Virtual Device Manager (AVD), contenu dans le Android SDK**
- un IDE

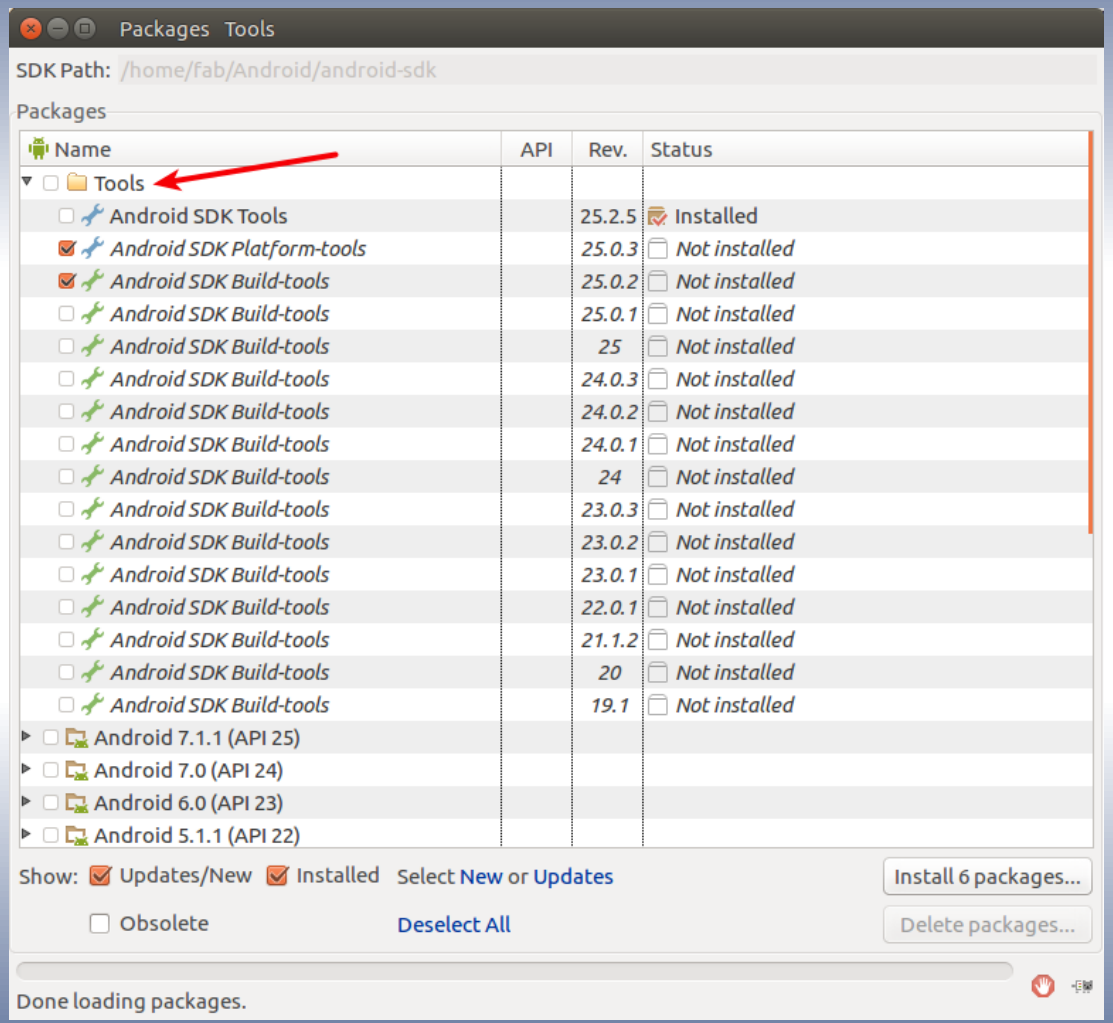
Android SDK : téléchargement

décompression dans un répertoire, e.g. Android-sdk.
SDK_PATH dans la suite)

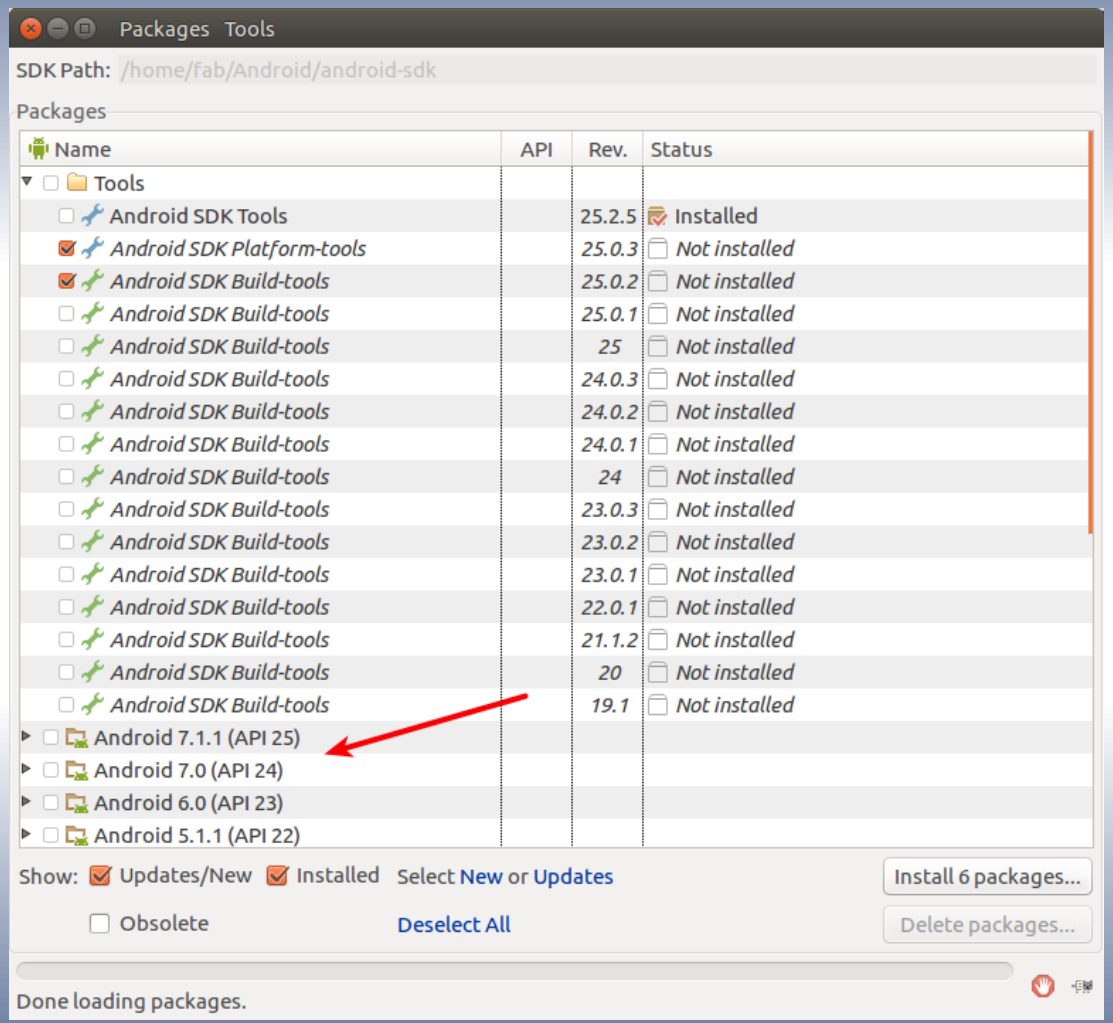


Lancement du SDK manager : SDK_PATH/tools/**android** (sans argument)

Le SDK Manager : tools



Le SDK Manager : Android APIs



Le SDK Manager : Extras

Packages Tools

SDK Path: /home/fab/Android/android-sdk

Packages

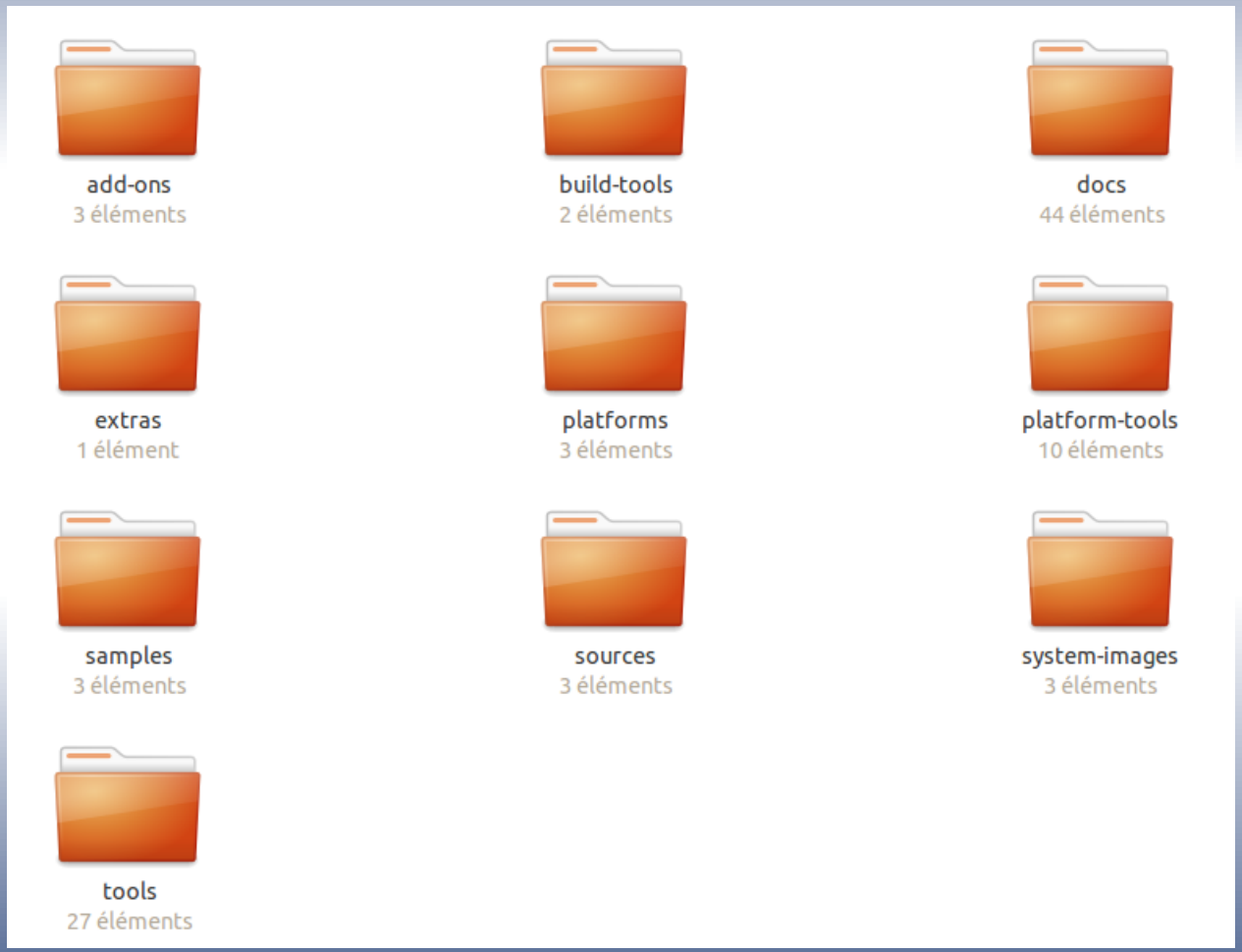
Name	API	Rev.	Status
Android 4.0.3 (API 15)			
Android 4.0 (API 14)			
Android 3.2 (API 13)			
Android 3.1 (API 12)			
Android 3.0 (API 11)			
Android 2.3.3 (API 10)			
Android 2.3.1 (API 9)			
Android 2.2 (API 8)			
Android 2.1 (API 7)			
Extras			
Android Support Repository		*41*	*Not installed*
Android Auto Desktop Head Unit emulator		*1.1*	*Not installed*
Google Play services		*38*	*Not installed*
Google Repository		*42*	*Not installed*
Google Play APK Expansion library		*1*	*Not installed*
Google Play Licensing Library		*1*	*Not installed*
Google Play Billing Library		*5*	*Not installed*
Android Auto API Simulators		*1*	*Not installed*
Google USB Driver		*11*	*Not compatible with Linux*
Google Web Driver		*2*	*Not installed*
Intel x86 Emulator Accelerator (HAXM installer)		*6.0.5*	*Not compatible with Linux*

Show: Updates/New Installed Select New or Updates — Install 6 packages...

Obsolete — Deselect All — Delete packages...

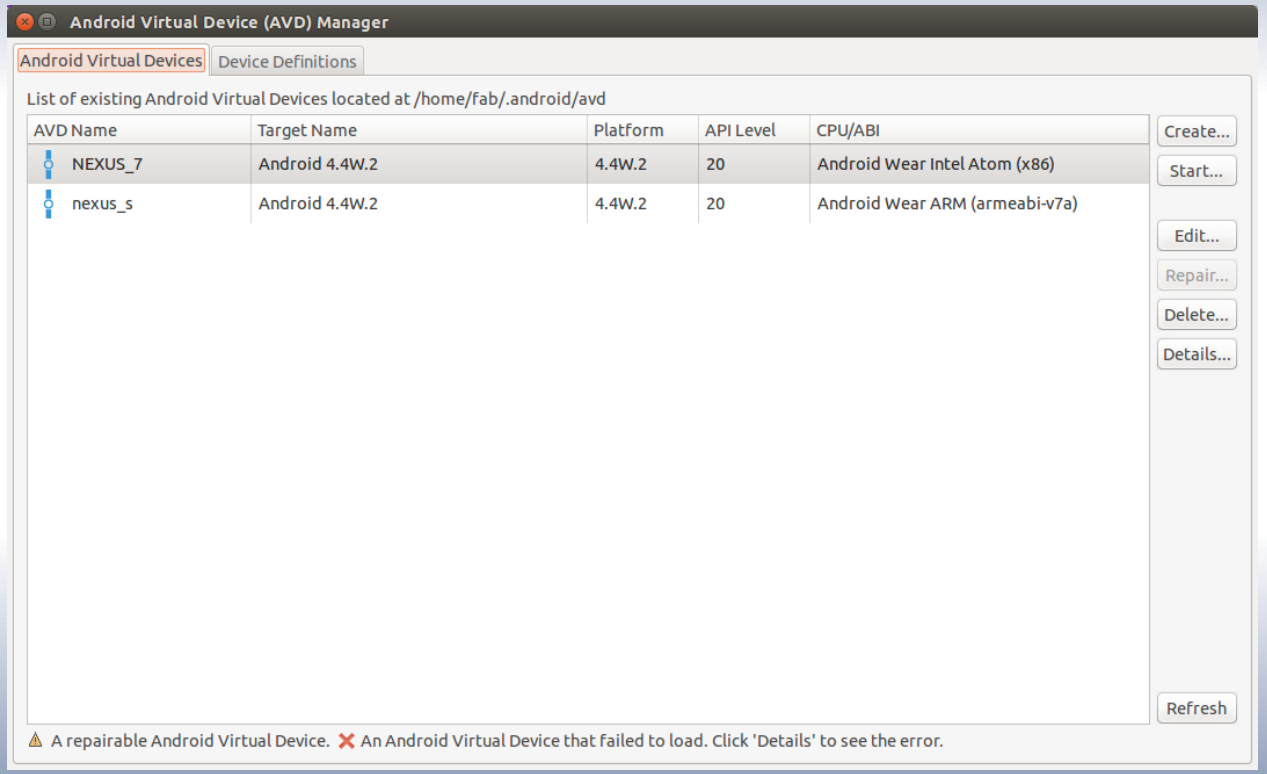
Done loading packages.

