*Lesson 17*

# Android Persistency: SQL Databases

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Notes are based on:

Android Developers
http://developer.android.com/index.html

# SQL Databases

## Using SQL databases in Android.

Android (as well as iPhone OS) uses an embedded standalone program called **SQLite** which can be used to:

create a database,
define SQL tables,
indices,
queries,
views,
triggers

Insert rows,
delete rows,
change rows,
run queries and
administer a SQLite database file.

# SQL Databases

## About SQLite

Characteristics of SQLite:

- self-contained,
- serverless,
- zero-configuration,
- transactional SQL database engine.

According to their website, SQLite is the *most widely deployed SQL database engine in the world* . The source code for SQLite is in the public domain.

**Reference**:
http://sqlite.org/index.html

# SQL Databases

## Using SQLite

1. SQLite implements most of the SQL-92 standard for SQL.
2. It has partial support for triggers and allows most complex queries (exceptions include: *right/full outer joins, grant/revoke, updatable views*).
3. SQLITE *does not implement referential integrity constraints* through the *foreign key* constraint model.
4. SQLite uses a *relaxed data typing model*.
5. Instead of assigning a type to an entire column, types are assigned to individual values (this is similar to the *Variant* type in Visual Basic).
6. There is no data type checking, therefore it is possible to insert a string into numeric column and so on.

Documentation on SQLITE available at http://www.sqlite.org/sqlite.html
Good GUI tool for SQLITE available at: http://sqliteadmin.orbmu2k.de/

# SQL Databases

## How to create a SQLite database?
## Method 1

```
public static SQLiteDatabase.openDatabase ( String path,
                    SQLiteDatabase.CursorFactory factory,
                    int flags )
```

Open the database according to the flags OPEN_READWRITE, OPEN_READONLY, CREATE_IF_NECESSARY . Sets the locale of the database to the system's current locale.

***Parameters***

**path** to database file to open and/or create

**factory** an optional factory class that is called to instantiate a cursor when query is called, or null for default

**flags** to control database access mode

**Returns** the newly opened database

**Throws** *SQLiteException* if the database cannot be opened

# SQL Databases

## How to create a SQLite database?
## Method 1

```
SQLiteDatabase.openDatabase(  myDbPath,
                              null,
                              SQLiteDatabase.CREATE_IF_NECESSARY);
```

Open the database according to the flags OPEN_READWRITE, OPEN_READONLY, CREATE_IF_NECESSARY . Sets the locale of the database to the system's current locale.

***Parameters***

**path** to database file to open and/or create

**factory** an optional factory class that is called to instantiate a cursor when query is called, or null for default

**flags** to control database access mode

**Returns** the newly opened database

**Throws** *SQLiteException* if the database cannot be opened

# Example 1. Create a SQLite Database

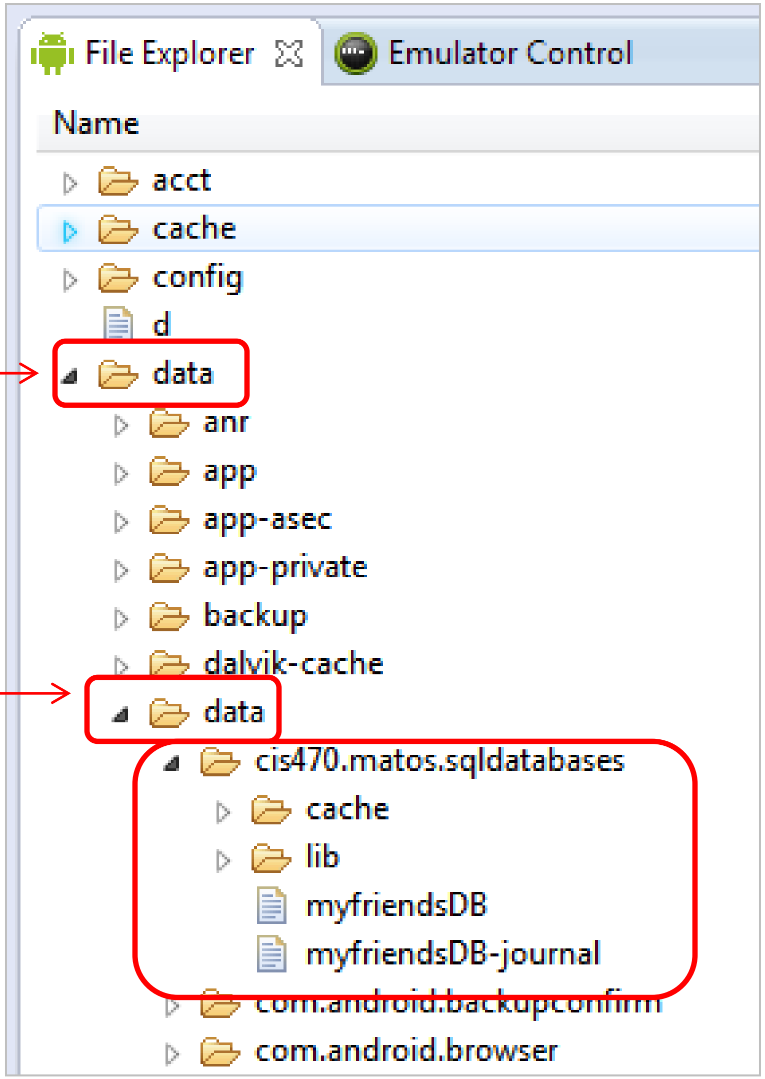
```
package cis70.matos.sqldatabases;
public class SQLDemo1 extends Activity {
   SQLiteDatabase db;
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
        // this provides the 'real' path name to theexternal SD card
        String SDcardPath = Environment.getExternalStorageDirectory().getPath();
        // For internal memory: "data/data/cis470.matos.sqldatabases/myfriendsDB"
        TextView txtMsg = (TextView)findViewById(R.id.txtMsg);
          String myDbPath = SDcardPath + "/" + "myfriends";
          txtMsg.setText("DB Path: " + myDbPath);
          try {
                db = SQLiteDatabase.openDatabase(myDbPath,
                                          null,
                                          SQLiteDatabase.CREATE_IF_NECESSARY);
          // here you do something with your database ...
          db.close();
          txtMsg.append("\nAll done!");
        }
        catch (SQLiteException e) {
           txtMsg.append( e.getMessage() );
        }
    }//onCreate
}//class
```

# SQL Databases

## Example 1.
## Create a SQLite Database using Internal Memory

**Android's System Image:**

/data/data/cis470.matos.sqldatabases/myfriendsDB



# SQL Databases

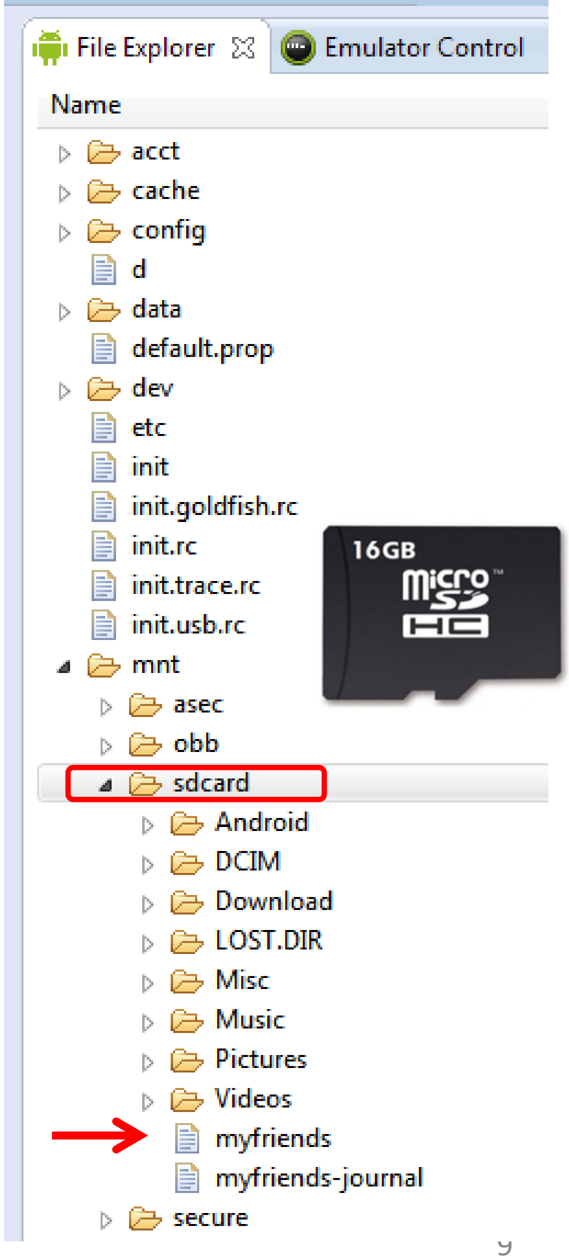
## Example 1.
## Creating the database  file on the SD card

Using:

```
SQLiteDatabase db;

db = SQLiteDatabase.openDatabase(
         "sdcard/myfriendsDB",
         null,
         SQLiteDatabase.CREATE_IF_NECESSARY
         );
```

