LFE Medieninformatik • Prof. Dr. Heinrich Hußmann (Dozent), Alexander De Luca, Gregor Broll (supervisors)

Praktikum Entwicklung von Mediensystemen mit Android

Introduction to Android

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Outline

- Schedule
- Organizational Stuff
- Introduction to Android
- Exercise 1

Schedule

- Two phases: individual and team phase
- Phase 1 – Individual Phase:
  - Introduction to basics about Android
  - Exercises 1 to 4
  - Each student works on exercises himself/herself
  - Weekly meetings
- Phase 2 – Project Phase:
  - Concept and implementation of an Android application
  - Students work in teams
  - Regular milestone meetings

Timeline

Date	Topic / Activity
29.04.2009	Introduction to Android
06.05.2009	Implementing a User Interface
13.05.2009	Storing, Retrieving and Exposing Data
20.05.2009	Brainstorming, Application Design
27.05.2009	Project Phase Starts
17.06.2009	1st Milestone Meeting
08.07.2009	2nd Milestone Meeting (Preparation for User Study)
29.07.2009	Final Presentation, End of Practical

Organizational Stuff I

- 4 SWS
- Weekly meetings
  - Wednesday, 10:00 (s.t.) - 12:00
  - Room 107, Amalienstraße 17

- Homepage:
  - http://www.medien.ifi.lmu.de/lehre/ss09/pem

Organizational Stuff II

- Students work in teams
- SVN accounts for each team
  - svn://murx.medien.ifi.lmu.de/ss09/pem/team[number] (e.g. svn://murx.medien.ifi.lmu.de/ss09/pem/team1)
- Students check their exercises in with their group‘s SVN repository

- Needed Accounts
  - SVN username

Teams

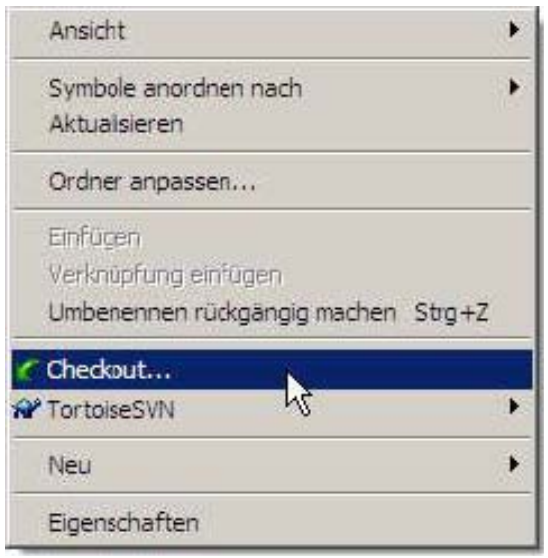
- Team 1
  - Daniel Kaltenthaler
  - Katrin Mekker
- Team 2
  - Matthias Hoyer
  - Sonja Rümelin
  - Henri Palleis
- Team 3
  - Mihai Gottschling
  - Nina Hubig

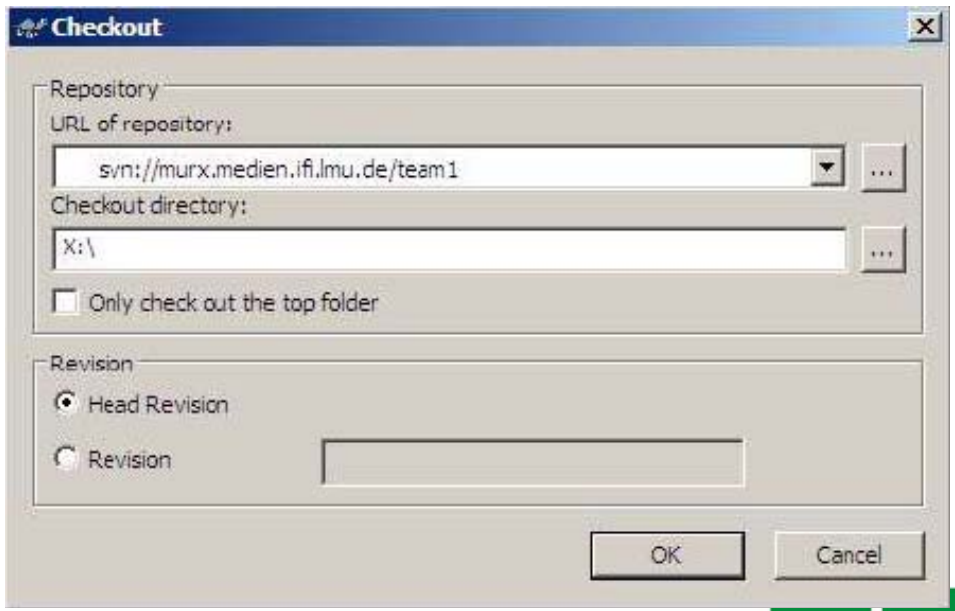
Technology – SVN I

- SVN - General
  - Version control system
  - Enables collective editing of shared source code
  - Data stored in a „Repository“ which is accessed over the network
  - Editing on local copies of the files
  - Old version available on the server
  - When possible, files will be merged automatically when edited by multiple users at the same time
  - Similar to CVS

Technology – SVN II

- SVN – First Steps (using Tortoise SVN)
  1. Download a SVN Client like Tortoise SVN for Windows
     http://tortoisesvn.net/
  2. Checkout your team repository (creates a local copy of the repository)
     Create an empty folder, open it, right-click and choose „Checkout“.





Technology – SVN III

- SVN – First Steps (using Tortoise SVN)
  3. Each time you start working perform the “Update“ command.
  4. Each time you‘re done working perform a “Commit”. Both commands are located in the right-click menu.
  5. Further functionalities are available in the right-click menu like “delete“, “rename“ and more.
     Attention: Do not use the OS-functionalities for this functions.

For further Information read the German SVN introduction by Richard Atterer, which can be found here:
http://www.medien.ifi.lmu.de/fileadmin/mimuc/mmp_ss04/Projektaufgabe/mmp-subversion.pdf

An Introduction to Android - Outline

- What is Android?
- Installation
- Getting Started
- Anatomy of an Android Application
- Life Cycle of an Android Application

What is Android?

- Released in Nov. 2007 – rumored to be some kind of GPhone
- Open, free mobile platform with a complete software stack
  - Operating system
  - Middleware
  - Key mobile applications
- Developed by the Open Handset Alliance
- Built on the open Linux kernel
- Custom Dalvik virtual machine for mobile environments
- Applications written in Java
- Open source; Apache v2 open source license
- Applications can access all core functionalities of a mobile device
- No differentiation between core and 3rd party applications
- Can be extended to incorporate new technologies

Open Handset Alliance

- Group of more than 30 technology and mobile companies led by Google
  - Mobile Operators, e.g. China Mobile, KDDI, NTT DoCoMo, T-Mobile, Sprint Nextelk, Telefonica
  - Semiconductor Companies, e.g. Broadcom, Intel, Nvidia, Qualcomm, SiRF, Texas Instruments
  - Handset Manufactureres, e.g. HTC, LG, Motorola, Samsung
  - Software Companies, e.g. eBay, Google,
- Goal: „*to accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience* “
- Android as the first project towards an open and free mobile experience, but also commercial deployment
- URL: www.openhandsetalliance.com/index.html

