APPLICATION PROGRAMMING: MOBILE COMPUTING [INEA00112W]

Marek Piasecki PhD

Android OS Introduction (W2/2014)

Choose yourself and new technologies

HUMAN CAPITAL
HUMAN – BEST INVESTMENT!

Wrocław University of Technology

EUROPEAN SOCIAL FUND

Project co-financed from the EU European Social Fund

Android

- A software platform and OS for mobile devices
- Based on the Linux kernel
- Developed by Google and later the Open Handset Alliance (OHA) consisting of mobile operators, semiconductor companies, handset manufacturers, software companies, …
- Software installed by end-users must be written in Java, and will not have access to lower level device API's
- Android market: http://www.android.com/app
  https://play.google.com

Open Handset Alliance

- In the year 2007, 34 companies, including Google, have formed an **alliance to promote Android** and to develop features and handsets to take advantage of the platform. At the moment over **78 companies**.
- Includes handset **manufacturers** such as: LG, HTC, Motorola and Samsung, chip firms such as Qualcomm and **mobile operators** like T-Mobile and China Mobile.
- **None** of the handset partners in the alliance has **abandoned existing** platforms in favour of Android
- http://www.openhandsetalliance.com/

Example Android Phones ’2009

HTC G1, Droid, Tattoo

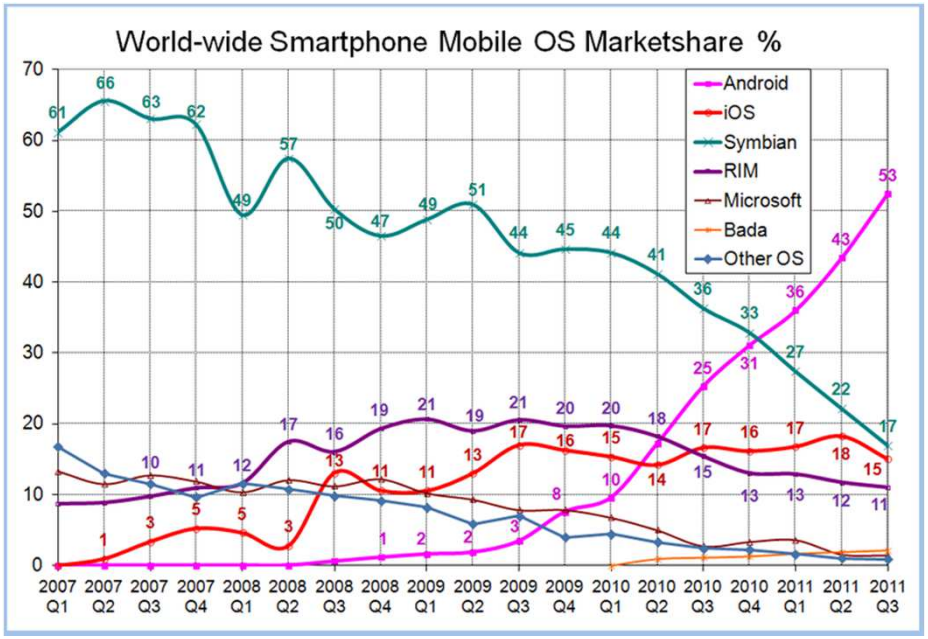
Motorola Droid (X)