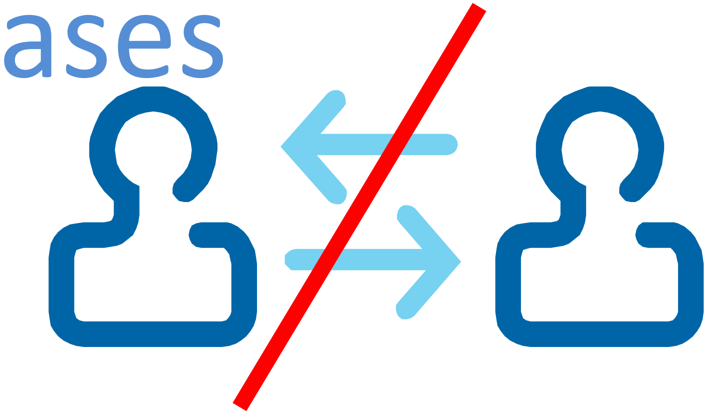
Manifest must include:

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



```
acct
cache
config
d
data
default.prop
dev
etc
init
init.goldfish.rc
init.rc
init.trace.rc
init.usb.rc
mnt
  asec
  obb
  sdcard
    Android
    DCIM
    Download
    LOST.DIR
    Misc
    Music
    Pictures
    Videos
    myfriends
    myfriends-journal
  secure
```

# SQL Databases



## Warning

Beware of sharing issues.

You *cannot* access internal databases belonging to other people (instead use Content Providers or external SD resident DBs).

An SD resident database requires the Manifest to include:

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

**NOTE:** *SQLITE (as well as most DBMSs) is not case sensitive.*

# SQL Databases

## Example2

**An alternative way of opening/creating a SQLITE database in your local Android's data space is given below**

```
  SQLiteDatabase  db =  this.openOrCreateDatabase(
                             "myfriendsDB",
                              MODE_PRIVATE,
                              null);
```

If this app is created in a namespace called "**cis493.sql1**", the full name of the newly created database file will be:

**/data/data/cis493.sql1/databases/myfriendsDB**

This file could later be used by other activities in the app or exported out of the emulator (adb push…) and given to a tool such as SQLITE_ADMINISTRATOR (see notes at the end).

# SQL Databases

## Example2

### An alternative way of opening/creating a SQLITE database in your local Android’s System Image is given below

```
SQLiteDatabase  db =  this.openOrCreateDatabase(
                                "myfriendsDB2",
                                 MODE_PRIVATE,
                                 null);
```

Where:

1. **“myFriendsDB2”** is the abbreviated file path. The prefix is assigned by Android as: /data/data/<app namespace>/databases/myFriendsDB2.

2. **MODE** could be: MODE_PRIVATE, MODE_WORLD_READABLE, and MODE_WORLD_WRITEABLE. Meaningful for apps consisting of multiples activities.

3. **null** refers to optional **factory** class parameter (skip for now)

# SQL Databases

## Executing SQL commands on the Database

Once created, the database is ready for normal operations such as:
*creating, altering, dropping resources (tables, indices, triggers, views, queries etc.) or administrating database resources (containers, users, …).*

***Action* queries** and ***Retrieval* queries** represent the most common operations against the database.

- A *retrieval* query is typically a *SQL-Select* command in which a table holding a number of fields and rows is produced as an answer to a data request.

- An *action* query usually performs maintenance and administrative tasks such as manipulating tables, users, environment, etc.

# SQL Databases

## Transaction Processing

Transactions are desirable because they help maintaining consistent data and prevent unwanted data losses due to abnormal termination of execution.

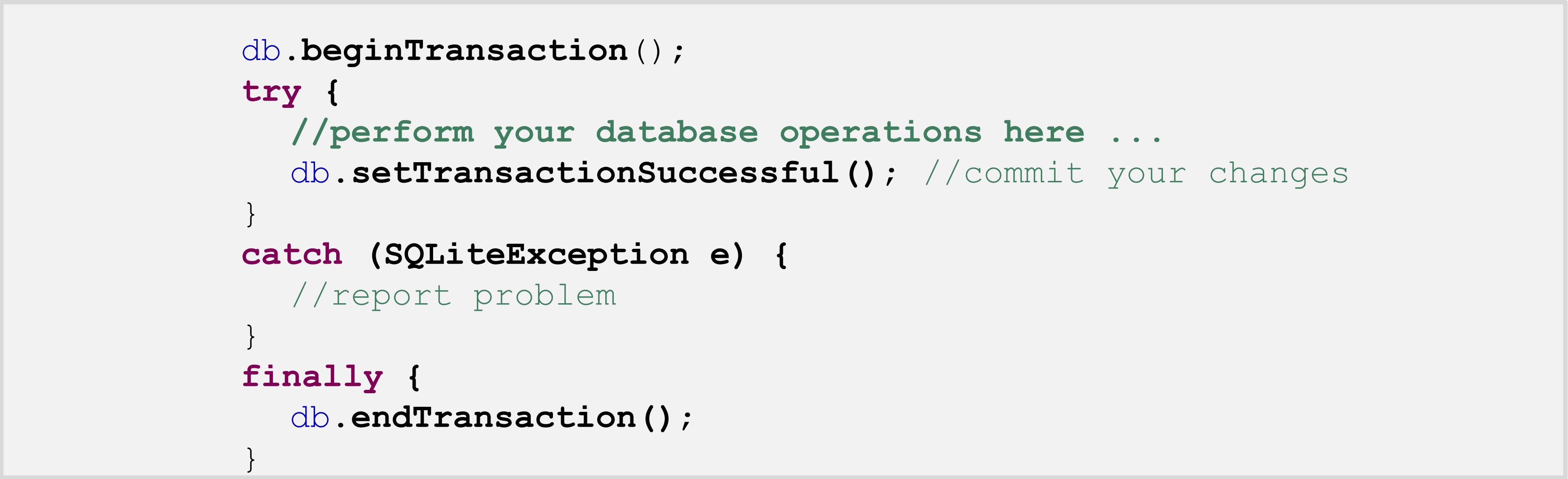
In general it is convenient to process *action queries* inside the protective frame of a *database transaction* in which the policy of "*complete success or total failure*" is transparently enforced.

*This notion is called: **atomicity** to reflect that all parts of a method are fused in an indivisible-like statement.*

# SQL Databases

## Transaction Processing

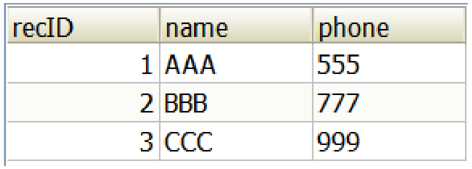
The typical Android way of running transactions on a SQLiteDatabase is illustrated in the following fragment (Assume **db** is defined as a  SQLiteDatabase)



```
db.beginTransaction();
try {
   //perform your database operations here ...
   db.setTransactionSuccessful(); //commit your changes
}
catch (SQLiteException e) {
   //report problem
}
finally {
   db.endTransaction();
}
```

The transaction is defined between the methods: *beginTransaction* and *endTransaction*. You need to issue the *setTransactionSuccessful*()call to commit any changes. The absence of it provokes an implicit *rollback; consequently the database is reset to the state previous to the beginning of the transaction*

# SQL Databases



| recID | name | phone |
|---|---|---|
| 1 | AAA | 555 |
| 2 | BBB | 777 |
| 3 | CCC | 999 |

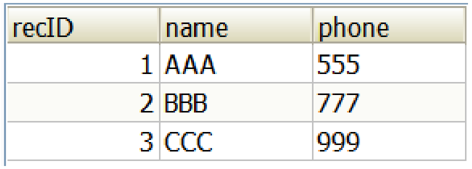
## Creating-Populating a Table

SQL Syntax for the creating and populating of a table looks like this:

```
create table tblAMIGO (
             recID integer PRIMARY KEY autoincrement,
             name  text,
             phone text );
```

```
insert into tblAMIGO(name, phone) values ('AAA', '555' );
```

# SQL Databases



| recID | name | phone |
|---|---|---|
| 1 | AAA | 555 |
| 2 | BBB | 777 |
| 3 | CCC | 999 |

## Creating-Populating a Table

We will use the **execSQL(…)** method to manipulate SQL *action queries*.
The following example creates a new table called **tblAmigo**.

The table has three fields: a numeric unique identifier called *recID*, and two string fields representing our friend's *name* and *phone*. If a table with such a name exists it is first dropped and then created anew. Finally three rows are inserted in the table.

***Note**: for presentation economy we do not show the entire code which should include a transaction frame.*

```
db.execSQL("create table tblAMIGO ("
                + " recID integer PRIMARY KEY autoincrement, "
                + " name  text, "
                + " phone text );  "    );

db.execSQL( "insert into tblAMIGO(name, phone) values ('AAA', '555' );"  );
db.execSQL( "insert into tblAMIGO(name, phone) values ('BBB', '777' );"  );
db.execSQL( "insert into tblAMIGO(name, phone) values ('CCC', '999' );"  );
```

# SQL Databases

## Creating-Populating a Table

**Comments**

1. The field **recID** is defined as **PRIMARY KEY** of the table. The "*autoincrement*" feature guarantees that each new record will be given a unique serial number (0,1,2,…).

