Lecture SQL06
Qt and SQL – Part I

Unless otherwise noted, lecture notes are derived from
Visual Quickstart Guide: SQL, Third Edition, by Chris Fehily

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Outline

- Accessing SQL from Qt
- Connecting to MySQL
- Connecting to SQLite
- Connection Errors
- Querying the Database from Qt
- Interacting with the Database via GUI

Accessing SQL from Qt

- Modify the **.pro** file
  - As with the networks module, you must modify the **.pro** file for your Qt program to access the Qt SQL module
  - Add the following statement

    QT += sql
- Include the header file in your source file(s)

  #include <QtSql>

Connecting to MySQL

```
QSqlDatabase  db = QSqlDatabase::addDatabase( "QMYSQL" );

db.setHostName( "localhost" );    // db on local machine
db.setDatabaseName( "somefilenamehere" );
db.setUserName( "myusername" );
db.setPassword( "mypassword" );

if ( !db.open() )
{
  qDebug() << db.lastError();
  qDebug() << "Error:  Unable to connect due to above error";
}
```

Connecting to SQLite

```
QSqlDatabase  db = QSqlDatabase::addDatabase( "QSQLITE" );

db.setDatabaseName( "vetclinic.db" );

if ( !db.open() )
{
  qDebug() << db.lastError();
  qDebug() << "Error:  Unable to connect due to above error";
}
```

Can also specify

```
db.setDatabaseName(":memory:");
```

to have database created in memory

Connection Errors - 1

- In general your program may be interacting with a remote database
- As such, a query may not complete successfully for a variety of reasons
  - Connection failure (ex. file not found)
  - Authentication problem
  - Network issue
  - Poorly formed query
  - Etc.

Connection Errors - 2

- You should add error handling code
  - To detect problems related to establishing an initial connection
  - To address the possibility that any subsequent database access may also fail

Connecting to SQLite

```
QSqlDatabase  db = QSqlDatabase::addDatabase( "QSQLITE" );

db.setDatabaseName( "vetclinic.db" );

if ( !db.open() )
{
  qDebug() << db.lastError();
  qDebug() << "Error:  Unable to connect due to above error";
}
```

Can also specify

```
db.setDatabaseName(":memory:");
```

to have database created in memory

Querying the Database from Qt Without a GUI

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Relations

customers

UID	Last Name	First Name
128	Smith	John
324	Doe	John
245	Jones	Mark
756	Smith	Jane
459	Moore	Sara
721	Parks	Ralph

vets

UID
324
245

accounts

UID	Balance
128	0
756	45
459	0
721	10

pets

UID	Pet Name	Type
128	Spot	Dog
324	Rex	Dog
756	Tiger	Cat
756	Fluffy	Cat
459	Tweety	Bird
721	Yippy	Dog
128	Rover	Dog
245	Stripes	Cat
324	Cupcake	Dog
459	Chewy	Dog

VetClinic Qt/SQL Example - 1

```
//
// Direct Interaction with an SQLite Database from Qt4
//
#include <QApplication>
#include <QtSql>
#include <QtDebug>

int main(int argc, char* argv[])
{
    QApplication myApp(argc, argv);

    QSqlDatabase db = QSqlDatabase::addDatabase("QSQLITE");
    db.setDatabaseName("vetclinic.db");

    if ( !db.open() )
    {
        qDebug() << db.lastError();
        qDebug() << "Error: Unable to connect";
        return 1;
    }
```

VetClinic Qt/SQL Example - 2

```
// Direct Interaction with an SQLite Database from Qt4

    // Create query and use exec call to hand it an argument and execute it
    QSqlQuery q;

    q.exec("SELECT * FROM pets WHERE type='Dog'");  <== No error handling here

    while ( q.next() )
    {
        qDebug() << "UID=" << q.value(0).toInt()
                 << "   PetName=" << q.value(1).toString()
                 << "   Type=" << q.value(2).toString();
    }
```

exec( ) returns true if query executes successfully; false otherwise
next( ) / previous( ) retrieves next/previous record in the result

