Mobile Devices

Database Access and SQLite

Randy J. Fortier
@randy_Fortier
randy.Fortier@uoit.ca

Outline

- In this section, we'll:
  - Learn about support for databases in Android
  - Learn about SQLite
  - Create an SQLite database
  - Use databases from within Android apps
    - Create, read, update, and delete
  - Manage database versions

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Mobile Devices

SQLite

SQLite

- Open source
- Simple
- Stores data in a single file
- Uses memory for many operations
- Small footprint (< 400kb)
- Zero configuration
- Also used by iOS, WP, BB, …

SQLite Details

- Runs using the same permissions as your app
- Supports atomicity, consistency, isolation, durability (ACID) for transactions
- Supports prepared statements, inner and left outer joins, sub-queries, query grouping, autoincrement fields, alter table, triggers, read-only views
- Supports most of the SQL92 standard

UNIVERSITY OF ONTARIO
INSTITUTE OF TECHNOLOGY

Mobile Devices

Database Access in Android

Database Access in Android

- Database access was designed with best practices in mind
  - e.g. versioning of databases, creating an initial version of the database on first execution
  - These practices sometimes take some getting used to

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteOpenHelper

- This class acts as a lifecycle manager for your database
- Lifecycle events:
  - Create (create database structure)
  - Upgrade (change database structure)
  - Downgrade (not often used)
  - Open

SQLiteOpenHelper

- This class acts as a lifecycle manager for your database
- Lifecycle events:
  - Create (create database structure)
    - Create all your tables and other database objects
    - Called when you run your app, and a database file cannot be found
  - Upgrade (change database structure)
  - Downgrade (not often used)
  - Open

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteOpenHelper

- This class acts as a lifecycle manager for your database
- Lifecycle events:
  - Create (create database structure)
  - Upgrade (change database structure)
    - Update the database structure
    - Migrate existing data to the new structure
    - Called when the version number increases
  - Downgrade (not often used)
  - Open

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteOpenHelper

- This class acts as a lifecycle manager for your database
- Lifecycle events:
  - Create (create database structure)
  - Upgrade (change database structure)
  - Downgrade (not often used)
    - Update database to previously used structure
    - Migrate data to the previous structure
  - Open

SQLiteOpenHelper

- This class acts as a lifecycle manager for your database
- Lifecycle events:
  - Create (create database structure)
  - Upgrade (change database structure)
  - Downgrade (not often used)
  - Open
    - You could keep track of open connections to the database
    - However, most of the time, developers just use the inherited functionality here

SQLiteOpenHelper

- To use SQLiteOpenHelper:
  - Create a subclass of SQLiteOpenHelper
  - Identify the database version number
  - Implement the onCreate() method
  - Implement the onUpdate() method

SQLiteOpenHelper

- To use SQLiteOpenHelper:
  - Create a subclass of SQLiteOpenHelper
  - Identify the database version number
    - Initially, the database version number of 1
    - If you change the structure of your database in the new version of your app, increase this number
    - The version number of your database does not have to correspond to the version number of your app
      - e.g. If you update your app, but don't change the database structure, do not increase the version number
  - Implement the onCreate() method
  - Implement the onUpdate() method

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteOpenHelper

- To use SQLiteOpenHelper:
  - Create a subclass of SQLiteOpenHelper
  - Identify the database version number
  - Implement the onCreate() method
    - Execute the SQL to create your database tables
  - Implement the onUpdate() method

SQLiteOpenHelper

- To use SQLiteOpenHelper:
  - Create a subclass of SQLiteOpenHelper
  - Identify the database version number
  - Implement the onCreate() method
  - Implement the onUpdate() method
    - Execute the SQL to modify your database structure
    - If you have many versions, this can be difficult
      - Advice: Try to think carefully about the future and prepare your database for any future features you can come up with
    - A good approach: Perform step-wise increments (e.g. 2.0 to 2.2 becomes 2.0 to 2.1, and 2.1 to 2.2)
    - This method takes old and new version numbers

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteOpenHelper

- A lot of Android developers use their SQLiteOpenHelper subclass for the data access functionality for that data
  - SQLiteOpenHelpers can be created for each table in your database
  - Create methods for creating (insert), reading (queries), updating (update), and deleting (delete) (CRUD)

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteDatabase

- For most database operations, this will be all you need
- It has several helper methods:
  - `insert(String tableName, String nullColumnHack, ContentValues values)`
  - `query(String tableName, String[] columns, String selection, String[] selectionArgs, String groupBy, String having, String orderBy)`
  - `rawQuery(String sql, String[] selectionArgs)`
  - `update(String tableName, ContentValues values, String whereClause, String[] whereArgs)`
  - `delete(String tableName, String whereClause, String[] whereArgs)`
  - `execSQL(String sql, Object[] bindArgs)`

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

SQLiteDatabase

- The methods rawQuery() and query() both return a Cursor
  - Cursors represent the result set returned by the database
  - Important methods:
    - `getCount()         # of rows`
    - `getColumnCount()   # of cols`
    - `moveToFirst(), moveToLast(), moveToNext(), moveToPrevious()`
    - `moveToPosition(5) # move to 6th row`
    - `getString(3)       # get 4th column as string`
    - `getInt(4)          # get 5th column as integer`

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

ContentValues

- In a few methods in SQLiteDatabase, a ContentValues object is used to store a number of name/value pairs
  - e.g. values to be inserted, new values for an update
  - Important methods:
    - `put(“columnName”, “a value”)`

Wrap-Up

- In this section, we learned about:
  - Lightweight databases
  - SQLite
  - SQLiteOpenHelper
  - CRUD
  - SQLiteDatabase
  - Cursor
  - ContentValues

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY