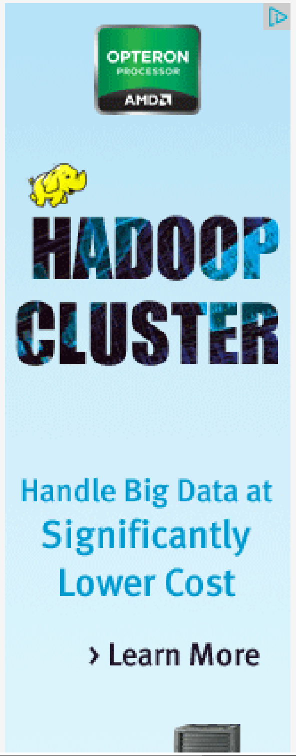
by Lars Vogel



Android SQLite Database and ContentProvider - Tutorial

Based on Android 4.0

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Revision History

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Revision 0.2 - 4.5	31.12.2010 - 06.01.2013	Lars Vogel	bug fixes and enhancements

Using the Android SQLite Database

This tutorial describes how to use the SQLite database in Android applications. It also demonstrates how to use existing ContentProvider and how to define new ones. It also demonstrates the usage of the Loader framework which allows to load data asynchronously.

The tutorial is based on Eclipse 4.2, Java 1.6 and Android 4.2.

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1. SQLite and Android

1.1. What is SQLite?

SQLite is an Open Source Database which is embedded into Android. SQLite supports standard relational database features like SQL syntax, transactions and prepared statements. In addition it requires only little memory at runtime (approx. 250 KByte).

SQLite supports the data types `TEXT` (similar to String in Java), `INTEGER` (similar to long in Java) and `REAL` (similar to double in Java). All other types must be converted into one of these fields before saving them in the database. SQLite itself does not validate if the types written to the columns are actually of the defined type, e.g. you can write an integer into a string column and vice versa.

More information about SQLite can be found on the SQLite website: **http://www.sqlite.org**.

1.2. SQLite in Android

SQLite is available on every Android device. Using an SQLite database in Android does not require any database setup or administration.

You only have to define the SQL statements for creating and updating the database. Afterwards the database is automatically managed for you by the Android platform.

Access to an SQLite database involves accessing the filesystem. This can be slow. Therefore it is recommended to perform database operations asynchronously, for example inside the `AsyncTask` class.

If your application creates a database, this database is by default saved in the directory `DATA/data/APP_NAME/databases/FILENAME`.

The parts of the above directory are constructed based on the following rules. `DATA` is the path which the `Environment.getDataDirectory()` method returns. `APP_NAME` is your application name. `FILENAME` is the name you specify in your application code for the database.

2. Prerequisites for this tutorial

The following assumes that you have already basic knowledge in Android development. Please check the **Android development tutorial** to learn the basics.

3. SQLite Architecture

3.1. Packages

The package `android.database` contains all general classes for working with databases. `android.database.sqlite` contains the SQLite specific classes.

3.2. SQLiteOpenHelper

To create and upgrade a database in your Android application you usually subclass `SQLiteOpenHelper`. In the constructor of your subclass you call the `super()` method of `SQLiteOpenHelper`, specifying the database name and the current database version.

In this class you need to override the `onCreate()` and `onUpgrade()` methods.

`onCreate()` is called by the framework, if the database does not exists.

`onUpgrade()` is called, if the database version is increased in your application code. This method allows you to update the database schema.

Both methods receive an `SQLiteDatabase` object as parameter which represents the database.

`SQLiteOpenHelper` provides the methods `getReadableDatabase()` and `getWriteableDatabase()` to get access to an `SQLiteDatabase` object; either in read or write mode.

The database tables should use the identifier `_id` for the primary key of the table. Several Android functions rely on this standard.

It is best practice to create a separate class per table. This class defines static `onCreate()` and `onUpdate()` methods. These methods are called in the corresponding methods of `SQLiteOpenHelper`. This way your implementation of `SQLiteOpenHelper` will stay readable, even if you have several tables.

3.3. SQLiteDatabase

`SQLiteDatabase` is the base class for working with a SQLite database in Android and provides methods to open, query, update and close the database.

More specifically `SQLiteDatabase` provides the `insert()`, `update()` and `delete()` methods.

In addition it provides the `execSQL()` method, which allows to execute an SQL statement directly.

The object `ContentValues` allows to define key/values. The "key" represents the table column identifier and the "value" represents the content for the table record in this column. `ContentValues` can be used for inserts and updates of database entries.

Queries can be created via the `rawQuery()` and `query()` methods or via the `SQLiteQueryBuilder` class .

`rawQuery()` directly accepts an SQL select statement as input.

`query()` provides a structured interface for specifying the SQL query.

`SQLiteQueryBuilder` is a convenience class that helps to build SQL queries.

3.4. rawQuery() Example

The following gives an example of a `rawQuery()` call.

```
Cursor cursor = getReadableDatabase().
  rawQuery("select * from todo where _id = ?", new String[] { id });
```

3.5. query() Example

The following gives an example of a `query()` call.

```
return database.query(DATABASE_TABLE,
  new String[] { KEY_ROWID, KEY_CATEGORY, KEY_SUMMARY, KEY_DESCRIPTION },
  null, null, null, null, null);
```

The method `query()` has the following parameters.

Table 1. Parameters of the query() method

Parameter	Comment
String dbName	The table name to compile the query against.
int[] columnNames	A list of which table columns to return. Passing "null" will return all columns.
String whereClause	Where-clause, i.e. filter for the selection of data, null will select all data.
String[] selectionArgs	You may include ?s in the "whereClause"". These placeholders will get replaced by the values from the selectionArgs array.
String[] groupBy	A filter declaring how to group rows, null will cause the rows to not be grouped.
String[] having	Filter for the groups, null means no filter.
String[] orderBy	Table columns which will be used to order the data, null means no ordering.

If a condition is not required you can pass `null`, e.g. for the group by clause.

The "whereClause" is specified without the word "where", for example a "where" statement might look like: "_id=19 and summary=?".

If you specify placeholder values in the where clause via `?`, you pass them as the selectionArgs parameter to the query.

3.6. Cursor

A query returns a `Cursor` object. A Cursor represents the result of a query and basically points to one row of the query result. This way Android can buffer the query results efficiently; as it does not have to load all data into memory.

To get the number of elements of the resulting query use the `getCount()` method.

To move between individual data rows, you can use the `moveToFirst()` and `moveToNext()` methods. The `isAfterLast()` method allows to check if the end of the query result has been reached.

`Cursor` provides typed `get*()` methods, e.g. `getLong(columnIndex)`, `getString(columnIndex)` to access the column data for the current position of the result. The "columnIndex" is the number of the column you are accessing.

`Cursor` also provides the `getColumnIndexOrThrow(String)` method which allows to get the column index for a column name of the table.

A `Cursor` needs to be closed with the `close()` method call.

3.7. ListViews, ListActivities and SimpleCursorAdapter

`ListViews` are `Views` which allow to display a list of elements.

`ListActivities` are specialized *Activities* which make the usage of `ListViews` easier.

To work with databases and `ListViews` you can use the `SimpleCursorAdapter`. The `SimpleCursorAdapter` allows to set a layout for each row of the `ListViews`.

You also define an array which contains the column names and another array which contains the IDs of `Views` which should be filled with the data.

The `SimpleCursorAdapter` class will map the columns to the `Views` based on the `Cursor` passed to it.