SDK_PATH/ après téléchargement (plusieurs Go)



Android Virtual Device Manager (AVD)

Lancement AVD : **SDK_PATH/tools/android avd**



Outils requis

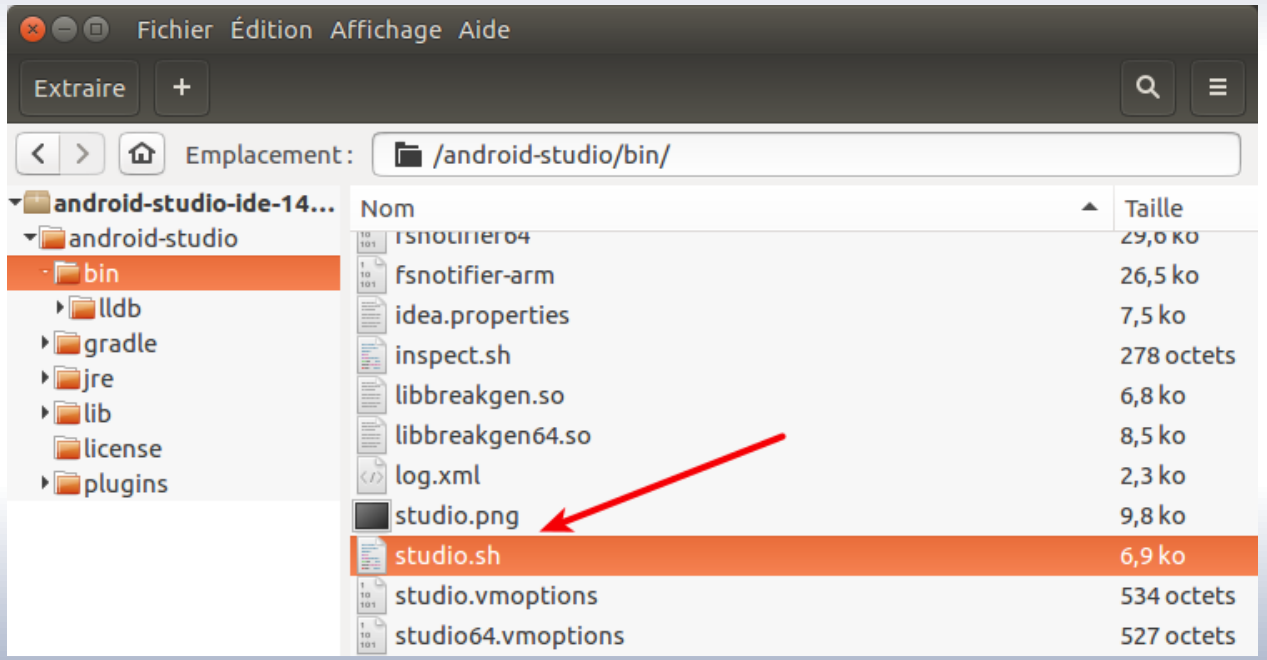
IDE pour programmer une application Android :

2 solutions :

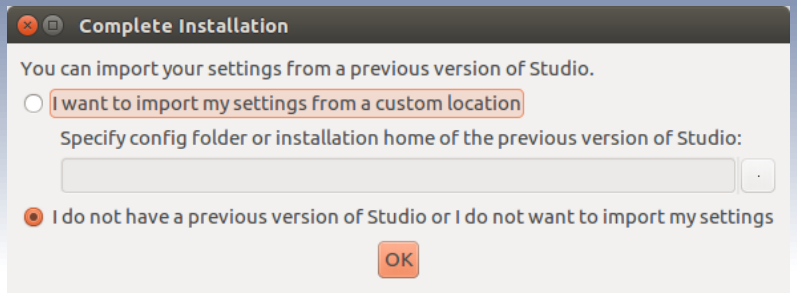
- Eclipse avec le plugin **Andmore** : ▸ taper android dans le marketplace d'Eclipse
- Android Studio (supporté par Google) : ▸ https://developer.android.com/studio

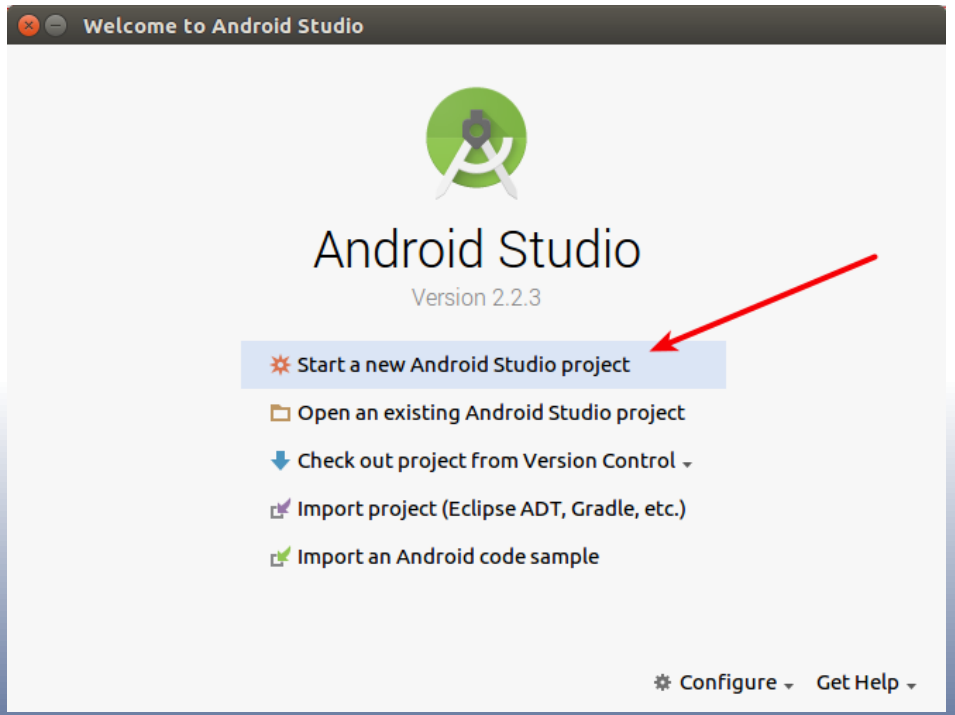
Android Studio

Contenu de l'archive (téléchargera tout le reste : tools, sdk, etc.)

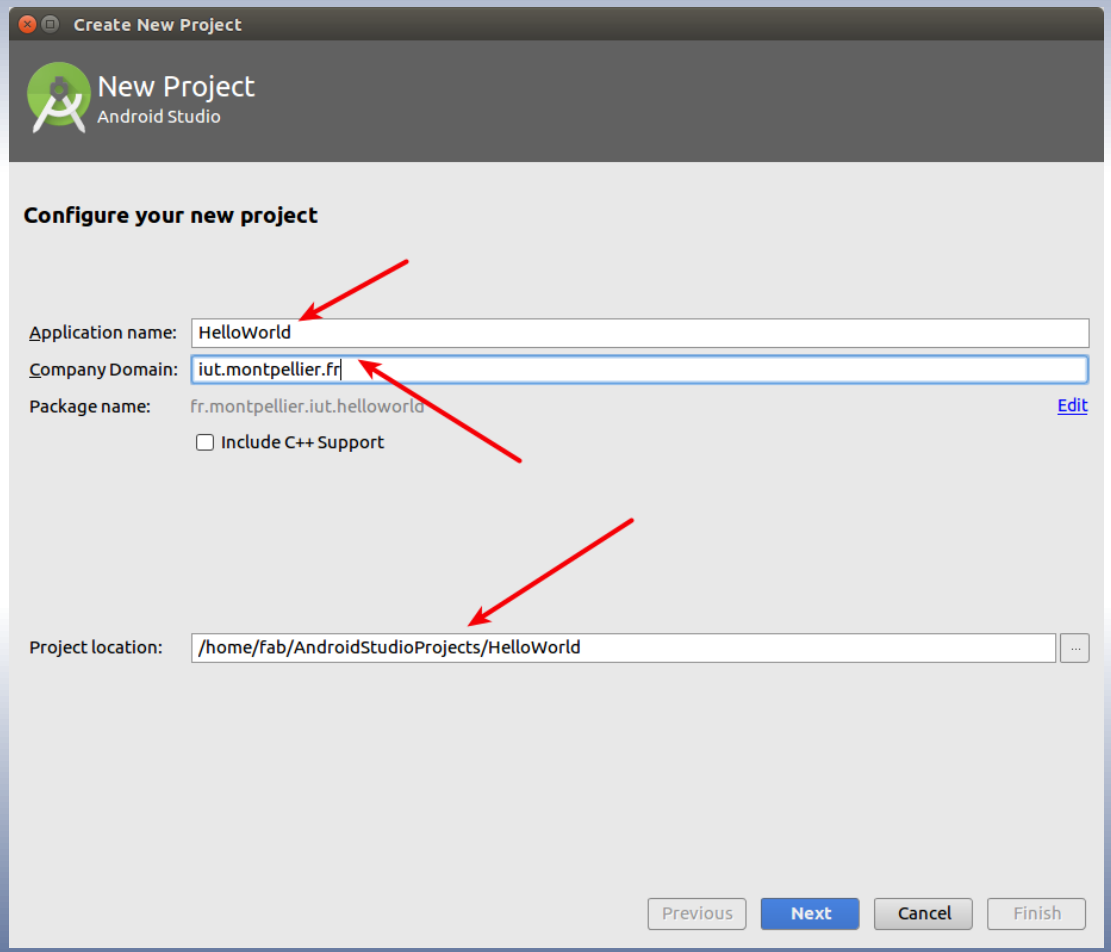


Android Studio

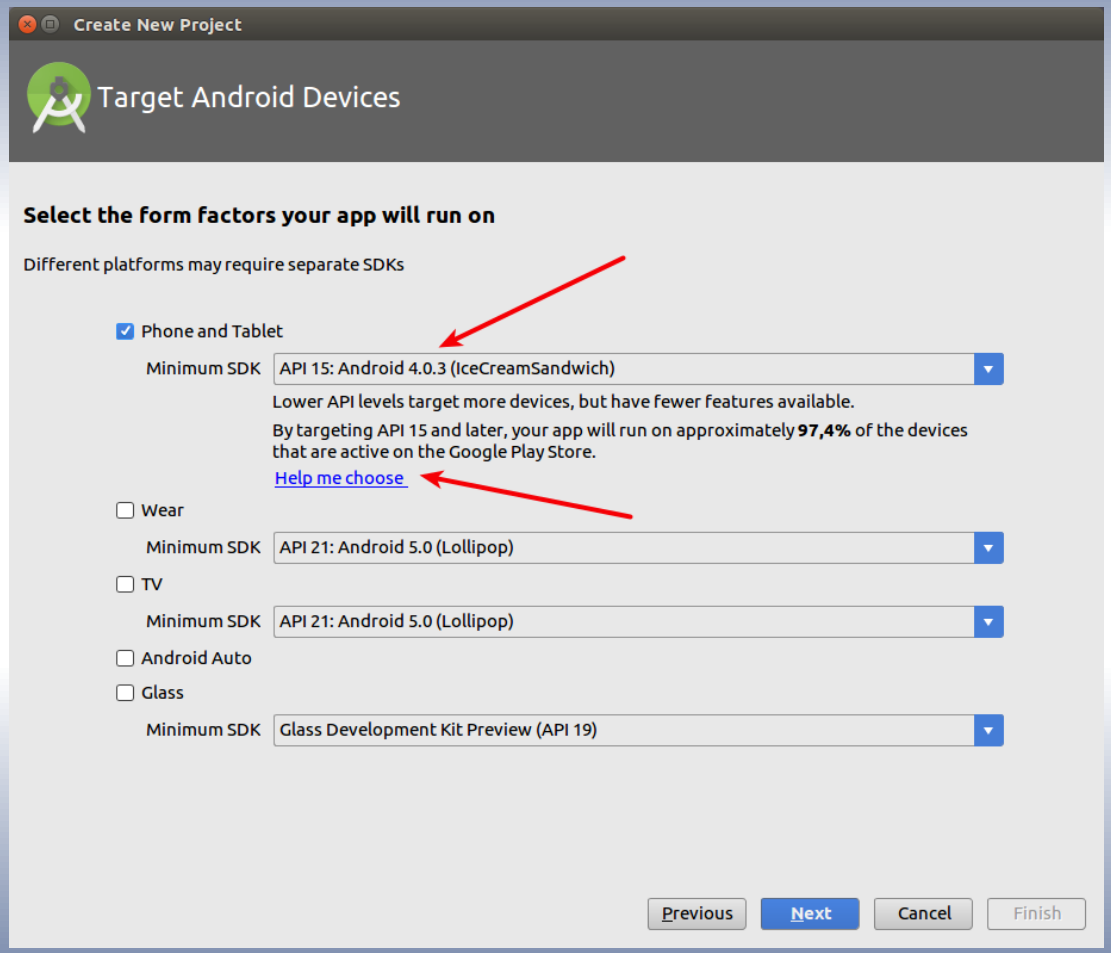




New project : 1. caractéristiques principales



2. Sélection de l'API Minimum



2. Sélection de l'API Minimum

Android Platform/API Version Distribution

ANDROID PLATFORM VERSION	API LEVEL	CUMULATIVE DISTRIBUTION
2.3 Gingerbread	10	
4.0 Ice Cream Sandwich	15	97,4%
4.1 Jelly Bean	16	95,2%
4.2 Jelly Bean	17	87,4%
4.3 Jelly Bean	18	76,9%
4.4 KitKat	19	73,9%
5.0 Lollipop	21	40,5%
5.1 Lollipop	22	24,1%
6.0 Marshmallow	23	4,7%

Ice Cream Sandwich

Contacts Provider

Social APIs
User profile
Invite intent
Large photos

Calendar Provider

Calendar APIs
Event intents

Voicemail Provider

Add voicemails to the device

Multimedia

Media effects for images and videos
Remote control client
Improved media player

Camera

Face detection
Focus and metering areas
Continuous auto focus
Camera broadcast intents

Connectivity

Android Beam for NDEF push with NFC
Wi-Fi P2P connections
Bluetooth health profile
Network usage and controls

Accessibility

Explore-by-touch mode
Accessibility for views
Accessibility services
Improved text-to-speech engine support

User Interface

Spell checker services
Improved action bar
Grid layout
Texture view
Switch widget
Improved popup menus
System themes
Controls for system UI visibility
Hover event support
Hardware acceleration for all windows