2. The database data types are very simple, for instance we will use: ***text, varchar, integer, float, numeric, date, time, timestamp, blob, boolean,*** and so on.

3. In general, any well-formed SQL action command (`insert, delete, update, create, drop, alter`, etc.) could be framed inside an **execSQL( . . . )** method.

4. You should make the call to execSQL inside of a *try-catch-finally* block. Be aware of potential **SQLiteException** situations thrown by the method.

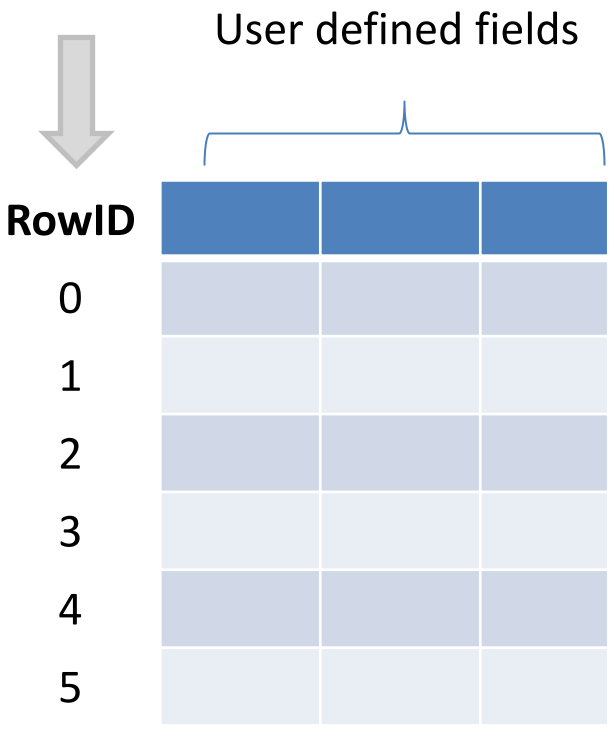
# SQL Databases

## Creating-Populating a Table

**NOTE:**

SQLITE uses an **invisible** field called ***ROWID*** to uniquely identify each row in each table.

Consequently in our example the field ***recID*** and the database ***ROWID*** are functionally similar.



User defined fields

**RowID**

0

1

2

3

4

5

# SQL Databases

## Asking SQL Questions

1. Retrieval queries are *SQL-select* statements.
2. *Answers* produced by retrieval queries are always held in an *output table.*
3. In order to process the *resulting rows*, the user should provide a **cursor** device. Cursors allow a *row-by-row access* of the records returned by the retrieval queries.

Android offers two mechanisms for phrasing SQL-select statements: ***rawQueries*** and ***simple queries***. Both return a database *cursor*.

1. **Raw queries** take for input a syntactically correct SQL-select statement. The select query could be as complex as needed and involve any number of tables (remember that *right outer joins* are not supported).

2. **Simple queries** are compact parametized select-like statements that operate on a single table (for developers who prefer not to use SQL).

# SQL Databases

## SQL Select Syntax (see http://www.sqlite.org/lang.html )

SQL-select statements are based on the following components

```
     select    field_1, field_2, … , field_n
       from    table_1, table_2,  … , table_n
```

```
      where   ( restriction-join-conditions )
   order by   field_n1, …, field_nm
   group by   field_m1, … , field_mk
     having   (group-condition)
```

The first two lines are mandatory, the rest is optional.

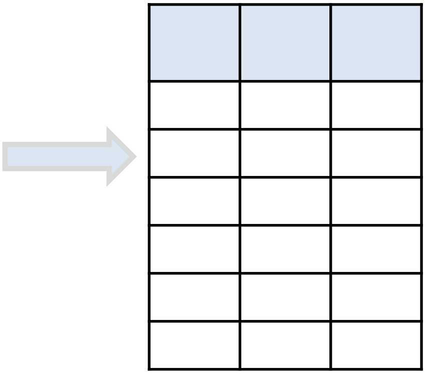
# **SQL** Databases

## Example of SQL Select Statements (see http://www.sqlite.org/lang.html )

```
  select    LastName, cellPhone
    from    ClientTable
   where    state = ‘Ohio’
order by    LastName
```

```
  select    city, count(*) as TotalClients
    from    ClientTable
group by    city
```

# SQL Databases



## Example1. Using RawQuery (version 1)

Consider the following code fragment

```
Cursor c1 = db.rawQuery(
                "select count(*) as Total from tblAMIGO",
                null);
```

1. The previous *rawQuery* contains a select-statement that counts the rows in the table tblAMIGO.
2. The result of this count is held in a table having only one row and one column. The column is called “**Total**”.
3. The cursor **c1** will be used to traverse the rows (only one!) of the resulting table.
4. Fetching a row using cursor **c1** requires advancing to the next record in the answer set.
5. Later the (singleton) field **total** must be bound to a local Java variable.
   *Soon we will show how to do that.*

# SQL Databases

## Example2. Using Parametized RawQuery (version 2)

**Using arguments.** Assume we want to count how many friends are there whose name is ‘BBB’ and their recID > 1. We could use the following construction

```
String mySQL = "select count(*) as Total "
             + " from tblAmigo "
             + " where recID > ? "
             + "   and name  = ? ";

String[] args = {"1", "BBB"};

Cursor c1 = db.rawQuery(mySQL, args);
```

? Parameters

# SQL Databases

## Example2. Using Parametized RawQuery (version 2)

### Using arguments.

After the substitutions are made the resulting SQL statement is:

```
select count(*) as Total
  from tblAmigo
 where recID > 1
   and name = ‘BBB’
```

**NOTE**:

⚠ Partial matching using expressions such as: **name like ‘?%’** does not seem to work for now. Wait for an Android fix!

# SQL Databases

## Example2. Using RawQuery (version 3)

**Using arguments.** Assume we want to count how many friends are there whose name is ‘BBB’ and their recID > 1. *We could concatenate pieces of the string. Special care around (single) quoted strings.*

```
String[] args = {"1", "BBB"};

String mySQL = " select count(*) as Total "
             + "  from tblAmigo "
             + " where recID > " + args[0]
             + "   and name  = '" + args[1] + "'";


Cursor c1 = db.rawQuery(mySQL, null);
```

# SQL Databases

## Simple Queries

Simple queries use a *template* oriented schema whose goal is to 'help' non-SQL developers in their process of querying a database. The *template* exposes a parametric version of a basic SQL select statement.

Simple queries can *only* retrieve data from a *single table*.

The method's signature has a fixed sequence of seven arguments representing:

1. the table name,
2. the columns to be retrieved,
3. the search condition (where-clause),
4. arguments for the where-clause,
5. the group-by clause,
6. having-clause, and
7. the order-by clause.

# SQL Databases

## Simple Queries

The signature of the Android’s simple query method is:

```
query( String    table,
       String[]  columns,
       String    selection,
       String[]  selectionArgs,
       String    groupBy,
       String    having,
       String    orderBy )
```

# SQL Databases

## Simple Queries. Example 1

Query the *EmployeeTable*, find the average salary of female employees supervised by 123456789. Report results by *Dno.* List first the highest average, and so on, do not include depts. having less than two employees.

```
String[] columns =
             {"Dno", "Avg(Salary) as AVG"};

String[] conditionArgs =
             {"F", "123456789"};
Cursor c =  db.query(
           "EmployeeTable",                        ← table name
           columns,                                ← columns
           "sex = ? And superSsn = ? " ,           ← condition
           conditionArgs,                          ← condition args
           "Dno",                                  ← group by
           "Count(*) > 2",                         ← having
           "AVG Desc "                             ← order by
);
```

# SQL Databases

## Simple Queries. Example 2

The following query selects from each row of the *tblAMIGO* table the columns: *recID*, *name*, and *phone*. RecID must be greater than 2, and names must begin with ‘B’ and have three or more letters.

```
 String [] columns = {"recID", "name", "phone"};

 Cursor c1 = db.query (
       "tblAMIGO",
       columns,
       "recID > 2 and length(name) >= 3 and name like 'B%' ",
       null, null, null,
       "recID" );

int theTotal = c1.getCount();
```

# SQL Databases

## Simple Queries. Example 2 (cont.)

1. The String array *columns* holds the name of fields to be selected.
2. The retrieval condition is explicitly provided.
3. Several fields are missing in the call including: *selectionArgs, group-by,* and *having-clause*. Instead the **null** value is used to signal their absence.
4. The last argument indicates the result should be sorted on "*recID*" sequence.

```
 String [] columns = {"recID", "name", "phone"};

Cursor c1 = db.query (
       "tblAMIGO",
       columns,
       "recID > 2 and length(name) >= 3 and name like 'B%' ",
       null, null, null,
       "recID" );
```

# SQL Databases

## Simple Queries. Example 3

In this example we will construct a more complex SQL select statement.

