

Praktikum Entwicklung Mediensysteme (für Master)

Storing, Retrieving and Exposing
Data



Introduction

- All application data are private to an application
- Mechanisms to make data available for other applications
- Some simple/basic applications do not require information to be stored
- More elaborated software needs storage/retrieval functionality for different functionalities like:
 - Preserving an application's status (paused, first startup, etc.)
 - Saving user preferences (font size, sound on/off, etc.)
 - Working with complex data structures (calendars, maps, etc.)
 - ...



Different Storage Methods

- Depending on the purpose of storing data, Android offers approaches with different complexity:
 - Store and retrieve simple name/value pairs
 - File operations (read, write, create, delete, etc.)
 - SQLite databases to work with complex data structures
 - Network operations to store and retrieve data from a network
 - Content providers to read/write data from an application's private data

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Preferences

File IO

SQLite-Databases

Network Storage

Content-Providers



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Preferences

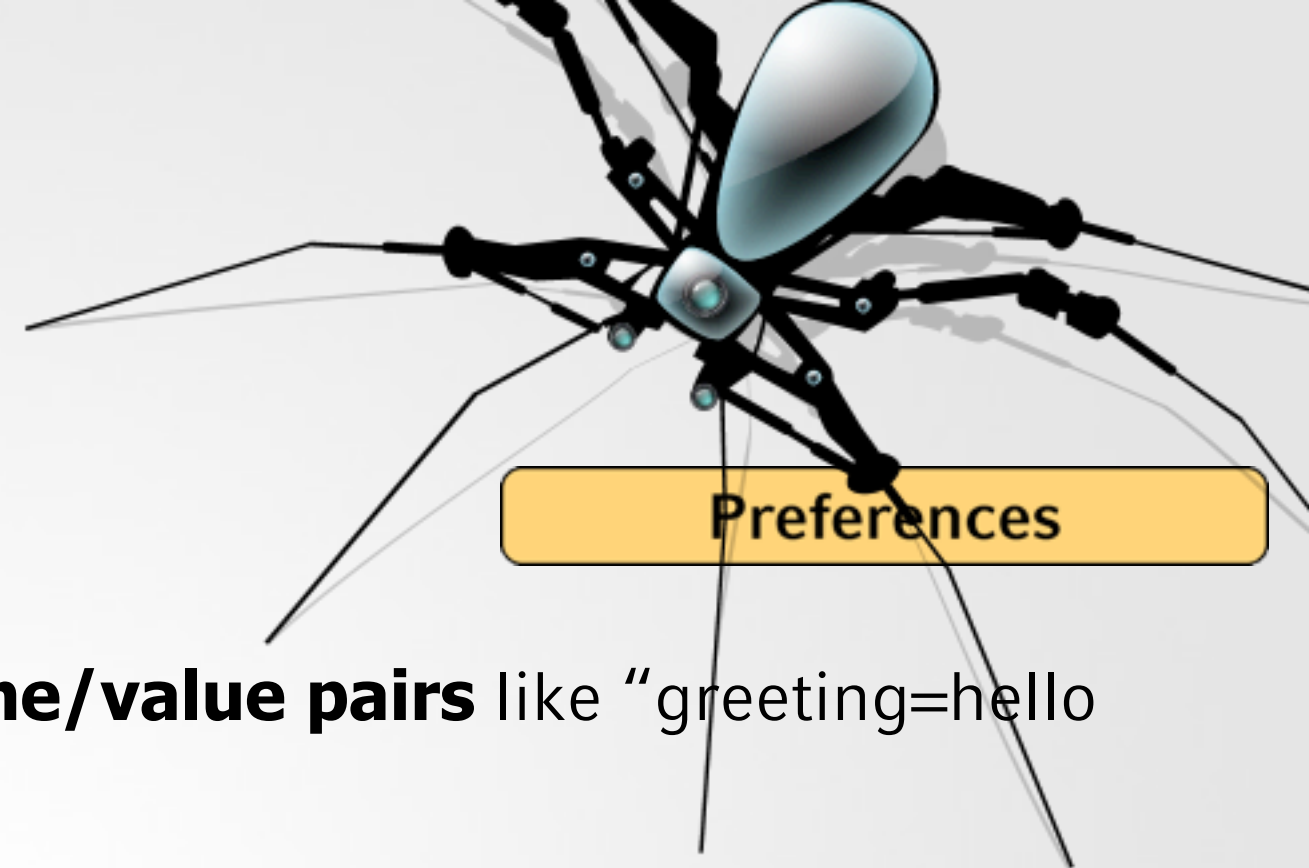
File-IO

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Preferences



- Application preferences are simple **name/value pairs** like "greeting=hello name" or "sound = off"
- To work with preferences, Android offers an extremely simple approach
- Preferences can only be shared with other components in **the same** package
- Preferences cannot be shared across packages
- Private preferences will not be shared at all
- Storage location is not defined and inaccessible for other applications

sound: off

username: hugo

font_size: 10pt

pem: rocks

Using Preferences

Preferences

- **Reading** Preferences

- `Context.getSharedPreferences(String name, int mode)` opens a set of preferences defined by "name"
- If a name is assigned, the preferences set will be shared amongst the components of the same package
- `Activity.getSharedPreferences(int mode)` can be used to open a set that is private to the calling activity

Opens a preferences set with the name "Preferences" in private mode

```
SharedPreferences settings = getSharedPreferences("Preferences", MODE_PRIVATE);  
boolean sound = settings.getBoolean("sound", false);
```

↑
Reads a boolean parameter from the set. If the parameter does not exist, it will be created with the value defined in the second attribute. (other functions: `getAll()`, `getInt()`, `getString()`, etc.)