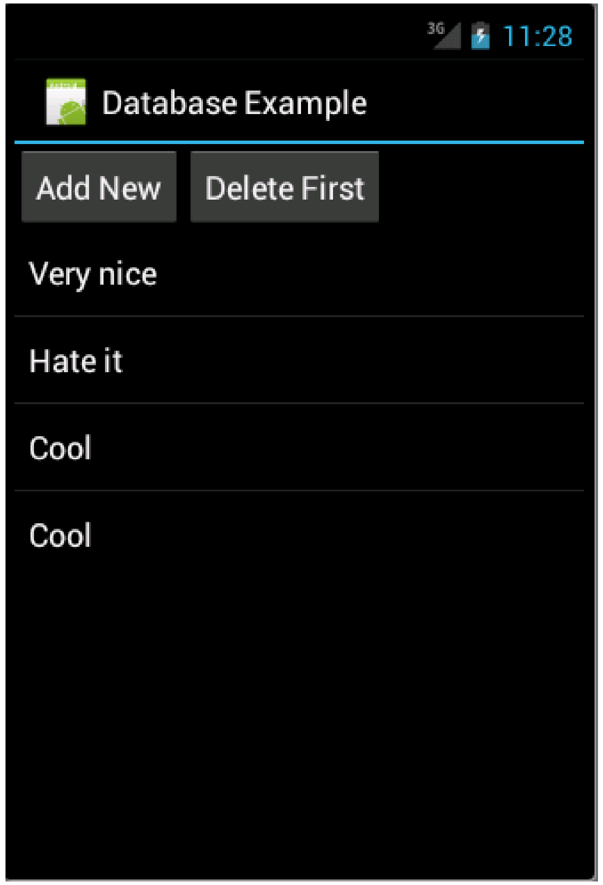
To obtain the `Cursor` you should use the `Loader` class.

4. Tutorial: Using SQLite

4.1. Introduction to the project

The following demonstrates how to work with an SQLite database. We will use a data access object (DAO) to manage the data for us. The DAO is responsible for handling the database connection and for accessing and modifying the data. It will also convert the database objects into real Java Objects, so that our user interface code does not have to deal with the persistence layer.

The resulting application will look like the following.



Using a DAO is not always the right approach. A DAO creates Java model objects; using a database directly or via a `ContentProvider` is typically more resource efficient as you can avoid the creation of model objects.

I still demonstrate the usage of the DAO in this example to have a relatively simple example to begin with. Use the latest version of Android 4.0. This is currently API Level 15. Otherwise I would have to introduce the `Loader` class, which should be used as of Android 3.0 for managing a database `Cursor`. And this class introduces additional complexity.

4.2. Create Project

Create the new Android project with the name `de.vogella.android.sqlite.first` and an `Activity` called *TestDatabaseActivity*.

4.3. Database and Data Model

Create the `MySQLiteHelper` class. This class is responsible for creating the database. The `onUpdate()` method will simply delete all existing data and re-create the table. It also defines several constants for the table name and the table columns.

```java
package de.vogella.android.sqlite.first;

import android.content.Context;
import android.database.sqlite.SQLiteDatabase;
import android.database.sqlite.SQLiteOpenHelper;
import android.util.Log;

public class MySQLiteHelper extends SQLiteOpenHelper {

  public static final String TABLE_COMMENTS = "comments";
  public static final String COLUMN_ID = "_id";
  public static final String COLUMN_COMMENT = "comment";

  private static final String DATABASE_NAME = "commments.db";
  private static final int DATABASE_VERSION = 1;

  // Database creation sql statement
  private static final String DATABASE_CREATE = "create table "
      + TABLE_COMMENTS + "(" + COLUMN_ID
      + " integer primary key autoincrement, " + COLUMN_COMMENT
      + " text not null);";

  public MySQLiteHelper(Context context) {
    super(context, DATABASE_NAME, null, DATABASE_VERSION);
  }

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

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

}
```

Create the `Comment` class. This class is our model and contains the data we will save in the database and show in the user interface.

```java
package de.vogella.android.sqlite.first;

public class Comment {
  private long id;
  private String comment;

  public long getId() {
    return id;
  }

  public void setId(long id) {
    this.id = id;
  }

  public String getComment() {
    return comment;
  }

  public void setComment(String comment) {
    this.comment = comment;
  }

  // Will be used by the ArrayAdapter in the ListView
  @Override
  public String toString() {
    return comment;
  }
}
```

Create the `CommentsDataSource` class. This class is our DAO. It maintains the database connection and supports adding new comments and fetching all comments.

```java
package de.vogella.android.sqlite.first;

import java.util.ArrayList;
import java.util.List;

import android.content.ContentValues;
import android.content.Context;
import android.database.Cursor;
import android.database.SQLException;
import android.database.sqlite.SQLiteDatabase;

public class CommentsDataSource {
  // Database fields
  private SQLiteDatabase database;
  private MySQLiteHelper dbHelper;
  private String[] allColumns = { MySQLiteHelper.COLUMN_ID,
      MySQLiteHelper.COLUMN_COMMENT };

  public CommentsDataSource(Context context) {
    dbHelper = new MySQLiteHelper(context);
  }

  public void open() throws SQLException {
    database = dbHelper.getWritableDatabase();
  }

  public void close() {
    dbHelper.close();
  }

  public Comment createComment(String comment) {
    ContentValues values = new ContentValues();
    values.put(MySQLiteHelper.COLUMN_COMMENT, comment);
    long insertId = database.insert(MySQLiteHelper.TABLE_COMMENTS, null,
        values);
    Cursor cursor = database.query(MySQLiteHelper.TABLE_COMMENTS,
        allColumns, MySQLiteHelper.COLUMN_ID + " = " + insertId, null,
        null, null, null);
    cursor.moveToFirst();
    Comment newComment = cursorToComment(cursor);
    cursor.close();
    return newComment;
  }

  public void deleteComment(Comment comment) {
    long id = comment.getId();
    System.out.println("Comment deleted with id: " + id);
    database.delete(MySQLiteHelper.TABLE_COMMENTS, MySQLiteHelper.COLUMN_ID
        + " = " + id, null);
  }

  public List<Comment> getAllComments() {
    List<Comment> comments = new ArrayList<Comment>();

    Cursor cursor = database.query(MySQLiteHelper.TABLE_COMMENTS,
        allColumns, null, null, null, null, null);

    cursor.moveToFirst();
    while (!cursor.isAfterLast()) {
      Comment comment = cursorToComment(cursor);
      comments.add(comment);
      cursor.moveToNext();
    }
    // Make sure to close the cursor
    cursor.close();
    return comments;
  }

  private Comment cursorToComment(Cursor cursor) {
    Comment comment = new Comment();
    comment.setId(cursor.getLong(0));
    comment.setComment(cursor.getString(1));
    return comment;
  }
}
```

4.4. User Interface

Change your *main.xml* layout file in the *res/layout* folder to the following. This layout has two buttons for adding and deleting comments and a `ListView` which will be used to display the existing comments. The comment text will be generated later in the `Activity` by a small random generator.

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical" >

    <LinearLayout
        android:id="@+id/group"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content" >

        <Button
            android:id="@+id/add"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:text="Add New"
            android:onClick="onClick"/>

        <Button
            android:id="@+id/delete"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:text="Delete First"
            android:onClick="onClick"/>

    </LinearLayout>

    <ListView
        android:id="@android:id/list"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:text="@string/hello" />

</LinearLayout>
```

Change your `TestDatabaseActivity` class. to the following. We use here a ListActivity for displaying the data.

```
package de.vogella.android.sqlite.first;

import java.util.List;
import java.util.Random;

import android.app.ListActivity;
import android.os.Bundle;
import android.view.View;
import android.widget.ArrayAdapter;

public class TestDatabaseActivity extends ListActivity {
  private CommentsDataSource datasource;

  @Override
  public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.main);

    datasource = new CommentsDataSource(this);
    datasource.open();

    List<Comment> values = datasource.getAllComments();

    // Use the SimpleCursorAdapter to show the
    // elements in a ListView
    ArrayAdapter<Comment> adapter = new ArrayAdapter<Comment>(this,
        android.R.layout.simple_list_item_1, values);
    setListAdapter(adapter);
  }

  // Will be called via the onClick attribute
  // of the buttons in main.xml
  public void onClick(View view) {
    @SuppressWarnings("unchecked")
    ArrayAdapter<Comment> adapter = (ArrayAdapter<Comment>) getListAdapter();
    Comment comment = null;
    switch (view.getId()) {
    case R.id.add:
      String[] comments = new String[] { "Cool", "Very nice", "Hate it" };
      int nextInt = new Random().nextInt(3);
      // Save the new comment to the database
      comment = datasource.createComment(comments[nextInt]);
      adapter.add(comment);
```

```
        break;
      case R.id.delete:
        if (getListAdapter().getCount() > 0) {
          comment = (Comment) getListAdapter().getItem(0);
          datasource.deleteComment(comment);
          adapter.remove(comment);
        }
        break;
      }
      adapter.notifyDataSetChanged();
    }

    @Override
    protected void onResume() {
      datasource.open();
      super.onResume();
    }

    @Override
    protected void onPause() {
      datasource.close();
      super.onPause();
    }

  }
```

4.5. Running the apps

Install your application and use the *Add* and *Delete* button. Restart your application to validate that the data is still there.

5. ContentProvider and sharing data

5.1. ContentProvider Overview

An SQLite database is private to the application which creates it. If you want to share data with other applications you can use a `ContentProvider`.

A `ContentProvider` allows applications to access data. In most cases this data is stored in an SQlite database.

A `ContentProvider` can be used internally in an application to access data. If the data should be shared with another application a `ContentProvider` allows this.

The access to a `ContentProvider` is done via an URI. The basis for the URI is defined in the declaration of the `ContentProvider` in the *AndroidManifest.xml* file via the `android:authorities` attribute.

Many Android datasources, e.g. the contacts, are accessible via `ContentProviders`. Typically the implementing classes for a `ContentProviders` provide public constants for the URIs.

5.2. Own ContentProvider

To create your own `ContentProvider` you have to define a class which extends `android.content.ContentProvider`. You also declare your `ContentProvider` in the *AndroidManifest.xml* file. This entry must specify the `android:authorities` attribute which allows to identify the `ContentProvider`. This authority is the basis for the URI to access data and must be unique.

```
<provider
       android:authorities="de.vogella.android.todos.contentprovider"
       android:name=".contentprovider.MyTodoContentProvider" >
</provider>
```

Your ContentProvider must implement several methods, e.g. `query()`, `insert()`, `update()`, `delete()`, `getType()` and `onCreate()`. In case you do not support certain methods its good practice to throw an `UnsupportedOperationException()`.

The query() method must return a Cursor object.

5.3. Security and ContentProvider

By default a `ContentProvider` will be available to other programs. If you want to use your `ContentProvider` only internally you can use the attribute `android:exported=false` in the declaration of your `ContentProvider` in the *AndroidManifest.xml* file.

5.4. Thread Safety

If you work directly with databases and have multiple writers from different threads you may run into concurrency issues.

The `ContentProvider` can be accessed from several programs at the same time, therefore you must implement the access thread-safe. The easiest way is to use the keyword `synchronized` in front of all methods of the `ContentProvider`, so that only one thread can access these methods at the same time.

If you do not require that Android synchronizes data access to the `ContentProvider`, set the `android:multiprocess=true` attribute in your <provider> definition in the *`AndroidManifest.xml`* file. This permits an instance of the provider to be created in each client process, eliminating the need to perform interprocess communication (IPC).

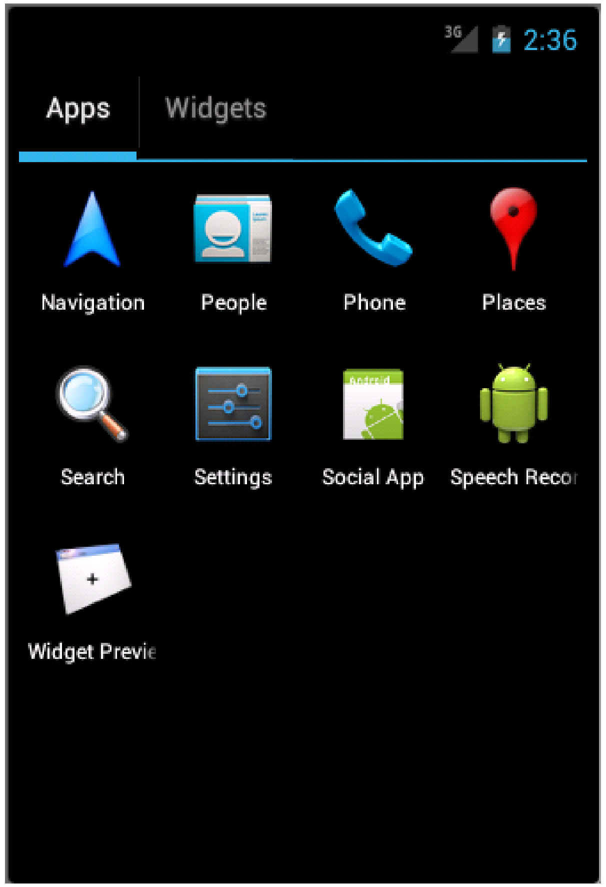
6. Tutorial: Using ContentProvider

6.1. Overview

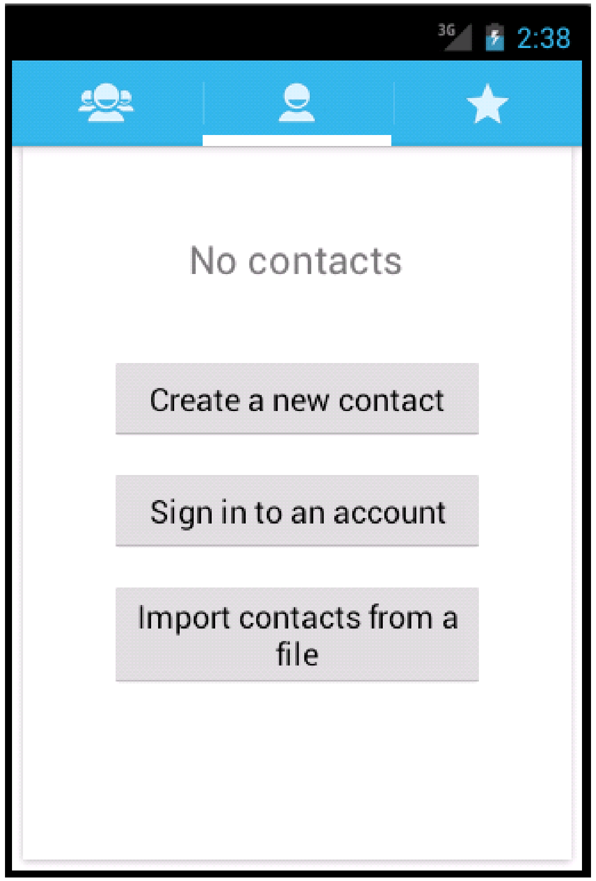
The following example will use an existing `ContentProvider` from the *People* application.

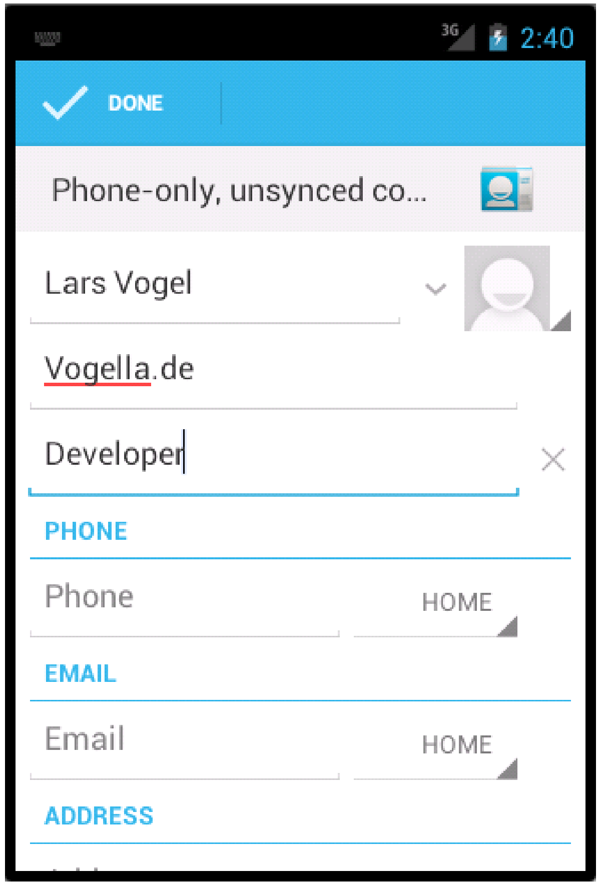
6.2. Create contacts on your emulator

For this example we need a few maintained contacts. Select the home menu and then the *People* entry to create contacts.



The app will ask you if you want to login. Either login or select "Not now". Press ""Create a new contact". You can create local contacts.


2:38
No contacts
Create a new contact
Sign in to an account
Import contacts from a file



Finish adding your first contact. Afterwards the app allows you to add more contacts via the + button. As a result you should have a few new contacts in your application.

6.3. Using the Contact Content Provider

Create a new Android project called *de.vogella.android.contentprovider* with the *Activity* called *ContactsActivity*.

Change the corresponding layout file in the `res/layout` folder. Rename the ID of the existing `TextView` to `contactview`. Delete the default text.

The resulting layout file should look like the following.

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