> *We are interested in tallying how many groups of friends whose recID > 3 have the same name. In addition, we want to see ‘name’ groups having no more than four people each.*

A possible SQL-select statement for this query would be something like:

```
select name, count(*) as TotalSubGroup
  from tblAMIGO
 where recID > 3
 group by name
having count(*) <= 4;
```

# SQL Databases

## Simple Queries. Example 3 (cont.)

An Android solution for the problem using a simple template query follows.

```
String [] selectColumns =  {"name", "count(*) as TotalSubGroup"};
String    whereCondition = "recID > ?";
String [] whereConditionArgs = {"3"};
String    groupBy = "name";
String    having =  "count(*) <= 4";
String    orderBy = "name";

Cursor myCur =  db.query (
                  "tblAMIGO",
                  selectColumns,
                  whereCondition, whereConditionArgs,
                  groupBy,
                  having,
                  null  );
```

# SQL Databases

## Simple Queries. Example 3 (cont.)

**Observations**

1. The *selectColumns* array indicates two fields *name* which is already part of the table, and *TotalSubGroup* which is to be computed as the count(*) of each name sub-group.

2. The symbol **?** in the *whereCondition* is a *place-marker* for a substitution. The value “**3**” taken from the *whereConditionArgs* is to be injected there.

3. The *groupBy* clause uses ‘*name’* as a key to create sub-groups of rows with the same *name* value. The *having* clause makes sure we only choose subgroups no larger than four people.

# SQL Databases

## Cursors

Android cursors are used to gain (sequential & random) access to tables produced by SQL *select* statements.

Cursors primarily provide *one row-at-the-time* operations on a table. Cursors include several types of operators, among them:

1. **Positional awareness operators** (*isFirst(), isLast(), isBeforeFirst(), isAfterLast()* ),
2. **Record Navigation** (*moveToFirst(), moveToLast(), moveToNext(), moveToPrevious(), move(n)* )
3. **Field extraction** (*getInt, getString, getFloat, getBlob, getDate, etc.*)
4. **Schema inspection** (getColumnName, getColumnNames, getColumnIndex, getColumnCount, getCount)

# SQL Databases

## Example 4. Cursors

1. The following example uses a cursor to handle the individual results of a SQL statement.
2. The select-command extracts from the tblAMIGO table the values indicated in the columns array, namely: *recID*, *name*, and *phone*.
3. The *getColumnIndex* method is called to determine the position of chosen columns in the current row.
4. The getters: *getInt*, *getString* commands are used for field extraction.
5. The *moveToNext* command forces the cursor to displace from its before-first position to the first available row.
6. The loop is executed until the cursor cannot be advanced any further.

# SQL Databases

## Example 4. Cursors

```
String [] columns ={"recID", "name", "phone"};

Cursor myCur = db.query("tblAMIGO", columns,
                            null, null, null, null, "recID");

int idCol = myCur.getColumnIndex("recID");
int nameCol = myCur.getColumnIndex("name");
int phoneCol = myCur.getColumnIndex("phone");

while (myCur.moveToNext()) {
    columns[0] = Integer.toString((myCur.getInt(idCol)));
    columns[1] = myCur.getString(nameCol);
    columns[2] = myCur.getString(phoneCol);

    txtMsg.append("\n" + columns[0] + " "
                       + columns[1] + " "
                       + columns[2] );
}
```

# SQL Databases

## SQL Action Queries

Action queries are the SQL way of performing maintenance operations on tables and database resources (i.e. *insert, delete, update, create table, drop, …*).

**Examples**:

```
insert into tblAmigos values ( ‘Macarena’,  ‘555-1234’ );

update tblAmigos set name = ‘Maria Macarena’ where phone = ‘555-1234’;

delete from tblAmigos where phone = ‘555-1234’;

create table Temp ( column1 int, column2 text, column3 date );

drop table Temp;
```

# SQL Databases

## SQL Action Queries

1. Cursors provide **READ_ONLY** access to records.
2. Early versions of the Android SDK included cursor commands to sequentially modify records. Those operators have been deprecated in Release 1.0.
3. Methods such as *cursor.updateInt(...)* and *cursor.deleteRow(...)* are not valid anymore.
4. Instead use an action SQL command in an ***execSQL*(...)** method (explained in the next section).

# SQL Databases

## ExecSQL – Action Queries

Perhaps the simplest Android way to phrase a SQL action query is to ‘stitch’ together the pieces of the SQL statement and give it to the ***execSQL*****(…)** method.

As an example consider the following case

```
db.execSQL(
      "update tblAMIGO set name = (name || 'XXX') where phone >= '001' ");
```

*this statement appends ‘XXX’ to the name of those whose phone number is equal or greater than ‘001’.*

**Note**

The symbol **||** is the SQL *concatenate* operator

# SQL Databases

## ExecSQL – Action Queries (cont.)

Consider the action query:

```
db.execSQL(
      "update tblAMIGO set name = (name || 'XXX') where phone >= '001' ");
```

Alternatively, the SQL statement could be 'pasted' from pieces as follows:

```
String theValue  =  " …";  //some phone value goes here

db.execSQL( "update tblAMIGO set name = (name || 'XXX') " +
                  " where phone >= '" + theValue + "' " );
```

The same strategy could be applied to other SQL statements such as:
"*delete from … where…*", "insert into ….", etc.

# SQL Databases

## Other Android Solutions for Table Maintenance

Although they are not as general as the technique suggested in the previous section, Android provides a number of additional methods to perform *insert, delete, update* operations.

```
public long insert(String table,
                   String nullColumnHack,
                   ContentValues values )

public int update( String table,
                   ContentValues values,
                   String whereClause, String[] whereArgs )

public int delete( String table,
                   String whereClause, String[] whereArgs)
```

# SQL Databases

**Database insert Operator**

```
public long insert(String table, String nullColumnHack, ContentValues values)
```

Convenient method for inserting a row into the database.

***Parameters***

table — the table to insert the row into

nullColumnHack — SQL doesn't allow inserting a completely empty row, so if argument *values is empty this column* will explicitly be assigned a NULL value.

values — this map (*name, value*) contains the initial column values for the row. The keys should be the column names and the values the column values

Returns — the row ID of the newly inserted row, or -1 if an error occurred

# SQL Databases

## Example – Database insert Operator

```
ContentValues initialValues = new ContentValues();

initialValues.put("name", "ABC");
initialValues.put("phone", "101");
int rowPosition = (int) db.insert("tblAMIGO", null, initialValues);

initialValues.put("name", "DEF");
initialValues.put("phone", "202");
rowPosition = (int) db.insert("tblAMIGO", null, initialValues);

initialValues.clear();
rowPosition = (int) db.insert("tblAMIGO", null, initialValues);
rowPosition = (int) db.insert("tblAMIGO", "name", initialValues);
```

# SQL Databases

## Example – Database insert Operator – Comments

- **Lines 1-3** define the set of <key, values> called *initialValues to be later inserted in a record of the form <recID, name, phone> . Remember that recID is an autoincremented field. All this work is done to pre-assemble the record < ???, "ABCC", "101">. Here ??? will be the recID field to be determined by the database when the record is accepted.*
- **Line 4** requests the set of <key, values> held in *initialValues to be added to the table tblAMIGO. If the operation fails the insert method returns -1, otherwise the position of the row identifier is returned.*
- **Lines 5-7** define a new set of values to be used as input to the insert operator. The record <???, "DEF", "202"> is placed after the row previously inserted in table tblAMIGO.
- **Line 9** resets the map to empty.
- **Line 10** attempts the insertion of an empty record. SQL rejects the operation and returns -1
- **Line 11** is similar to the code in Line 10, however the presence of a *nullColumnHack variable ("name" in this case) makes SQL change its behavior; the row is generated with null values everywhere except the key autonumber (recID).*

# SQL Databases

## Database update Operator

```
public int update ( String table,
                    ContentValues values,
                    String whereClause,  String[] whereArgs  )
```

Convenient method for updating rows in the database.

***Parameters***

table            the table to update in

values          a map <name,value> from column names to new column values.
                    null is a valid value that will be translated to NULL.

whereClause  the optional WHERE clause to apply when updating.
                    Passing null will update all rows.

*Returns*          *the number of rows affected*

# SQL Databases

## Example - Database update Operator

We want to use the “update” method to express the SQL statement:

**Update tblAmigo set name = ‘maria’ where (recID > 2 and recID < 7)**

Here are the steps to make the call using Android Update Method

```
1. String [] whereArgs = {"2", "7"};

2. ContentValues updValues = new ContentValues();
3. updValues.put("name", "Maria");

4. int recAffected =  db.update( "tblAMIGO",
                                updValues,
                                "recID > ? and recID < ?",
                                whereArgs );
```

# SQL Databases

## Example /Comments - Database update Operator

**Line 1** defines the String array holding the (two) arguments used by the *whereClause*.

**Lines 2-3** define and populate a map <*key, value*> to be used by the update operator. The map expresses the idea "*set given column to given value*". In our case the "name" field will acquire the value "maria".

**Line 4** invokes the execution of the update operator. After completion it returns the number of records affected by the update (0 If it fails).

In the example a **filter** is given to select the rows to be updated. In this case the condition is "*recID > ? and recID < ?*". The **?** symbols represent placeholders for values supplied by the array *whereArgs.* After the substitutions are made the new filter is: "*recID > 2 and recID < 7*".