Using Preferences

Preferences

- **Writing** Preferences

- Changes on preferences are done using an Editor (SharedPreferences.Editor) object
- Each setting has one global Editor instance to administrate changes
- Consequence: each change will be available to every activity working with that preferences set

Gets the Editor instance of the preferences set

```
SharedPreferences.Editor editor = settings.edit();  
editor.putBoolean("sound", false);  
// COMMIT!!  
editor.commit();
```

Writes a boolean to a parameter

Attention: Changes are not drawn back to the settings before the commit is performed



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Files

- Files can be used to store bigger amounts of data than using preferences
- Android offers functionality to read/write files
- Only local files can be accessed
- **Advantage:** can store huge amounts of data
- **Disadvantage:** file update or changes in the format might result in huge programming effort

Reading Files

- `Context.openFileInput(String name)` opens a `FileInputStream` of a private file associated with the application
- Throws a `FileNotFoundException` if the file doesn't exist

Open the file "test2.txt" (can be any name)

```
FileInputStream in = this.openFileInput("test2.txt");
```

```
...  
in.close();
```



Don't forget to close the InputStream at the end

Writing Files

- `Context.openFileOutput(String name, int mode)` opens a `FileOutputStream` of a private file associated with the application
- If the file does not exist, it will be created
- `FileOutputStreams` can be opened in append mode, which means that new data will be added at the end of the file

Open the file "test2.txt" for writing (can be any name)



```
FileOutputStream out = this.openFileOutput("test2.txt", MODE_APPEND);  
...  
in.close();
```



Using MODE-APPEND opens the file in append mode

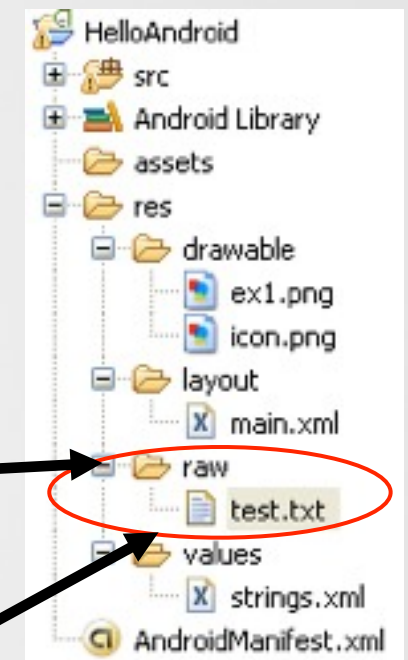


Don't forget to close the InputStream at the end

Static Files

File-IO

- To open static files packed in the application, use `Resources.openRawResource` (`R.raw.mydatafile`)
- The files have to be put in the folder `res/raw/`



Get the contexts resources

```
InputStream in = this.getResources().openRawResource(R.raw.test);  
...  
in.close();
```

↑
Don't forget to close the InputStream at the end

Using the SD-Card

File-IO

- Bigger amounts of data should usually be written/read from SD-Card
- Using the external storage requires permission
- Set it in Manifest.xml-File

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



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SQLite Databases

- In some cases, files are not efficient
 - If multi-threaded data access is relevant
 - If the application is dealing with complex data structures that might change
 - Etc.
- Therefore, Android comes with built-in SQLite support
- Databases are private to the package that created them
- **Databases should not be used to store files**

SQLite Databases

- SQLite is a lightweight software library
- Implements a fully ACID-compliant database
 - Atomicity
 - Consistency
 - Isolation
 - Durability
- Size only several kilobytes
- Some SQL statements are only partially supported (e.g. ALTER TABLE)
- Only few types of data
- See <http://www.sqlite.org/> for more information

Creating a Database

SQLite-Databases

- Opening a database should create it when needed
- Creating a database always means taking care of future Versions
- Version-Numbers make sure which kind of DB is currently used
- An extra class usually called „DBAdapter.java“ is used for all database access

SQLite-Databases

```
public class DBAdapter extends SQLiteOpenHelper {
    public static final String KEY_ROWID = "_id";
    private static final String TAG = "DBAdapter";

    private static final String DATABASE_NAME = "mydb";
    private static final String DATABASE_TABLE = "table_one";
    private static final int DATABASE_VERSION = 1;
    private static final String TABLE_CREATE = "create table "+DATABASE_TABLE+" (" +
        KEY_ROWID + " integer primary key autoincrement);";

    private SQLiteDatabase db;


    public DBAdapter(Context ctx) {
        super(ctx, DATABASE_NAME, null, DATABASE_VERSION);
        db=getWritableDatabase();
    }

    @Override
    public void onCreate(SQLiteDatabase db) {
        db.execSQL(TABLE_CREATE);
    }

    @Override
    public void onUpgrade(SQLiteDatabase db, int oldVersion, int newVersion) {
        Log.w(TAG, "Upgrading database from version " + oldVersion + " to "
            + newVersion + ", which will destroy all old data");
        db.execSQL("DROP TABLE IF EXISTS " + DATABASE_TABLE);
        onCreate(db);
    }
}
```



Fetching Data

- Data is provided using Cursors
- Cursors are the result of a specific query to the database holding the request result
- Cursors are traversed line by line
 - Similar to an Iterator in Java
- DBAdapter should provide request-methods that return such a Cursor

	id	someNumber
	1	8
	2	10
	3	2

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Fetching Data

To create a cursor, a query has to be executed either by SQL using `rawQuery()` or by more elaborated methods like `query()`



```
Cursor cur = dbase.rawQuery("SELECT * FROM test", null);
```

```
if (cur != null) {  
    int numColumn = cur.getColumnIndex("someNumber");  
    if (cur.moveToFirst()) {  
        do {  
            int num = cur.getInt(numColumn);  
            ...do something with it...  
        } while (cur.moveToNext());  
    }  
}
```

Attributes are retrieved with their index

Cursor offers different methods to retrieve different datatypes like `getInt(int index)` `getString(int index)` etc

`moveToNext()` moves the cursor to the next row. It returns false if no more row is available. Other possible moves are `moveToPrevious()` and `moveToFirst()`

Fetching Data

```
public Cursor getAllEntrys() {  
    return db.query(DATABASE_TABLE, new String[] { KEY_ROWID }, null, null,  
        null, null, null);  
}
```

