Special Interest Group on Innovative Software 2013-2014

Workshop on Android app development

Session 1: Android App Development - Application Fundamentals

Contents

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1 Setup development environment and emulator

1.1 Download and install ADT (Android Developer Tools)

Tools that you will need for Android app development:

Option 1:

- Eclipse IDE with built-in ADT (Android Developer Tools)

Option 2:

- Eclipse IDE for Java Developers
- Java SDK
- ADT plugin for Eclipse
- Android SDK

We will choose option 1 in this tutorial (64bit) and please get a copy of the **All-in-One** package from: http://developer.android.com/sdk/index.html

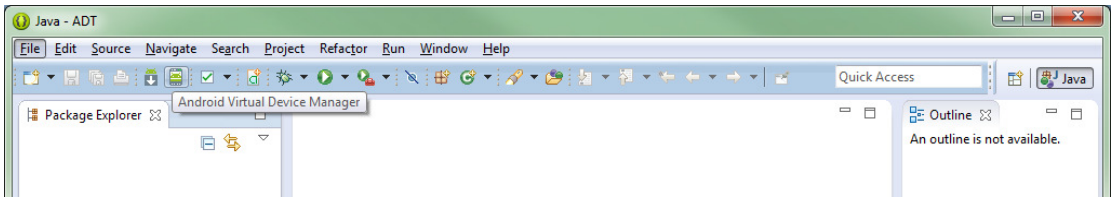
*Please make sure you have your JDK 1.7 (x64) installed on your computer. You may get it from http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html.

Extract the zip file in **C:** and navigate to **C:\adt-bundle-windows-x86_64-20131030**. Double click **eclipse.exe** to start the Android development tool. Choose your own workspace when asked.

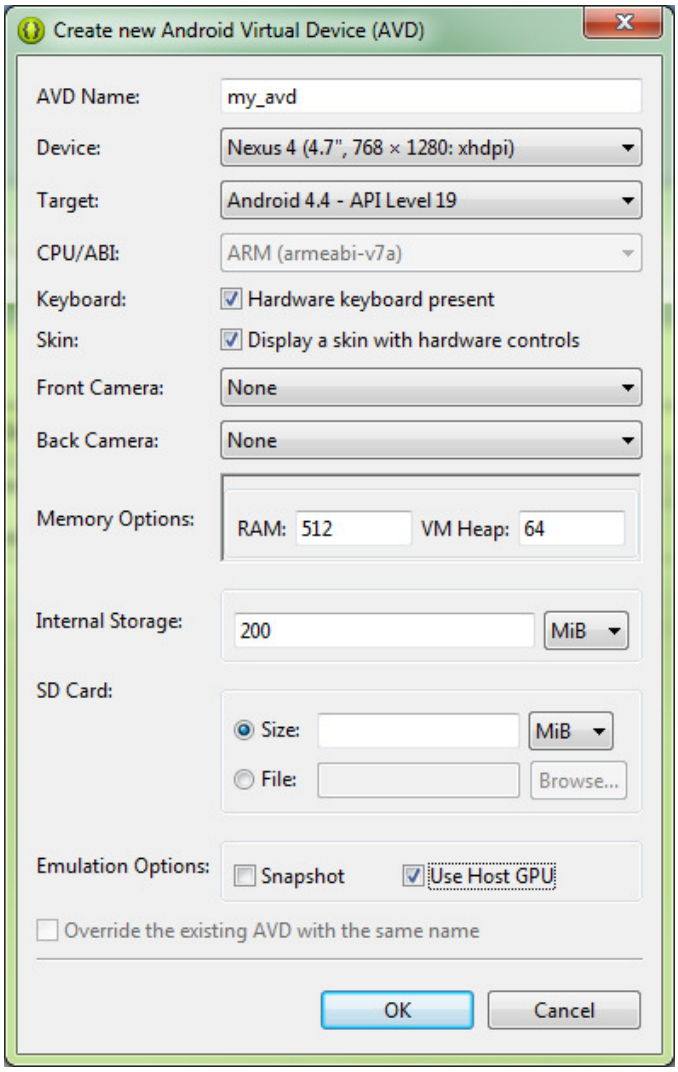
1.2 Prepare and control your emulator

The package contains the latest Android system image (4.4, as of 2013-12-10) and we will base on this to create an Android 4.4 emulator. Except where noted, examples used in our tutorials (Session 1 - 3) are still compatible with Android API Level 8 or above.

Close the **Welcome!** tab and click on the icon of **Android Virtual Device Manager** in the toolbar.



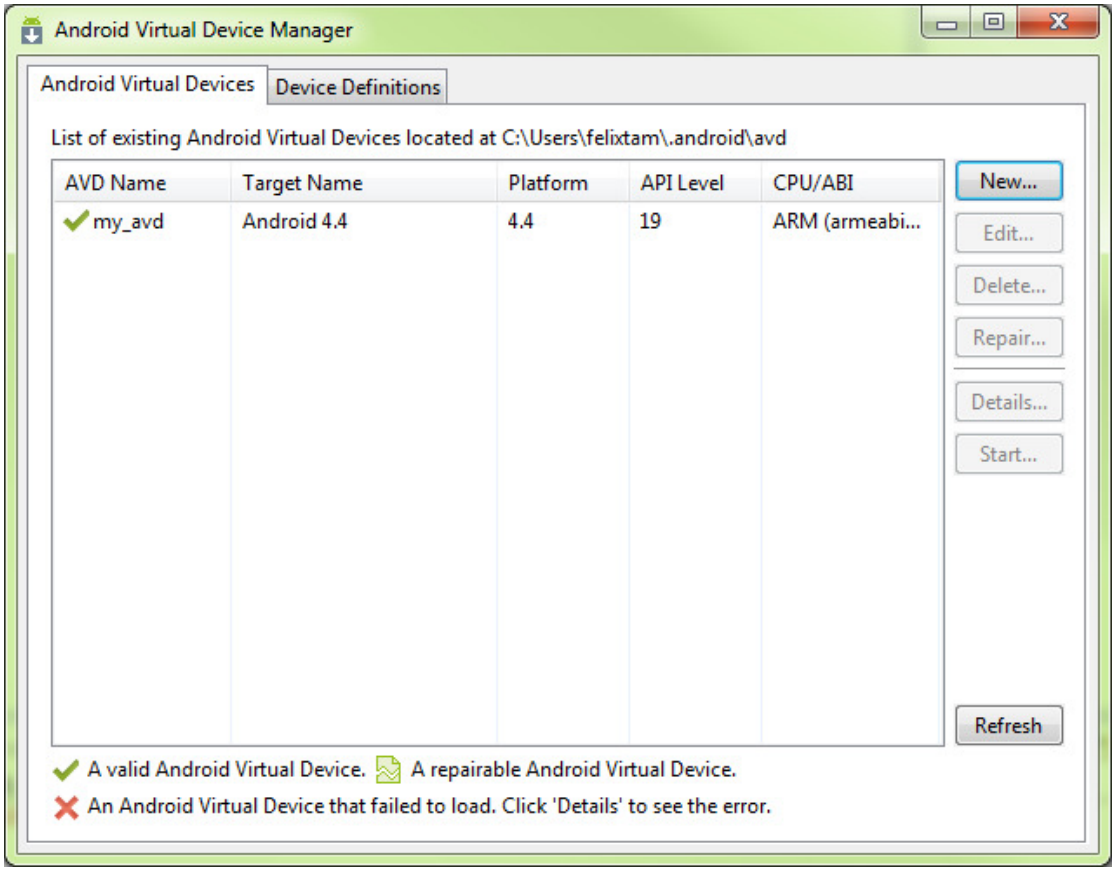
Click on **New** and input the parameters as the screenshot shown below.



Click on **Start** to start the emulator. If you received an error message " **Emulator error: This AVD's configuration is missing a kernel file"**, please make sure the **system environment variable** is set to the path of your SDK directory with variable name **ANDROID_SDK_ROOT**

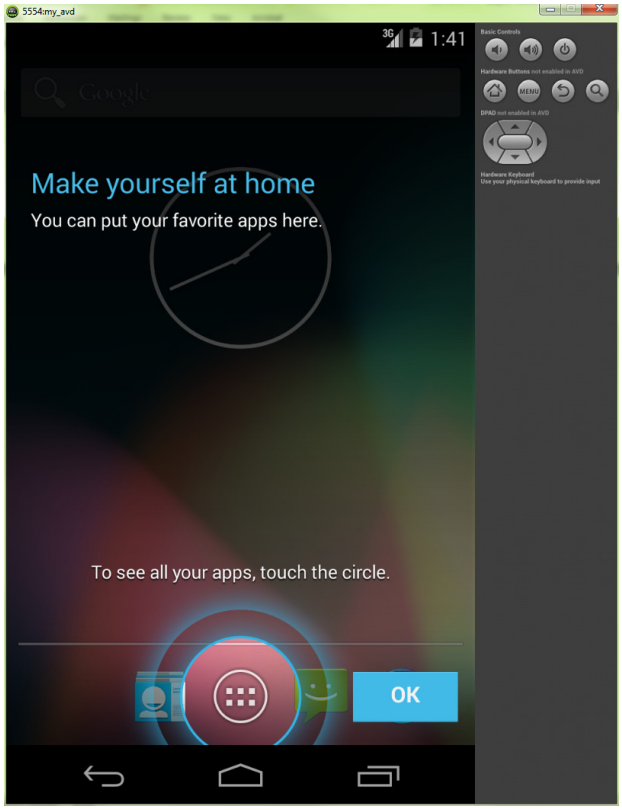
To set the **system environment variable,** click on **Start** > **Right click Computer** > **Advanced system settings > Advanced > Environment Variables**. Click **New** or **Edit ANDROID_SDK_ROOT** variable, and then specify the path of the SDK folder. E.g. C:\ adt-bundle-windows-x86\sdk

Also, if you received an error message "**PANIC: Could not open: my_avd**", please copy the **"avd"** folder from **"C:\Users\test1\.android"** to **"C:\Users\your_id\.android"**.



After the Android system is started successfully, you will see the following screen in the emulator.

*If the **Auto Monitor Logcat** dialog is promoted, select **Yes, monitor logcat…** and click the **OK** button.