```
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical" >

    <TextView
        android:id="@+id/contactview"
        android:layout_width="match_parent"
        android:layout_height="match_parent" />

</LinearLayout>
```

Access to the contact `ContentProvider` requires a certain permission, as not all applications should have access to the contact information. Open the *`AndroidManifest.xml`* file, and select the *Permissions* tab. On that tab click the *Add* button, and select the *Uses Permission*. From the drop-down list select the *`android.permission.READ_CONTACTS`* entry.

Change the coding of the activity.

```
package de.vogella.android.contentprovider;

import android.app.Activity;
import android.database.Cursor;
import android.net.Uri;
import android.os.Bundle;
import android.provider.ContactsContract;
import android.widget.TextView;

public class ContactsActivity extends Activity {

/** Called when the activity is first created. */

  @Override
  public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_contacts);
    TextView contactView = (TextView) findViewById(R.id.contactview);

    Cursor cursor = getContacts();

    while (cursor.moveToNext()) {

      String displayName = cursor.getString(cursor
          .getColumnIndex(ContactsContract.Data.DISPLAY_NAME));
      contactView.append("Name: ");
      contactView.append(displayName);
      contactView.append("\n");
    }
  }
  private Cursor getContacts() {
    // Run query
    Uri uri = ContactsContract.Contacts.CONTENT_URI;
    String[] projection = new String[] { ContactsContract.Contacts._ID,
        ContactsContract.Contacts.DISPLAY_NAME };
    String selection = ContactsContract.Contacts.IN_VISIBLE_GROUP + " = '"
        + ("1") + "'";
    String[] selectionArgs = null;
    String sortOrder = ContactsContract.Contacts.DISPLAY_NAME
        + " COLLATE LOCALIZED ASC";


    return managedQuery(uri, projection, selection, selectionArgs,
        sortOrder);
  }

}
```

If you run this application the data is read from the `ContentProvider` of the People application and displayed in a `TextView`. Typically you would display such data in a `ListView`.

7. Loader

Loaders have been introduced in Android 3.0 and are part of the compatibility layer for older Android versions (from Android 1.6). They are available in the *Activity* and the *Fragment* class.

Loaders allow to load data asynchronously, can monitor the source of the data and deliver new results when the content changes. They also persists between configuration changes.

You can use the abstract `AsyncTaskLoader` class as basis for own *Loader* implementations.

For a *ContentProvider* based on an *SQLite* database you would typically use the `CursorLoader` class. This *Loader* performs the cursor query in a background thread so that the application is not blocked.

It is good practice that an *Activity* which uses a *Loader* implements the `LoaderManager.LoaderCallbacks` interface directly.

The creation of a *Loader* via the `getLoaderManager().initLoader(0, null, this)` method call.

The third parameter of `initLoader()` is the class which is called once the initialization has been started (callback class). Typically the *Activity* is used as callback class. The first parameter is a unique ID which can be used by the callback class to identify which *Loader* should be created. The second parameter is a bundle which can be given to the callback class for more information.

The `Loader` is not directly created by the `getLoaderManager().initLoader()` method call, but must be created by the callback class in the `onCreateLoader()` method.

Once the `Loader` is created the `onLoadFinished()` method of the callback class is called. Here you can update your user interface.

If the `Cursor` becomes invalid, the `onLoaderReset()` method is called on the callback class.

8. Cursors and Loaders

One of the challenges with accessing databases is that this access is slow. The other challenge is that the application needs to consider the life-cycle of the components correctly, e.g. opening and closing the cursor if a configuration change happens.

To manage the life-cycle you could use the `managedQuery()` method in *Activities* prior to Android 3.0.

As of Android 3.0 this method is deprecated and you should use the `Loader` framework to access the `ContentProvider`.

The `SimpleCursorAdapter` class, which can be used with `ListViews`, has the `swapCursor()` method. Your *Loader* can use this method to update the `Cursor` in its `onLoadFinished()` method.

The `CursorLoader` class reconnect the `Cursor` after a configuration change.

9. Tutorial: SQLite, own ContentProvider and Loader

9.1. Overview

The following demo is also available in the Android Market. To allow more users to play with the app, it has been downported to Android 2.3. If you have a barcode scanner installed on your Android phone, you can scan the following QR Code to go to the example app in the Android market. Please note that the app looks and behaves differently due to the different Android versions, e.g. you have an `OptionMenu` instead of the *ActionBar* and the theme is different.

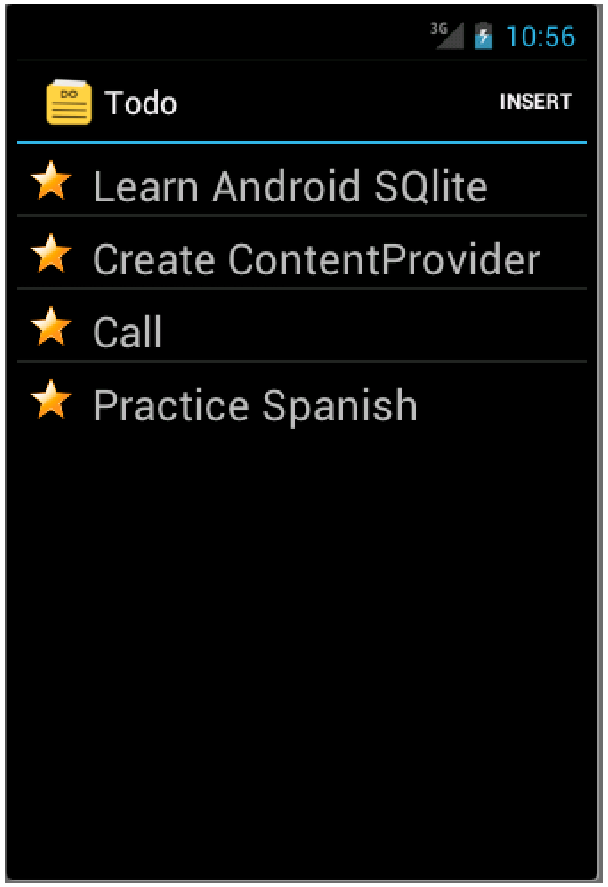
We will create a "To-do" application which allows the user to enter tasks for himself. These items will be stored in the SQLite database and accessed via a `ContentProvider`.

The tasks are called "todo items" or "todos" in this tutorial.

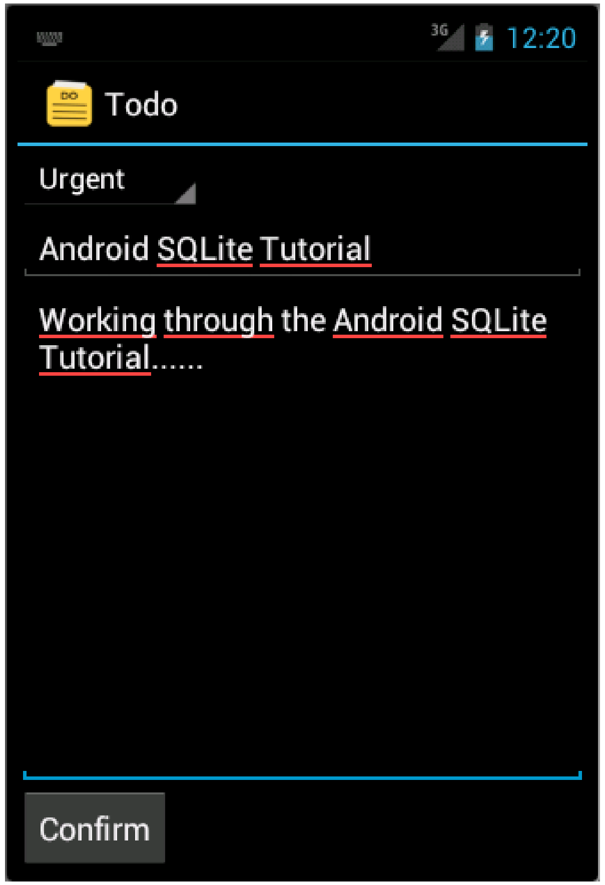
The application consists out of two *Activities*, one for seeing a list of all todo items and one for creating and changing a specific todo item. Both *Activities* will communicate via *Intents*.

To asynchronously load and manage the `Cursor` the main `Activity` will use a `Loader`.

The resulting application will look similar to the following.



Learn Android SQlite
Create ContentProvider
Call
Practice Spanish



Android SQLite Tutorial

Working through the Android SQLite Tutorial......

9.2. Project

Create the project `de.vogella.android.todos` with the `Activity` called `TodosOverviewActivity`. Create another `Activity` called `TodoDetailActivity`.

9.3. Database classes

Create the package `de.vogella.android.todos.database`. This package will store the classes for the database handling.

As said earlier I consider having one separate class per table as best practice. Even though we have only one table in this example we will follow this practice. This way we are prepared in case our database schema grows.

Create the following class. This class also contains constants for the table name and the columns.