- query(), a more elaborated method
 - table: The table to query from
 - columns: Which columns to fetch
 - selection: the „Where“-Clause with placeholders?
 - selectionArgs: Values to fill placeholders
 - groupBy: SQL groupBy-Values
 - having: SQL having-Values
 - orderBy: How to order the resulting datasets

Insert, Update

```
@Override  
public void onCreate(SQLiteDatabase db) {  
    db.execSQL(DATABASE_CREATE);  
}
```

```
db.execSQL("CREATE TABLE test (_id INTEGER PRIMARY KEY,  
someNumber INTEGER);");
```

- Some examples:

```
db.execSQL("Insert into test (_id, someNumber) values (1,8);");
```

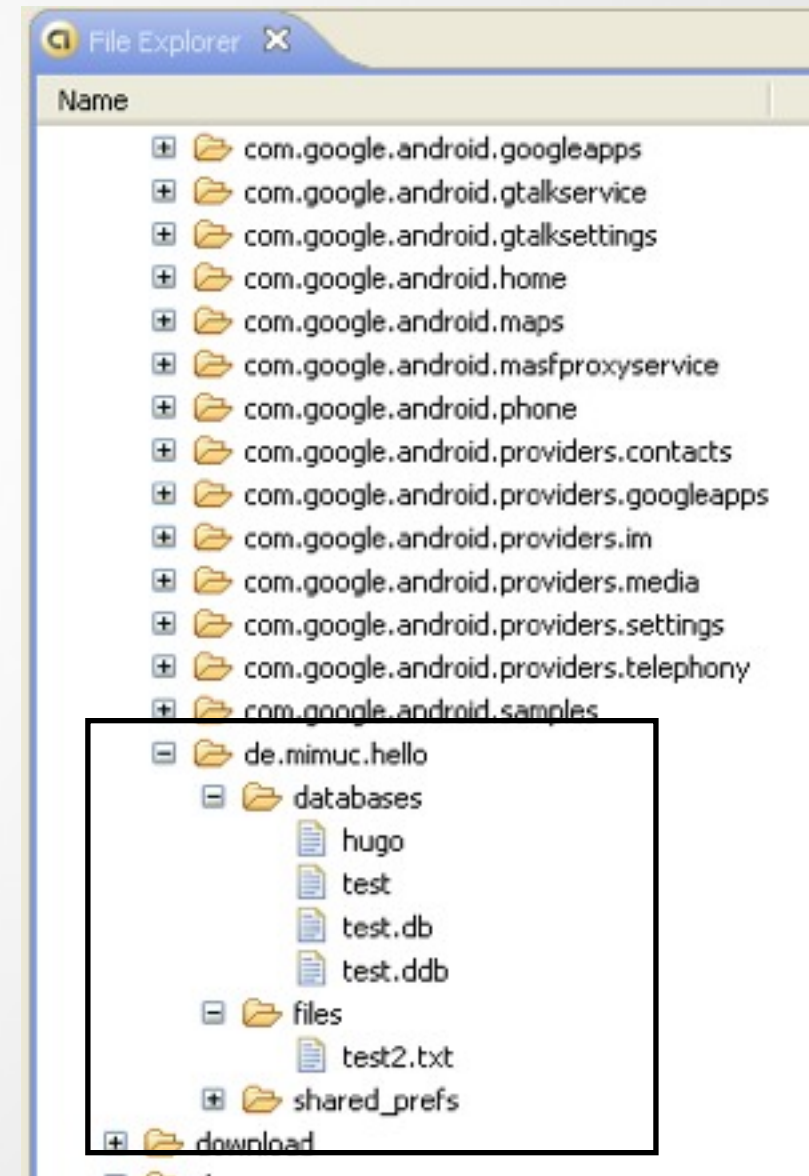
```
db.execSQL("DROP TABLE test");
```


SQLiteQueryBuilder

- Optional interface to build correct SQL statements using code
- Usage:
 - Create new SQLiteQueryBuilder object
 - Then use setTables, appendWhere, appendColumns
 - In the end, use query or buildQuery

Using the IDE to Check Files and Databases

- FileExplorer-View
- Check Files and Databases at /data/data/<package_name>/files/databases
- Only possible on a „rooted“ device/emulators.
- **Don't root the test devices!**





Preferences

File-IO

SQLite-Databases

Network Storage

Content-Providers

Network Access

Network Storage

- Android also supports network access to access files remotely (through the network)
- Two major packages:
 - `java.net.*` contains the standard Java network APIs
 - `android.net.*` adds additional helper classes to the standard Java APIs



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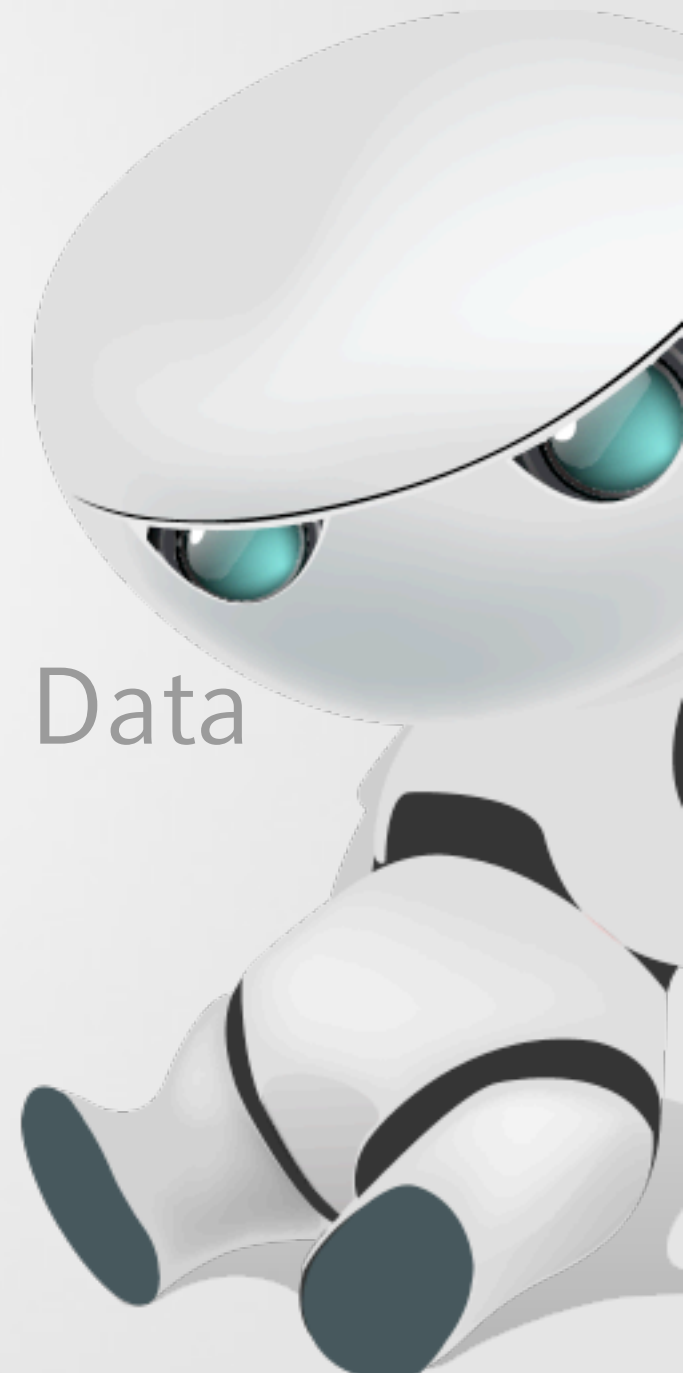
Content Providers