Enterprise

VPN services
Device policies
Certificate management

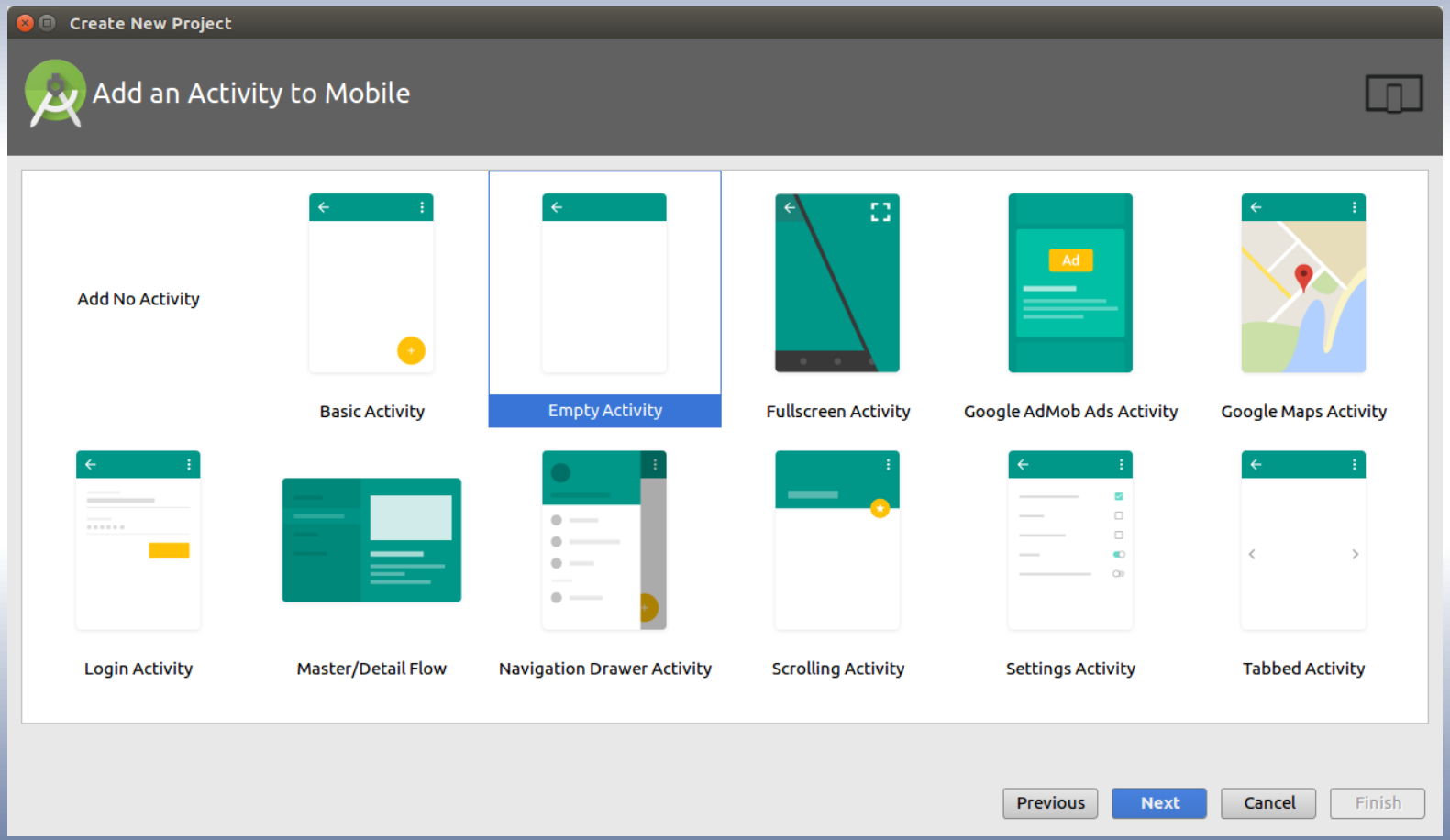
Device Sensors

Improved sensors
Temperature sensor
Humidity sensor

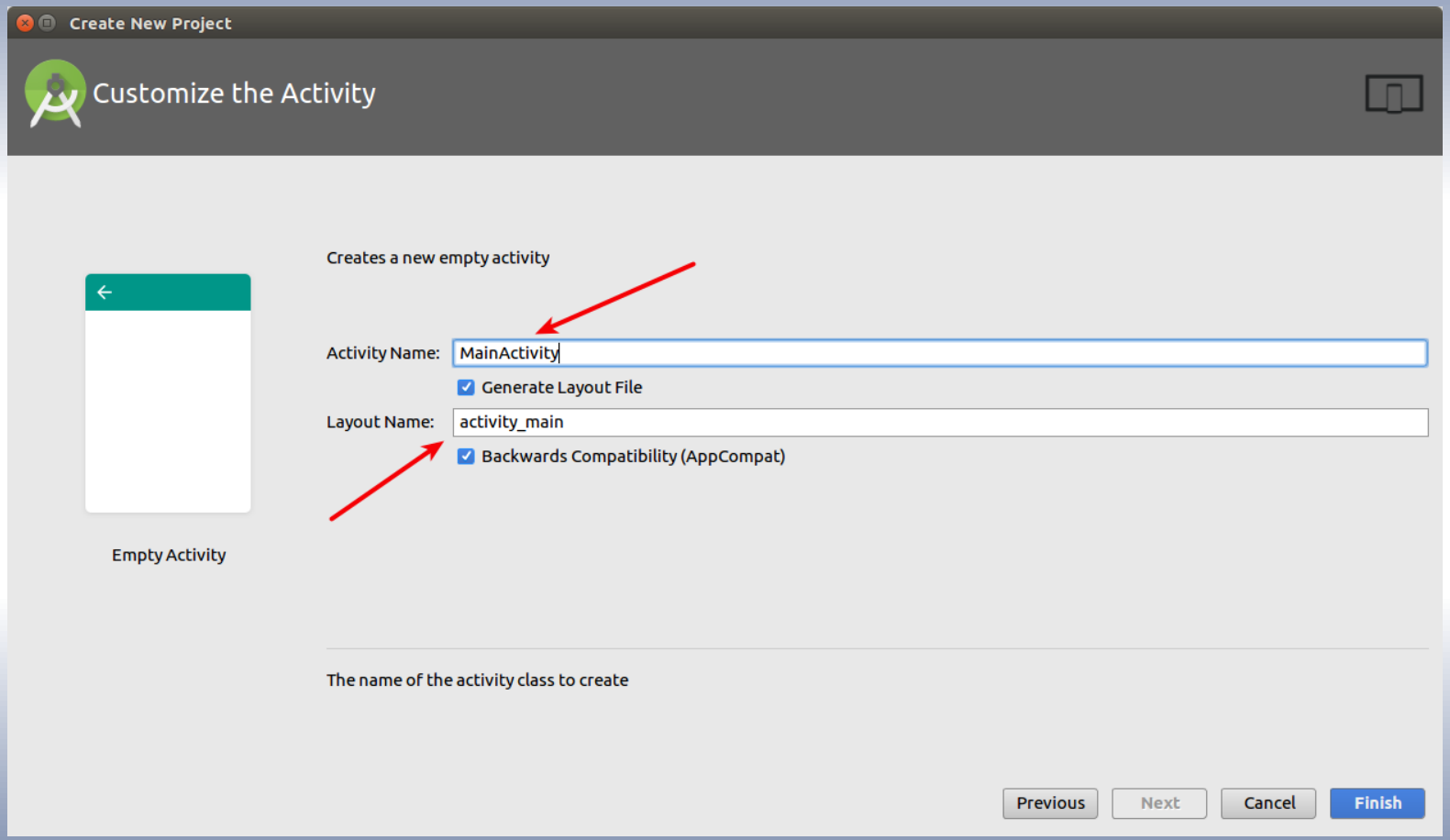
https://developer.android.com/about/versions/android-4.0.html

OK Cancel

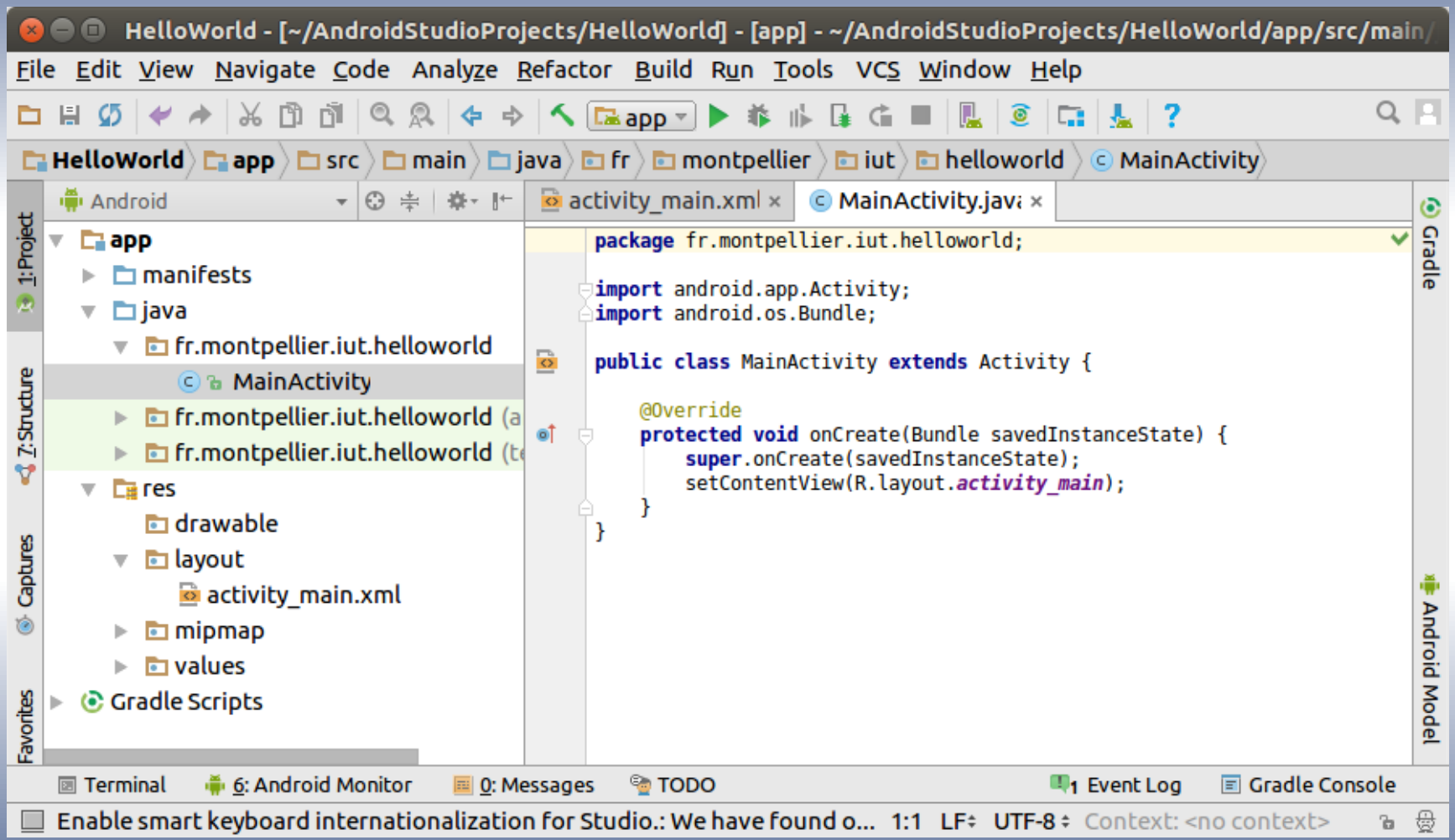
3. Choix de l'activité héritée : Empty Activity (hello world)



4. Paramétrage des noms de fichiers



5. Vue globale



Création d'un projet en ligne de commande

$ android list targets (API disponibles), ./sdkmanager

```
fab@beltegeuse:~/tmp$ android list targets
Available Android targets:
----------
id: 1 or "android-19"
     Name: Android 4.4.2
     Type: Platform
     API level: 19
     Revision: 4
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default), WVGA854, WXGA720, WXGA800, WXGA800-7in
 Tag/ABIs : default/armeabi-v7a, default/x86
----------
id: 2 or "android-20"
     Name: Android 4.4W.2
     Type: Platform
     API level: 20
     Revision: 2
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default), WVGA854, WXGA720, WXGA800, WXGA800-7in, AndroidWearRound, A
 Tag/ABIs : android-wear/armeabi-v7a, android-wear/x86
----------
id: 3 or "android-21"
     Name: Android 5.0.1
     Type: Platform
     API level: 21
     Revision: 2
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default), WVGA854, WXGA720, WXGA800, WXGA800-7in
 Tag/ABIs : android-tv/armeabi-v7a, android-tv/x86, default/armeabi-v7a, default/x86, default/x86_64
----------
id: 4 or "Google Inc.:Google APIs:19"
     Name: Google APIs
     Type: Add-On
     Vendor: Google Inc.
     Revision: 9
     Description: Android + Google APIs
     Based on Android 4.4.2 (API level 19)
     Libraries:
      * com.google.android.media.effects (effects.jar)
          Collection of video effects
      * com.android.future.usb.accessory (usb.jar)
          API for USB Accessories
      * com.google.android.maps (maps.jar)
          API for Google Maps
     Skins: HVGA, QVGA, WQVGA400, WQVGA432, WSVGA, WVGA800 (default), WVGA854, WXGA720, WXGA800, WXGA800-7in
 Tag/ABIs : default/armeabi-v7a
----------
```

Création du projet

fab@beltegeuse: ~/tmp

fab@beltegeuse: ~ | fab@beltegeuse: ~/tmp | fab@beltegeuse: ~/tmp

```
fab@beltegeuse:~/tmp$ android create project --target 4 --name HelloWorld --path ./HelloWorld --activity MainActivity --package fr.iut.hello
Created project directory: ./HelloWorld
Created directory /home/fab/tmp/HelloWorld/src/fr/iut/hello
Added file ./HelloWorld/src/fr/iut/hello/MainActivity.java
Created directory /home/fab/tmp/HelloWorld/res
Created directory /home/fab/tmp/HelloWorld/bin
Created directory /home/fab/tmp/HelloWorld/libs
Created directory /home/fab/tmp/HelloWorld/res/values
Added file ./HelloWorld/res/values/strings.xml
Created directory /home/fab/tmp/HelloWorld/res/layout
Added file ./HelloWorld/res/layout/main.xml
Created directory /home/fab/tmp/HelloWorld/res/drawable-xhdpi
Created directory /home/fab/tmp/HelloWorld/res/drawable-hdpi
Created directory /home/fab/tmp/HelloWorld/res/drawable-mdpi
Created directory /home/fab/tmp/HelloWorld/res/drawable-ldpi
Added file ./HelloWorld/AndroidManifest.xml
Added file ./HelloWorld/build.xml
Added file ./HelloWorld/proguard-project.txt
fab@beltegeuse:~/tmp$
```

Contenu du projet

Dossier App

- **build**/ : fichier générés
- **libs**/ : librairies additionnelles
- **src**/ : intégralité des sources pour le développement (appli + tests)

Contenu du projet

Dossier App/src/

- **androidTest/** : tests de l'application dans l'environnement android
- **test/** : tests internes à l'application
- **main** : sources de l'application
  - **main/java** : sources Java, e.g. la classe qui lance l'activité
  - **main/res** : les ressources de l'application
    - **drawable-(h)(m)(l)dpi/** images dans différentes résolutions
    - **layout/** GUI design général
    - **values/** valeurs des variables
    - **menu/** définition des menus
- **main/AndroidManifest.xml** : description et éléments-clés de l'application (nom, activité principale, intents, etc.)

./app/src/main/AndroidManifest.xml : description

activity_main.xml | main.tex | strings.xml | HelloWorld Manifest

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="fr.iutmontp.helloworld"
    android:versionCode="1"
    android:versionName="1.0" >

    <uses-sdk
        android:minSdkVersion="8"
        android:targetSdkVersion="21" />

    <application
        android:allowBackup="true"
        android:icon="@drawable/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
        <activity
            android:name=".MainActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>