```
package de.vogella.android.todos.database;

import android.database.sqlite.SQLiteDatabase;
import android.util.Log;

public class TodoTable {

  // Database table
  public static final String TABLE_TODO = "todo";
  public static final String COLUMN_ID = "_id";
  public static final String COLUMN_CATEGORY = "category";
  public static final String COLUMN_SUMMARY = "summary";
  public static final String COLUMN_DESCRIPTION = "description";

  // Database creation SQL statement
  private static final String DATABASE_CREATE = "create table "
      + TABLE_TODO
      + "("
      + COLUMN_ID + " integer primary key autoincrement, "
      + COLUMN_CATEGORY + " text not null, "
      + COLUMN_SUMMARY + " text not null,"
      + COLUMN_DESCRIPTION
      + " text not null"
      + ");";

  public static void onCreate(SQLiteDatabase database) {
    database.execSQL(DATABASE_CREATE);
  }

  public static void onUpgrade(SQLiteDatabase database, int oldVersion,
      int newVersion) {
    Log.w(TodoTable.class.getName(), "Upgrading database from version "
        + oldVersion + " to " + newVersion
        + ", which will destroy all old data");
    database.execSQL("DROP TABLE IF EXISTS " + TABLE_TODO);
    onCreate(database);
  }
}
```

Create the following `TodoDatabaseHelper` class. This class extends `SQLiteOpenHelper` and calls the static methods of the `TodoTable` helper class.

```
package de.vogella.android.todos.database;

import android.content.Context;
import android.database.sqlite.SQLiteDatabase;
import android.database.sqlite.SQLiteOpenHelper;

public class TodoDatabaseHelper extends SQLiteOpenHelper {

  private static final String DATABASE_NAME = "todotable.db";
  private static final int DATABASE_VERSION = 1;

  public TodoDatabaseHelper(Context context) {
    super(context, DATABASE_NAME, null, DATABASE_VERSION);
  }

  // Method is called during creation of the database
  @Override
  public void onCreate(SQLiteDatabase database) {
    TodoTable.onCreate(database);
  }

  // Method is called during an upgrade of the database,
  // e.g. if you increase the database version
  @Override
  public void onUpgrade(SQLiteDatabase database, int oldVersion,
      int newVersion) {
    TodoTable.onUpgrade(database, oldVersion, newVersion);
  }
}
```

We will use a `ContentProvider` for accessing the database; we will not write a data access object (DAO) as we did in the previous SQlite example.

9.4. Create ContentProvider

Create the package `de.vogella.android.todos.contentprovider`.

Create the following `MyTodoContentProvider` class which extends `ContentProvider`.

```
package de.vogella.android.todos.contentprovider;

import java.util.Arrays;
import java.util.HashSet;

import android.content.ContentProvider;
import android.content.ContentResolver;
import android.content.ContentValues;
import android.content.UriMatcher;
import android.database.Cursor;
import android.database.sqlite.SQLiteDatabase;
import android.database.sqlite.SQLiteQueryBuilder;
import android.net.Uri;
```

```java
import android.text.TextUtils;
import de.vogella.android.todos.database.TodoDatabaseHelper;
import de.vogella.android.todos.database.TodoTable;

public class MyTodoContentProvider extends ContentProvider {

  // database
  private TodoDatabaseHelper database;

  // Used for the UriMacher
  private static final int TODOS = 10;
  private static final int TODO_ID = 20;

  private static final String AUTHORITY = "de.vogella.android.todos.contentprovider";

  private static final String BASE_PATH = "todos";
  public static final Uri CONTENT_URI = Uri.parse("content://" + AUTHORITY
      + "/" + BASE_PATH);

  public static final String CONTENT_TYPE = ContentResolver.CURSOR_DIR_BASE_TYPE
      + "/todos";
  public static final String CONTENT_ITEM_TYPE = ContentResolver.CURSOR_ITEM_BASE_TYPE
      + "/todo";

  private static final UriMatcher sURIMatcher = new UriMatcher(UriMatcher.NO_MATCH);
  static {
    sURIMatcher.addURI(AUTHORITY, BASE_PATH, TODOS);
    sURIMatcher.addURI(AUTHORITY, BASE_PATH + "/#", TODO_ID);
  }

  @Override
  public boolean onCreate() {
    database = new TodoDatabaseHelper(getContext());
    return false;
  }

  @Override
  public Cursor query(Uri uri, String[] projection, String selection,
      String[] selectionArgs, String sortOrder) {