# SQL Databases

## Database delete Operator

```
public int delete ( String table, String whereClause, String[] whereArgs )
```

Convenient method for deleting rows in the database.

***Parameters***

table — the table to delete from

whereClause — the optional WHERE clause to apply when deleting. Passing null will delete all rows.

*Returns* — the number of rows affected if a *whereClause* is passed in, 0 otherwise.
*To remove all rows and get a count pass "1" as the whereClause.*

# SQL Databases

## Example - Database delete Operator

Consider the following SQL statement:

Delete from tblAmigo wehere recID > 2 and recID < 7

An equivalent version using the **delete method** follows:

```
1.  String [] whereArgs = {"2", "7"};

2.  recAffected = db.delete("tblAMIGO",
                  "recID > ? and recID < ?",
                  whereArgs);
```

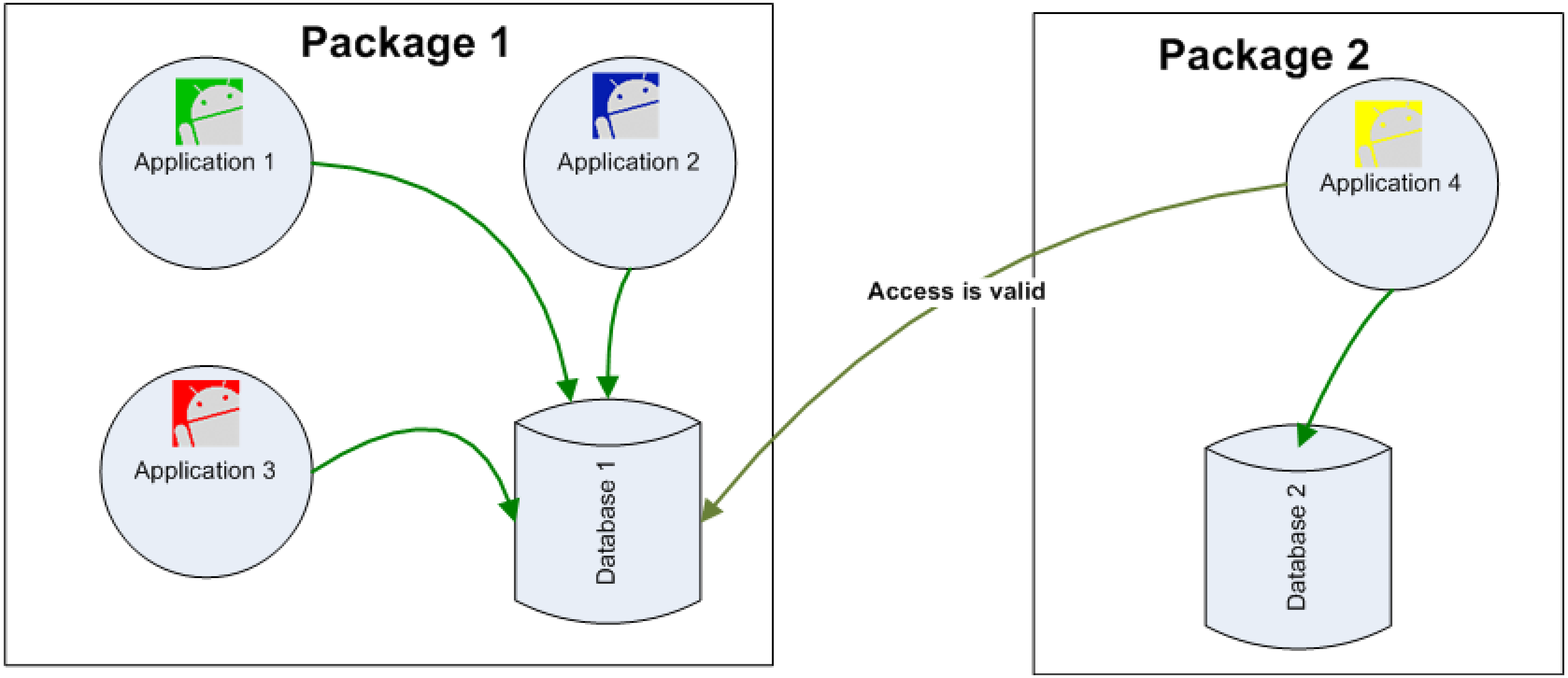
**Line 2** requests the deleting from the tblAMIGO of those records whose recID is in between the values 2, and 7. The actual values are taken from the *whereArgs* array shown in **Line 1**. The method returns the number of rows deleted after executing the command.

# SQL Databases

## Database Visibility

Any Application can access an **externally** SD stored database. All it's needed is knowledge of the path where the database file is located.

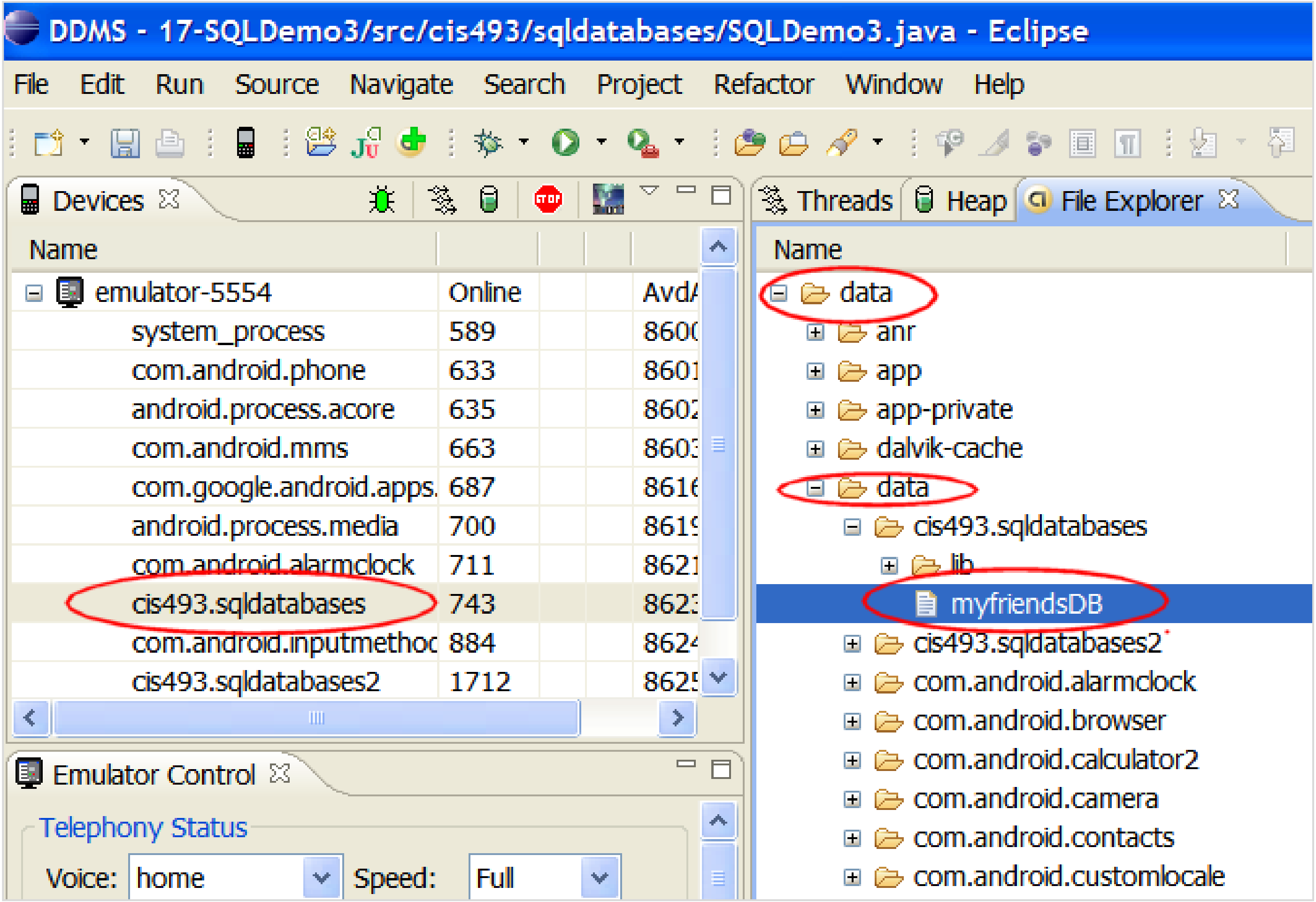
*Other ways of sharing data will be explored later (ContentProvider).*



# SQL Databases

## Database Location

Emulator’s *File Explorer* showing the placement of the database



DDMS - 17-SQLDemo3/src/cis493/sqldatabases/SQLDemo3.java - Eclipse

File Edit Run Source Navigate Search Project Refactor Window Help
Devices
Threads
Heap
File Explorer
Emulator Control

| Name | | |
|---|---|---|
| emulator-5554 | Online | Avd/ |
| system_process | 589 | 8600 |
| com.android.phone | 633 | 8601 |
| android.process.acore | 635 | 8602 |
| com.android.mms | 663 | 8603 |
| com.google.android.apps. | 687 | 8616 |
| android.process.media | 700 | 8619 |
| com.android.alarmclock | 711 | 8621 |
| cis493.sqldatabases | 743 | 8623 |
| com.android.inputmethoc | 884 | 8624 |
| cis493.sqldatabases2 | 1712 | 8625 |

Telephony Status

Voice: home Speed: Full

Name

- data
  - anr
  - app
  - app-private
  - dalvik-cache
  - data
    - cis493.sqldatabases
      - lib
      - myfriendsDB
    - cis493.sqldatabases2
    - com.android.alarmclock
    - com.android.browser
    - com.android.calculator2
    - com.android.camera
    - com.android.contacts
    - com.android.customlocale

# SQL Databases

## Using SQLITE Command Line

The Android SDK contains a command line interface to SQLITE databases.
To open/Create a database use the command

```
C:> sqlite3 myNewDatabase
```

You may directly reach the Emulator’s data folder and operate on existing databases.