Output

```
UID= 128    PetName= "Spot"     Type= "Dog"
UID= 324    PetName= "Rex"     Type= "Dog"
UID= 721    PetName= "Yippy"     Type= "Dog"
UID= 128    PetName= "Rover"     Type= "Dog"
UID= 324    PetName= "Cupcake"     Type= "Dog"
UID= 459    PetName= "Chewy"     Type= "Dog"
```

VetClinic Qt/SQL Example - 3

```
// Direct Interaction with an SQLite Database from Qt4

    // Create query object and execute it immediately
    QSqlQuery qq("SELECT * FROM customers WHERE lastname='Smith'");

    if ( !qq.isActive() )      <== Error handling here
    {
        qDebug() << qq.lastError();
        qDebug() << "Error: unable to complete query";
        return 1;
    }
    while ( qq.next() )
    {
        qDebug() << "UID=" << qq.value(0).toInt()
                 << "   LastName=" << qq.value(1).toString()
                 << "   FirstName=" << qq.value(2).toString();
    }
```

isActive( ) returns true if query has executed successfully but is not yet finished

Output

```
UID= 128    LastName= "Smith"    FirstName= "John"
UID= 756    LastName= "Smith"    FirstName= "Jane"
```

VetClinic Qt/SQL Example - 4

```
// Direct Interaction with an SQLite Database from Qt4

    // Create poorly formed SQL query and attempt to execute it
    QSqlQuery qqq("SELECT * FROM goats");

    if ( !qqq.isActive() )    <== Error handling here
    {
        qDebug() << qqq.lastError();
        qDebug() << "Deliberate failed SQL query";
    }
```

Output

```
QSqlError(1, "Unable to execute statement", "no such table: goats")
Deliberate failed SQL query
```

VetClinic Qt/SQL Example - 5

```
// Direct Interaction with an SQLite Database from Qt4

    // Create query using placeholders for actual values
    // Bind values to the placeholders at runtime
    // Execute query
    QSqlQuery qqqq;
    qqqq.prepare("INSERT INTO pets (uid, petname, type) "          <== Method #1
                 "VALUES(:uid, :petname, :type)");
    qqqq.bindValue(":uid", 999);
    qqqq.bindValue(":petname", "Jaws");
    qqqq.bindValue(":type", "Shark");
    if ( !qqqq.exec() )
    {
        qDebug() << qqqq.lastError();
        qDebug() << "Error on INSERT";
        return 1;
    }
```

Use of bindValue with unvalidated user inputs introduces a risk of SQL injection attack.

VetClinic Qt/SQL Example - 6

```
// Direct Interaction with an SQLite Database from Qt4

    // Create query using placeholders for actual values
    // Bind values to the placeholders at runtime
    // Execute query                                                    Method #2
    QSqlQuery qqqq;
    qqqq.prepare("INSERT INTO pets (uid, petname, type) VALUES(?, ?, ?)");
    qqqq.addBindValue(999);
    qqqq.addBindValue("Jaws");
    qqqq.addBindValue("Shark");
    if ( !qqqq.exec() )
    {
        qDebug() << qqqq.lastError();
        qDebug() << "Error on INSERT";
        return 1;
    }
```

VetClinic Qt/SQL Example - 7

```
// Direct Interaction with an SQLite Database from Qt4

    QSqlQuery qqqqq("SELECT * FROM pets;");
    while ( qqqqq.next() )
    {
        qDebug() << "UID=" << qqqqq.value(0).toInt()
                 << "   PetName=" << qqqqq.value(1).toString()
                 << "   Type=" << qqqqq.value(2).toString();
    }
    qDebug() << endl;
```

Output

```
UID= 128    PetName= "Spot"    Type= "Dog"
UID= 324    PetName= "Rex"    Type= "Dog"
UID= 756    PetName= "Tiger"    Type= "Cat"
UID= 756    PetName= "Fluffy"    Type= "Cat"
UID= 459    PetName= "Tweety"    Type= "Bird"
UID= 721    PetName= "Yippy"    Type= "Dog"
UID= 128    PetName= "Rover"    Type= "Dog"
UID= 245    PetName= "Stripes"    Type= "Cat"
UID= 324    PetName= "Cupcake"    Type= "Dog"
UID= 459    PetName= "Chewy"    Type= "Dog"
UID= 999    PetName= "Jaws"    Type= "Shark"
```

VetClinic SQL Example - 8

```
qqqqq.exec("UPDATE pets SET type='Goldfish' WHERE petname='Jaws'");
qqqqq.exec("SELECT * FROM pets;");
while ( qqqqq.next() )
{
    qDebug() << "UID=" << qqqqq.value(0).toInt()
             << "   PetName=" << qqqqq.value(1).toString()
             << "   Type=" << qqqqq.value(2).toString();
}
qDebug() << endl;
```

Updating a Row

Output:

```
UID= 128    PetName= "Spot"     Type= "Dog"
UID= 324    PetName= "Rex"     Type= "Dog"
UID= 756    PetName= "Tiger"     Type= "Cat"
UID= 756    PetName= "Fluffy"     Type= "Cat"
UID= 459    PetName= "Tweety"     Type= "Bird"
UID= 721    PetName= "Yippy"     Type= "Dog"
UID= 128    PetName= "Rover"     Type= "Dog"
UID= 245    PetName= "Stripes"     Type= "Cat"
UID= 324    PetName= "Cupcake"     Type= "Dog"
UID= 459    PetName= "Chewy"     Type= "Dog"
UID= 999    PetName= "Jaws"     Type= "Goldfish"
```

VetClinic SQL Example - 9

Deleting a Row

```
qqqqq.exec("DELETE FROM pets WHERE petname='Jaws'");

qqqqq.exec("SELECT * FROM pets;");
while ( qqqqq.next() )
{
    qDebug() << "UID=" << qqqqq.value(0).toInt()
             << "   PetName=" << qqqqq.value(1).toString()
             << "   Type=" << qqqqq.value(2).toString();
}
qDebug() << endl;
```

Output:

```
UID= 128    PetName= "Spot"     Type= "Dog"
UID= 324    PetName= "Rex"     Type= "Dog"
UID= 756    PetName= "Tiger"     Type= "Cat"
UID= 756    PetName= "Fluffy"     Type= "Cat"
UID= 459    PetName= "Tweety"     Type= "Bird"
UID= 721    PetName= "Yippy"     Type= "Dog"
UID= 128    PetName= "Rover"     Type= "Dog"
UID= 245    PetName= "Stripes"     Type= "Cat"
UID= 324    PetName= "Cupcake"     Type= "Dog"
UID= 459    PetName= "Chewy"     Type= "Dog"
```

Querying the Database from Qt With a GUI

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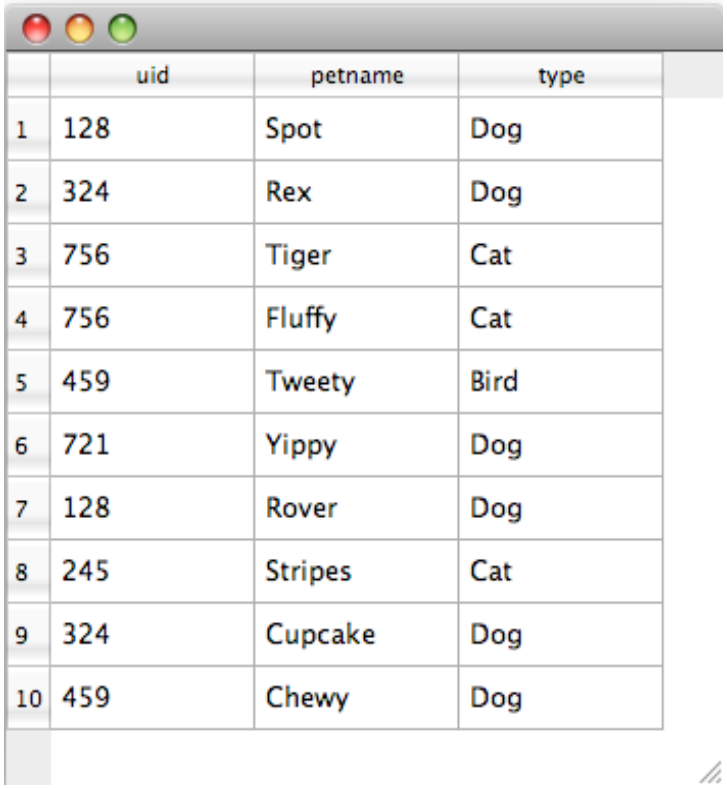
Models