Content-Providers

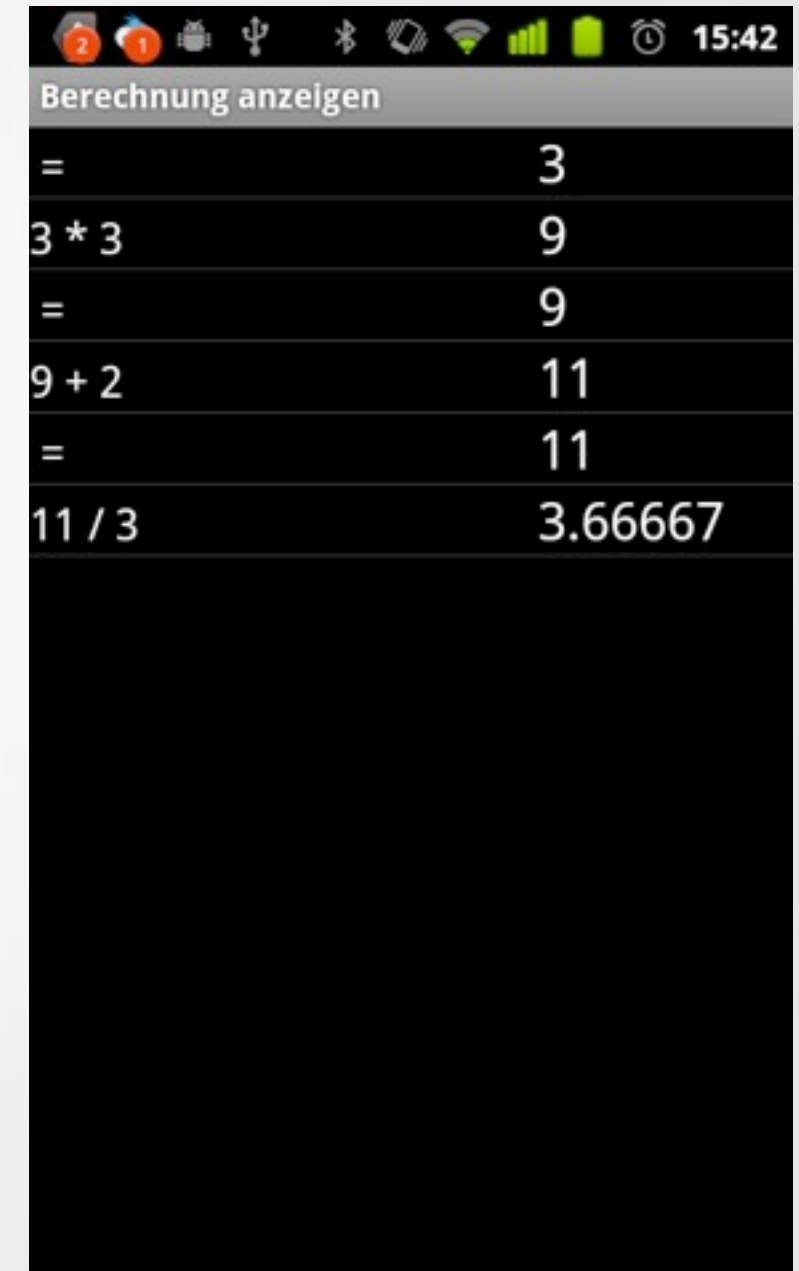
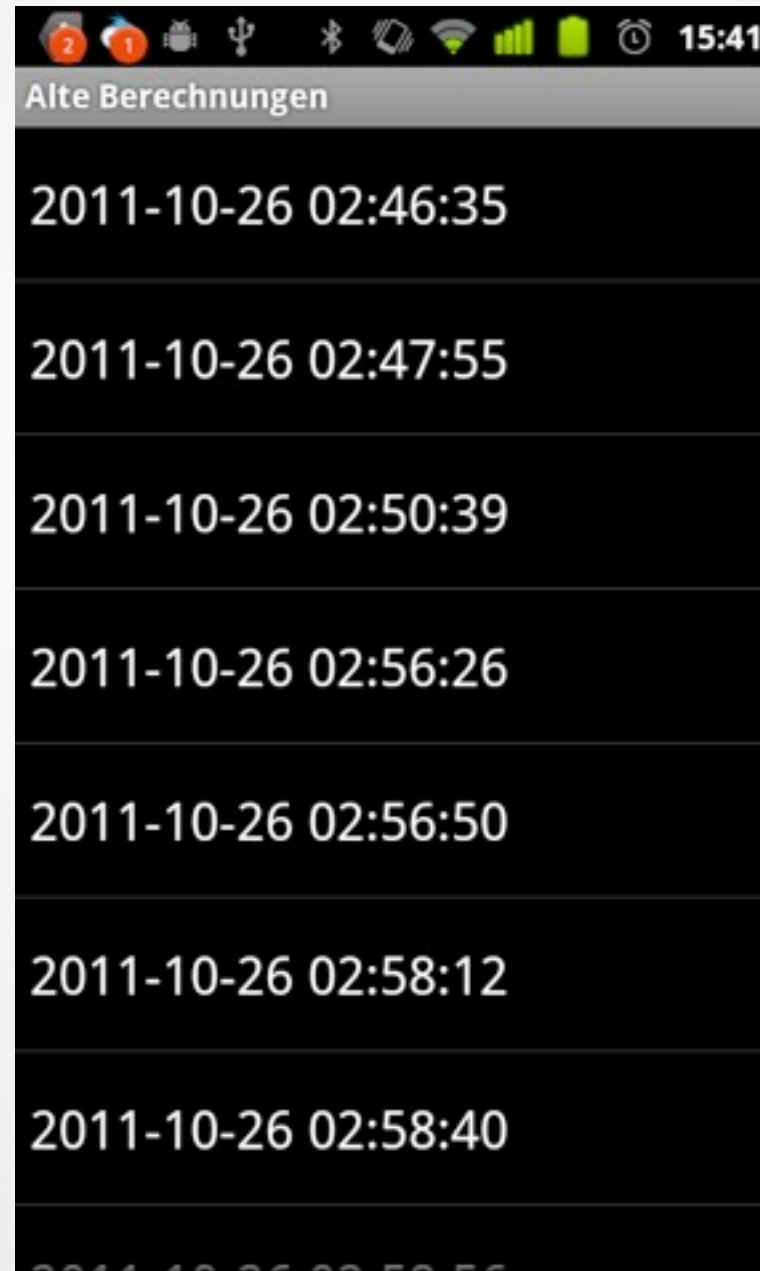
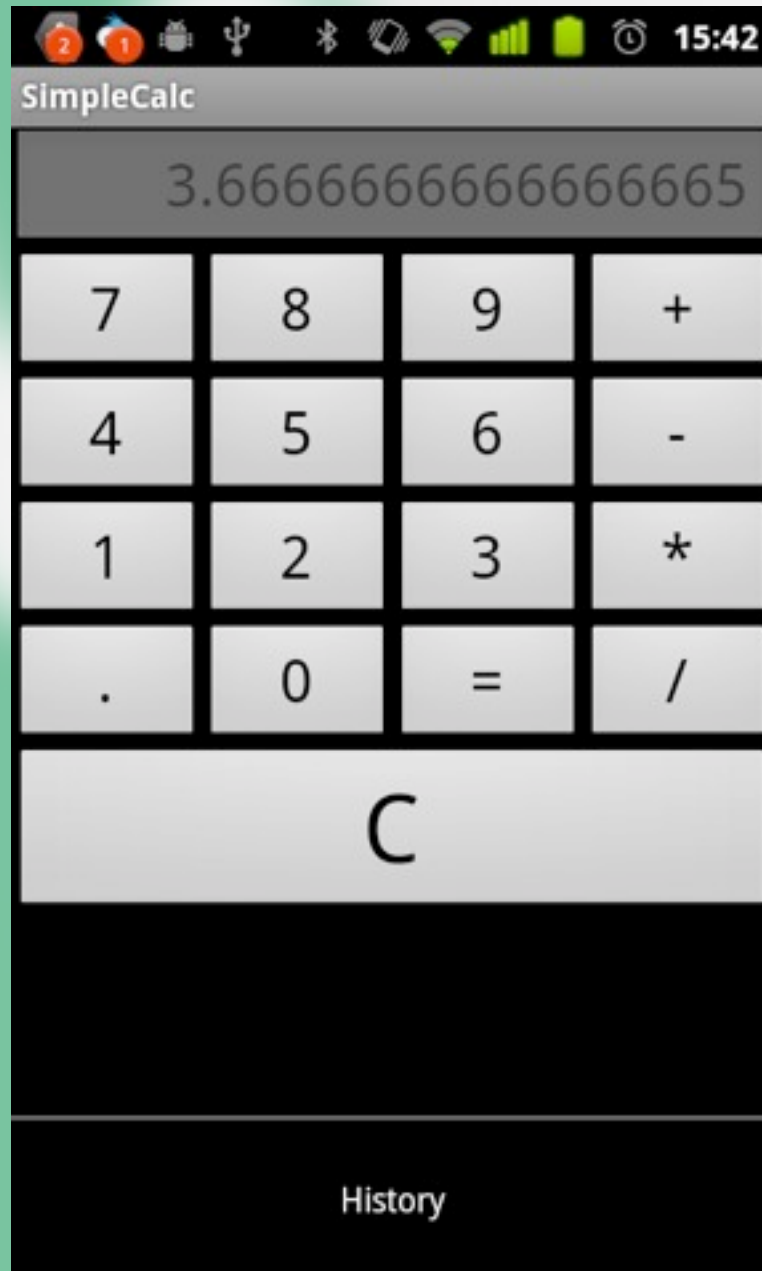
- All preferences, files and databases created by an Android application are private
- To share data with other applications, an application has to **create** a Content Provider
- To retrieve data of another application its content provider has to be **called**
- Androids **native Content Providers** include:
 - CallLog: information about placed and received calls
 - Settings.System: system settings and preferences

