ORM Lite Package

Version 4.12 February 2011 Copyright 2010 to 2011 by Gray Watson.

Published by Gray Watson

Permission is granted to make and distribute verbatim copies of this manual provided the copyright notice and this permission notice are preserved on all copies.

ORMLite 1

ORMLite

Version 4.12 – February 2011

ORMLite provides a lightweight Object Relational Mapping between Java classes and SQL databases – see http://en.wikipedia.org/wiki/Object-relational_mapping. There are certainly more mature ORMs which provide this functionality including Hibernate and iBatis. However, the author wanted a simple yet powerful wrapper around the JDBC functions and Hibernate and iBatis are significantly more complicated with many dependencies.

ORMLite supports JDBC connections to MySQL, Postgres, Microsoft SQL Server, H2, Derby, HSQLDB, and Sqlite and can be extended to additional ones relatively easily. ORM-Lite also supports native database calls on Android OS. There are also initial implementations for DB2 and Oracle although the author needs access to each of these database types to tune the support. Contact the author if your database is not supported.

To get started quickly with ORMLite, see the examples section of the document which has various working code packages and Android applications. See Chapter 7 [Examples], page 47. There is also a HTML version of this documentation – see http://ormlite.com/docs/ormlite.html.

Gray Watson http://256.com/gray/

1 Getting Started

1.1 Downloading ORMLite Jar

To get started with ORMLite, you will need to download the jar files. They are available on the central maven repository (http://repo1.maven.org/maven2/com/j256/ormlite/) or from Sourceforge (http://sourceforge.net/projects/ormlite/files/). See the http://ormlite.com/ home page for the most up-to-date repositories.

Users that are connecting to SQL databases via JDBC connections will need to download the ormlite-jdbc-4.12.jar and ormlite-core-4.12.jar files. For use with Android applications, you should download the ormlite-android-4.12.jar and ormlite-core-4.12.jar files instead. For either JDBC or Android you will also need the ormlite-core release which has the ORMLite backend implementations. ORMLite does not have any required external dependencies although there are some other packages that you may want to use. See Section 5.6 [Dependencies], page 42. The code works with Java 5 or later.

1.2 Configuring a Class

The following is an example class that is configured to be persisted to a database using ORMLite annotations. The <code>QDatabaseTable</code> annotation configures the Account class to be persisted to the database table named <code>accounts</code>. The <code>QDatabaseField</code> annotations map the fields on the Account to the database columns with the same names.

The name field is configured as the primary key for the database table by using the id = true annotation field. Also, notice that a no-argument constructor is needed so the object can be returned by a query. For more information (JPA annotations and other ways to configure classes) see the class setup information later in the manual. See Section 2.1 [Class Setup], page 7.

```
@DatabaseTable(tableName = "accounts")
public class Account {

    @DatabaseField(id = true)
    private String name;
    @DatabaseField
    private String password;

public Account() {
        // ORMLite needs a no-arg constructor
    }
    public Account(String name, String password) {
        this.name = name;
        this.password = password;
    }
    public String getName() {
        return name;
    }
}
```

```
}
  public String getPassword() {
    return password;
}
```

1.3 Configuring a DAO

A typical Java pattern is to isolate the database operations in Data Access Objects (DAO) classes. Each DAO provides create, delete, update, etc. type of functionality and specializes in the handling a particular persisted class. To set up a DAO, you will need a DAO interface and an implementation class. ORMLite provides a base DAO interface and a base implementation class. The following is an example DAO interface corresponding to the Account class from the previous section of the manual:

You are not *required* to create a DAO class for every one of your persisted objects. You can use the **createDao** static method on the BaseDaoImpl class to create a DAO class without having to define one. For example:

```
Dao<Account, String> accountDao =
   BaseDaoImpl.createDao(connectionSource, Account.class);
Dao<Order, Integer> orderDao =
   BaseDaoImpl.createDao(connectionSource, Order.class);
```

More information about setting up the DAOs is available later in the manual. See Section 2.4 [DAO Setup], page 16.

1.4 Code Example

The code in this section demonstrates how to use the classes presented in the previous two sections. The code uses the native Java H2 database to create the in-memory test databases. You will need to add the H2 jar file to your classpath if you want to run the example as-is. *NOTE*: Android users should see the Android specific documentation later in the manual. See Chapter 4 [Use With Android], page 33.

The client performs the following steps.

- It creates a connection source which handles connections to the database.
- It instantiates a dao for the Account object.
- The accounts database table is created. This step is not needed if the table already exists.

```
public class AccountApp {
   public static void main(String[] args) throws Exception {
      // this uses h2 by default but change to match your database
      String databaseUrl = "jdbc:h2:mem:account";
      // create a connection source to our database
      ConnectionSource connectionSource =
            new JdbcConnectionSource(databaseUrl);

      // instantiate the dao
      Dao<Account, String> accountDao =
            BaseDaoImpl.createDao(connectionSource, Account.class);

      // if you need to create the 'accounts' table make this call
      TableUtils.createTable(connectionSource, Account.class);
```

Once we have configured our database objects, we can use them to create an Account, persist it to the database, and query for it from the database by its ID:

```
// create an instance of Account
Account account = new Account();
account.setName("Jim Coakley");

// persist the account object to the database
// it should return 1 for the 1 row inserted
if (accountDao.create(account) != 1) {
    throw new Exception("Failure adding account");
}

// retrieve the account from the database by its id field (name)
Account account2 = accountDao.queryForId("Jim Coakley");
System.out.println("Account: " + account2.getName());

// close the connection source
connectionSource.close();
}
```

For more examples including working code and Android application projects see see Chapter 7 [Examples], page 47.

You should be able to get started using ORMLite by this point. To understand more of the functionality available with ORMLite, continue on with the next section. See Chapter 2 [Using], page 7.

2 How to Use

This chapter goes into more detail about how to use ORMLite.

2.1 Setting Up Your Classes

To setup your classes to be persisted you need to do the following things:

- 1. Add the @DatabaseTable annotation to the top of each class. You can also use @Entity.
- 2. Add the @DatabaseField annotation right before each field to be persisted. You can also use @Column and others.
- 3. Add a no-argument constructor to each class with at least package visibility.

2.1.1 Adding ORMLite Annotations

Annotations are special code markers have have been available in Java since version 5 that provide meta information about classes, methods, or fields. To specify what classes and fields to store in the database, ORMLite supports either its own annotations (@DatabaseTable and @DatabaseField) or the more standard annotations from the javax.persistence package. See Section 2.1.2 [Javax Persistence Annotations], page 11. Annotations are the easiest way to configure your classes but you can also configure the class using Java code or Spring XML. See Section 5.2 [Class Configuration], page 36.

With ORMLite annotations, for each of the Java classes that you would like to persist to your SQL database, you will need to add the <code>QDatabaseTable</code> annotation right above the <code>public class</code> line. Each class marked with one of these annotations will be persisted into its own database table. For example:

```
@DatabaseTable(tableName = "accounts")
public class Account {
...
```

The @DatabaseTable annotations can have an optional tableName argument which specifies the name of the table that corresponds to the class. If not specified, the class name, with normalized case, is used by default. With the above example each Account object will be persisted as a row in the accounts table in the database. If the tableName was not specified, the account table would be used instead.

Additionally, for each of the classes, you will need to add a <code>QDatabaseField</code> annotation to each of the *fields* in the class that are to be persisted to the database. Each field is persisted as a column of a database row. For example:

```
@DatabaseTable(tableName = "accounts")
public class Account {
    @DatabaseField(id = true)
    private String name;

    @DatabaseField(canBeNull = false)
    private String password;
```

. . .

In the above example, each row in the accounts table has 2 columns:

- the name column which is a string and also is the database identity (id) of the row
- the password column, also a string which can not be null

The @DatabaseField annotation can have the following fields:

columnName

String name of the column in the database that will hold this field. If not set then the field name, with normalized case, is used instead.

dataType

The type of the field as the DataType class. Usually the type is taken from Java class of the field and does not need to be specified. This corresponds to the SQL type. See Section 2.2 [Persisted Types], page 13.

defaultValue

String default value of the field when we are creating a new row in the table. Default is none.

width

Integer width of string fields. Some databases do not support this unfortunately. Default for those that do is 255.

canBeNull

Boolean whether the field can be assigned to null value. Default is true. If set to false then you must provide a value for this field on every object inserted into the database.

id

Boolean whether the field is the id field or not. Default is false. Only one field can have this set in a class. Id fields uniquely identity a row and are required if you want to use the query, update, refresh, and delete by ID methods. Only one of this, generatedId, and generatedIdSequence can be specified. See Section 2.9.1 [Id Column], page 20.

generatedId

Boolean whether the field is an auto-generated id field. Default is false. Only one field can have this set in a class. This tells the database to auto-generate a corresponding id for every row inserted. When an object with a generated-id is created using the Dao.create() method, the database will generate an id for the row which will be returned and set in the object by the create method. Some databases require sequences for generated ids in which case the sequence name will be auto-generated. To specify the name of the sequence use generatedIdSequence. Only one of this, id, and generatedIdSequence can be specified. See Section 2.9.2 [GeneratedId Column], page 21.

generatedIdSequence

String name of the sequence number to be used to generate this value. Same as generatedId but you can specify the sequence name to use. Default is

none. Only one field can have this set in a class. This is only necessary for databases which require sequences for generated ids. If you use generatedId instead then the code will auto-generate a sequence name. Only one of this, id, and generatedId can be specified. See Section 2.9.3 [GeneratedIdSequence Column], page 21.

foreign

Boolean setting which identifies this field as corresponding to another class that is also stored in the database. Default is false. The field must not be a primitive type. The other class must have an id field (either id, generatedId, or generatedIdSequence) which will be stored in this table. When an object is returned from a query call, any foreign objects will *just* have the id field set. See Section 2.12 [Foreign Objects], page 25.

useGetSet

Boolean that says that the field should be accessed with get and set methods. Default is false which instead uses direct field access via Java reflection. This may be necessary if the object you are storing has protections around it.

