Android Workshop

Informatiklehrertag Bayern (ILTB)
26.9.2011

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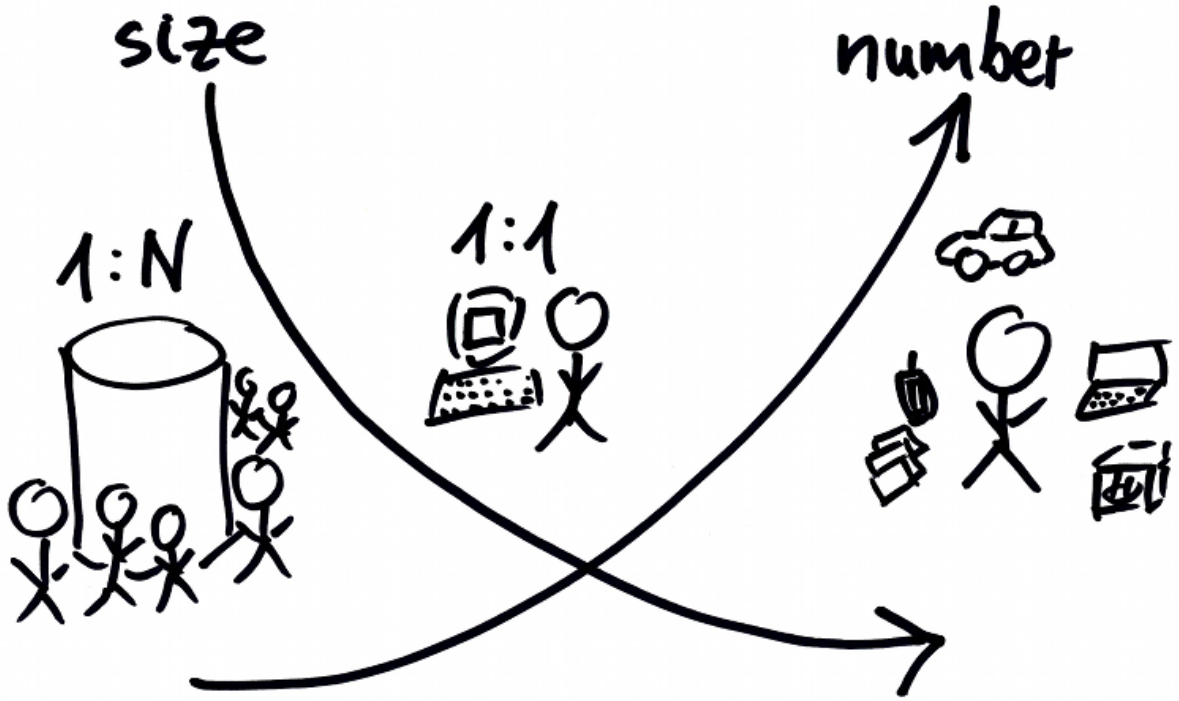
Mobile Interaction Lab, LMU München

Mobile Interaction is Usage in Context

- Primary real-world task

Adapted from a slide of Albrecht Schmidt at T-Labs

Ubiquitous Computing



- Computers embedded in everyday things
- Technology moves into the background
- Computers in the world, instead of world in the computer


INFORMATION

iPhone Sandwich Pressure Input

Michael Rohs, Sven Kratz
Deutsche Telekom Laboratories, TU Berlin

Mobile Application Development

- Who of you owns a mobile phone?
  - Which platform does it have?
  - How to install the programs on the device?
  - Is it possible to develop applications for this device?
  - Which programming languages and tools can be used?

Zeitplanung

10:45-12:00	Android Workshop, Teil 1, 1h15
12:00-12:15	Kaffeepause
12:15-13:30	Android Workshop, Teil 2, 1h15
13:30-14:45	Mittagessen
14:45-16:00	Smartphones programmieren (Ute Heuer)

Diese Folien:

http://tdi.ifi.lmu.de/2011

Ziel: Ein Orts-basiertes Quiz

- Was macht der Benutzer? (→ „Szenario“)

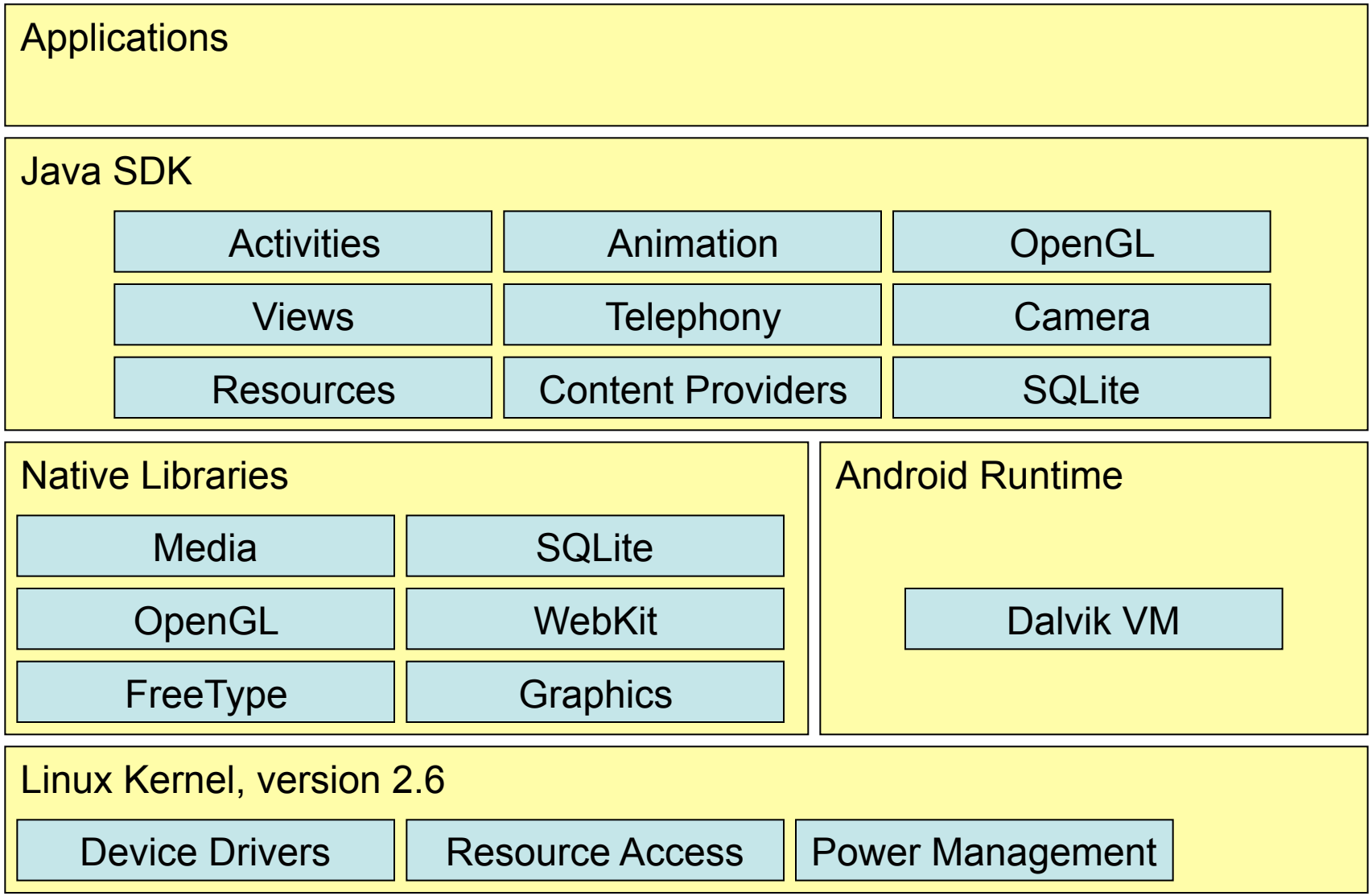
- „Jan ist zu Besuch in München. Er möchte mehr über die Stadt erfahren und lädt sich das neue mobile Quiz auf sein Handy. Er geht durch die Stadt. Wenn er sich einer Sehenswürdigkeit nähert, vibriert sein Handy und zeigt ein Bild und eine Erklärung dazu. Unter dem Bild sind eine Frage und vier mögliche Antworten zu sehen. Durch Antippen der richtigen Antwort bekommt er Pluspunkte. Wählt er eine falsche Antwort aus, handelt er sich Minuspunkte ein. Wenn er genügend Punkte ergattert hat, bekommt er einen günstigeren Eintritt im Museum.“

Realisierung

- Ortsinformation verarbeiten
- Bild und Text auf dem Display anzeigen
- Eingaben vom Touch-Screen verarbeiten
- zwischen Bildschirmen hin- und herschalten

Android

Android Software Stack



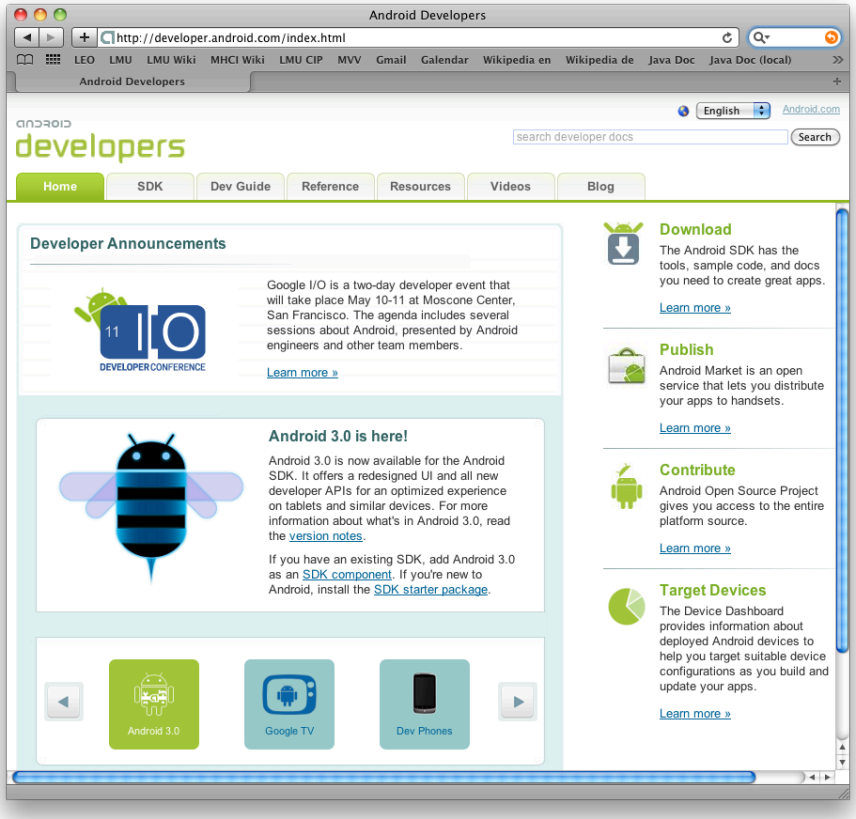
Android Characteristics

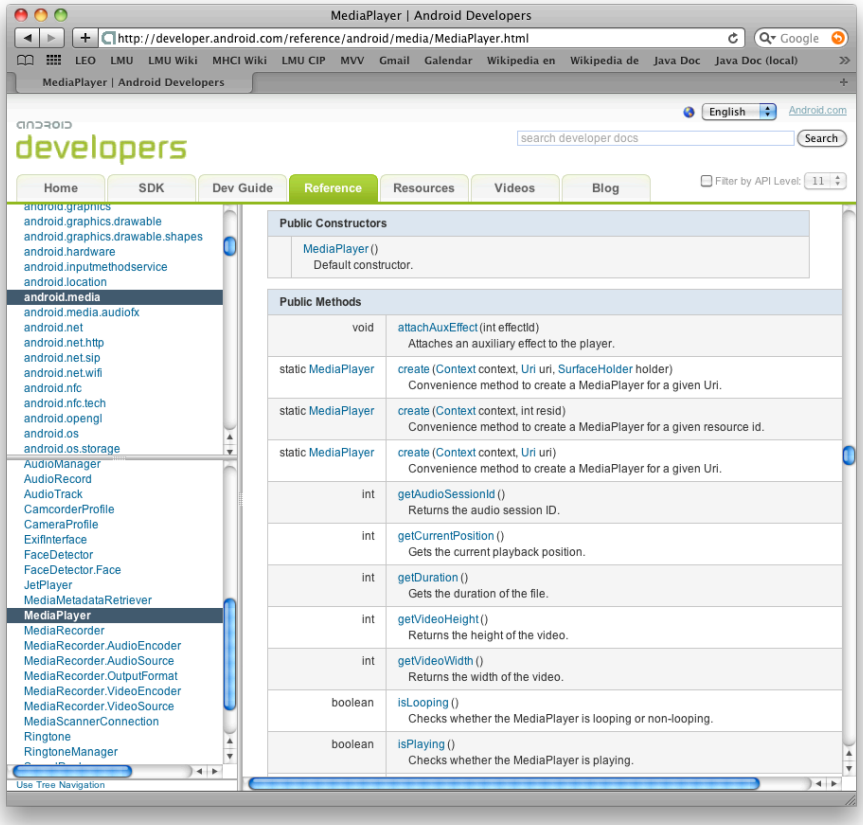
- Activity
  - Activities are the components of an application
  - Represent a logical unit of user action
  - Typically represented by a screen containing views
  - Can be invoked externally
- Declarative UI definition
  - XML files specify user interface resources
  - Resources (layout definitions, strings, bitmaps)
  - Separation of code and user interface
- “Teachable”
  - Clear semantics of Java, clear design and concepts

Installing Android

Android Resources

- Android developer pages (platform documentation)
  - http://developer.android.com





Required Software

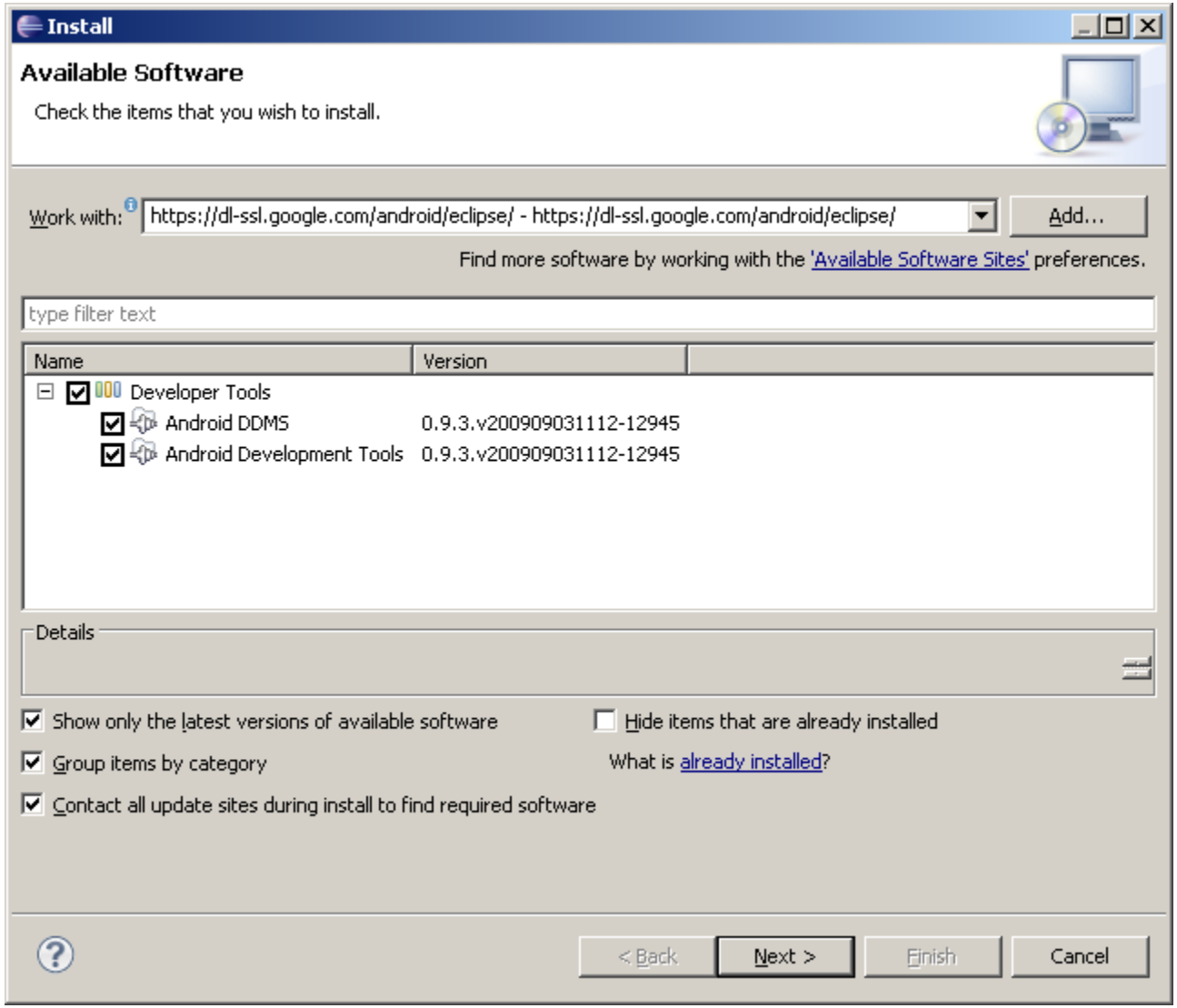
- Java JDK 6, Standard Edition (not only JRE)
  - http://java.sun.com/javase/downloads/index.jsp
- Eclipse IDE (3.4 or newer)
  - http://www.eclipse.org/downloads/
  - Eclipse IDE for Java Developers
- Android SDK starter package (depending on your platform)
  - http://dl.google.com/android/android-sdk_r08-windows.zip
  - http://dl.google.com/android/android-sdk_r08-mac_86.zip
  - http://dl.google.com/android/android-sdk_r08-linux_86.tgz
- See also: “Quick Steps”
  - http://developer.android.com/sdk/index.html

Installation

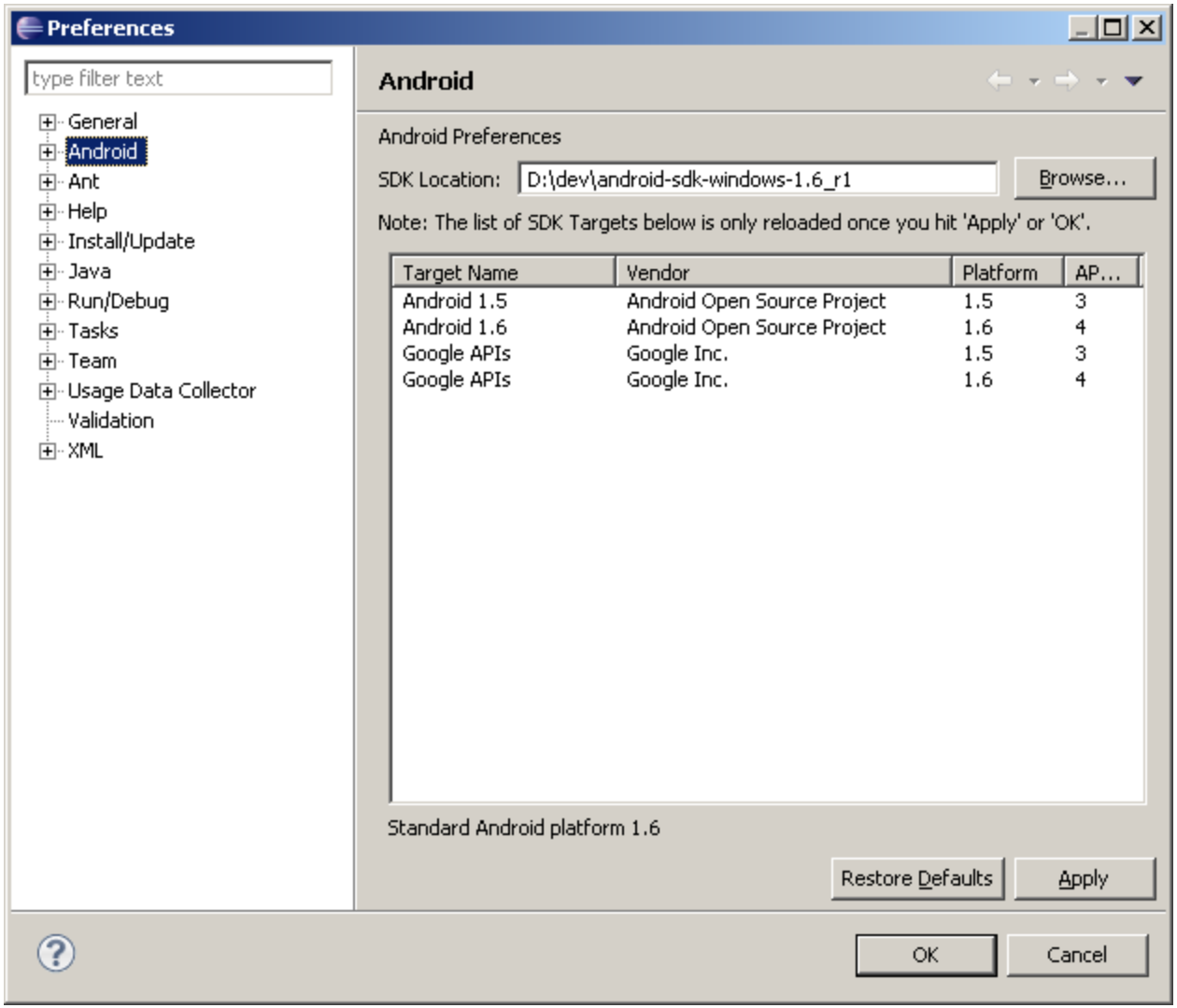
- Start Eclipse
  - Terminal oder Alt-F2: “eclipse-ide-3.6” eintippen
- In Eclipse: Install Android SDK
  - Menu: Help, Install New Software…
  - https://dl-ssl.google.com/android/eclipse/
- Point Eclipse to the Android SDK starter package
  - Menu: Window, preferences, Android, SDK Location
  - /soft/IFI/lang/android-sdk-r10/iX86-unknown-linux
- In Eclipse: Android SDK and AVD Manager
  - Window / Android SDK and AVD Manager
  - New... / Virtual Devices / 2.2 (oder 1.6) mit Google API
- Mobile Phone
  - Anwendungen, Entwicklung: USB-Debugging, ...

In Eclipse: Install New Software...

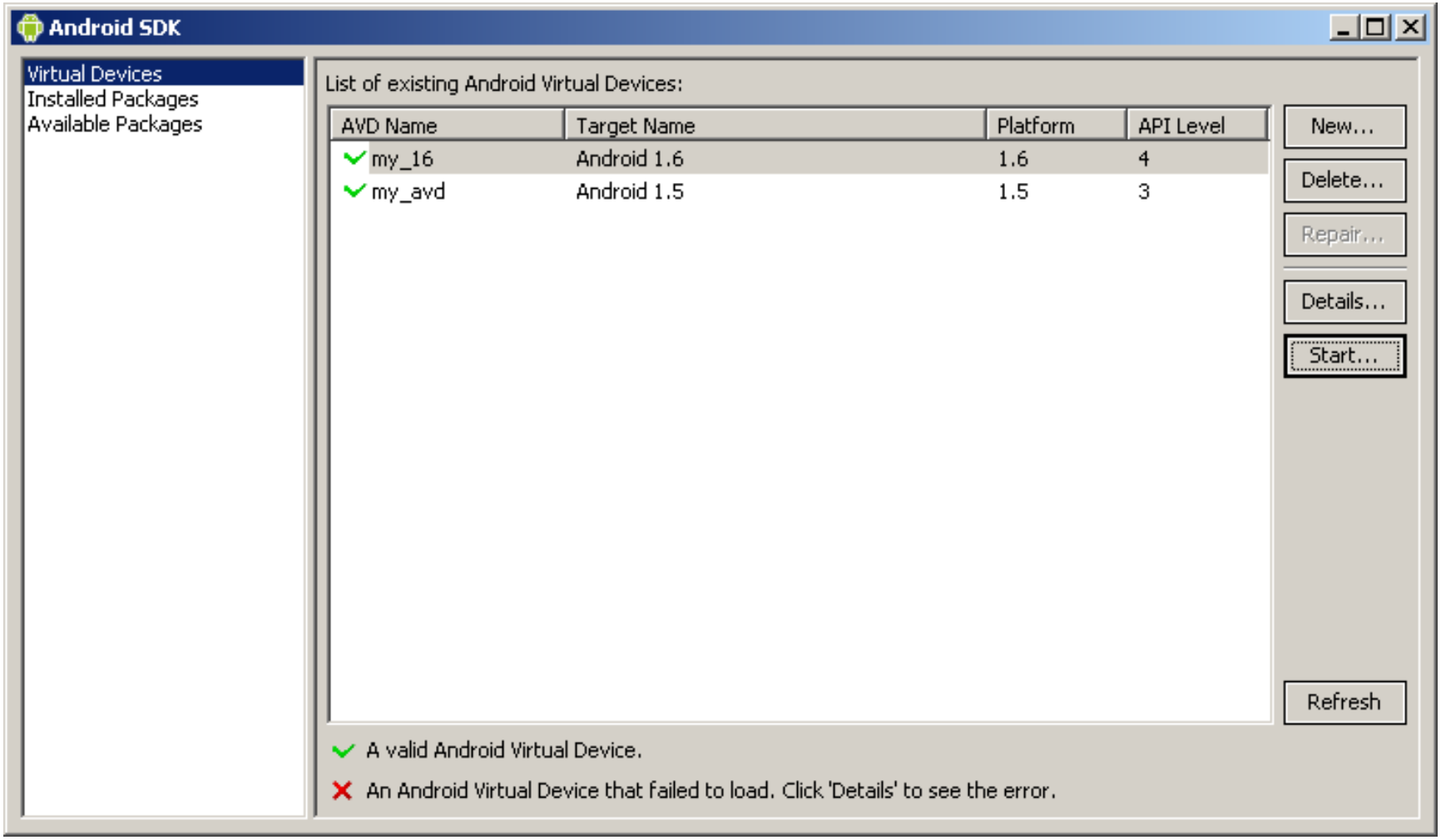
Android Plugin – https://dl-ssl.google.com/android/eclipse/



