Hello, World

As a developer, you know that the first impression of a development framework is how easy it is to write "Hello, World." Well, on Android, it's pretty easy. It's particularly easy if you're using Eclipse as your IDE, because we've provided a great plugin that handles your project creation and management to greatly speed up your development cycles.

This tutorial assumes that you're using Eclipse. If you're using the command line, see Building and Running from the Command Line. You can then return to this tutorial and ignore anything about Eclipse.

Before you start, you should already have the SDK installed, and if you're using Eclipse, you should have installed the ADT plugin as well. If you have not installed these, see Installing the Android SDK and return here when you've completed the installation.

Install a Platform

To run the Hello World application, you need to install at least one Android platform in your SDK environment. If you have not already performed this step, you need to do it now.

To install a platform in Eclipse:

1. In the Android SDK Manager, choose **Available Packages** in the left panel.
2. In the right panel, expand the Android Repository list to display the components available for installation.
3. Select at least one platform to install, and click **Install Selected**. If you aren't sure which platform to install, use the latest version.

Create an AVD

To learn more about how to use AVDs and the options available to you, see Managing Virtual Devices.

In this tutorial, you will run your application in the Android Emulator. Before you can launch the emulator, you must create an Android Virtual Device (AVD). An AVD defines the system image and device settings used by the emulator.

To create an AVD:

1. In Eclipse, select **Window > AVD Manager**.
2. Select **Virtual Devices** in the left panel.

3. Click **New...**.

The **Create New AVD** dialog appears.

4. Type the name of the AVD, such as "my_avd".
5. Choose a target.

The target is the platform (that is, the version of the Android SDK, such as 2.3.3) you want to run on the emulator. For this tutorial, choose the latest platform that you have installed and ignore the rest of the fields.

6. Click **Create AVD**.

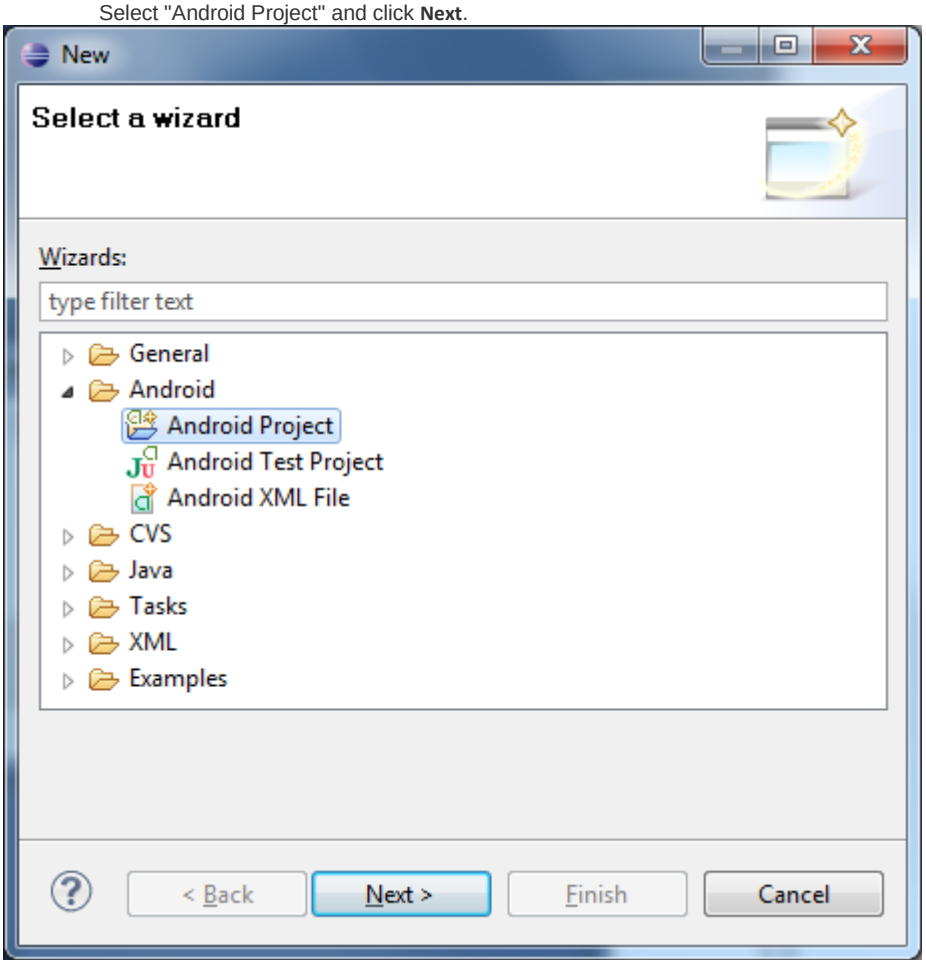
Create a New Android Project

After you've created an AVD you can move to the next step and start a new Android project in Eclipse.