NOTE: The name of the get method must match getXxx() where Xxx is the name of the field with the first letter capitalized. The get must return a class which matches the field's exactly. The set method must match setXxx(), have a single argument whose class matches the field's exactly, and return void. For example:

```
@DatabaseField(useGetSet = true)
private Integer orderCount;

public Integer getOrderCount() {
   return orderCount;
}

public void setOrderCount(Integer orderCount) {
   this.orderCount = orderCount;
}
```

unknownEnumName

If the field is a Java enumerated type then you can specify the name of a enumerated value which will be used if the value of a database row is not found in the enumerated type. If this is not specified and a database row *does* contain an unknown name or ordinal value then a SQLException is thrown when the row is being read from the database. This is useful to handle backwards compatibility when handling out-of-date database values as well as forwards compatibility if old software is accessing up-to-date data or if you have to roll a release back.

throwIfNull

Boolean that tells ORMLite to throw an exception if it sees a null value in a database row and is trying to store it in a primitive field. By default it is false. If it is false and the database field is null, then the value of the primitive will be set to 0 (false, null, etc.). This can only be used on a primitive field.

persisted

Set this to be false (default true) to not store this field in the database. This is useful if you want to have the annotation on all of your fields but turn off the writing of some of them to the database.

format

This allows you to specify format information of a particular field. Right now only the Date fields support it when a default value is being converted or if you are using the DATE_STRING type.

unique

Adds a constraint to the field that it has to be unique across all rows in the table. This allows you to have a unique field in the table even though it is not the id field. For example, you might have an Account class which has a generated account-id but you also want the email address to be unique across all Accounts. You can also use the uniqueIndexName to create an index for this field. For unique constraints across multiple fields, see the uniqueIndex below.

index

Boolean value (default false) to have the database add an index for this field. This will create an index with the name columnName with a "_idx" suffix. To specify a specific name of the index or to index multiple fields, use the indexName field.

uniqueIndex

Boolean value (default false) to have the database add a unique index for this field. Same as index but this will ensure that all of the values in the index are unique. If you just want to make sure of unique-ness then you can use the unique field instead.

indexName

String value (default none) to have the database add an index for this field with this name. You do not need to specify the index boolean as well. To index multiple fields together in one index, each of the fields should have the same indexName value.

uniqueIndexName

String value (default none) to have the database add a unique index for this field with this name. Same as index but this will ensure that all of the values in the index are unique. For example, this means that you can insert ("pittsburgh", "pa") and ("harrisburg", "pa") and ("pittsburgh", "tx") but not another ("pittsburgh", "pa").

foreignAutoRefresh

Set this to be true (default false) to have a foreign field automagically refreshed when an object is queried. This will *not* automagically create the foreign object but when the object is queried, a separate database call will be made to load of the fields of the foreign object via an internal DAO. The default is to just have the ID field in the object retrieved and for the caller to call refresh on the correct DAO.

NOTE: This will create another DAO object internally so low memory devices may want to call refresh by hand.

2.1.2 Using javax.persistence Annotations

Instead of using the ORMLite annotations (see Section 2.1.1 [Local Annotations], page 7), you can use the more standard JPA annotations from the javax.persistence package. In place of the @DatabaseTable annotation, you can use the javax.persistence @Entity annotation. For example:

```
@Entity(name = "accounts")
public class Account {
```

The @Entity annotations can have an optional name argument which specifies the table name. If not specified, the class name with normalized case is used by default.

Instead of using the <code>QDatabaseField</code> annotation on each of the fields, you can use the <code>javax.persistence</code> annotations: <code>QColumn</code>, <code>QId</code>, <code>QGeneratedValue</code>, <code>QOneToOne</code>, and <code>QManyToOne</code>. For example:

```
@Entity(name = "accounts")
public class Account {
    @Id
    private String name;
    @Column(nullable = false)
    private String password;
```

The following javax.persistence annotations and fields are supported:

@Column

Specifies the field to be persisted to the database. You can also just specify the @Id annotation. The following annotation fields are supported, the rest are ignored.

name

Used to specify the name of the associated database column. If not provided then the field name is taken.

length

Specifies the length (or width) of the database field. Maybe only applicable for Strings and only supported by certain database types. Default for those that do is 255. Same as the width field in the @DatabaseField annotation.

nullable

Set to true to have a field not be able to be inserted into the database with a null value. Same as the canBeNull field in the @DatabaseField annotation.

unique

Adds a constraint to the field that it has to be unique across all rows in the table. Same as the unique field in the @DatabaseField annotation.

@Id

Used to specify a field to be persisted to the database as a primary row-id. If you want to have the id be auto-generated, you will need to also specify the @GeneratedValue annotation.

@GeneratedValue

Used to define an id field as having a auto-generated value. This is only used in addition to the @Id annotation. See the generatedId field in the @DatabaseField annotation for more details.

@OneToOne or @ManyToOne

Fields with these annotations are assumed to be foreign fields. See Section 2.12 [Foreign Objects], page 25. ORMLite does *not* enforce the many or one relationship nor does it use any of the annotation fields. It just uses the existence of either of these annotations to indicate that it is a foreign object.

If the @Column annotation is used on a field that has a unknown type then it is assumed to be a Serializable field and the object should implement java.io.Serializable. See [datatype serializable], page 14.

2.1.3 Adding a No-Argument-Constructor

After you have added the class and field annotations, you will also need to add a no-argument constructor with *at least* package visibility. When an object is returned from a query, ORMLite constructs the object using Java reflection and a constructor needs to be called.

```
Account() {
    // all persisted classes must define a no-arg constructor
    // with at least package visibility
}
So your final example Account class with annotations and constructor would look like:
    @DatabaseTable(tableName = "accounts")
    public class Account {
        @DatabaseField(id = true)
        private String name;

        @DatabaseField(canBeNull = false)
        private String password;
        ...
Account() {
```

```
// all persisted classes must define a no-arg constructor
    // with at least package visibility
}
....
}
```

2.2 Persisted Data Types

The following Java types can be persisted to the database by ORMLite. Database specific code helps to translate between the SQL types and the database specific handling of those types. See Section 2.5 [Database Type], page 16.

```
String (DataType.STRING)
```

Persisted as SQL type VARCHAR.

boolean or Boolean (DataType.BOOLEAN or DataType.BOOLEAN_OBJ)

Persisted as SQL type BOOLEAN.

java.util.Date (DataType.DATE)

Persisted as SQL type TIMESTAMP. This type automatically uses an internal ? argument because the string format of it is unreliable to match the database format. See Section 3.5 [Select Arguments], page 32. See also DATE_LONG and DATE_STRING.

NOTE: This is a different class from java.sql.Date.

NOTE: Certain databases only provide seconds resolution so the milliseconds will be 0.

java.util.Date (DataType.DATE_LONG)

You can also specify the dataType field to the @DatabaseField annotation as a DataType.DATE_LONG in which case the milliseconds value of the Date will be stored as an LONG. See also DATE and DATE_STRING.

NOTE: This is a different class from java.sql.Date.

NOTE: Certain databases only provide seconds resolution so the milliseconds will be 0.

java.util.Date (DATE_STRING)

You can also specify the dataType field to the @DatabaseField annotation as a DataType.DATE_STRING in which case the date will be stored as a string in yyyy-MM-dd HH:mm:ss.SSSSSS format. You can use the format field in DatabaseField to set the date to another format. See also DATE and DATE_LONG.

NOTE: This is a different class from java.sql.Date.

NOTE: Certain databases only provide seconds resolution so the milliseconds will be 0.

NOTE: Because of reentrant issues with SimpleDateFormat, synchronization is done every time a DATE_STRING date is converted to/from the database.

```
byte or Byte (DataType.BYTE or DataType.BYTE_OBJ)
```

Persisted as SQL type TINYINT.

short or Short (DataType.SHORT or DataType.SHORT_OBJ)
Persisted as SQL type SMALLINT.

int or Integer (DataType.INTEGER or DataType.INTEGER_OBJ)
Persisted as SQL type INTEGER.

long or Long (DataType.LONG or DataType.LONG_OBJ)
Persisted as SQL type BIGINT.

float or Float (DataType.FLOAT or DataType.FLOAT_OBJ)

Persisted as SQL type FLOAT.

double or Double (DataType.DOUBLE or DataType.DOUBLE_OBJ)
Persisted as SQL type DOUBLE.

Serializable (DataType.SERIALIZABLE)

Persisted as SQL type VARBINARY. This is a special type that serializes an object as a sequence of bytes and then descrializes it on the way back. The field must be an object that implements the <code>java.io.Serializable</code> interface. Depending on the database type, there will be limits to the size of the object that can be stored. YMMV.

Some databases place restrictions on this field type that it cannot be the id column in a class. Other databases do not allow you to query on this type of field at all. If your database does support it, you may also have to use a Select Argument to query for this type. See Section 3.5 [Select Arguments], page 32.

enum or Enum (DataType.ENUM_STRING)

Persisted by default as the enumerated value's string name as a VAR-CHAR type. The string name is the default (and recommended over ENUM_INTEGER) because it allows you to add additional enums anywhere in the list without worrying about having to convert data later.

You can also also specify an *unknownEnumName* name with the @DatabaseField annotation which will be used if an unknown value is found in the database. See [unknownEnumName], page 9.

enum or Enum (DataType.ENUM_INTEGER)

You specify the dataType field (from the @DatabaseField annotation) as a DataType.ENUM_INTEGER in which case the ordinal of the enum value will be stored as an INTEGER. The name (ENUM_STRING) is the default (and recommended) because it allows you to add additional enums anywhere in the list without worrying about having to convert data later. If you insert (or remove) an enum from the list that is being stored as a number, then old data will be un-persisted incorrectly.

You can also also specify an *unknownEnumName* name with the @DatabaseField annotation which will be used if an unknown value is found in the database. See [unknownEnumName], page 9.

NOTE: ORMLite also supports the concept of foreign objects where the id of another object is stored in the database. See Section 2.12 [Foreign Objects], page 25.

2.3 Connection Sources

NOTE: With regards to connection sources, Android users should see the Android specific documentation later in the manual. See Chapter 4 [Use With Android], page 33.

To use the database and the DAO objects, you will need to configure what JDBC calls a DataSource (see the javax.sql.DataSource class) and what ORMLite calls a ConnectionSource. A ConnectionSource is a factory for connections to the physical SQL database. Here is a code example that creates a simple, single-connection source.

```
// single connection source example for a database URI
ConnectionSource connectionSource =
  new JdbcConnectionSource("jdbc:h2:mem:account");
```

The package also includes the class JdbcPooledConnectionSource which is a relatively simple implementation of a pooled connection source. As database connections are released, instead of being closed they are added to an internal list so they can be reallocated at a later time. New connections are created on demand only if there are no dormant connections that can be reused. JdbcPooledConnectionSource is also synchronized and can be used my multiple threads. It has settings for the maximum number of free connections before they are closed as well as a maximum age before a connection is closed.

```
// single connection source example
JdbcPooledConnectionSource connectionSource =
  new JdbcPooledConnectionSource("jdbc:h2:mem:account");
// only keep the connections open for 5 minutes
connectionSource.setMaxConnectionAgeMillis(5 * 60 * 1000);
```

There are many other, external data sources that can be used instead, including more robust and probably higher-performance pooled connection managers. You can instantiate your own directly and wrap it in the DataSourceConnectionSource class which delegates to it.

```
// basic Apache data source
BasicDataSource dataSource = new BasicDataSource();
dataSource.setUrl("jdbc:h2:mem:account");
// we wrap it in the DataSourceConnectionSource
ConnectionSource connectionSource =
   new DataSourceConnectionSource(dataSource);
```

When you are done with your ConnectionSource, you will want to call a close() method to close any underlying connections. Something like the following pattern is recommended.

```
JdbcConnectionSource connectionSource =
    new JdbcPooledConnectionSource("jdbc:h2:mem:account");
try {
    // work with the data-source and DAOs
    ...
} finally {
    connectionSource.close();
}
```

Unfortunately, the DataSource interface does not have a close method so if you are using the DataSourceConnectionSource you will have to close the underlying DataSource by hand – the close() method on the DataSourceConnectionSource does *nothing*.