Set Path to Android SDK Starter Package



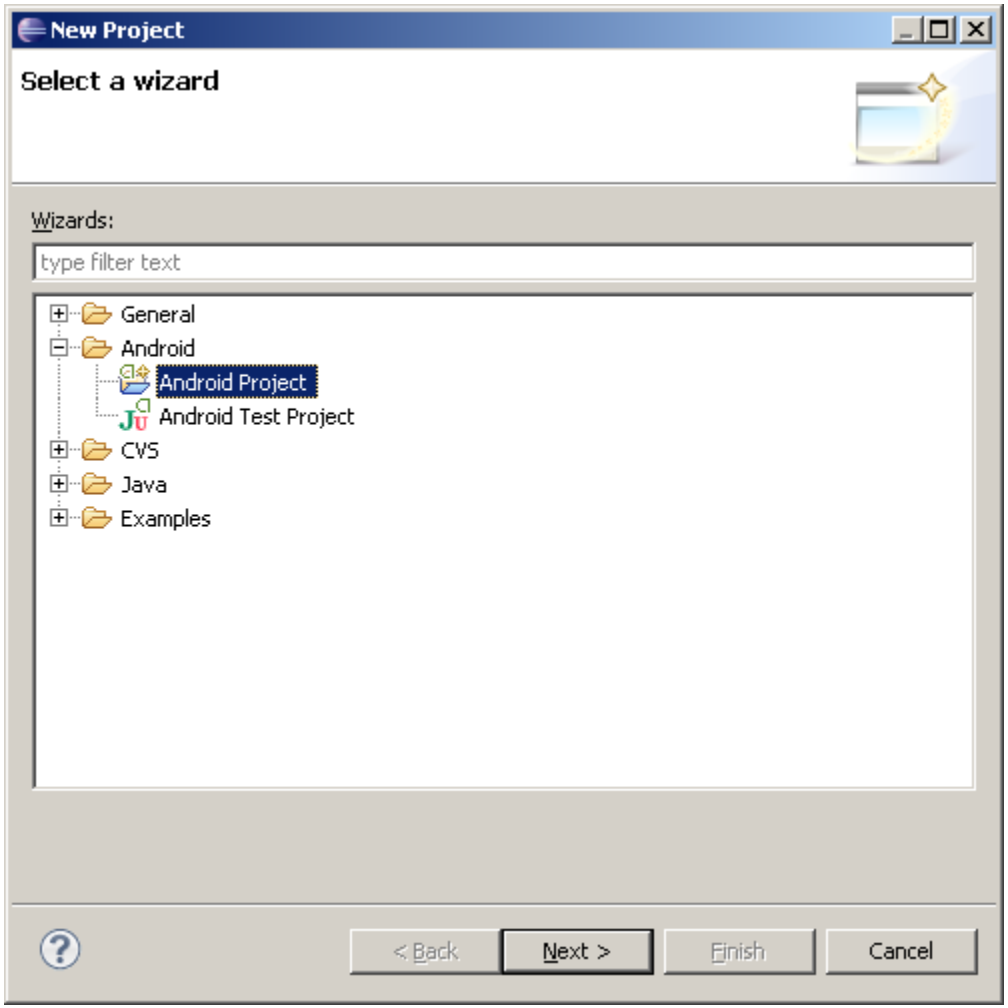
Define Android Virtual Device

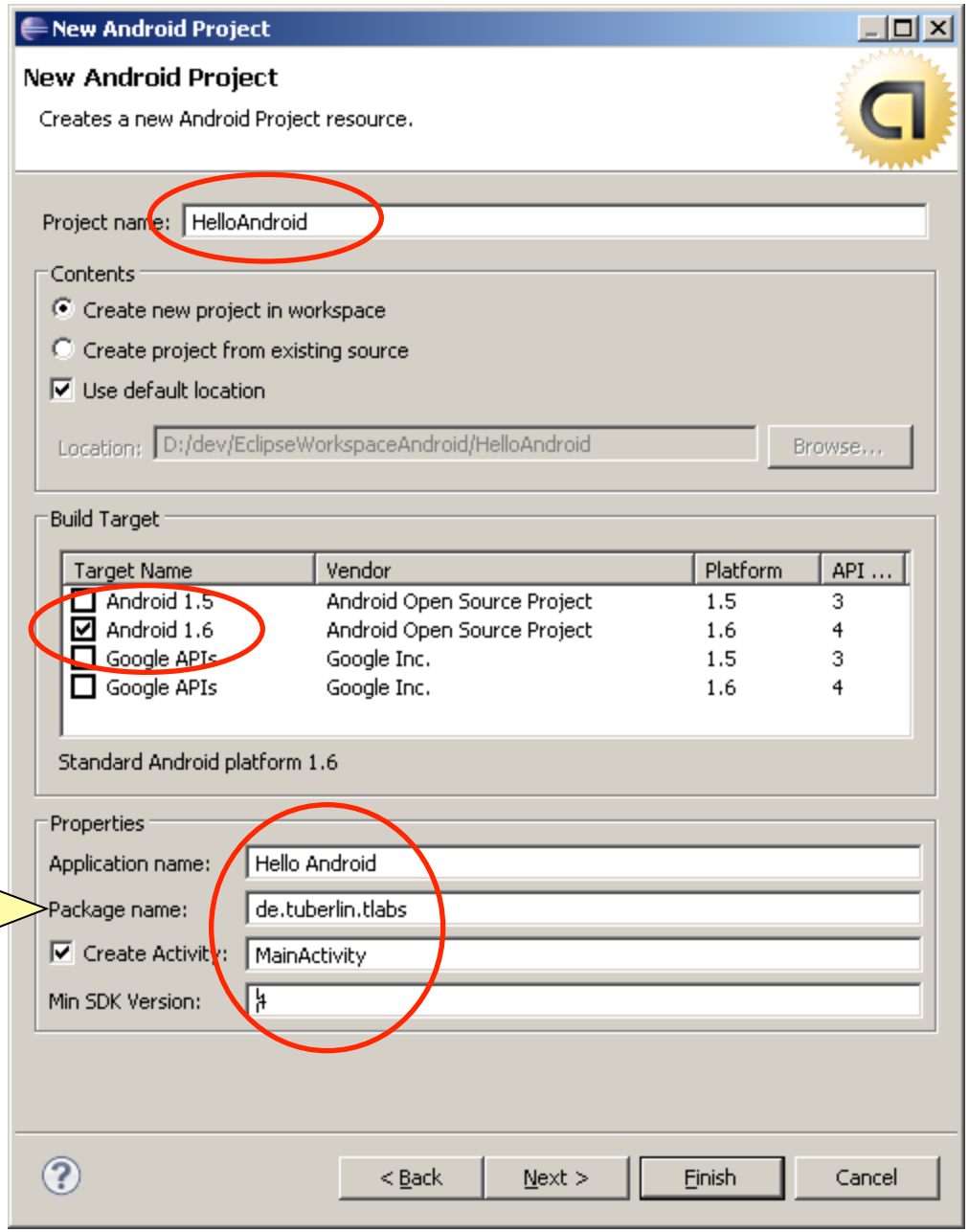


“Hello World”

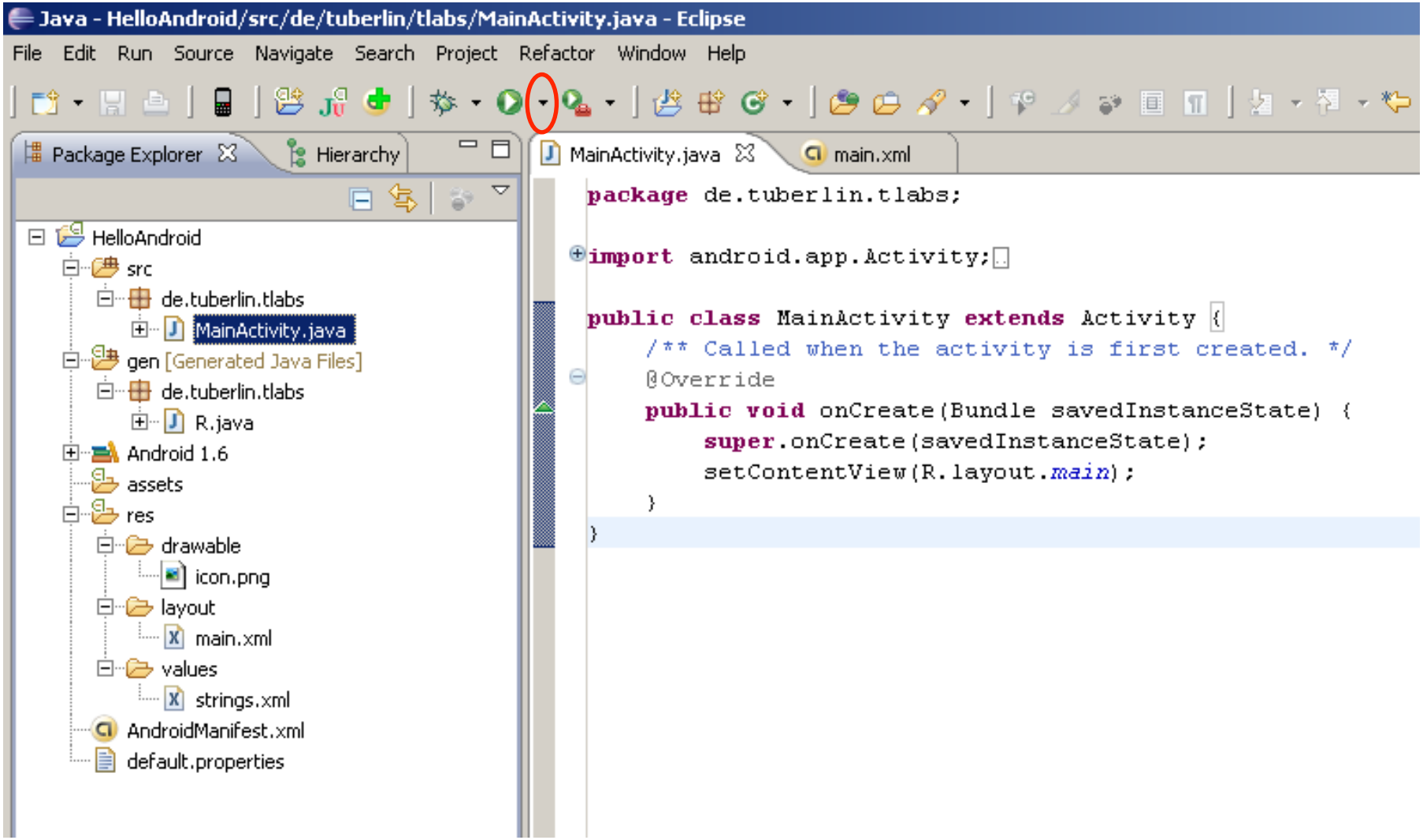
Creating Your First Android Project

File → New Project → Android → Android Project





Uniquely identifies the application!


Java - HelloAndroid/src/de/tuberlin/tlabs/MainActivity.java - Eclipse
File Edit Run Source Navigate Search Project Refactor Window Help
Package Explorer
Hierarchy
HelloAndroid
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de.tuberlin.tlabs
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de.tuberlin.tlabs
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MainActivity.java
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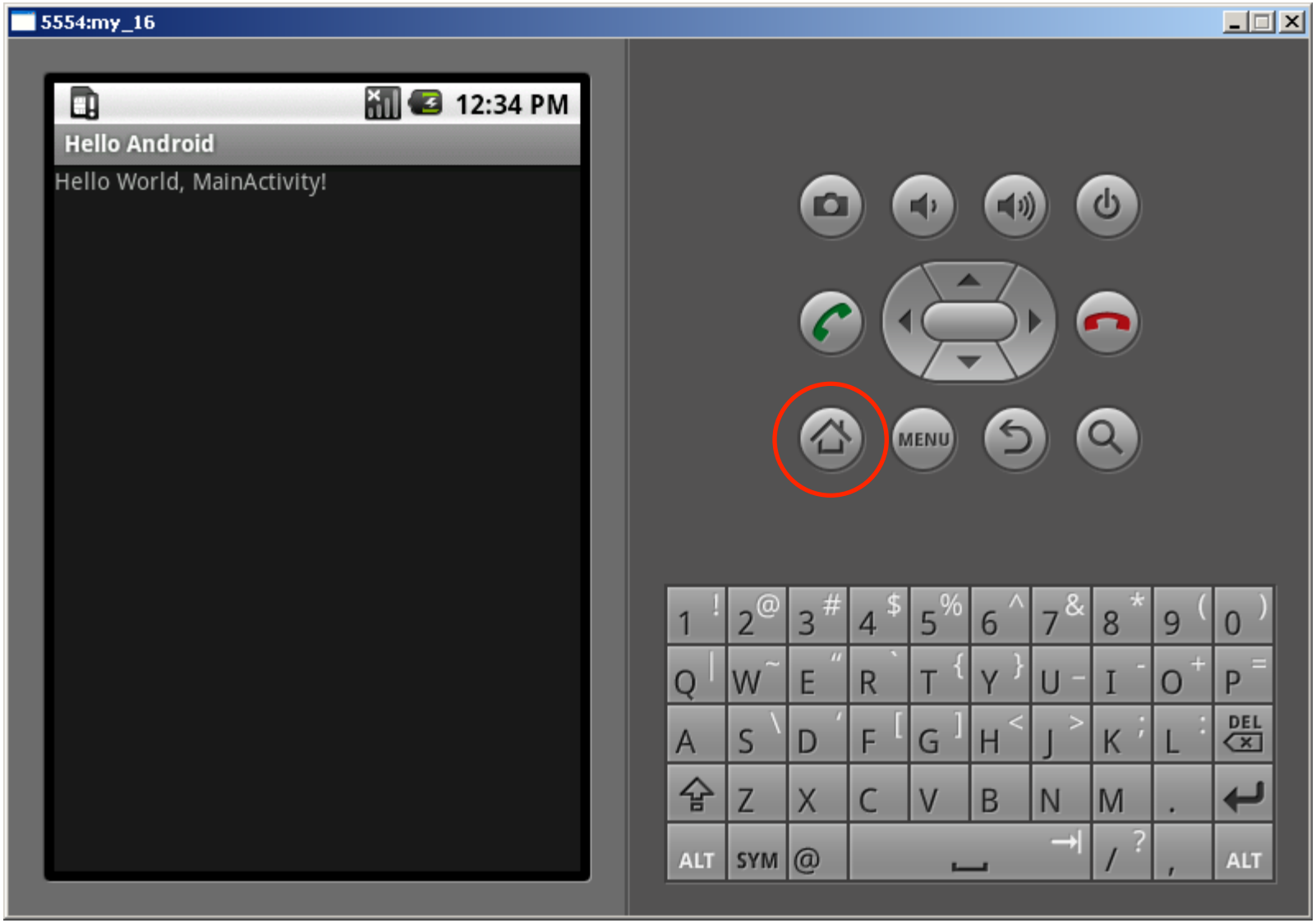
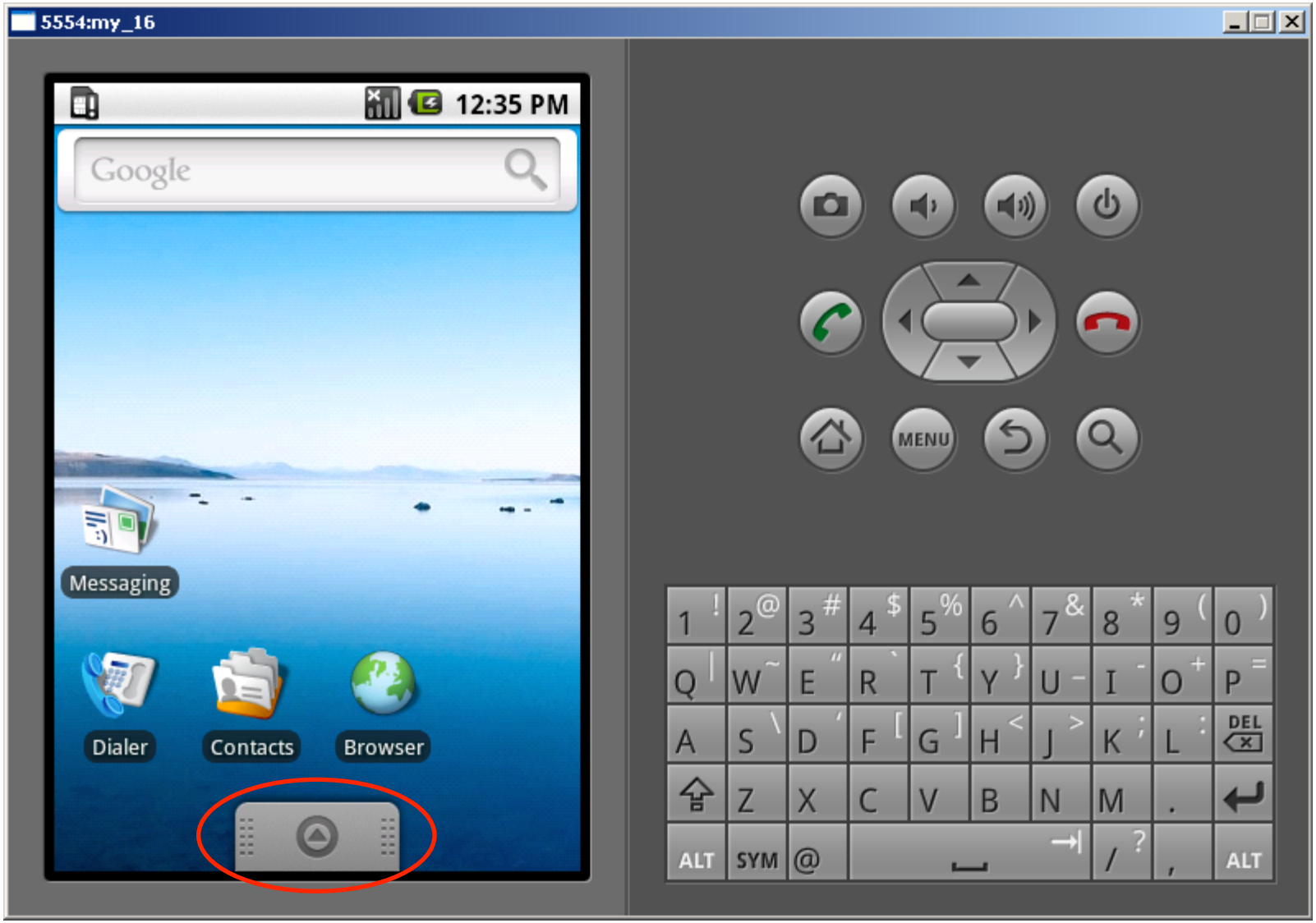
super.onCreate(savedInstanceState);
setContentView(R.layout.main);
}
}


5554:my_16
12:34 PM
Hello Android
Hello World, MainActivity!
MENU


5554:my_16
12:35 PM
Google
Messaging
Dialer
Contacts
Browser
MENU
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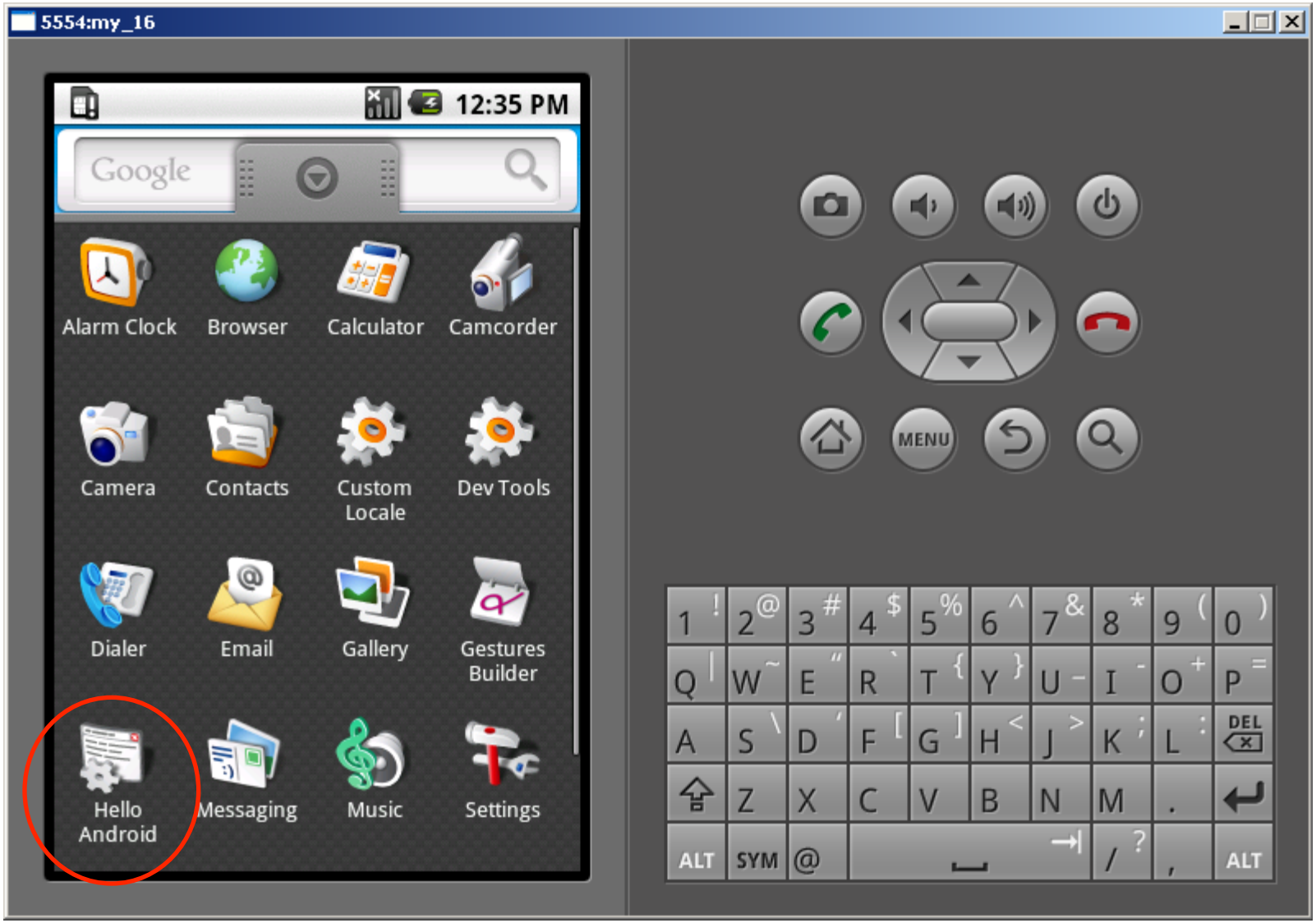
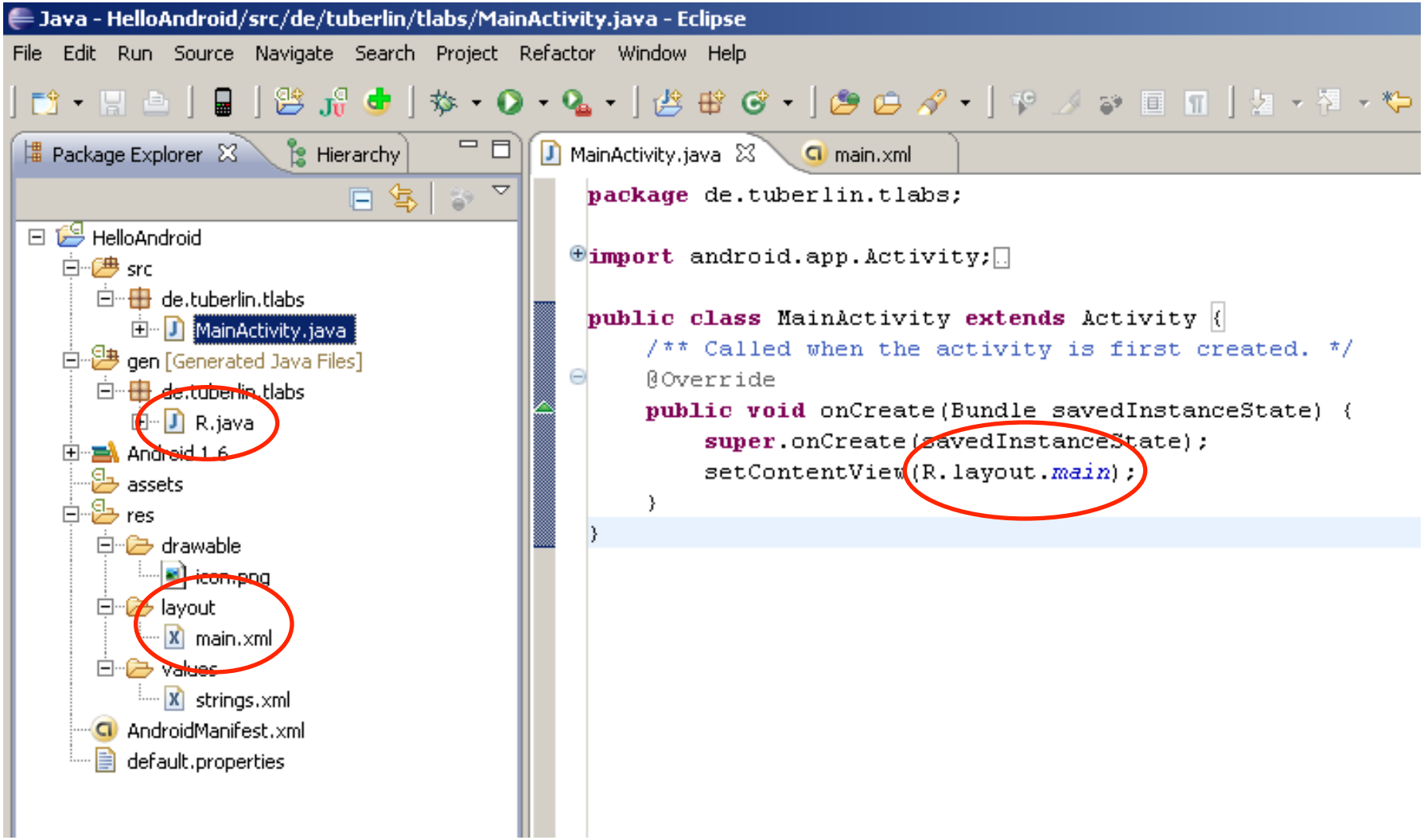

5554:my_16
12:35 PM
Google
Alarm Clock
Browser
Calculator
Camcorder
Camera
Contacts
Custom Locale
Dev Tools
Dialer
Email
Gallery
Gestures Builder
Hello Android
Messaging
Music
Settings
MENU
ALT
SYM
DEL

Exercise:

Install Android + Create “Hello World”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de.tuberlin.tlabs
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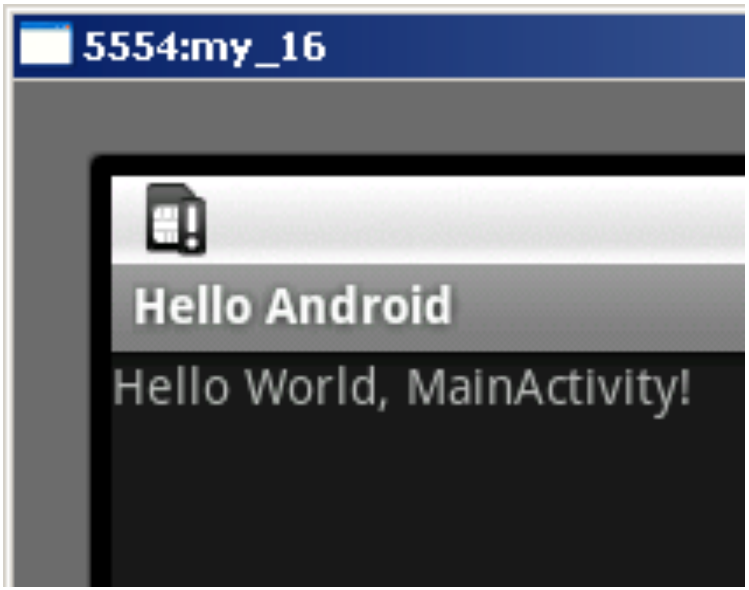
@Override
public void onCreate(Bundle savedInstanceState) {
super.onCreate(savedInstanceState);
setContentView(R.layout.main);
}
}

Declarative definition of UIs
main.xml

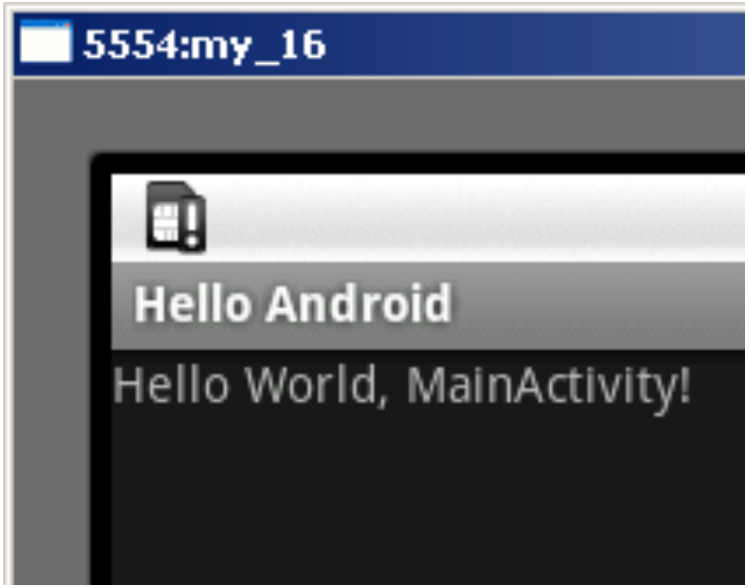
```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
    >
<TextView
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"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



Separating text strings from source code strings.xml

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello World, MainActivity!</string>
    <string name="app_name">Hello Android</string>
</resources>
```

- Default language in res/values/strings.xml
- Localized languages in res/values-xx ← language qualifier
  - French in res/values-fr/strings.xml
  - Hindi in res/values-hi/strings.xml
  - etc.