- QSqlQueryModel
  - Read-only model for displaying SELECT output
- QSqlTableModel
  - Editable model for single table
- QSqlRelationalModel
  - Editable model for single table which refers to other tables

VetClinic SQL Example - 11

```
// QSqlQueryModel

#include <QApplication>
#include <QtSql>
#include <QTableView>
#include <QtDebug>
using namespace std;

int main(int argc, char* argv[])
{
    QApplication myApp(argc, argv);

    QSqlDatabase db = QSqlDatabase::addDatabase("QSQLITE");
    db.setDatabaseName("vetclinic.db");

    if ( !db.open() )
    {
        qDebug() << db.lastError();
        qDebug() << "Error: Unable to connect";
        return 1;
    }

    QSqlQueryModel model;
    model.setQuery("SELECT * FROM pets");

    QTableView view;
    view.setModel(&model);
    view.show();

    return myApp.exec();
} // End main()
```



	uid	petname	type
1	128	Spot	Dog
2	324	Rex	Dog
3	756	Tiger	Cat
4	756	Fluffy	Cat
5	459	Tweety	Bird
6	721	Yippy	Dog
7	128	Rover	Dog
8	245	Stripes	Cat
9	324	Cupcake	Dog
10	459	Chewy	Dog

VetClinic SQL Example - 12

```
// QSqlQueryModel
#include <QApplication>
#include <QtSql>
#include <QTableView>
#include <QtDebug>
using namespace std;

int main(int argc, char* argv[])
{
    QApplication myApp(argc, argv);

    QSqlDatabase db = QSqlDatabase::addDatabase("QSQLITE");
    db.setDatabaseName("vetclinic.db");

    if ( !db.open() )
    {
        qDebug() << db.lastError();
        qDebug() << "Error: Unable to connect";
        return 1;
    }

    QSqlQuery q("INSERT INTO pets (uid, petname, type) VALUES(999, 'Jaws', 'Shark')");
    QSqlTableModel* model = new QSqlTableModel;
    model->setTable("pets");
    model->select();
    model->setEditStrategy(QSqlTableModel::OnRowChange);

    QTableView* view = new QTableView;
    view->setModel(model);
    view->show();

    return myApp.exec();
} // End main()
```

VetClinic SQL Example - 13

	uid	petname	type
1	128	Spot	Dog
2	324	Rex	Dog
3	756	Tiger	Cat
4	756	Fluffy	Cat
5	459	Tweety	Bird
6	721	Yippy	Dog
7	128	Rover	Dog
8	245	Stripes	Cat
9	324	Cupcake	Dog
10	459	Chewy	Dog
11	999	Jaws	Shark

	uid	petname	type
1	128	Spot	Dog
2	324	Rex	Dog
3	756	Tiger	Cat
4	756	Fluffy	Cat
5	459	Tweety	Bird
6	721	Yippy	Dog
7	128	Rover	Dog
8	245	Stripes	Cat
9	324	Cupcake	Dog
10	459	Chewy	Dog
11	999	Orca	Shark

VetClinic SQL Example - 14

```
// QSqlQueryModel
#include <QApplication>
#include <QtSql>
#include <QTableView>
#include <QtDebug>
using namespace std;

int main(int argc, char* argv[])
{
    QApplication myApp(argc, argv);

    QSqlDatabase db = QSqlDatabase::addDatabase("QSQLITE");
    db.setDatabaseName("vetclinic.db");

    if ( !db.open() )
    {
        qDebug() << db.lastError();
        qDebug() << "Error: Unable to connect";
        return 1;
    }

    QSqlQuery q("INSERT INTO pets (uid, petname, type) VALUES(999, 'Jaws', 'Shark')");
    QSqlTableModel* model = new QSqlTableModel;
    model->setTable("pets");
    model->select();
    model->setEditStrategy(QSqlTableModel::OnFieldChange);

    QTableView* view = new QTableView;
    view->setModel(model);
    view->show();

    return myApp.exec();
} // End main()
```