2.4 Setting Up the DAOs

Once you have annotated your classes and defined your ConnectionSource you will need to create the Data Access Object (DAO) class(es). The pattern that we recommend is to define an interface which extends the Dao interface and will be used in the code. The interface isn't required but it is a good pattern so your code is less tied to JDBC for persistence. Each DAO has two generic parameters: the class we are persisting with the DAO, and the class of the ID-column that will be used to identify a specific database row. If you class does not have an ID field, you can put Object or Void as the 2nd argument. For example, in the above Account class, the "name" field is the ID column (id = true) so the ID class is String. Example:

That's all you need to define your DAO classes. You are free to add more methods to your DAO interfaces and implementations if there are specific operations that are needed and not provided by the Dao base classes. More on how to use these DAOs later. See Section 2.8 [DAO Usage], page 19.

You are not *required* to create a DAO class for every one of your persisted objects. You can use the createDao static method on the BaseDaoImpl class to create a DAO class without having to define one. For example:

```
Dao<Account, String> accountDao =
   BaseDaoImpl.createDao(connectionSource, Account.class);
Dao<Order, Integer> orderDao =
   BaseDaoImpl.createDao(connectionSource, Order.class);
```

2.5 Database Type

ORMLite uses an internal DatabaseType object which defines all of the per-database information necessary to support the various features on all of the different database types.

The JdbcConnectionSource uses the database URL to pick the correct DatabaseType. If it picks an incorrect one then you may need to set the DatabaseType on the connection source *directly*. For example:

```
String databaseUrl = "jdbc:derby://dbserver1:1527/";
DatabaseType databaseType = new DerbyClientServerDatabaseType();
ConnectionSource connectionSource =
   new JdbcConnectionSource(databaseUrl, databaseType);
```

Android users do not need to worry about this because the AndroidConnectionSource always uses the SqliteAndroidDatabaseType. See Chapter 4 [Use With Android], page 33.

For more information about the database specific code in the DatabaseType see later in the manual. See Section 5.3 [Database Type Details], page 37.

2.6 Supported Databases

ORMLite supports the following database flavors. Some of them have some specific documentation that needs to be obeyed.

MySQL

Tables are created in MySQL with the InnoDB engine by default using CREATE TABLE . . . ENGINE=InnoDB. If you want to use another engine, you can instantiate the MysqlDatabaseType directly and use the setCreateTableSuffix() method to use the default or another engine. Also, MySQL does some funky stuff with the last-modification time if a Date is defined as a TIMESTAMP so DATETIME was used instead.

Postgres

No special instructions.

Microsoft SQL Server

No special instructions.

H2

No special instructions. I use this database for all of my internal testing with in-memory and small on-disk databases.

Derby

There are two drivers for Derby: one embedded and one client/server. ORMLite makes an attempt to detect the right driver but you may have to set the right database type on your ConnectionSource directly if it doesn't. See Section 2.5 [Database Type], page 16.

HSQLDB

No special instructions.

SQLite

There are multiple SQLite drivers out there. Make sure you use the Xerial one (http://www.xerial.org/trac/Xerial/wiki/SQLiteJDBC) and not the Zentus one (http://www.zentus.com/sqlitejdbc/) which does not support generated ids.

Android SQLite

Android's SQLite database is accessed through direct calls to the Android database API methods.

DB2

I do not have access to an DB2 database so I cannot run any tests to make sure that my support for it works well. Please contact me if you have an DB2 database that I can develop against.

Oracle

I do not have access to an Oracle database so I cannot run any tests to make sure that my support for it works well. Please contact me if you have an Oracle database that I can develop against.

Please contact the author if your database is not supported.

2.7 Tying It All Together

So you have annotated the objects to be persisted, added the no-arg constructor, created your ConnectionSource, and defined your DAO classes. You are ready to start persisting and querying your database objects. The following code ties it all together:

```
// h2 by default but change to match your database
String databaseUrl = "jdbc:h2:mem:account";
JdbcConnectionSource connectionSource =
  new JdbcConnectionSource(databaseUrl);
// instantiate the dao with the connection source
AccountDaoImpl accountDao = new AccountDaoImpl(connectionSource);
// if you need to create the 'accounts' table make this call
TableUtils.createTable(connectionSource, Account.class);
// create an instance of Account
Account account = new Account("Jim Coakley");
// persist the account object to the database
// it should return 1 for the 1 row inserted
if (accountDao.create(account) != 1) {
  // error handling ...
// other code ...
// destroy the data source which should close underlying connections
connectionSource.destroy();
```

For more examples, see the code later in the manual. See Chapter 7 [Examples], page 47.

2.8 DAO Usage

The following database operations are easily accomplished by using the DAO methods:

create and persist an object to the database

This inserts a new row to the database table associated with the object.

```
Account account = new Account();
account.name = "Jim Coakley";
// only 1 row should have been affected
if (accountDao.create(account) != 1) {
    // error handling ...
}
```

query for it's id column

If the object has an id field defined by the annotations, then we can lookup an object in the database using its id.

```
Account account = accountDao.queryForId(name);
if (account == null) {
  account not found handling ...
}
```

update the database row associated with the object

If you change fields in an object in memory, you must call update to persist those changes to the database. This requires an id field.

```
account.password = "_secret";
// 1 row should be updated
if (accountDao.update(account) != 1) {
   // error handling ...
}
```

refreshing our object if the database has changed

If some other entity has changed a row the database corresponding to an object in memory, you will need to refresh that object to get the memory object upto-date. This requires an id field.

```
// 1 row should be found
if (accountDao.refresh(account) != 1) {
   // error handling ...
}
```

delete the account from the database

Removes the row that corresponds to the object from the database. Once the object has been deleted from the database, you can continue to use the object in memory but any update or refresh calls will fail. This requires an id field.

```
// 1 row should be affected
if (accountDao.delete(account) != 1) {
   // error handling ...
}
```

iterate through all of the rows in a table:

The DAO is also an iterator so you can easily run through all of the rows in the database:

```
// page through all of the accounts in the database
for (Account account : accountDao) {
    System.out.println(account.getName());
}
```

NOTE: you must page through *all* items for the iterator to close the underlying SQL object. If you don't go all of the way, the garbage collector will close the SQL statement some time later which is considered bad form.

For a detailed list of the methods in the DAO see see Section 5.4 [DAO Methods], page 39.

2.9 Identity Columns

Database rows are identified by a particular column which is defined as the *identity* column. This can either be supplied by the user or auto-generated by the database. Identity columns have unique values for every row in the table and they are required if you want to query-by-id, delete, refresh, or update a particular row using the DAO. To configure a field as an identity field, you should use one (and only one) of the following three settings from <code>@DatabaseField: id</code>, <code>generatedId</code>, or <code>generatedIdSequence</code>.

2.9.1 Fields With id

With our Account example class, the string name field has been marked with id = true. This means that the name is the identity column for the object. Each account stored in the database must have a unique value for the name field – you cannot have two rows with the name "John Smith".

```
public class Account {
    @DatabaseField(id = true)
    private String name;
    ...
}
```

When you use the DAO to lookup an account with a particular name, you will use the identity field to locate the Account object in the database:

```
Account account = accountDao.queryForId("John Smith");
if (account == null) {
    // the name "John Smith" does not match any rows
}
```

NOTE: If you need to change the value of an object's id field, you must use the Dao.updateId() method which takes the current object still with its old id value and the new value. ORMLite has to first locate the object by its old id and then update it with the new id. See [updateId], page 39.

2.9.2 Fields With generatedId

You can configure a long or integer field to be a *generated* identity column. The id number column for each row will then be automatically generated by the database.

```
public class Order {
    @DatabaseField(generatedId = true)
    private int id;
    ...
}
```

When an Order object is passed to create and stored to the database, the generated identity value is returned by the database and set on the object by ORMLite. In the majority of database types, the generated value starts at 1 and increases by 1 every time a new row is inserted into the table.

```
// build our order object without and id
Order order = new Order("Jim Sanders", 12.34);
...
if (orderDao.create(order) != 1) {
    // error handling unless 1 row was inserted
}
System.out.println("Order id " + order.getId() +
    " was persisted to the database");
// query for the order with an id of 1372
order = orderDao.queryForId(1372);
if (order == null) {
    // none of the order rows have an id of 1372
}
```

In the above code example, an order is constructed with name and amount (for example). When it is passed to the DAO's create method, the id field has not been set. After it has been saved to the database, the generated-id will be set on the id field by ORMLite and will be available when getId() is called on the order after the create method returns.

 $\it NOTE:$ Depending on the database type, you may not be able to change the value of an auto-generated id field.

2.9.3 Fields With generatedIdSequence

Some databases use what's called a sequence number generator to provide the generated id value. If you use <code>generatedId = true</code> with those databases, a sequence name will be auto-generated by ORMLite. If, however, you need to set the name of the sequence to match existing schema, you can used the <code>generatedIdSequence</code> value which takes a string name for the sequence.

```
public class Order {
    @DatabaseField(generatedIdSequence = "order_id_seq")
    private int id;
    ...
}
```

In the above example, the id value is again automatically generated but using a sequence with the name order_id_seq. This will throw an exception if you are working with a database which does not support sequences.

NOTE: Depending on the database type, you may not be able to change the value of an auto-generated id field.

2.10 Indexing Fields

ORMLite provides some limited support for indexing of various fields in your data classes. First off, it is important to point out that any field marked as an id field is already indexed. Fields that are id fields do not need to have additional indexes built and if they are specified, errors may result with certain database.