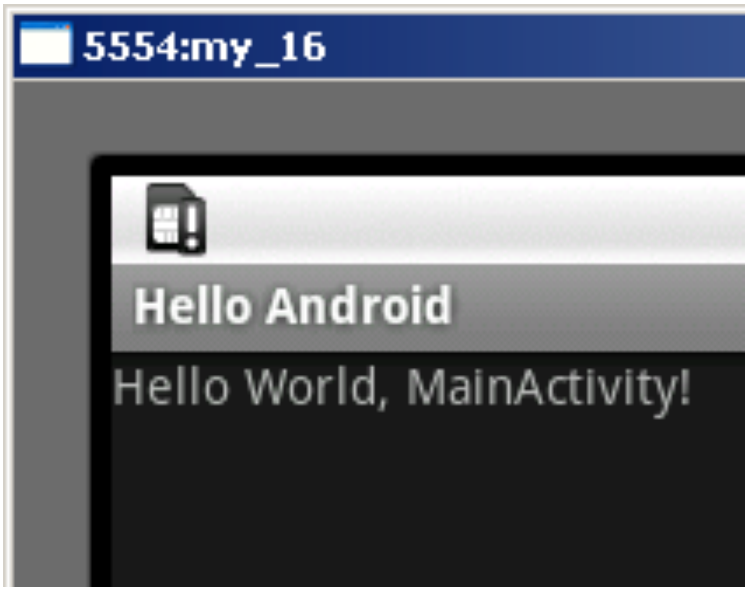
R.java

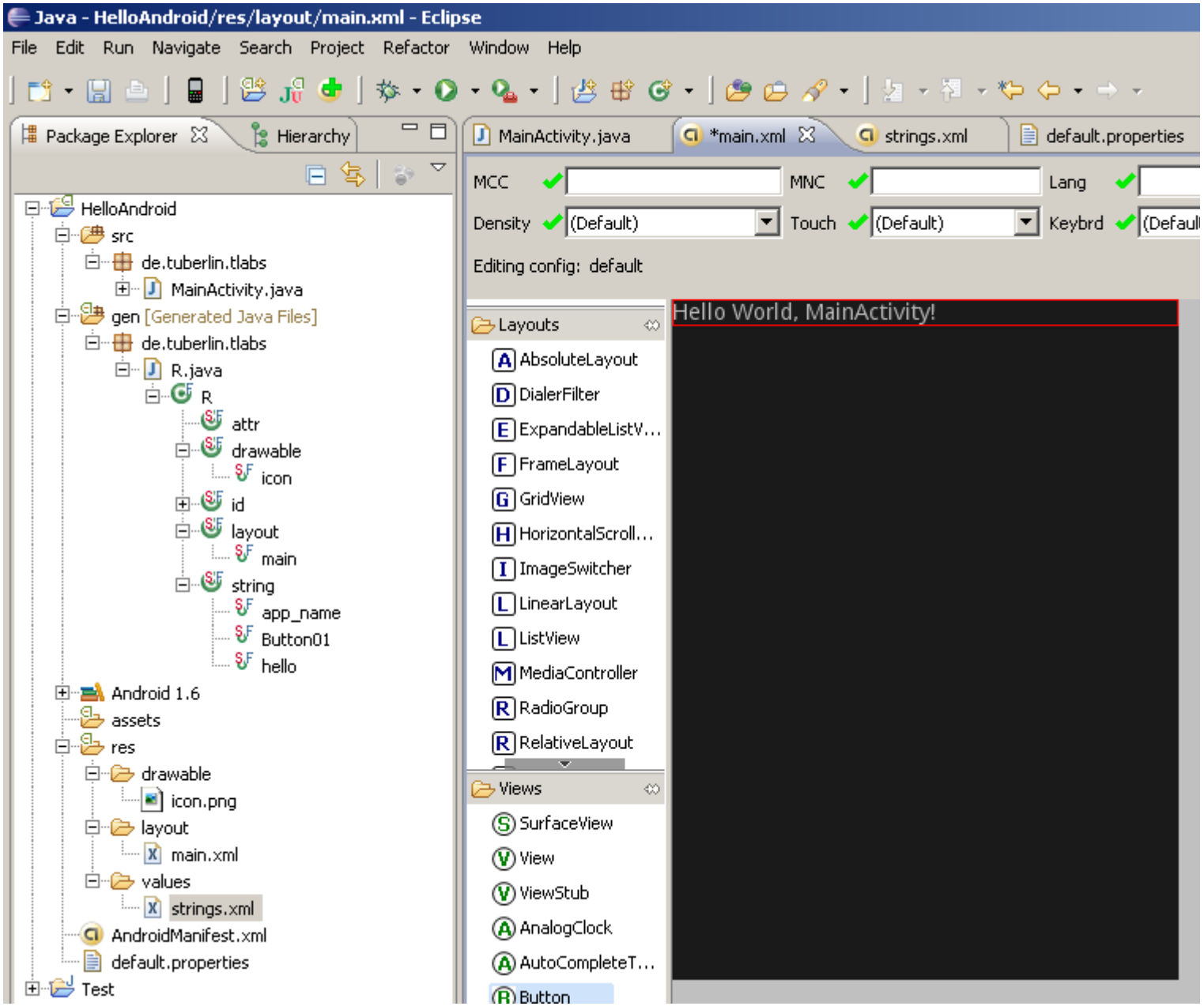
```
/* AUTO-GENERATED FILE.  DO NOT MODIFY.
 *
 * This class was automatically generated by the
 * aapt tool from the resource data it found.  It
 * should not be modified by hand.
 */

package de.tuberlin.tlabs;

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 Button01=0x7f050000;
    }
    public static final class layout {
        public static final int main=0x7f030000;
    }
    public static final class string {
        public static final int Button01=0x7f040002;
        public static final int app_name=0x7f040001;
        public static final int hello=0x7f040000;
    }
}
```

Never ever edit R.java!!!

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icon
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layout
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string
app_name
Button01
hello
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icon.png
layout
main.xml
values
strings.xml
AndroidManifest.xml
default.properties
Test
MainActivity.java
*main.xml
strings.xml
default.properties
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MNC
Lang
Density
(Default)
Touch
(Default)
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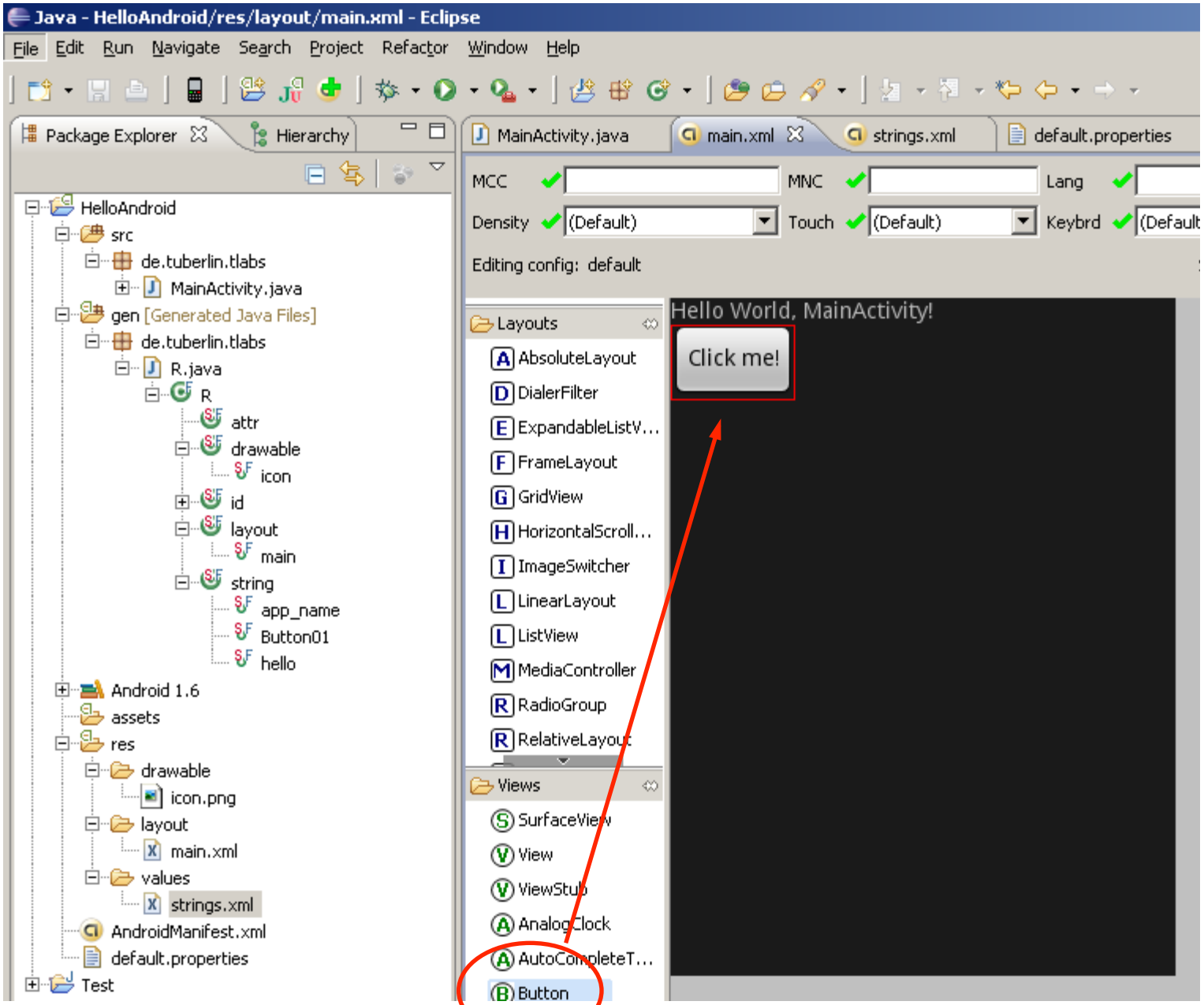
Layouts
AbsoluteLayout
DialerFilter
ExpandableListV...
FrameLayout
GridView
HorizontalScroll...
ImageSwitcher
LinearLayout
ListView
MediaController
RadioGroup
RelativeLayout
Views
SurfaceView
View
ViewStub
AnalogClock
AutoCompleteT...
Button
Hello World, MainActivity!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Button
Hello World, MainActivity!
Click me!

Declarative Definition of UIs
main.xml

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    android:orientation="vertical"
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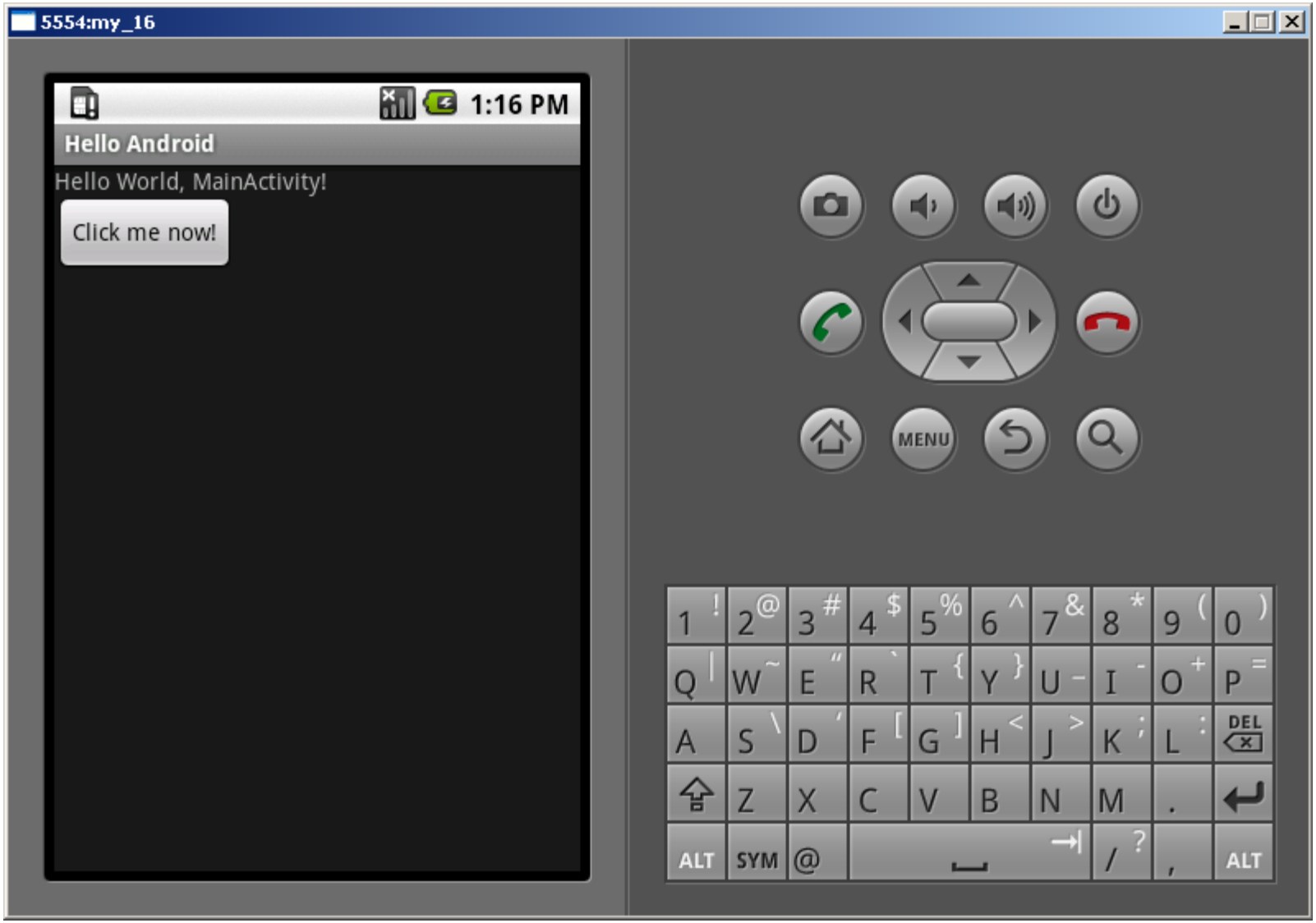
    android:layout_height="fill_parent"
    >
<TextView
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    android:text="@string/hello"
    />
<Button
    android:text="@string/Button01"
    android:id="@+id/Button01"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    />
</LinearLayout>
```

strings.xml

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello World, MainActivity!</string>
    <string name="app_name">Hello Android</string>
    <string name="Button01">Click me now!</string>
</resources>
```


5554:my_16
1:16 PM
Hello Android
Hello World, MainActivity!
Click me now!
MENU
ALT
SYM
ALT

Handling Button Click Events

- XML

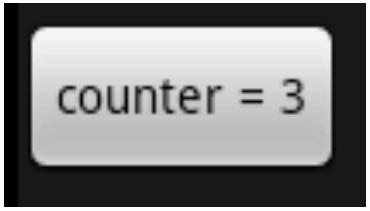
```
<Button android:id="@+id/button1" android:text="Basic Button"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content" />
```

- Java

```
public class MainActivity extends Activity implements
                                                View.OnClickListener {
    public void onCreate(Bundle savedInstanceState) {
        ...
        Button b = (Button) findViewById(R.id.button1);
        b.setOnClickListener(this);
    }

    private int counter = 0;

    public void onClick(View v) {
        Button b = (Button)v;
        b.setText("counter = " + (++counter));
    }
}
```



Exercise:

- Add a button to “Hello World”

UI from XML resources MainActivity.java

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

public class MainActivity extends Activity {

    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }
}
```

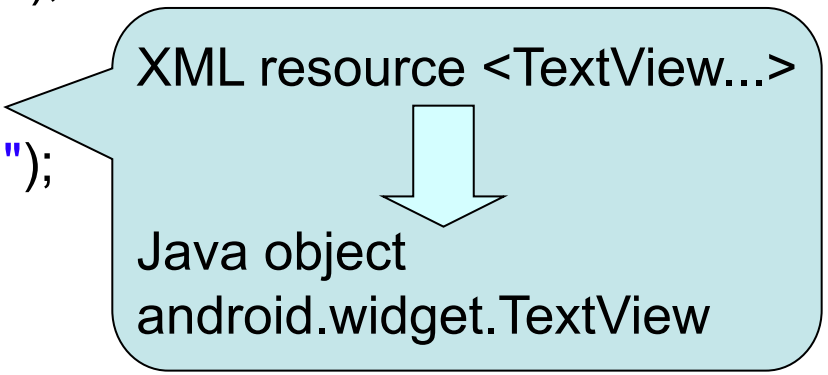
UI programmatically defined MainActivity.java

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

public class MainActivity extends Activity {

    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
//        setContentView(R.layout.main);
        TextView tv = new TextView(this);
        tv.setText("Hello World (TextView)!");
        setContentView(tv);
    }

}
```



Touch Input: MotionEvent

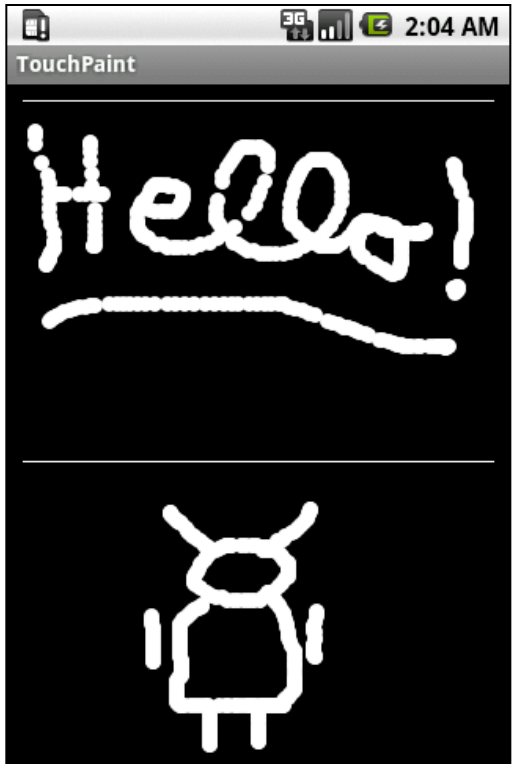
- Method View.onTouchEvent(MotionEvent e)
- Motion event data
  - x, y, time, action, source, pressure, size
- Sources depend on hardware
  - Mouse, pen, finger, trackball
- Actions
  - ACTION_DOWN
  - ACTION_MOVE
  - ACTION_UP
  - ACTION_CANCEL
- Motion history
  - Sequence of coordinates between events

Touch Input Painting

```
public class TouchPaint extends Activity {

    private MyView myView;

    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        myView = new MyView(this);
        setContentView(myView);
    }
}
```



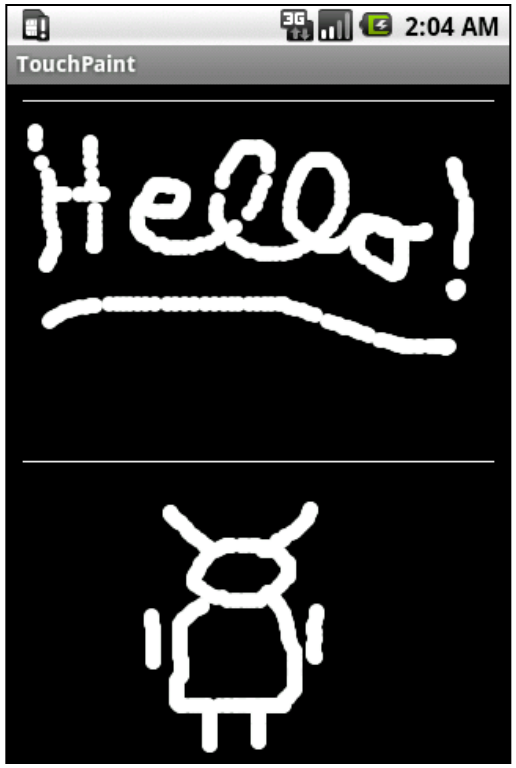
Touch Input Painting

```
public class MyView extends View {
    private final Paint paint = new Paint();
    private int x = 0, y = 0;

    public MyView(Context c) {
        super(c);
        paint.setARGB(255, 255, 255, 255);
    }

    protected void onDraw(Canvas c) {
        c.drawCircle(x, y, 3, paint);
    }

    public boolean onTouchEvent(MotionEvent e) {
        x = (int)e.getX(); y = (int)e.getY();
        invalidate();
        return true;
    }
}
```



Concepts so far

- Project directory structure
  - src, gen, res, AndroidManifest.xml
- Resources
  - Declarative view definitions in XML
  - Localization of string resources
  - Resource identifiers
- Touch input
  - Motion events

Activities

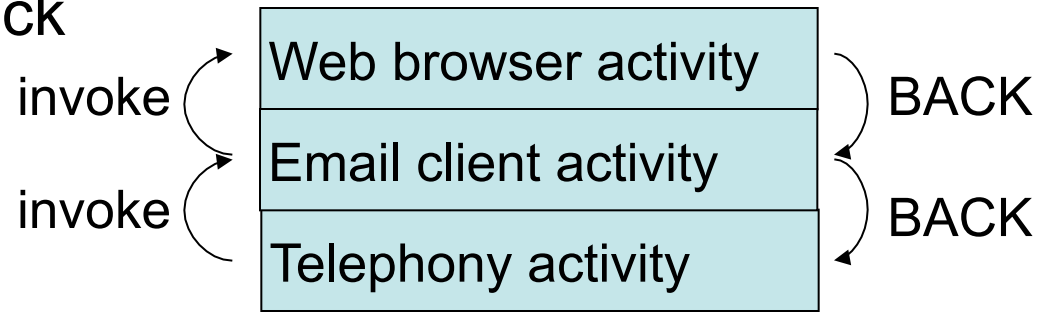
- Independent components of the application
  - Components “crash” individually
- Represent data and behavior of one View
  - Roughly: the model and controller of the MVC pattern
- Example: text messaging application
  - Activity 1 shows list of contacts
  - Activity 2 to write a message to a chosen contact
  - Activity 3 to review sent messages
- View of an Activity typically fills the screen
  - Views grouped in hierarchy
  - Parents control layout of children
  - Leaf view react to user actions
  - Associate root view with activity: activity.setContentView(view id);

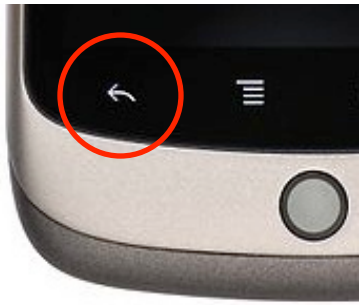
Activity Lifecycle

- Managed by system based on resources and user needs
- States
  - Running: in foreground (at top of activity stack)
  - Paused: partially visible, lost focus (e.g. dialog on top)
  - Stopped: invisible
- Lifecycle callback methods of an Activity
  - **protected void** onCreate(Bundle savedInstanceState);
  - **protected void** onStart();
  - **protected void** onRestart();
  - **protected void** onResume();
  - **protected void** onPause();
  - **protected void** onStop();
  - **protected void** onDestroy();

Tasks

- Task: what the user experiences as an “application”
  - Notion of an “application” blurry in component-based system
  - Tasks can span multiple activities and applications
- Example scenario for a task
  - User talks on the phone, looks up an email to answer a question, follows a link to a Web page with the desired information
  - Talk on phone: telephony application
  - Look up email: email client
  - Reading Web page: web browser
- Activity stack of a task:





Intents

- Intents are
  - Messages to the system
  - (Passive) representations of an operation to be performed
  - “Glue” between activities
  - Enable late runtime binding across applications
- Primary pieces: action and data
  - Example: action: ACTION_VIEW, data: URI to view
- Intents used to
  - Invoke other applications
  - Represent actions to be performed in the future
  - Register for events (→ publish-and-subscribe)

Example: Invoking an Activity

- Activity to be invoked

```
public class BasicActivity extends Activity {
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
}   }
```

- In AndroidManifest.xml

```
<activity android:name="BasicActivity" android:label="My Basic Activity">
    <intent-filter>
        <action android:name="de.lmu.intent.action.ShowBasicView" />
        <category android:name="android.intent.category.DEFAULT" />
    </intent-filter>
</activity>
```

- From another activity

```
Intent intent = new Intent("de.lmu.intent.action.ShowBasicView");
startActivity(intent);
```

Available Intents in Android

- Available intents
  - Browser: open a browser window
  - Dialer: calling phone numbers
  - Google Maps: open to the given location
  - Google Streetview: open to the given location

- Examples

```
Intent intent = new Intent(Intent.ACTION_VIEW);
intent.setData(Uri.parse("http://www.lmu.de"));
startActivity(intent);

Intent intent = new Intent(Intent.ACTION_VIEW);
intent.setData(Uri.parse("geo:52.5127,13.3210?z=17"));
startActivity(intent);
```

