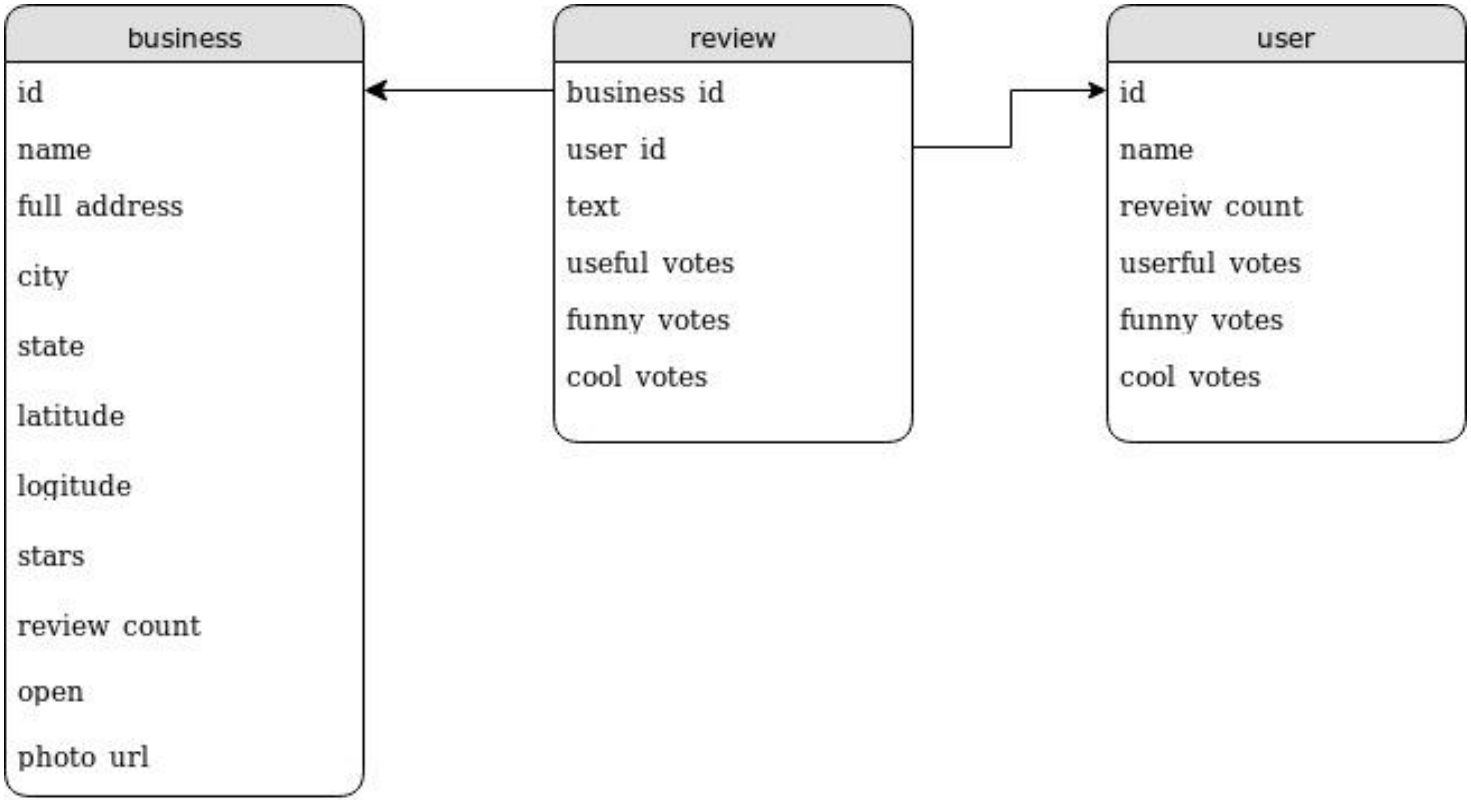
Intro to Yelp & SQL

CS 1270 Database Management Systems
Slides by Jon

Yelp DB schema:



Your task:

1. Connect to Yelp DB via JDBC
2. Run SQL Queries that answer the questions
3. Retrieve query results and return them

1. Connect to JDBC

To connect, you will need to establish a connection

```
Class.forName("org.sqlite.JDBC"); // not necessary

conn = DriverManager.getConnection(

    "jdbc:sqlite:/course/cs127/pub/yelp/yelp.db");
```

2. Run a SQL query

Once connected, you will write a string as a SQL query that looks something like this:

```
String query = "SELECT ...
                FROM ...
                WHERE att1 = ?;
```

Note the use of variable parameters given by `"?"`. You will set those parameters in the next step

2. Run a SQL query

Then compile the query with a "prepared statement":

```
PreparedStatement stat =
    conn.prepareStatement(query);
```

Why not just use 'Statement'?

Statement will be used for executing static SQL **statements** and it can't accept input parameters. **PreparedStatement** will be used for executing SQL **statements** many times dynamically. It will accept input parameters.
From https://stackoverflow.com/questions/3271249/difference-between-statement-and-preparedstatement

2. Run SQL Query

Set your parameters:

```
stat.setString(1, my_variable);
```

Note: 1 corresponds to the first "?" in your sql query, 2 corresponds to the second "?", 3 corresponds to the third "?", etc.

Now, execute the query and save the results:

```
ResultSet results = stat.executeQuery();
```

3. Retrieve results and return them

Create a list of objects to hold the values in the result set (see stencil code classes for useful objects)

```
List<My_Object> my_objectList = new
        ArrayList<My_Object>();
```

loop through tuples of the result set, creating a new object for each tuple and adding values of each tuple to the object:

```
while(results.next()){
    My_Object my_object_name = new My_Object();
    my_object_name.setAtt(results.getString("<att>"));
    my_objectList.add(object_name);
```

3. Retrieve results and return them

Look up JDBC docs to see the different `getObject()` methods for extracting values from the resultSet. Here are a few:

```
getString("att")
getDouble("att")
getInt("att")
```

Finally, close the result set and return the list:

```
results.close();
return objectList;
```

Overview of SQL

Basic Structure:

```
SELECT att1, att2/2 AS 'half_att2', DISTINCT(att3) 'my_att'
FROM rel1, rel2
WHERE att1 = 'x' AND att2 < 'y' OR (att3, att4) >= (z, w)
ORDER BY half_att2
LIMIT 5
```

JOINS

Instead of cross product, you can use JOINs

```
...FROM rel1 JOIN rel2 ON rel1.att1 = rel2.att1 AND
rel1.att2 = rel2.att2
```

Alternative that automatically matches on similarly named attributes:

```
    FROM rel1 NATURAL JOIN rel2
```

Alternative that matches on the attributes in the using clause if they are in both relations):

```
    FROM rel1 JOIN rel2 USING (att1, att2)
```

Note: You can do a theta join on attributes with different names using the ON clause with a comparison. You can use any of =, <, <=, >, >=, <>

AGGREGATE FUNCTIONS: COUNT(), SUM(), MAX(), MIN(), AVG()

```
SELECT att1, SUM(att1) sum_1, MAX(att2) max_2,
FROM some_rel
WHERE <condition>
GROUP BY att1, att2,
HAVING (sum_1, max_2) = (4, 5)
```

Should avoid ambiguity by only including in SELECT clause att's that are either aggregates or that are mentioned in the GROUP BY clause.
SQLite does support select statement on non-aggregate att's not in the group by clause, but this is not good practice.

HAVING clause must come after GROUP BY clause, and is the equivalent of WHERE clause but on aggregate values.