    // Uisng SQLiteQueryBuilder instead of query() method
    SQLiteQueryBuilder queryBuilder = new SQLiteQueryBuilder();

    // Check if the caller has requested a column which does not exists
    checkColumns(projection);

    // Set the table
    queryBuilder.setTables(TodoTable.TABLE_TODO);

    int uriType = sURIMatcher.match(uri);
    switch (uriType) {
    case TODOS:
      break;
    case TODO_ID:
      // Adding the ID to the original query
      queryBuilder.appendWhere(TodoTable.COLUMN_ID + "="
          + uri.getLastPathSegment());
      break;
    default:
      throw new IllegalArgumentException("Unknown URI: " + uri);
    }

    SQLiteDatabase db = database.getWritableDatabase();
    Cursor cursor = queryBuilder.query(db, projection, selection,
        selectionArgs, null, null, sortOrder);
    // Make sure that potential listeners are getting notified
    cursor.setNotificationUri(getContext().getContentResolver(), uri);

    return cursor;
  }

  @Override
  public String getType(Uri uri) {
    return null;
  }

  @Override
  public Uri insert(Uri uri, ContentValues values) {
    int uriType = sURIMatcher.match(uri);
    SQLiteDatabase sqlDB = database.getWritableDatabase();
    int rowsDeleted = 0;
    long id = 0;
    switch (uriType) {
    case TODOS:
      id = sqlDB.insert(TodoTable.TABLE_TODO, null, values);
      break;
    default:
      throw new IllegalArgumentException("Unknown URI: " + uri);
    }
    getContext().getContentResolver().notifyChange(uri, null);
    return Uri.parse(BASE_PATH + "/" + id);
  }

  @Override
  public int delete(Uri uri, String selection, String[] selectionArgs) {
    int uriType = sURIMatcher.match(uri);
    SQLiteDatabase sqlDB = database.getWritableDatabase();
    int rowsDeleted = 0;
    switch (uriType) {
    case TODOS:
      rowsDeleted = sqlDB.delete(TodoTable.TABLE_TODO, selection,
          selectionArgs);
      break;
    case TODO_ID:
      String id = uri.getLastPathSegment();
      if (TextUtils.isEmpty(selection)) {
        rowsDeleted = sqlDB.delete(TodoTable.TABLE_TODO,
            TodoTable.COLUMN_ID + "=" + id,
            null);
      } else {
        rowsDeleted = sqlDB.delete(TodoTable.TABLE_TODO,
            TodoTable.COLUMN_ID + "=" + id
            + " and " + selection,
            selectionArgs);
      }
      break;
    default:
      throw new IllegalArgumentException("Unknown URI: " + uri);
    }
    getContext().getContentResolver().notifyChange(uri, null);
    return rowsDeleted;
  }

  @Override
  public int update(Uri uri, ContentValues values, String selection,
      String[] selectionArgs) {

    int uriType = sURIMatcher.match(uri);
    SQLiteDatabase sqlDB = database.getWritableDatabase();
    int rowsUpdated = 0;
    switch (uriType) {
    case TODOS:
      rowsUpdated = sqlDB.update(TodoTable.TABLE_TODO,
          values,
          selection,
          selectionArgs);
      break;
    case TODO_ID:
      String id = uri.getLastPathSegment();
      if (TextUtils.isEmpty(selection)) {
        rowsUpdated = sqlDB.update(TodoTable.TABLE_TODO,
            values,
            TodoTable.COLUMN_ID + "=" + id,
            null);
      } else {
        rowsUpdated = sqlDB.update(TodoTable.TABLE_TODO,
            values,
            TodoTable.COLUMN_ID + "=" + id
            + " and "
            + selection,
            selectionArgs);
      }
      break;
    default:
      throw new IllegalArgumentException("Unknown URI: " + uri);
    }
    getContext().getContentResolver().notifyChange(uri, null);
    return rowsUpdated;
  }
```

```
  private void checkColumns(String[] projection) {
    String[] available = { TodoTable.COLUMN_CATEGORY,
        TodoTable.COLUMN_SUMMARY, TodoTable.COLUMN_DESCRIPTION,
        TodoTable.COLUMN_ID };
    if (projection != null) {
      HashSet<String> requestedColumns = new HashSet<String>(Arrays.asList(projection));
      HashSet<String> availableColumns = new HashSet<String>(Arrays.asList(available));
      // Check if all columns which are requested are available
      if (!availableColumns.containsAll(requestedColumns)) {
        throw new IllegalArgumentException("Unknown columns in projection");
      }
    }
  }

}
```

`MyTodoContentProvider` implements `update()`, `insert()`, `delete()` and `query()` methods. These methods map more or less directly to the `SQLiteDatabase` interface.

It also has the `checkColumns()` method to validate that a query only requests valid columns.

Register your `ContentProvider` in your AndroidManifest.xml file.

```
<application
  <!-- Place the following after the Activity
       Definition
  -->
  <provider
      android:name=".contentprovider.MyTodoContentProvider"
      android:authorities="de.vogella.android.todos.contentprovider" >
   </provider>
</application>
```

9.5. Resources

Our application requires several resources. First define a menu `listmenu.xml` in the folder `res/menu`. If you use the Android resource wizard to create the "listmenu.xml" file, the folder will be created for you; if you create the file manually you also need to create the folder manually.

This XML file will be used to define the option menu in our application. The `android:showAsAction="always"` attribute will ensure that this menu entry is displayed in the *ActionBar* of our application.

```
<?xml version="1.0" encoding="utf-8"?>
<menu xmlns:android="http://schemas.android.com/apk/res/android" >

    <item
        android:id="@+id/insert"
        android:showAsAction="always"
        android:title="Insert">
    </item>

</menu>
```

The user will be able to select the priority for the todo items. For the priorities we create a string array. Create the following file `priority.xml` in the `res/values` folder .

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

    <string-array name="priorities">
        <item>Urgent</item>
        <item>Reminder</item>
    </string-array>

</resources>
```

Define also additional strings for the application. Edit `strings.xml` under `res/values`.

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
  <string name="hello">Hello World, Todo!</string>
  <string name="app_name">Todo</string>
  <string name="no_todos">Currently there are no Todo items maintained</string>
  <string name="menu_insert">Add Item</string>
  <string name="menu_delete">Delete Todo</string>
  <string name="todo_summary">Summary</string>
  <string name="todo_description">Delete Todo</string>
  <string name="todo_edit_summary">Summary</string>
  <string name="todo_edit_description">Description</string>
  <string name="todo_edit_confirm">Confirm</string>
</resources>
```

9.6. Layouts

We will define three layouts. One will be used for the display of a row in the list, the other ones will be used by our *Activities*.

The row layout refers to an icon called *reminder*. Paste an icon of type "png" called "reminder.png" into your `res/drawable` folders (`drawable-hdpi`, `drawable-mdpi`, `drawable-ldpi`)

If you do not have an icon available you can copy the icon created by the Android wizard (ic_launcher.png in the res/drawable* folders) or rename the reference in the layout file. Please note that the Android Development Tools sometimes change the name of this generated icon , so your file might not be called "ic_launcher.png".

Alternatively you could remove the icon definition from the "todo_row.xml" layout definition file which you will create in the next step.

Create the "todo_row.xml" layout file in the folder *`res/layout`*.

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="wrap_content" >

    <ImageView
        android:id="@+id/icon"
        android:layout_width="30dp"
        android:layout_height="24dp"
        android:layout_marginLeft="4dp"
        android:layout_marginRight="8dp"
        android:layout_marginTop="8dp"
        android:src="@drawable/reminder" >
    </ImageView>

    <TextView
        android:id="@+id/label"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:layout_marginTop="6dp"
        android:lines="1"
        android:text="@+id/TextView01"
        android:textSize="24dp"
        >
    </TextView>

</LinearLayout>
```

Create the `todo_list.xml` layout file. This layout defines how the list looks like.