Define the contents of the application AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="de.lmu.mobilehci.myapp"
    android:versionCode="1"
    android:versionName="1.0">
  <application android:icon="@drawable/icon" android:label="@string/app_name">
    <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>
  <uses-sdk android:minSdkVersion="4" />
</manifest>
```

Uniquely identifies the application!

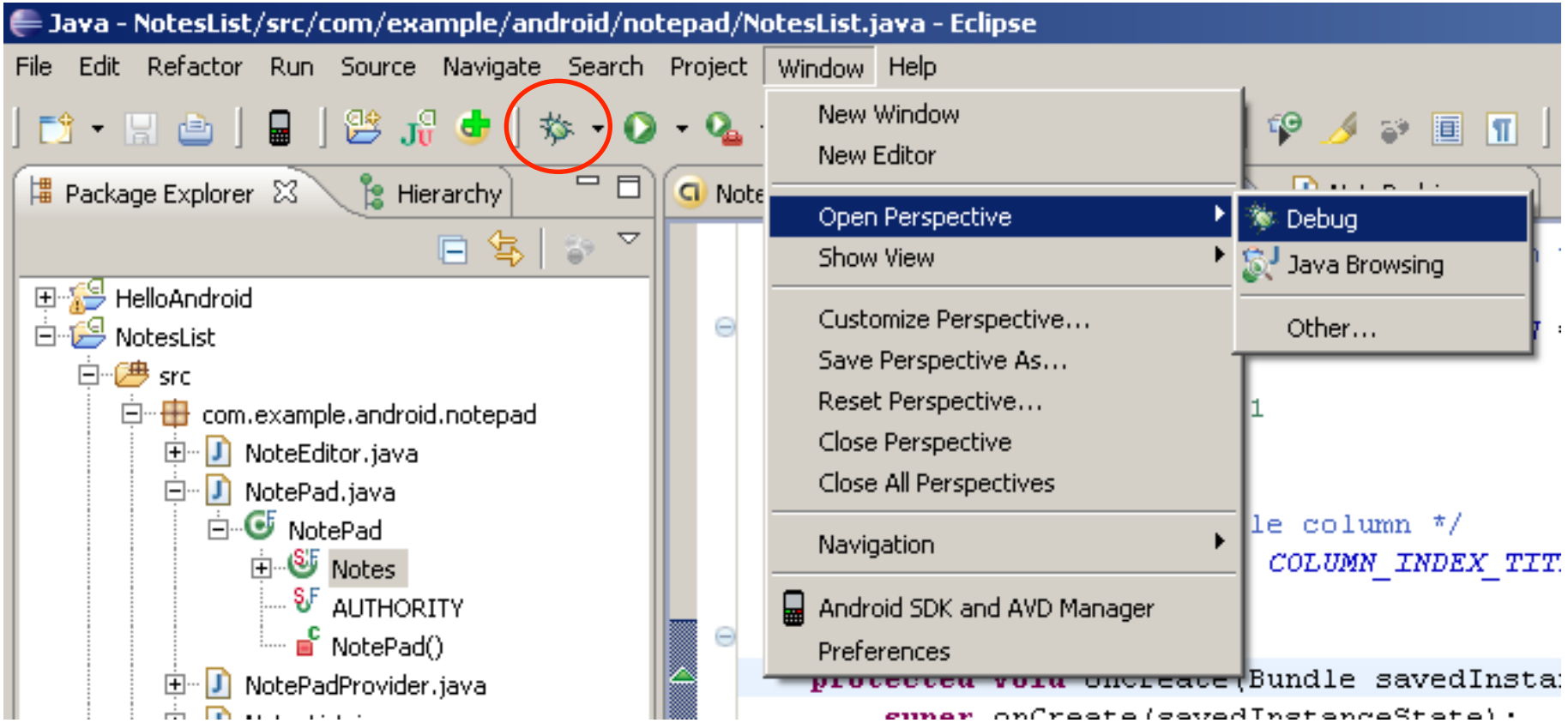
Add for android:debuggable="true" on-device debugging!

- Initial activity of application
- Listed in application launcher

Eclipse

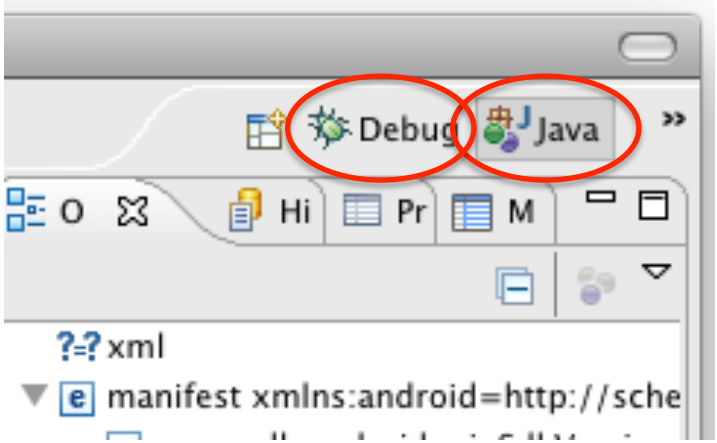
Integrated Development Environment (IDE)

Eclipse Perspectives



Eclipse Perspectives

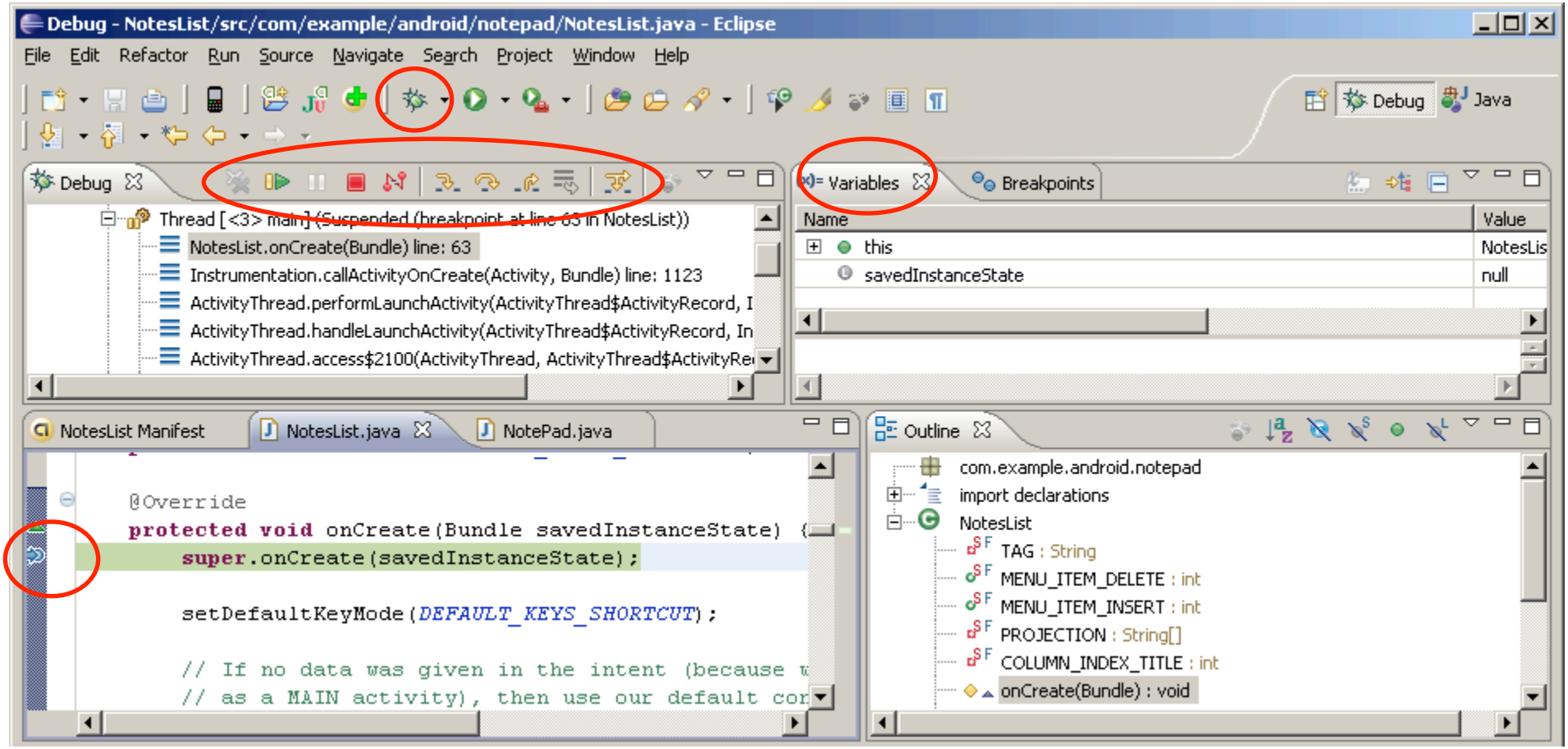
- Java Perspective
  - Writing source code
  - Adding resources
- Debug Perspective
  - Setting breakpoints
  - Inspecting variables



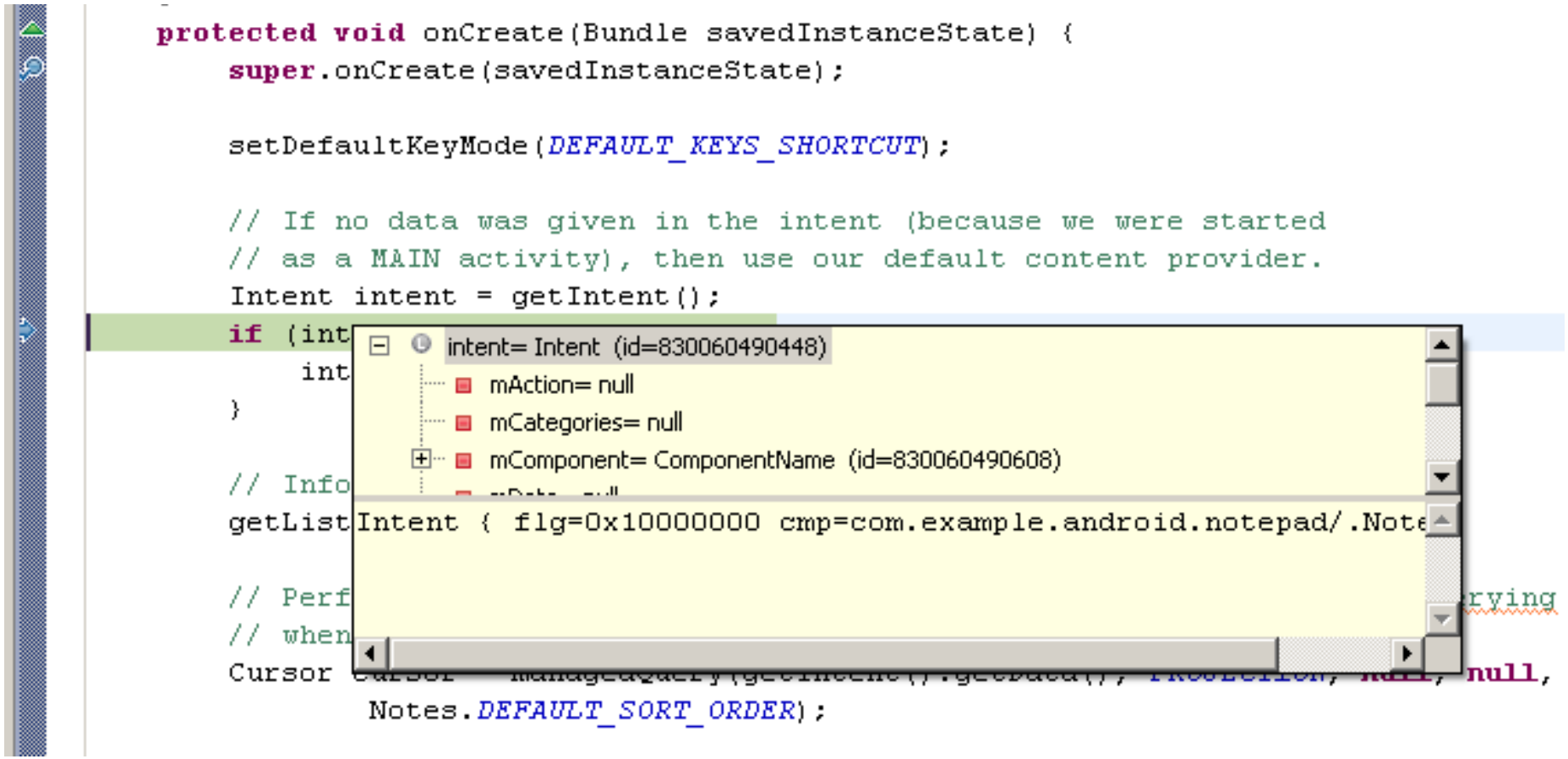
Eclipse tips:
Ctrl + Shift + O: organize imports
Ctrl + Space: show completions
F3: go to definition (e.g. of a class or method)

Debugging in the Emulator

- Set Breakpoint with Ctrl+Shift+B (⌘ +Shift+B)
- Step through code with F5, F6, F7 (*fn* + F5, F6, F7)



Inspecting Variables

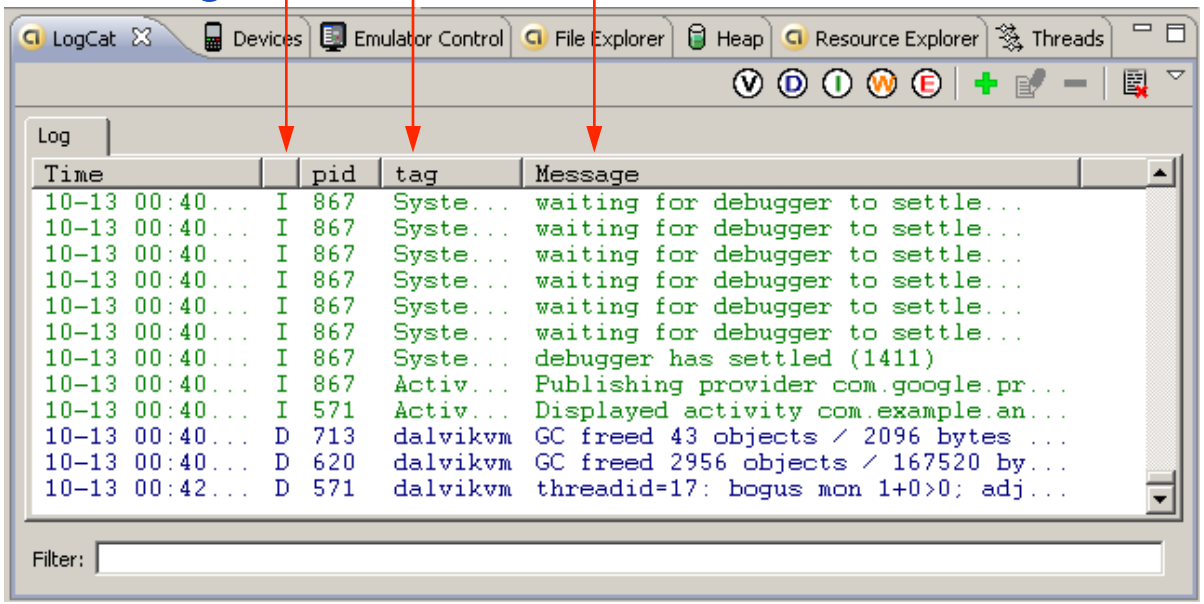


Logging and Tracing

- android.util.Log
  - informational, warning, error methods
  - Example:

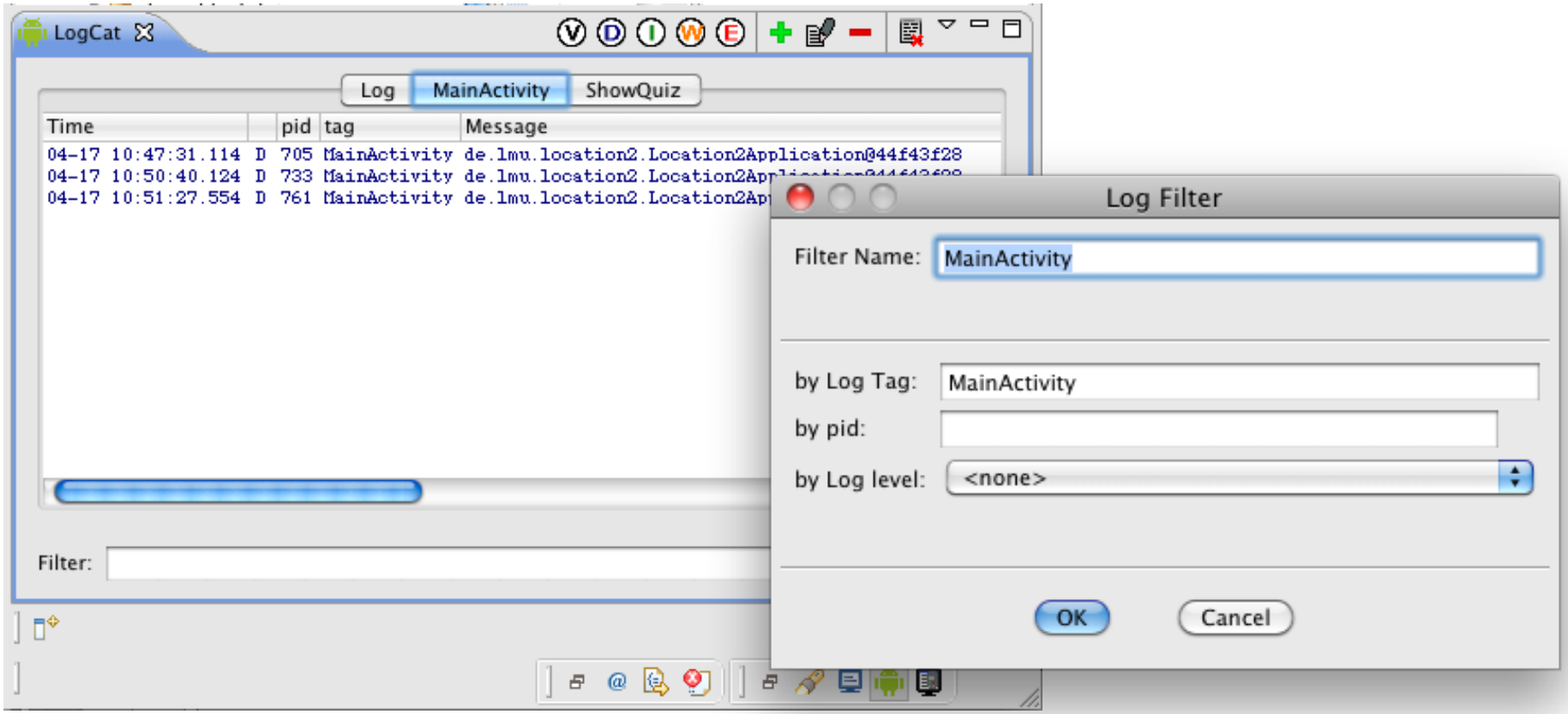
Log.d(TAG, "getAddress: " + s);

- android.os.Debug
  - Debug.startMethodTracing
  - Debug.stopMethodTracing
  - trace viewer tool
- File explorer tool to view files on the device



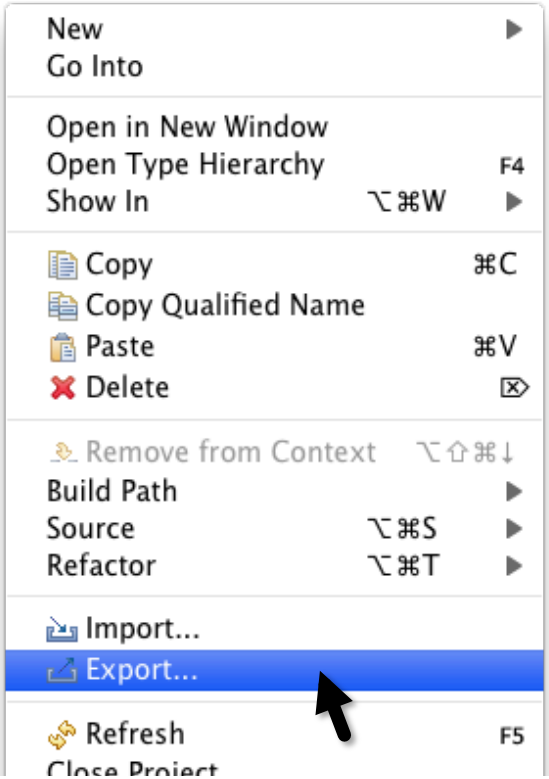
Filtering Eclipse Debug Output

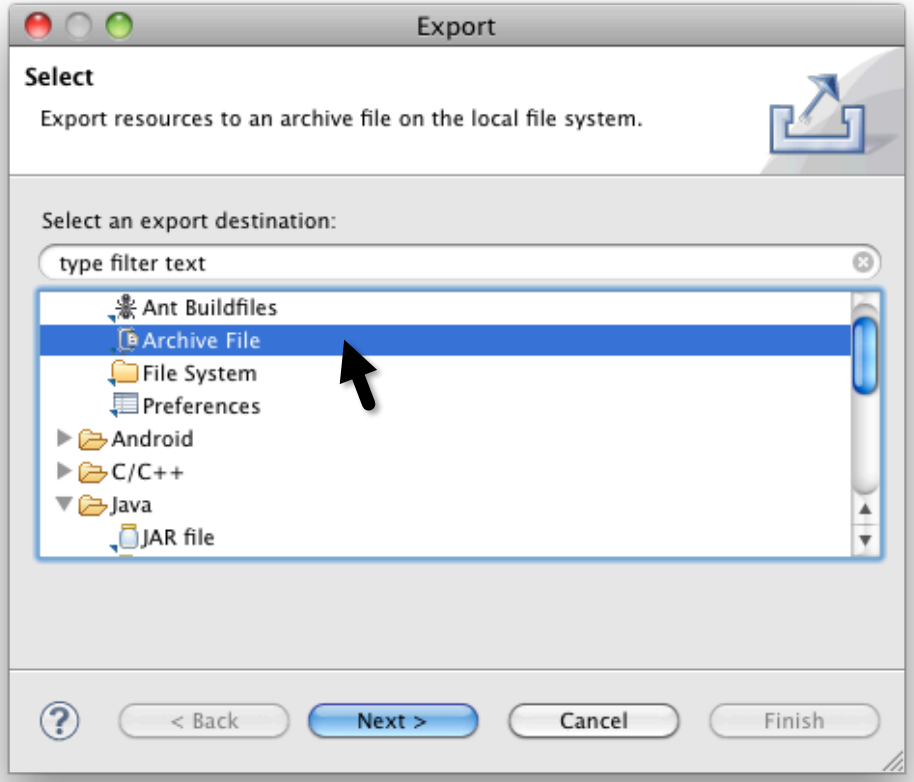
```
Log.d("MainActivity", "onCreate");
```



Exportieren / Importieren von Projekten

- Android-Projekte exportieren
  - Eclipse → File → Export → General → Archive File (zip)



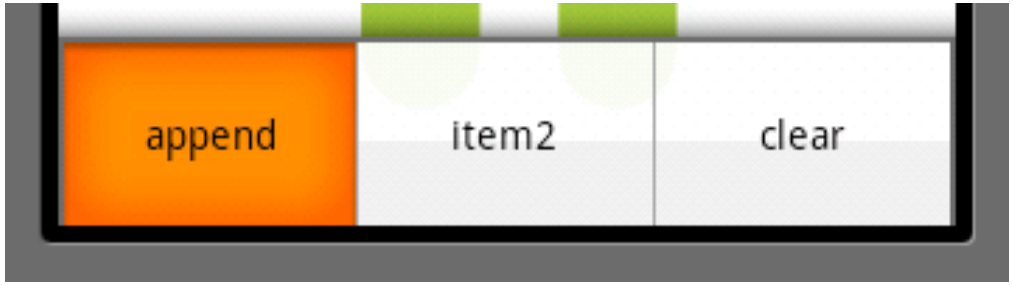


Menus

Menus

- An activity is associated with a single menu
- Use onCreateOptionsMenu(Menu m) to populate menu
- Creating an options menu

```
public boolean onCreateOptionsMenu(Menu menu) {
    super.onCreateOptionsMenu(menu);
    menu.add(0, 1, 0, "append"); // group, id, order, title
    menu.add(0, 2, 1, "item2");
    menu.add(0, 3, 2, "clear");
    return true; // return true to enable menu
}
```



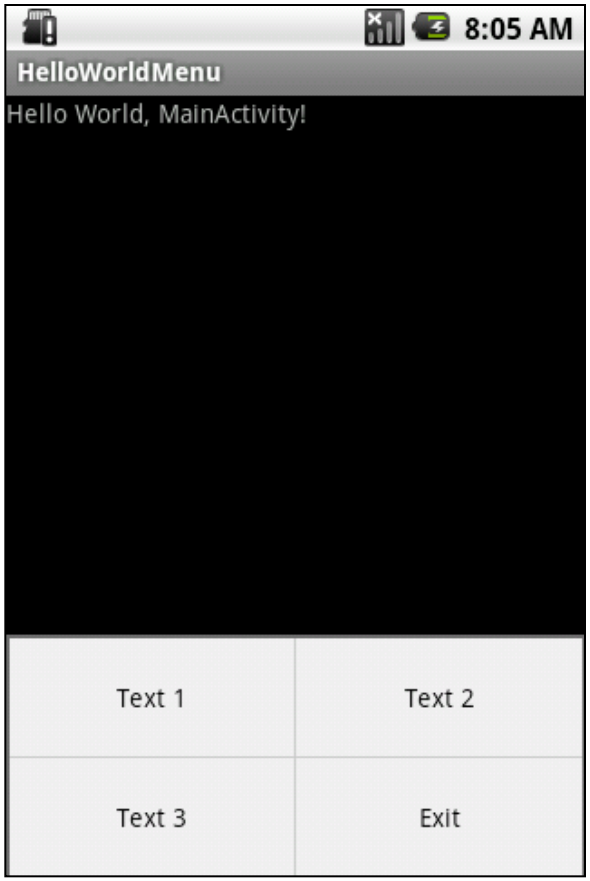
Responding to Menu Selection

- Overriding onOptionsItemSelected

```
public boolean onOptionsItemSelected(MenuItem item) {
    Log.d("MainActivity", "menu id = " + item.getItemId() +
            ", title = " + item.getTitle().toString());
    switch (item.getItemId()) {
        case X: // id of handeled item
        // handle item X
        return true;
        ...
    }
}
```

Exercise: A Menu for Hello World

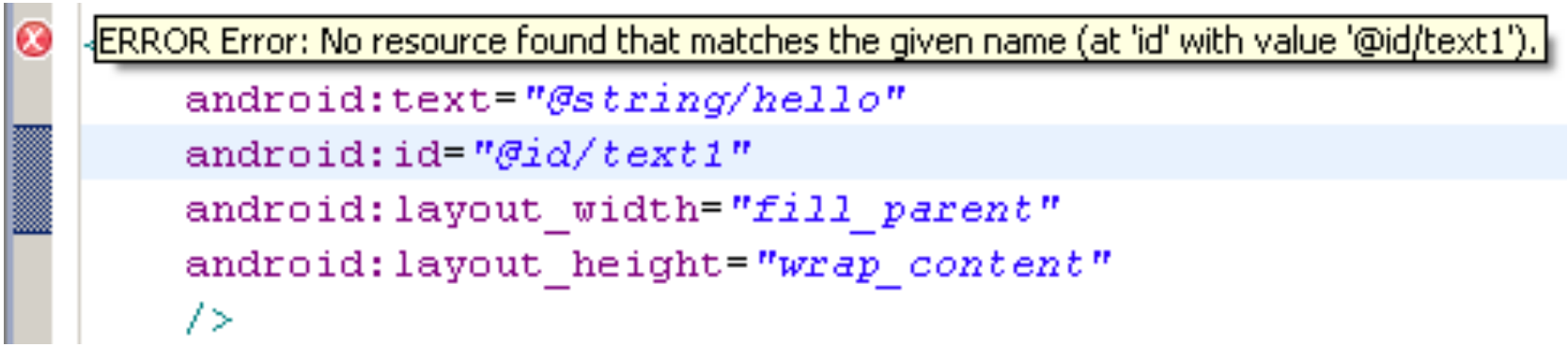
- Add a menu with four items to “Hello World”
- Menu items 1-3 changes text shown in the top of the display
  - setText(...)
- Menu item 1 → Probestudium
- Menu item 2 → LMU
- Menu item 3 → Android
- Menu item 4: Exit the application
  - finish()



Resources

Resource-Reference Syntax

- “+” Use id if it already exists, otherwise create new id
- @id/text1



- @+id/text1

```
<TextView
    android:text="@string/hello"
    android:id="@+id/text1"
    android:layout_width="fill_parent"
    android:layout_height="wrap_content"
    />
<Button
```

Image Resources

- Automatic id generation for images in /res/drawable
  - Example: /res/drawable/sample_image.jpg → R.drawable.sample_image
- Supported types: .gif, .jpg, .png

- Usage in Java

```
Button b = (Button)this.findViewById(R.id.Button01);
b.setBackgroundResource(R.drawable.sample_image);
```

- Usage in XML