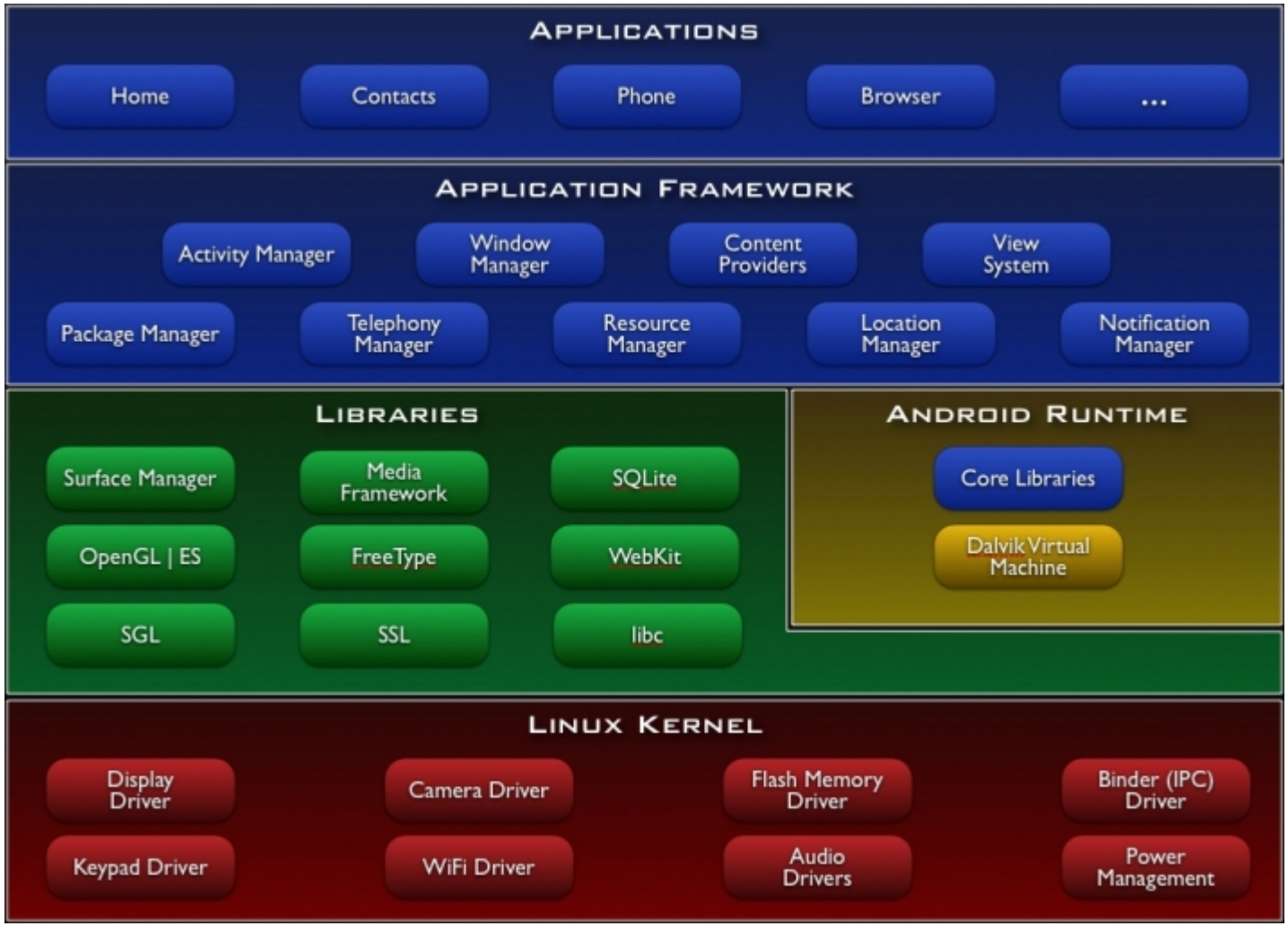
Source: www.openhandsetalliance.com/

Android Features

- **Application framework** enabling reuse and replacement of components
- **Dalvik virtual machine** optimized for mobile devices
- **Integrated browser** based on the open source WebKit engine
- **Optimized graphics** powered by a custom 2D graphics library; 3D graphics based on the OpenGL ES 1.0 specification (hardware acceleration optional)
- **SQLite** for structured data storage
- **Media support** for common audio, video, and still image formats (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF)
- **GSM Telephony** (hardware dependent)
- **Bluetooth, EDGE, 3G, and WiFi** (hardware dependent)
- **Camera, GPS, compass, and accelerometer** (hardware dependent)
- **Rich development environment** including a device emulator, tools for debugging, memory and performance profiling, and a plugin for the Eclipse IDE

Source: http://code.google.com/android/index.html

Android Architecture



Source: http://developer.android.com

Linux Kernel

- Linux kernel version 2.6
- Abstraction layer between hardware and the software stack
- Core services
  - Security
  - Memory management
  - Process management
  - Network stack
  - Driver model

Source: http://developer.android.com

Libraries

- C/C++ libraries used by various Android components
- Developers can use their capabilities through the application framework
- Includes:
  - Media Libraries: includes MPEG4, H.264, MP3, JPG, PNG, ...
  - WebKit/LibWebCore: web browser engine
  - SQLite: relational database engine
  - Libraries/engines for 2D and 3D graphics

Source: http://developer.android.com

Android Runtime

- Core libraries provide Java functionalities
- Dalvik virtual machine relies on Linux kernel for e.g. threading or low-level memory management
- Devices can run multiple Dalvik VMs, every Android application runs with its own instance of Dalvik VM
- VM executes optimized Dalvik Executable files (.dex)
- Dx-tool transforms compiled Java-files into dex-files