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
```

```
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical" >

    <ListView
        android:id="@android:id/list"
        android:layout_width="match_parent"
        android:layout_height="wrap_content" >
    </ListView>

    <TextView
        android:id="@android:id/empty"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/no_todos" />

</LinearLayout>
```

Create the `todo_edit.xml` layout file. This layout will be used to display and edit an individual todo item in the `TodoDetailActivity` `Activity`.

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical" >

    <Spinner
        android:id="@+id/category"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:entries="@array/priorities" >
    </Spinner>

    <LinearLayout
        android:id="@+id/LinearLayout01"
        android:layout_width="match_parent"
        android:layout_height="wrap_content" >

        <EditText
            android:id="@+id/todo_edit_summary"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="1"
            android:hint="@string/todo_edit_summary"
            android:imeOptions="actionNext" >
        </EditText>
    </LinearLayout>

    <EditText
```

```
        android:id="@+id/todo_edit_description"
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:layout_weight="1"
        android:gravity="top"
        android:hint="@string/todo_edit_description"
        android:imeOptions="actionNext" >
    </EditText>

    <Button
        android:id="@+id/todo_edit_button"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/todo_edit_confirm" >
    </Button>

</LinearLayout>
```

9.7. Activities

Change the coding of your activities to the following. First `TodosOverviewActivity.java`.

```
package de.vogella.android.todos;

import android.app.ListActivity;
import android.app.LoaderManager;
import android.content.CursorLoader;
import android.content.Intent;
import android.content.Loader;
import android.database.Cursor;
import android.net.Uri;
import android.os.Bundle;
import android.view.ContextMenu;
import android.view.ContextMenu.ContextMenuInfo;
import android.view.Menu;
import android.view.MenuInflater;
import android.view.MenuItem;
import android.view.View;
import android.widget.AdapterView.AdapterContextMenuInfo;
import android.widget.ListView;
import android.widget.SimpleCursorAdapter;
import de.vogella.android.todos.contentprovider.MyTodoContentProvider;
import de.vogella.android.todos.database.TodoTable;

/*
 * TodosOverviewActivity displays the existing todo items
 * in a list
 *
 * You can create new ones via the ActionBar entry "Insert"
 * You can delete existing ones via a long press on the item
 */

public class TodosOverviewActivity extends ListActivity implements
    LoaderManager.LoaderCallbacks<Cursor> {
  private static final int ACTIVITY_CREATE = 0;
  private static final int ACTIVITY_EDIT = 1;
  private static final int DELETE_ID = Menu.FIRST + 1;
  // private Cursor cursor;
  private SimpleCursorAdapter adapter;


/** Called when the activity is first created. */

  @Override
  public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.todo_list);
    this.getListView().setDividerHeight(2);
    fillData();
    registerForContextMenu(getListView());
  }

  // Create the menu based on the XML defintion
  @Override
  public boolean onCreateOptionsMenu(Menu menu) {
    MenuInflater inflater = getMenuInflater();
    inflater.inflate(R.menu.listmenu, menu);
    return true;
  }

  // Reaction to the menu selection
  @Override
  public boolean onOptionsItemSelected(MenuItem item) {
    switch (item.getItemId()) {
    case R.id.insert:
      createTodo();
      return true;
    }
    return super.onOptionsItemSelected(item);
  }

  @Override
  public boolean onContextItemSelected(MenuItem item) {
    switch (item.getItemId()) {
    case DELETE_ID:
      AdapterContextMenuInfo info = (AdapterContextMenuInfo) item
          .getMenuInfo();
      Uri uri = Uri.parse(MyTodoContentProvider.CONTENT_URI + "/"
          + info.id);
      getContentResolver().delete(uri, null, null);
      fillData();
      return true;
    }
    return super.onContextItemSelected(item);
  }

  private void createTodo() {
    Intent i = new Intent(this, TodoDetailActivity.class);
    startActivity(i, ACTIVITY_CREATE);
  }

  // Opens the second activity if an entry is clicked
  @Override
  protected void onListItemClick(ListView l, View v, int position, long id) {
    super.onListItemClick(l, v, position, id);
    Intent i = new Intent(this, TodoDetailActivity.class);
    Uri todoUri = Uri.parse(MyTodoContentProvider.CONTENT_URI + "/" + id);
    i.putExtra(MyTodoContentProvider.CONTENT_ITEM_TYPE, todoUri);

    // Activity returns an result if called with startActivityForResult
    startActivity(i, ACTIVITY_EDIT);
  }



  private void fillData() {

    // Fields from the database (projection)
    // Must include the _id column for the adapter to work
    String[] from = new String[] { TodoTable.COLUMN_SUMMARY };
    // Fields on the UI to which we map
    int[] to = new int[] { R.id.label };

    getLoaderManager().initLoader(0, null, this);
    adapter = new SimpleCursorAdapter(this, R.layout.todo_row, null, from,
        to, 0);

    setListAdapter(adapter);
  }

  @Override
  public void onCreateContextMenu(ContextMenu menu, View v,
      ContextMenuInfo menuInfo) {
    super.onCreateContextMenu(menu, v, menuInfo);
    menu.add(0, DELETE_ID, 0, R.string.menu_delete);
  }

  // Creates a new loader after the initLoader () call
  @Override
  public Loader<Cursor> onCreateLoader(int id, Bundle args) {
    String[] projection = { TodoTable.COLUMN_ID, TodoTable.COLUMN_SUMMARY };
    CursorLoader cursorLoader = new CursorLoader(this,
        MyTodoContentProvider.CONTENT_URI, projection, null, null, null);
    return cursorLoader;
  }
  @Override
  public void onLoadFinished(Loader<Cursor> loader, Cursor data) {
    adapter.swapCursor(data);
  }

  @Override
  public void onLoaderReset(Loader<Cursor> loader) {
    // data is not available anymore, delete reference
    adapter.swapCursor(null);
  }

}
```