Assume an emulator is running.

We will use **adb shell** to tap in the emulator’s internal memory

# SQL Databases

## Using SQLITE Command Line

After opening the DOS command window type the following commands:

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

E:\Android> adb shell

# sqlite3 /data/data/matos.sql1/databases/myfriendsDB

sqlite3 /data/data/matos.sql1/databases/myfriendsDB
SQLite version 3.5.9
Enter ".help" for instructions
```

# SQL Databases

## Using SQLITE Command Line

After opening the DOS command window type the following commands:

```
sqlite> .tables
.tables
android_metadata  tblAMIGO

sqlite> select * from tblAMIGO;

1|AAAXXX|555
2|BBBXXX|777
3|Maria|999
4|Maria|000
5|Maria|001

sqlite> .exit
#
```

# SQL Databases

## Summary of SQLITE3 commands

```
sqlite3> .help

.bail ON|OFF           Stop after hitting an error.  Default OFF
.databases             List names and files of attached databases
.dump ?TABLE? ...      Dump the database in an SQL text format
.echo ON|OFF           Turn command echo on or off
.exit                  Exit this program
.explain ON|OFF        Turn output mode suitable for EXPLAIN on or off.
.header(s) ON|OFF      Turn display of headers on or off
.help                  Show this message
.import FILE TABLE     Import data from FILE into TABLE
.indices TABLE         Show names of all indices on TABLE
.load FILE ?ENTRY?     Load an extension library
```

# SQL Databases

## Summary of SQLITE3 commands

```
.mode MODE ?TABLE?   Set output mode where MODE is one of:
             csv         Comma-separated values
             column      Left-aligned columns.  (See .width)
             html        HTML <table> code
             insert      SQL insert statements for TABLE
             line        One value per line
             list        Values delimited by .separator string
             tabs        Tab-separated values
             tcl         TCL list elements

.nullvalue STRING        Print STRING in place of NULL values
.output FILENAME         Send output to FILENAME
.output stdout           Send output to the screen
.prompt MAIN CONTINUE      Replace the standard prompts
```

# SQL Databases

## Summary of SQLITE3 commands

| | |
|---|---|
| .quit | Exit this program |
| .read FILENAME | Execute SQL in FILENAME |
| .schema ?TABLE? | Show the CREATE statements |
| .separator STRING | Change separator used by output mode and .import |
| .show | Show the current values for various settings |
| .tables ?PATTERN? | List names of tables matching a LIKE pattern |
| .timeout MS | Try opening locked tables for MS milliseconds |
| .width NUM NUM ... | Set column widths for "column" mode |

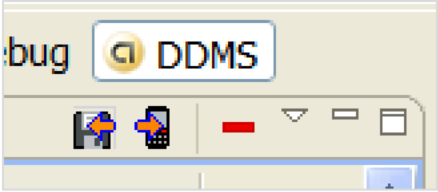
# SQL Databases

## Using GUI Tools for SQLITE

In order to move a copy of the database in and out of the Emulator's storage space and either receive or send the file into/from the local computer's file system you may use the commands:

**adb pull** *<full_path_to_database>* and
**adb push** *<full_path_to_database>*.

You may also use the Eclipse's *DDMS Perspective* to push/pull files in/out the emulator's file system.



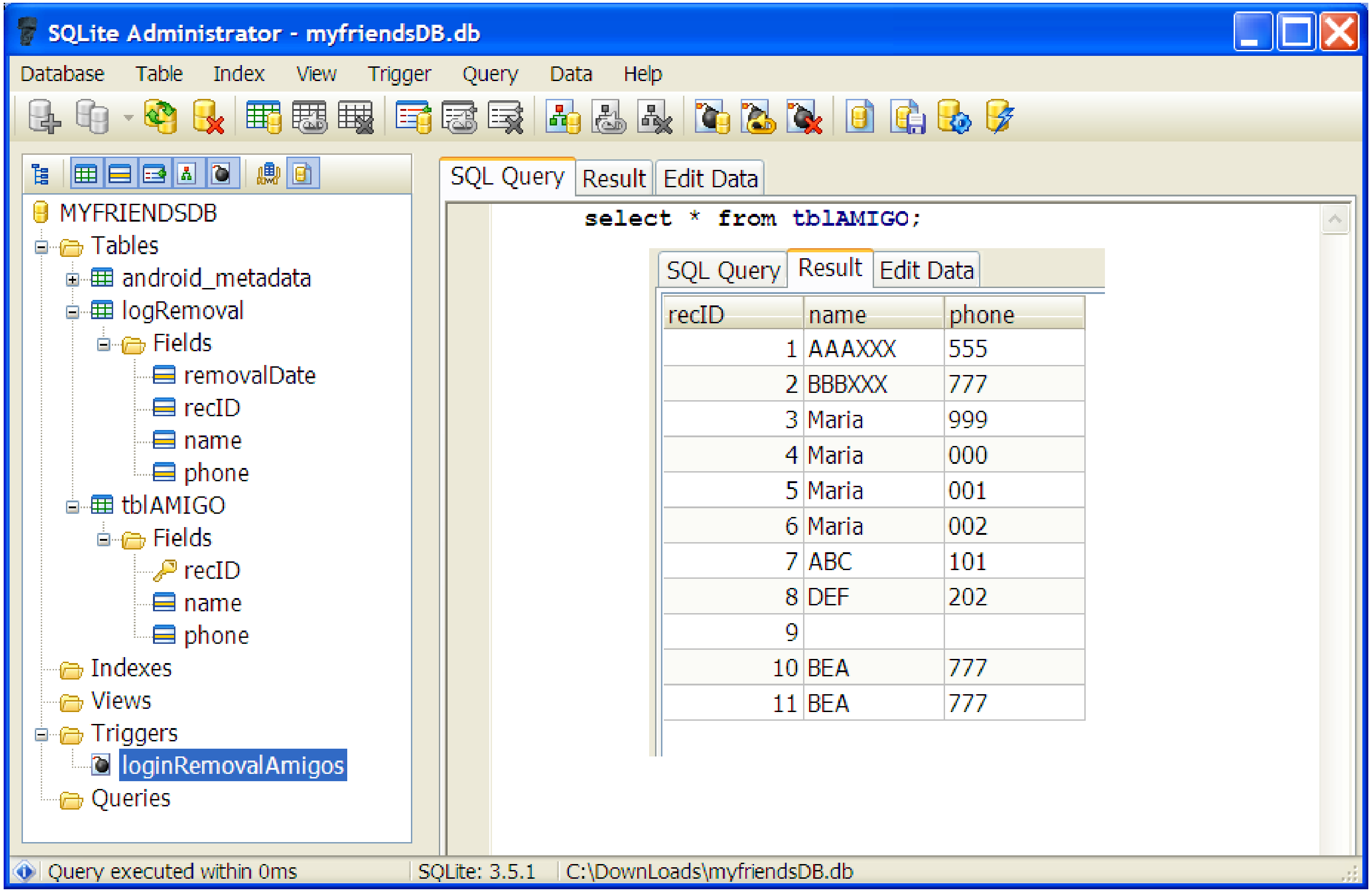
Once the database is in your computer's disk you may manipulate the database using a 'user-friendly' tool such as:

- **SQLite Manager** (Firefox adds-on)
- **SQLite Administrator** (http://sqliteadmin.orbmu2k.de)

In this example we use SQLite Administrator.

# SQL Databases

## Using *SQLite Administrator*