Single-Exercise till 17.05.2012

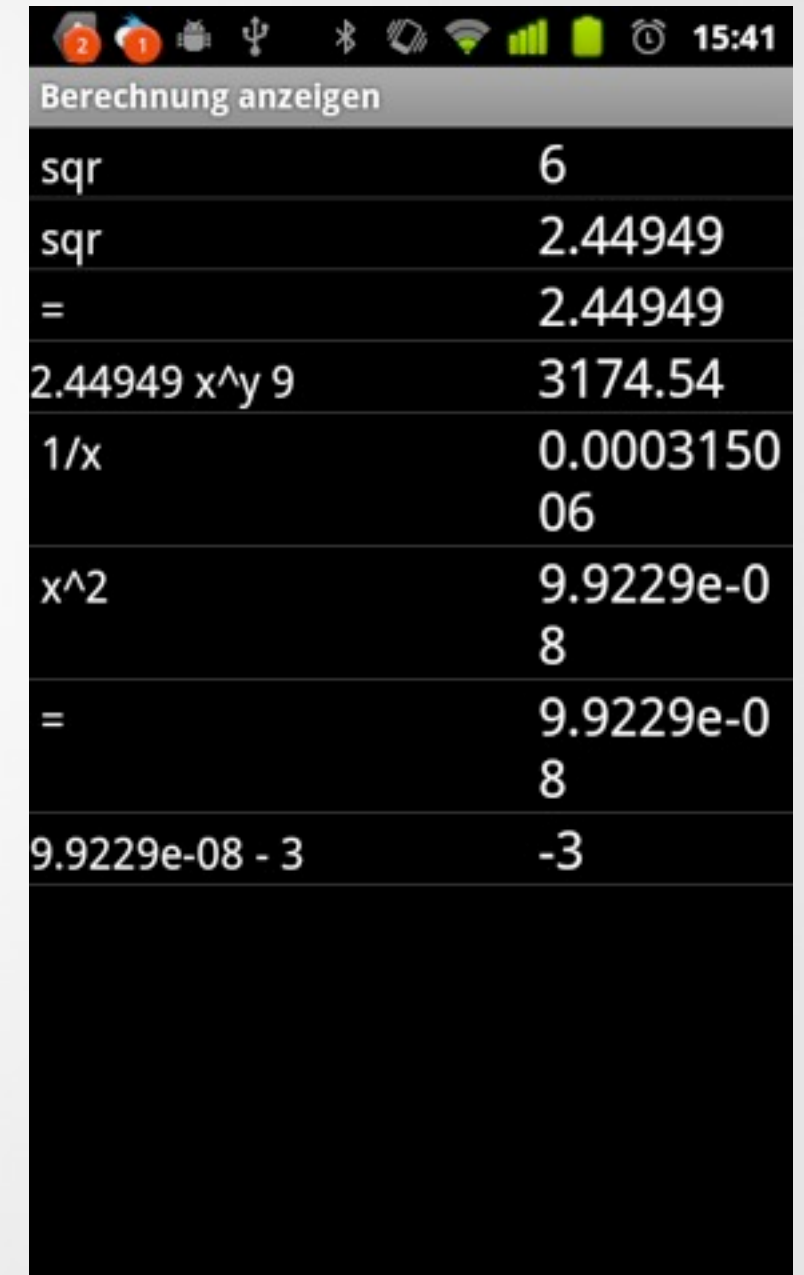
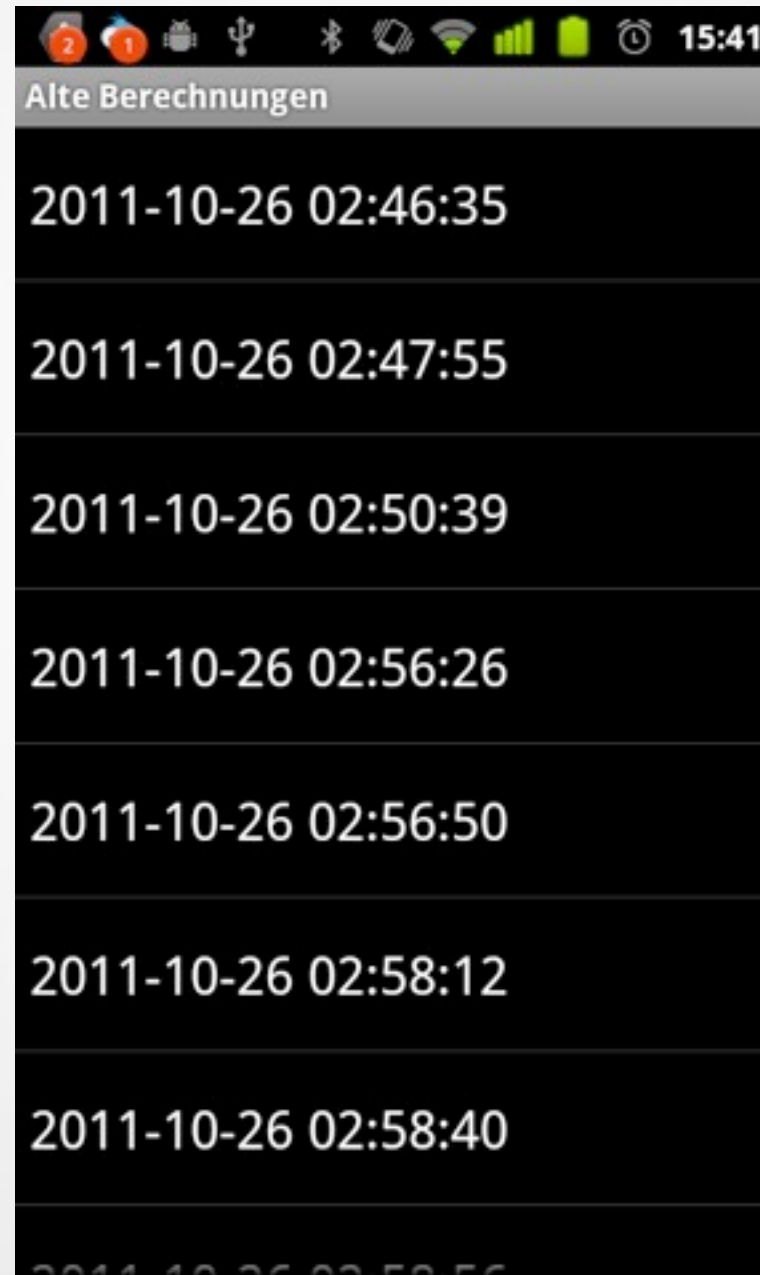
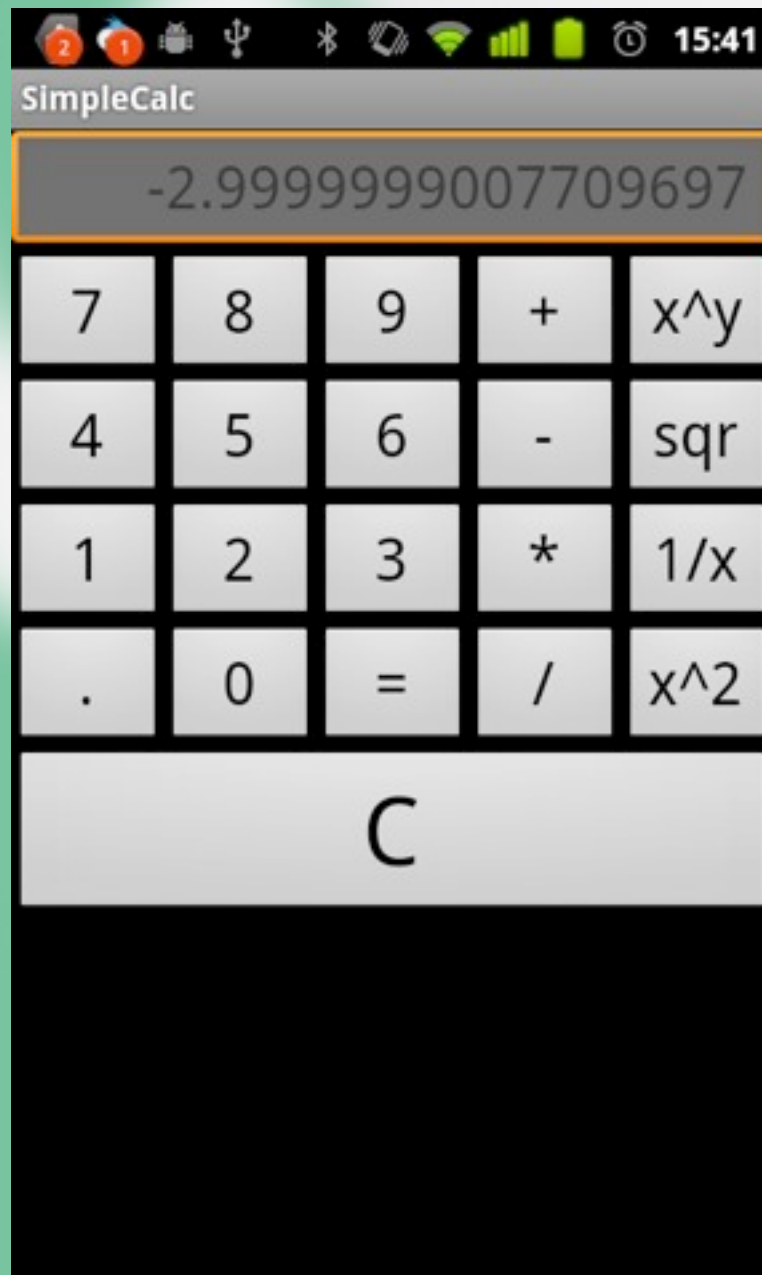
Storing, Retrieving and Exposing Data