</manifest>
```

Éditeur pour les fichiers manifest

HelloWorld Manifest

Android Manifest

Manifest General Attributes

Defines general information about the AndroidManifest.xml

Package	com.examplefr.iutmontp.helloworld	Browse...
Version code	1	
Version name	1.0	Browse...
Shared user id		Browse...
Shared user label		Browse...
Install location		

Manifest Extras

Uses Sdk

Add... Remove... Up Down

Attributes for Uses Sdk

The tag describes the SDK features that the containing package must be running on to operate correctly.

Min SDK version	8	Browse...
Target SDK version	21	Browse...
Max SDK version		

Exporting

To export the application for distribution, you have the following options:

- Use the Export Wizard to export and sign an APK
- Export an unsigned APK and sign it manually

Links

The content of the Android Manifest is made up of three sections. You can also edit the XML directly.

- Application: Activities, intent filters, providers, services and receivers.
- Permission: Permissions defined and permissions used.
- Instrumentation: Instrumentation defined.
- XML Source: Directly edit the AndroidManifest.xml file.
- Documentation: Documentation from the Android SDK for AndroidManifest.xml.

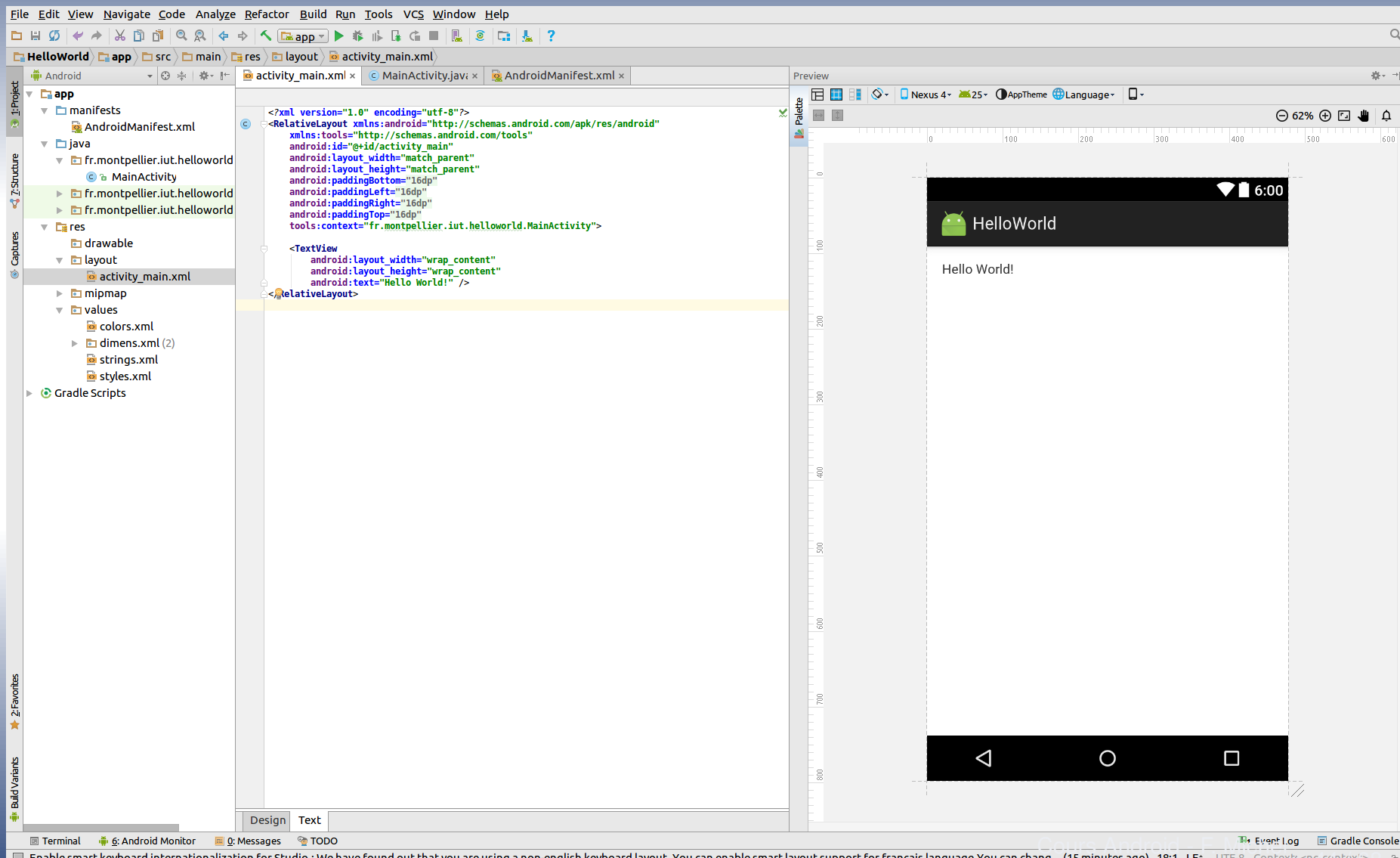
Manifest | Application | Permissions | Instrumentation | AndroidManifest.xml

.../res/layout/activity_main.xml : disposition GUI

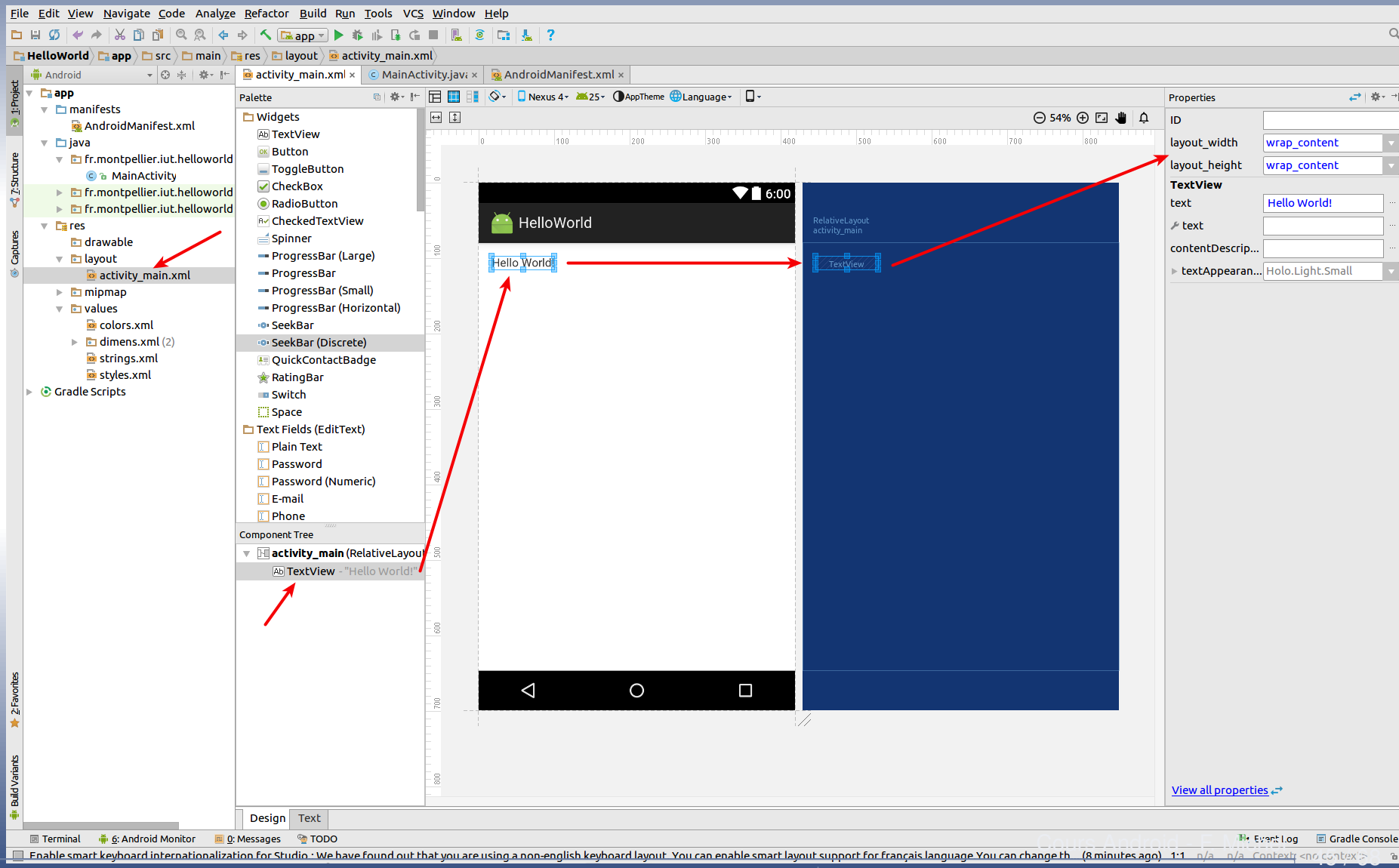
activity_main.xml

```
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="@dimen/activity_vertical_margin"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    tools:context="com.examplefr.iutmontp.helloworld.MainActivity" >

    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/hello_world" />

</RelativeLayout>
```

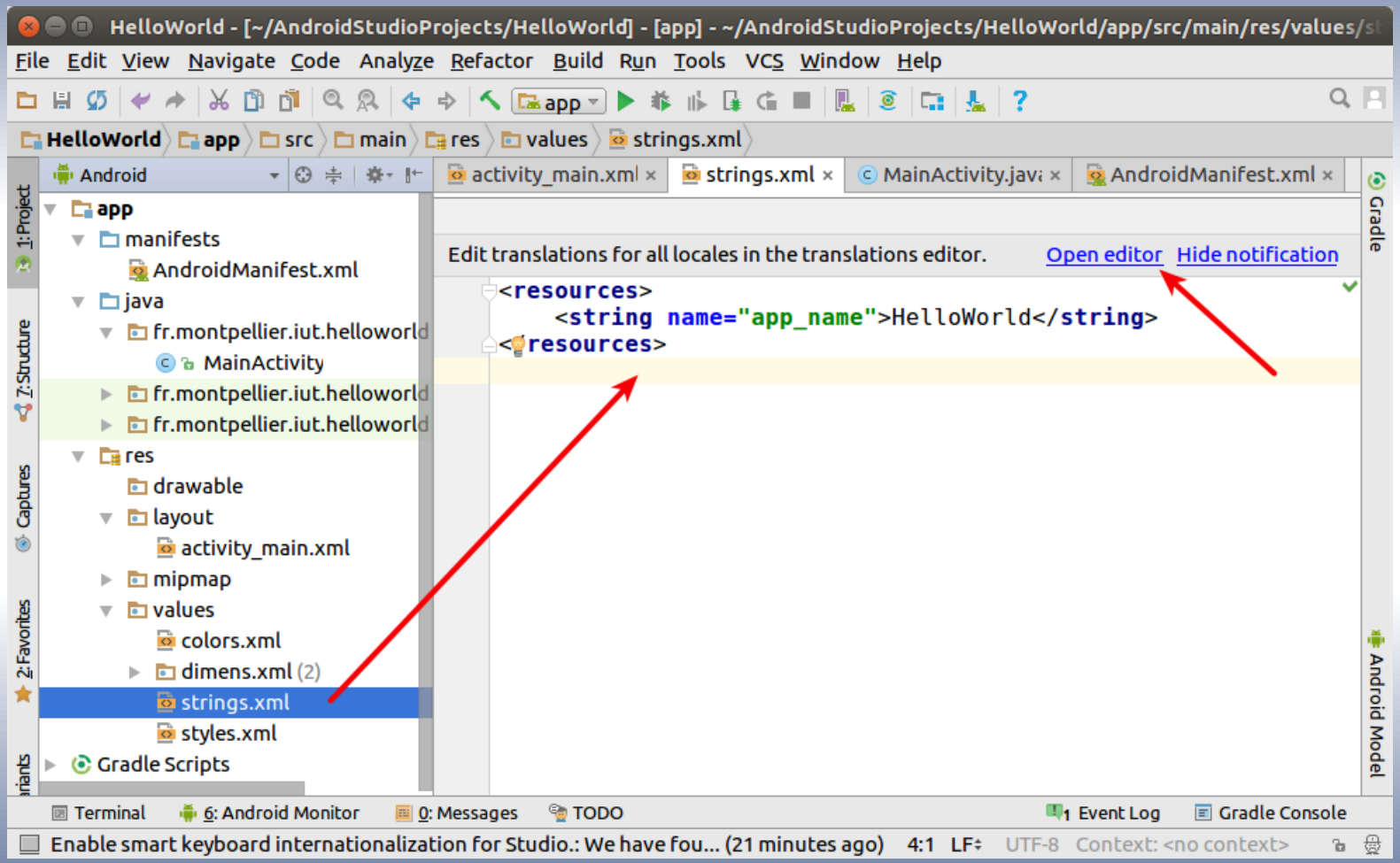
Éditeur de layout (*text mode*)



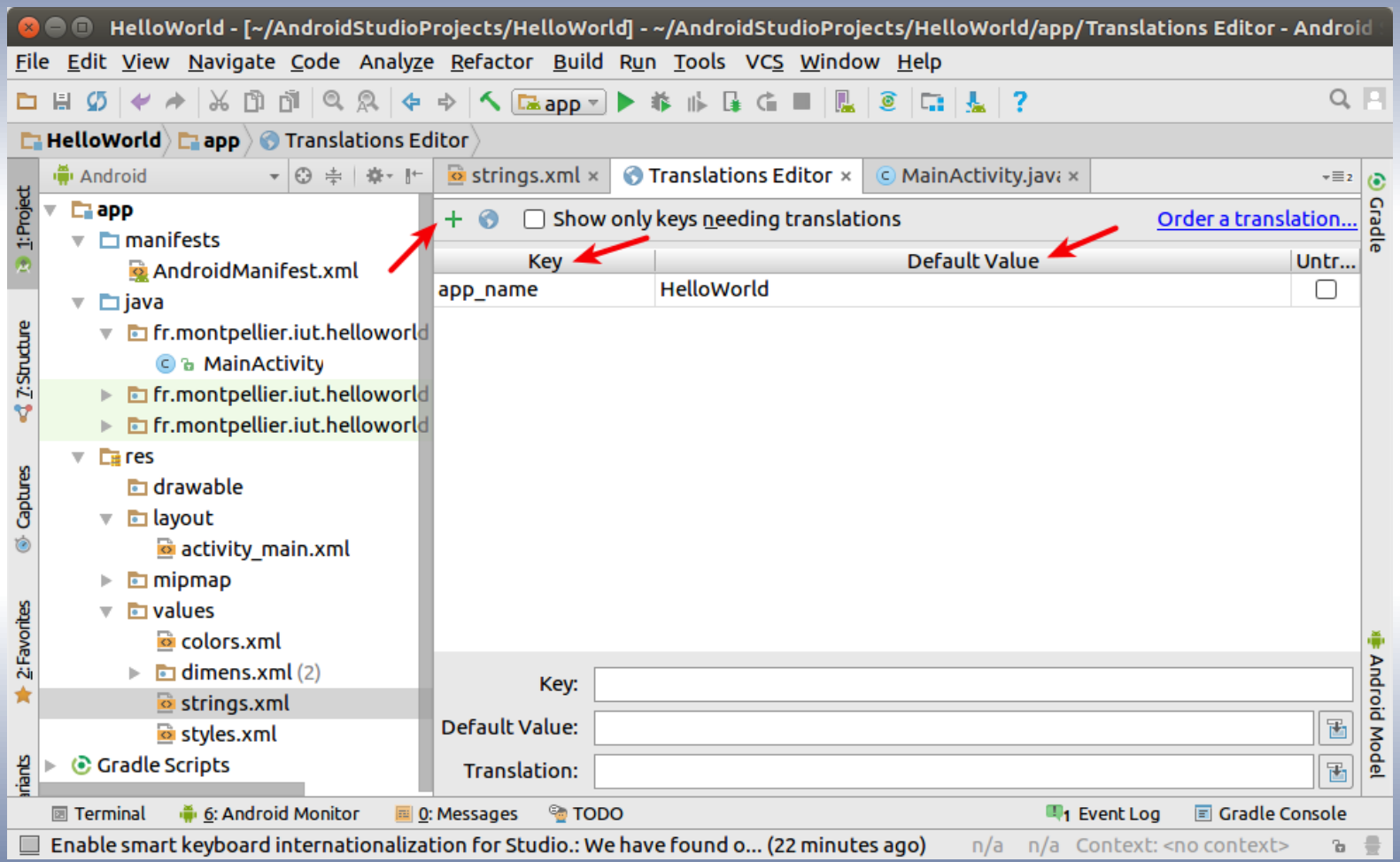
Éditeur de layout (*design mode*)



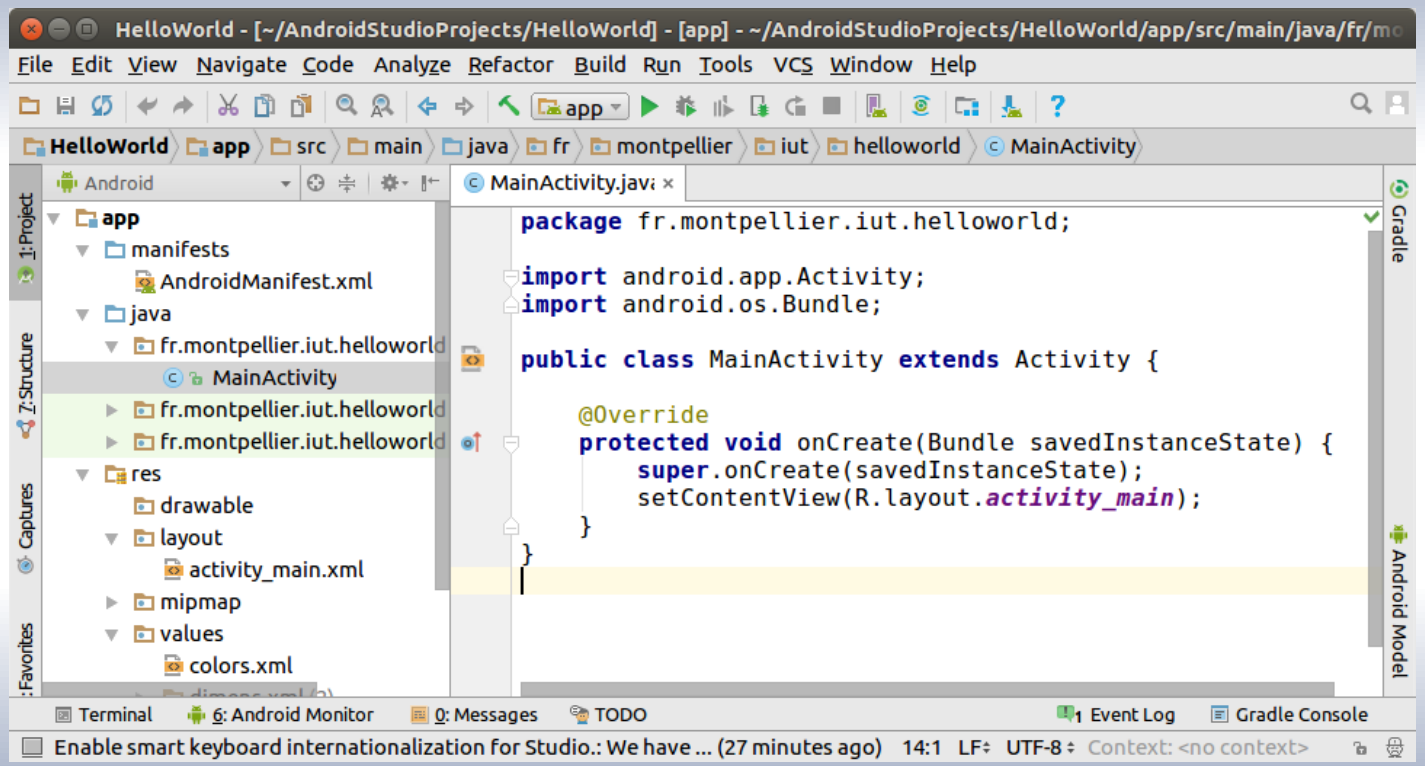
strings.xml : valeurs des variables



Éditeur pour *strings.xml*



/src/.../MainActivity.java : activité



/build/.../R.java : définition d'identifiants

Fichier Édition Affichage Rechercher Outils Documents Aide

Ouvrir Enregistrer

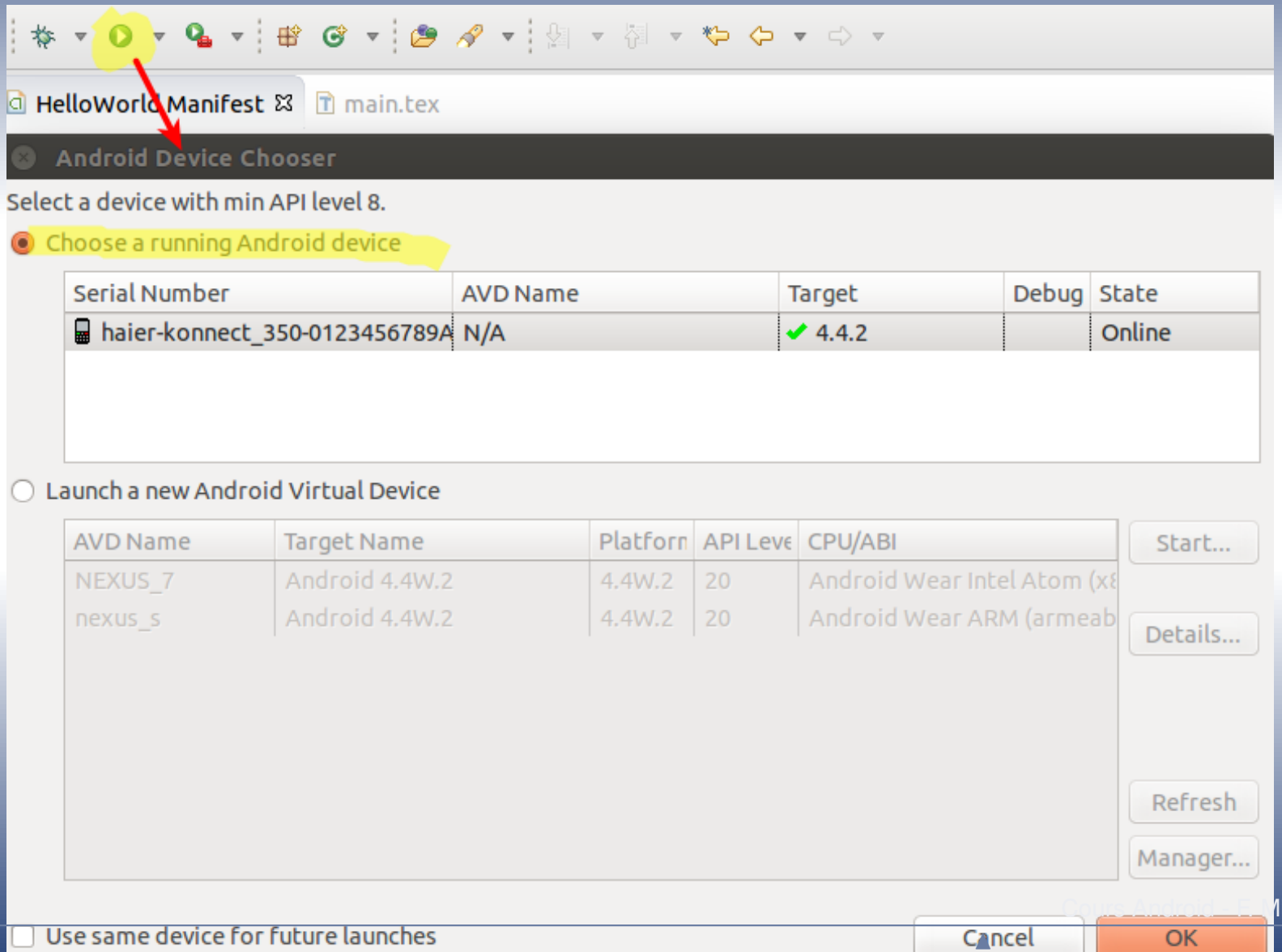
```
/* AUTO-GENERATED FILE.  DO NOT MODIFY.
 *
 * This class was automatically generated by the
 * aapt tool from the resource data it found.  It
 * should not be modified by hand.
 */
package fr.montpellier.iut.helloworld;