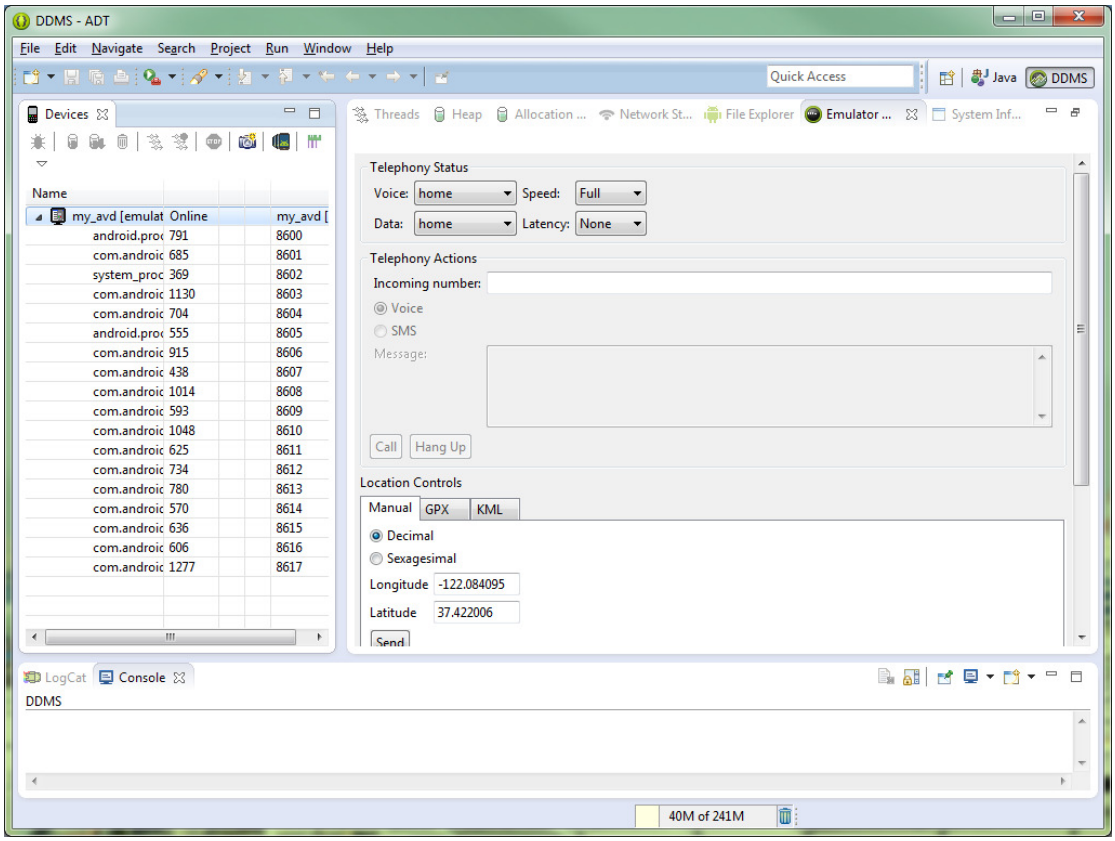
A list of shortcuts which are useful for controlling the emulator during testing

Emulated Device Key	Keyboard Key
Home	HOME
Menu	F2 or Page-up button
Back	ESC
Call/dial button	F3
Hangup/end call button	F4
Search	F5
Power button	F7
Switch to previous layout orientation (for example, portrait, landscape)	KEYPAD_7, Ctrl-F11
Switch to next layout orientation (for example, portrait, landscape)	KEYPAD_9, Ctrl-F12
Toggle cell networking on/off	F8
Toggle full screen mode	Alt-Enter
Toggle trackball mode	F6
Enter trackball mode temporarily (while key is pressed)	Delete

1.3 Monitor and debug in the emulator

Click on **Window > Open Perspective > DDMS** to open DDMS (Dalvik Debug Monitor Server) perspective. Below are some of the functions you can do with DDMS:

- View files inside the emulator
- Simulate different telephony statuses
- Simulate the longitude and Latitude value
- View the system message including the exceptions thrown by your app using **LogCat**.

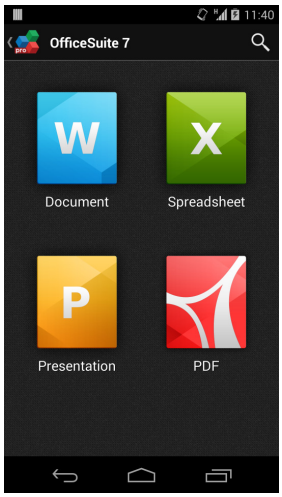


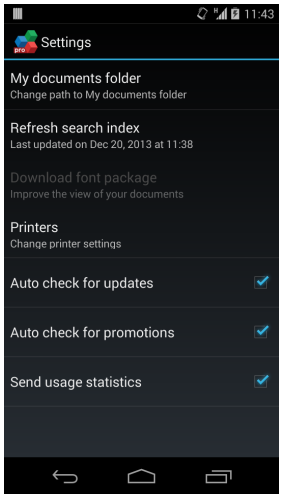
2 Understand Android apps

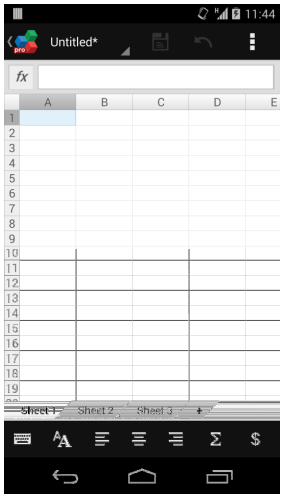
2.1 Application components

Activities

- Each activity is a single screen with a user interface
- Every screen is implemented as a subclass of **android.app.Activity**



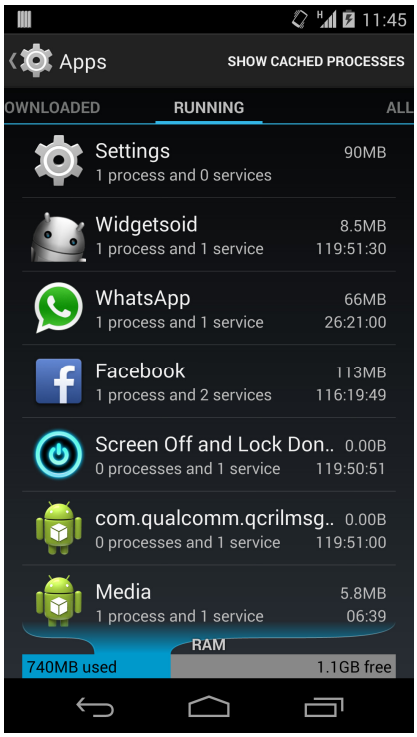




Services

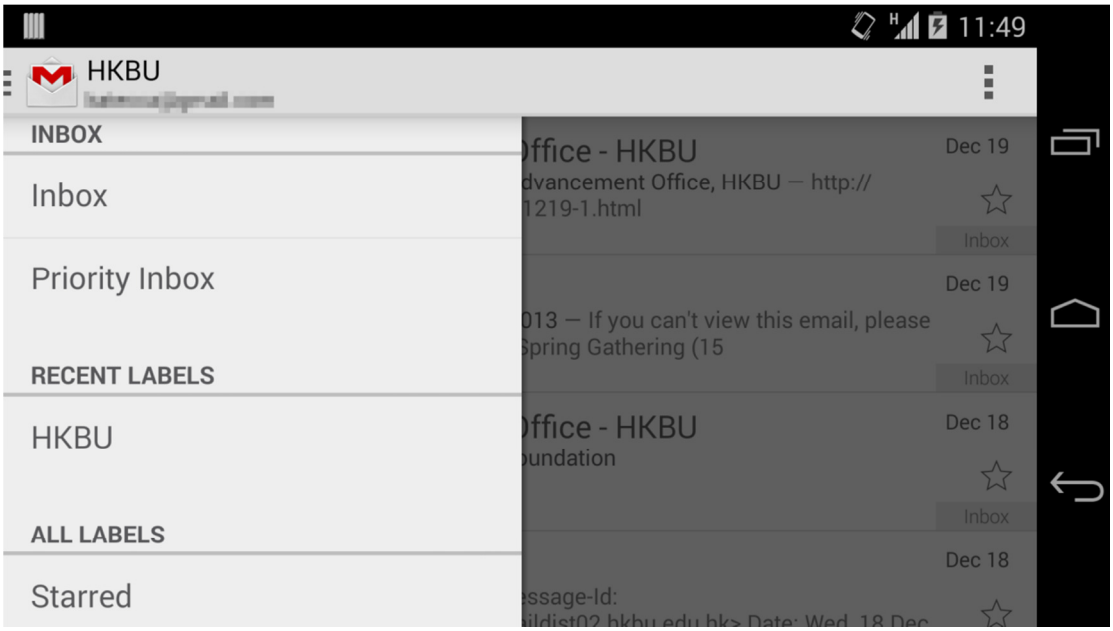
- Run in background
- No user interface
- Designed for performing tasks running in background without user interaction

Every service is implemented as a subclass of **android.app.Service**



Fragment (Introduced since API Level 11 / v4 support library)

- Represents a particular interface which encapsulated in an activity.
- Reusable UI
- Excellent interaction with ActionBar



Content providers

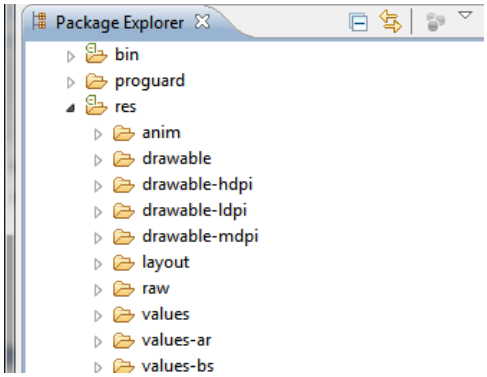
- A shared set of application data
- E.g. Contacts, Calendar (Android 4.0)

Broadcast receivers

- A component designed to respond to global broadcast announcements
- System broadcast announcements E.g. change of battery status/network status etc.

2.2 Application resources

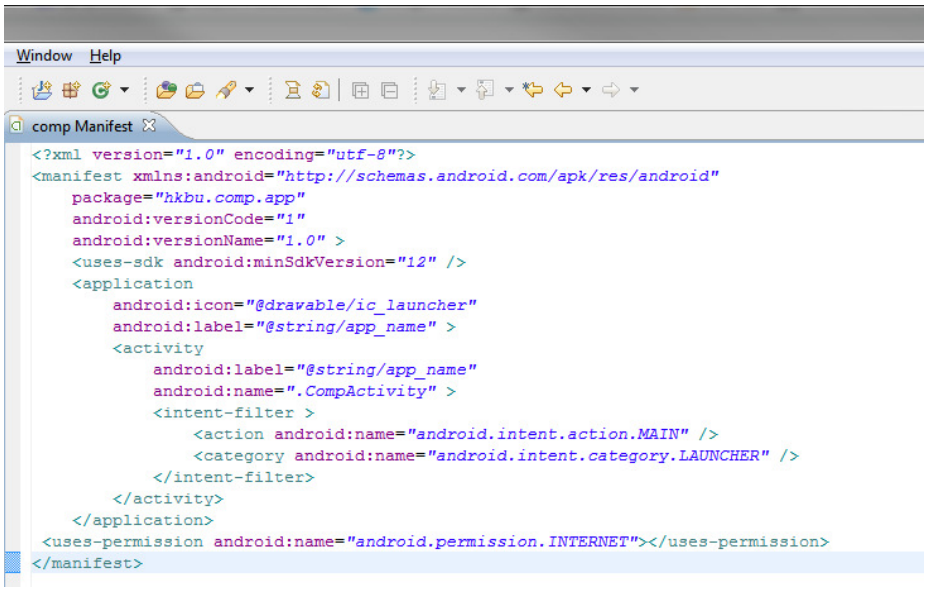
- Provide resources to your apps. E.g. Image, Video, Audio, Text etc…
- Resource are put under **res** directory of your Android project
- Every resource is identified by a resource ID
- Resources can have qualifier names for alternatives E.g. layout-**land**, values-**ja**, drawable-**hdpi** etc



2.3 App properties

We use a file called **AndroidManifest.xml** to describe the information about your app to the system and Google play as well. Inside this file, you can:

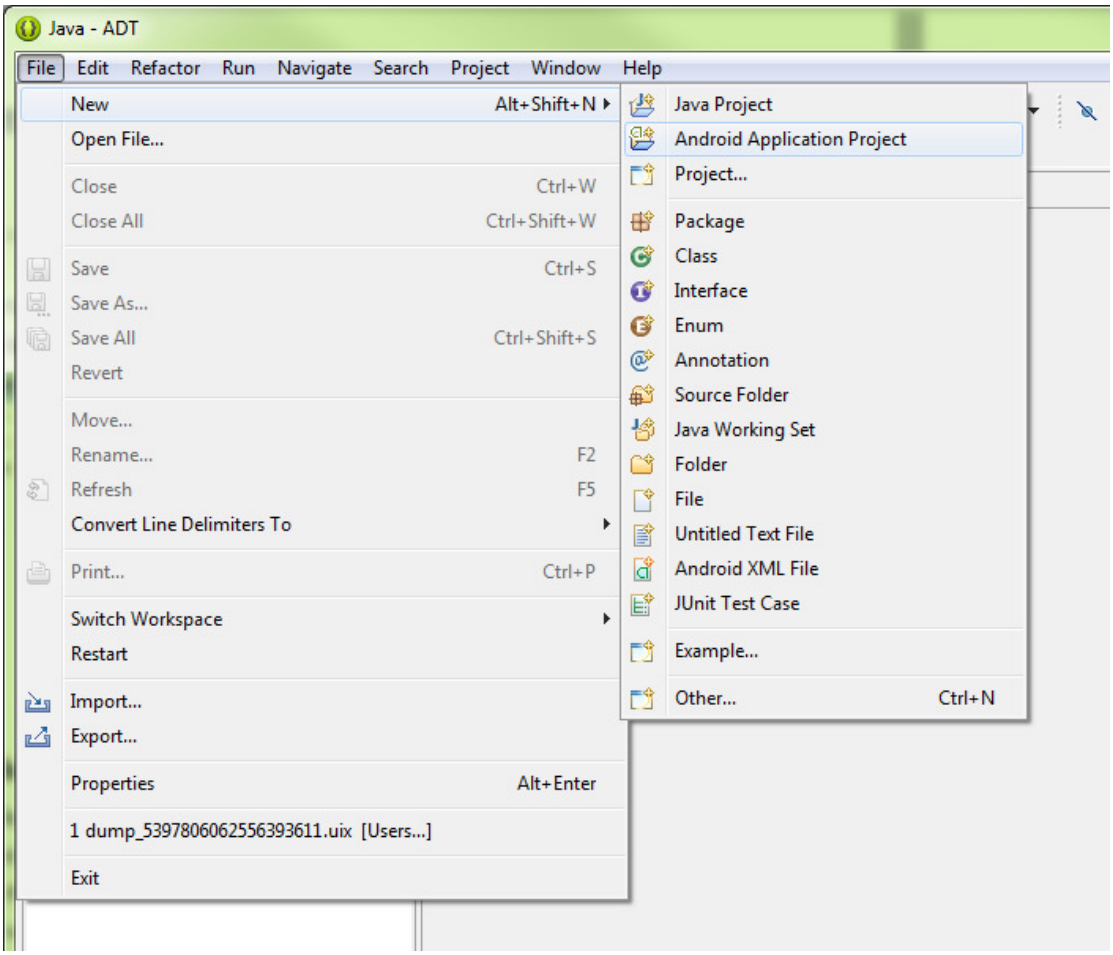
- Define your package name
- Define your version code and version name
- Define your app icon
- Define your App components (Activities/Services/Receivers etc.)
- Define the permission(s) should be granted



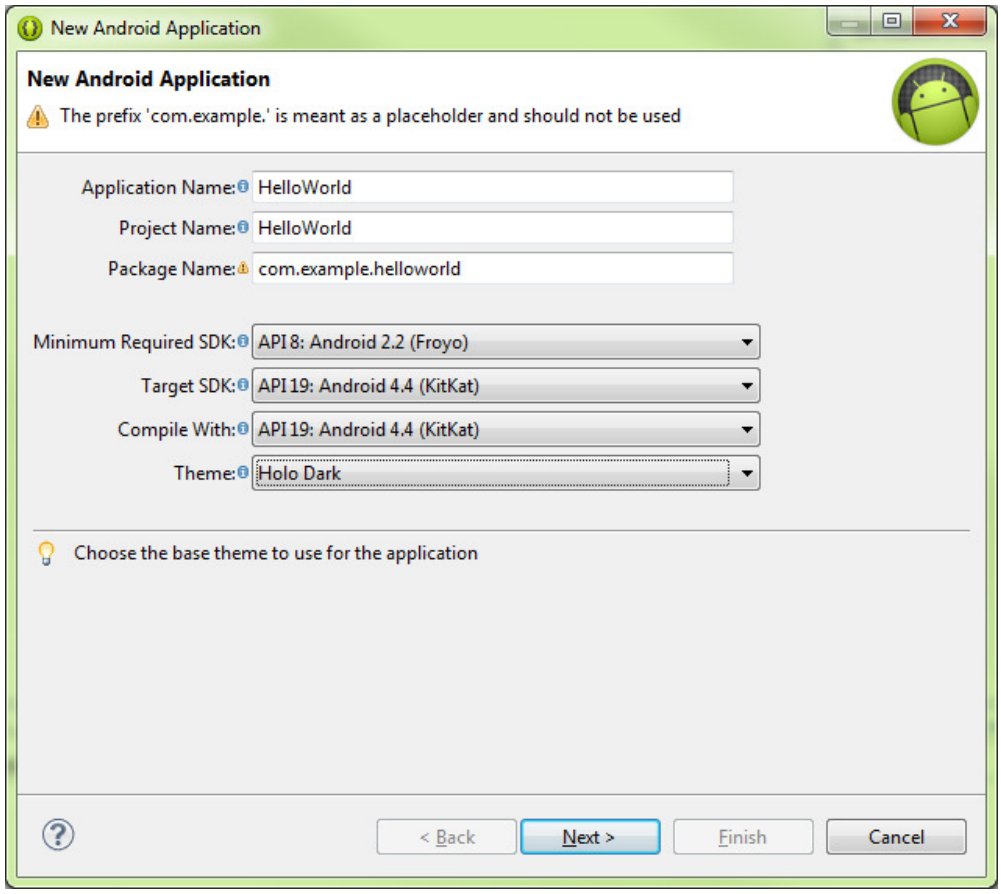
You may refer to http://developer.android.com/guide/topics/manifest/manifest-intro.html for details.

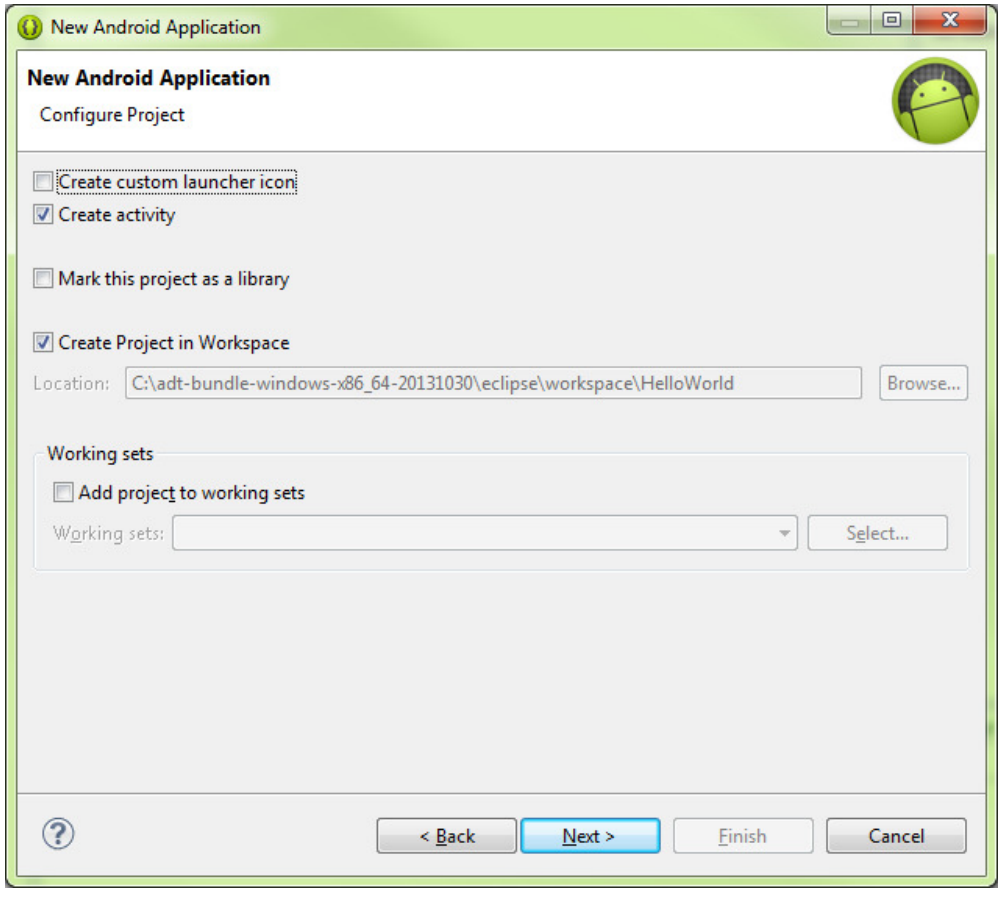
3 Create your first Android app

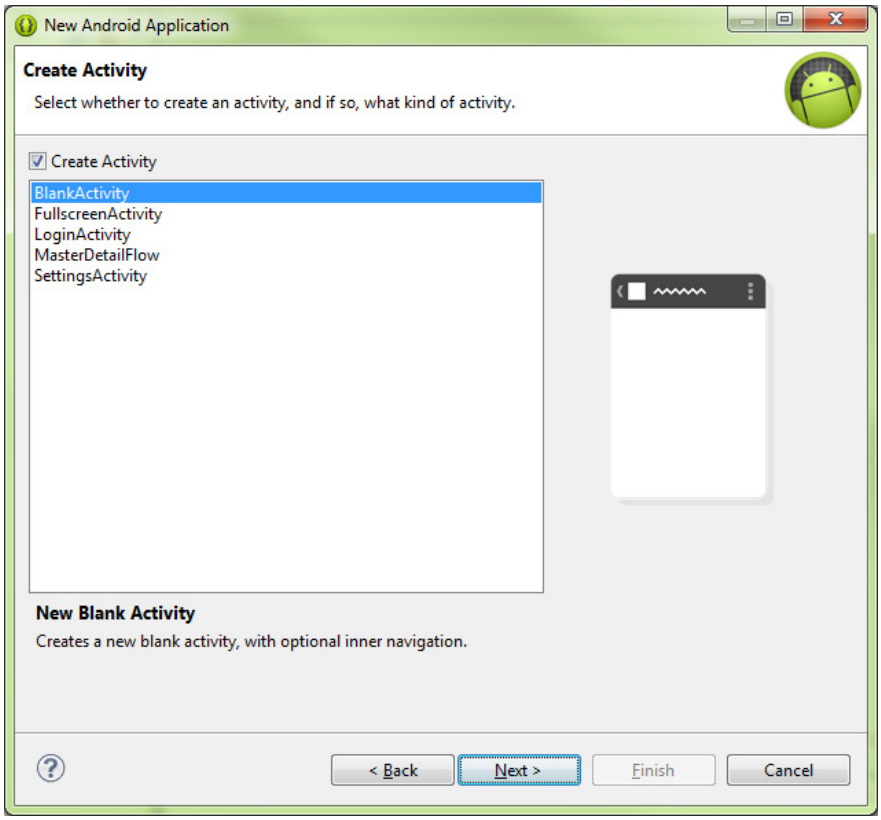
1. Start Eclipse, select **File > New > Android Application Project.**

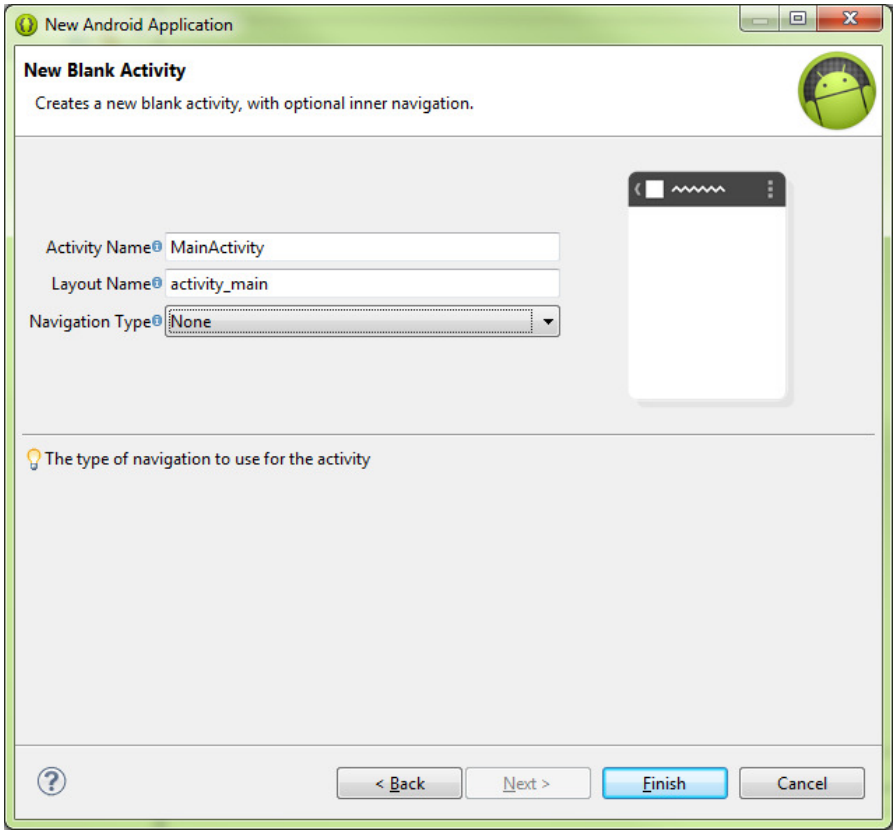


2. Input the required information as below. We will create an app with a blank activity equipped with ActionBar. Since we have checked the option **"Create Activity"** during project setup, the ADT will automatically generate a default activity and related resources right after the project is created.