To add an index on a non-id field, all you need to do is add the index = true boolean field to the @DatabaseField annotation. See [index], page 10. This will create a non-unique index after the table is created for the field and will drop the index if the table is then dropped. Indexes help optimize queries and can significantly improve times on queries to medium to large sized tables.

```
public class Account {
    @DatabaseField(id = true)
    private String name;
    // this indexes the city field so queries on city
    // will go faster for large tables
    @DatabaseField(index = true)
    private String city;
    ...
}
```

This example creates the index account_city_idx on the Account table. If you want to use a different name, you can use the indexName = "othername" field instead which allows you to specify the name of the index.

If you often query on (for example) city and state fields together, you might want to create an index on both fields. ORMLite supports creating indexes on multiple fields by specifying the same <code>indexName</code> value for each of the fields you want to be included in the index.

```
@DatabaseField(indexName = "account_citystate_idx")
private String city;
@DatabaseField(indexName = "account_citystate_idx")
private String state;
```

This example will create one index for both the city and state fields. Note that queries on the city by itself will not be optimized – only queries on both city and state will be. With some databases, it may be better to create a single field index on each field and let the database use both indexes if you are querying on city and state. For other databases, creating an index on multiple fields is recommended. You may need to experiment and use the SQL EXPLAIN command to pinpoint how your database is utilizing your indicies.

To create *unique* indexes, there is a uniqueIndex = true and uniqueIndexName = "othername" fields also available on the @DatabaseField annotation. These work the

same as the above settings but will instead create unique indexes that ensure that no two row has the same value(s) for the indexed field(s).

2.11 Issuing Raw SQL Statements

In a number of instances, using the defined DAO functionality may not be enough to change your database. For this reason, ORMLite has calls which allow you to issue raw query, update, and execute statements to the database.

2.11.1 Issuing Raw Queries

The built-in methods available in the Dao interface and the QueryBuilder classes don't provide the ability to handle all types of queries. For example, aggregation queries (sum, count, avg, etc.) cannot be handled as an object since every query has a different result list. To handle these queries, you can issue raw database queries using the queryRaw methods on DAO. These methods return a GenericRawResults object which represents a result as an array of strings, array of objects, or user objects. See the documentation on the GenericRawResults object for more details on how to use it, or take a look at the following examples.

```
// find out how many orders account-id #10 has
GenericRawResults<String[]> rawResults =
  orderDao.queryRaw(
    "select count(*) from orders where account_id = 10");
// there should be 1 result
List<String[]> results = rawResults.getResults();
// the results array should have 1 value
String[] resultArray = results.get(0);
// this should print the number of orders that have this account-id
System.out.println("Account-id 10 has " + resultArray[0] + " orders");
```

For large numbers of results, you should consider using the iterator() method on the GenericRawResults object which uses database paging. For example:

If some of your fields cannot be appropriately mapped to strings, you can also return the fields as an <code>Object[]</code> if you pass in the types of the resulting columns. For example:

```
// return the orders with the sum of their amounts per account
GenericRawResults<Object[]> rawResults =
```

NOTE: select * can return fields in different orders depending on the database type. To make sure that the data-type array matches the returned columns you must specify the fields specifically and not with a SQL *.

You can also map the results into your own object by passing in a RawRowMapper object. This will call the mapping object with an array of strings and allow it to convert the strings into an object. For example:

```
// return the orders with the sum of their amounts per account
GenericRawResults<Foo> rawResults =
  orderDao.queryRaw(
    "select account_id, sum(amount) from orders group by account_id",
   new RawRowMapper<Foo>() {
     public Foo mapRow(String[] columnNames, String[] resultColumns) {
    return new Foo(Long.parseLong(resultColumns[0]),
         Integer.parseInt(resultColumns[1]));
    }
    });
// page through the results
for (Foo foo : rawResults) {
 System.out.println("Account-id " + foo.accountId + " has "
    + foo.totalOrders + " total orders");
}
rawResults.close();
```

 $\it NOTE$: The query and the resulting strings can be $\it very$ database-type specific. For example:

- 1. Certain databases need any column names specified in uppercase others need lower-case.
- 2. You may have to quote your column or table names if they are reserved words.
- 3. The resulting column names also could be uppercase or lowercase.
- 4. select * can return fields in different orders depending on the database type.

NOTE: Like other ORMLite iterators, you will need to make sure you iterate through all of the results to have the statement closed automatically. You can also call the GenericRawResults.close() method to make sure the iterator, and any associated database connections, is closed.

2.11.2 Issuing Raw Update Statements

You can also issue raw update statements against the database if the DAO functionality does not give you enough flexibility. Update SQL statements must contain the reserved words INSERT, DELETE, or UPDATE. For example:

2.11.3 Issuing Raw Execute Statements

You can also issue raw update statements against the database if the DAO functionality does not give you enough flexibility. For example:

```
fooDao.executeRaw("TRUNCATE TABLE accountlog");
```

Certain database types allow table truncation which you can call through the raw execute method. If truncate is not supported by the database then you can instead do:

```
fooDao.executeRaw("DELETE FROM accountlog");
```

2.12 Foreign Object Fields

ORMLite supports the concept of "foreign" objects where one or more of the fields correspond to an object are persisted in another table in the same database. For example, if you had an Order objects in your database and each Order had a corresponding Account object, then the Order object would have foreign Account field. With foreign objects, just the id field from the Account is persisted to the Order table as the column "account_id". For example, the Order class might look something like:

```
@DatabaseTable(tableName = "orders")
public class Order {
    @DatabaseField(generatedId = true)
    private int id;
    @DatabaseField(canBeNull = false, foreign = true)
    private Account account;
    ...
}
```

When the Order table was created, something like the following SQL would be generated:

```
CREATE TABLE 'orders'
  ('id' INTEGER AUTO_INCREMENT , 'account_id' INTEGER,
    PRIMARY KEY ('id'));
```

Notice that the name of the field is not account but is instead account_id. You will need to use this field name if you are querying for it. You can set the column name using the columnName field in the DatabaseField annotation. See [columnName], page 8.

When you are creating a field with a foreign object, please note that the foreign object will *not* automatically be created for you. If your foreign object has a generated-id which

is provided by the database then you need to create it *before* you create any objects that reference it. For example:

```
Account account = new Account("Jim Coakley");
if (accountDao.create(account) != 1) {
    // error handling ...
}
// this will create the account object and set any generated ids
// now we can set the account on the order and create it
Order order = new Order("Jim Sanders", 12.34);
order.setAccount(account);
...
if (orderDao.create(order) != 1) {
    // error handling unless 1 row was inserted
```

When you query for an order, you will get an Order object with an account field object that *only* has its id field set. The rest of the fields in the foreign Account object will have default values (null, 0, false, etc.). If you want to use other fields in the Account, you must call refresh on the accountDao class to get the Account object filled in. For example:

```
Order order = orderDao.queryForId(orderId);
System.out.println("Account-id on the order should be set: " +
    order.account.id);
// this should print null for order.account.name
System.out.println("But other fields on the account should not be set: "
    + order.account.name);

// so we refresh the account using the AccountDao
if (accountDao.refresh(order.getAccount()) != 1) {
    // error handling ...
}
System.out.println("Now the account fields will be set: " +
    order.account.name);
```

You can have the foreign objects automagically refreshed by using the foreignAutoRefresh setting. See [foreignAutoRefresh], page 10.

NOTE: Because we use refresh, foreign objects are therefor required to have an id field.

The Where() object has some method calls to help with using foreign objects. see [foreignIdEq], page 30 and see [foreignIdIn], page 30. There is also example code to show how to use foreign objects. See [foreign objects example], page 47.

3 Custom Statement Builder

The DAOs have methods to query for an object that matches an id field (queryForId) as well as query for all objects (queryForAll) and iterating through all of the objects in a table (iterator). However, for more specified queries, there is the queryBuilder() method which returns a QueryBuilder object for the DAO with which you can construct custom queries to return a sub-set of the table.

3.1 Query Builder Basics

Here's how you use the query builder to construct custom queries. First, it is a good pattern to set the column names of the fields with Java constants so you can use them in queries. For example:

```
@DatabaseTable(tableName = "accounts")
public class Account {
    public static final String PASSWORD_FIELD_NAME = "password";
...
    @DatabaseField(canBeNull = false, columnName = PASSWORD_FIELD_NAME)
    private String password;
```

This allows us to construct queries using the password field name without having the renaming of a field in the future break our queries. This should be done *even* if the name of the field and the column name are the same.

```
// get our query builder from the DAO
QueryBuilder<Account, String> queryBuilder =
   accountDao.queryBuilder();
// the 'password' field must be equal to "qwerty"
queryBuilder.where().eq(Account.PASSWORD_FIELD_NAME, "qwerty");
// prepare our sql statement
PreparedQuery<Account, String> preparedQuery =
   queryBuilder.prepare();
// query for all accounts that have that password
List<Account> accountList = accountDao.query(preparedQuery);
```

You get a QueryBuilder object from the Dao.queryBuilder method, call methods on it to build your custom query, call queryBuilder.prepare() which returns a PreparedQuery object, and then pass the PreparedQuery to the DAO's query or iterator methods.

As a short cut, you can also call the prepare() method on the Where object to do something like the following:

```
// query for all accounts that have that password
List<Account> accountList =
   accountDao.query(
        accountDao.queryBuilder().where()
        .eq(Account.PASSWORD_FIELD_NAME, "qwerty")
        .prepare());
```

3.2 Building Queries

There are a couple of different ways that you can build queries. The QueryBuilder has been written for ease of use as well for power users. Simple queries can be done linearly:

```
QueryBuilder<Account, String> queryBuilder =
       accountDao.queryBuilder();
     // get the WHERE object to build our query
     Where<Account, String> where = queryBuilder.where();
     // the name field must be equal to "foo"
     where.eq(Account.NAME_FIELD_NAME, "foo");
     // and
     where.and();
     // the password field must be equal to "_secret"
     where.eq(Account.PASSWORD_FIELD_NAME, "_secret");
     PreparedQuery<Account, String> preparedQuery =
       queryBuilder.prepare();
  The SQL query that will be generated from the above example will be approximately:
     SELECT * FROM account
       WHERE (name = 'foo' AND password = '_secret')
  If you'd rather chain the methods onto one line (like StringBuilder), this can also be
written as:
     queryBuilder.where()
       .eq(Account.NAME_FIELD_NAME, "foo")
       .and()
       .eq(Account.PASSWORD_FIELD_NAME, "_secret");
  If you'd rather use parenthesis to group the comparisons properly then you can call:
     Where<Account, String> where = queryBuilder.where();
     where.and(where.eq(Account.NAME_FIELD_NAME, "foo"),
               where.eq(Account.PASSWORD_FIELD_NAME, "_secret"));
  All three of the above call formats produce the same SQL. For complex queries that mix
ANDs and ORs, the last format may be necessary to get the grouping correct. For example,
here's a complex query:
     Where<Account, String> where = queryBuilder.where();
     where.or(
       where.and(
         where.eq(Account.NAME_FIELD_NAME, "foo"),
         where.eq(Account.PASSWORD_FIELD_NAME, "_secret")),
       where.and(
         where.eq(Account.NAME_FIELD_NAME, "bar"),
         where.eq(Account.PASSWORD_FIELD_NAME, "qwerty")));
  This produces the following approximate SQL:
     SELECT * FROM account
       WHERE ((name = 'foo' AND password = '_secret')
              OR (name = 'bar' AND password = 'qwerty'))
```

The QueryBuilder also allows you to set what specific select columns you want returned, specify the 'ORDER BY' and 'GROUP BY' fields, and various other SQL features (LIKE, IN, >, >=, <, <=, <>, IS NULL, DISTINCT, ...). See Section 3.4 [Where Capabilities], page 29. You can also see the javadocs on QueryBuilder and Where classes for more information. A good SQL reference site can be found at http://www.w3schools.com/Sql/.