public final class R {
    public static final class attr {
    }
    public static final class color {
        public static final int colorAccent=0x7f050000;
        public static final int colorPrimary=0x7f050001;
        public static final int colorPrimaryDark=0x7f050002;
    }
    public static final class dimen {
        public static final int activity_horizontal_margin=0x7f040000;
        public static final int activity_vertical_margin=0x7f040001;
    }
    public static final class id {
        public static final int activity_main=0x7f080000;
    }
    public static final class layout {
        public static final int activity_main=0x7f030000;
    }
```

Exécution sur un vrai dispositif

Mise en place du dispositif pour le développement

- connexion usb : ▸ drivers windows ▸ configuration linux
- sous linux, la commande ***lsusb*** liste les connexions usb
  ▸ plus d'information
- activation *USB debugging* sur le dispositif :
  Settings > Developer options
  à partir de Android 4.2 : Settings > About phone (7 tappes successives).

Exécution du projet



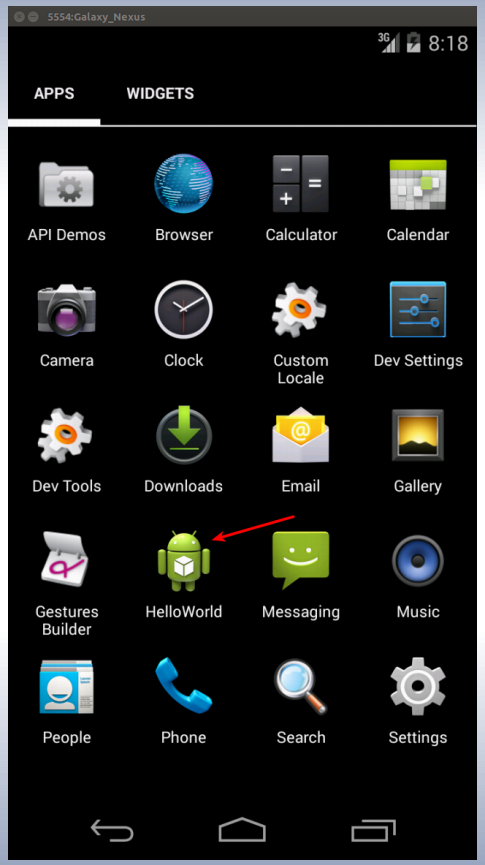
Exécution en ligne de commande

```
fab@beltegeuse: ~/tmp/HelloWorld
fab@beltegeuse:~/tmp/HelloWorld$ ant debug
Buildfile: /home/fab/tmp/HelloWorld/build.xml
```

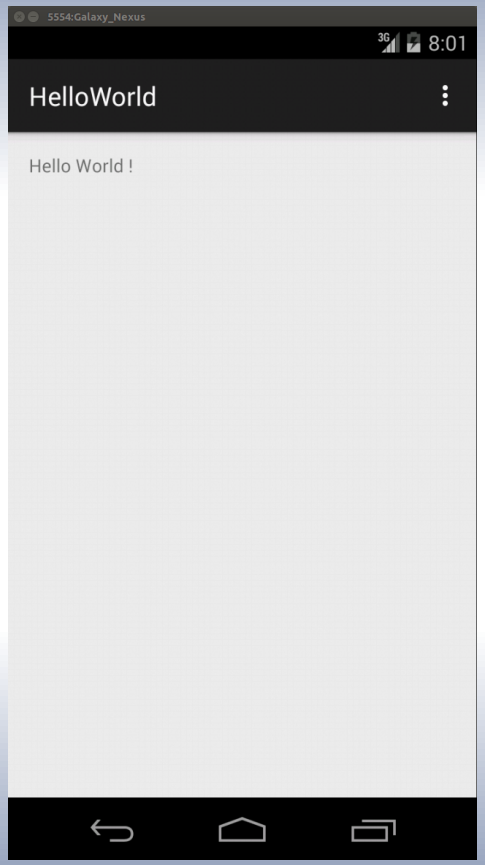
Compilation OK $\Rightarrow$ Déploiement :