Source: http://developer.android.com

Applications / Application Framework

- Core applications, e.g. contacts, mail, phone, browser, calender, maps, ...
- Full access to all framework APIs for core applications
- Simplified reuse of components
- Applications written in Java

Source: http://developer.android.com

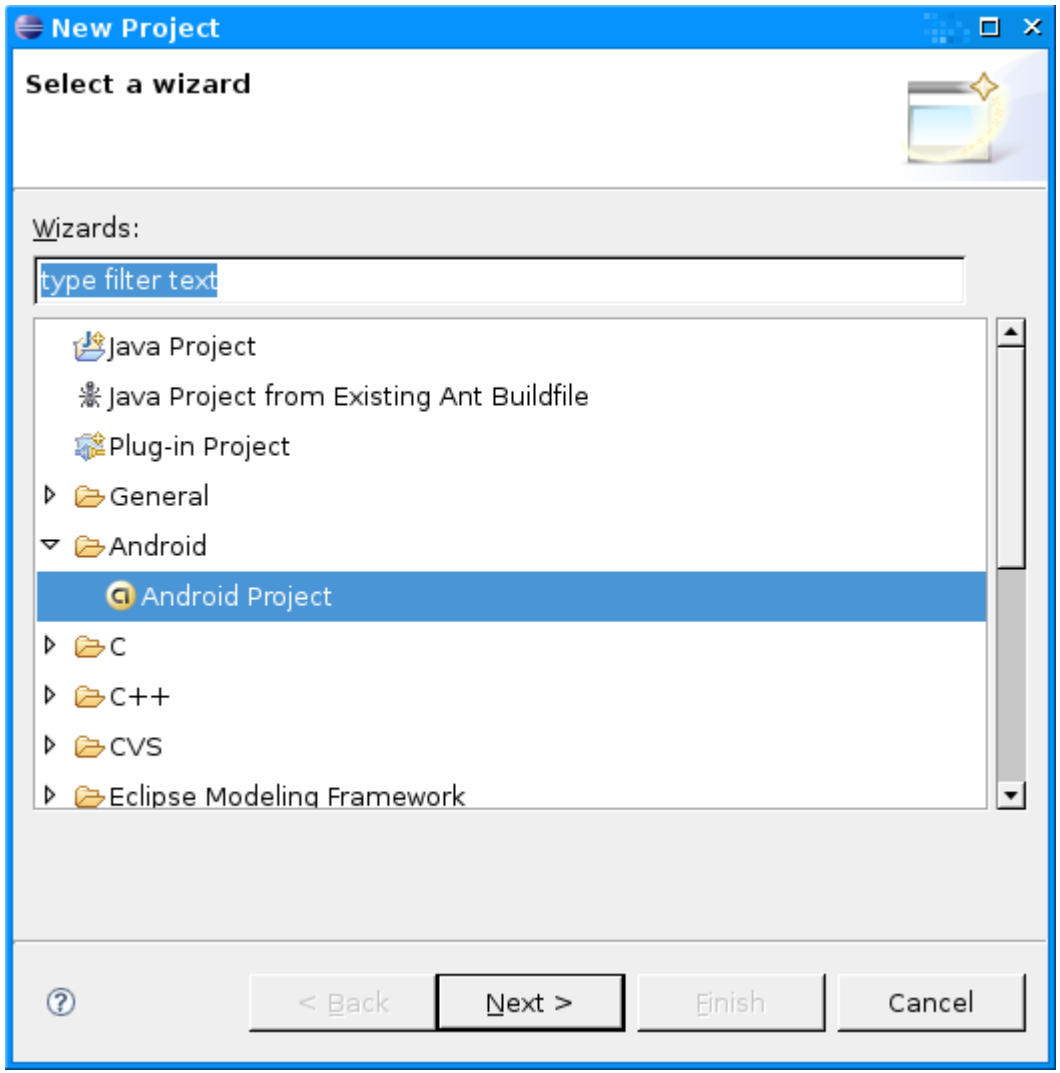
Core Android Packages

- android.util
  - contains various low-level utility classes, such as specialized container classes, XML utilities, etc.
- android.os
  - provides basic operating system services, message passing, and inter-process communication.
- android.graphics
  - is the core rendering package.
- android.text, android.text.method, android.text.style, and android.text.util
  - supply a rich set of text processing tools, supporting rich text, input methods, etc.
- android.database
  - contains low-level APIs for working with databases.
- android.content
  - provides various services for accessing data on the device: applications installed on the device and their associated resources, and content providers for persistent dynamic data.
- android.view
  - is the core user-interface framework.
- android.widget
  - supplies standard user interface elements (lists, buttons, layout managers, etc) built from the view package.
- android.app
  - provides the high-level application model, implemented using Activities.

Installing and Using the Android SDK

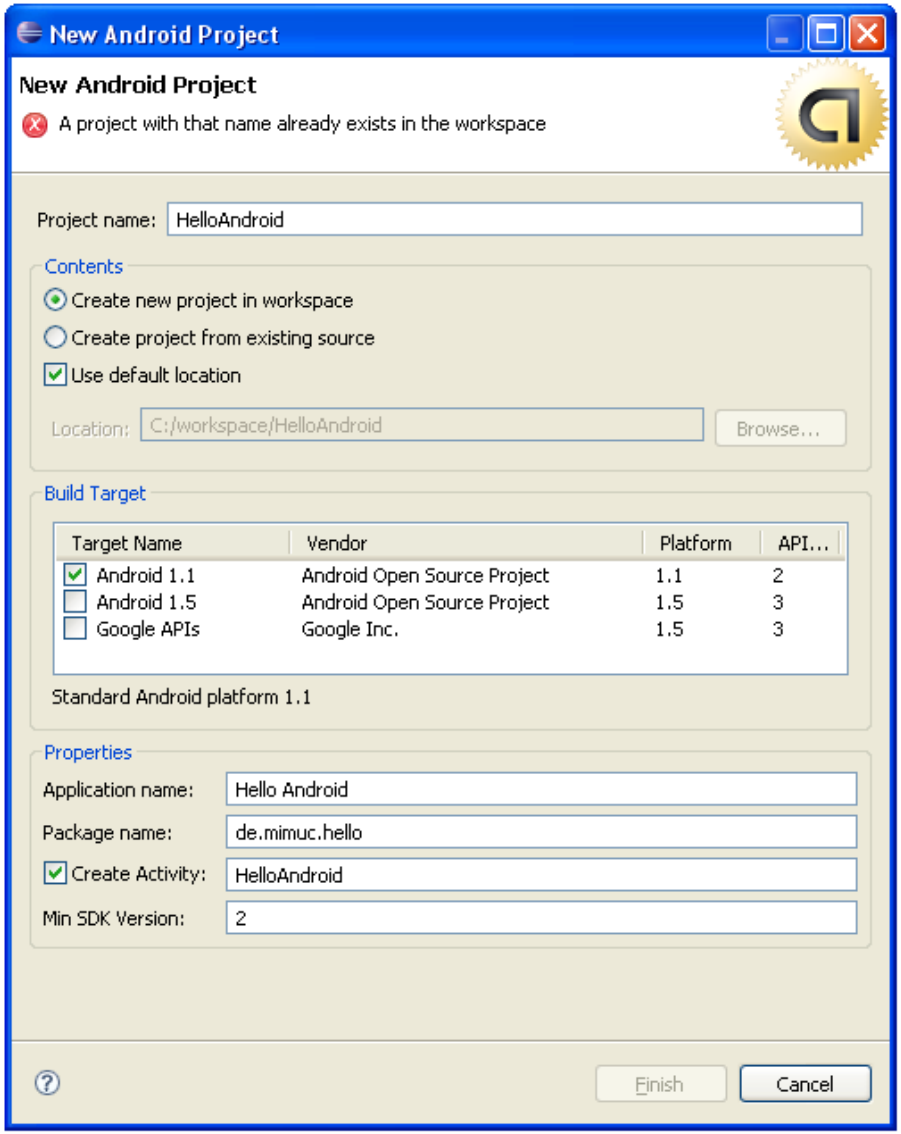
- Please follow instructions from the Android doc
  http://developer.android.com/sdk/1.5_r1/installing.html
- Download and install the Android SDK
- SDK includes documentation, tools and examples
- Set up your IDE; Eclipse (Java EE) recommended
- Install Eclipse Android Development Tools (ADT) plugin, connect it with the Android SDK
- Create an Android project
  - Standard Eclipse procedure
- Set up a launch configuration
  - Run application from menu or
  - Define settings for run configuration (project, activity, emulator options, ...) from Run > Open Run Dialog >
- Run Android application in emulator