3.3 Building Statements

The DAO can also be used to construct custom UPDATE and DELETE statements. Update statements are used to change certain fields in rows from the table that match the WHERE pattern – or update *all* rows if no where(). Delete statements are used to delete rows from the table that match the WHERE pattern – or delete *all* rows if no where().

For example, if you want to update the passwords for all of the Accounts in your table that are currently null to the string "none", then you might do something like the following:

```
UpdateBuilder<Account, String> updateBuilder =
    accountDao.updateBuilder();
// update the password to be "none"
updateBuilder.updateColumnValue("password", "none");
// only update the rows where password is null
updateBuilder.where().isNull(Account.PASSWORD_FIELD_NAME);
accountDao.update(updateBuilder.prepare());
With update, you can also specify the update value to be an expression:
// update hasDogs boolean to true if dogC > 0
updateBuilder.updateColumnExpression(
    "hasDogs", "dogC > 0");
```

To help you construct your expressions, you can use the UpdateBuilder's escape methods escapeColumnName and escapeValue can take a string or a StringBuilder. This will protect you if columns or values are reserved words.

If, instead, you wanted to delete the rows in the Accounts table whose password is currently null, then you might do something like the following:

```
DeleteBuilder<Account, String> deleteBuilder =
   accountDao.deleteBuilder();
// only delete the rows where password is null
deleteBuilder.where().isNull(Account.PASSWORD_FIELD_NAME);
accountDao.delete(deleteBuilder.prepare());
```

3.4 Where Capabilities

The following are some details about the various method calls for adding WHERE SQL statements to your custom select, delete, and update statements. See the Javadocs for the Where class for the most up-to-date information about the available methods. All of the methods return the Where object so you can chain them together.

For a good tutorial of SQL commands, here's a good site: http://www.w3schools.com/sql/sql_where.asp.

and()

Binary AND operation which takes the previous clause and the next clause and AND's them together. This is when you are using inline query calls.

and(Where<T, ID> left, Where<T, ID> right)

Binary AND operation which takes 2 arguments and AND's them together. This is when you are *not* using inline query calls but instead want to use standard arguments.

between (String columnName, Object low, Object high)

Add a BETWEEN clause which makes sure the column is between the low and high parameters.

eq(String columnName, Object value)

Add a '=' clause which makes sure the column is equal to the value.

exists(QueryBuilder<?, ?> subQueryBuilder)

Add a EXISTS clause with a sub-query inside of parenthesis. This will return returns as long as the inner query returns results.

NOTE: The sub-query will be prepared at the same time that the outside query is.

foreignIdEq(Dao<OD, OID> dataDao, OD data)

Add a clause where the ID is the id from a foreign field in the data that is passed in.

foreignIdIn(Dao<OD, OID> dataDao, OD... datas)

Add a IN clause where the ID is the id from a foreign field in the data items that are passed in.

foreignIdIn(Dao<OD, OID> dataDao, Iterable<OD> datas)

Add a IN clause where the ID is the id from a foreign field in the data items iterable that is passed in.

ge(String columnName, Object value)

Add a '>=' clause which makes sure the column is greater-than or equals-to the value.

gt(String columnName, Object value)

Add a '>' clause which makes sure the column is greater-than the value.

idEq(ID id)

Add a clause where the ID is equals to the argument.

idEq(Dao<OD, ?> dataDao, OD data)

Add a clause where the ID is extracted from an existing object.

in(String columnName, Iterable<?> objects)

Add a IN clause which makes sure the column is equal-to one of the objects from the Iterable (probably collection) passed in.

in(String columnName, Object... objects)

Add a IN clause which makes sure the column is equal-to one of the objects passed in.

in(String columnName, QueryBuilder<?, ?> subQueryBuilder)

Add a IN clause which makes sure the column is in one of the columns returned from a sub-query inside of parenthesis. The QueryBuilder must return 1 and only one column which can be set with the QueryBuilder.selectColumns(String...) method calls. That 1 argument must match the SQL type of the column-name passed to this method.

NOTE: The sub-query will be prepared at the same time that the outside query is.

isNull(String columnName)

Add a 'IS NULL' clause which makes sure the column's value is null. '=' NULL does not work.

isNotNull(String columnName)

Add a 'IS NOT NULL' clause so the column must not be null. '<>' NULL does not work.

le(String columnName, Object value)

Add a '<=' clause which makes sure the column is less-than or equals-to the value.

lt(String columnName, Object value)

Add a '<' clause which makes sure the column is less-than the value.

like(String columnName, Object value)

Add a LIKE clause which makes sure the column match the value using '%' patterns.

ne(String columnName, Object value)

Add a '<>' clause which makes sure the column is not-equal-to the value.

not()

Used to NOT the next clause specified when using inline query calls.

not(Where<T, ID> comparison)

Used to NOT the argument clause specified. This is when you are *not* using inline query calls but instead want to use standard arguments.

or()

Binary OR operation which takes the previous clause and the next clause and OR's them together. This is when you are using inline query calls.

or(Where<T, ID> left, Where<T, ID> right)

Binary OR operation which takes 2 arguments and OR's them together. This is when you are *not* using inline query calls but instead want to use standard arguments.

prepare()

A short-cut for calling prepare() on the original QueryBuilder.prepare(). This method returns a PreparedQuery object.

3.5 Using Select Arguments

Select Arguments are arguments that are used in WHERE operations can be specified directly as value arguments (as in the above examples) or as a SelectArg object. SelectArgs are used to set the value of an argument at a later time – they generate a SQL '?'.

For example:

```
QueryBuilder<Account, String> queryBuilder =
  accountDao.queryBuilder();
Where < Account, String > where = queryBuilder.where();
SelectArg selectArg = new SelectArg();
// define our query as 'name = ?'
where.eq(Account.NAME_FIELD_NAME, selectArg);
// prepare it so it is ready for later query or iterator calls
PreparedQuery<Account, String> preparedQuery =
  queryBuilder.prepare();
// later we can set the select argument and issue the query
selectArg.setValue("foo");
List<Account> accounts = accountDao.query(preparedQuery);
// then we can set the select argument to another
// value and re-run the query
selectArg.setValue("bar");
accounts = accountDao.query(preparedQuery);
```

Certain data types use an internal SelectArg object because the string value of the object does not reliably match the database form of the object. java.util.Date is one example of such a type.

NOTE: SelectArg objects have protection against being used in more than one column name. You must instantiate a new object if you want to use a SelectArg with another column.

4 Using With Android

Because of the lack of support for JDBC in Android OS, ORMLite makes direct calls to the Android database APIs to access SQLite databases. You should make sure that you have downloaded and are depending on the ormlite-android.jar file and not the ormlite-jdbc.jar version. Although a number of developers are using the package in their projects, we continue to improve how ORMLite integrates with the Android classes. Feedback on this would be welcome.

After you have read the getting started section (see Chapter 1 [Getting Started], page 3), the following instructions should be followed to help you get ORMLite working under Android OS.

- 1. You will need to create your own database helper class which should probably extend the OrmLiteSqliteOpenHelper class. This class creates and upgrades the database when your app is installed and can also provide the DAO classes used by your other classes. Your helper class must implement the methods onCreate(SQLiteDatabase sqliteDatabase, ConnectionSource connectionSource) and onUpgrade(SQLiteDatabase database, ConnectionSource connectionSource, int oldVersion, int newVersion). onCreate creates the database when your app is first installed while onUpgrade handles the upgrading of the database tables when you upgrade your app to a new version. There is a sample DatabaseHelper class as well as examples projects online: http://ormlite.com/android/examples/.
- 2. The helper can be kept open across all activities in your app with the same Sqlite database connection reused by all threads. If you open multiple connections to the same database, stale data and unexpected results may occur. We recommend using the OpenHelperManager to monitor the usage of the helper it will create it on the first access, track each time a part of your code is using it, and then it will close the last time the helper is released.
- 3. The OpenHelperManager will by default look for the full class name of your own database helper class in the open_helper_classname value defined in res/values/strings.xml. You can instead set a SqliteOpenHelperFactory on the manager directly in a static {} block in your code.
- 4. Once you have defined your database helper and are managing it correctly, you will need to use it in your Activity classes. An easy way to use the OpenHelperManager is to extend OrmLiteBaseActivity for each of your activity classes there is also OrmLiteBaseService and OrmLiteBaseTabActivity. These classes provide a getHelper() method to access the database helper whenever it is needed and will automatically release the helper in the onDestroy() method. There is a sample HelloAndroid activity class in the the sample section of the tests and on the web site along with a SampleData example class. See [android examples], page 47.
- 5. If you do not want to extend the base classes then you will need to duplicate their basic functionality of calling OpenHelperManager.getHelper(Context context) at the start of your code, save the helper and use it as much as you want, and then calling OpenHelperManager.release() when you are done with it.
- 6. The Android native SQLite database type is SqliteAndroidDatabaseType and is used by the base classes internally.

Please see the example code documention for more information. See [android examples], page 47. Again, feedback on this is welcome.

5 Advanced Concepts

5.1 Spring Configuration

ORMLite contains some classes which make it easy to configure the various database classes using the Spring framework. For more information about the Spring Framework, see http://www.springsource.org/.

TableCreator

Spring bean that auto-creates any tables that it finds DAOs for if the system property ormlite.auto.create.tables has been set to true. It will also auto-drop any tables that were auto-created if the property ormlite.auto.drop.tables has been set to true. This should be used carefully and probably only in tests.

DaoFactory

Spring bean that can be used to create Dao's for certain classes without needing to define their own Dao class.