1. In Eclipse, select **File > New > Project...**.

If the ADT Plugin for Eclipse has been successfully installed, the resulting dialog should have a folder labeled "Android" which should contain "Android Project". (After you create one or more Android projects, an entry for "Android XML File" will also be available.)

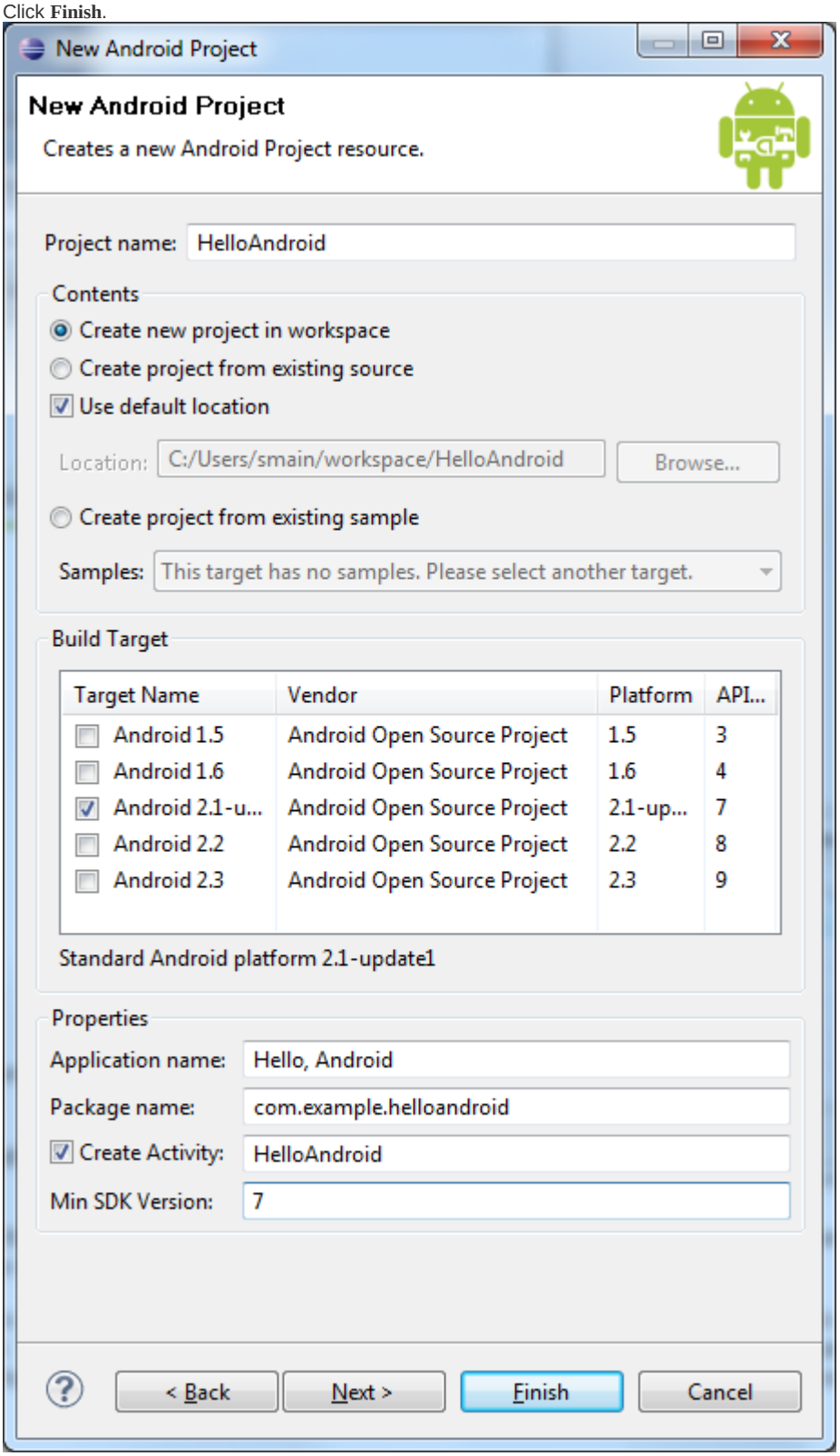
2. Select "Android Project" and click **Next**.



3. Fill in the project details with the following values:

- *Project name:* HelloAndroid
- *Build Target:* Select a platform version that is equal to or lower than the target you chose for your AVD.
- *Application name:* Hello, Android
- *Package name:* com.example.helloandroid (or your own private namespace)
- *Create Activity:* HelloAndroid

Click **Finish**.



Here is a description of each field:

Project Name

This is the Eclipse project name — the name of the directory that contains the project files.

Build Target

This is the version of the Android SDK that you're using to build your application. For example, if you choose Android 2.1, your application will be compiled against the Android 2.1 platform library. The target you choose here does not have to match the target you chose for your AVD; however, the target must be equal to or lower than the target you chose for your AVD. Android applications are forward-compatible, which means an application will run on the platform against which it is built as well as all platforms that are released in the future. For example, an application that is built against the 2.1 platform library will run normally on an AVD or device that is running the 2.3.3. The reverse is not true.

Application Name

This is the human-readable title for your application — the name that appears on the Android device.

Package Name

This is the package namespace (following the same rules as for packages in the Java programming language) that you want all your source code to reside under. This also sets the package name under which the stub Activity is generated.

Your package name must be unique across all packages installed on the Android system; for this reason, it's important to use a standard domain-style package for your applications. The example above uses the "com.example" namespace, which is a namespace reserved for example documentation — when you develop your own applications, you should use a namespace that's appropriate to your organization or entity.

Create Activity

This is the name for the class stub that is generated by the plugin. This is a subclass of Android's `Activity` class. An Activity is simply a class that can run and do work. It can create a UI if it chooses, but it doesn't need to. As the checkbox suggests, this is optional, but an Activity is almost always used as the basis for an application.

Min SDK Version

This value specifies the minimum API Level on which your application will run. The *Min SDK Version* should be the same as the *Build Target* you chose. For example, if the *Build Target* is Android 2.1, then the *Min SDK Version* should be 7 or lower (it can never be higher than 7). For more information, see Android API Levels.

Other fields: The checkbox for "Use default location" allows you to change the location on disk where the project's files are generated and stored.

Your Android project is now ready. It should be visible in the Package Explorer on the left. Open the `HelloAndroid.java` file, located inside *HelloAndroid > src > com.example.helloandroid*). It should look like this:

```
package com.example.helloandroid;

import android.app.Activity;
import android.os.Bundle;

public class HelloAndroid extends Activity {
    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }
}
```

Notice that the class is based on the `Activity` class. An Activity is a single application entity that is used to perform actions. An application may have many separate activities, but the user interacts with them one at a time. The `onCreate()` method is called by the Android system when your Activity starts — it is where you should perform all initialization and UI setup. An activity is not required to have a user interface, but usually does.

Now let's modify some code!

Construct the UI

Take a look at the revised code below and then make the same changes to your HelloAndroid class. The bold items are lines that have been added.

```
package com.example.helloandroid;

import android.app.Activity;
import android.os.Bundle;
import android.widget.TextView;

public class HelloAndroid extends Activity {
   /** Called when the activity is first created. */
   @Override
   public void onCreate(Bundle savedInstanceState) {
       super.onCreate(savedInstanceState);
       TextView tv = new TextView(this);
       tv.setText("Hello, Android");
       setContentView(tv);
   }
}
```

> **Tip:** An easy way to add import packages to your project is to press **Ctrl-Shift-O** (**Cmd-Shift-O**, on Mac). This is an Eclipse shortcut that identifies missing packages based on your code and adds them for you. You may have to expand the `import` statements in your code for this to work.

An Android user interface is composed of hierarchies of objects called Views. A `View` is a drawable object used as an element in your UI layout, such as a button, image, or (in this case) a text label. Each of these objects is a subclass of the View class and the subclass that handles text is `TextView`.

In this change, you create a TextView with the class constructor, which accepts an Android `Context` instance as its parameter. A Context is a handle to the system; it provides services like resolving resources, obtaining access to databases and preferences, and so on. The Activity class inherits from Context, and because your HelloAndroid class is a subclass of Activity, it is also a Context. So, you can pass `this` as your Context reference to the TextView.