```
<Button android:text="@string/Button01"
…
android:background="@drawable/sample_image" />
```

UI Components

- Common Controls
- Layout Managers
- Menus
- Dialogs

Core UI Component Classes

java.lang.Object
↑ android.view.View
↑ android.view.ViewGroup
↑ android.widget.LinearLayout

- android.view.View
  - Rectangular area on the screen
  - Responsible for drawing and event handling
  - Base class for widgets (buttons, text fields, etc.)
- android.view.ViewGroup
  - Is a view and contains other views (“container”)
  - Base class for layouts
- Layouts
  - Invisible containers that hold other Views
  - Define their layout properties (position, padding, size, etc.)
  - Example: LinearLayout (horizontal / vertical list of children)

Design UI in XML, Reference in Java

- Assign IDs in XML

```
<TextView android:id="@+id/nameValue" .../>
<TextView android:id="@+id/addrValue" ... />
```

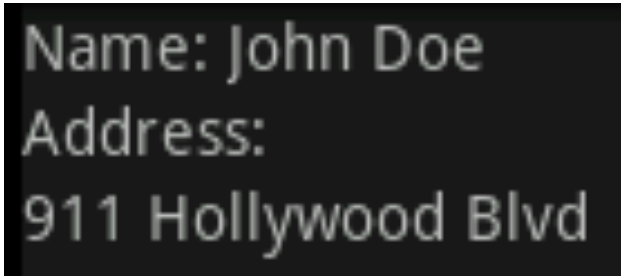
- Refer to controls using IDs

```
TextView nameValue = (TextView) findViewById(R.id.nameValue);
nameValue.setText("John Doe");
TextView addrValue = (TextView)findViewById(R.id.addrValue);
addrValue.setText("911 Hollywood Blvd.");
```

- View must have been loaded before referencing IDs

```
setContentView(R.layout.test);
```

Creating a UI in XML (/res/layout/test.xml)

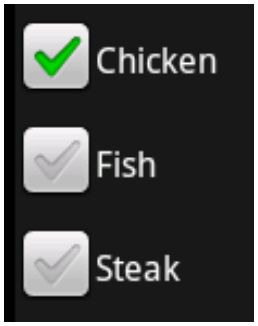


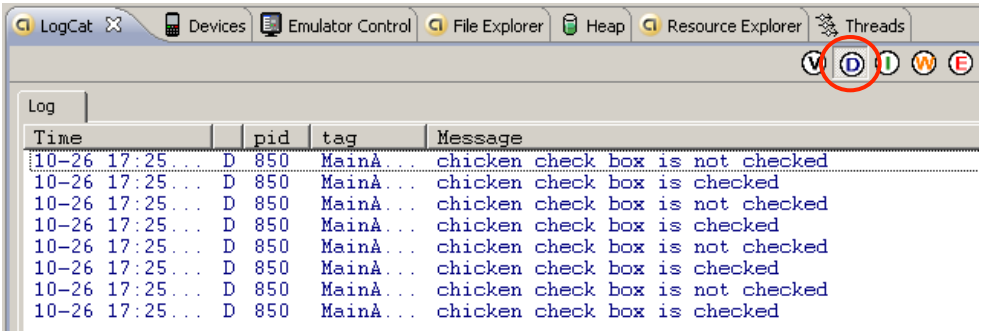

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical" android:layout_width="fill_parent"
    android:layout_height="fill_parent">
  <LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
      android:orientation="horizontal" android:layout_width="fill_parent"
      android:layout_height="wrap_content">
    <TextView android:layout_width="wrap_content"
      android:layout_height="wrap_content" android:text="Name: " />
    <TextView android:layout_width="wrap_content"
      android:layout_height="wrap_content" android:text="John Doe" />
  </LinearLayout>
  <LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical" android:layout_width="fill_parent"
    android:layout_height="wrap_content">
  <TextView android:layout_width="fill_parent"
    android:layout_height="wrap_content" android:text="Address:" />
  <TextView android:layout_width="fill_parent"
    android:layout_height="wrap_content" android:text="911 Hollywood Blvd." />
  </LinearLayout>
</LinearLayout>
```

Setting the XML UI in Java

```
public class MainActivity extends Activity {
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.test);
    }
}
```

CheckBox





- XML

```
<LinearLayout android:orientation="vertical" ... >
    <CheckBox android:id="@+id/chicken" android:text="Chicken" ... />
    <CheckBox android:id="@+id/fish" android:text="Fish" ... />
    <CheckBox android:id="@+id/steak" android:text="Steak" ... />
</LinearLayout>
```

- Java

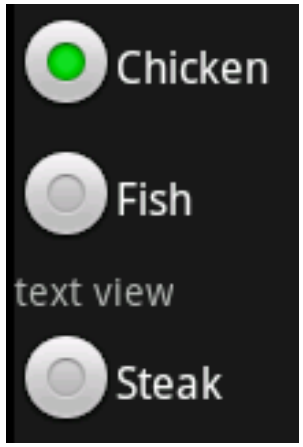
```
CheckBox cb = (CheckBox) findViewById(R.id.chicken);
cb.setChecked(true);
cb.setOnCheckedChangeListener(new OnCheckedChangeListener() {
  public void onCheckedChanged(CompoundButton b, boolean isChecked) {
     Log.d("MainActivity", "chicken check box is " +
        (isChecked ? "" : "not ") + "checked");
  }
});
```

Radio Button

- XML

```
<LinearLayout android:orientation="vertical"
        android:layout_width="wrap_content“
        android:layout_height="wrap_content">
    <RadioGroup android:layout_width="wrap_content“
        android:layout_height="wrap_content">
        <RadioButton android:text="Chicken"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content" />
        <RadioButton android:text="Fish"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content" />
        ...
    </RadioGroup>
</LinearLayout>
```

- Radio groups can contain arbitrary views



Location-Based Services

Location-Based Services

- Location APIs: Access location data (GPS, WiFi, GSM)
  - android.location
  - LocationManager
  - Geocoder
- Mapping APIs: Display and navigate maps
  - com.google.android.maps
  - MapView
  - MapActivity

Permissions (in AndroidManifest.xml)

- Permissions for location-based services

```
<uses-permission
    android:name="android.permission.ACCESS_FINE_LOCATION" />
<uses-permission
    android:name="android.permission.ACCESS_COARSE_LOCATION" />
<uses-permission
    android:name="android.permission.INTERNET" />
```

- Child of element <application>
  - `<uses-library android:name="com.google.android.maps" />`

- Example
  - http://developer.android.com/intl/fr/guide/tutorials/views/hello-mapview.html

Location Manager Service

- Obtain device's geographical location
- Get notification upon entering a specified location

Example: Last Location

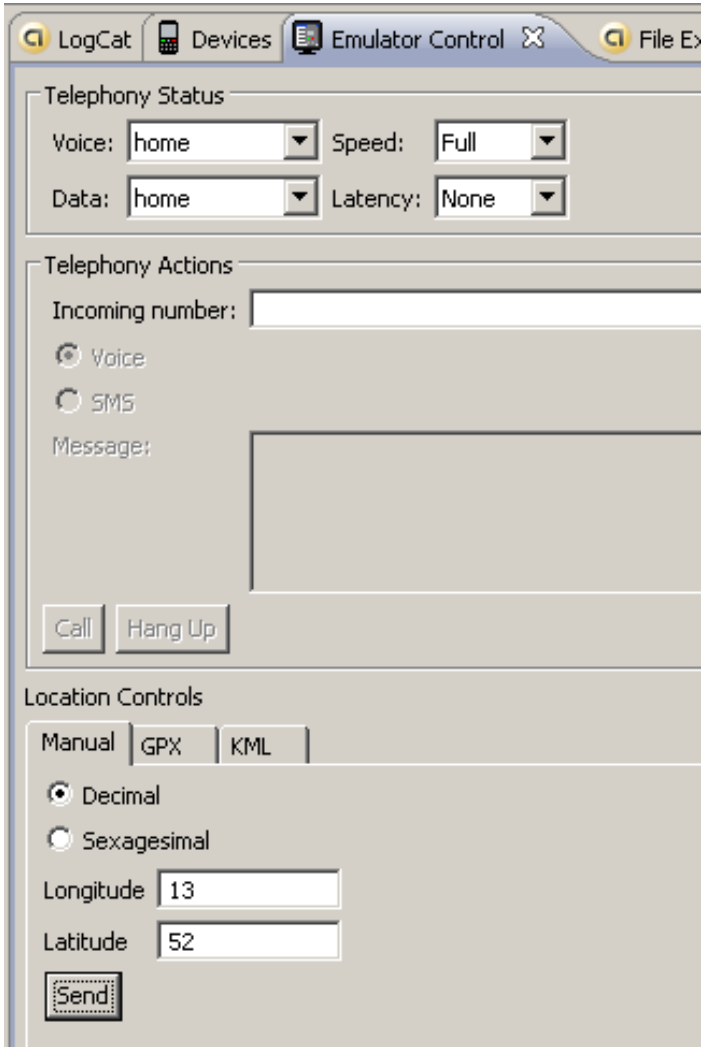
```
public class LocationManagerDemoActivity extends Activity {
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        LocationManager locMgr = (LocationManager)
                getSystemService(Context.LOCATION_SERVICE);
        Location loc = locMgr
                .getLastKnownLocation(LocationManager.GPS_PROVIDER);
        Toast.makeText(this, loc.toString(), 10000).show();
        Log.d("last location", loc.toString());
        List<String> providerList = locMgr.getAllProviders();
        Iterator<String> iter = providerList.iterator();
        while (iter.hasNext()) {
            Log.d("provider", iter.next().toString());
} } }
```

Example: Location Updates

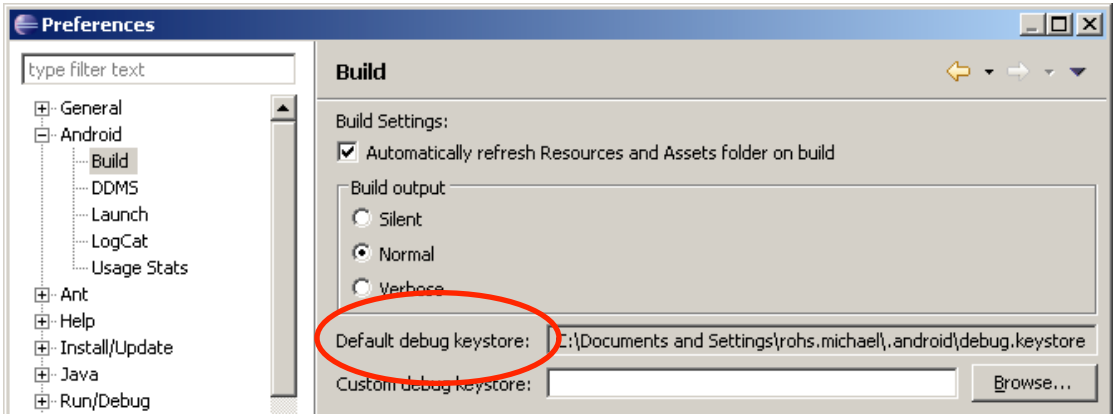
```
public class LocationUpdateDemoActivity extends Activity {
   public void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      LocationManager locMgr = (LocationManager)
            getSystemService(Context.LOCATION_SERVICE);
      LocationListener locListener = new LocationListener() {
         public void onLocationChanged(Location location) {
            if (location != null) {
               Toast.makeText(getBaseContext(),
                  "New location (" + location.getLatitude() + ", " +
                  location.getLongitude() + ")", Toast.LENGTH_LONG).show();
               }
            }
            public void onProviderDisabled(String provider) {}
            public void onProviderEnabled(String provider) {}
            public void onStatusChanged(String provider, int status, Bundle extras) {}
         };
      locMgr.requestLocationUpdates(LocationManager.GPS_PROVIDER,
            0, 0, locListener);
}}
```

Simulated Location for the Emulator

- Dalvik Debug Monitor Service
- Play back GPS traces
  - GPX: GPS Exchange Format
  - KML: Keyhole Markup Language
- Telnet to a running emulator
  - telnet localhost <emulator port>
  - geo fix <lon> <lat>
  - geo nmea <nmea sentence>
- Example
  - telnet localhost 5554
  - geo fix 13 52
  - http://developer.android.com/intl/fr/guide/developing/tools/emulator.html



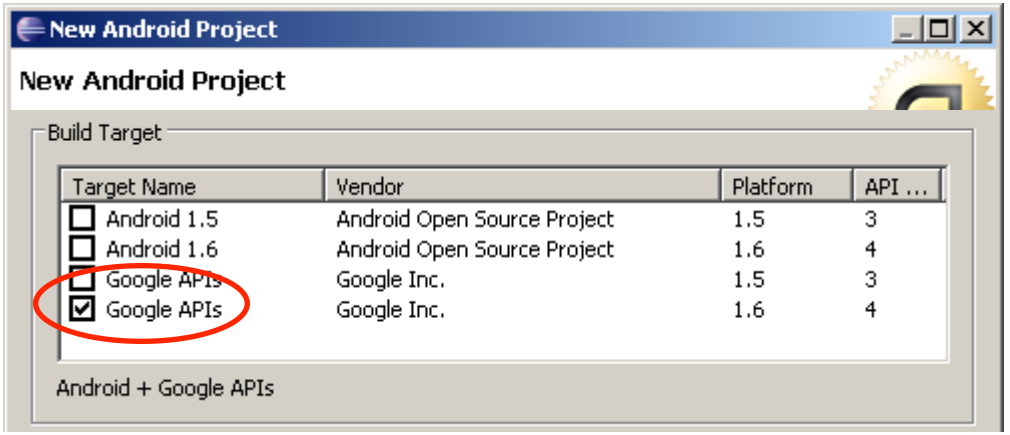
Map API Key



- Locate keystore
- Open command line
- Get MD5 hash of debug certificate

  keytool -list -alias androiddebugkey
  -keystore "C:\Documents and Settings\<user>\.android\debug.keystore"
  -storepass android -keypass android

- Get the key from Google
  - http://code.google.com/android/maps-api-signup.html
- Projects using maps need build target "GoogleAPIs"
  - Potentially needs a new AVD



Example Map View

- XML

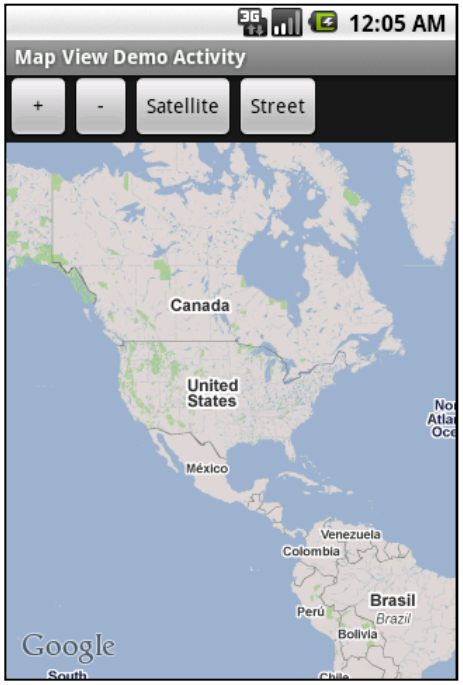
```
<LinearLayout xmlns:android="http://schemas..."
    android:orientation="vertical" android:layout_... >
    <com.google.android.maps.MapView android:layout_...
        android:apiKey="02LvHoUW1Z_HVYZWU..." />
</LinearLayout>
```

- Java

```
public class MapViewDemoActivity extends MapActivity {
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.mapview);
    }
    protected boolean isRouteDisplayed() { return false; }
}
```

Example Map View with Controls

```
<LinearLayout xmlns:android="http://schemas..."
                android:orientation="vertical" ...>
  <LinearLayout android:orientation="horizontal" android:layout_...>
    <Button android:id="@+id/zoomin" android:text="  +  " ... />
    <Button android:id="@+id/zoomout" android:text="  -  " ... />
    ...
  </LinearLayout>
  <com.google.android.maps.MapView
    android:id="@+id/mapview“
    android:apiKey="02Lv..." ... />
</LinearLayout>
```



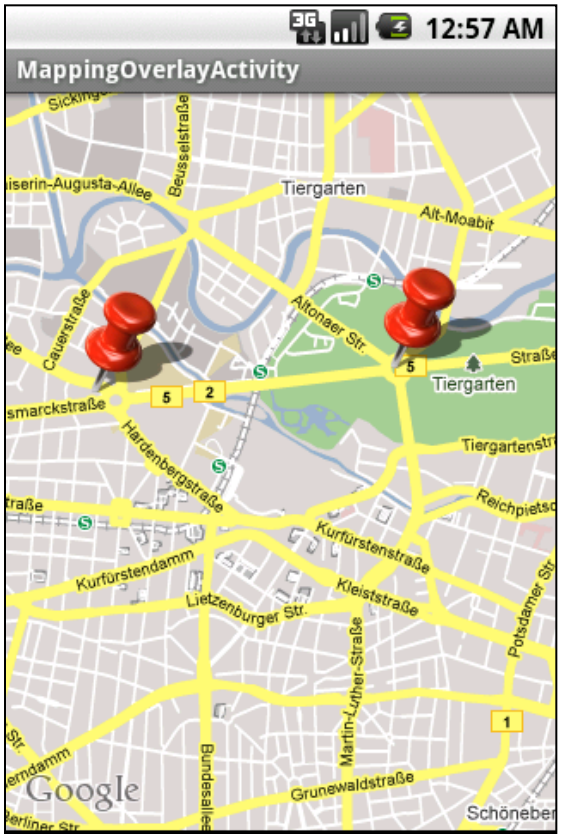
Example Map View with Controls

```
public class MapViewDemoActivity extends MapActivity {
    private MapView mapView;
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.mapview);
        mapView = (MapView) findViewById(R.id.mapview);
        Button zoominBtn = (Button) findViewById(R.id.zoomin);
        zoominBtn.setOnClickListener(new OnClickListener() {
            public void onClick(View view) {
                mapView.getController().zoomIn();
            }});
        ...
    }
    protected boolean isRouteDisplayed() { return false; }
}
```

Using Overlays

- /res/layout/mapviewoverlay.xml

```
<LinearLayout xmlns:android="http://schemas..."
                    android:orientation="vertical" ...>
   <com.google.android.maps.MapView
      android:id="@+id/mapviewoverlay"
      android:apiKey="02Lv..." ... />
</LinearLayout>
```



Using Overlays

```
public class MappingOverlayActivity extends MapActivity {
    private MapView mapView;
    private GeoPoint tlabs = new GeoPoint((int)(
        52.513036 * 1000000), (int)(13.320281 * 1000000));
    private GeoPoint saeule = new GeoPoint((int)(
        52.514495 * 1000000), (int)(13.350130 * 1000000));

    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.mapviewoverlay);
        mapView = (MapView) findViewById(R.id.mapviewoverlay);
        mapView.setBuiltInZoomControls(true);
        mapView.setClickable(true);
        mapView.getController().setCenter(tlabs);
        mapView.getController().setZoom(14);
        Drawable marker = getResources().getDrawable(R.drawable.pushpin);
        mapView.getOverlays().add(new InterestingLocations(marker));
    }
...}
```

Using Overlays

```
class InterestingLocations extends ItemizedOverlay<OverlayItem> {
    private List<OverlayItem> locations = new ArrayList<OverlayItem>();
    private Drawable marker;
    public InterestingLocations(Drawable marker) {
        super(marker);
        this.marker = marker;
        locations.add(new OverlayItem(tlabs, "T-Labs", "T-Labs"));
        locations.add(new OverlayItem(saeule, "Siegessäule", "Siegessäule"));
        populate();
    }
    public void draw(Canvas canvas, MapView mapView, boolean shadow) {
        super.draw(canvas, mapView, shadow);
        boundCenterBottom(marker);
    }
    protected OverlayItem createItem(int i) {
        return locations.get(i);
    }
    public int size() {
        return locations.size();
    }
}
```

Marker hotspot: bottom center

The Location Quiz

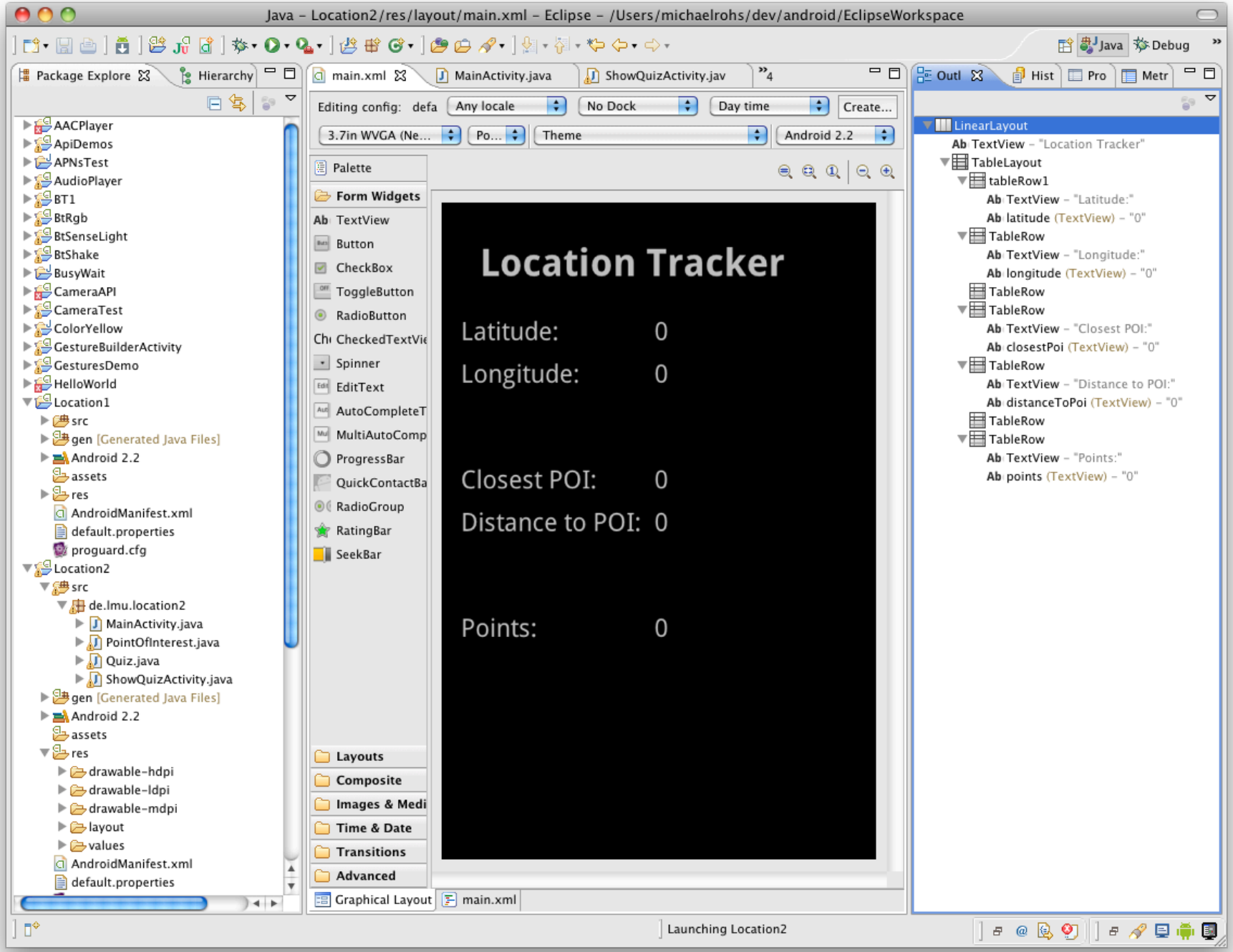
The Main Screen → MainActivity

- Show current location
- Show nearest point-of-interest
- Show number of game points

The Quiz Screen → ShowQuizActivity

- Title of the point-of-interest
- Image of the POI
- Question
- Choices

  (the correct one gives positive, the wrong one negative points)
- Submit button


Java – Location2/res/layout/main.xml – Eclipse – /Users/michaelrohs/dev/android/EclipseWorkspace
Package Explore
Hierarchy
AACPlayer
ApiDemos
APNsTest
AudioPlayer
BT1
BtRgb
BtSenseLight
BtShake
BusyWait
CameraAPI
CameraTest
ColorYellow
GestureBuilderActivity
GesturesDemo
HelloWorld
Location1
src
gen [Generated Java Files]
Android 2.2
assets
res
AndroidManifest.xml
default.properties
proguard.cfg
Location2
src
de.lmu.location2
MainActivity.java
PointOfInterest.java
Quiz.java
ShowQuizActivity.java
gen [Generated Java Files]
Android 2.2
assets
res
drawable-hdpi
drawable-ldpi
drawable-mdpi
layout
values
AndroidManifest.xml
default.properties
main.xml
MainActivity.java
ShowQuizActivity.jav
Editing config: defa
Any locale
No Dock
Day time
Create...
3.7in WVGA (Ne...
Po...
Theme
Android 2.2
Palette
Form Widgets
TextView
Button
CheckBox
ToggleButton
RadioButton
CheckedTextVie
Spinner
EditText
AutoCompleteT
MultiAutoComp
ProgressBar
QuickContactBa
RadioGroup
RatingBar
SeekBar
Layouts
Composite
Images & Medi
Time & Date
Transitions
Advanced
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Longitude: 0
Closest POI: 0
Distance to POI: 0
Points: 0
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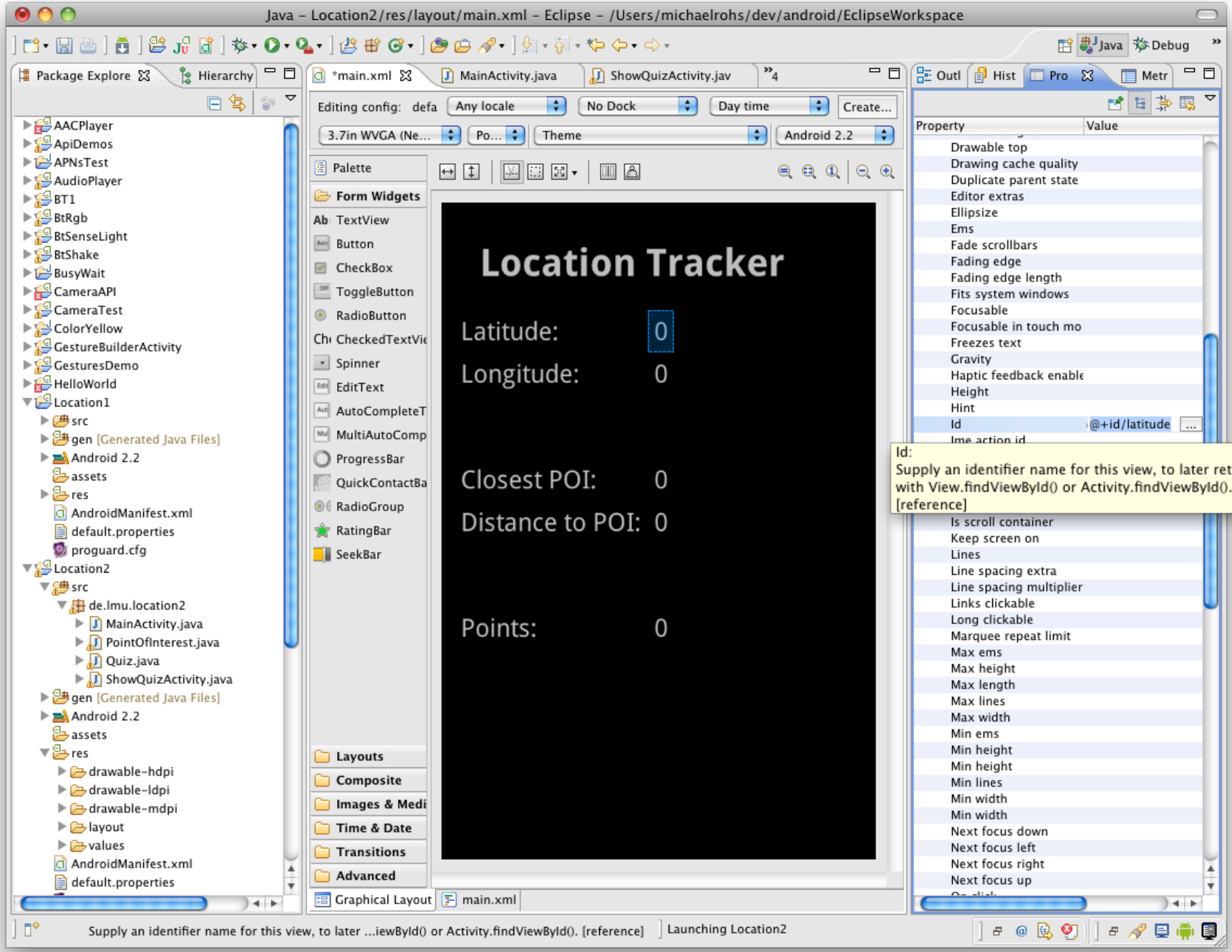
Pro
Metr
LinearLayout
TextView – "Location Tracker"
TableLayout
tableRow1
TextView – "Latitude:"
latitude (TextView) – "0"
TableRow
TextView – "Longitude:"
longitude (TextView) – "0"
TableRow
TableRow
TextView – "Closest POI:"
closestPoi (TextView) – "0"
TableRow
TextView – "Distance to POI:"
distanceToPoi (TextView) – "0"
TableRow
TableRow
TextView – "Points:"
points (TextView) – "0"
Launching Location2