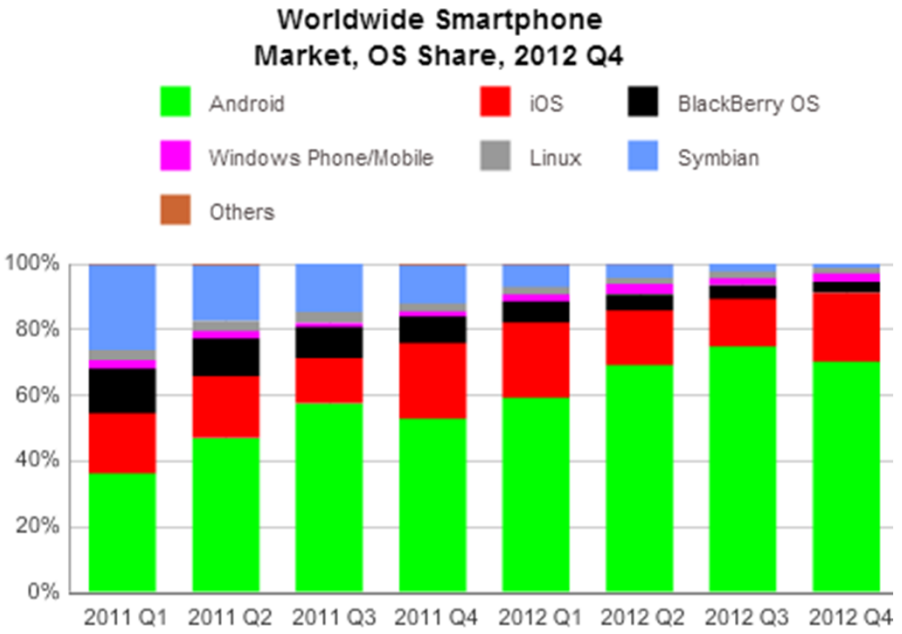
Suno S880

Sony Ericsson X10

Samsung Galaxy

Evolution in MarketShare





market share of **75%** at the end of 2012, with **500 million** devices activated in total, **1.3 million** activations per day

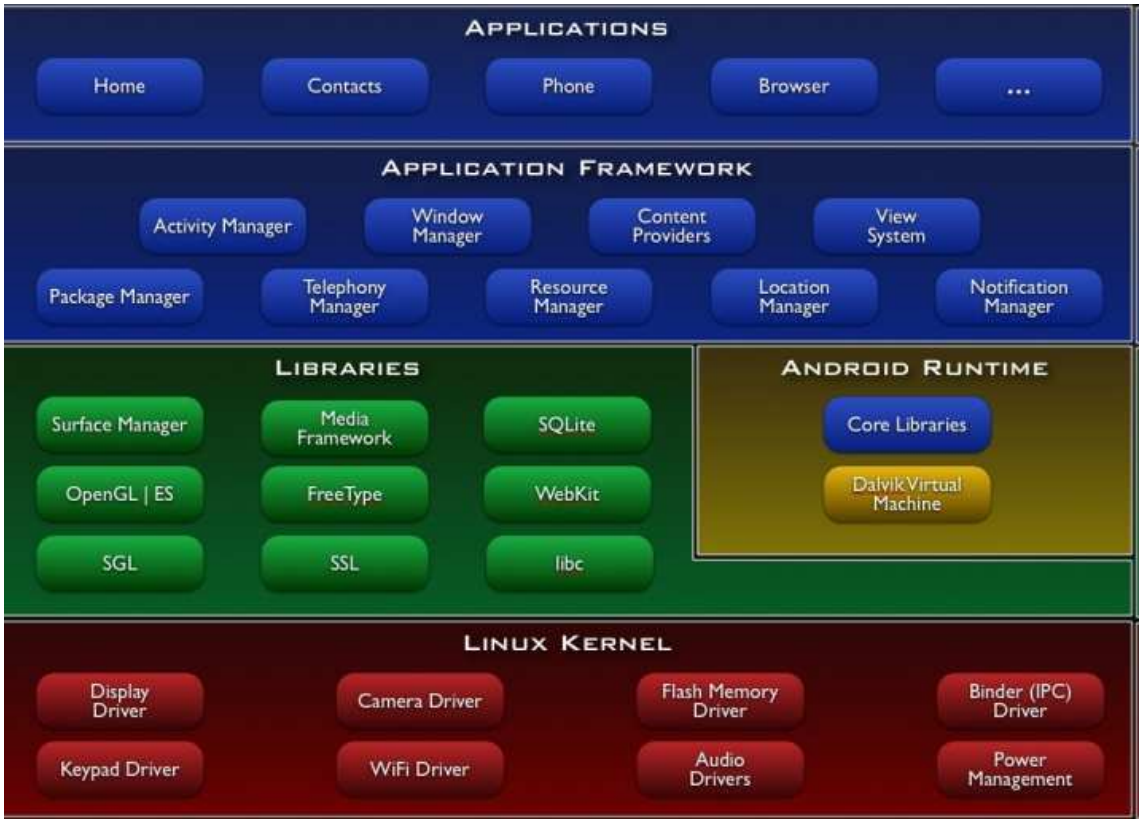
Open Source ?