New Android Application
New Android Application
The prefix 'com.example.' is meant as a placeholder and should not be used
Application Name: HelloWorld
Project Name: HelloWorld
Package Name: com.example.helloworld
Minimum Required SDK: API 8: Android 2.2 (Froyo)
Target SDK: API 19: Android 4.4 (KitKat)
Compile With: API 19: Android 4.4 (KitKat)
Theme: Holo Dark
Choose the base theme to use for the application
< Back
Next >
Finish
Cancel


New Android Application
New Android Application
Configure Project
Create custom launcher icon
Create activity
Mark this project as a library
Create Project in Workspace
Location: C:\adt-bundle-windows-x86_64-20131030\eclipse\workspace\HelloWorld
Browse...
Working sets
Add project to working sets
Working sets:
Select...
< Back
Next >
Finish
Cancel



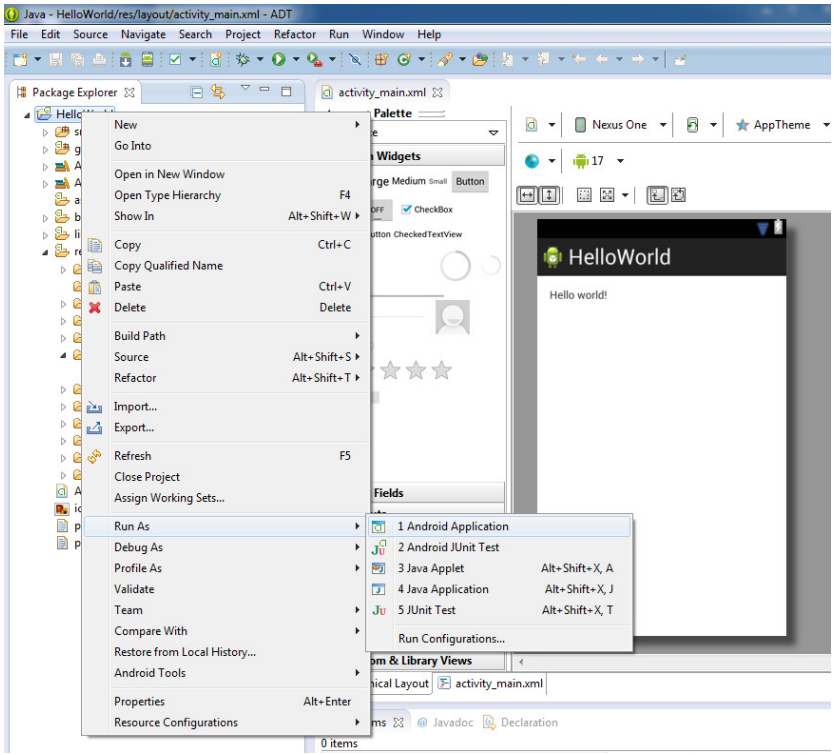


That's it. You have your first **HelloWorld** Android app.

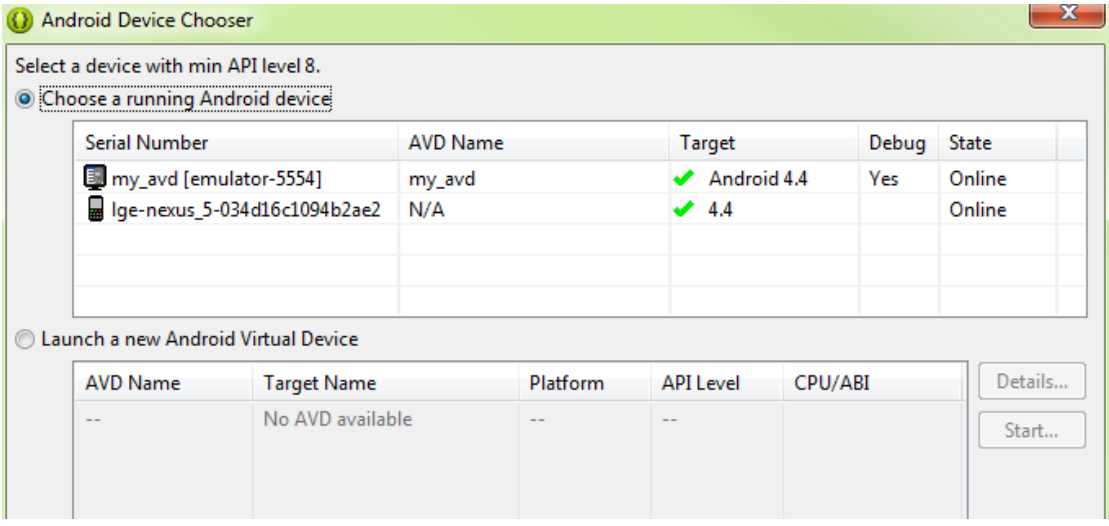
4 Run and debug your apps

4.1 Use an emulator

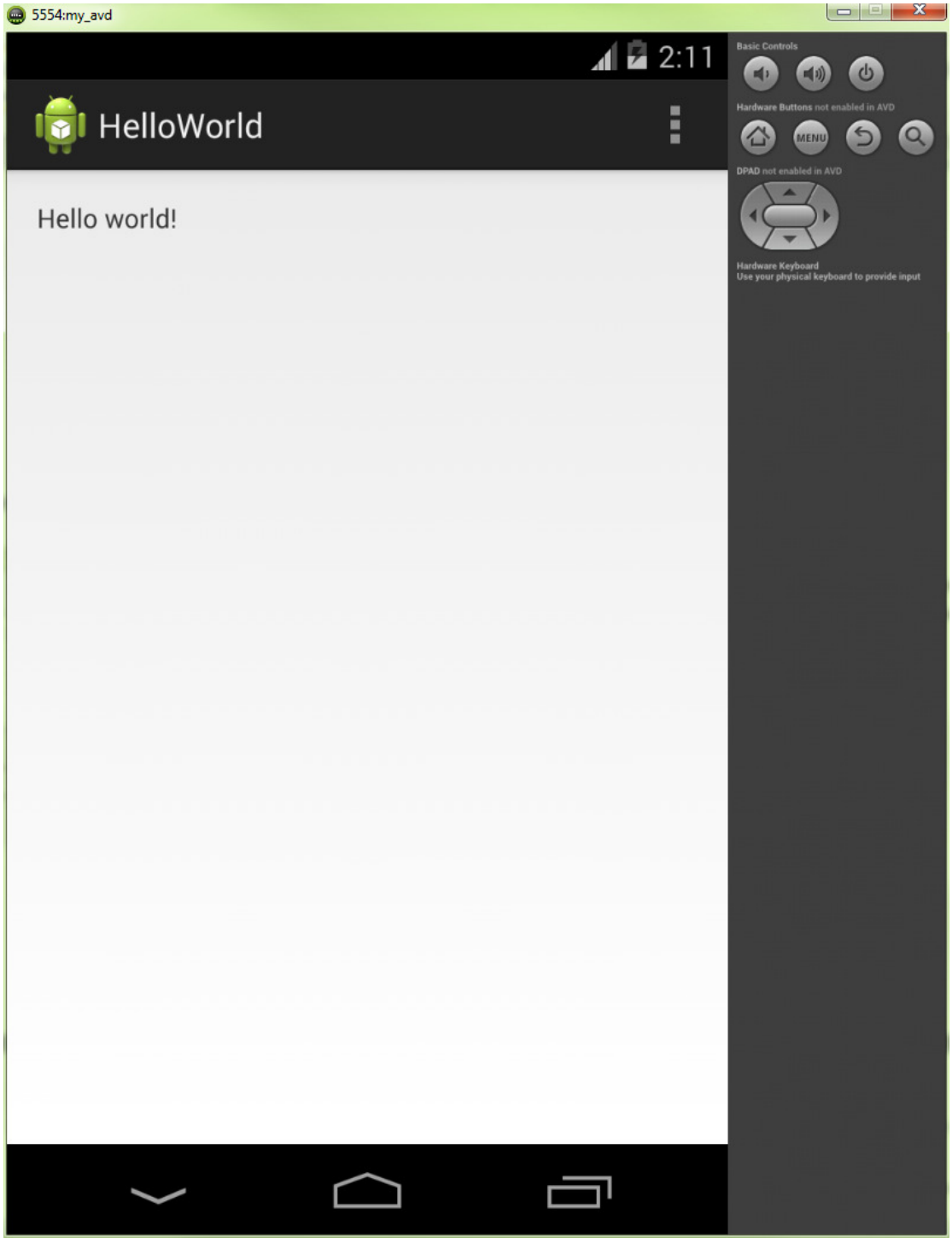
To run your app in an emulator, right click on the project in **Eclipse** and choose **Run As > Android Application**.



Choose the emulator (if more than one emulator or device attached) you are going to use.