Java – Location2/res/layout/main.xml – Eclipse – /Users/michaelrohs/dev/android/EclipseWorkspace
Package Explore
Hierarchy
AACPlayer
ApiDemos
APNsTest
AudioPlayer
BT1
BtRgb
BtSenseLight
BtShake
BusyWait
CameraAPI
CameraTest
ColorYellow
GestureBuilderActivity
GesturesDemo
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MainActivity.java
PointOfInterest.java
Quiz.java
ShowQuizActivity.java
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Closest POI: 0
Distance to POI: 0
Points: 0
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Focusable
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Freezes text
Gravity
Haptic feedback enable
Height
Hint
Id
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Ime action id
Id:
Supply an identifier name for this view, to later retrieve it with View.findViewById() or Activity.findViewById(). [reference]
Is scroll container
Keep screen on
Lines
Line spacing extra
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Links clickable
Long clickable
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Next focus down
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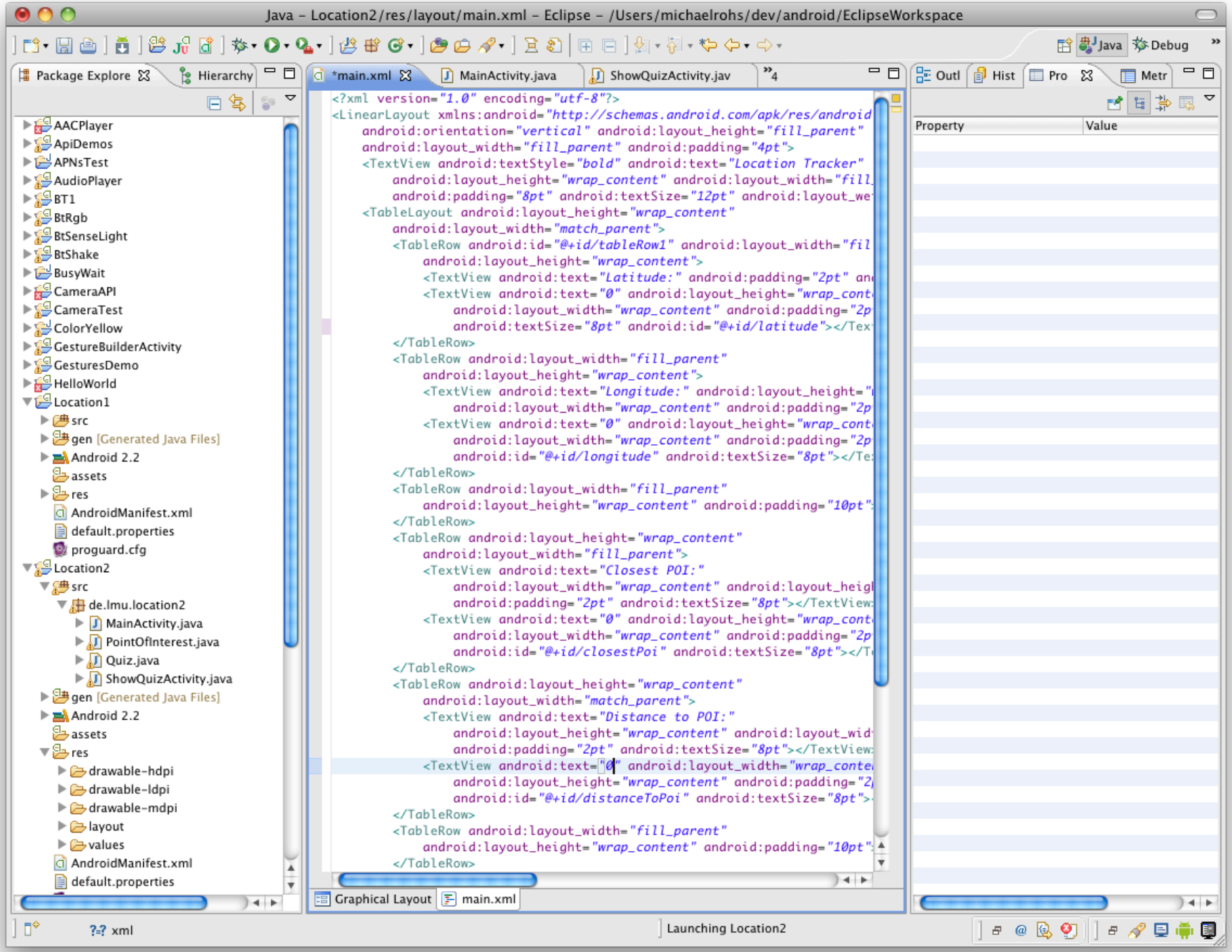
Next focus up
Supply an identifier name for this view, to later ...iewById() or Activity.findViewById(). [reference]
Launching Location2


Java – Location2/res/layout/main.xml – Eclipse – /Users/michaelrohs/dev/android/EclipseWorkspace
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ShowQuizActivity.java
gen [Generated Java Files]
Android 2.2
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<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android
android:orientation="vertical" android:layout_height="fill_parent"
android:layout_width="fill_parent" android:padding="4pt">
<TextView android:textStyle="bold" android:text="Location Tracker"
android:layout_height="wrap_content" android:layout_width="fill
android:padding="8pt" android:textSize="12pt" android:layout_we
<TableLayout android:layout_height="wrap_content"
android:layout_width="match_parent">
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</TableRow>
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android:layout_width="wrap_content" android:padding="2p
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android:padding="2pt" android:textSize="8pt"></TextView
<TextView android:text="0" android:layout_width="wrap_conte
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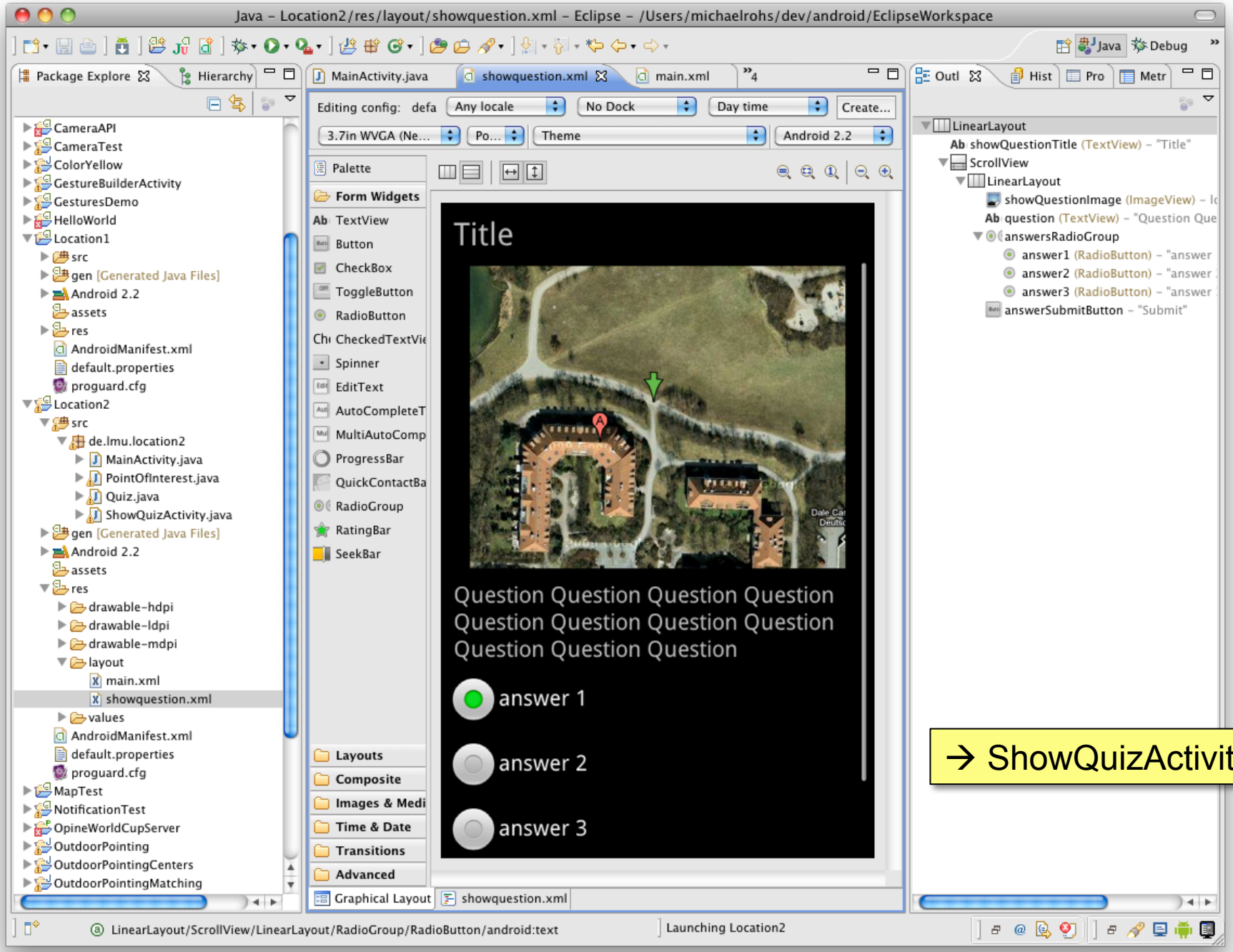
android:id="@+id/distanceToPoi" android:textSize="8pt">
</TableRow>
<TableRow android:layout_width="fill_parent"
android:layout_height="wrap_content" android:padding="10pt"
</TableRow>
Graphical Layout
main.xml
xml
Launching Location2

Accessing GUI Elements in Java

```
public class MainActivity extends Activity implements LocationListener {
    TextView latitudeView;
    TextView longitudeView;
    …
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);

        latitudeView = (TextView) findViewById(R.id.latitude);
        longitudeView = (TextView) findViewById(R.id.longitude);
        closestPoiView = (TextView) findViewById(R.id.closestPoi);
      …
    }
```


Java – Location2/res/layout/showquestion.xml – Eclipse – /Users/michaelrohs/dev/android/EclipseWorkspace
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ScrollView
LinearLayout
showQuestionImage (ImageView)
question (TextView) – "Question Que
answersRadioGroup
answer1 (RadioButton) – "answer
answer2 (RadioButton) – "answer
answer3 (RadioButton) – "answer
answerSubmitButton – "Submit"
→ ShowQuizActivity
LinearLayout/ScrollView/LinearLayout/RadioGroup/RadioButton/android:text
Launching Location2

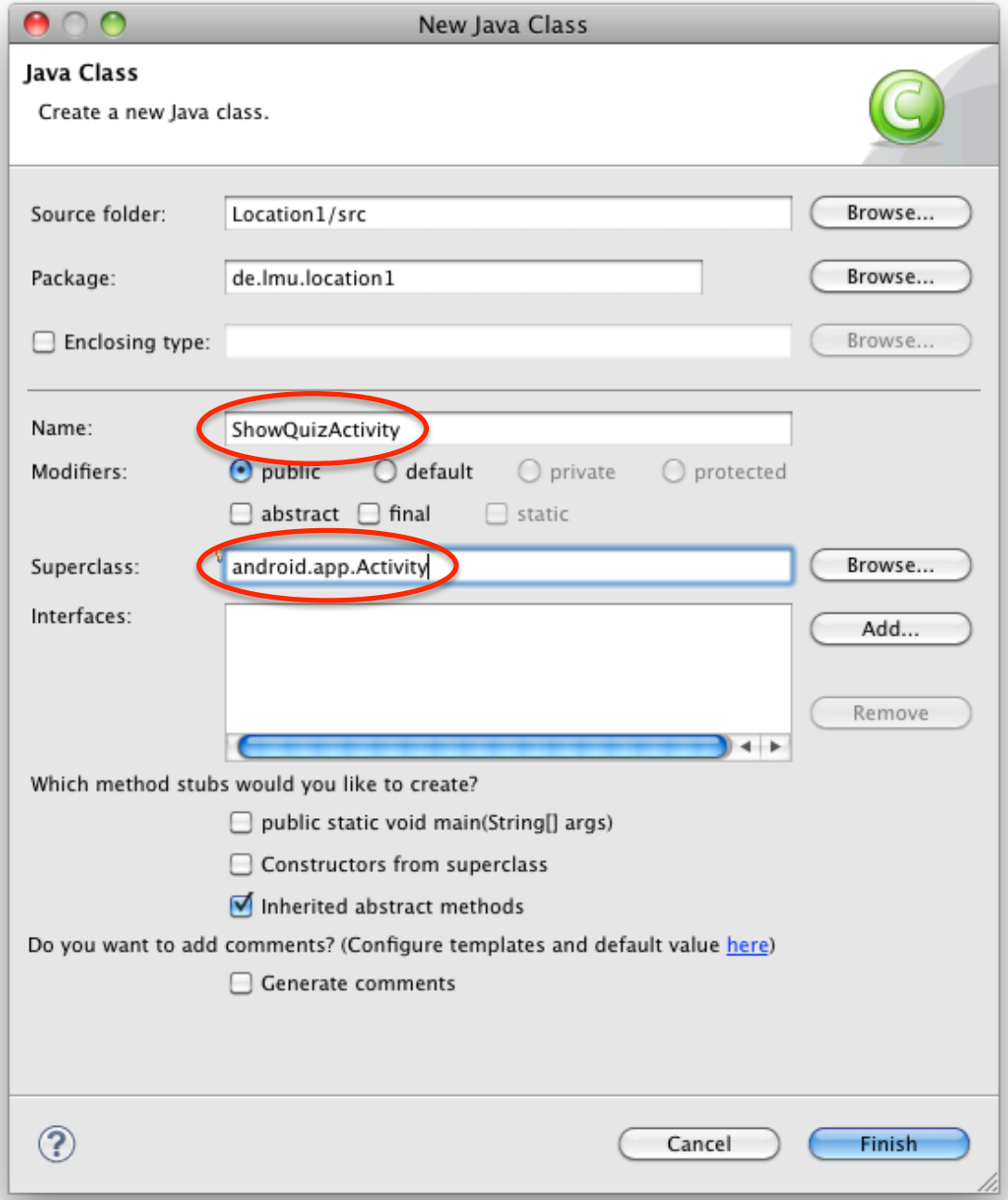
Exercise

- Exercise: Create Main View and Quiz View
  - main view in /res/layout/main.xml
  - quiz view in /res/layout/showquiz.xml
    (start by copying main.xml, then adapt it)

Using Activities

Activities

- Create new class ShowQuizActivity
- Superclass: android.app.Activity



ShowQuizActivity → AndroidManifest.xml

- Activity class:

```
public class ShowQuizActivity extends Activity {
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.showquiz);
} }
```

- AndroidManifest.xml (inside application element)

```
<activity android:name="de.lmu.quiz.ShowQuizActivity"
          android:label="showquiz"
    android:screenOrientation="portrait">
</activity>
```

How to start the new activity?

- Starting an activity:

```
Intent intent = new Intent(this, ShowQuizActivity.class);
startActivityForResult(intent, requestCode);
```

- Processing the result when the activity returns:

```
void onActivityResult(int requestCode, int resultCode, Intent data) {
    // do something with the result…
}
```

- Exercise:
  - Create the ShowQuizActivity
  - Create a menu in the MainActivity
  - Start ShowQuizActivity from the menu

How to return to the previous activity?

- Set result and finish the activity

  setResult(points);

  finish();

- Exercise: Return from ShowQuizActivity to MainActivity
  - Set OnClickListener for submit button in ShowQuizActivity
  - When button is clicked, set result to 123 and finish the task
  - Show the result in the points view in MainActivity

How to copy data from one activity to another?

- Add “extras” to Intent objects

```
Intent intent = new Intent(this, ShowQuizActivity.class);
intent.putExtra("title", "Target 1");
intent.putExtra("image", R.drawable.location1);
startActivityForResult(intent, resultCode);
```

- Can put primitive types and Serializable types into extras
  - java.io.Serializable is just a “tagging” interface (no methods)

Exercise

- Show title and image of a location
  - Use a (small) image from the Web
  - Name the image “location1.png” (or “location1.jpg”)
  - Put the image into all “/res/drawable-*” folders
  - Put title and image-id into intent extras
  - Show the image in the ShowQuizActivity

How to share complex data between activities?

- In the calling activity, create a public static member (class variable) that references the shared object

```
public static PointOfInterest sharedPoi = null;
```

- Before starting the new activity, set the shared object

```
Intent intent = new Intent(this, ShowQuizActivity.class);
sharedPoi = closestPoi;
startActivity(intent);
```

- Use original shared object in called activity

```
TextView titleView = (TextView) findViewById(R.id.showQuestionTitle);
titleView.setText(MainActivity.sharedPoi.title);
```

How to share complex data between activities? (possibility 2)

- Subclass android.app.Application, put shared data there

```
public class LocationQuiz extends Application {
    int points = 0;
    PointOfInterest currentPoi = null;
}
```

- Change AndroidManifest.xml

```
<application android:name="de.lmu.location.LocationQuiz" …>
    …
</application>
```

- Access shared data in activities

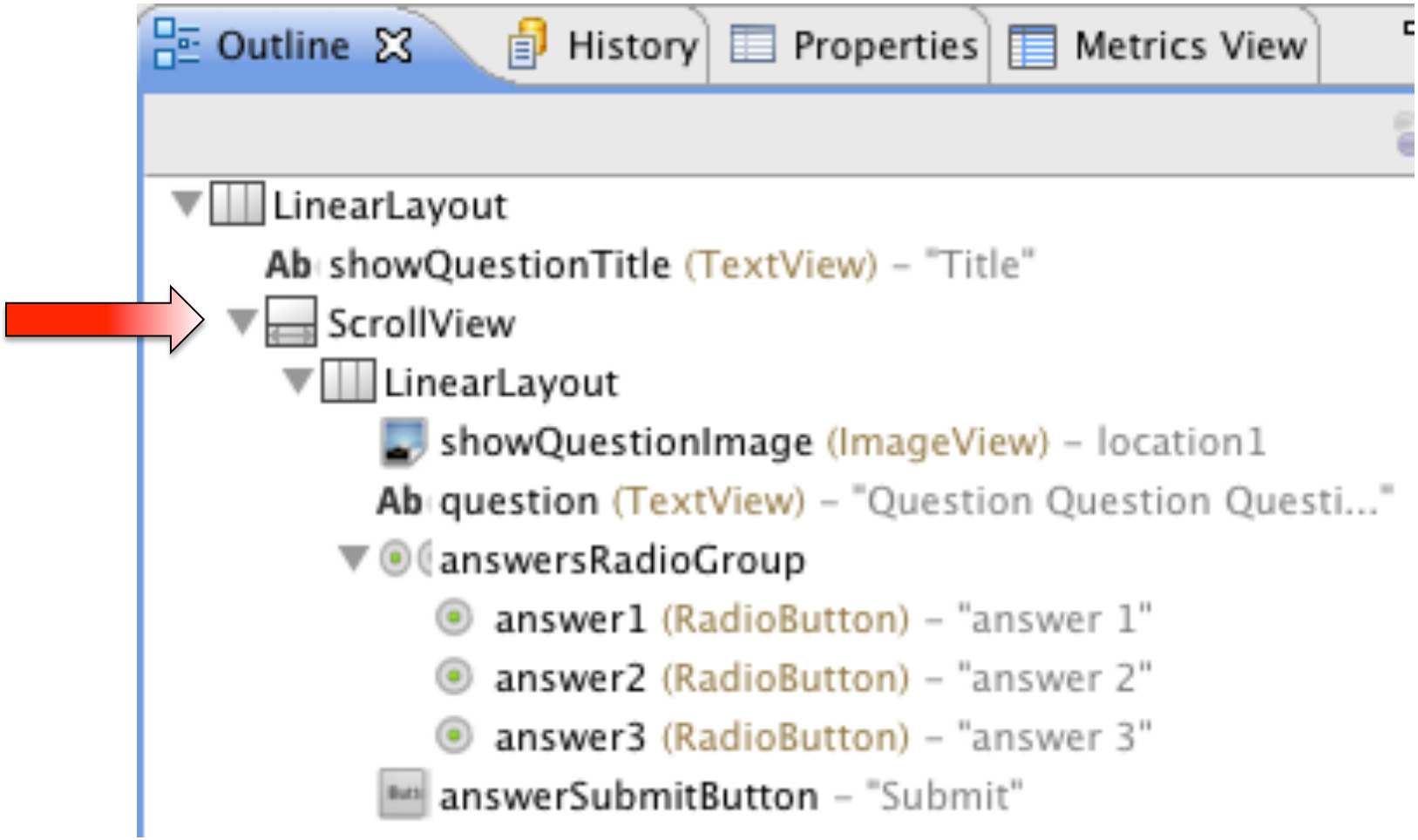
```
LocationQuiz app = (LocationQuiz) getApplication();
app.currentPoi = …;
app.points = 0;
```

Location

GPS (Global Positioning System)

Layout of QuizActivity

- If content can be larger than the screen: ScrollView



Data Structures

- Need to define classes that hold data
- Which classes to define?

- Exercise: Create classes to hold the required data

- Exercise: Example POIs and quizzes
  - Take a few sample points-of-interest and quizzes and enter them in your data structures

class PointOfInterest

- longitude, latitude
  - double
- Name
  - string
- Bild
  - int (Resource-ID)
- Radius
  - double
- Frage:
  - QuizQuestion

class QuizQuestion

- Frage
  - String
- Antworten
  - String[n] – feste Anz. Antworten
  - ArrayList<String> -- variable Anz. Antworten
- Bewertung
  - Versch. Punkte pro Antwort: int[n] (nach Schwierigkeitsgrad?)
  - Nur eine richtige Antwort: int

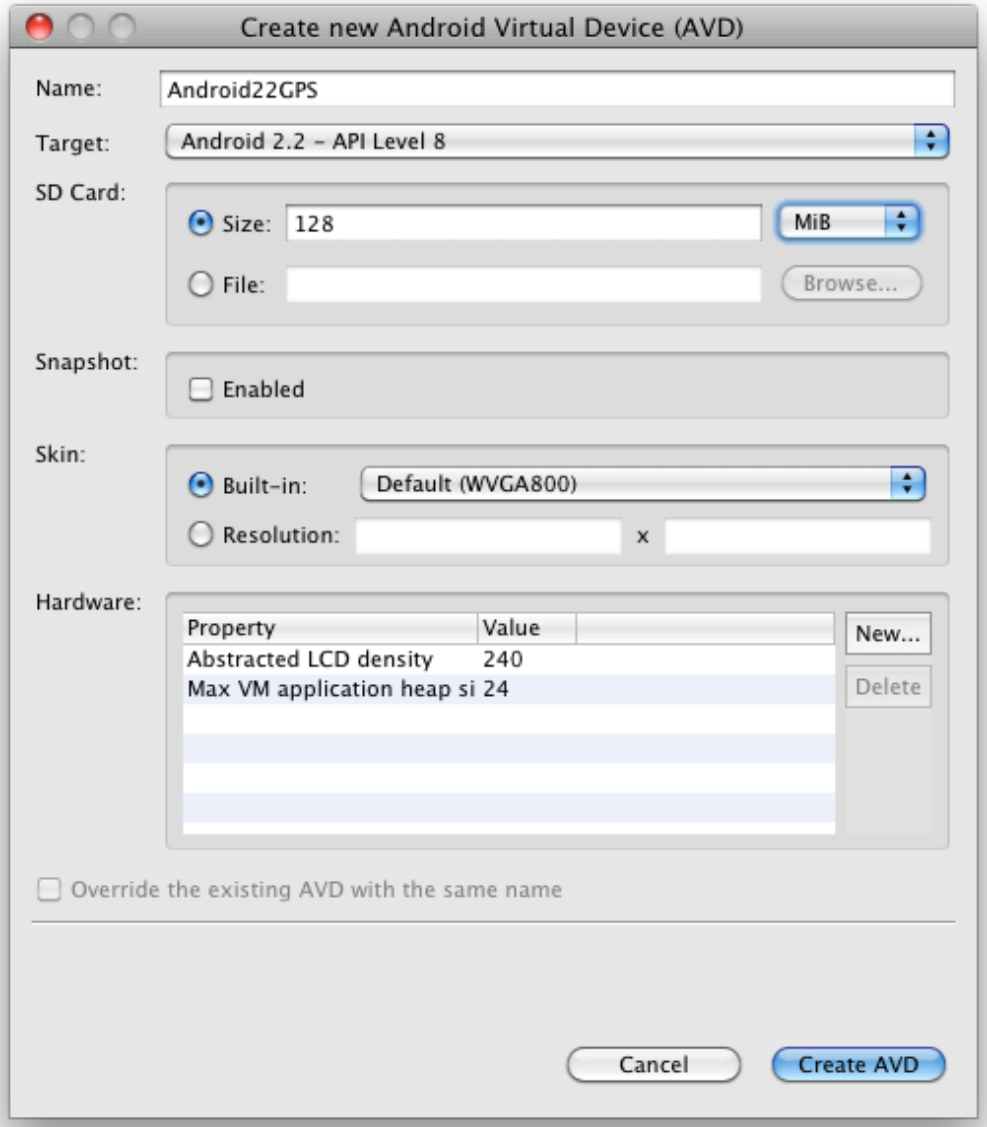
Class POI Constructor

```
POI(    double lat,
        double lon,
        double radius,
        String name,
        int imageID,
        QuizQuestion q ) {}
QuizQuestion (      String frage,
                    String antwort1,
                    String antwort2,
                    String antwort3,
                    int richtigeAntwort) {}
```

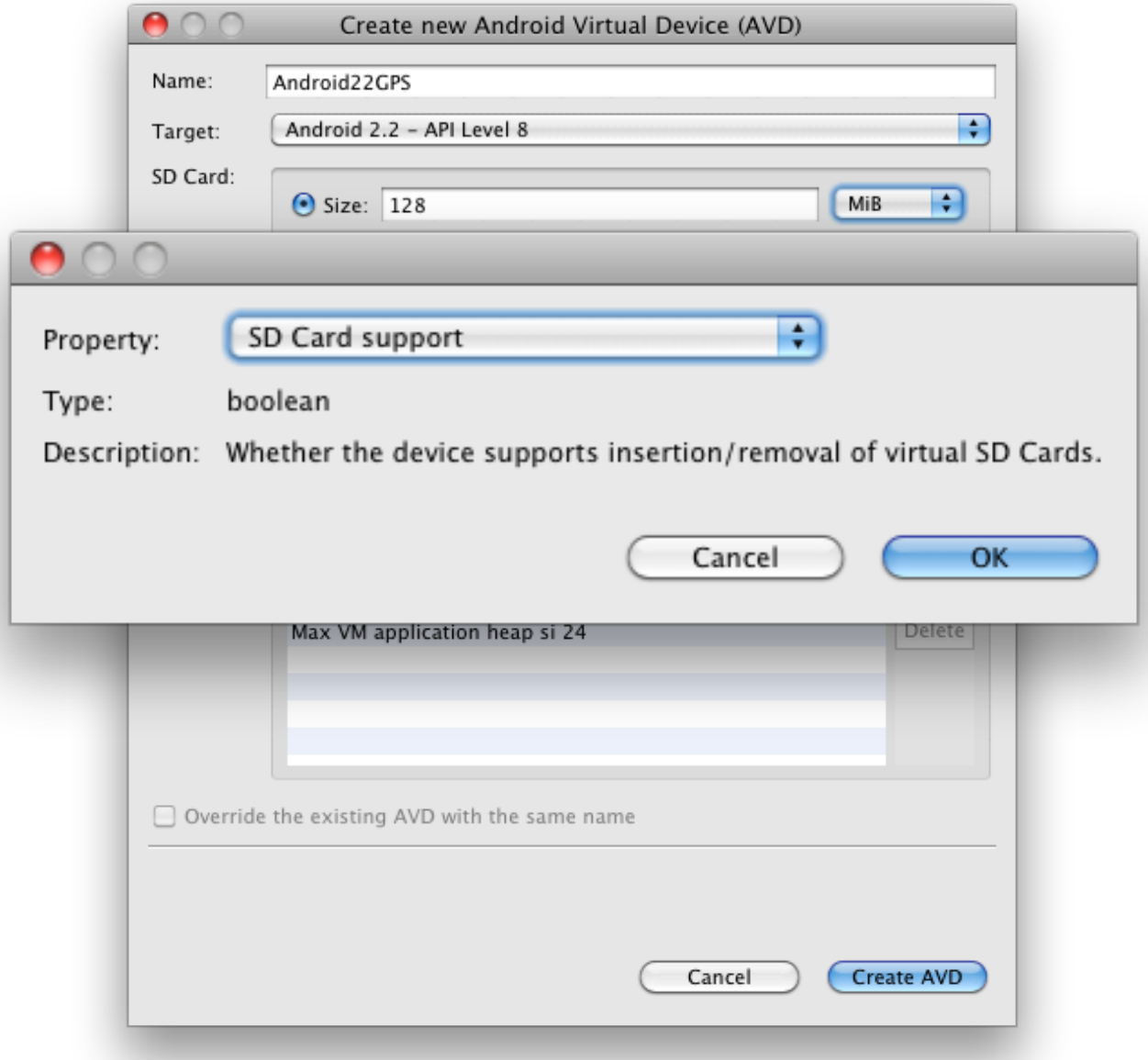
How to save POIs?