Here's an example of a full Spring configuration.

```
<!-- URL used for database, probably should be in properties file -->
<bean id="databaseUrl" class="java.lang.String">
    <!-- we are using the in-memory H2 database in this example -->
    <constructor-arg index="0" value="jdbc:h2:mem:account" />
</bean>
<!-- datasource used by ORMLite to connect to the database -->
<bean id="connectionSource"</pre>
    class="com.j256.ormlite.jdbc.JdbcConnectionSource"
    init-method="initialize">
    cproperty name="url" ref="databaseUrl" />
    <!-- probably should use system properties for these too -->
    cproperty name="username" value="foo" />
    cproperty name="password" value="bar" />
</bean>
<!-- abstract dao that is common to all defined daos -->
<bean id="baseDao" abstract="true" init-method="initialize">
    cproperty name="connectionSource" ref="connectionSource" />
</bean>
<!-- our daos -->
<bean id="accountDao"</pre>
    class="com.j256.ormlite.examples.common.AccountDaoImpl"
    parent="baseDao" />
<bean id="deliveryDao" class="com.j256.ormlite.spring.DaoFactory" factory-method="crea</pre>
<constructor-arg index="0" ref="connectionSource" />
```

```
<constructor-arg index="1" value="com.j256.ormlite.examples.spring.Delivery" />
</bean>
```

You can also take a look at the spring example code. See [spring example], page 47.

5.2 Class Configuration

The simplest mechanism for configuring a class to be persisted by ORMLite is to use the @DatabaseTable and @DatabaseField annotations. See Section 2.1.1 [Local Annotations], page 7. However if you do not own the class you are persisting or there are permission problems with the class, you may want to configure the class using Java code instead.

To configure a class in code, you use the DatabaseFieldConfig and DatabaseTableConfig objects. The field config object holds all of the details that are in the @DatabaseField annotation as well as the name of the corresponding field in the object. The DatabaseTableConfig object holds the class and the corresponding list of DatabaseFieldConfigs. For example, to configure the Account object using Java code you'd do something like the following:

```
List<DatabaseFieldConfig> fieldConfigs =
    new ArrayList<DatabaseFieldConfig>();
fieldConfigs.add(new DatabaseFieldConfig("name", null, DataType.UNKNOWN,
    null, 0, false, false, true, null, false, null, false));
fieldConfigs.add(new DatabaseFieldConfig("password", null,
    DataType.UNKNOWN, null, 0, false, false, false, null, false, null,
    false));
DatabaseTableConfig<Account> accountTableConfig
    = new DatabaseTableConfig<Account>(Account.class, fieldConfigs);
AccountDaoImpl accountDao =
    new AccountDaoImpl(connectionSource, accountTableConfig);
```

See the Javadocs for the DatabaseFieldConfig class for the fields to pass to the constructor. You can also use the no-argument constructor and call the setters for each field. You use the setters as well when you are configuring a class using Spring wiring. Here is the above example in Spring:

You can also look at the field configuration example code. See [field config example], page 47.

5.3 Database Specific Code

ORMLite isolates the database-specific code in the DatabaseType classes found in com.j256.ormlite.db. Each of the supported databases has a class there which implements the code needed to handle the unique features of the database (H2DatabaseType, MySqlDatabaseType, etc.). If you want to help develop and test against other SQL databases, a externally available server that the author could connect to and test against would be appreciated. Please contact the author if your database is not supported or if you want to help.

The following methods are currently used by the system to isolate the database specific behavior in one place. See the javadocs for the DatabaseType class for more information.

isDatabaseUrlThisType

Return true if the database URL corresponds to this database type. Usually the URL is in the form jdbc:ddd:... where ddd is the driver url part.

loadDriver

Load the driver class associated with this database so it can wire itself into IDBC

appendColumnArg

Takes a field type and appends the SQL necessary to create the field. It may also generate arguments for the end of the table create statement or commands that must run before or after the table create.

convertColumnName

Convert and return the column name for table and sequence creation. Often this is necessary to fix case issues.

dropColumnArg

Takes a field type and adds all of the commands necessary to drop the column from the database.

appendEscapedEntityName

Add a entity-name (table or column name) word to the SQL wrapped in the proper characters to escape it. This avoids problems with table, column, and sequence-names being reserved words.

appendEscapedWord

Add the word to the string builder wrapped in the proper characters to escape it. This avoids problems with data values being reserved words.

generateIdSequenceName

Return the name of an ID sequence based on the table-name and the field-type of the id. This is required by some database types when we have generated ids.

getCommentLinePrefix

Return the prefix to put at the front of a SQL line to mark it as a comment.

isIdSequenceNeeded

Return true if the database needs a sequence when you insert for generated IDs. Some databases handle generated ids internally.

getFieldConverter

Return the field converter associated with a particular field type. This allows the database instance to convert a field as necessary before it goes to the database.

isVarcharFieldWidthSupported

Return true if the database supports the width parameter on VARCHAR fields.

isLimitSupported

Return true if the database supports the LIMIT sql command.

isLimitAfterSelect

Return true if the LIMIT should be called after SELECT otherwise at the end of the WHERE (the default).

appendLimitValue

Add the necessary SQL to limit the results to a certain number.

appendSelectNextValFromSequence

Add the SQL necessary to get the next-value from a sequence. This is only necessary if isIdSequenceNeeded returns true.

appendCreateTableSuffix

Append the SQL necessary to properly finish a CREATE TABLE line.

isCreateTableReturnsZero

Returns true if a 'CREATE TABLE' statement should return 0. False if > 0.

isEntityNamesMustBeUpCase

Returns true if table and field names should be made uppercase. This is an unfortunate "feature" of Derby and Hsqldb. See the Javadocs for the class for more information.

isNestedSavePointsSupported

Returns true if the database supports nested savepoints (transactions).

isSerializableIdAllowed

Returns true if the datatype Seriliable is allowed as an identity column. Mostly for testing purposes.

5.4 DAO Methods

The DAO classes provide the following methods that you can use to store your objects to your database. This list may be out of date. See the Dao interface class for the latest methods.

queryForId(ID id)

Looks up the id in the database and retrieves an object associated with it.

queryForFirst(PreparedQuery<T> preparedQuery)

Query for and return the first item in the object table which matches a prepared statement. This can be used to return the object that matches a single unique column. You should use queryForId if you want to query for the id column.

queryForAll()

Query for all of the items in the object table and return a list of them. For medium sized or large tables, this may load a lot of objects into memory so you should consider using the iterator method instead.

queryBuilder()

Create and return a new QueryBuilder object which allows you to build a custom query. See Section 3.1 [QueryBuilder Basics], page 27.

updateBuilder()

Create and return a new UpdateBuilder object which allows you to build a custom update statement. See [updateBuilder], page 29.

deleteBuilder()

Create and return a new DeleteBuilder object which allows you to build a custom delete statement. See [deleteBuilder], page 29.

query(PreparedQuery<T> preparedQuery)

Query for the items in the object table which match a prepared statement. See Chapter 3 [Statement Builder], page 27. This returns a list of matching objects. For medium sized or large tables, this may load a lot of objects into memory so you should consider using the iterator method instead.

create(T data)

Create a new entry in the database from an object. Should return 1 indicating 1 row was inserted.

update(T data)

Save the fields from an object to the database. If you have made changes to an object, this is how you persist those changes to the database. You cannot use this method to update the id field – see updateId. This should return 1 since 1 row was updated.

updateId(T data)

Update an object in the database to change its id to a new id. The data *must* have its current id set and the new-id is passed in as an argument. After the id has been updated in the database, the id field of the data object will also be changed. This should return 1 since 1 row was updated.

update(PreparedUpdate<T> preparedUpdate)

Update objects that match a custom update statement.

refresh(T data, ID newId)

Does a query for the object's id and copies in each of the field values from the database to refresh the data parameter. Any local object changes to persisted fields will be overwritten. If the database has been updated this brings your local object up-to-date. This should return 1 since 1 row was retrieved.

delete(T data)

Delete an object from the database. This should return 1 since 1 row was removed.

delete (Collection<T> datas)

Delete a collection of objects from the database using an IN SQL clause. This returns the number of rows that were deleted.

deleteIds(Collection<ID> ids)

Delete the objects that match the collection of ids from the database using an IN SQL clause. This returns the number of rows that were deleted.

delete(PreparedDelete<T> preparedDelete)

Delete objects that match a custom delete statement.

iterator

This method satisfies the Iterable Java interface for the class and allows you to iterate through the objects in the table using SQL. This method allows you to do something like:

```
for (Account account : accountDao) { ... }
```

WARNING: See the Dao class for warnings about using this method.

iterator(PreparedQuery<T> preparedQuery)

Same is the iterator method but with a prepared statement parameter. See Chapter 3 [Statement Builder], page 27.

iteratorRaw(String query)

Same as the prepared statement iterator except it takes a raw SQL select statement argument. This is the iterator version of the queryForAllRaw method. Although you should use the iterator method for most queries, this method allows you to do special queries that aren't supported otherwise. Like the above iterator methods, you must call close on the GenericRawResults object returned by the method once you are done with it.

queryRaw(String query)

Query for all of the items in the object table that match the SQL select query argument. This method allows you to do special queries that aren't supported otherwise. For medium sized or large tables, this may load a lot of objects into memory so you should consider using the iterator() method on the GenericRawResults instead of the getResults method. See Section 2.11.1 [Raw Queries], page 23.

queryRaw(String query, RawRowMapper<UO> mapper)

Same as the above queryRaw method but with the addition of a row mapper. Instead of each row being returned as an array of strings, this will map the row using the mapper object passed in. See Section 2.11.1 [Raw Queries], page 23.

queryRaw(String query, DataType[] columnTypes)

Same as the above queryRaw method but with the addition of a an array of column data types. Instead of each row being returned as an array of strings, they are returned as an array of objects. See Section 2.11.1 [Raw Queries], page 23.

executeRaw(String statement)

Run a raw execute SQL statement against the database. See Section 2.11.3 [Raw Executes], page 25.

updateRaw(String statement)

Run a raw update SQL statement (INSERT, DELETE, or UPDATE against the database. See Section 2.11.2 [Raw Updates], page 25.

callBatchTasks(Callable callable)

Call the call-able that will perform a number of batch tasks. This is for performance when you want to run a number of database operations at once – maybe loading data from a file. This will turn off what databases call "auto-commit" mode, run the call-able and then re-enable "auto-commit".

NOTE: This is only supported by databases that support auto-commit. Android, for example, does not support auto-commit although using the TransactionManager and performing actions within a transaction seems to have the same batch performance implications.