```
select * from tblAMIGO;
```

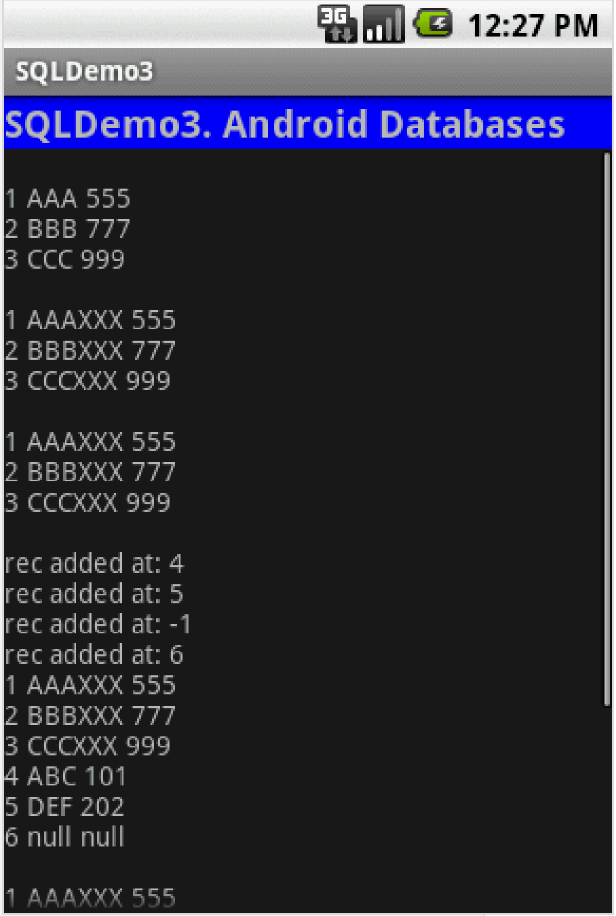
| recID | name | phone |
|---|---|---|
| 1 | AAAXXX | 555 |
| 2 | BBBXXX | 777 |
| 3 | Maria | 999 |
| 4 | Maria | 000 |
| 5 | Maria | 001 |
| 6 | Maria | 002 |
| 7 | ABC | 101 |
| 8 | DEF | 202 |
| 9 | | |
| 10 | BEA | 777 |
| 11 | BEA | 777 |

Query executed within 0ms | SQLite: 3.5.1 | C:\DownLoads\myfriendsDB.db

# SQL Databases

## **Example**: Complete Listing for Previous Fragments

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
   android:orientation="vertical"
   android:layout_width="fill_parent"
   android:layout_height="fill_parent"
   >
         <TextView
         android:id="@+id/txtCaption"
         android:text="SQLDemo3. Android Databases"
         android:layout_width="fill_parent"
         android:layout_height="wrap_content"
         android:background="#ff0000ff"
         android:textSize="20px"
         android:textStyle="bold"/>

         <ScrollView
         android:id="@+id/ScrollView01"
         android:layout_width="fill_parent"
         android:layout_height="fill_parent">
                  <TextView
                  android:id="@+id/txtMsg"
                  android:text=""
                  android:layout_width="fill_parent"
                  android:layout_height="wrap_content"  />
         </ScrollView>
</LinearLayout>
```



SQLDemo3. Android Databases

```
1 AAA 555
2 BBB 777
3 CCC 999

1 AAAXXX 555
2 BBBXXX 777
3 CCCXXX 999

1 AAAXXX 555
2 BBBXXX 777
3 CCCXXX 999

rec added at: 4
rec added at: 5
rec added at: -1
rec added at: 6
1 AAAXXX 555
2 BBBXXX 777
3 CCCXXX 999
4 ABC 101
5 DEF 202
6 null null

1 AAAXXX 555
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments

```
//USING ANDROID-SQLITE DATABASES
package cis493.sqldatabases;

import android.app.Activity;
import android.content.ContentValues;
import android.database.Cursor;
import android.database.SQLException;
import android.database.sqlite.SQLiteDatabase;
import android.database.sqlite.SQLiteException;
import android.os.Bundle;
import android.widget.TextView;
import android.widget.Toast;

public class SQLDemo3 extends Activity {
SQLiteDatabase db;
TextView txtMsg;
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
        txtMsg = (TextView) findViewById(R.id.txtMsg);
```

# SQL Databases

## **Example**: Complete Listing for Previous Fragments

```
    try {
        openDatabase();       //open (create if needed) database
        dropTable();          //if needed drop table tblAmigos
        insertSomeDbData();   //create-populate tblAmigos
        useRawQuery1();       //fixed SQL with no arguments
        useRawQuery2();       //parameter substitution
        useRawQuery3();       //manual string concatenation
        useSimpleQuery1();    //simple query
        useSimpleQuery2();    //nontrivial 'simple query'
        useCursor1();         //retrieve rows from a table
        updateDB();           //use execSQL to update
        useInsertMethod();    //use insert method
        useUpdateMethod();    //use update method
        useDeleteMethod();    //use delete method

        db.close();//make sure to release the DB
        Toast.makeText(this,"All done!",1).show();
    } catch (Exception e) {
        Toast.makeText(this,e.getMessage(),1).show();
    }
}// onCreate
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **openDatabase** ]

```
private void openDatabase() {
       try {
          db = SQLiteDatabase.openDatabase(
                   "data/data/cis493.sqldatabases/myfriendsDB",
                   //"sdcard/myfriendsDB",
                   null,
                   SQLiteDatabase.CREATE_IF_NECESSARY)  ;

          Toast.makeText(this, "DB was opened!", 1).show();
       }
       catch (SQLiteException e) {
          Toast.makeText(this, e.getMessage(), 1).show();
       }
   }//createDatabase
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments **[insertSomeDbData]**

```
private void insertSomeDbData() {
    //create table: tblAmigo
    db.beginTransaction();
   try {
        db.execSQL("create table tblAMIGO ("
                  + " recID integer PRIMARY KEY autoincrement, "
                  + " name  text, "
                  + " phone text );  ");
        //commit your changes
        db.setTransactionSuccessful();

        Toast.makeText(this, "Table was created",1).show();
   } catch (SQLException e1) {
        Toast.makeText(this, e1.getMessage(),1).show();
   }
   finally {
        //finish transaction processing
        db.endTransaction();
   }
```

# SQL Databases

## Example: Complete Listing for Previous Fragments [**insertSomeDbData**]

```
   // populate table: tblAmigo
   db.beginTransaction();
   try {
       //insert rows
      db.execSQL( "insert into tblAMIGO(name, phone) "
                + " values ('AAA', '555' );" );
     db.execSQL("insert into tblAMIGO(name, phone) "
                + " values ('BBB', '777' );" );
     db.execSQL("insert into tblAMIGO(name, phone) "
                + " values ('CCC', '999' );" );

     //commit your changes
     db.setTransactionSuccessful();
     Toast.makeText(this, " 3 records were inserted",1).show();
     }
    catch (SQLiteException e2) {
     //report problem
     Toast.makeText(this, e2.getMessage(),1).show();
    }
    finally {
     db.endTransaction();
    }
}//insertSomeData
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [**useRawQuery1**]

```
private void useRawQuery1() {
   try {
      //hard-coded SQL-select command with no arguments
      String mySQL ="select count(*) as Total from tblAMIGO";

      Cursor c1 = db.rawQuery(mySQL, null);

      int index = c1.getColumnIndex("Total");
      //advance to the next record (first rec. if necessary)
      c1.moveToNext();
      int theTotal = c1.getInt(index);
      Toast.makeText(this, "Total1: " + theTotal, 1).show();

   } catch (Exception e) {
      Toast.makeText(this, e.getMessage(), 1).show();
   }
}//useRawQuery1
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [**useRawQuery2**]

```
private void useRawQuery2() {
   try {
       // ? arguments provided for automatic replacement
       String mySQL = " select count(*) as Total "
                      + " from tblAmigo "
                      + " where recID > ? "
                      + "   and name  = ? ";
       String[] args = {"1", "BBB"};
       Cursor c1 = db.rawQuery(mySQL, args);

       int index = c1.getColumnIndex("Total");
       //advance to the next record (first rec. if necessary)
       c1.moveToNext();
       int theTotal = c1.getInt(index);
       Toast.makeText(this, "Total2: " + theTotal, 1).show();
    } catch (Exception e) {
       Toast.makeText(this, e.getMessage(), 1).show();
  }
}//useRawQuery2
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [**useRawQuery3**]

```
private void useRawQuery3() {
   try {
       //arguments injected by manual string concatenation
       String[] args = {"1", "BBB"};

       String mySQL = " select count(*) as Total "
           + "  from tblAmigo "
             + " where recID > "  + args[0]
             + "   and name  = '" + args[1] + "'";

       Cursor c1 = db.rawQuery(mySQL, null);
       int index = c1.getColumnIndex("Total");
       //advance to the next record (first rec. if necessary)
       c1.moveToNext();
       int theTotal = c1.getInt(index);
       Toast.makeText(this, "Total3: " + theTotal, 1).show();
    } catch (Exception e) {
       Toast.makeText(this, e.getMessage(), 1).show();
    }
}//useRawQuery3
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [**simpleQuery1**]

```
  private void useSimpleQuery1() {
    try {
        //simple (implicit) query on one table
        String [] columns = {"recID", "name", "phone"};

        Cursor c1 = db.query (
            "tblAMIGO",
            columns,
            "recID > 2 and length(name) >= 3 and name like 'B%' ",
            null, null, null,
            "recID" );

        int theTotal = c1.getCount();
        Toast.makeText(this, "Total4: " + theTotal, 1).show();
    } catch (Exception e) {
        Toast.makeText(this, e.getMessage(), 1).show();
    }
}//useSimpleQuery1
```

# SQL Databases

## **Example**: Complete Listing for Previous Fragments [**simpleQuery2** ]

```
private void useSimpleQuery2() {
   try {
       //nontrivial 'simple query' on one table
       String [] selectColumns =  {"name", "count(*) as TotalSubGroup"};
       String    whereCondition = "recID >= ?";
       String [] whereConditionArgs = {"1"};
       String    groupBy = "name";
       String    having =  "count(*) <= 4";
       String    orderBy = "name";