(from: Android Software Development Kit License Agreement)

3.2 You agree that Google (or Google's licensors) own all legal right, title and interest in and to the SDK, including any intellectual property rights which subsist in the SDK.
Use, reproduction and distribution of components of the SDK licensed under an open source software license are governed solely by the terms of that open source software license and not by this License Agreement.
Until the SDK is released under an open source license, you may not extract the source code or create a derivative work of the SDK.

It's „Open” in the sense,
that you don't need permission to ship an application.

Android OS Architecture



Android applications are written in Java

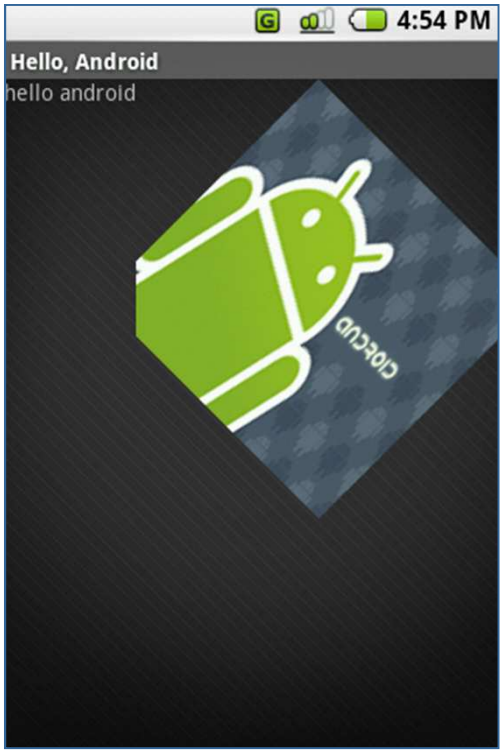
- Android encourages high-level development
- Uses Java as main programming language
- Inherits basic classes from conventional Java
  - String, Container, Math, IO, Network
- Adds new classes specific to mobile devices
  - Camera, Telephony, Map, GPS, Speech

Example code in Java

```
package com.google.android.helloactivity;

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

public class HelloActivity extends Activity {
    public HelloActivity() {
    }
    @Override
    public void onCreate(Bundle icicle) {
        super.onCreate(icicle);
        setContentView(R.layout.hello_activity);
    }
}
```

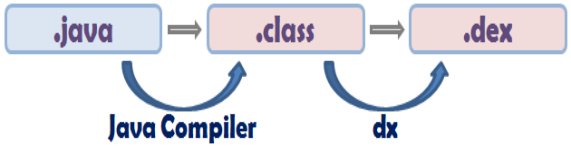


Common Stucture of Android Applications

- **Activity Manager** that manages the life cycle of applications and provides a common navigation backstack
- **Notification Manager** that enables all apps to display custom alerts in the status bar
- **Resource Manager** providing access to non-code resources such as localized strings, graphics, and layout files
- **Content Providers** that enable applications to access data from other applications (such as Contacts), or to share their own data
- **Views** such as lists, grids, text boxes, buttons, and even an embeddable web browser
- **Activity** is the presentation layer of your app: there will be one per screen, and the Views provide the UI to the activity
- **Intents** specify what specific action should be performed
- **Broadcast receivers** can trigger intents that start an application
- **Data storage** provide data for your apps, and can be shared between apps – database, file, and shared preferences (hash map) used by group of applications