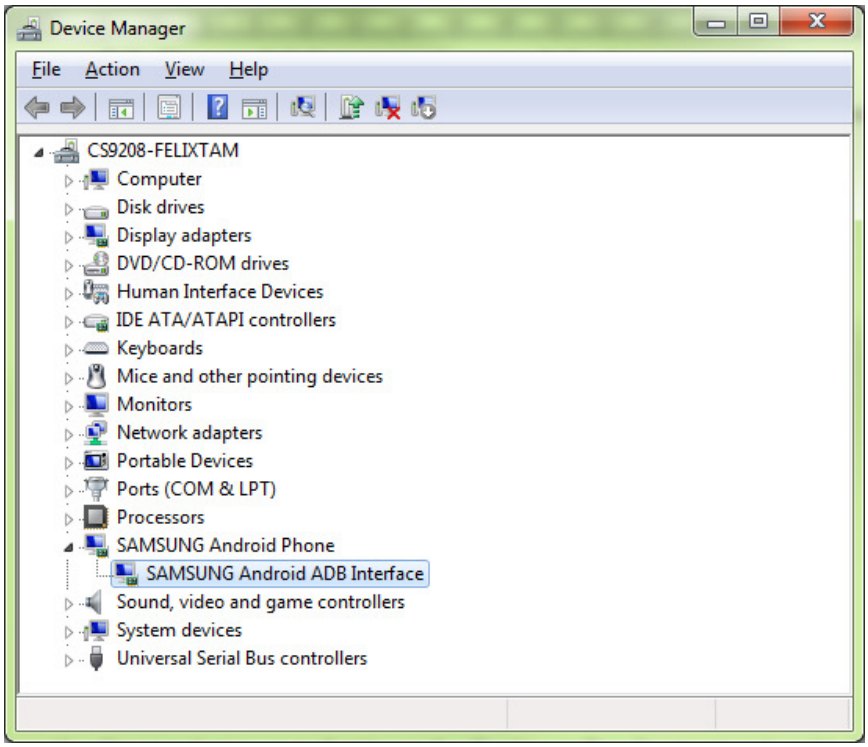


After a while the emulator should start your app

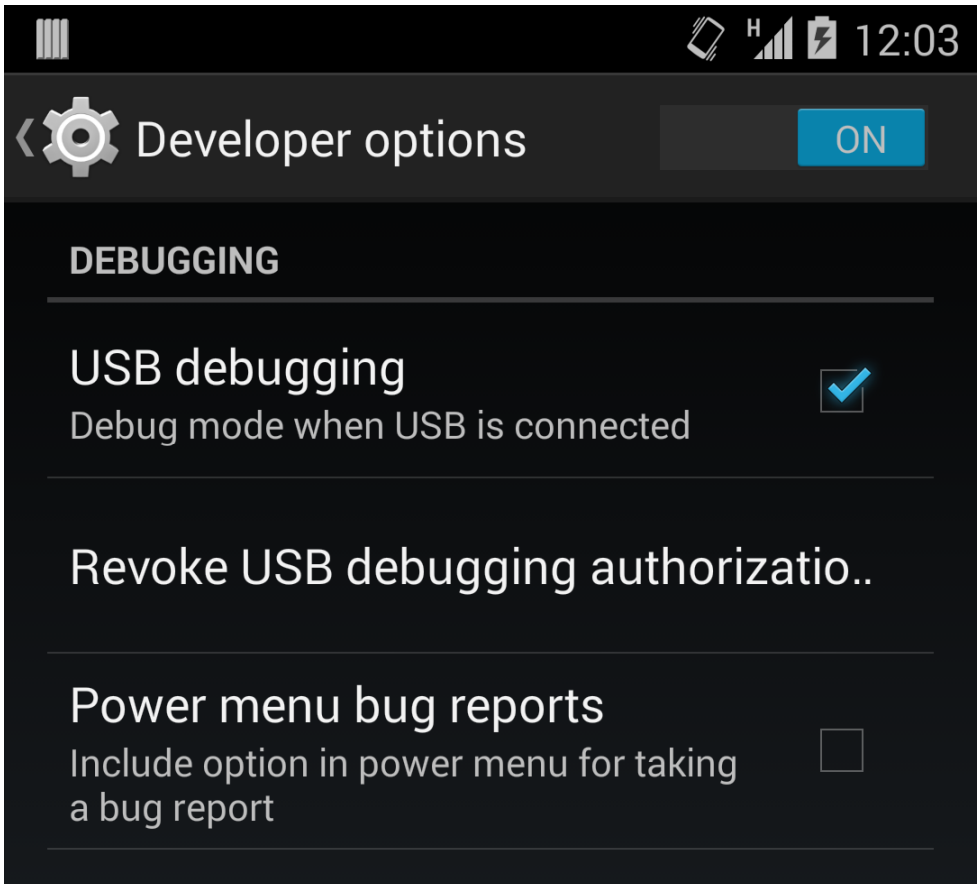


4.2 Use a real device

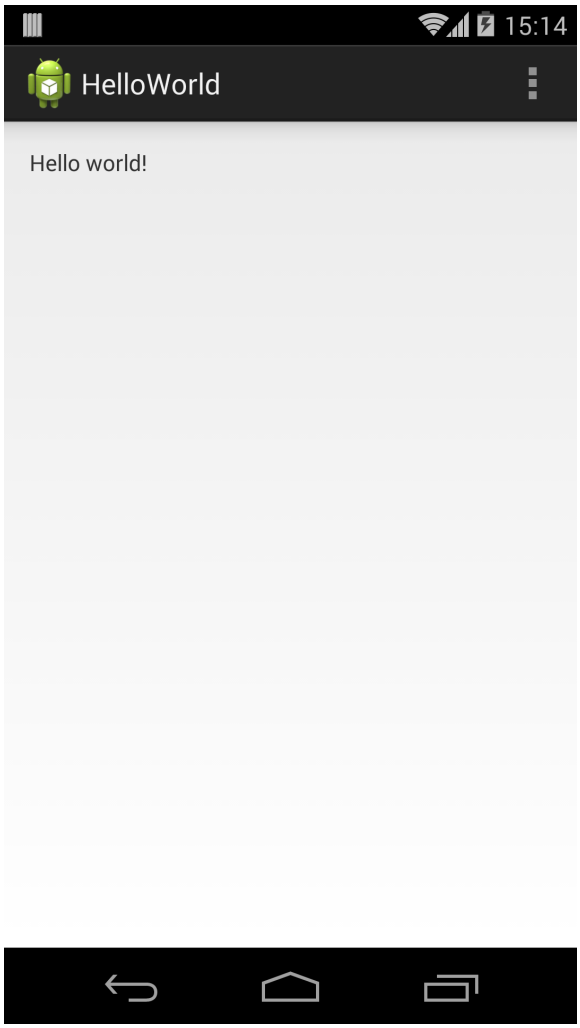
Make sure the driver of your device is properly installed in **Device Manager** otherwise the ADB will not be able to detect the present of your device. You may visit http://developer.android.com/tools/extras/oem-usb.html#Drivers for the driver details of your device.



On your device, go to **System settings > Developer options** and enables the **USB debugging** option.



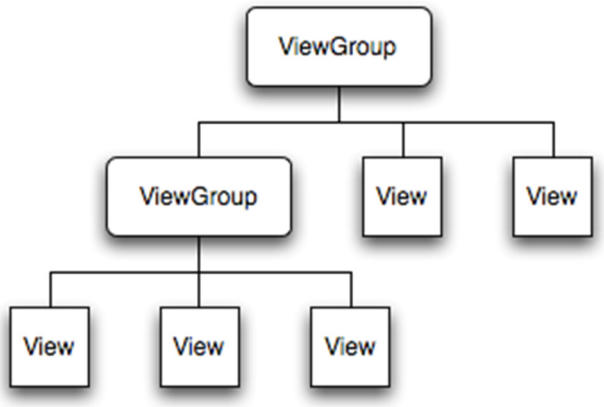
Run the application from Eclipse using the same steps written for an emulator and select your real device in **Android Device Chooser** window.



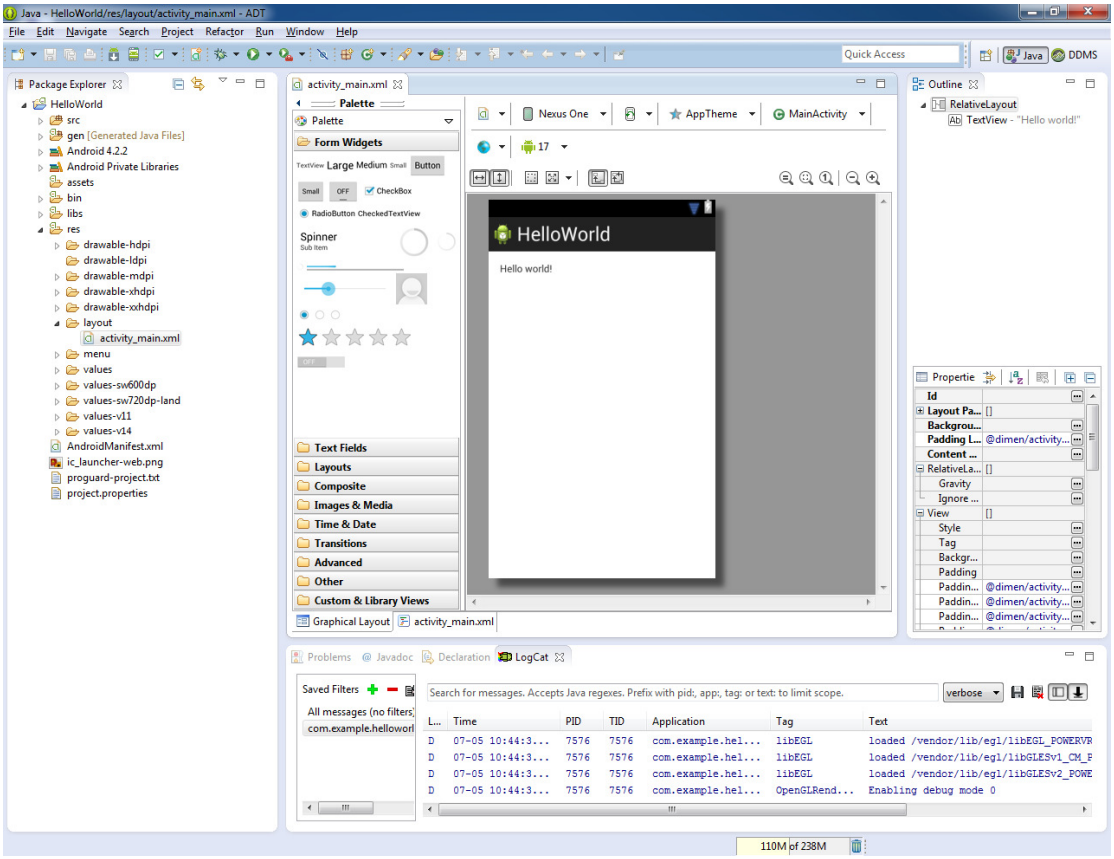
The result should be as same as using the emulator.

5 Adding more UI elements

All UI elements are built using **View** and **ViewGroup** objects in an application. The **View** can be extended to a **TextView**, **ImageView, WebView** etc, and the **ViewGroup** serves as layout architecture which describes how the **View** to be organized in an activity. Apart from building UI directly using Java code, we can also create the interface using XML document. By using XML markups, we can simplify our code and make debugging easier.



The XML layout file is saved in **res/layout**. By using the HelloWorld app as an example, you will find the initial UI is defined in activity_main.xml. When you open the activity_main.xml, Eclipse will show you a graphical UI editor for the interface preview.



However, the GUI editor is not sophisticated enough. The final appearance of the interface layout may differ from the preview in the editor. Therefore, the best practice is to create the UI elements by using XML markups directly. To do this, you can click on the **xxx.xml** tab.