Next, you define the text content with `setText()`.

Finally, you pass the TextView to `setContentView()` in order to display it as the content for the Activity UI. If your Activity doesn't call this method, then no UI is present and the system will display a blank screen.

There it is — "Hello, World" in Android! The next step, of course, is to see it running.

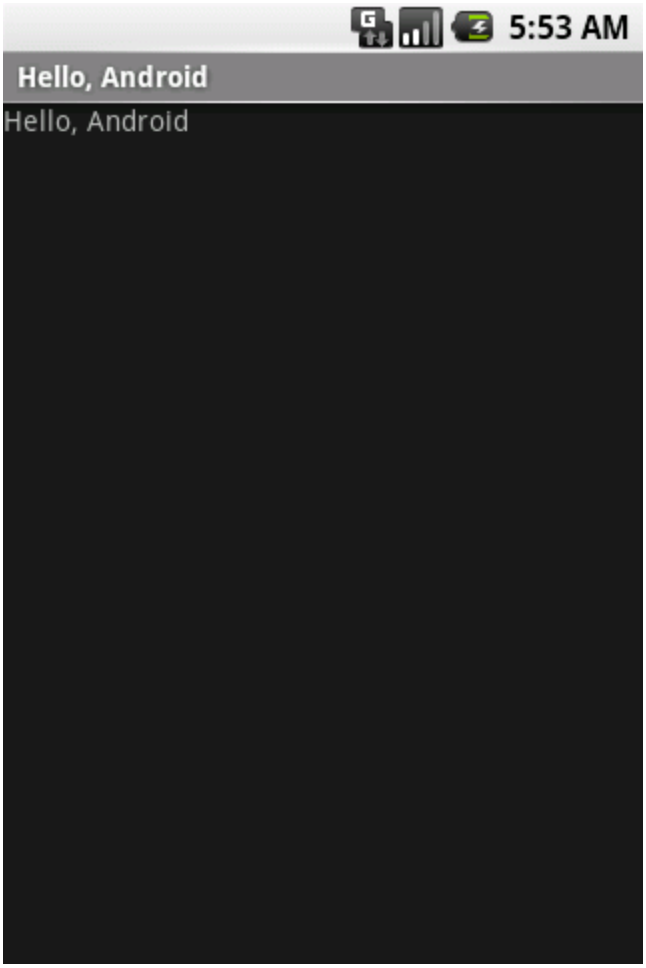
Run the Application

The Eclipse plugin makes it easy to run your applications:

1. Select **Run > Run**.
2. Select "Android Application".

To learn more about creating and editing run configurations in Eclipse, refer to Developing In Eclipse, with ADT.

The Eclipse plugin automatically creates a new run configuration for your project and then launches the Android Emulator. Depending on your environment, the Android emulator might take several minutes to boot fully, so please be patient. When the emulator is booted, the Eclipse plugin installs your application and launches the default Activity. You should now see something like this:



The "Hello, Android" you see in the grey bar is actually the application title. The Eclipse plugin creates this automatically (the string is defined in the `res/values/strings.xml` file and referenced by your `AndroidManifest.xml` file). The text below the title is the actual text that you have created in the TextView object.

That concludes the basic "Hello World" tutorial, but you should continue reading for some more valuable information about developing Android applications.

Upgrade the UI to an XML Layout

The "Hello, World" example you just completed uses what is called a "programmatic" UI layout. This means that you constructed and built your application's UI directly in source code. If you've done much UI programming, you're probably familiar with how brittle that approach can sometimes be: small changes in layout can result in big source-code headaches. It's also easy to forget to properly connect Views together, which can result in errors in your layout and wasted time debugging your code.

That's why Android provides an alternate UI construction model: XML-based layout files. The easiest way to explain this concept is to show an example. Here's an XML layout file that is identical in behavior to the programmatically-constructed example:

```
<?xml version="1.0" encoding="utf-8"?>
<TextView xmlns:android="http://schemas.android.com/apk/res/android"
  android:id="@+id/textview"
  android:layout_width="fill_parent"
  android:layout_height="fill_parent"
  android:text="@string/hello"/>
```

The general structure of an Android XML layout file is simple: it's a tree of XML elements, wherein each node is the name of a View class (this example, however, is just one View element). You can use the name of any class that extends `View` as an element in your XML layouts, including custom View classes you define in your own code. This structure makes it easy to quickly build up UIs, using a more simple structure and syntax than you would use in a programmatic layout. This model is inspired by the web development model, wherein you can separate the presentation of your application (its UI) from the application logic used to fetch and fill in data.