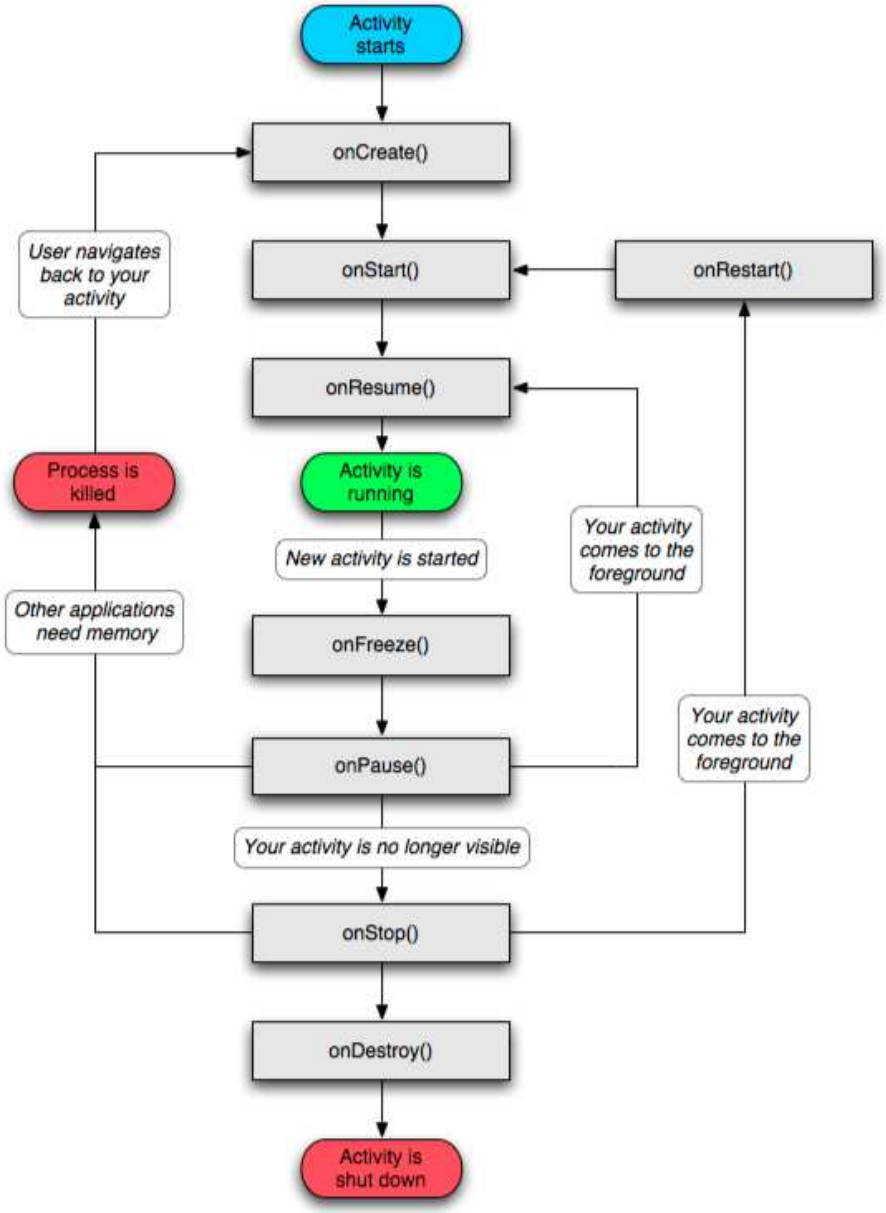
Android Runtime

Dalvik Virtual Machine:



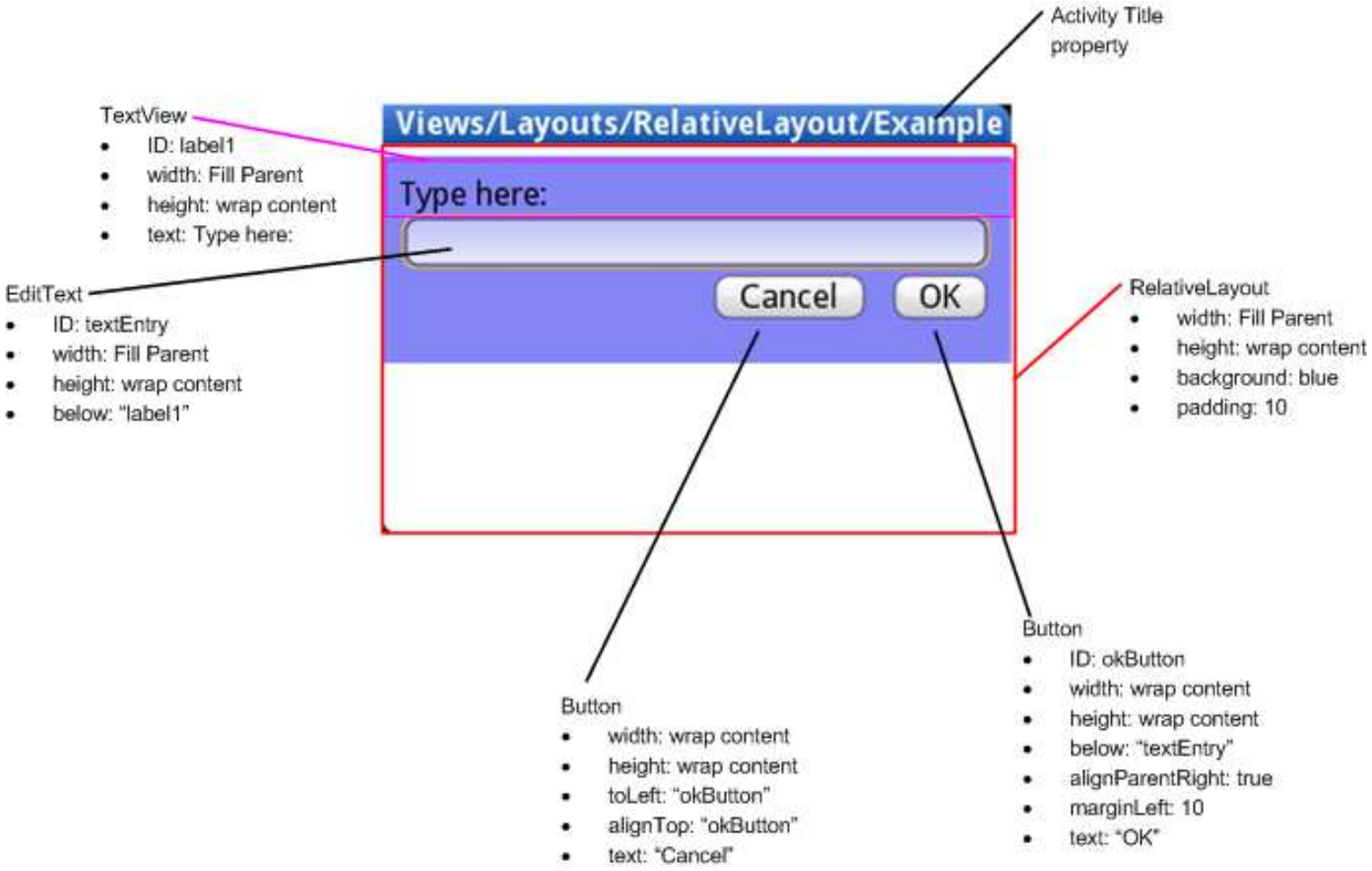
- Providing environment on which every Android application runs
- Each Android application runs in its own process, with its own instance of the Dalvik VM.
- Dalvik has been written so that a device can run multiple VMs efficiently
- Executing the Dalvik Executable (.dex) format which is optimized for minimal memory footprint.

Lifecycle of Android „Activity”