And `TodoDetailActivity.java`

```
package de.vogella.android.todos;

import android.app.Activity;
import android.content.ContentValues;
import android.database.Cursor;
import android.net.Uri;
import android.os.Bundle;
import android.text.TextUtils;
import android.view.View;
import android.widget.Button;
import android.widget.EditText;
import android.widget.Spinner;
import android.widget.Toast;
import de.vogella.android.todos.contentprovider.MyTodoContentProvider;
import de.vogella.android.todos.database.TodoTable;

/*
 * TodoDetailActivity allows to enter a new todo item
 * or to change an existing
 */
public class TodoDetailActivity extends Activity {
  private Spinner mCategory;
  private EditText mTitleText;
  private EditText mBodyText;

  private Uri todoUri;

  @Override
  protected void onCreate(Bundle bundle) {
    super.onCreate(bundle);
    setContentView(R.layout.todo_edit);

    mCategory = (Spinner) findViewById(R.id.category);
    mTitleText = (EditText) findViewById(R.id.todo_edit_summary);
    mBodyText = (EditText) findViewById(R.id.todo_edit_description);
    Button confirmButton = (Button) findViewById(R.id.todo_edit_button);

    Bundle extras = getIntent().getExtras();

    // Check from the saved Instance
    todoUri = (bundle == null) ? null : (Uri) bundle
        .getParcelable(MyTodoContentProvider.CONTENT_ITEM_TYPE);

    // Or passed from the other activity
    if (extras != null) {
      todoUri = extras
          .getParcelable(MyTodoContentProvider.CONTENT_ITEM_TYPE);

      fillData(todoUri);
    }

    confirmButton.setOnClickListener(new View.OnClickListener() {
      public void onClick(View view) {
        if (TextUtils.isEmpty(mTitleText.getText().toString())) {
          makeToast();
        } else {
          setResult(RESULT_OK);
          finish();
        }
      }

    });
  }

  private void fillData(Uri uri) {
    String[] projection = { TodoTable.COLUMN_SUMMARY,
        TodoTable.COLUMN_DESCRIPTION, TodoTable.COLUMN_CATEGORY };
    Cursor cursor = getContentResolver().query(uri, projection, null, null,
        null);
    if (cursor != null) {
      cursor.moveToFirst();
      String category = cursor.getString(cursor
          .getColumnIndexOrThrow(TodoTable.COLUMN_CATEGORY));

      for (int i = 0; i < mCategory.getCount(); i++) {

        String s = (String) mCategory.getItemAtPosition(i);
        if (s.equalsIgnoreCase(category)) {
          mCategory.setSelection(i);
        }
      }

      mTitleText.setText(cursor.getString(cursor
          .getColumnIndexOrThrow(TodoTable.COLUMN_SUMMARY)));
      mBodyText.setText(cursor.getString(cursor
          .getColumnIndexOrThrow(TodoTable.COLUMN_DESCRIPTION)));

      // Always close the cursor
      cursor.close();
    }
  }

  protected void onSaveInstanceState(Bundle outState) {
    super.onSaveInstanceState(outState);
    saveState();
    outState.putParcelable(MyTodoContentProvider.CONTENT_ITEM_TYPE, todoUri);
  }

  @Override
  protected void onPause() {
    super.onPause();
    saveState();
  }

  private void saveState() {
    String category = (String) mCategory.getSelectedItem();
    String summary = mTitleText.getText().toString();
    String description = mBodyText.getText().toString();

    // Only save if either summary or description
    // is available

    if (description.length() == 0 && summary.length() == 0) {
      return;
    }

    ContentValues values = new ContentValues();
    values.put(TodoTable.COLUMN_CATEGORY, category);
    values.put(TodoTable.COLUMN_SUMMARY, summary);
    values.put(TodoTable.COLUMN_DESCRIPTION, description);

    if (todoUri == null) {
      // New todo
      todoUri = getContentResolver().insert(MyTodoContentProvider.CONTENT_URI, values);
    } else {
      // Update todo
      getContentResolver().update(todoUri, values, null, null);
    }
  }

  private void makeToast() {
    Toast.makeText(TodoDetailActivity.this, "Please maintain a summary",
        Toast.LENGTH_LONG).show();
  }
}
```

The resulting `AndroidManifest.xml` looks like the following.

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

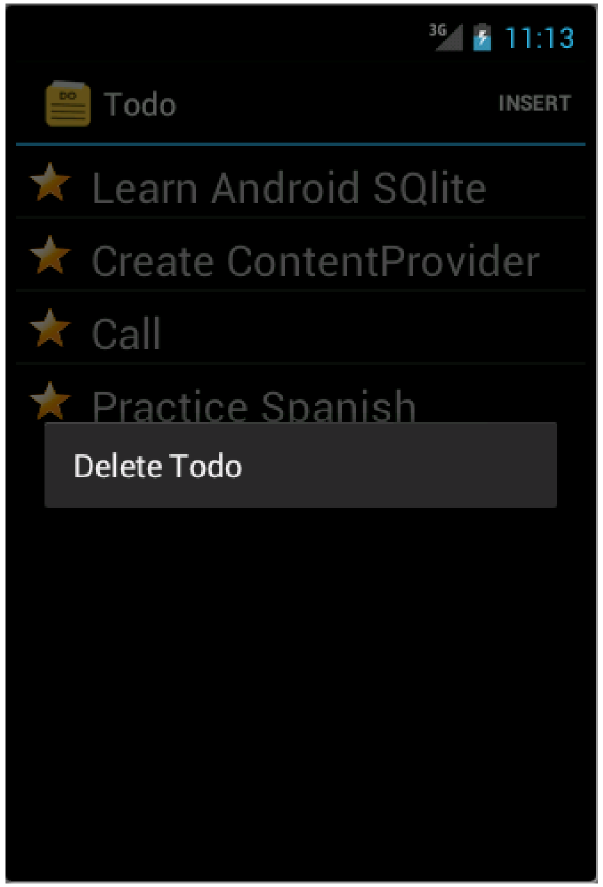
```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="de.vogella.android.todos"
    android:versionCode="1"
    android:versionName="1.0" >

    <uses-sdk android:minSdkVersion="15" />

    <application
        android:icon="@drawable/icon"
        android:label="@string/app_name" >
        <activity
            android:name=".TodosOverviewActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
        <activity
            android:name=".TodoDetailActivity"
            android:windowSoftInputMode="stateVisible|adjustResize" >
        </activity>

        <provider
            android:name=".contentprovider.MyTodoContentProvider"
            android:authorities="de.vogella.android.todos.contentprovider" >
        </provider>
    </application>

</manifest>
```

Please note that android:windowSoftInputMode="stateVisible|adjustResize" is defined for the `TodoDetailActivity`. This makes the keyboard harmonize better with the widgets, but it is not required for this tutorial.

9.8. Start your application

Start your application. You should be able to enter a new todo item via the "Insert" button in the ActionBar.

An existing todo item can be deleted on the list via a long press.



To change an existing todo item, touch the corresponding row. This starts the second `Activity`.

10. Accessing SQLite databases directly

10.1. Storage location of the SQLite database

SQlite stores the whole database in a file. If you have access to this file, you can work directly with the data base. Accessing the SQlite database file only works in the emulator or on a rooted device.

A standard Android device will not grant read-access to the database file.

10.2. Shell access to the database

It is possible to access an SQLite database on the emulator or a rooted device via the command line. For this use the following command to connect to the device.

```
adb shell
```

The command adb is located in your Android SDK installation folder in the "platform-tools" subfolder.

Afterwards you use the "cd" command to switch the database directory and use the "sqlite3" command to connect to a database. For example in my case:

```
# Switch to the data directory
cd /data/data
# Our application
cd de.vogella.android.todos
# Switch to the database dir
cd databases
# Check the content
ls
# Assuming that there is a todotable file
# connect to this table
sqlite3 todotable.db
```

The most important commands are:

Table 2. SQlite commands

Command	**Description**
.help	List all commands and options.
.exit	Exit the sqlite3 command.
.schema	Show the CREATE statements which were used to create the tables of the current database.

You find the complete documentation of SQlite at **http://www.sqlite.org/sqlite.html** .

11. More on ListViews

Please see **Android ListView Tutorial** for an introduction into `ListViews` and `ListActivities` .

12. Get the Kindle edition

This tutorial is available for your Kindle.

Wizard's Wand
vogella
Android SQLite Database and ContentProvider
Storing and accessing your data in the embedded database
Kindle Edition
Lars Vogel

13. Questions and Discussion

Before posting questions, please see the **vogella FAQ**. If you have questions or find an error in this article please use the **www.vogella.com Google Group**. I have created a short list **how to create good questions** which might also help you.

14. Links and Literature

14.1. Source Code

Source Code of Examples

14.2. Android SQLite resources

SQlite website

SQL Tutorial

SQLiteManager Eclipse Plug-in

14.3. Android Resources

Android Tutorial

ListView Tutorial

Intents

Android Background Processing Tutorial

Android Location API and Google Maps

Android and Networking

14.4. vogella Resources

vogella Training Android and Eclipse Training from the vogella team

Android Tutorial Introduction to Android Programming

GWT Tutorial Program in Java and compile to JavaScript and HTML

Eclipse RCP Tutorial Create native applications in Java

JUnit Tutorial Test your application

Git Tutorial Put everything you have under distributed version control system