```
fab@beltegeuse: ~/tmp/HelloWorld
fab@beltegeuse:~/tmp/HelloWorld$ adb install -r bin/HelloWorld-debug.apk
515 KB/s (37526 bytes in 0.071s)
        pkg: /data/local/tmp/HelloWorld-debug.apk
Success
fab@beltegeuse:~/tmp/HelloWorld$
```

Une fois déployée

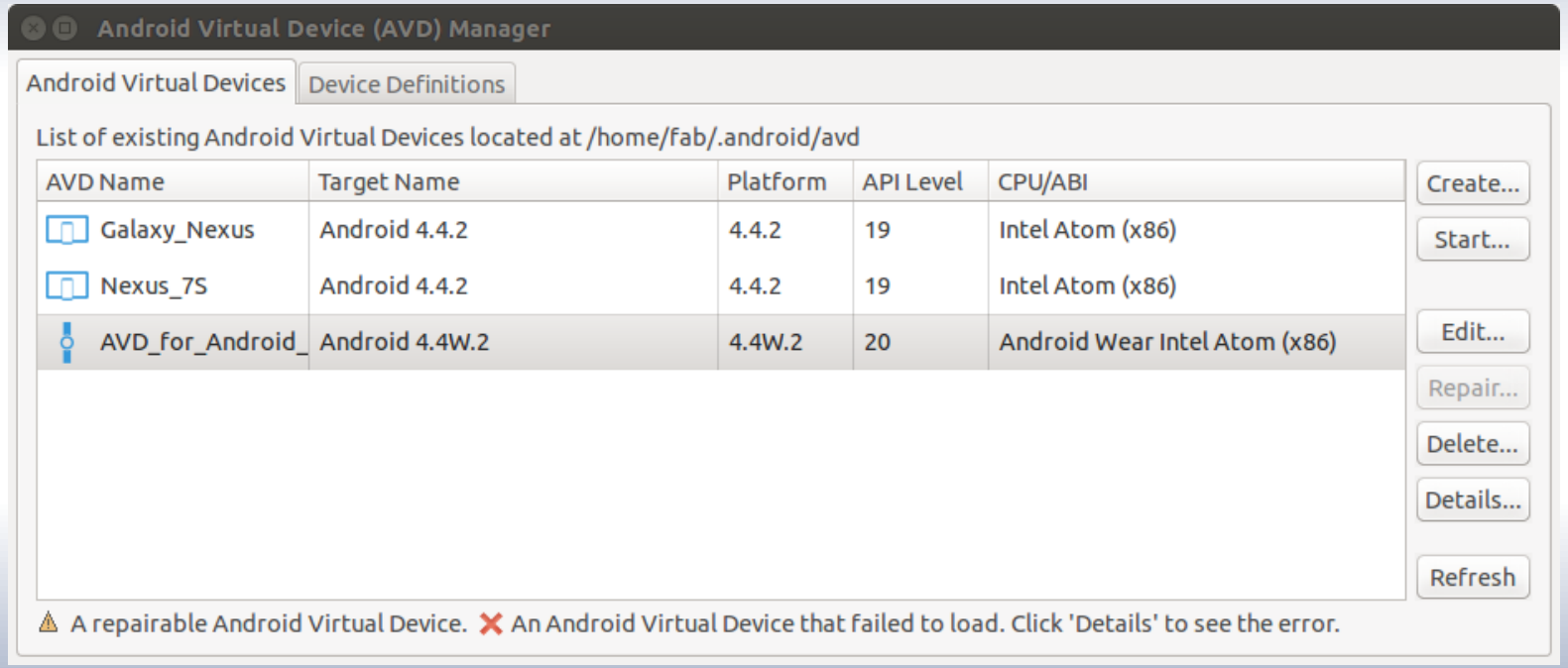


Résultat →

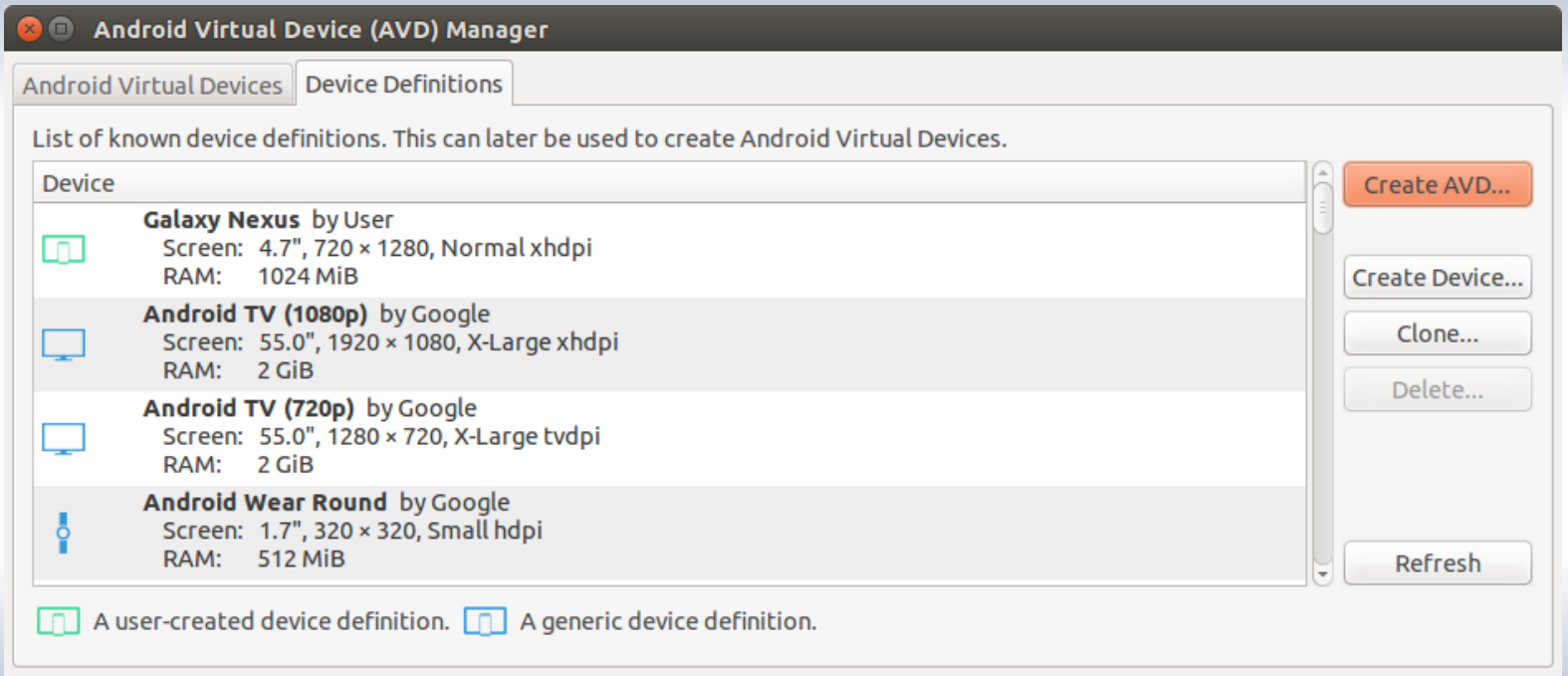


Exécution sur un émulateur : outil AVD

Dans un terminal : `$ android avd`

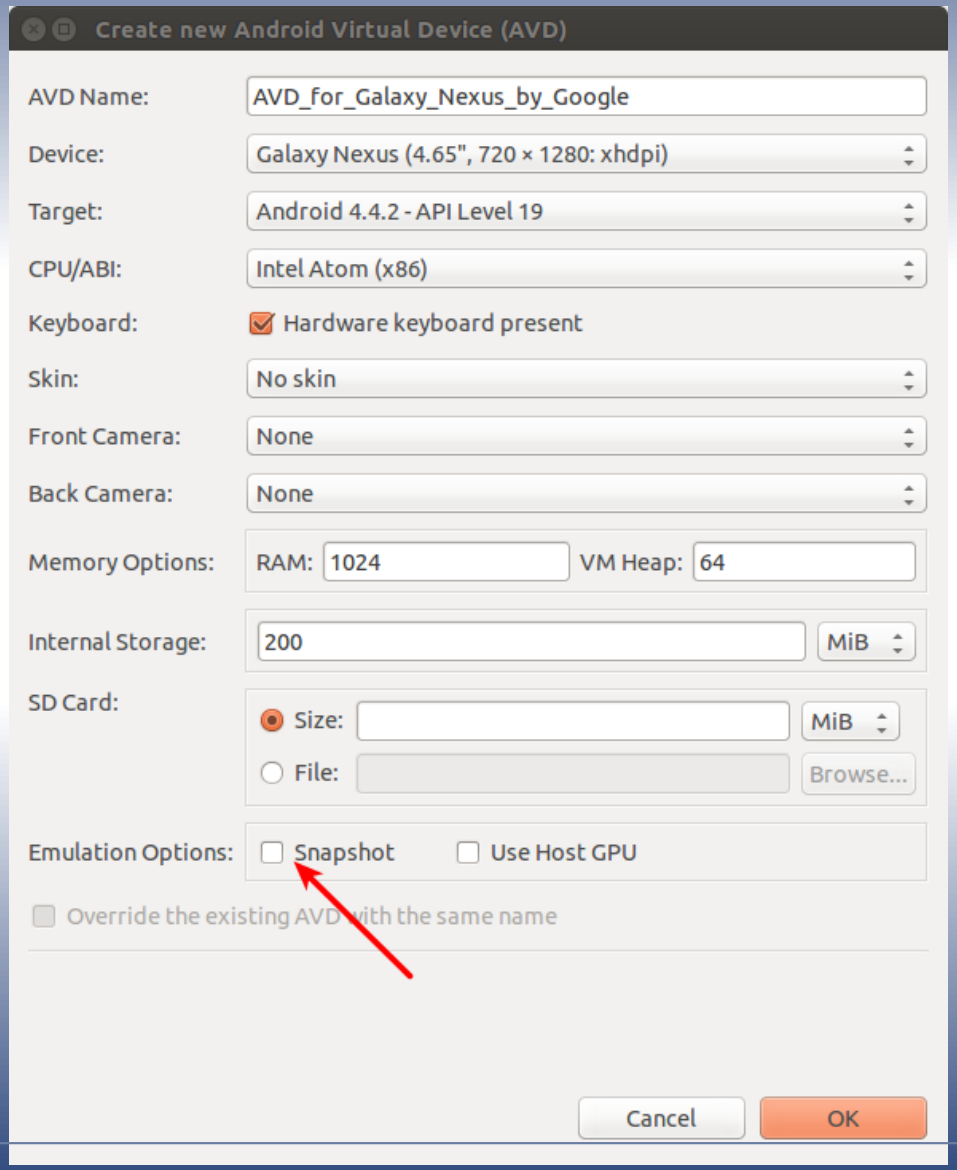


Définition déjà présentes

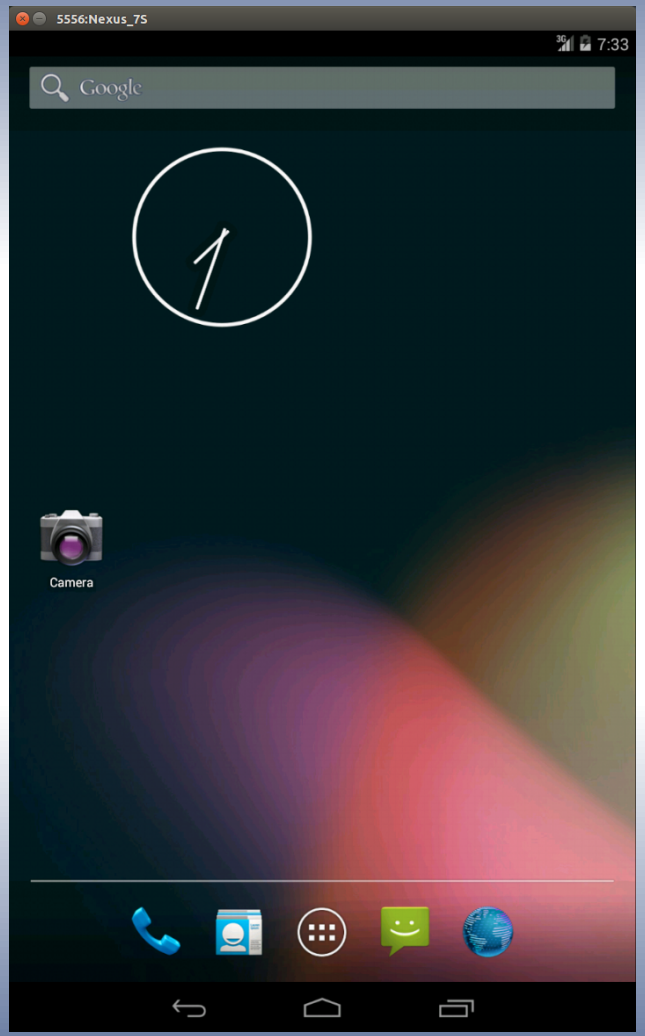


Création d'une AVD

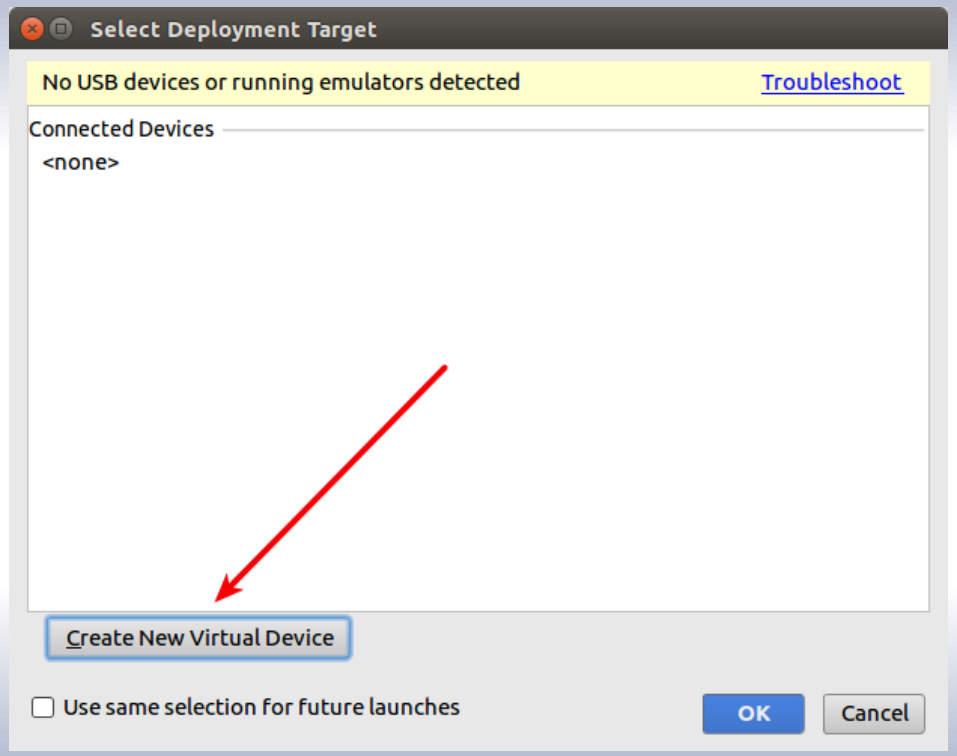
▸ en ligne de commande



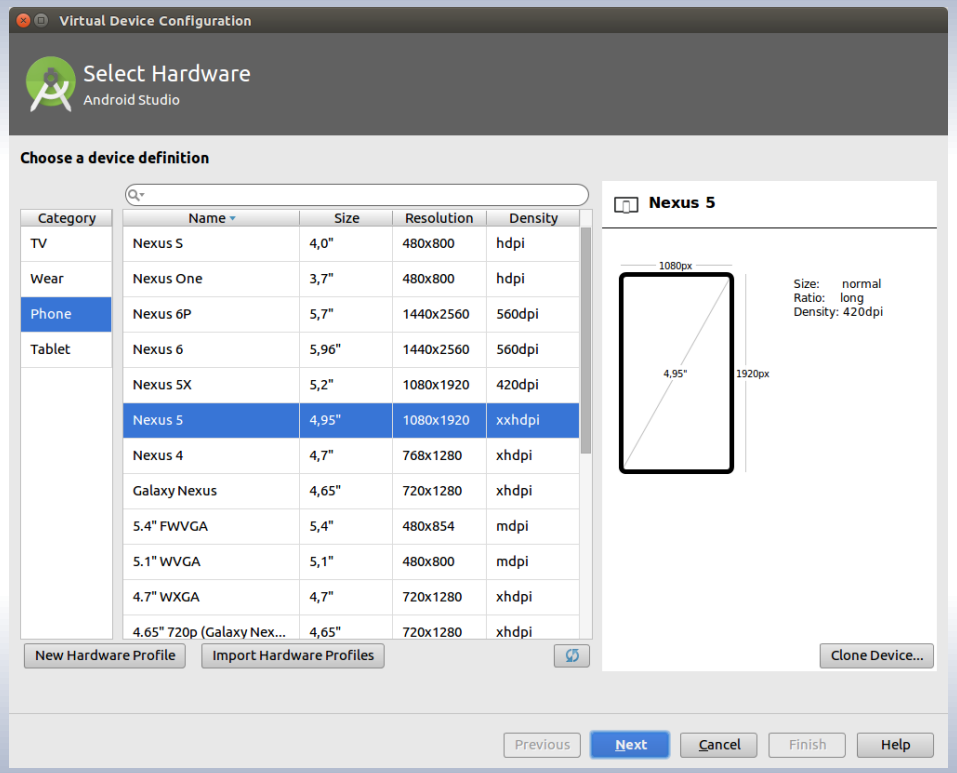
Start →



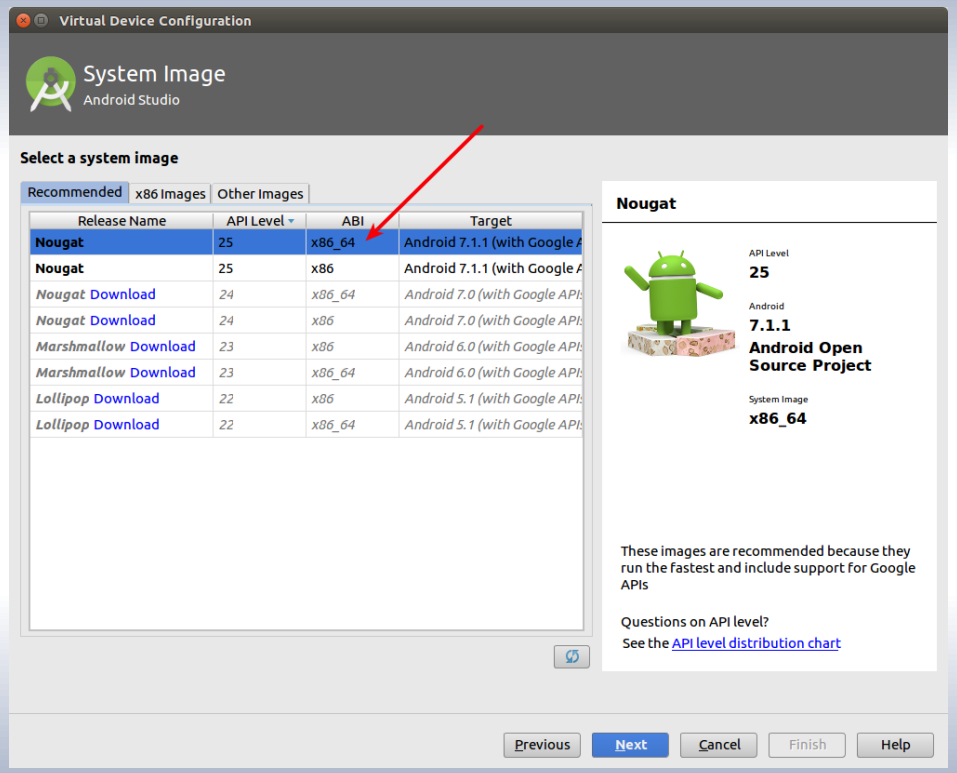
Sous Android Studio



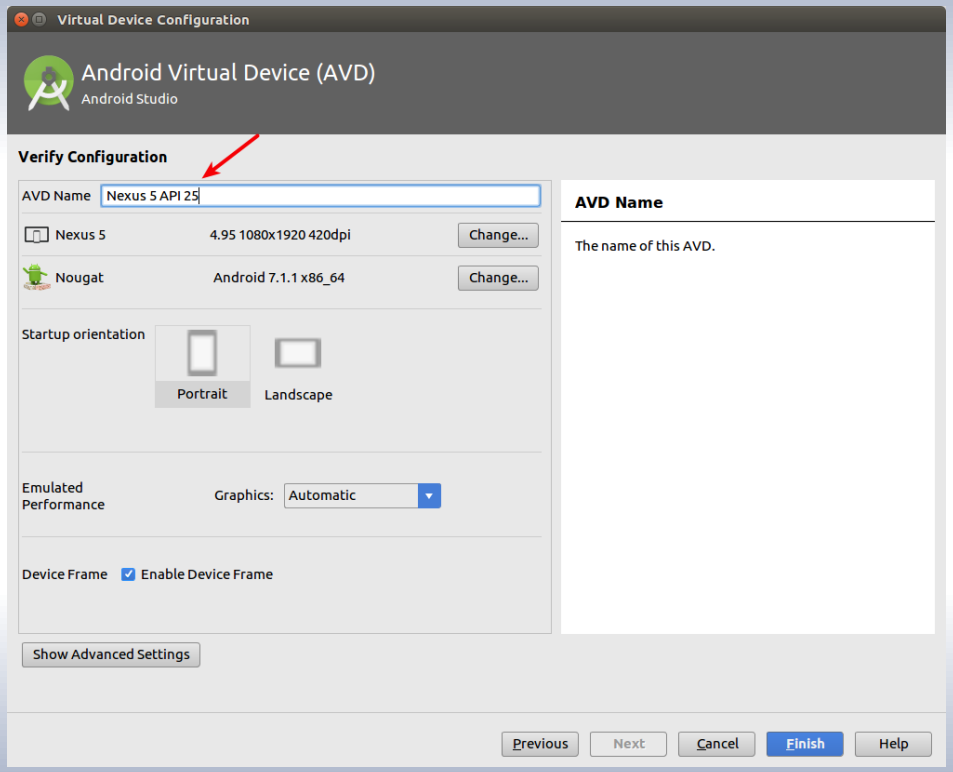
Sous Android Studio



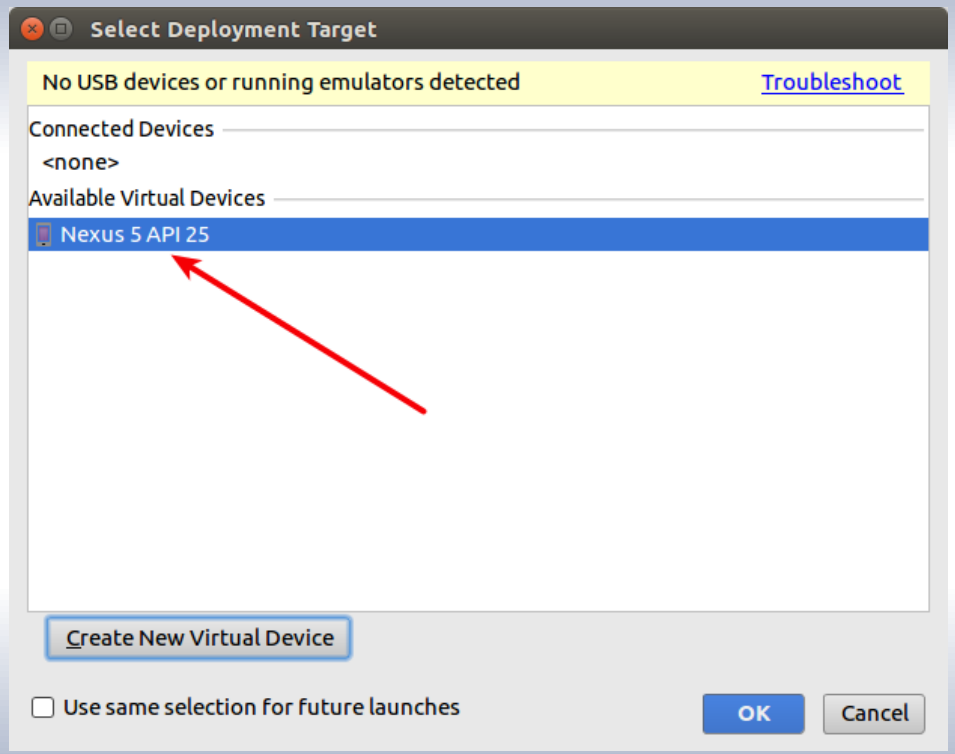
Sous Android Studio