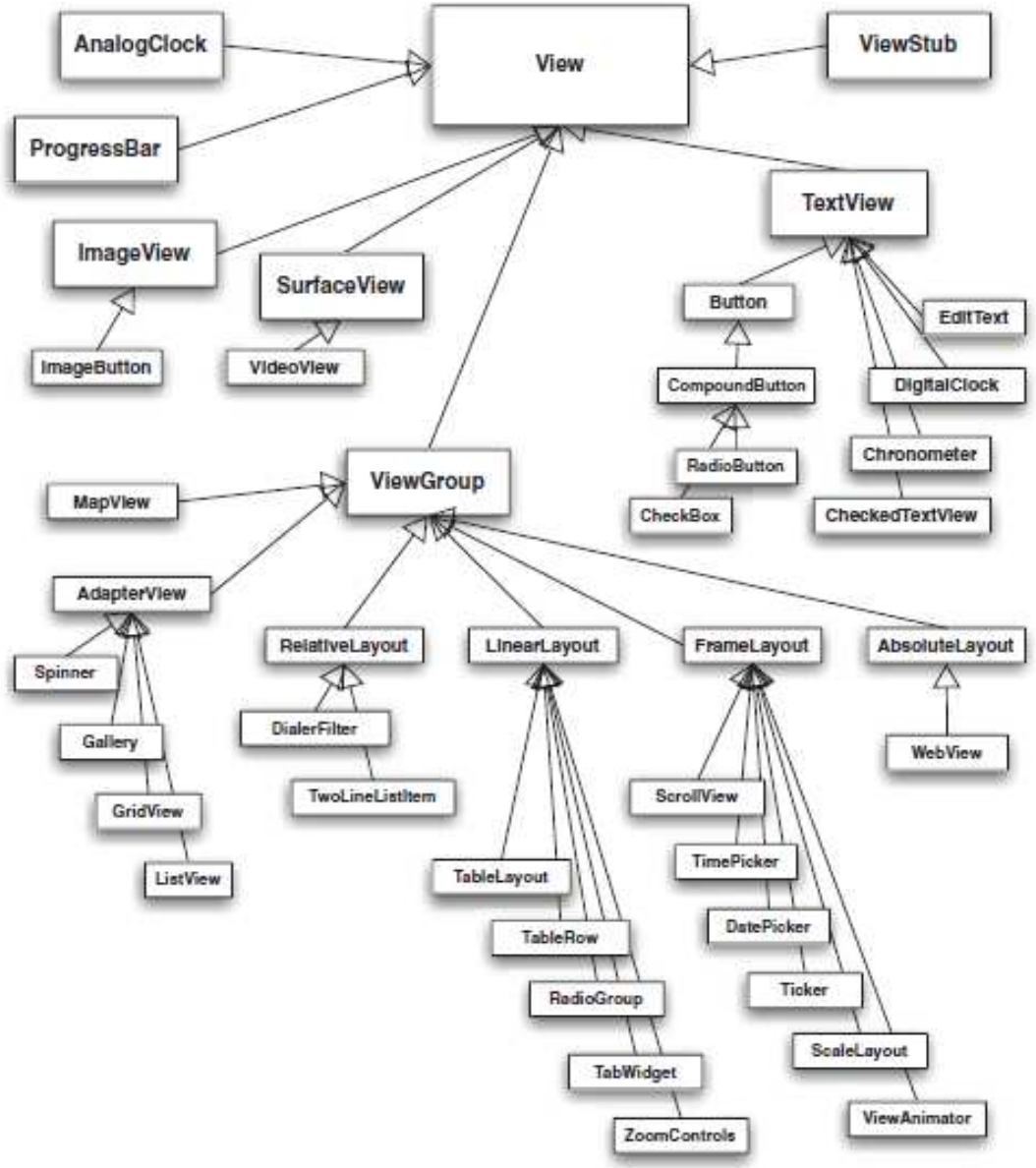


User Interface Elements and Layouts

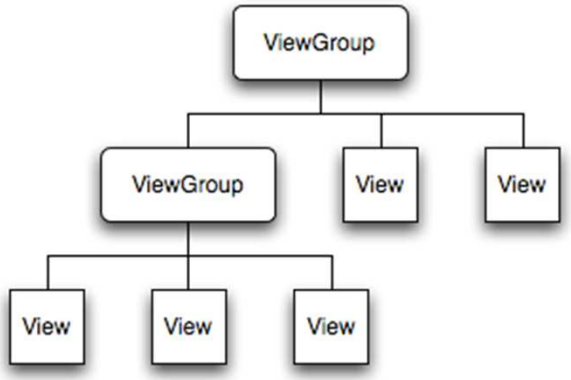
(defined in XML)