5.5 ORMLite Logging

ORMLite uses a log system which can plug into Apache commons logging, Log4j, Android Log, or its own internal log implementations. The logger code in com.j256.ormlite.logger first looks for the android.util.Log and if found will use the Android internal logger. Next it looks fororg.apache.commons.logging.LogFactory class in the classpath – if found it will use Apache commons logging. If that class is not found it then looks for org.apache.log4j.Logger and if found will use Log4j. If none of these classes are available it will use an internal logger – see LocalLog. The logger code also provides simple {} argument expansion like slf4j which means that you can save on toString() calls and StringBuilder operations if the log level is not high enough. This allows me to do something like the following:

```
private static Logger logger =
  LoggerFactory.getLogger(QueryBuilder.class);
...
logger.debug("built statement {}", statement);
```

If you are using log4j (through Apache commons logging or directly), you can use something like the following as your log4j.properties file to see details about the SQL calls.

```
log4j.rootLogger=INFO, stdout
log4j.appender.stdout=org.apache.log4j.ConsoleAppender
log4j.appender.stdout.layout=org.apache.log4j.PatternLayout

# print the date in ISO 8601 format
log4j.appender.stdout.layout.ConversionPattern=%d{ISO8601} [%p] %c{1} %m%n

# be more verbose with our code
log4j.logger.com.j256.ormlite=DEBUG

# to enable logging of arguments to all of the SQL calls
# uncomment the following line
#log4j.logger.com.j256.ormlite.stmt.mapped.BaseMappedStatement=TRACE
```

Notice that you can uncomment the last line in the above log4j.properties file to log the arguments to the various SQL calls. This may expose passwords or other sensitive information in the database so probably should only be used during debugging and should not be the default.

5.6 External Dependencies

ORMLite does not have any direct dependencies. It has logging classes that depend on Apache commons-logging and Log4j but these classes will *not* be referenced unless they exist in the classpath.

If you want to get the ORMLite Junit tests to run, there are test dependencies on the following packages:

javax.persistence

For testing the compatibility annotations @Column and the like.

org.junit

We use Junit for our unit tasks.

org.easymock.easymock

We use, and are in love with, EasyMock. http://easymock.org/. It allows us to mock out dependencies so we can concentrate on testing a particular class instead of the whole package.

com.h2database

As a test database implementation, H2 is very fast and simple to use. Not as recommended as a production level database.

org.apache.log4j

For logging to files using the log4j.properties config. In the log4j package, you can exclude the following dependencies: com.sun.jmx.jmxri, com.sun.jdmk.jmxtools, javax.activation.activation, javax.jms.jms, javax.mail.mail.

6 Upgrading From Old Versions

We strive to maintain backwards compatibility and to provide deprecated versions of old classes and methods. However, sometimes when a new version is released, changes are made that require programmers to change their code and rarely the on-disk database formats.

6.1 Upgrade from Version 4.X to 4.10

4.10 was a reasonably large release containing some feature upgrades and some bug fixes. No data formats were changed, however the following API code was altered:

- We significantly refactored the RawResults class which is now deprecated and replaced it with the GenericRawResults class. See the GenericRawResults for more information. See Section 2.11.1 [Raw Queries], page 23.
- The Dao methods queryForAllRaw() and iteratorRaw() are now deprecated. They are replaced with queryRaw() methods. See the Dao class javadocs for more information
- Before this release the -jdbc and -android versions of ORMLite contained the -core functionality. In this release we split out the -core from the other packages so you will now need to install *both* the core and android (or jdbc) packages to get the package to work.

6.2 Upgrade from Version 3.X to 4.0

No data formats were changed, however the following API code was altered. Removed any outside usage of the DatabaseType since the ConnectionSource now provides it. Also added features to be able to prepare update and delete statements. To provide type safety, we've moved back to using QueryBuilder so we can have UpdateBuilder and DeleteBuilder. And instead of a PreparedStmt there is PreparedQuery, PreparedUpdate, and PreparedDelete. Here are the details:

- We have removed most of the cases where the user has to deal with the DatabaseType. All you need to set on the DAOs is the ConnectionSource which provides the database type internally. To create and drop the tables, also, you only need the ConnectionSource.
- Constructing a BaseDaoImpl now self-initializes if it is constructed with a ConnectionSource. This validates the class configurations meaning that it now throws a SQLException.
- Constructing a JdbcConnectionSource or DataSourceConnectionSource also now throws a SQLException since they also now self-initialize if they are constructed with the URL. This creates the internal database type and loads the driver class for it.
- Deprecated the createJdbcConnectionSource method in the DatabaseTypeUtils and turned the loadDriver method into a no-op. You now just instantiate the JdbcConnectionSource directly and there is no need for referencing the DatabaseTypeUtils anymore.
- Dao.statementBuilder() method changed (back) to Dao.queryBuilder().

- Dao.queryBuilder() returns a QueryBuilder instead of a StatementBuilder.
- You now call distinct() and limit() on the QueryBuilder. Unfortunately, there are no deprecated methods for them on the StatementBuilder.
- You now call selectColumns() on the QueryBuilder instead of columns() since now we have columns also in the UpdateBuilder. Unfortunately, there are no deprecated methods for them on the StatementBuilder.
- You call QueryBuilder.prepare() instead of StatementBuilder.prepareStatement(). It returns a PreparedQuery instead of a PreparedStmt. You pass a PreparedQuery into the Dao.query() and Dao.iterator() methods instead of a PreparedStmt.
- We removed the DatabaseTypeFactory class since it was no longer needed for Spring configurations.
- Removed BaseJdbcDao since it had been deprecated in 3.X.

6.3 Upgrade from Version 2.X to 3.2

The 3.2 release involved a very large code reorganization and migration. There were no on-disk changes unless you somehow managed to get ORMLite working previously on Android. The project was basically split into 3 pieces: core functionality, JDBC database handlers, and the new Android handler. With significant help from Kevin G, we abstracted all of the database calls into 3 interfaces: ConnectionSource (like a DataSource), DatabaseConnection (like a Connection) and DatabaseResults (like a ResultSet). Once we had the interfaces in place, we wrote delegation classes for JDBC and Android handlers. This means that as of 3.X we release 3 packages: ormlite-core (for developers), ormlite-jdbc (for people connecting to JDBC databases), and ormlite-android (for Android users). Both the JDBC and Android packages include all of the core code as well.

Along the way a number of specific changes were made to the methods and classes:

- Since we split off the JDBC, we renamed the BaseJdbcDao to be BaseDaoImpl in the core package. You will need to adjust any DAOs that you have.
- We are in the process of allowing custom delete and update methods so we took the major upgrade opportunity to rename the QueryBuilder object to be StatementBuilder. NOTE: this was reverted later.
- Because of the above, we also renamed Dao.queryBuilder() method to be statementBuilder(). NOTE: this was reverted later.
- Also renamed the PreparedQuery object to be PreparedStmt.
- One of the big changes for those of you using an external JDBC DataSource is that you no longer set it on the DAO directly. You need to wrap your DataSource in a DataSourceDatabaseConnection wrapper class which gets set on the DAO instead.

Again, there were no on-disk changes unless you somehow managed to get ORMLite working previously on Android. Since we were using JDBC before to do the data marshalling and now are doing it by hand, some of the data representations may have changed. Sorry for the lack of detail here.

6.4 Upgrade from Version 2.3 to 2.4

A bug was fixed in 2.4 with how we were handling Derby and Hsqldb. Both of these databases seem to be capitalizing table and field names in certain situations which meant that customized queries of ORMLite generated tables were affected. In version 2.4, all tables and field names are capitalized in the SQL generated for Derby and Hsqldb databases. This means that if you have data in these databases from a pre 2.4 version, the 2.4 version will not be able to find the tables and fields without renaming to be uppercase.

7 Example Code

Here is some example code to help you get going with ORMLite. I often find that code is the best documentation of how to get something working. Please feel free to suggest additional example packages for inclusion here. Source code submissions are welcome as long as you don't get piqued if we don't chose your's.

Simple, basic

This is a simple application which performs database operations on a single class/table. See soure code in SVN: http://ormlite.com/docs/example-simple.

Foreign objects

This example shows how to use foreign objects. See Section 2.12 [Foreign Objects], page 25. See the soure code in SVN: http://ormlite.com/docs/example-foreign.

Field configuration

This example shows how you can configure a class in ORMLite using Java code *instead* of annotations. See Section 5.2 [Class Configuration], page 36. See the source code in SVN: http://ormlite.com/docs/example-config.

Many to many

This example is a bit more complicated with multiple tables and is designed for folks trying to model a many-to-many relationship. It has a join-table, foreign fields, and also utilizes inner queries. See the soure code in SVN: http://ormlite.com/docs/example-many.

Spring wiring

To demonstrate how to use Spring wiring with ORMLite, this little program includes classes and XML configuration files. See soure code in SVN: http://ormlite.com/docs/example-spring.

For Android developers, there are also complete example application projects to help you get started with that operating system.

HelloAndroid

A basic Android application which does some database operations and then quits. See the source code in SVN: http://ormlite.com/docs/android-hello.

A tarball of the package is also here: http://ormlite.com/android/examples/.

ClickCounter

A nice little application written by Kevin G. that provides a counter type application using ORMLite. See the source code in SVN: http://ormlite.com/docs/android-click. A tarball of the package is also here: http://ormlite.com/android/examples/.

NotifyService

An example of a service application that uses ORMLite. See the source code in SVN: http://ormlite.com/docs/android-notify. A tarball of the package is also here: http://ormlite.com/android/examples/.

8 Contributions

There are a couple of people that I'd like to thank who helped with the project.

Kevin Galligan

Kevin was the impetus and the author of a good bit of the Android compatible code. He wrote the Android level support classes and did a ton of beta-testing of it. He's also provided all of the Android examples. Thanks much Kevin. See http://www.kagii.com/.

Jim Gloor

Jim was one of the Java gurus at a previous company. Thanks much for his JDBC code samples that started this effort.

Nelson Erb

Nelson was our self-appointed documentation and testing volunteer for a year. He did a great job summarizing sections of this document so we could create a better 'Getting Started' section. He also fleshed out a bunch of unit tests to improve coverage in some areas.

Robert Adamsky

I worked with Robert at a company where he laid out our entire DAO and hibernate class hierarchy. The DAO interface and the BaseDaoImpl where in some part modeled after his code. Thanks dude.

Thanks much to them all.

9 Project License

This document is part of the ORMLite package.