Exercise(Bachelor)



Exercise (Master)



Exercise

- Write a Calculator Application (+, -, *, /) that allows floating point values
- Database driven history of all old calculations (HistoryViewer)
- Clicking a history entry shows the calculation stack for that period (DisplayCalc)
- **Für Master:** Use Scientific Functions (at least $1/x$, x^y , x^2 , Wurzel)
- **This is no yet teamwork!** Make sure you work on your own. This is a multiple week exercise. So start early!
- Submit till **17.05.2012 - 12:00** via UniWorX

Software Planning till 24.05.2012



Sketch out your idea

- What will the core features be?
- What activities do you want to have?
- How should it look like?
- Create a PowerPoint (or Keynote) presentation for your idea and the start into the development process.
- Deadline: 24.05.2012 - 12:00

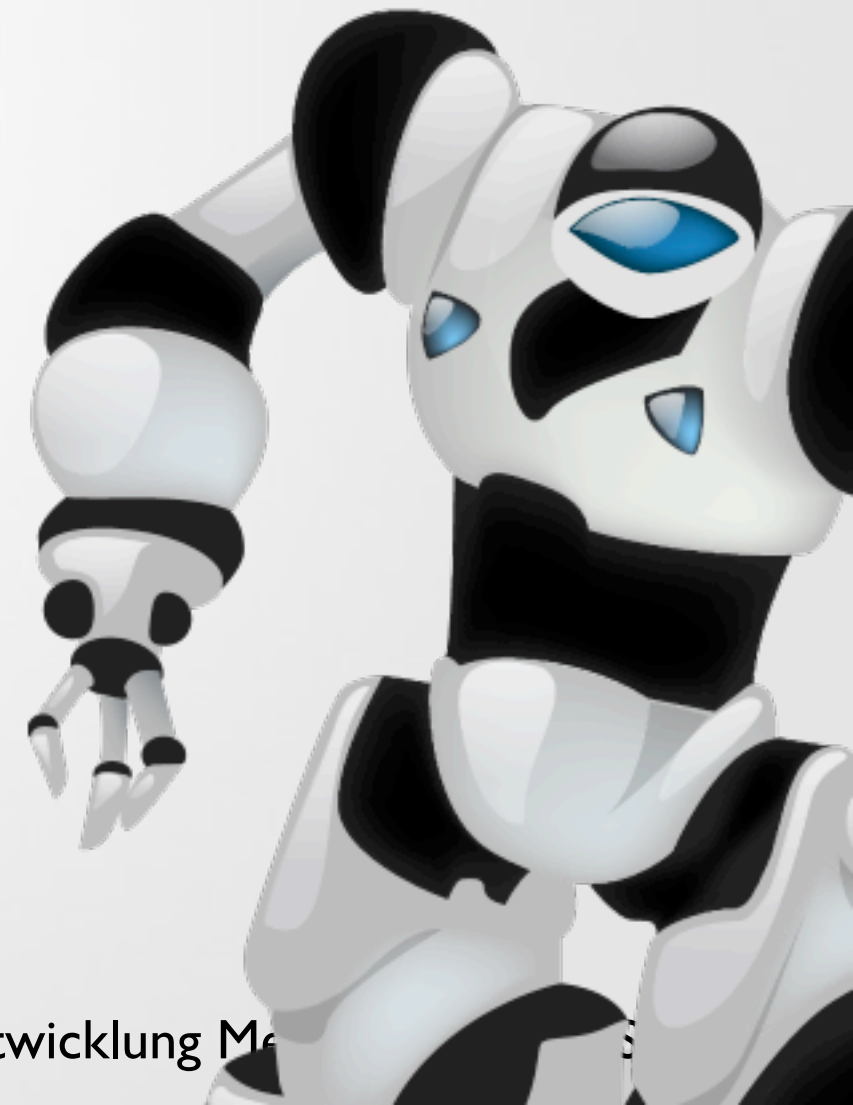
How to do Mock-Ups?



<http://www.smashingmagazine.com/2009/08/18/android-gui-psd-vector-kit/>

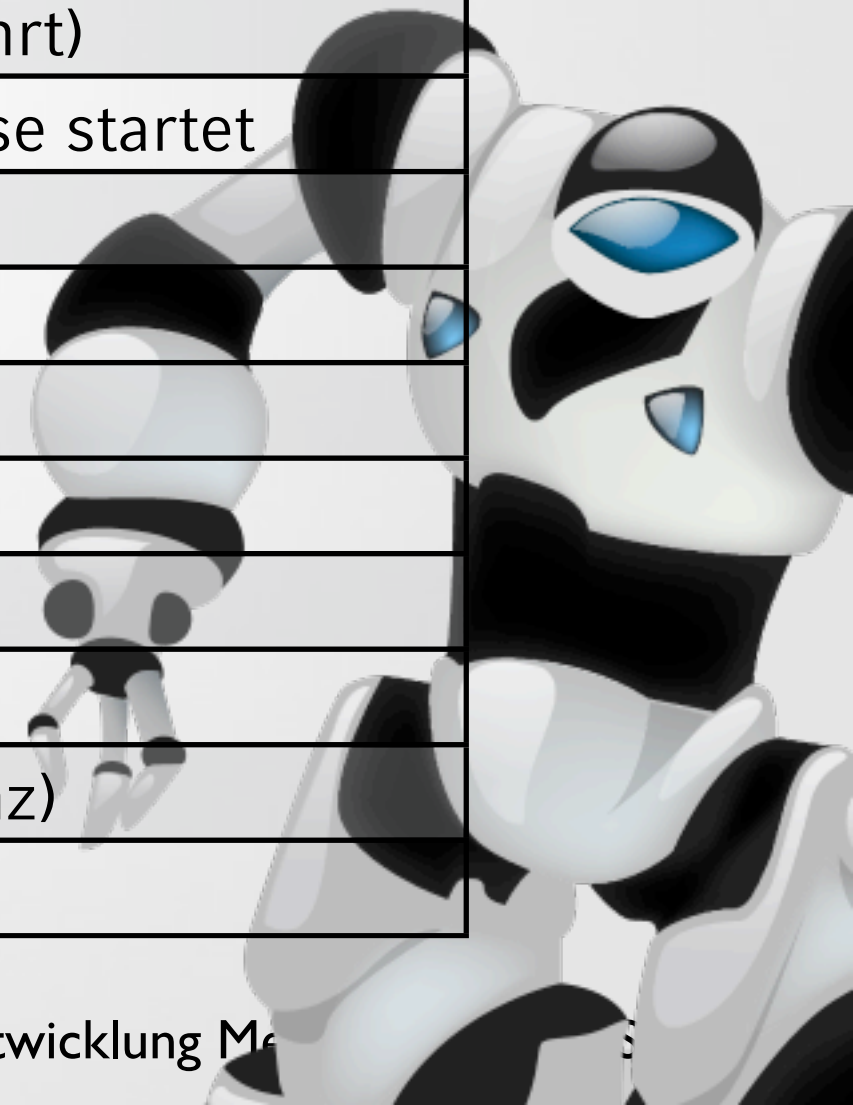


Project Milestones



Project Milestones

Date	Topic/Activity
19.04.	Einführung and Brainstorming Future Mobile
26.04.	
03.05.	Intensiveinführung Android
10.05.	entfällt (CHI Konferenz)
17.05.	entfällt (Christi Himmelfahrt)
24.05.	Projektpräsentation/Projektphase startet
31.05.	Milestone 1
07.06.	entfällt (Fronleichnam)
14.06.	
21.06.	Milestone 2
28.06.	
05.07.	Milestone 3
12.07.	entfällt (SOUPS Konferenz)
19.07.	Abschlusspräsentation



Gantt-Chart

- Fill out the Gantt-Chart according to your idea
- Make sure to have enough time for Bugtracking/Bugfixing
- Use this as part of your presentation and submit it separately
 - This will be used to track your progress
- A draft for your own Chart can be downloaded on the website



Fragen?