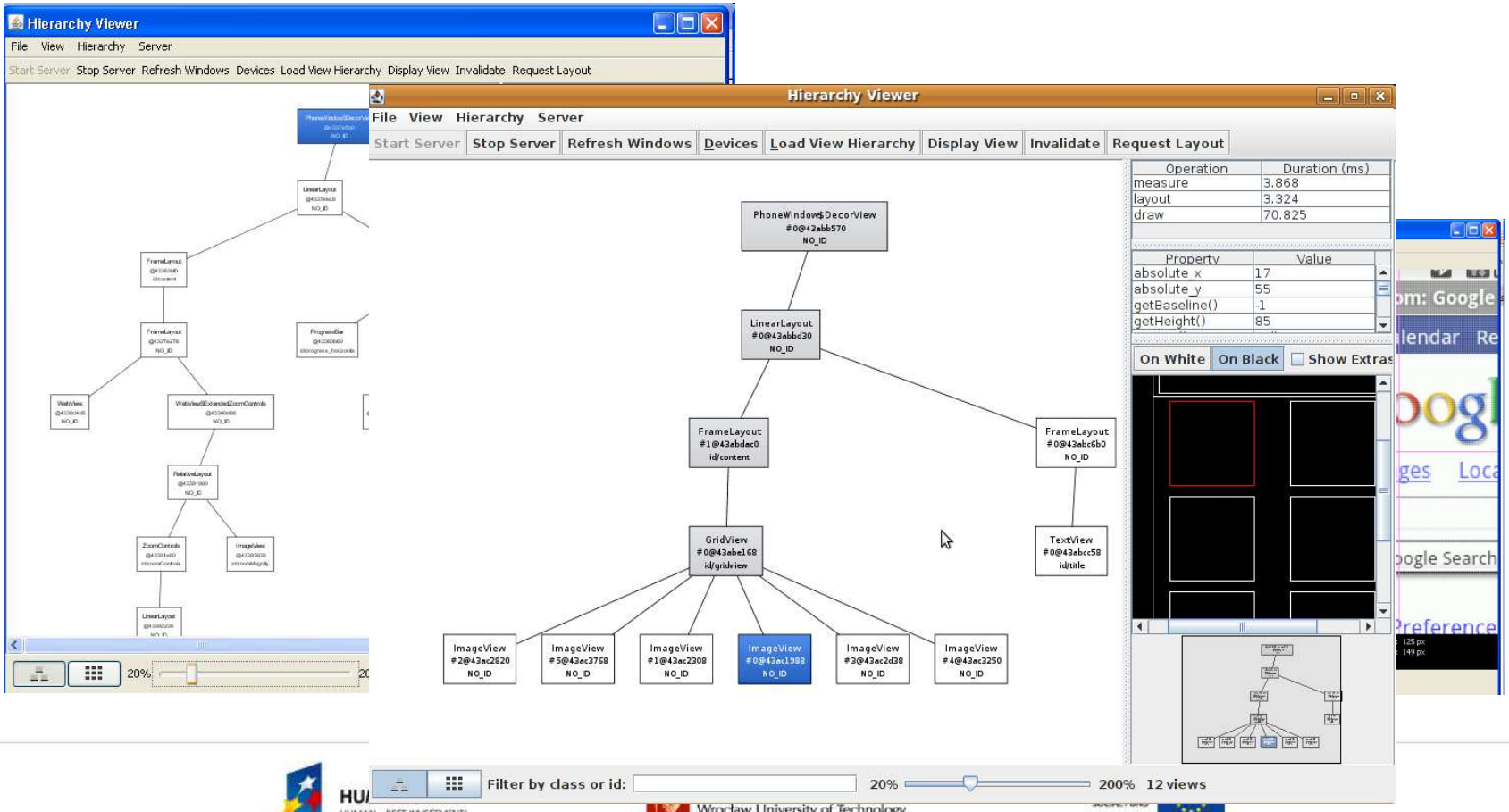
All Screens are Derived from View



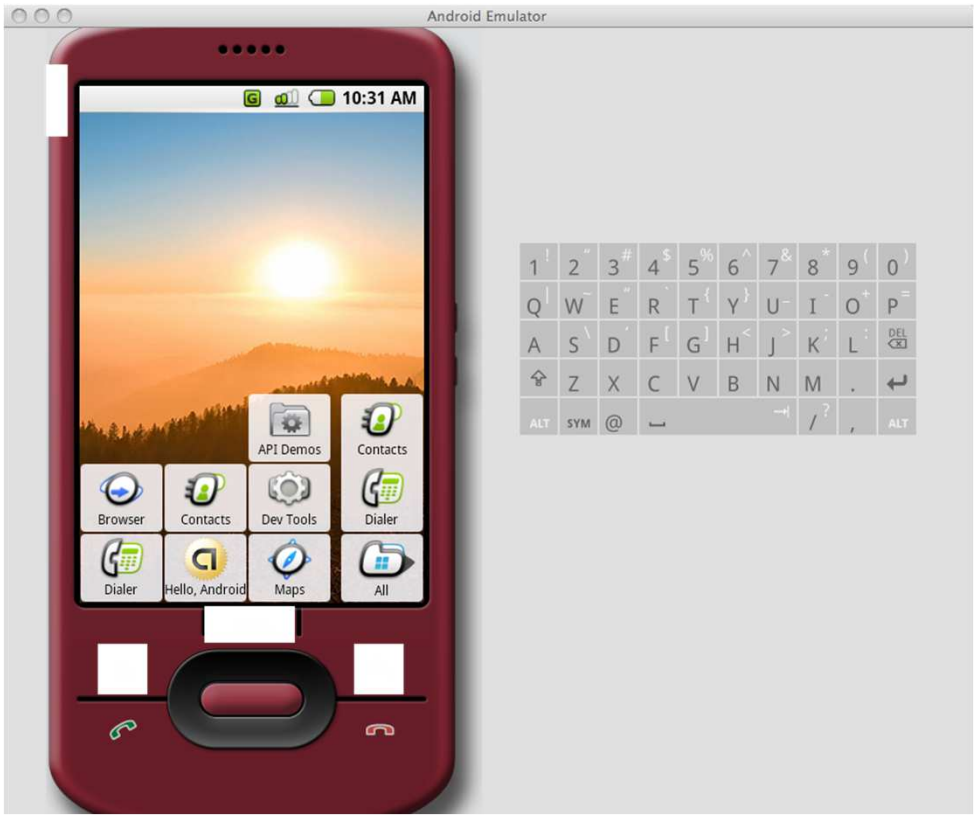
and create hierarchical structures



Hierarchy Viewer Tool to Optimize and Debug Interface



Android Emulator



Android Options for Storage of Data

- Put data into a preferences file (light-weight option)
- Put data into a 'normal' file
- Send data across the network to a web service
- Use built-in SQLite database

Storing Data in Preference Files

- Suitable for small ammount of data.
- Not sharable across applications,
  unless you expose them as a ‘content provider’.
- Use `Context.getSharedPreferences()`
  to read and write values as key-value pairs
- Use `Activity.getPreferences()`
  to keep them private to the calling activity

Storing Data in Files

- You can only access files available to the application
- Pre-included file directory: res/raw/mydata
- `Context.openFileOutput()`
  to write to a file (call with the name and path)
  Returns a standard Java FileOutputStream object.
- `Context.openFileInput()`
  to read data from a file (pass local name and path to the file)
  Returns FileInputStream object.

Persisting Data in a Database

- Android API uses the built-in SQLite db.
- All databases, SQLite and others, are stored on the device in directory /data/data/package_name/databases
- Each database is private to the application.
- If you want to make the data available to other applications, the database application should be exposed as a content provider.

Security in Android

- Android follows standard Linux security guidelines
- Each application runs in its own process
- Process permissions are enforced at user and group IDs assigned to processes
- Finer grained permissions are then granted per operations

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.google.android.app.myapp" >
<uses-permission id="android.permission.RECEIVE_SMS" />
</manifest>
```

Project co-financed from the EU European Social Fund

Example

(Android developer challenge winners)

- Compare Everywhere : scan barcodes and compare prices with nearby stores
- Locale : automatically change the mode of your phone depending on the location
- Wertago : what's hot tonight? Where are my friends? And who am I going to meet at that bar?
- PhoneBook 2.0: a secure, contextual and social address book
- BioWallet: biometric-based authentication
- Em-Radar: updates weather information and keeps family and friends connected in cases of public emergency

References

- Google Android SDK Installation and Hello World
  http://developer.android.com/sdk
- Google Android Application Fundamentals
  http://developer.android.com/guide/topics/fundamentals.html
- http://www.youtube.com/user/androiddevelopers
- http://www.anddev.org

Google believes it will be **easier and quicker** to develop new applications for Android than the other systems