- Dynamic List
  - e.g., ArrayList
  - create in MainActivity

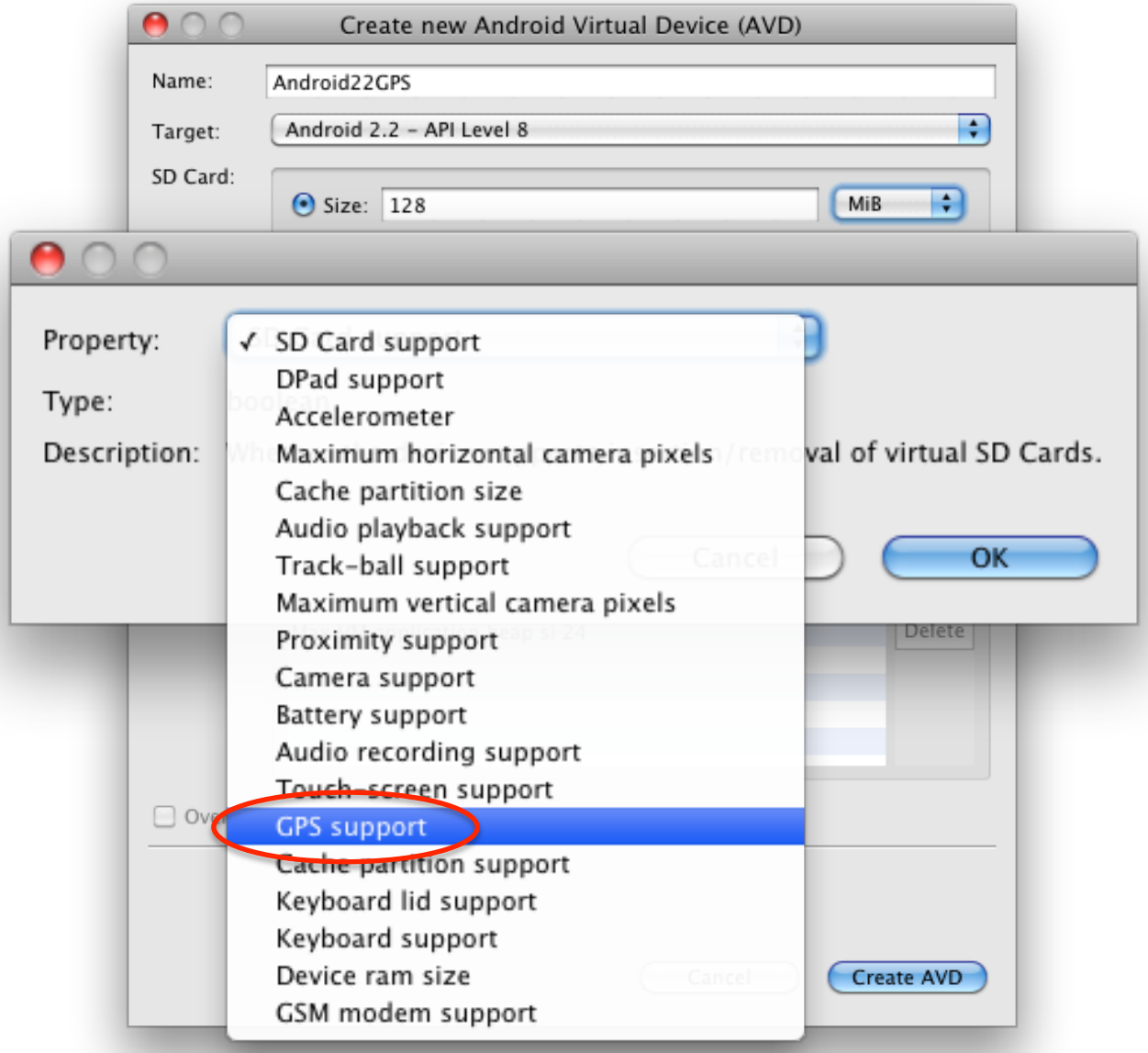
Enabling GPS on the Emulator



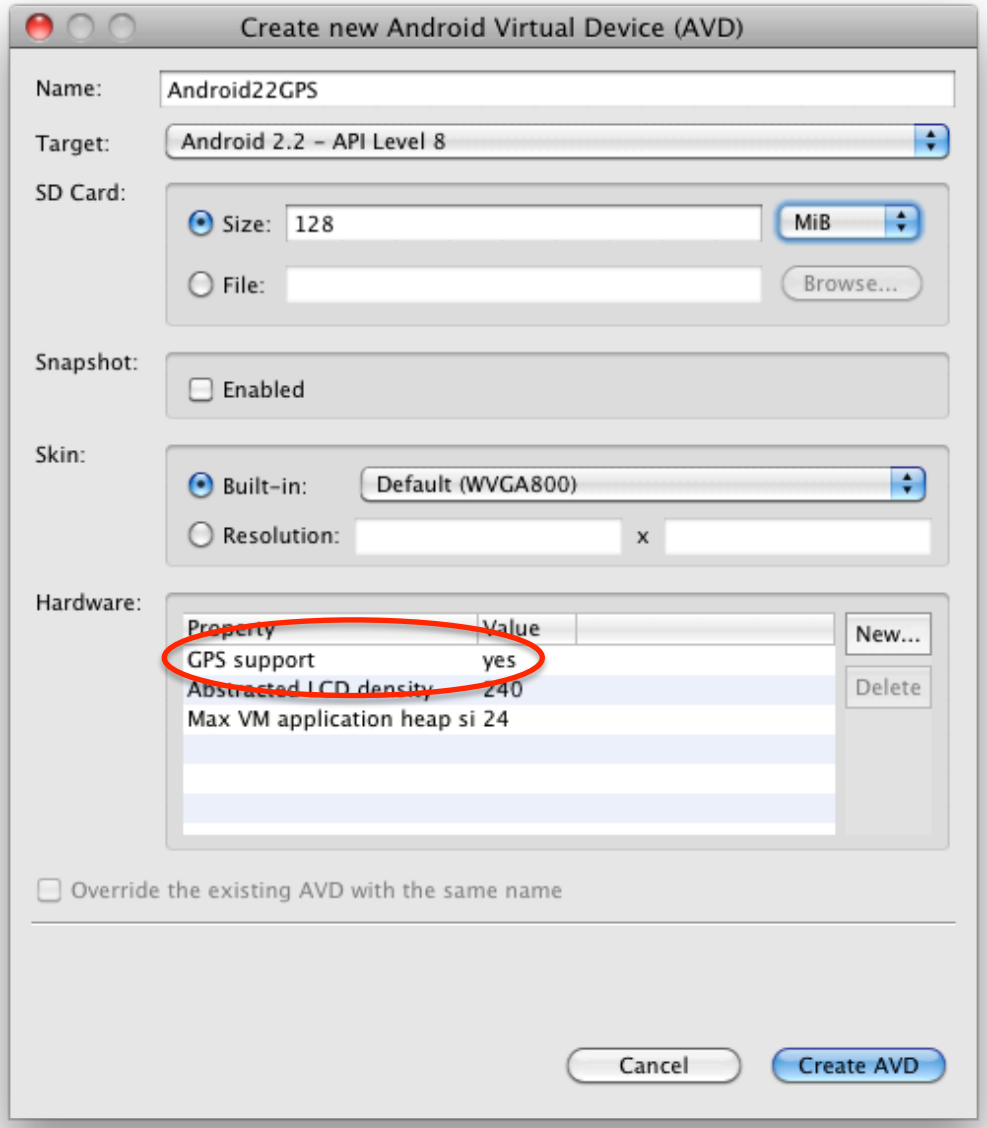
Enabling GPS on the Emulator



Enabling GPS on the Emulator

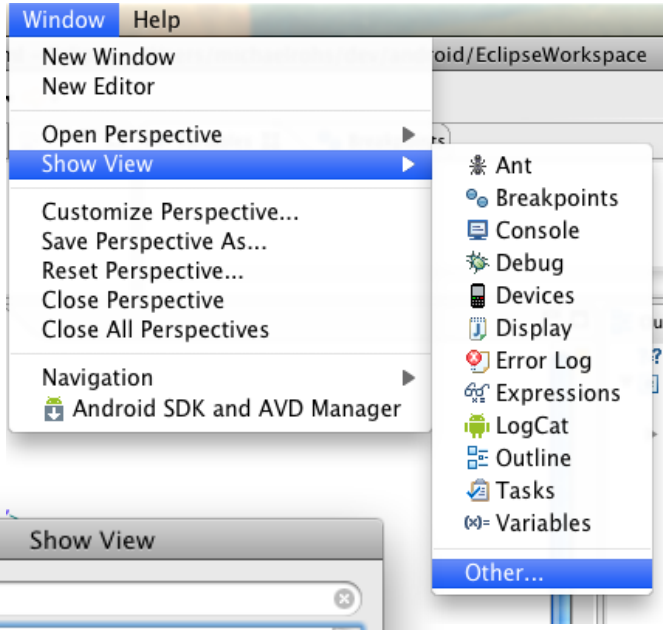


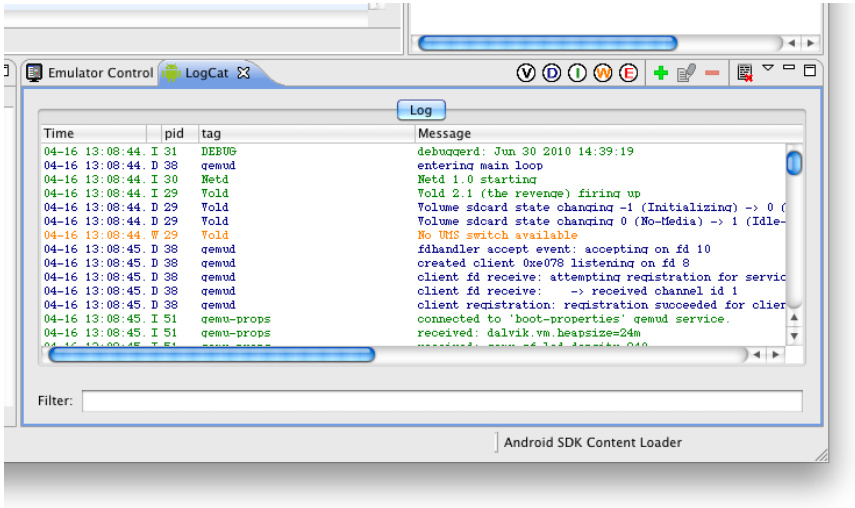
Enabling GPS on the Emulator

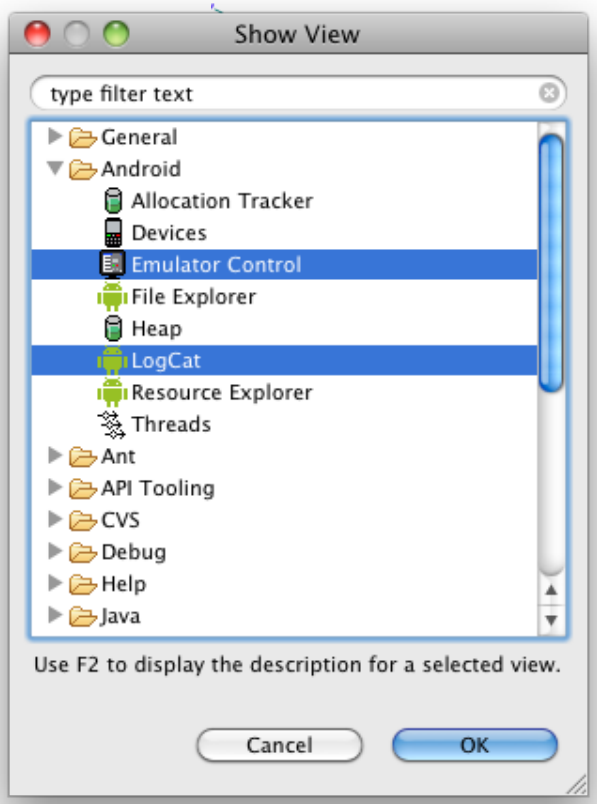


Eclipse Configuration

- LogCat View
  - Log.d output
- Emulator Control View
  - Entering locations



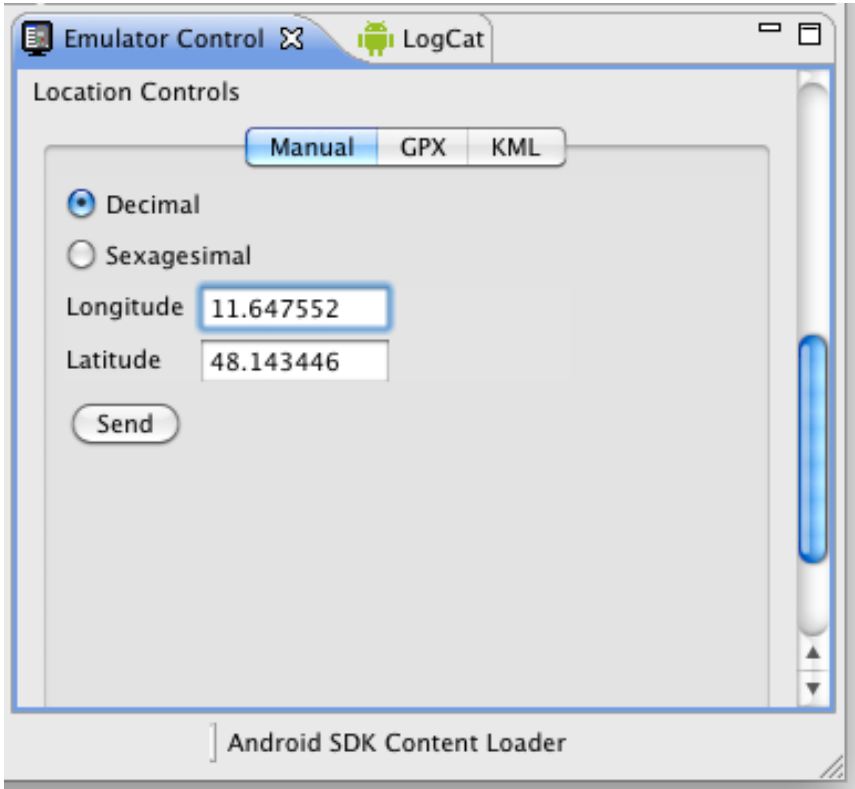




Entering Locations in Emulator Control View

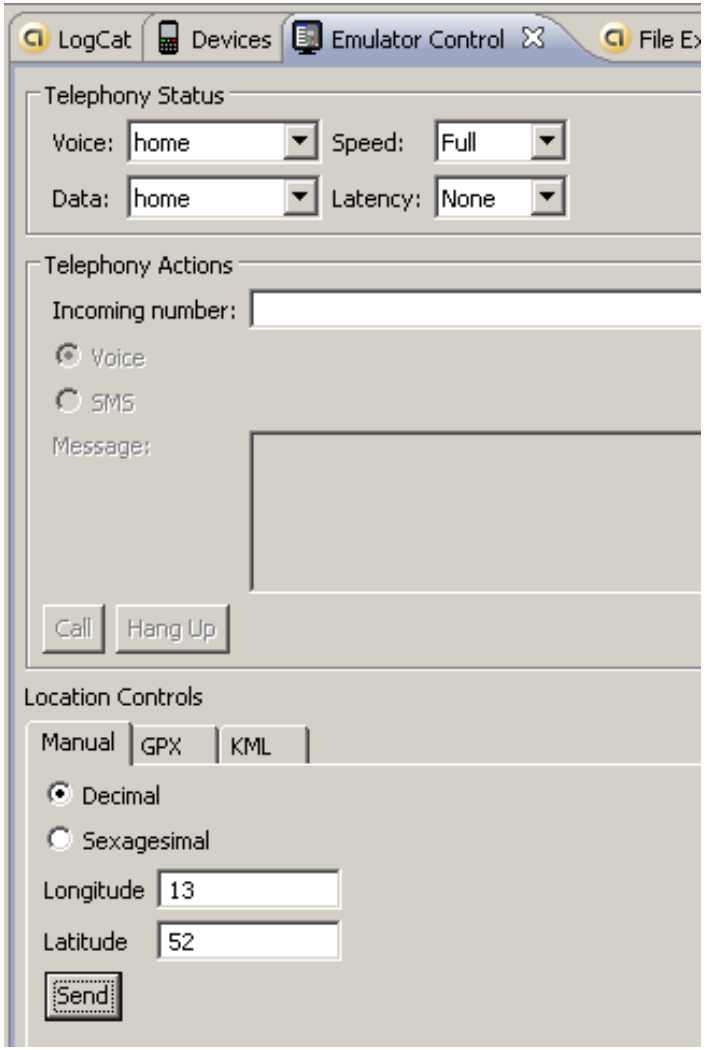
- How to get latitude and longitude?

  see next slides…



Simulated Location for the Emulator

- Dalvik Debug Monitor Service
- Play back GPS traces
  - GPX: GPS Exchange Format
  - KML: Keyhole Markup Language
- Telnet to a running emulator
  - telnet localhost <emulator port>
  - geo fix <lon> <lat>
  - geo nmea <nmea sentence>
- Example
  - telnet localhost 5554
  - geo fix 13 52
  - http://developer.android.com/intl/fr/guide/developing/tools/emulator.html



Keyhole Markup Language (KML)

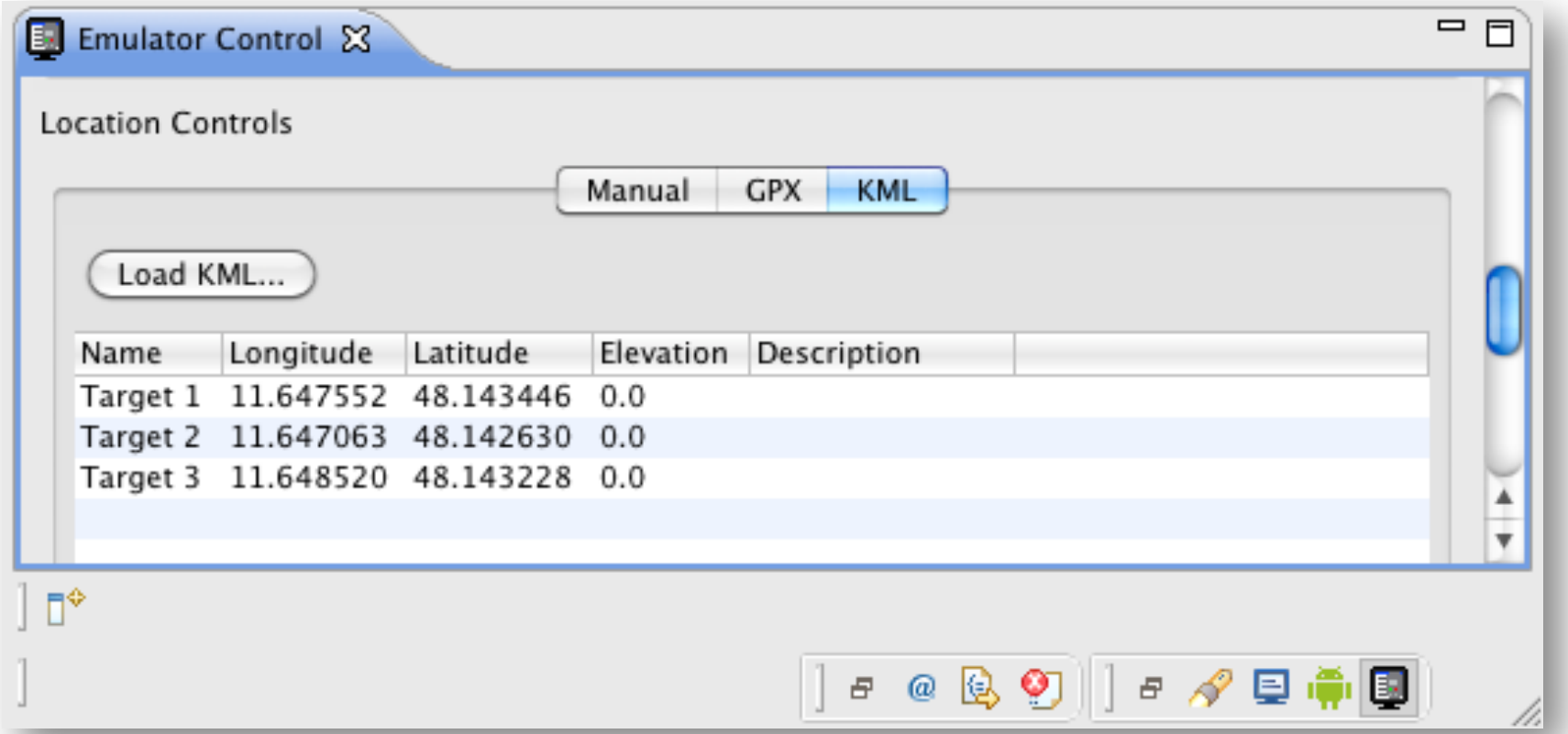
- XML-based language for expressing geographic information
  - Standardized by the Open Geospatial Consortium
  - Used in Google Maps (Mobile), Google Earth
- Example:

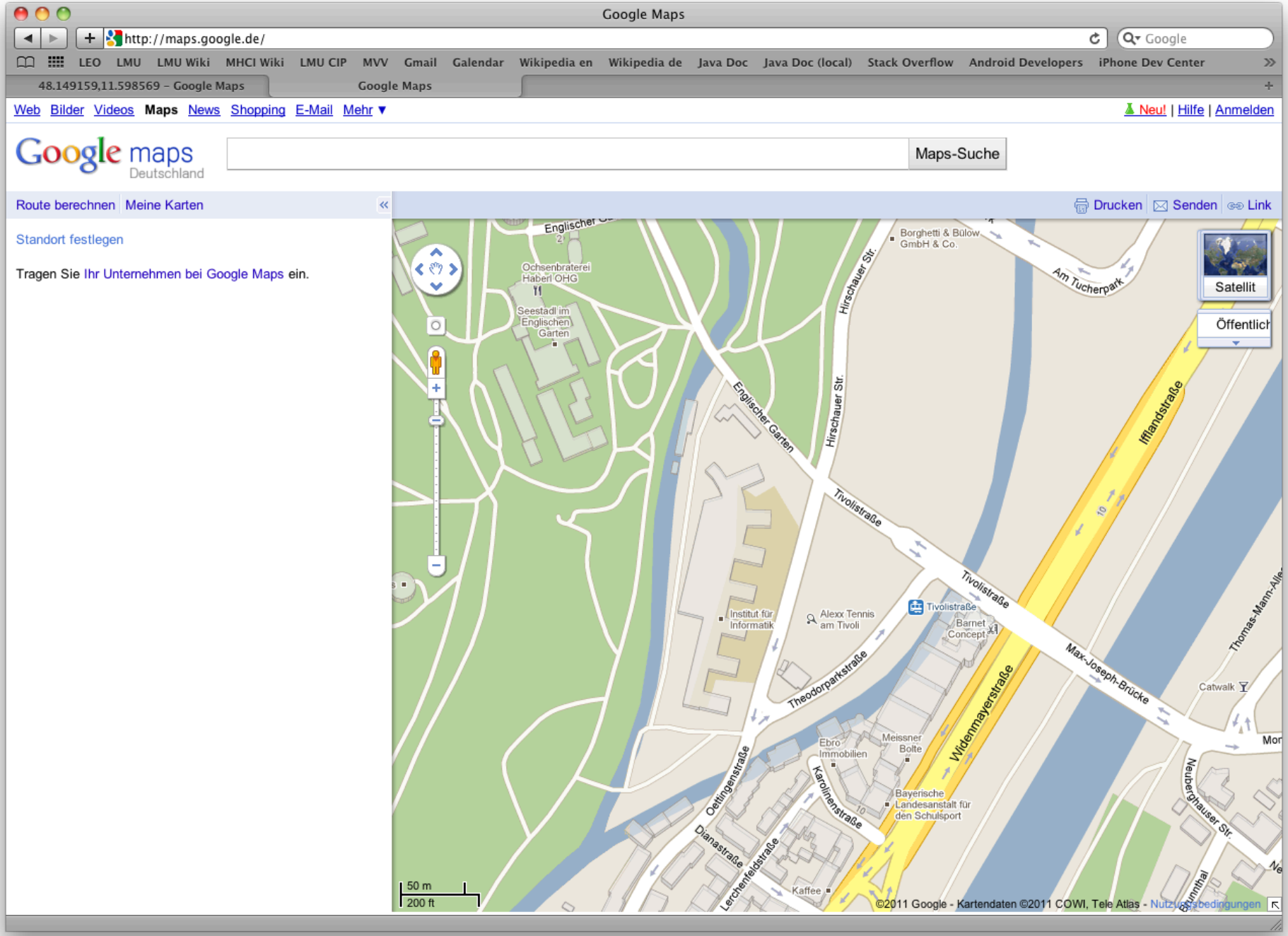
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.2">
  <Document>
    <Placemark>
      <name>Target 1</name>
      <description>This is the first target.</description>
      <Point>
        <coordinates>11.647552,48.143446,0</coordinates> <!-- longitude, latitude, altitude -->
      </Point>
    </Placemark>
  </Document>
</kml>
```

- Try it out: kml-samples.googlecode.com/svn/trunk/interactive/index.html

KML in the Emulator

- Click a row to send location to emulator




Google Maps
http://maps.google.de/
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Neu! | Hilfe | Anmelden
Google maps Deutschland
Maps-Suche
Route berechnen Meine Karten
Standort festlegen
Tragen Sie Ihr Unternehmen bei Google Maps ein.
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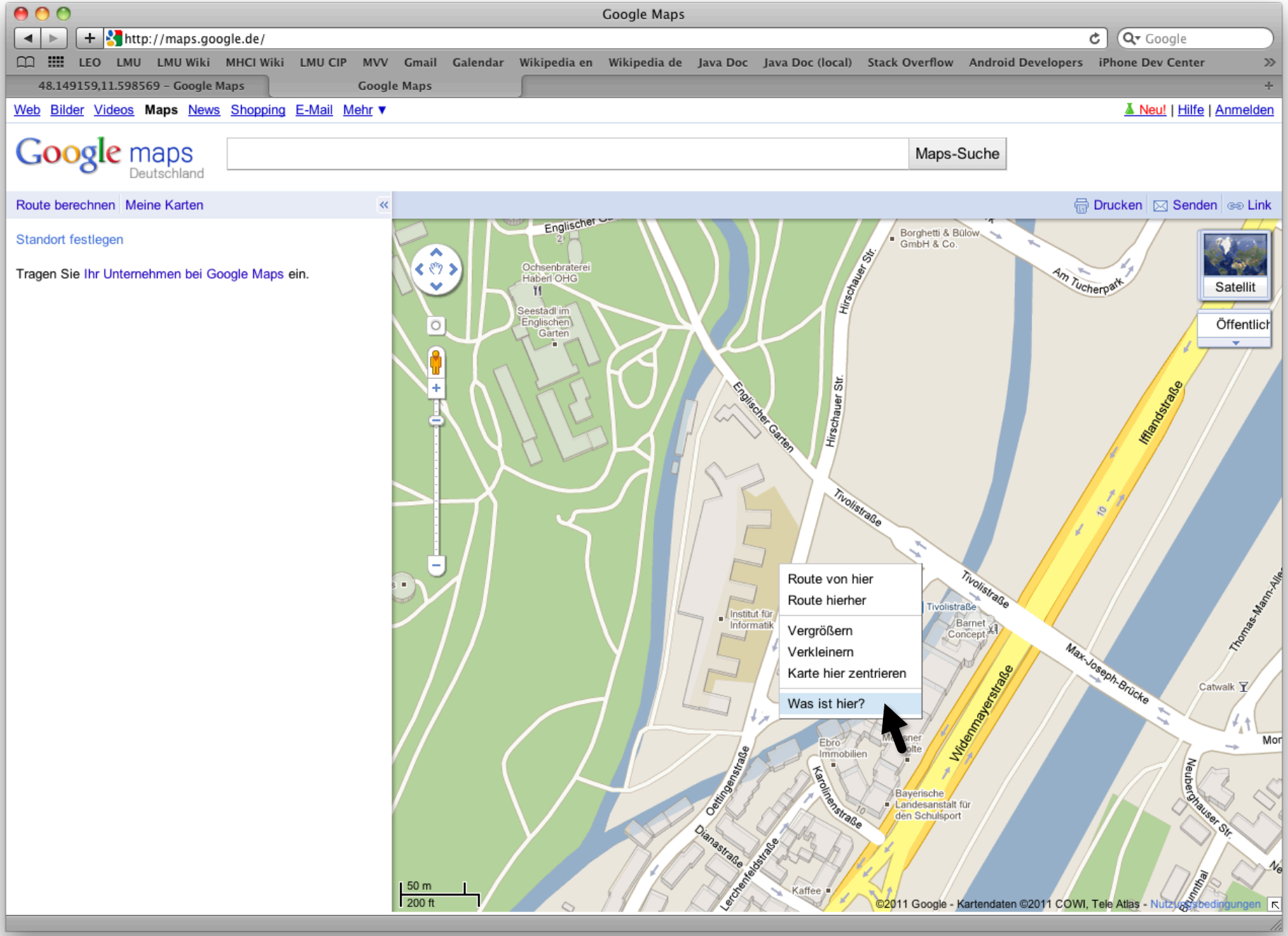
Hirschauer Str.
Am Tucherpark
Borghetti & Bülow GmbH & Co.
Ochsenbraterei Haberl OHG
Seestadl im Englischen Garten
Tivolistraße
Ifflandstraße
Institut für Informatik
Alexx Tennis am Tivoli
Barnet Concept
Theodorparkstraße
Max-Joseph-Brücke
Thomas-Mann-Allee
Catwalk
Widenmayerstraße
Ebro Immobilien
Meissner Bolte
Oettingenstraße
Karolinenstraße
Bayerische Landesanstalt für den Schulsport
Dianastraße
Lerchenfeldstraße
Kaffee
Neuberghauser Str.
Brunnthal
50 m
200 ft
©2011 Google - Kartendaten ©2011 COWI, Tele Atlas - Nutzungsbedingungen


Google Maps
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Karolinenstraße
Dianastraße
Lerchenfeldstraße
Neuberghauser Str.
Kaffee
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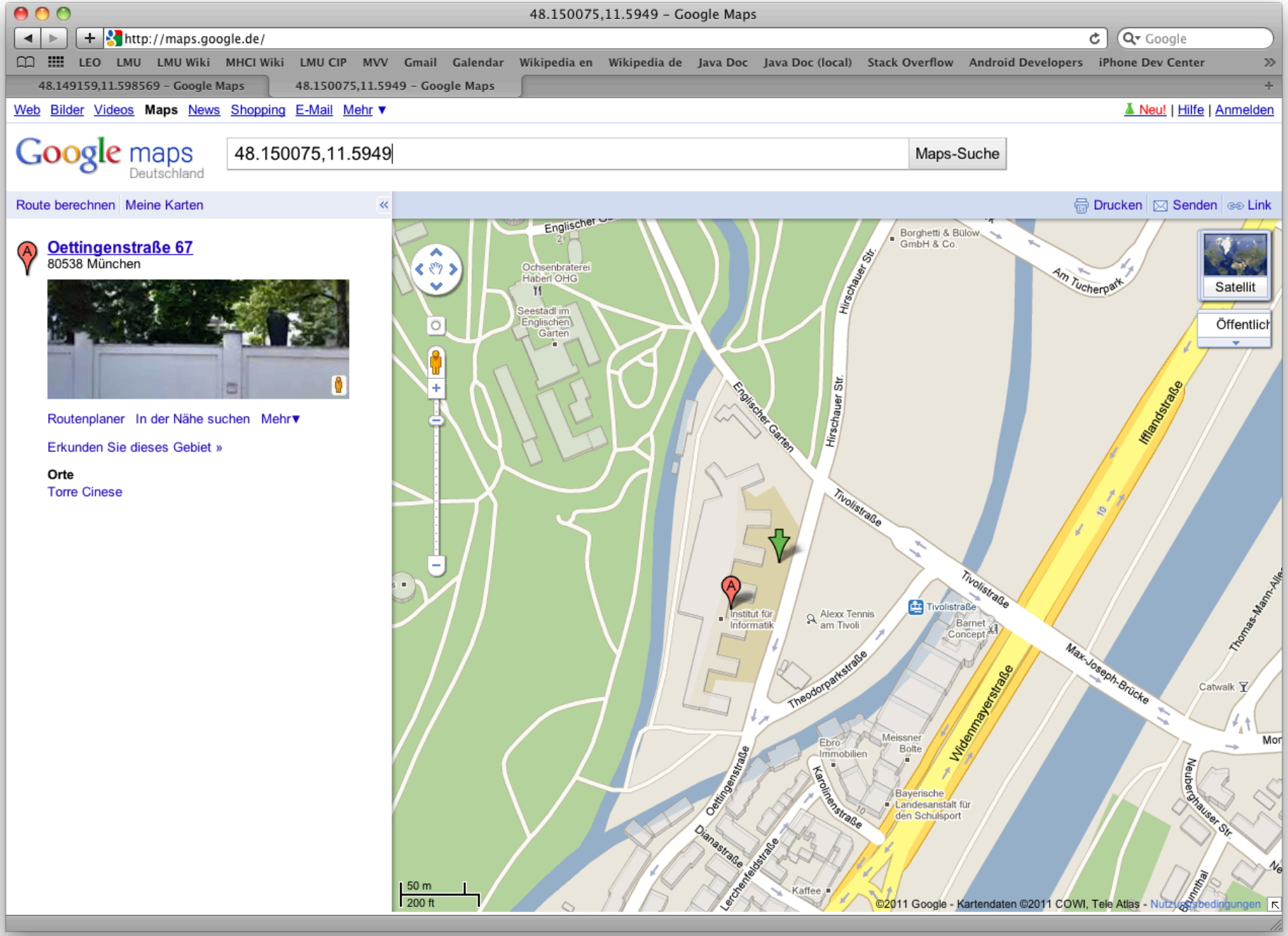
200 ft
©2011 Google - Kartendaten ©2011 COWI, Tele Atlas - Nutzungsbedingungen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Englischer Garten
Hirschauer Str.
Am Tucherpark
Ifflandstraße
Tivolistraße
Max-Joseph-Brücke
Theodorparkstraße
Widenmayerstraße
Oettingenstraße
Karolinenstraße
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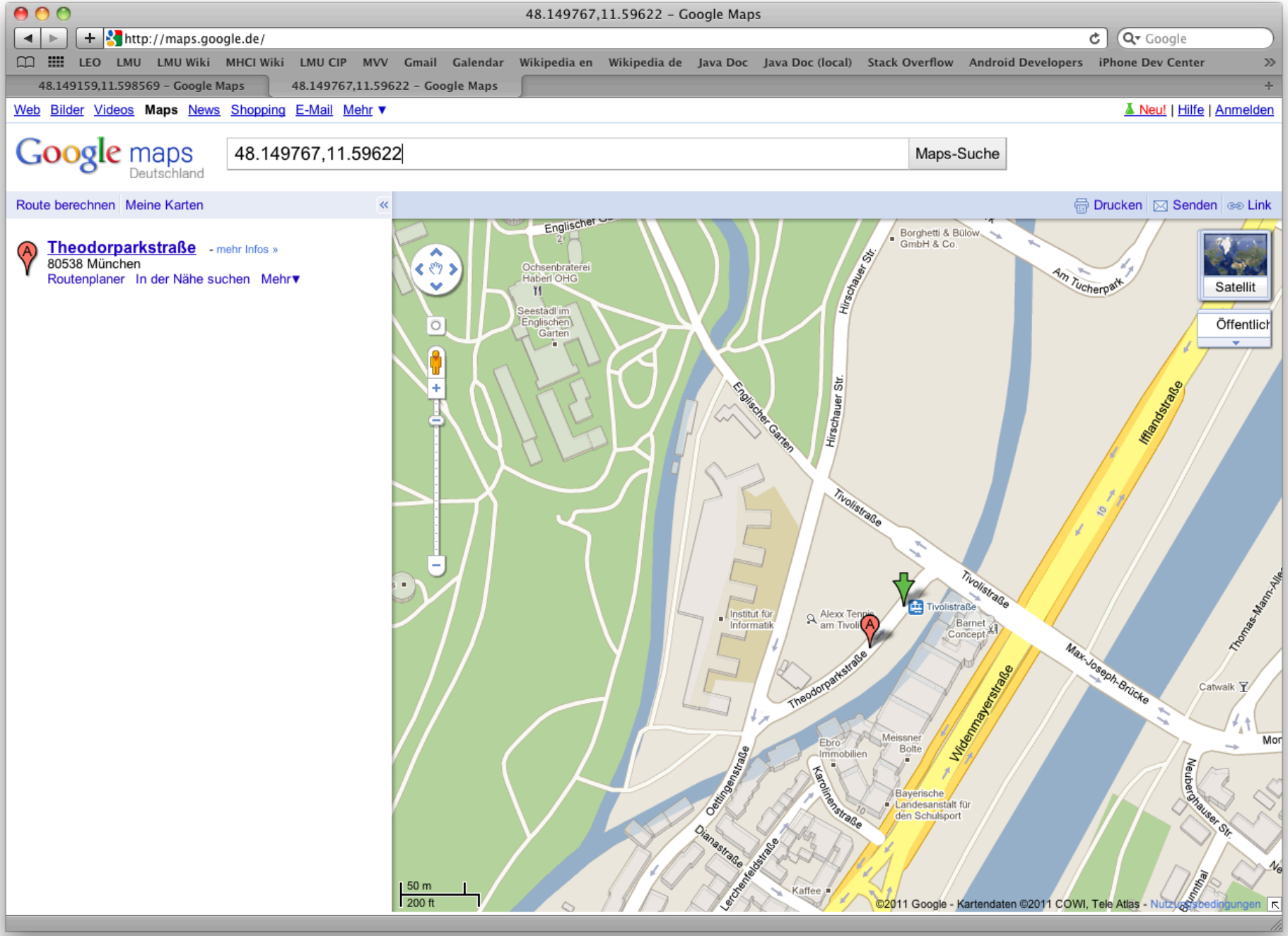
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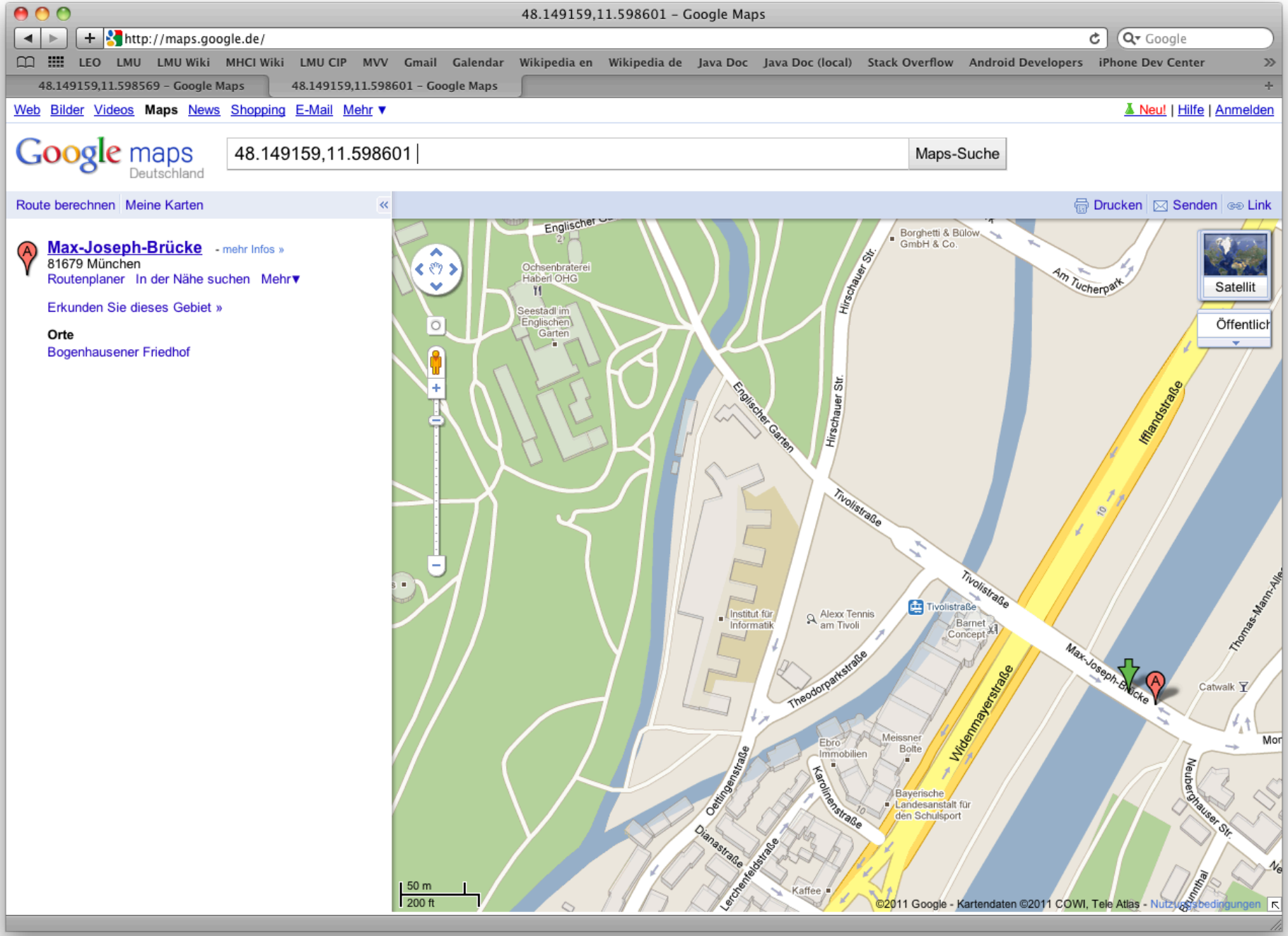
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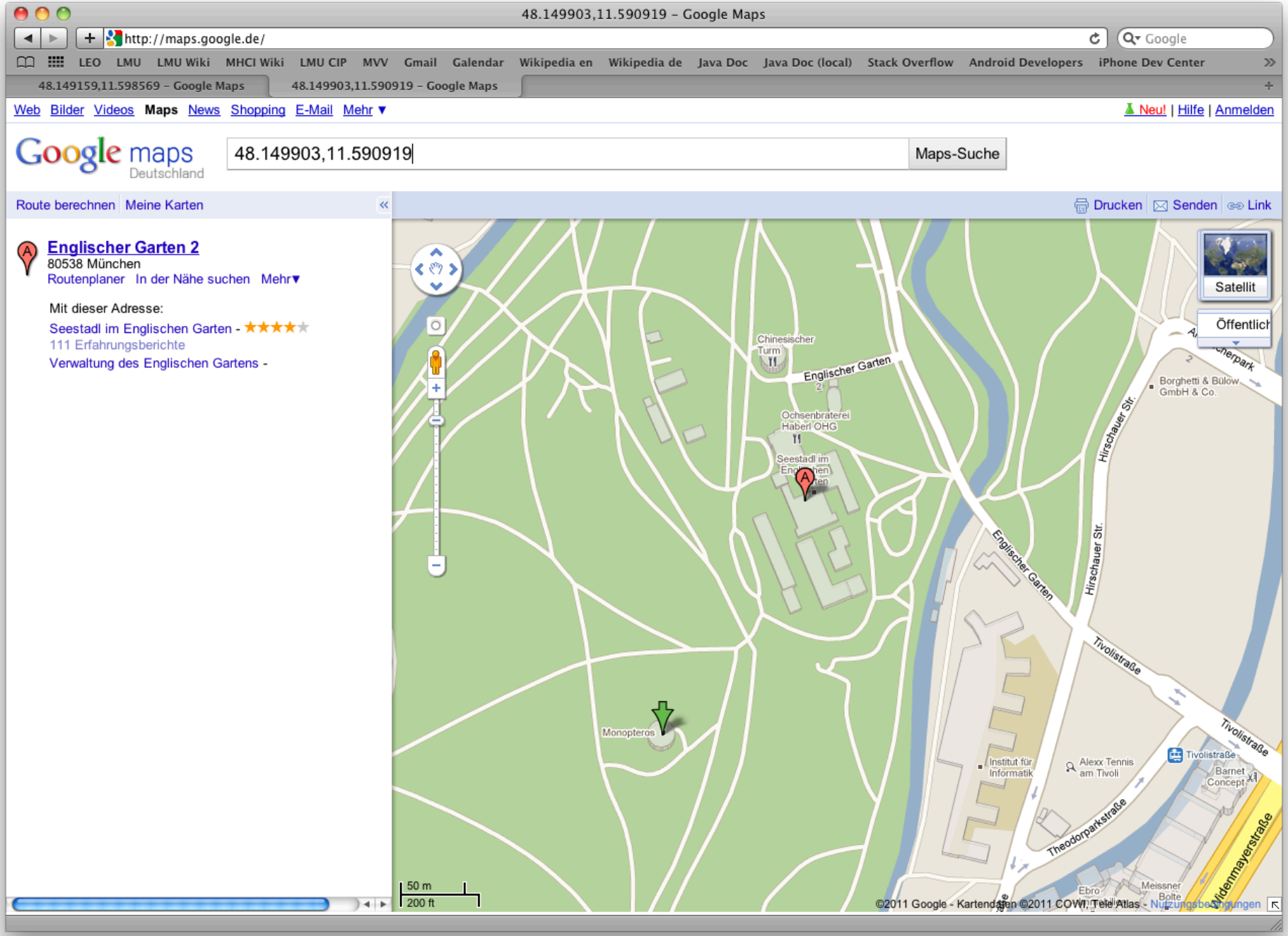
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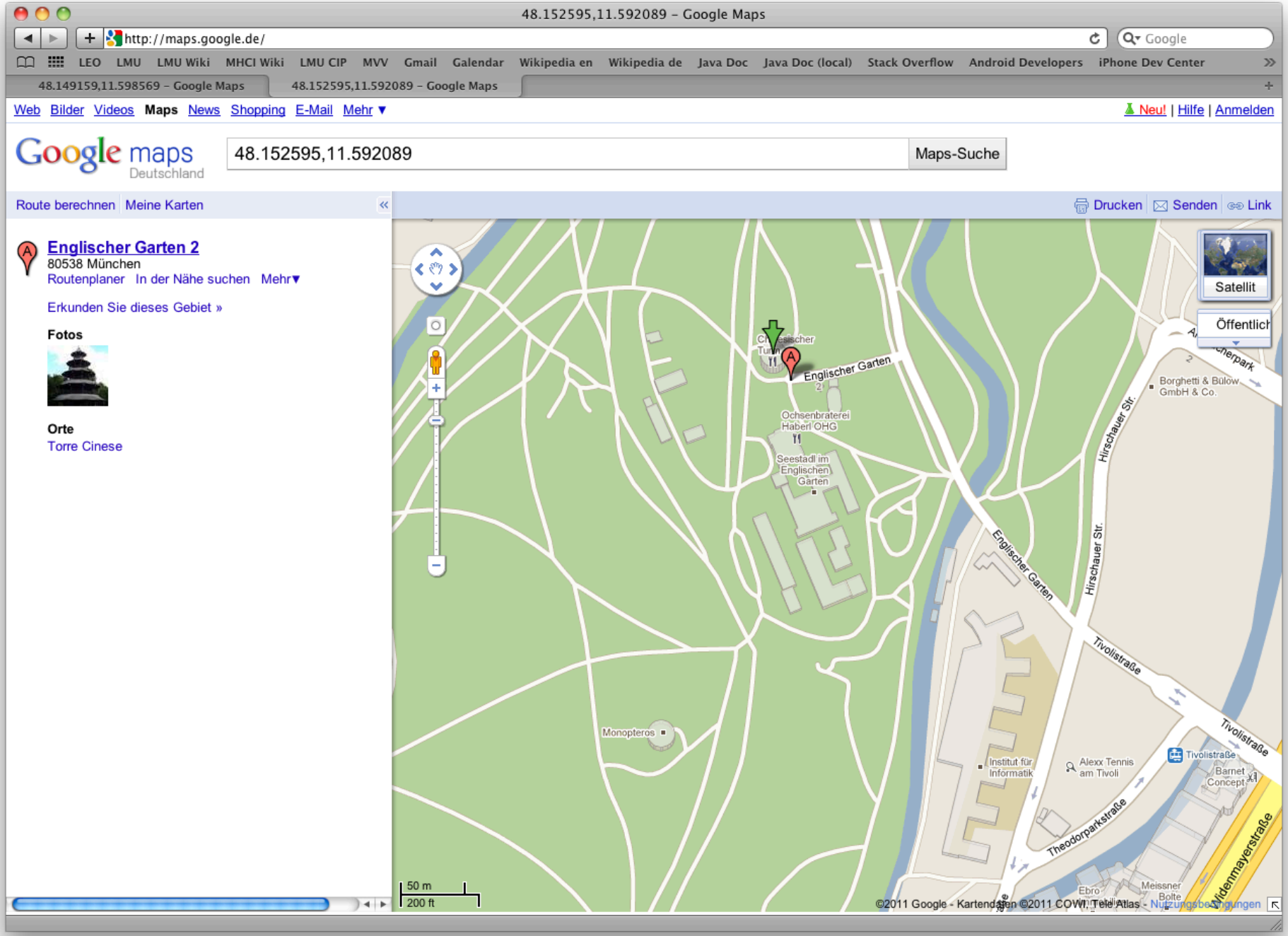
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Permissions (in AndroidManifest.xml)

- Permissions for location-based services

```
<uses-permission
  android:name="android.permission.ACCESS_COARSE_LOCATION" />
<uses-permission
  android:name="android.permission.ACCESS_FINE_LOCATION" />
<uses-permission
  android:name="android.permission.ACCESS_MOCK_LOCATION" />
<uses-permission
  android:name="android.permission.ACCESS_LOCATION_EXTRA_COMMANDS" />
<uses-permission
  android:name="android.permission.INTERNET" />
```

- Overview of Android permissions
  - http://developer.android.com/reference/android/Manifest.permission.html

Example Manifest for Location

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="de.lmu.location"
    android:versionCode="1"
    android:versionName="1.0">
  <uses-sdk android:minSdkVersion="8" />
  <application android:icon="@drawable/icon" android:label="@string/app_name" android:debuggable="true">
    <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>
  <uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />
  <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
  <uses-permission android:name="android.permission.ACCESS_MOCK_LOCATION" />
  <uses-permission android:name="android.permission.ACCESS_LOCATION_EXTRA_COMMANDS" />
  <uses-permission android:name="android.permission.VIBRATE" />
</manifest>
```

Distance Between Geo-Locations

- Distance (in m) between two geolocations

```
float[] results = new float[1];
Location.distanceBetween(lat, lon, poi.latitude, poi.longitude, results);
float distance = results[0];
```

Exercise: Location Updates

- Register for location updates from the location manager with an interval of 5s.
  - Only register for location updates when the MainActivity is actually active (i.e. use onResume and onPause to register/ unregister updates).
- Handle location updates in the MainActivity itself
  - See next slide for template
- Start ShowQuizActivity if the user enters a POI
  - Put POI data structure into Intent-extra

Template for Location Updates

```
public class MainActivity extends Activity implements LocationListener {
    LocationManager locationManager = null;
    …
    public void onLocationChanged(Location location) {
        if (location != null) {
            // process location update
        }
    }
    public void onProviderDisabled(String provider) {}
    public void onProviderEnabled(String provider) {}
    public void onStatusChanged(String provider, int status, Bundle ext) {}
}
```

How to vibrate the phone?

- Java

```
Vibrator vibrator = (Vibrator) getSystemService(Context.VIBRATOR_SERVICE);
vibrator.vibrate(1000);
```

- AndroidManifest.xml

```
<uses-permission android:name="android.permission.VIBRATE" />
```

- Exercise: Make the phone vibrate when the Quiz starts (i.e. when the user enters the target area)

Exercise: Field Test

- Try out your program outdoors

- Come back and improve it
- Find test users to evaluate your program
- Improve it some more…

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