5.1 Understand the UI XML layout structure

Using the activity_main.xml as an example:

```
<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=".MainActivity" >

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

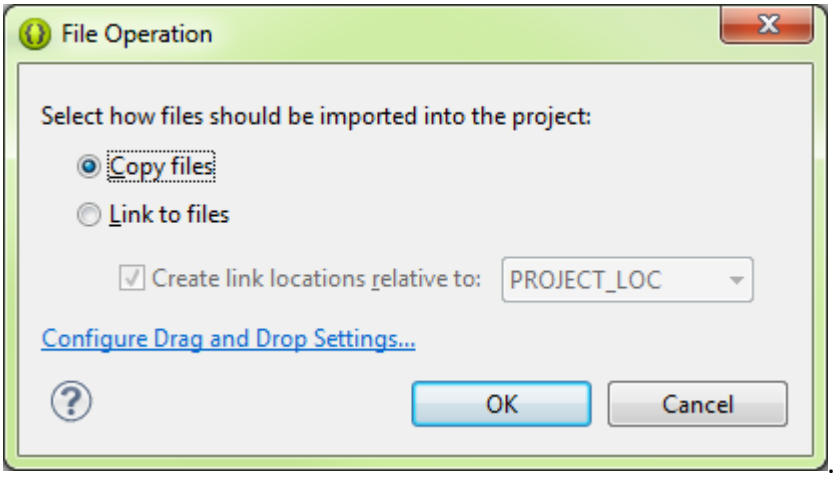
The **RelativeLayout** is a **ViewGroup** which holds its children in a relative way. The above **RelativeLayout** has only one child – **TextView**. Android uses **TextView** to display text to users. For a complete list of **ViewGroups** and **Views**, please refer to **http://developer.android.com/reference/android/view/ViewGroup.html** and **http://developer.android.com/reference/android/view/View.html** respectively.

Each kind of **ViewGroups** or **Views** has its own attributes. The attributes usually start with **android:xxx** where the **xxx** is the property name of an attribute. Different **ViewGroups** and **Views** share some common attributes but some of them are unique.

To have a quick outlook on different layouts and UI elements, please go to http://developer.android.com/guide/topics/ui/declaring-layout.html#CommonLayouts for the samples. Now, we will see how to add an image just below the text in our **activity_main.xml**.

5.2 Add an image to your app

1. Prepare an image. You may download this image http://developer.android.com/images/sdk-cube.png as an example.
2. Put the image under **res/drawable-hdpi**. If this folder is not found, you can create it manually using the **Package Explorer** in Eclipse.
3. Drag the image directly to the **drawable-hdpi** folder through the **Package Explorer**. In the **File Operation**, choose **Copy files**. You also need to rename the file if the characters are not in **(a-z)**, **(0-9)**, **(_)** and **(.)**



4. In the **res/layout/activity_main.xml**, edit the **TextView** attribute
   Add: **android:id="@+id/textView1"**

5. Add the following XML markup below the **TextView**

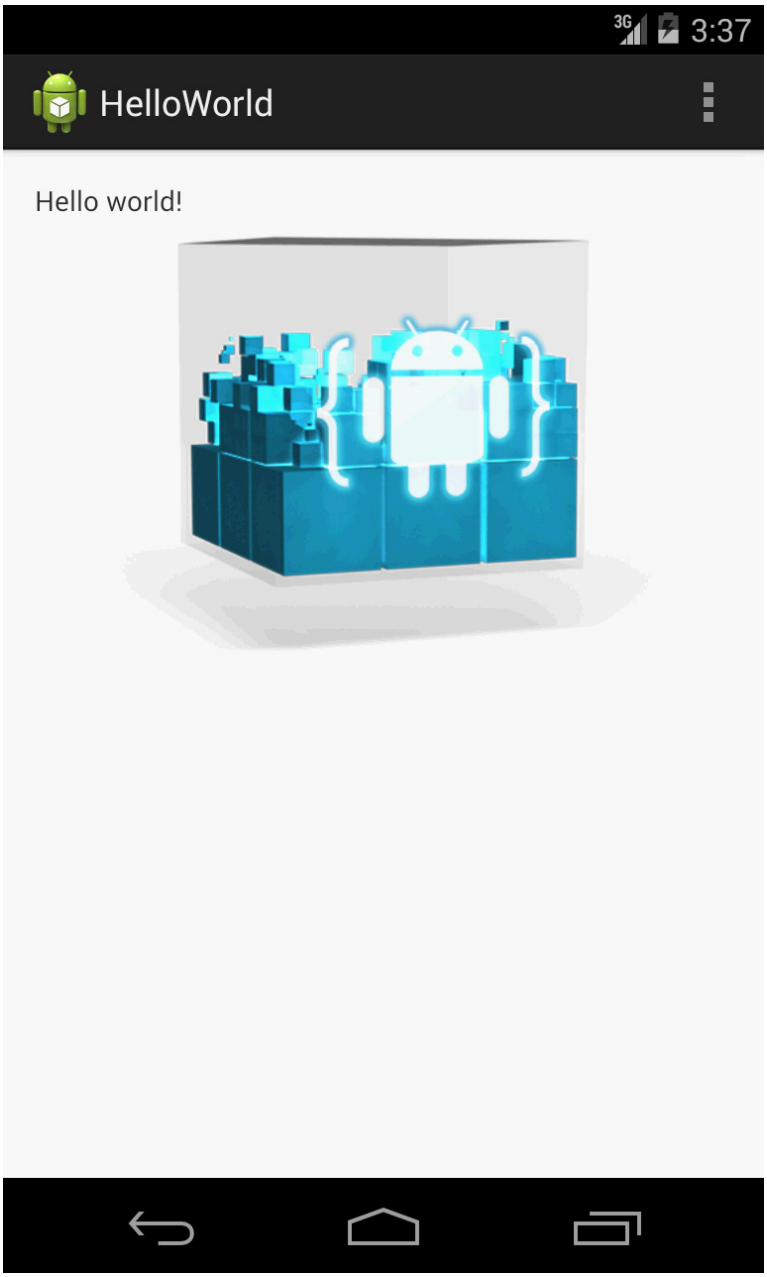
```
<ImageView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:src="@drawable/sdk_cube"
    android:layout_centerHorizontal="true"
    android:layout_below="@id/textView1"/>
```

   Code explanation:

   - The **ImageView** is used to show an image in the interface.
   - The **android:src** is used to specify the source of the image file. Here the path and the file name are **@drawable/sdk_cube**. (File extension is omitted)
   - The **android:layout_width** and **android:layout_height="wrap_content"** is used to specify the ImageView size which is the same as the image itself.

6. You can press the **Graphical Layout** tab to preview the result.

7. Run your app in the emulator and see the actual result. The final appearance should look like this:



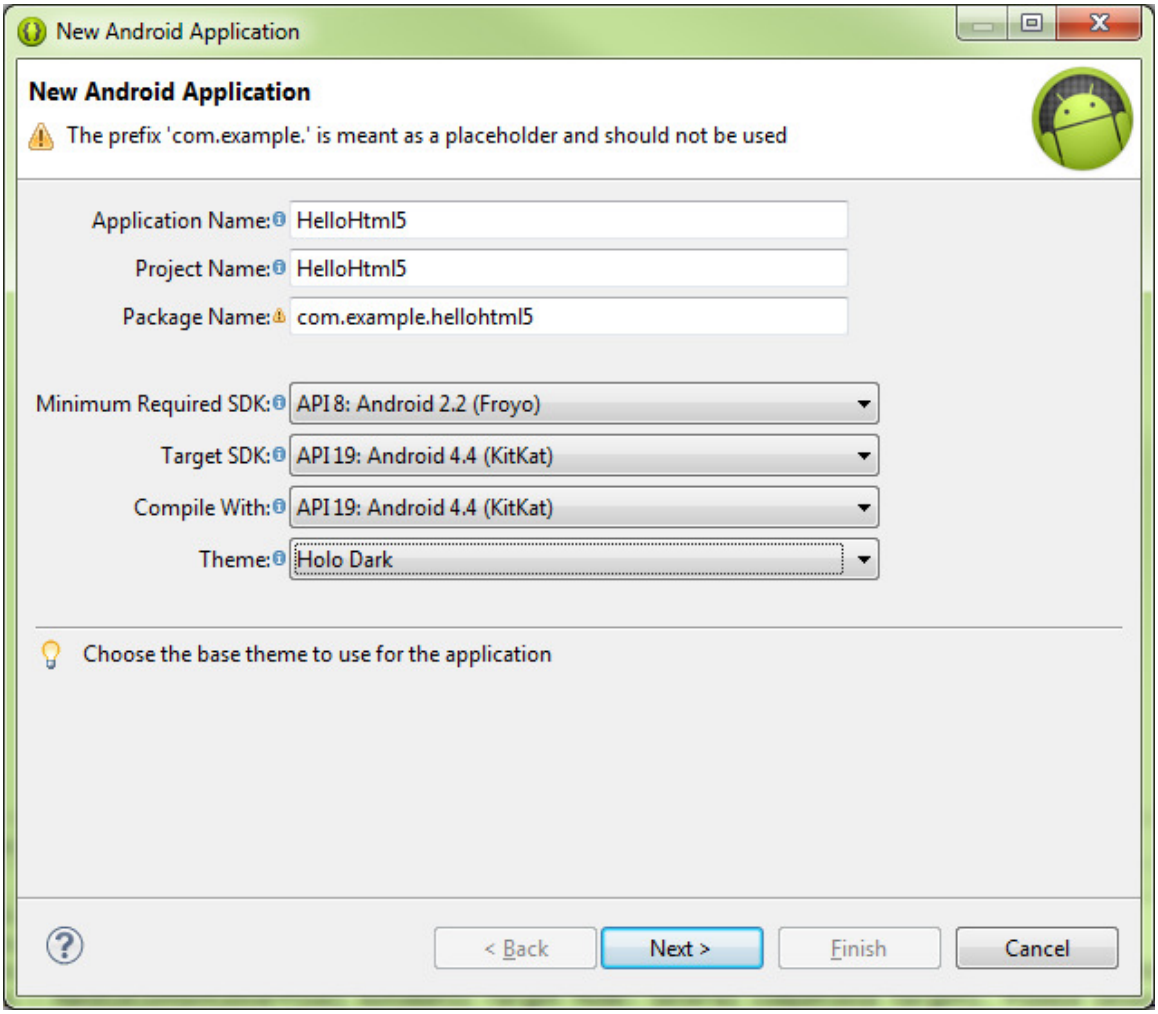
Complete project and sample codes available at **HelloWorld.zip**

6 Handle user input & using WebView for HTML5 mobile app

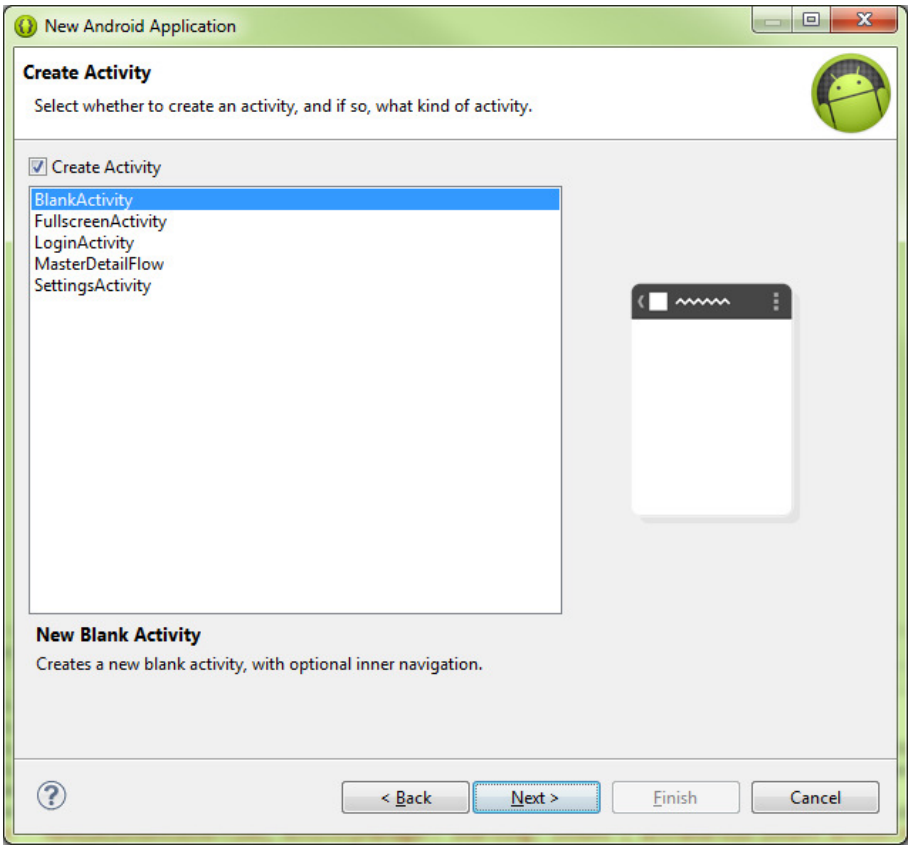
In this section, we will create an app to intercept user input and incorporate some HTML5 mobile app frameworks. Below are some frameworks which are popular:

- Sencha Touch
- jQuery Mobile
- jQTouch

1. Create a new Android project and input the required information as shown below.



2. Click **Next** three times and choose **BlankActivity.**



3. Click **Next** and **Finish** to create the project.
4. Delete the default generated **TextView** in activity_main.xml
5. Remove the attributes **android:paddingXXXX** from the **RelativeLayout**.
6. Add a **LinearLayout** inside the default RelativeLayout in activity_main.xml using the markup below. We will use this **LinearLayout** to hold the address bar (**EditText**) and the Go button.

```
<LinearLayout
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:id="@+id/linearLayout1">
</LinearLayout>
```

7. Inside this **LinearLayout,** we will add an **EditText** as an address bar and add a button next to it. To add an EditText, use the markup below:

```
<EditText
        android:id="@+id/editText1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_weight="1"
        android:hint="Enter URL"
```

android:ems="10"/>

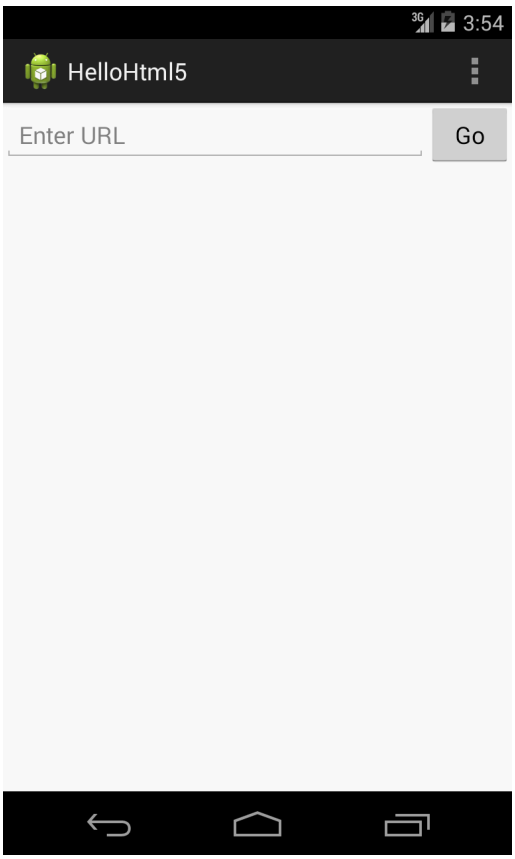
8. To add a button, use the markup below:

```
<Button
        android:id="@+id/button1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_weight="0"
        android:text="Go"/>
```

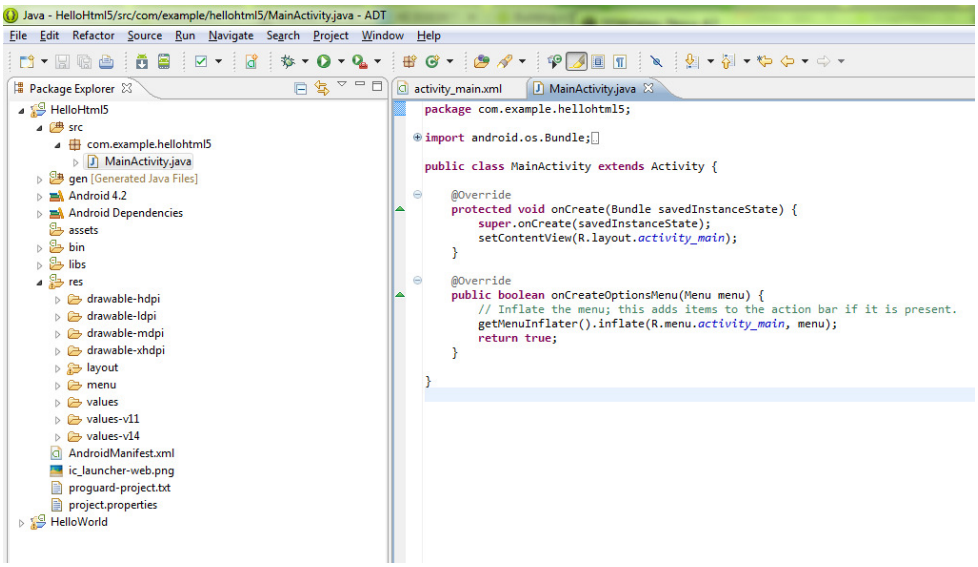
9. In this step we will add a WebView under the address bar (responsible for loading and showing the HTML5 mobile app framework). Add the following markup to **res/layout/activity_main.xml below** the **LinearLayout** created in step 5.