       Cursor c =  db.query ( "tblAMIGO",
                              selectColumns,
                              whereCondition, whereConditionArgs,
                              groupBy,
                              having,
                              orderBy  );

       int theTotal = c.getCount();
       Toast.makeText(this, "Total5: " + theTotal, 1).show();
     } catch (Exception e) {
       Toast.makeText(this, e.getMessage(), 1).show();
     }
}//useSimpleQuery2
```

# SQL Databases

## **Example**: Complete Listing for Previous Fragments [ **useCursor1** ]

```
private void useCursor1() {
 try {
   txtMsg.append("\n");
   // obtain a list of <recId, name, phone> from DB
   String[] columns = { "recID", "name", "phone" };
   Cursor c = db.query("tblAMIGO", columns,
             null, null, null, null, "recID");
   int theTotal = c.getCount();
   Toast.makeText(this, "Total6: " + theTotal, 1).show();
   int idCol = c.getColumnIndex("recID");
   int nameCol = c.getColumnIndex("name");
   int phoneCol = c.getColumnIndex("phone");
   while (c.moveToNext()) {
     columns[0] = Integer.toString((c.getInt(idCol)));
     columns[1] = c.getString(nameCol);
     columns[2] = c.getString(phoneCol);
     txtMsg.append( columns[0] + " " + columns[1] + " "
            + columns[2] + "\n" );
   }
   } catch (Exception e) {
    Toast.makeText(this, e.getMessage(), 1).show();
   }
 }//useCursor1
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **updateDB** ]

```
private void updateDB(){
   //action query using execSQL
   String theValue;
   try {
      theValue = "222";

      db.execSQL(  " update tblAMIGO "
                 + " set name = (name || 'XXX') "
                 + " where phone >= '" + theValue + "' " );

      useCursor1();
   } catch (Exception e) {
    Toast.makeText(this,"updateDB " + e.getMessage(), 1).show();
   }
   useCursor1();
}
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **dropTable** ]

```
  private void dropTable(){
    //(clean start) action query to drop table

    try {
         db.execSQL( " drop table tblAmigo; ");

         Toast.makeText(this, "Table dropped", 1).show();

    } catch (Exception e) {
         Toast.makeText(this,
                       "dropTable()\n" + e.getMessage(), 1).show();
    }
  }// dropTable
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **useInsertMethod** ]

```
public void useInsertMethod() {
   ContentValues initialValues = new ContentValues();

   initialValues.put("name", "ABC");
   initialValues.put("phone", "101");
   int rowPosition = (int) db.insert("tblAMIGO", null, initialValues);
   txtMsg.append("\nrec added at: " + rowPosition);

   initialValues.put("name", "DEF");
   initialValues.put("phone", "202");
   rowPosition = (int) db.insert("tblAMIGO", null, initialValues);
   txtMsg.append("\nrec added at: " + rowPosition);

   initialValues.clear();
   rowPosition = (int) db.insert("tblAMIGO", null, initialValues);
   txtMsg.append("\nrec added at: " + rowPosition);
   rowPosition = (int) db.insert("tblAMIGO", "name", initialValues);
   txtMsg.append("\nrec added at: " + rowPosition);

   useCursor1();

}// useInsertMethod
```

# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **useUpdateMethod** ]

```
private void useUpdateMethod() {
   //using the update method to change name of selected friend
   String [] whereArgs = {"2", "7"};

   ContentValues updValues = new ContentValues();
   updValues.put("name", "Maria");

   int recAffected =db.update( "tblAMIGO",
                               updValues,
                               "recID > ? and recID < ?",
                               whereArgs );

   Toast.makeText(this, "Total7: " + recAffected, 1).show();
   useCursor1();
}
```

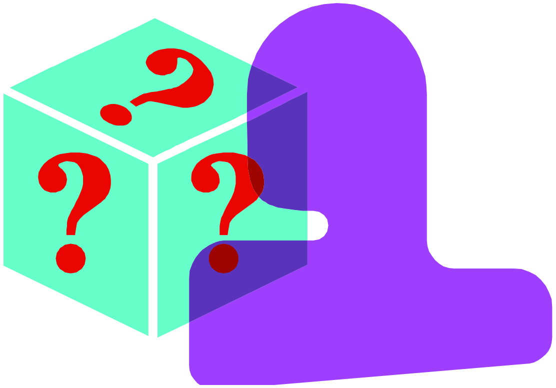
# SQL Databases

**Example**: Complete Listing for Previous Fragments [ **useDeleteMethod** ]

```
    private void useDeleteMethod() {
        //using the delete method to remove a group of friends
        //whose id# is between 2 and 7
        String [] whereArgs = {"2", "7"};

        int recAffected = db.delete("tblAMIGO",
                                    "recID > ? and recID < ?",
                                    whereArgs);


        Toast.makeText(this, "Total8: " + recAffected, 1).show();
        useCursor1();

    }// useDeleteMethod

}//class
```

# SQL Databases

Questions



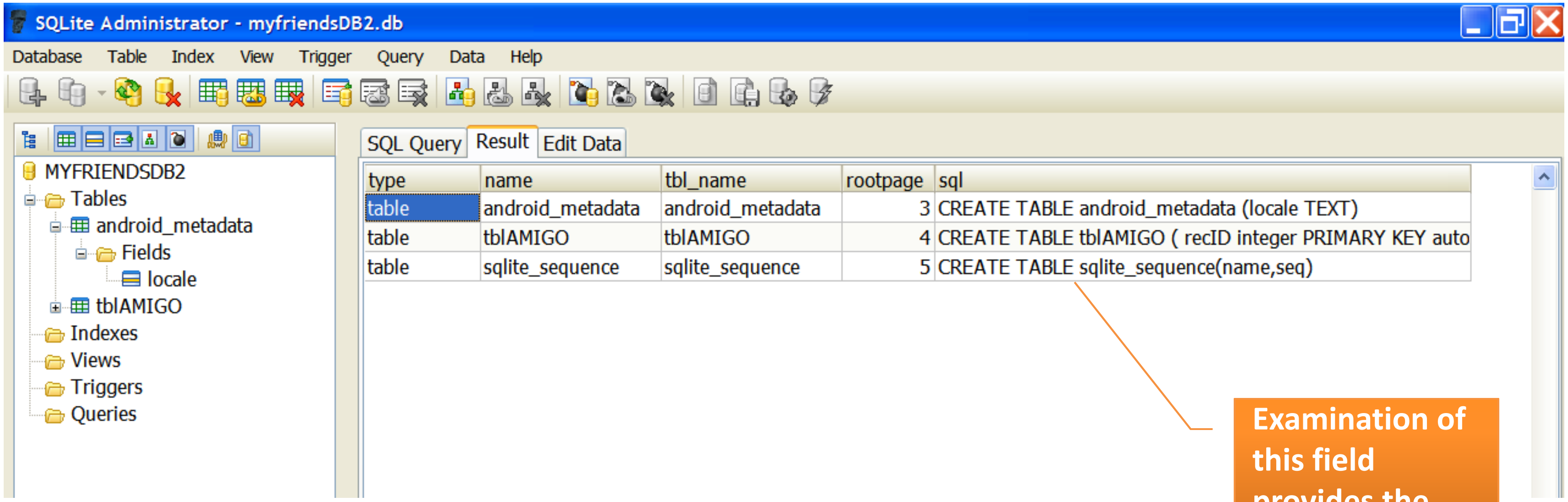
# SQL Databases

**Appendix 1: Database Dictionary - SQLITE Master Table**

You may query the SQLITE master table (named: ***sqlite_master***) looking for a table, index, or other database object.

**Example**

```
select * from sqlite_master;
```



| type | name | tbl_name | rootpage | sql |
|---|---|---|---|---|
| table | android_metadata | android_metadata | 3 | CREATE TABLE android_metadata (locale TEXT) |
| table | tblAMIGO | tblAMIGO | 4 | CREATE TABLE tblAMIGO ( recID integer PRIMARY KEY auto |
| table | sqlite_sequence | sqlite_sequence | 5 | CREATE TABLE sqlite_sequence(name,seq) |

**Examination of this field provides the table schema**

# SQL Databases

## Appendix 1:  Database Dictionary - SQLITE Master Table

In Java code you may phrase the test for existence of a database object using something similar to the following fragment

```
public boolean tableExists(SQLiteDatabase db, String tableName)
{
   //true if table exists, false otherwise
   String mySql = " SELECT name FROM sqlite_master "
                + " WHERE type='table'             "
                + "   AND name='" + tableName  + "'";

   int resultSize = db.rawQuery(mySql, null).getCount();

   if (resultSize ==0) {
        return true;
   } else
        return false;
}
```

# SQL Databases

**Appendix 2: Convenient Database Command**

In Java code you may phrase the request for “CREATE or REPLACE” a table using the following safe construct:

```
db.execSQL("DROP TABLE IF EXISTS tableXYZ");
```

**Appendix 3. Other SQLITE administration tools available from**

http://sqlite.org/cvstrac/wiki?p=ManagementTools