Permission to use, copy, modify, and/or distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS" AND THE AUTHOR DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

The author may be contacted via http://ormlite.com/

Index of Concepts 53

Index of Concepts

<	\mathbf{C}
<, SQL	1 can be null
<=, SQL	
♦, SQL	1 '1 1
, 5 d L	close data source
	closing an iterator
_	code examples
_	Column annotation
=, SQL	
	complex query
	configuration with Spring
>	configure a class in code
>, SQL 3	connection pooling
>=, SQL 3	Connection Source
>=, 5QL	connection source, simple
	constraint, unique
	constructor with no args
@	copyright
@Column	COUNT, using
@DatabaseField	Create Schema
@DatabaseTable	
	createDate inclined
©Entity	9
@GeneratedValue	8
@Id	. ~
@ManyToOne	4 1 1 4 4 4 4 4 4 4
@OneToOne	1 custom delete statement
A	custom query builder
A	custom statement bunder
aggregation queries	
AND, SQL	
Android examples 4	
Android OS support	I 1
Android SQLite database	
annotations	
arguments to queries	dae methods 30
author	DAO usage 10
auto create tables 3	data access object
auto drop tables	data source
auto refresh foreign objects	database connection
auto-generated id	8 database not supported
AVG, using	database sequences
	database specific code
	database type
B	DatabaseField annotation
_	databases supported
BasicDataSource	5 DatabaseTable annotation
BETWEEN, SQL 3	DataSourceConnectionSource
boolean	- Date
building queries 2	8 date formats
byte	3 DB2 database

	default value	gt, SQL
	delete builder	
A		тт
		п
		H2 database
Derby database		hibernate
destroy data source 15 15 16 16 16 16 17 17 17 18 18 18 19 18 19 19 19		HSQLDB database
Second color 14 I I I I I I I I I		
Arrival of the period of the		T
Beautify annotation 11 11 12 16 11 16 16 11 16 17 17		1
Id annotation		ibatis
E	drop tables	
Entity annotation		
Entity annotation 11 identity field 20 Enum integer 14 IN sub-query, SQL 30 enumerated name unknown 9 index creation 10 inner queries 30 equals, SQL 30 int 11 Execute raw sql statments 25 IN SOT NULL, SQL 31 EXISTS, SQL 30 iterating raw select statements 40 IS NULL, SQL 31 EXISTS, SQL 30 iterator 31 Existence 32 Existence 32 Existence 32 Existence 33 Existence 34 Existence 35 Exi	\mathbf{E}	· · · · · · · · · · · · · · · · · · ·
Enum integer	Entity apparation 11	· · · · · · · · · · · · · · · · · · ·
In SQL 30 10 10 30 3	· ·	v v
Index creation 10	_	
### squals, SQL 30 int		
Sequals SQL 30 int		inner queries
examples of code 47 introduction 1 execute raw sql statments 25 IS NOT NULL, SQL 31 EXISTS, SQL 30 iterating through all rows 19 external data sources 15 iterator 19, 40 iteratorRaw 23 F field access using getters and setters 9 field configuration example 47 field indexes 10 field width 8, 11 foreign object refreshing 26 foreign object, auto refresh 10 foreign objects, creating 25 format, field G generated id sequence 8 generated id sequence 10 generated IdSequence column 21 generated IdSequence column 22 generated Of the schema 35 GenericRawResults 21 logdj properties file 41 logd properties file 41 logd properties file 41 logd properties file 41 lickes, 31 lickes, 32 logdj properties file 41 lickes, 31 lickes, 32 logdj properties file 41 logd properties file 41 lickes, 31 lickes, 32 logdj properties file 41 logd properties file 41 logd properties file 41 logd properties file 41 logd properties file 41 lickes, 31 lickes, 32 logdj properties file 41 logd properties file		•
Sexecute raw sql statments 25		introduction
Sexecuting raw select statements 40		
EXISTS, SQL	•	
The statement of the	-	
IteratorRaw		9 9
J Java annotations S Java annotations		iteratorRaw
J Java annotations S Java annotations	F	
10 10 10 10 10 10 10 10		Л
field indexes 10 java date 13 field type 8 java long date 13 field width 8, 11 java string date 13 float 14 javax.persistence 11 foreign object refreshing 26 jdbc dao implementation 16 foreign objects, auto refresh 10 jdbc type 8 foreign objects 9, 25 JdbcConnectionSource 15 JPA 11, 42 K K Generated id 8 generated id sequence 8 generated identity field 21 generated identity sequence name 21 generated identity sequence name 21 generated didentity sequence olumn 21 generated didentity sequence olumn 21 generated Value annotation 21 Generated Value annotation 11 license 51 LIKE, SQL 31 Generic RawResults 23 log4j properties file 41		
field type 8 java long date 13 field width 8, 11 java string date 13 float 14 javax.persistence 11 foreign object refreshing 26 jdbc dao implementation 16 foreign objects, auto refresh 10 jdbc type 8 foreign objects example 47 JdbcConnectionSource 15 foreign objects, creating 25 JPA 11, 42 K K Generated id 8 L generated id sequence 8 L generated identity field 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedValue annotation 21 less than, SQL 31 GeneratedValue annotation 11 license 51 GenericRawResults 23 log4j properties file 41		o a constant of the constant o
field width		
Separated Sepa		
foreign object refreshing	,	
foreign object, auto refresh 10 jdbc type 8 foreign objects 9, 25 JdbcConnectionSource 15 foreign objects example 47 JPA 11, 42 foreign objects, creating 25 format, field 10 K G key field 8, 12 ge, SQL 30 30 generated id 8 L generated id sequence 8 le generated identity field 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedValue annotation 21 less than, SQL 31 GeneratedValue annotation 11 license 51 GeneratedNesults 23 log4j properties file 41		
Second color of the schema 19, 25 JdbcConnectionSource 15 JdbcConnectionSour		
foreign objects example 47 JPA 11, 42 foreign objects, creating 25 K format, field 10 K G key field 8, 12 ge, SQL 30 L generated id 8 L generated id sequence 8 L generated identity field 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41		
Goreign objects, creating 25 format, field 10 K K ge, SQL 30 generated id 8 generated id sequence 8 generated identity field 21 generated identity sequence name 21 generatedId column 21 generatedIdSequence column 21 generatedValue annotation 11 generatedValue annotation 11 generation of the schema 35 GenericRawResults 23 log4j properties file 41		
K K K K K K K K K K		JPA 11, 42
K G key field 8, 12 ge, SQL 30 L generated id 8 L generated identity field 21 le 31 generated identity sequence name 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41		
G key field 8, 12 ge, SQL 30 generated id 8 L generated id sequence 8 generated identity field 21 le 31 generated identity sequence name 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41		K
ge, SQL	G	kev field
L Separated id Separated id Separated id Separated id Separated id Separated identity field Separated identity sequence name Separated identity field Separated identity sequence name Separated identity sequence Separated identi		· · · · · · · · · · · · · · · · · · ·
generated id sequence	0 / •	T
generated identity field 21 le 31 generated identity sequence name 21 length of field 8, 11 generatedId column 21 less than or equals, SQL 31 generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41	9	$\mathbf L$
21 length of field 8, 11		le 31
generatedId column 21 less than or equals, SQL 31 generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41		
generatedIdSequence column 21 less than, SQL 31 GeneratedValue annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41	· .	,
Generated Value annotation 11 license 51 generation of the schema 35 LIKE, SQL 31 GenericRawResults 23 log4j properties file 41		
generation of the schema		, -
GenericRawResults		
	get and set method usage	
	greater than or equal, SQL	
	greater than SQL	
	GROUP BY, SQL	lt
	GROUP BY, SQL	lt

Index of Concepts 55

\mathbf{M}	\mathbf{R}
many to many example	raw execute statments
ManyToOne annotation	raw select statements 40
Microsoft SQL Server database	raw update statments
MySQL database	RawResults
MysQL database	refreshing an object
	refreshing foreign objects
N	remote objects
name of database column	C
naming a unique index	\mathbf{S}
naming an index	saving an object
	schema generation
ne	select arguments
no argument constructor	sequences
not equal to, SQL	Serializable
NOT, SQL	short
null comparison, SQL	simple connection source
null value allowed	simple example 47 spring example 47
null values and primitives 9	spring example
	spring framework
	spring wire a class
0	sql ?
object relational mapping	sql argument logging
OneToOne annotation	SQL Server database
	SQL type
OR, SQL	SQLite database
Oracle database	statement builder
ORDER BY, SQL	String
other data sources	sub-queries
	SUM, using
P	supported databases
parse format	\mathbf{T}
persist objects	
	TableCreator
persisted types	throwIfNull9
persisting an object	truncate table
pooled connection source	types that are persisted
Postgres database	
prepared statement	\mathbf{U}
primary key field	unique constraint
primitive null values	unique index creation
	unknownEnumName
	update an object id
Q	update builder
query arguments	update custom statement
query builder	update identity of object
query for all	update with raw sql
query for all raw	updateBuilder
	updateId
query for first	updating an object
query for id	usage example
query for objects	use with Android OS
queryForAllRaw	use with external data source

useGetSet using get and set methods using the DAOs	9	width of field	
V VARCHAR string	13	X Xerial SQLite driver	17
\mathbf{W}		${f Z}$	
where	27	Zentus SOLite driver	17

Table of Contents

1	Gett	ing Started 3
	1.1	Downloading ORMLite Jar
	1.2	Configuring a Class
	1.3	Configuring a DAO
	1.4	Code Example
2	How	to Use 7
	2.1	Setting Up Your Classes
		2.1.1 Adding ORMLite Annotations
		2.1.2 Using javax.persistence Annotations
		2.1.3 Adding a No-Argument-Constructor
	2.2	Persisted Data Types
	2.3	Connection Sources
	2.4	Setting Up the DAOs
	2.5	Database Type
	2.6	Supported Databases
	2.7	Tying It All Together
	2.8	DAO Usage
	2.9	Identity Columns
		2.9.1 Fields With id
		2.9.2 Fields With generatedId
	0.10	2.9.3 Fields With generatedIdSequence
	2.10	0
	2.11	•
		2.11.1 Issuing Raw Queries
		2.11.2 Issuing Raw Update Statements
	2.12	
3	Cust	om Statement Builder 27
	3.1	Query Builder Basics
	3.2	Building Queries
	3.3	Building Statements
	3.4	Where Capabilities
	3.5	Using Select Arguments

5	\mathbf{Adv}	anced Concepts	. 35
	5.1	Spring Configuration	35
	5.2	Class Configuration	
	5.3	Database Specific Code	37
	5.4	DAO Methods	38
	5.5	ORMLite Logging	41
	5.6	External Dependencies	42
6	Upg	rading From Old Versions	. 43
	6.1	Upgrade from Version 4.X to 4.10	43
	6.2	Upgrade from Version 3.X to 4.0	
	6.3	Upgrade from Version 2.X to 3.2	44
	6.4	Upgrade from Version 2.3 to 2.4	44
7	Exai	mple Code	. 47
8	Con	tributions	49
9	Proj	ject License	. 51
In	dev o	f Concepts	53