```
<WebView
        android:id="@+id/webView1"
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:layout_below="@id/linearLayout1"/>
```

10. Now try to run the app and it should look like this:



11. Starting from this step we will focus on the Java code. Open **MainActivity.java** under **src > com.example.hellohtml5.**



12. Create three private variables above the **onCreate** method, import necessary packages using Eclipse:

    private Button button;
    private EditText editText;
    private WebView webView;

13. Inside the **onCreate** method, add the following codes after **setContentView(R.layout.activity_main):**

    button = (Button)findViewById(R.id.button1);
    editText = (EditText)findViewById(R.id.editText1);
    webView = (WebView)findViewById(R.id.webView1);
    webView.getSettings().setJavaScriptEnabled(true);
    webView.setWebViewClient(new WebViewClient());

    *import **android.webkit.WebView; android.webkit.WebViewClient; android.widget.Button and android.widget.EditText;** to fix errors due to missing classes.

14. Create an **OnClickListener** for the button inside the MainActivity class. This listener will achieve the following goals:
    1. Intercept the click action of the button
    2. Read the URL typed in the EditText
    3. Instruct the WebView to load the page according the URL

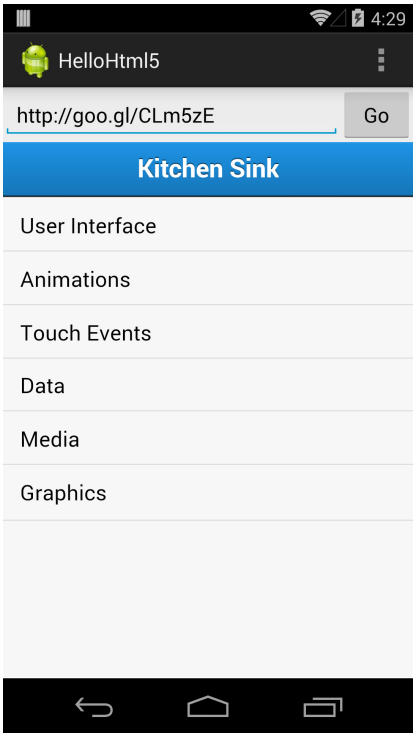
```
private OnClickListener buttonClick = new OnClickListener(){
    @Override
    public void onClick(View arg0) {
        webView.loadUrl(editText.getText().toString());
    }
};
```

*You should import **android.view.View.OnClickListener** when prompted for **OnClickListener** in Eclipse. Import **android.view.View** too.

15. Bound the **OnClickListener** to the Go button using follow code in onCreate():
    button.setOnClickListener(buttonClick);

16. Since the app will access Internet to load the HTML5 framework demo, we need to declare necessary permission in AndroidManifest.xml. Add the following permission declaration above the application element.
    <uses-permission android:name="android.permission.INTERNET" />

17. Run the app and test the HTML5 frameworks, type the links below in the address bar and tap on the **Go** button.
    *You are recommended to use a real device instead of emulator for having a better experience in this example.
    - **Sencha Touch**
      Full URL:
      http://cdn.sencha.io/touch/sencha-touch-2.1.0/examples/kitchensink/index.html
      Short URL: http://goo.gl/CLm5zE



- **jQuery Mobile**

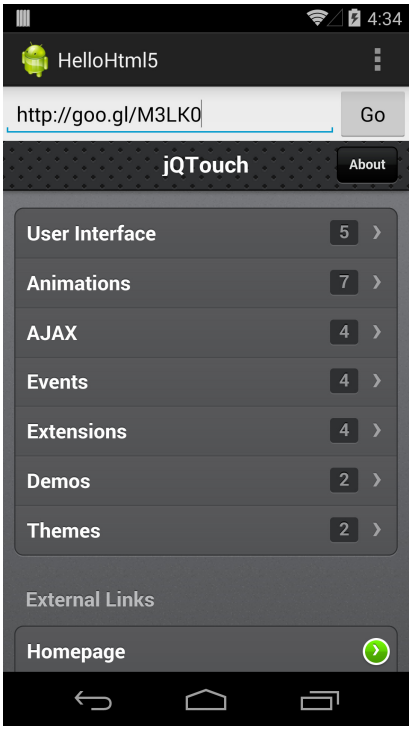
  Full URL: http://demos.jquerymobile.com/1.4.0/

  Short URL: http://goo.gl/yYjJOr

- **jQTouch**

  Full URL: http://jqtouch.com/preview/demos/main/#home

  Short URL: http://goo.gl/M3LK0



Complete project and sample codes available at **HelloHtml5.zip**

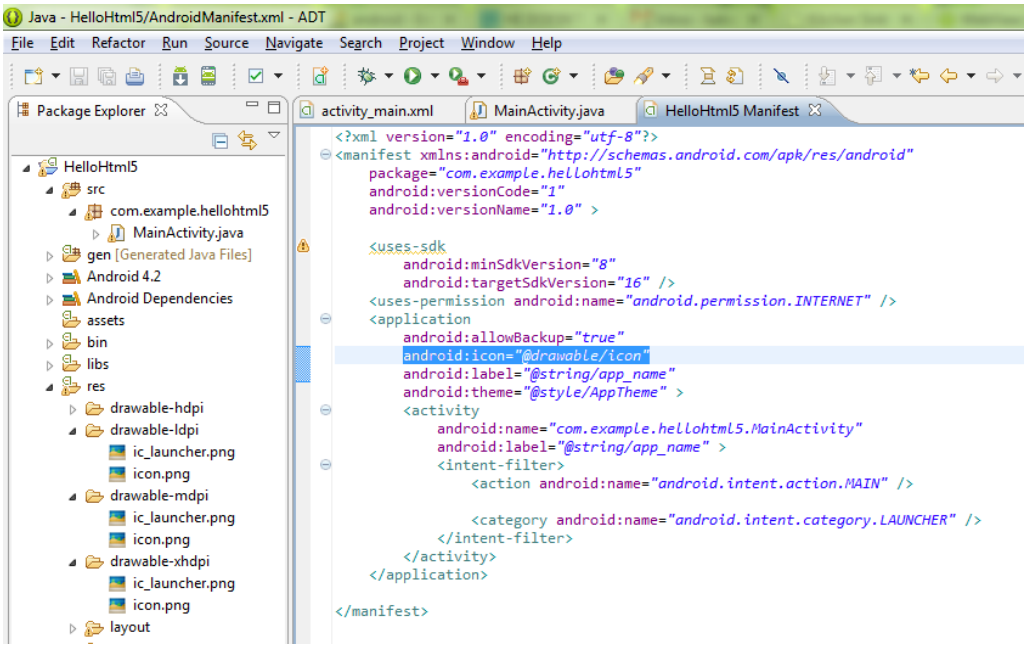
7. Publish your app

Before publishing the app to Google Play Store or distribute it to someone else, you should design an icon for your app instead of using the default one. Also, you may need to change the app name according to your preference later on.

7.1. Prepare your app icon

For the app icon, we have to prepare at least four different sizes for different screen resolutions. Namely: ldpi, mdpi, hdpi and xhdpi (There is also tvdpi). In the following steps, we will base on the previous example which is completed in section 6.

1. Please prepare an app icon and resize it to 36x36px for ldpi, 48x48 for mdpi, 72x72 for hdpi and 96 x 96 for xhdpi. For the app icon design guideline. Please refer to **http://developer.android.com/guide/practices/ui_guidelines/icon_design_launcher.html**. You can also get some free icons at www.iconarchive.com
2. Put the icon with the same file name (E.g. icon.png) into drawable-hdpi (72x72), drawable-mdpi (48x48) and drawable-ldpi (36x36) respectively.
3. Open the **AndroidManifest.xml**, change **android:icon="@drawable/ic_launcher"** to **android:icon="@drawable/icon".** You can delete the default launcher icon afterwards.



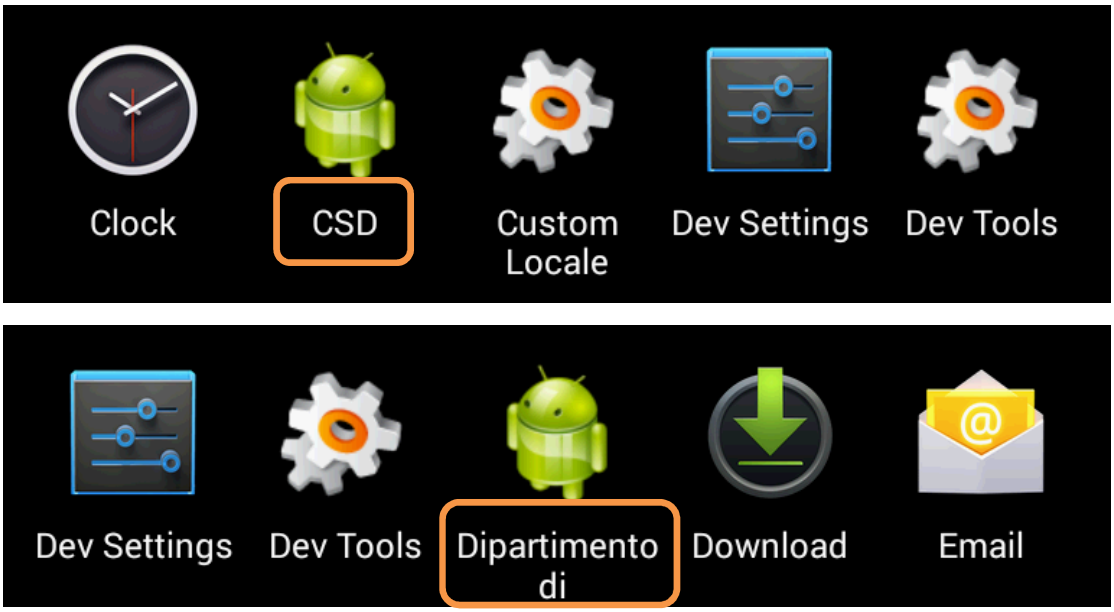
The new icon will be shown in the launcher after you deployed your app into the emulator or device.

7.2. Change the app name and apply localization

When you look at the **AndroidManifest.xml** file, you can see an attribute **android:label="@string/app_name"** is already added to the <application> tag. The **@string/app_name** refers to a value of an elements call **app_name** located in **value/strings.xml**. By storing the string in the values/strings.xml, we can easily localize our apps by using different qualifier name (language code this time).
E.g.: **it** for Italian, **zh-rTW** for Traditional Chinese, and **zh-rCN** for simplified Chinese

1. Go to **values/strings.xml**, change the app name to **CSD**.
2. Create a folder called **values-it** in **res** directory.
3. Create a **strings.xml** file inside the **values-it** and insert the following markup:
   ```
   <?xml version="1.0" encoding="utf-8"?>
   <resources>
       <string name="app_name">Dipartimento di Informatica</string>
   </resources>
   ```
4. Run your app in the emulator or device, you can see the app name is changed.
5. Now, change the locale setting in the emulator or device by going to **Settings > Language and input > Language > Italiano.** You should see the name of the app

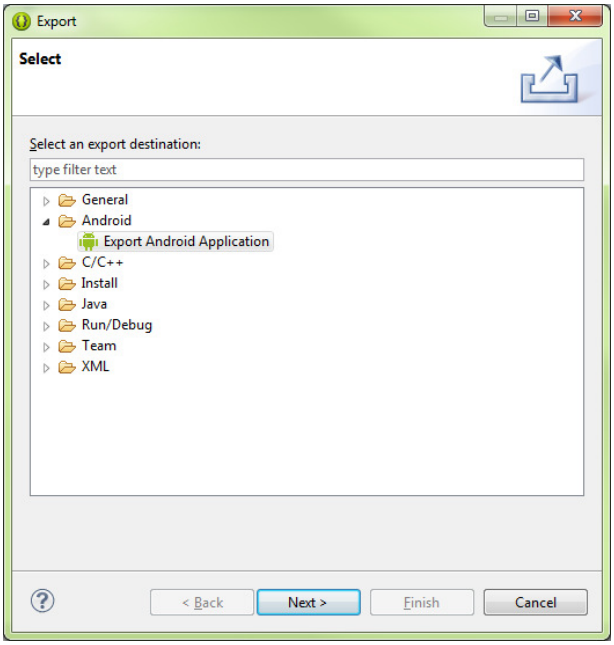
will be automatically changed to Italian.



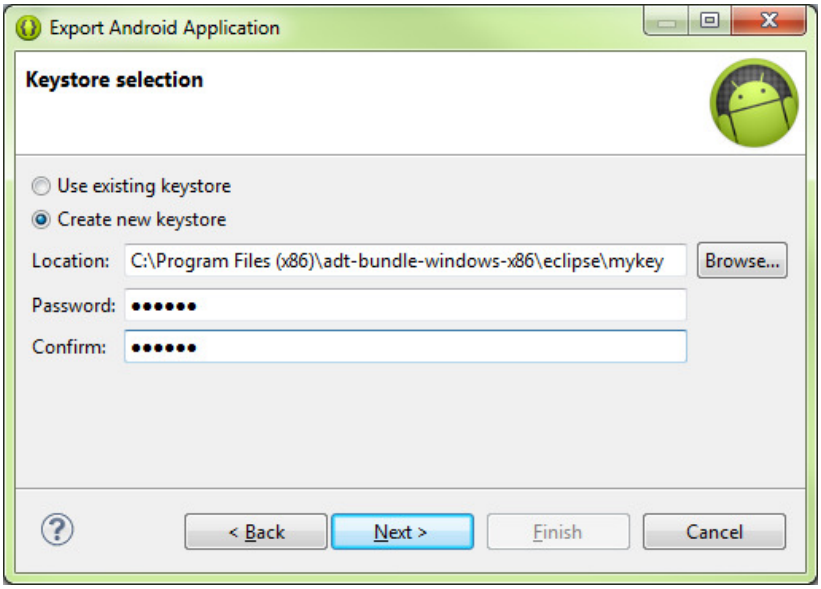
7.3. Sign and export the APK

For every Android app, you have to sign it before uploading it to Google Play Store or distributing it to others. The certificate used by ADT for deploying your app in the emulator or device is a debug key only. When exporting the Android app in Eclipse, you can create your own private key if you have not yet created.

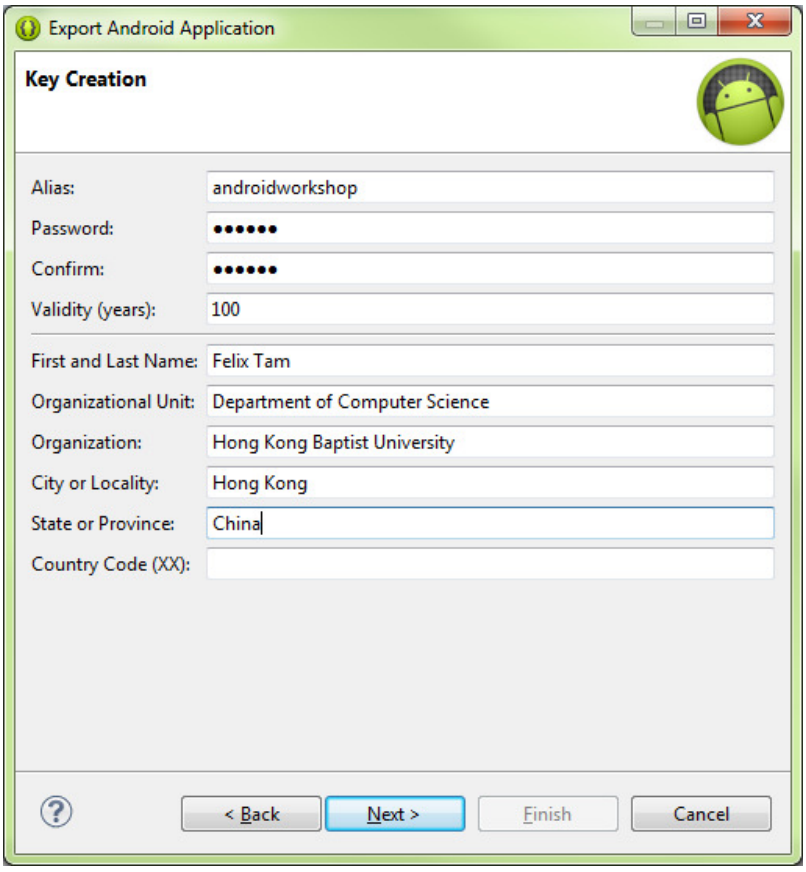
1. In Eclipse, right click your project and select **File > Export > Android > Export Android Application**.



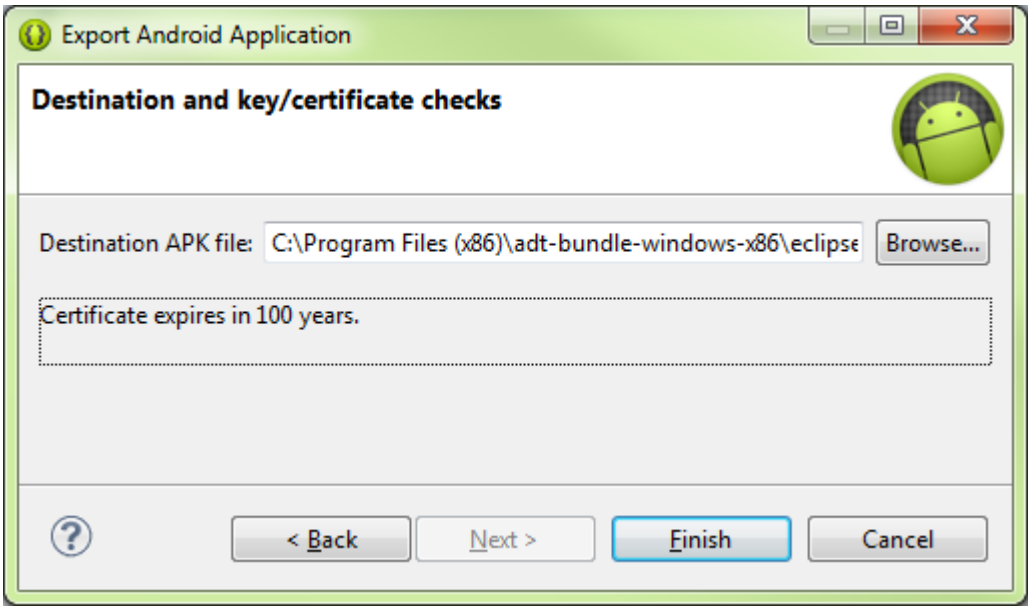
2. Click **Next** to continue if the selected project is correct.
3. Select **Create new keystore**, choose the location for saving the new keystore and enter the password.



4. Enter your personal information in **Key Creation** step. Below is a sample screenshot:



5. Choose your location for saving the APK file.



6. Now you are ready to distribute your APK file to Google Play Store or install it directly in any devices.

8. Reference and learning resources:

- Official Android developer website:
  http://developer.android.com/index.html
- Many common questions raised by other developers previously:
  http://stackoverflow.com/
- Many Android tutorials with complete source code:
  http://www.anddev.org
- Different ways for implementing listeners in Android app
  http://tseng-blog.nge-web.net/blog/2009/02/14/implementing-listeners-in-your-android-java-application/
- Special Interest Group on Innovative Software homepage:
  http://www.comp.hkbu.edu.hk/~sigis/