Hello Android I



Source: http://developer.android.com

Hello Android II



Hello Android III

```
package com.android.hello;

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 icicle) {
        super.onCreate(icicle);
        TextView tv = new TextView(this);
        tv.setText("Hello, Android");
        setContentView(tv);
    }
}
```

Source: http://code.google.com/android/index.html

Hello Android IV

Source: http://developer.android.com

Anatomy of an Android Application

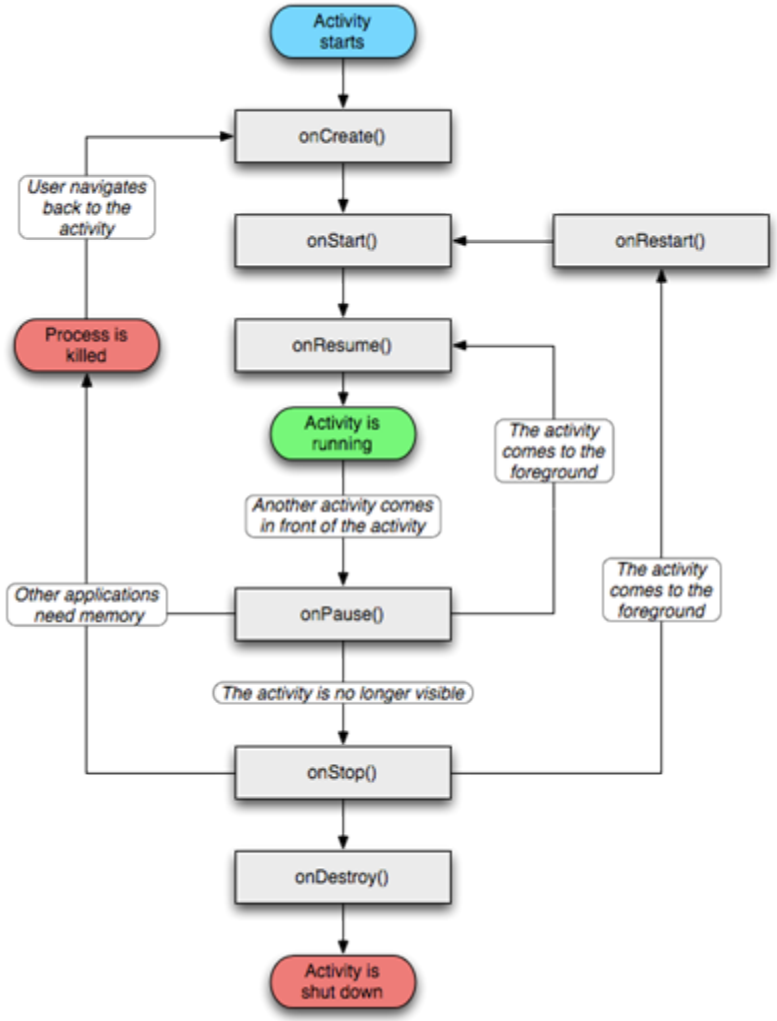
- 4 main building blocks for Android applications
  - Activity
  - Broadcast Receiver
  - Service
  - Content Provider
- AndroidManifest.xml lists all components of an application, their capabilities and requirements

```
<?xml version="1.0" encoding="utf-8"?>

<manifest xmlns:android="http://schemas.android.com/apk/res/android"
        package="com.my_domain.app.helloactivity">

    <application android:label="@string/app_name">

        <activity android:name=".HelloActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN"/>
                <category android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>

    </application>

</manifest>
```

Source: http://code.google.com/android/index.html

Activity

- Single, focused thing or task
- Extends the Activity base class
- Refers to a single screen in a (multi-screen) application
- Displays a UI, interacts with user, responds to events
- 2 main methods:
  - onCreate(Bundle): initialization of activity, set UI, ...
  - onPause(): leaving an activity
- Moving through screens by starting other activities
- Activities managed by activity stack
- New activity put on top of the stack
- 4 states: active/running, paused, stopped, killed/shut down



Source: http://developer.android.com

Intents and Intent Filters

- Intent
  - Abstract description of an operation/action to be performed
  - Mostly used for launching activities; “glue between activities”