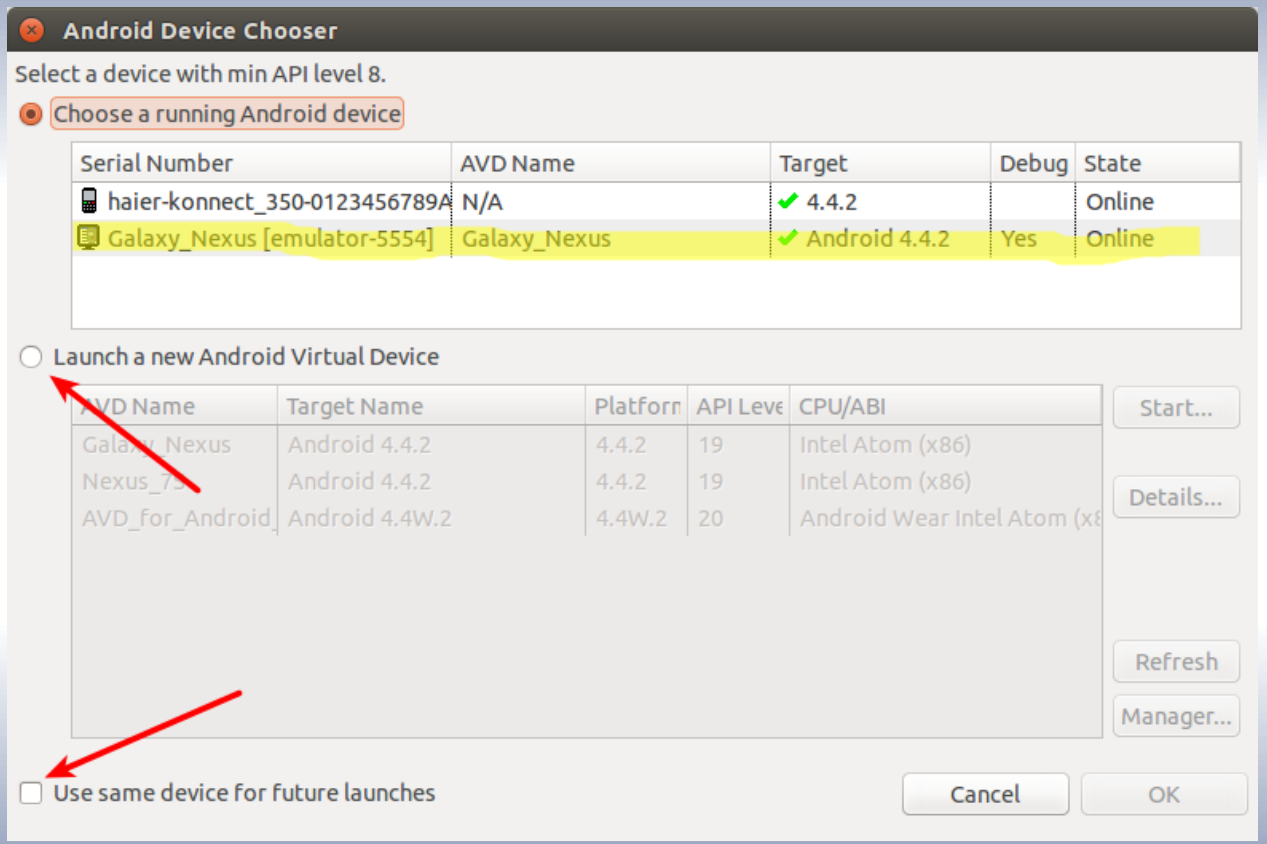
Sous Android Studio



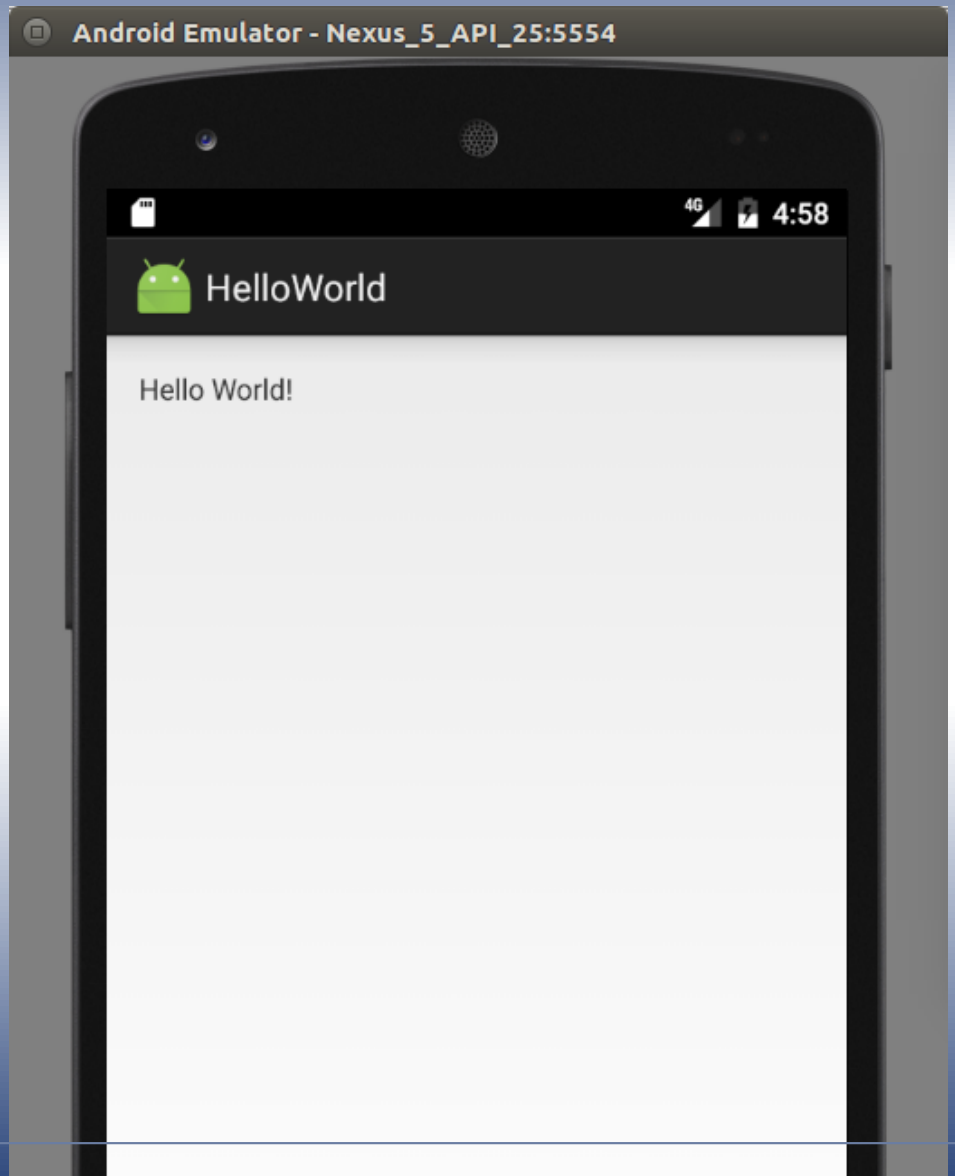
Sous Android Studio



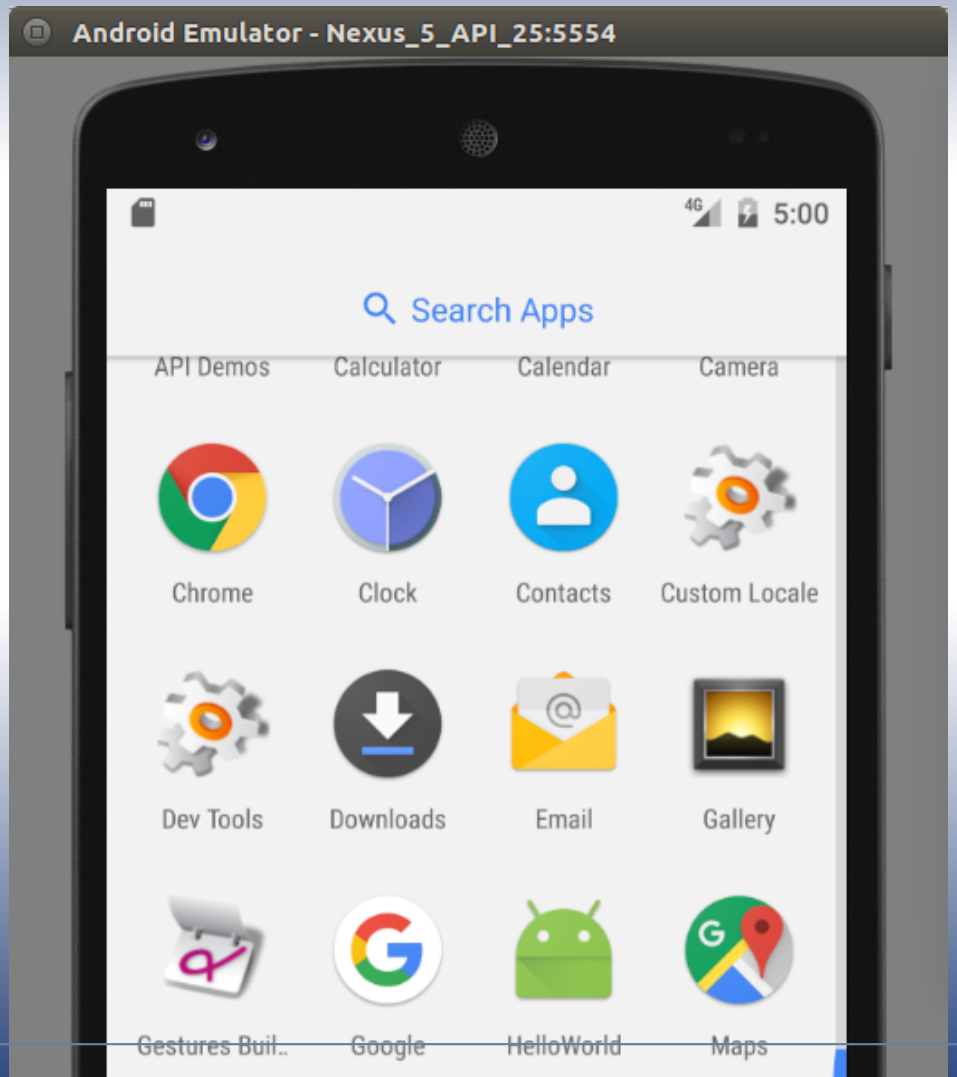
Sous Eclipse :



Exécution


Android Emulator - Nexus_5_API_25:5554
4:58
HelloWorld
Hello World!

L'application est maintenant disponible sur la cible (virtuelle ou non)



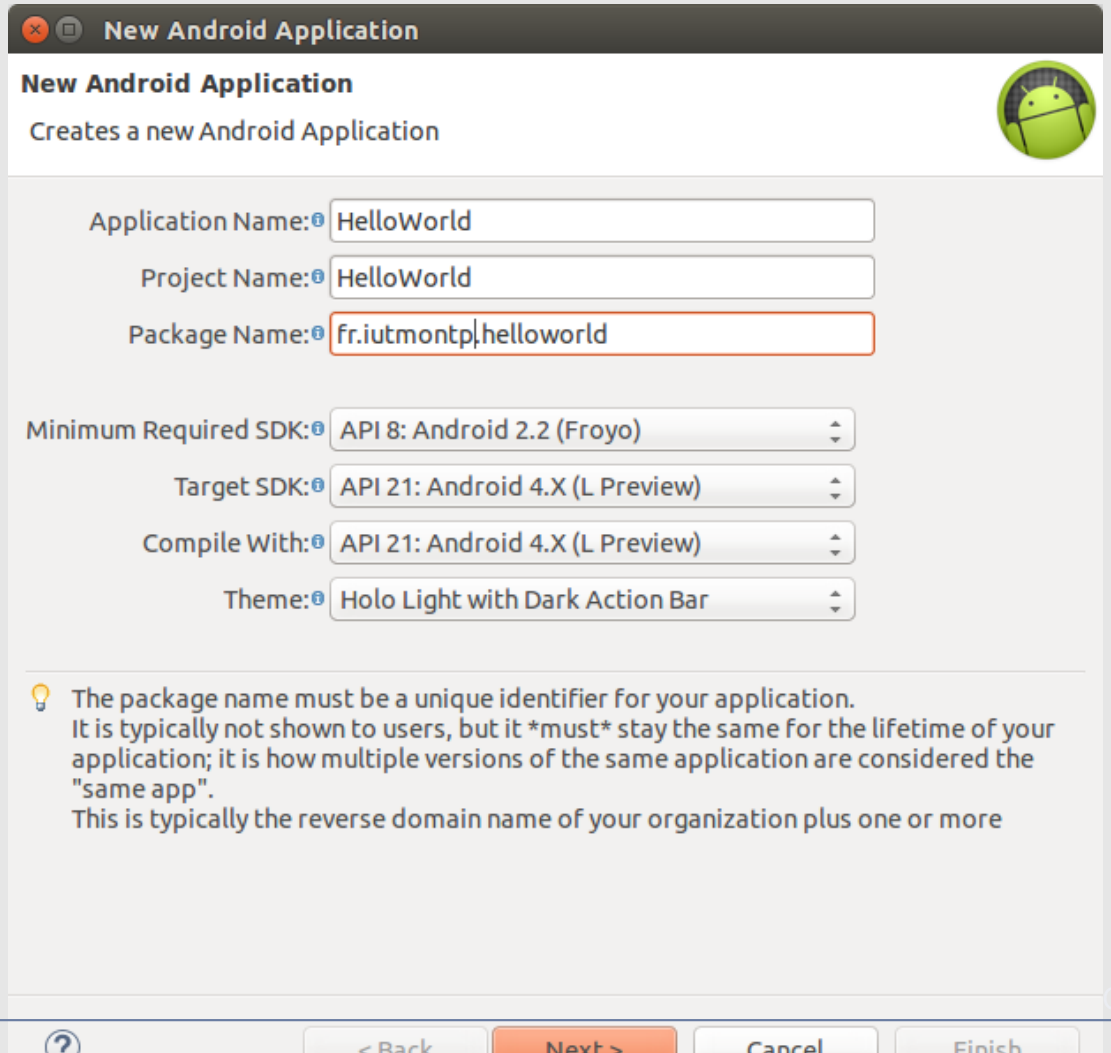
Résumé global

- La technologie Android :
  - Noyau Linux
  - Programmation Java
- Programmation Android
  - des outils pour le développement : SDK manager / AVD / un IDE.
  - une structure de projet standardisée (manifest, src, res, etc.)
  - des dispositifs pour le déploiement (virtuels et réels)

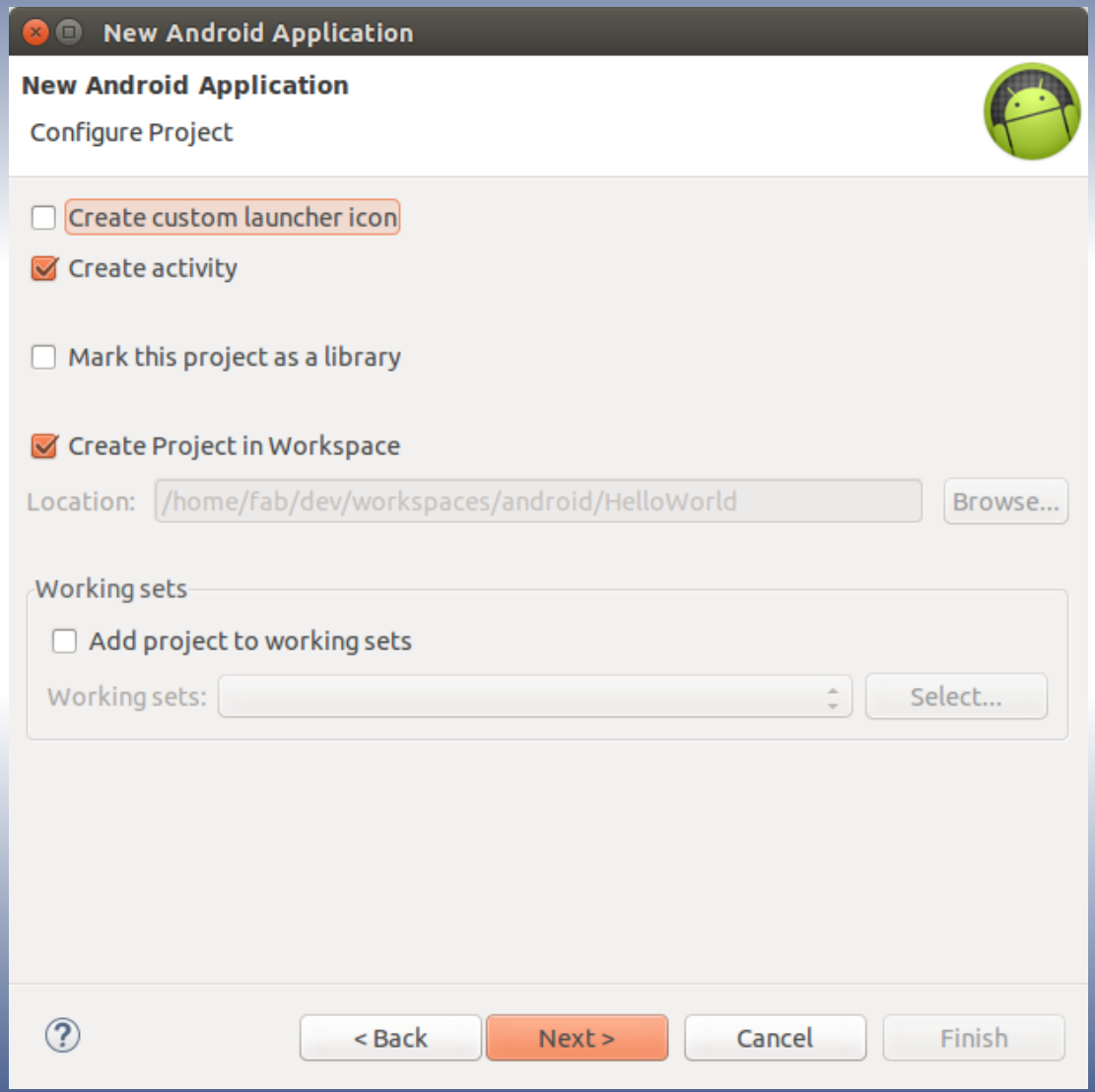
Ce cours reprend largement les tutoriaux en ligne proposés par Google : ▸ Android developers

Création d'un projet avec Eclipse

File → New → Android Application Project →