In the above XML example, there's just one View element: the `TextView`, which has five XML attributes. Here's a summary of what they mean:

Attribute	Meaning
`xmlns:android`	This is an XML namespace declaration that tells the Android tools that you are going to refer to common attributes defined in the Android namespace. The outermost tag in every Android layout file must have this attribute.
`android:id`	This attribute assigns a unique identifier to the `TextView` element. You can use the assigned ID to reference this View from your source code or from other XML resource declarations.
`android:layout_width`	This attribute defines how much of the available width on the screen this View should consume. In this case, it's the only View so you want it to take up the entire screen, which is what a value of "fill_parent" means.
`android:layout_height`	This is just like android:layout_width, except that it refers to available screen height.
`android:text`	This sets the text that the TextView should display. In this example, you use a string resource instead of a hard-coded string value. The *hello* string is defined in the *res/values/strings.xml* file. This is the recommended practice for inserting strings to your application, because it makes the localization of your application to other languages graceful, without need to hard-code changes to the layout file. For more information, see Resources and Internationalization.

These XML layout files belong in the `res/layout/` directory of your project. The "res" is short for "resources" and the directory contains all the non-code assets that your application requires. In addition to layout files, resources also include assets such as images, sounds, and localized strings.

Landscape layout

When you want a different design for landscape, put your layout XML file inside /res/layout-land. Android will automatically look here when the layout changes. Without this special landscape layout defined, Android will stretch the default layout.

The Eclipse plugin automatically creates one of these layout files for you: main.xml. In the "Hello World" application you just completed, this file was ignored and you created a layout programmatically. This was meant to teach you more about the Android framework, but you should almost always define your layout in an XML file instead of in your code. The following procedures will instruct you how to change your existing application to use an XML layout.

1. In the Eclipse Package Explorer, expand the `/res/layout/` folder and open `main.xml` (once opened, you might need to click the "main.xml" tab at the bottom of the window to see the XML source). Replace the contents with the following XML:

```
<?xml version="1.0" encoding="utf-8"?>
<TextView xmlns:android="http://schemas.android.com/apk/res/android"
  android:id="@+id/textview"
  android:layout_width="fill_parent"
  android:layout_height="fill_parent"
  android:text="@string/hello"/>
```

Save the file.

2. Inside the `res/values/` folder, open `strings.xml`. This is where you should save all default text strings for your user interface. If you're using Eclipse, then ADT will have started you with two strings, *hello* and *app_name*. Revise *hello* to something else. Perhaps "Hello, Android! I am a string resource!" The entire file should now look like this:

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello, Android! I am a string resource!</string>
    <string name="app_name">Hello, Android</string>
</resources>
```

3. Now open and modify your `HelloAndroid` class and use the XML layout. Edit the file to look like this:

```
package com.example.helloandroid;

import android.app.Activity;
import android.os.Bundle;

public class HelloAndroid extends Activity {
    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }
}
```

When you make this change, type it by hand to try the code-completion feature. As you begin typing "R.layout.main" the plugin will offer you suggestions. You'll find that it helps in a lot of situations.

Instead of passing `setContentView()` a View object, you give it a reference to the layout resource. The resource is identified as `R.layout.main`, which is actually a compiled object representation of the layout defined in `/res/layout/main.xml`. The Eclipse plugin automatically creates this reference for you inside the project's R.java class. If you're not using Eclipse, then the R.java class will be generated for you when you run Ant to build the application. (More about the R class in a moment.)

Now re-run your application — because you've created a launch configuration, all you need to do is click the green arrow icon to run, or select **Run** > **Run History** > **Android Activity**. Other than the change to the TextView string, the application looks the same. After all, the point was to show that the two different layout approaches produce identical results.

> **Note:** You may have to unlock the screen on the emulator to see your application — just as you would unlock the screen on a device. If you have problems running the emulator, see Using the Android Emulator.

Continue reading for an introduction to debugging and a little more information on using other IDEs. When you're ready to learn more, read Application Fundamentals for an introduction to all the elements that make Android applications work. Also refer to the Developer's Guide introduction page for an overview of the *Dev Guide* documentation.

R class

In Eclipse, open the file named `R.java` (in the `gen/` [Generated Java Files] folder). It should look something like this:

```
package com.example.helloandroid;

public final class R {
    public static final class attr {
    }
    public static final class drawable {
        public static final int icon=0x7f020000;
    }
    public static final class id {
        public static final int textview=0x7f050000;
    }
    public static final class layout {
        public static final int main=0x7f030000;
    }
    public static final class string {
        public static final int app_name=0x7f040001;
        public static final int hello=0x7f040000;
    }
}
```

A project's `R.java` file is an index into all the resources defined in the file. You use this class in your source code as a sort of short-hand way to refer to resources you've included in your project. This is particularly powerful with the code-completion features of IDEs like Eclipse because it lets you quickly and interactively locate the specific reference you're looking for.

It's possible yours looks slightly different than this (perhaps the hexadecimal values are different). For now, notice the inner class named "layout", and its member field "main". The Eclipse plugin noticed the XML layout file named main.xml and generated a class

for it here. As you add other resources to your project (such as strings in the `res/values/string.xml` file or drawables inside the `res/drawable/` directory) you'll see `R.java` change to keep up.

When not using Eclipse, this class file will be generated for you at build time (with the Ant tool).

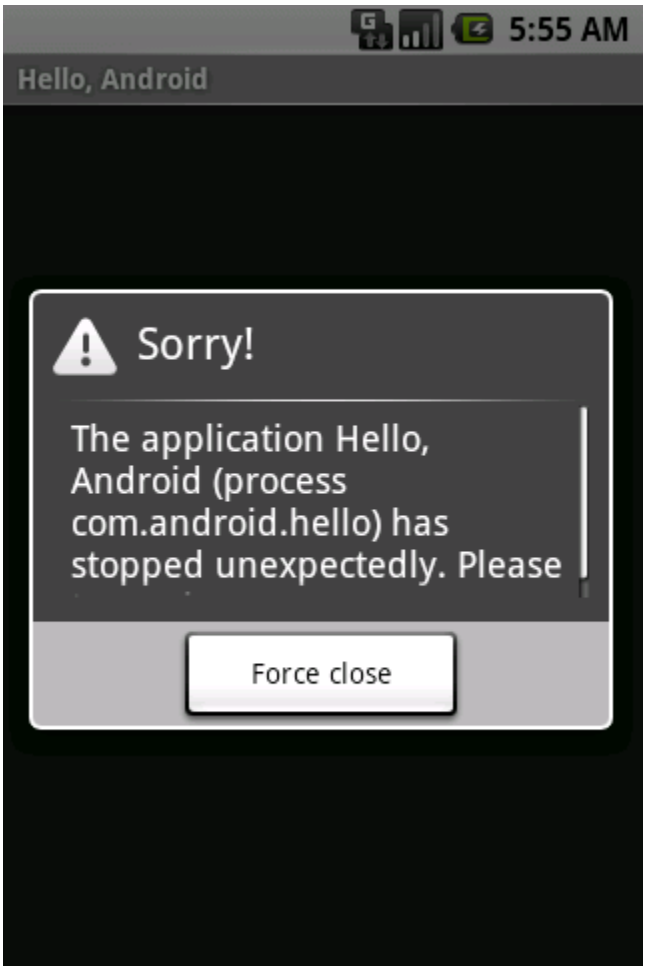
You should never edit this file by hand.

Debug Your Project

The Android Plugin for Eclipse also has excellent integration with the Eclipse debugger. To demonstrate this, introduce a bug into your code. Change your HelloAndroid source code to look like this:

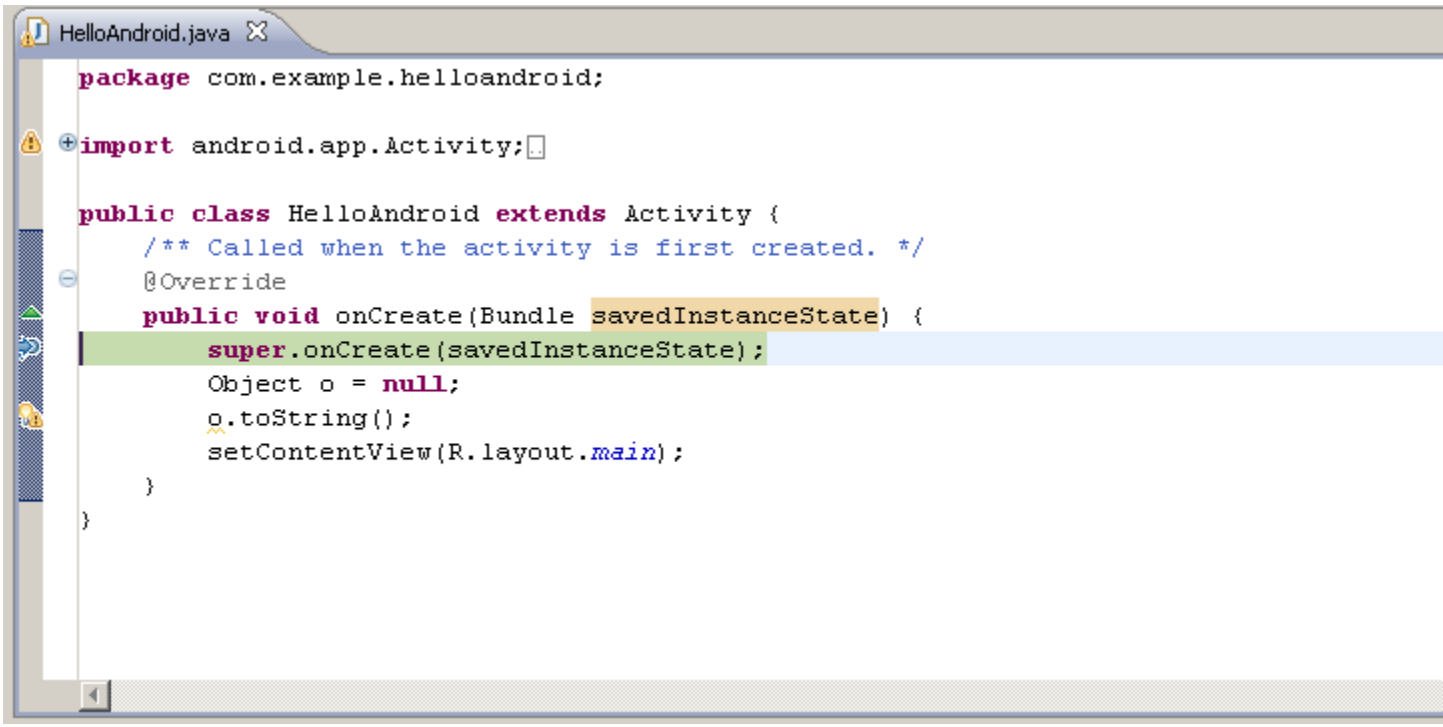
```
package com.example.helloandroid;