- Intent Filter
  - Describes what Intents an activity can handle
  - Activities publish Intent Filters describing their capabilities/ how they can handle certain Intents and their actions
  - Navigating between screens is accomplished by resolving Intents => system matches Intents and Intent Filters
  - Activity calls method startActivity(myIntent)

Broadcast Receiver, Service, Content Provider

- Broadcast Receiver
  - Used to execute code upon an external event, e.g. phone rings
  - Usually no UI; may use the NotificationManager
- Service
  - Application component running in the background
  - Runs indefinitely, no UI, no interaction with user
  - E.g. media player
- Content Provider
  - Used to share data with other applications

Life Cycle of an Android Application

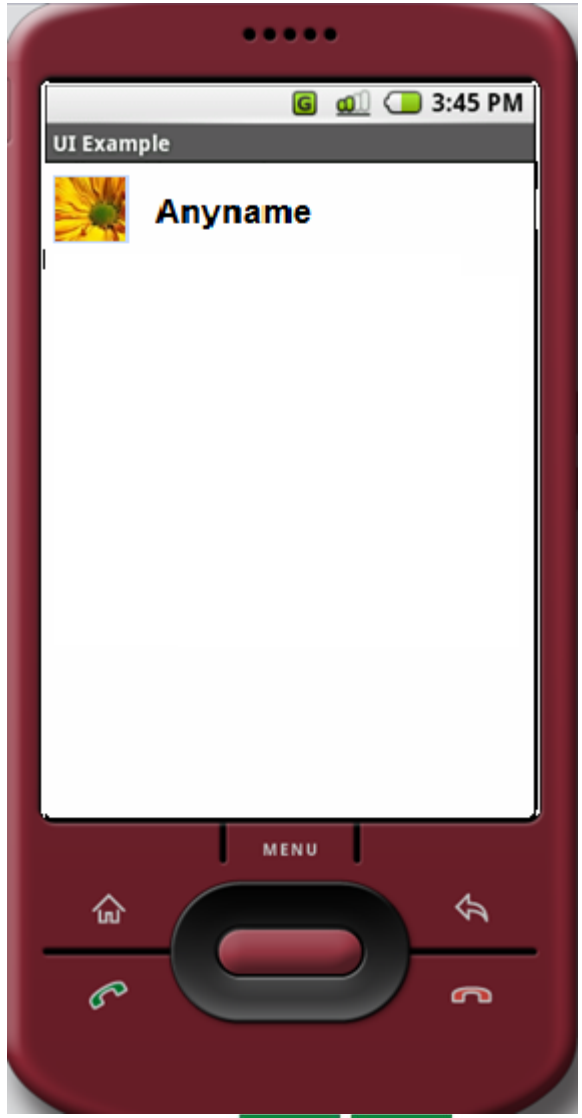
- Each Android application runs in its own Linux process
- Process's lifetime not directly controlled by application
- Determined by the system, depending on running applications, their importance, available memory
- Components (Activity, Service, Broadcast Receiver) impact the lifetime of the application's process
- Importance hierarchy for killing processes based on
  - Components running in them
  - The state of these components

Android's Importance Hierarchy

1. Foreground Process
   - Required for current user activities
   - E.g. running an Activity at the top of the screen
2. Visible Process
   - Activity is visible but not in the foreground (onPause())
   - E.g. previous activity displayed behind a foreground dialog
3. Service Process
   - Holds a Service, not directly visibleE.g. media player, network up/download
4. Background Process
   - Holds an Activity that is currently not visible (onStop())
   - Can be killed at any time to reclaim memory
5. Empty Process
   - Holds no active application components

Exercise 1

- Follow the Hello Android example
- Add a picture to the „Hello Android“-text
- Submit your solution using SVN
  - Create your personal folder „nachname“ in the SVN-repository of your group
  - Create a folder for each exercise named „exerciseX“ and put all necessary source files there
- **Submit your solution until Tuesday, 05.05.09, 12p.m.**



Source: http://code.google.com/android/index.html

Testing on the Phone

- Apps can be directly tested and debugged on the G1
- For USB drivers see http://developer.android.com/guide/developing/device.html

Links

- Android website: http://developer.android.com/
- Android SDK download: http://developer.android.com/sdk/1.5_r1/index.html

Questions?
Have Fun!