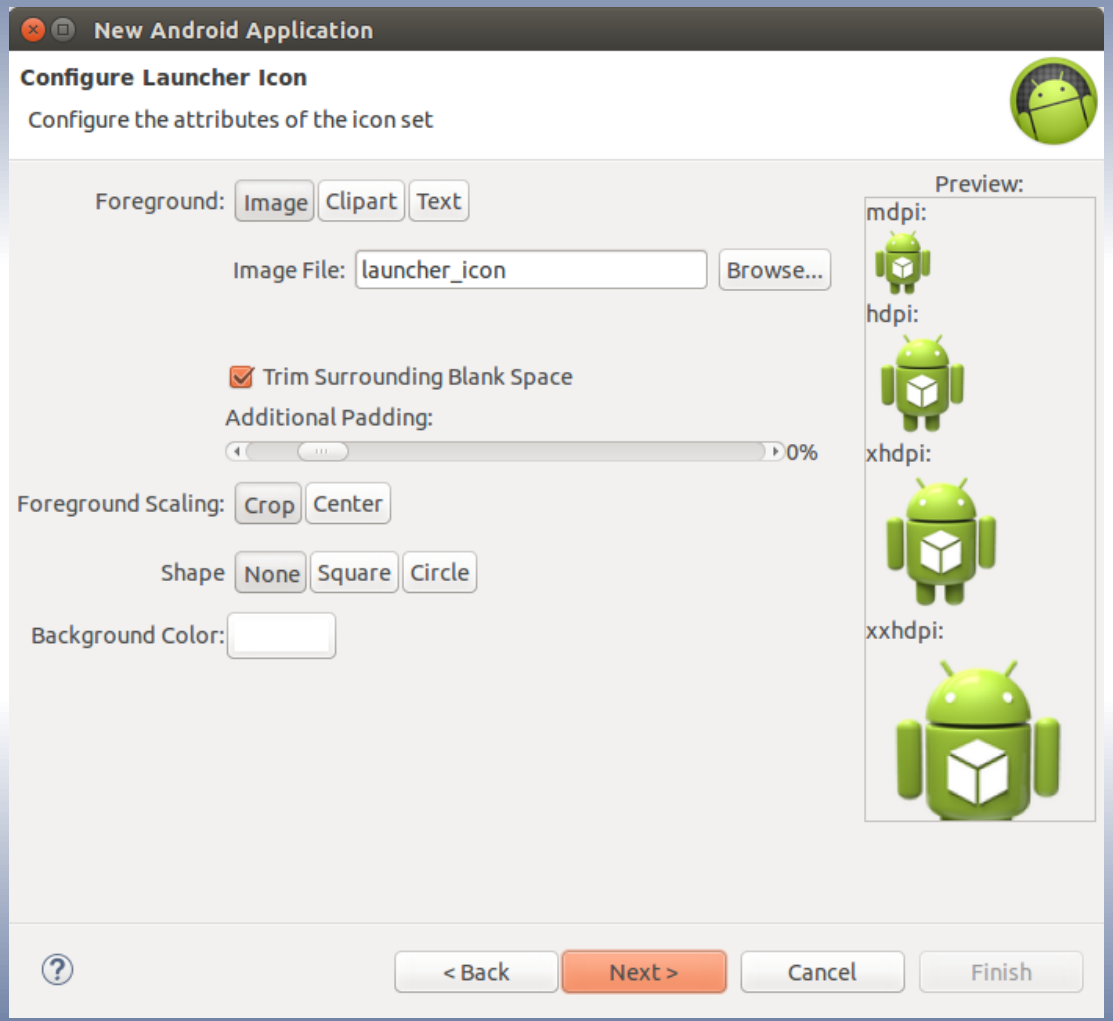


Paramétrage

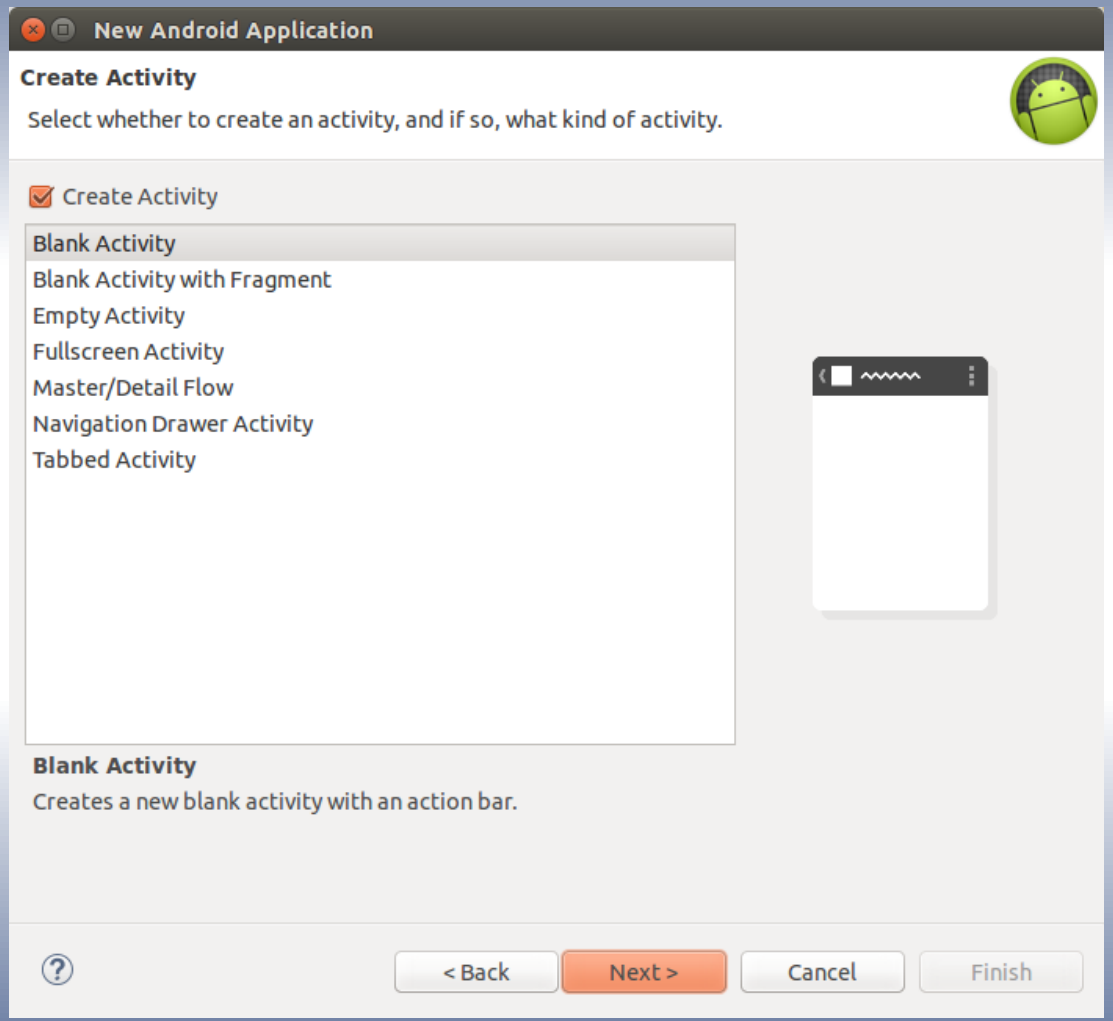


Paramétrage : Icon

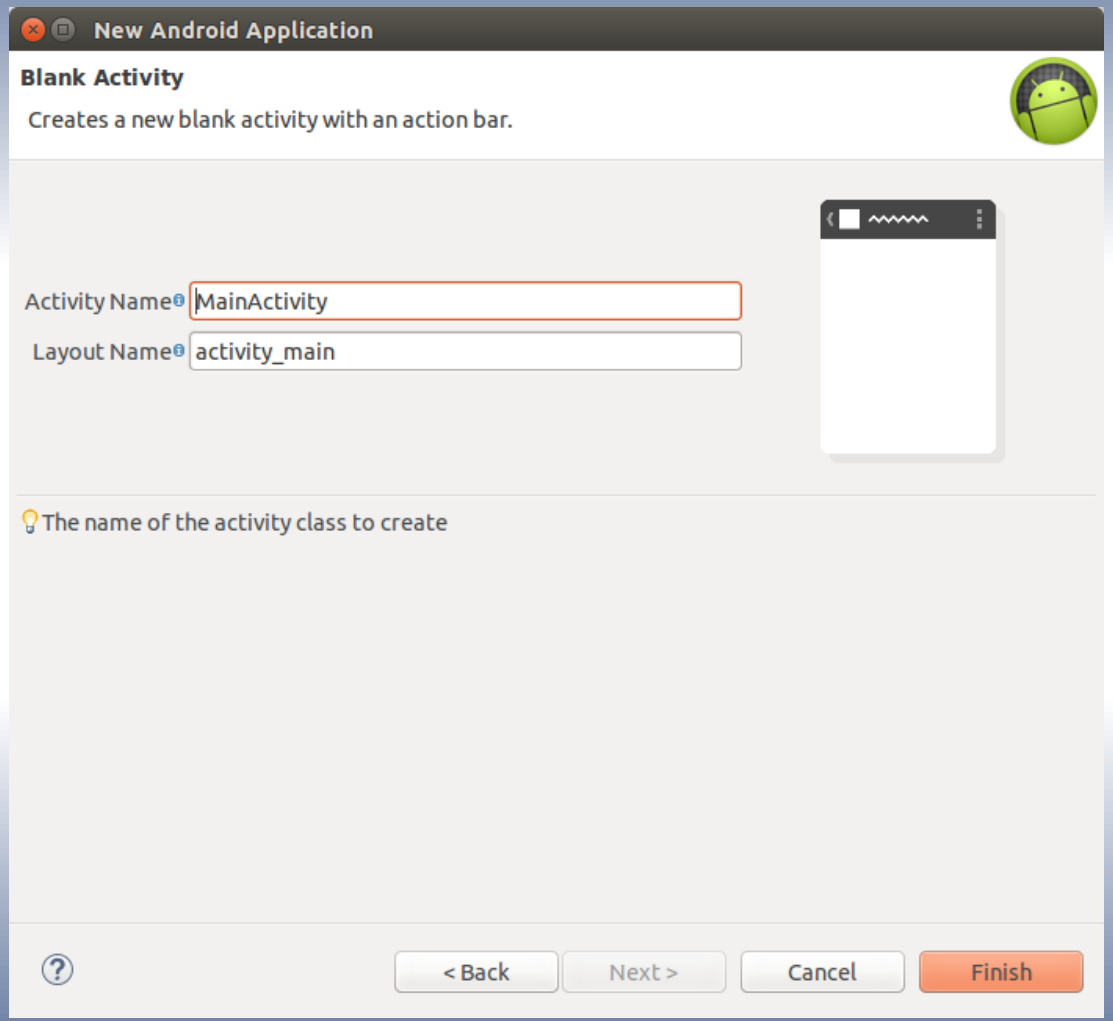
plus d'information



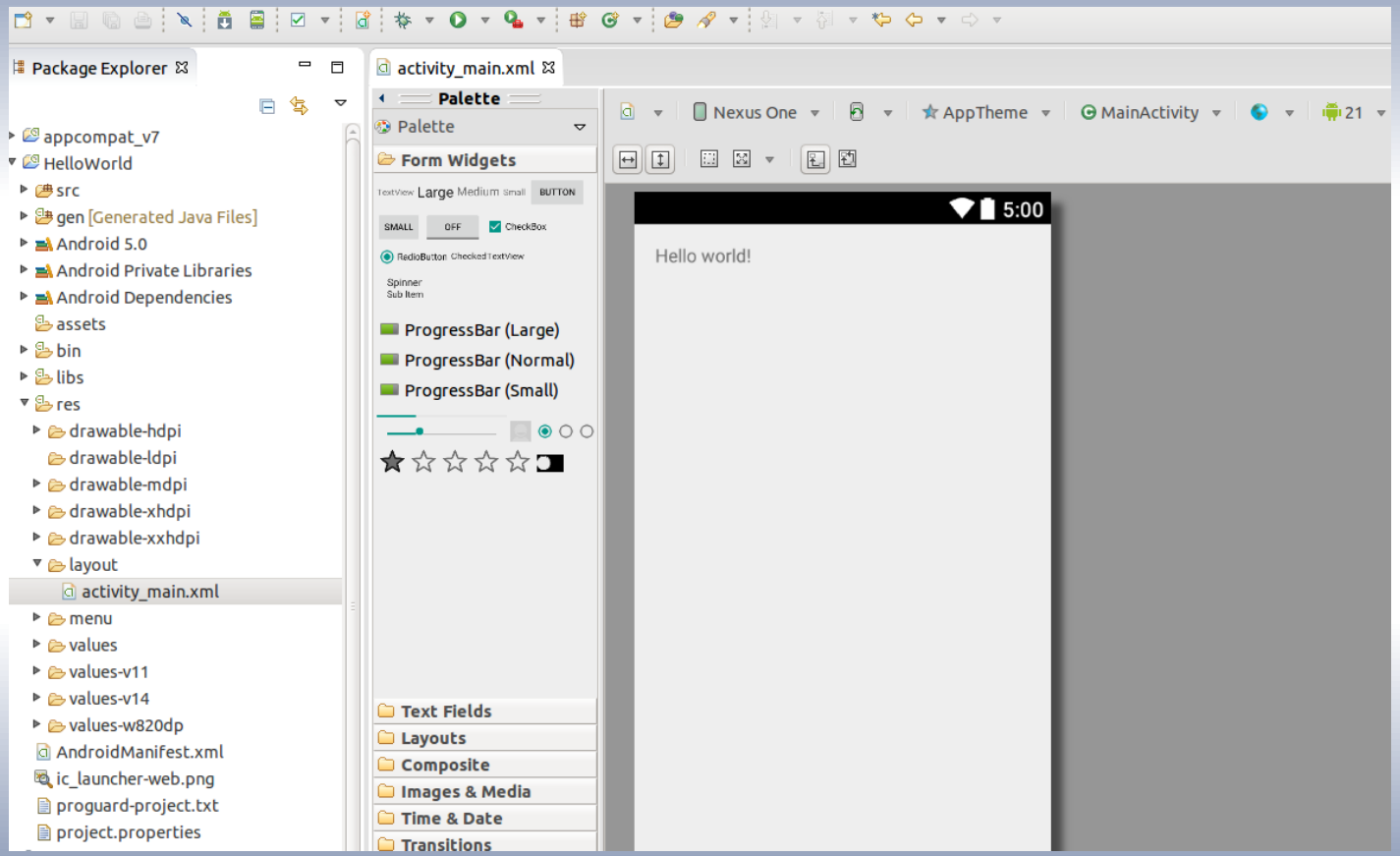
Paramétrage : Blank Activity (hello world)



Paramétrage



Résultat


Package Explorer
appcompat_v7
HelloWorld
src
gen [Generated Java Files]
Android 5.0
Android Private Libraries
Android Dependencies
assets
bin
libs
res
drawable-hdpi
drawable-ldpi
drawable-mdpi
drawable-xhdpi
drawable-xxhdpi
layout
activity_main.xml
menu
values
values-v11
values-v14
values-w820dp
AndroidManifest.xml
ic_launcher-web.png
proguard-project.txt
project.properties
activity_main.xml
Palette
Form Widgets
ProgressBar (Large)
ProgressBar (Normal)
ProgressBar (Small)
Text Fields
Layouts
Composite
Images & Media
Time & Date
Transitions
Nexus One
AppTheme
MainActivity
21
5:00
Hello world!