import android.app.Activity;
import android.os.Bundle;

public class HelloAndroid extends Activity {
    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        Object o = null;
        o.toString();
        setContentView(R.layout.main);
    }
}
```

This change simply introduces a NullPointerException into your code. If you run your application again, you'll eventually see this:



Press "Force Quit" to terminate the application and close the emulator window.

To find out more about the error, set a breakpoint in your source code on the line `Object o = null;` (double-click on the marker bar next to the source code line). Then select **Run** > **Debug History** > **Hello, Android** from the menu to enter debug mode. Your app will restart in the emulator, but this time it will suspend when it reaches the breakpoint you set. You can then step through the code in Eclipse's Debug Perspective, just as you would for any other application.



Creating the Project without Eclipse

If you don't use Eclipse (such as if you prefer another IDE, or simply use text editors and command line tools) then the Eclipse plugin can't help you. Don't worry though — you don't lose any functionality just because you don't use Eclipse.

The Android Plugin for Eclipse is really just a wrapper around a set of tools included with the Android SDK. (These tools, like the emulator, aapt, adb, ddms, and others are documented elsewhere.) Thus, it's possible to wrap those tools with another tool, such as an 'ant' build file.

The Android SDK includes a tool named "android" that can be used to create all the source code and directory stubs for your project, as well as an ant-compatible `build.xml` file. This allows you to build your project from the command line, or integrate it with the IDE of your choice.

For example, to create a HelloAndroid project similar to the one created in Eclipse, use this command:

```
android create project \
    --package com.example.helloandroid \
    --activity HelloAndroid \
    --target 2 \
    --path <path-to-your-project>/HelloAndroid
```

This creates the required folders and files for the project at the location defined by the *path*.