AGGREGATE FUNCTIONS: COUNT(), SUM(), MAX(), MIN(), AVG()

```
SELECT att1, SUM(att1) sum_1,
       MAX(att2) max_2,
FROM some_rel
GROUP BY att1, att2,
HAVING (sum_1, max_2) = (6, 5)
```

result: 3|6|5

att1	att2
2	1
2	1
2	1
2	3
2	3
3	5
3	5

SUBQUERIES

A subquery returns a relation that can then be operated on by other queries:

Structures:

One after the other

```
subq1 SET_OPERATION subq2
```

Or, the subquery can be a preface to the main query via the `WITH` clause:

```
WITH subq AS (SELECT ....)

    SELECT * FROM subq
    WHERE...
```

Or, the subquery can be nested in outer queries in the FROM clause:

```
SELECT a FROM (

    SELECT att2 as a FROM rel

        )

    WHERE ...
```

SET OPERATORS ON SUBQUERIES

`subquery1 UNION subquery2` (deletes all duplicates)

`subquery1 UNION ALL subquery2` (retains all duplicates)

`subquery1 INTERSECT subquery2` (deletes duplicates in the resultant intersection)

`subquery1 INTERSECT ALL subquery2` (retains duplicates in teh resultant intersection. Ex. 5 repeats in first relation, and 2 in second: retains 2)

`subquery1 EXCEPT subquery2` (deletes duplicates that appear in the second relation)

`subquery1 EXCEPT ALL subquery2` (retains duplicates. Ex. 5 repeats in first relation, and 2 in second: retains 3)

SUBQUERIES in the WHERE CLAUSE

Note: att1, att2, and att3 could all be the same att, or different

```
SELECT att1
FROM rel...
```

```
WHERE att2 IN (
    SELECT att3
    FROM rel
    WHERE
<condition>
)
```

returns true if at least one member of subquery result is equal to att2.

```
WHERE att > SOME (
    SELECT att
    FROM rel
    WHERE
<condition>
)
```

returns true if comparison holds true for at least one member of subquery result

```
WHERE EXISTS (
    SELECT att
    FROM rel
    WHERE
<condition>
)
```

returns true if subquery is not the empty set

```
WHERE UNIQUE (
    SELECT att
    FROM rel
    WHERE
<condition>
)
```

returns true if subquery contains no duplicates

SUBQUERIES in the SELECT CLAUSE

A "scalar subquery" is a subquery that returns no more than *one* value (i.e. one tuple with one attribute).

Technically, it's a relation, but SQL extracts the value and turns it into a scalar. Therefore you may write scalar subqueries wherever a scalar is allowed.

This means that you can have subqueries in the SELECT clause:

```
SELECT    att,
          (SELECT COUNT(*) FROM rel2)
FROM rel1
```

CORRELATED SUBQUERIES

A nested subquery may reference attributes of the outer query. This is called a 'correlated subquery'

In the WHERE clause:

```
SELECT att1
FROM rel1
WHERE EXISTS (
     SELECT att2
     FROM rel2
     WHERE rel1.att1 >= rel2.att2
)
```

In the oSELECT clause (if scalar):

```
SELECT att1,(
     SELECT MAX(att2)
     FROM rel2
     WHERE rel1.att1 >= rel2.att2
     )
FROM rel1
```

From the textbook p. 96: We note that nested subqueries in the from clause cannot use correlation variables from other relations in the from clause. However, SQL:2003 allows a subquery in the from clause that is prefixed by the lateral keyword to access attributes of preceding tables or subqueries in the from clause. For example, if we wish to print the names of each instructor, along with their salary and the average salary in their department, we could write the query as follows:

```
select name, salary, avg salary
from instructor I1, lateral (select avg(salary)
as avg salary
     from instructor I2
     where I2.dept_name= I1.dept_name):
```

Without the lateral clause, the subquery cannot access the correlation variable I1 from the outer query. Currently, only a few SQL implementations, such as IBM DB2, support the lateral clause.

DEALING WITH NULL COMPARISONS

The comparison of anything with null is unknown, therefore:

```
SELECT NULL and TRUE;
      -> UNKNOWN (NULL)
SELECT NULL and FALSE;
      -> FALSE (0)
SELECT NULL OR TRUE;
      -> TRUE (1)
SELECT NULL OR FALSE;
      -> UNKNOWN (NULL)
```

Checking for NULLs:

```
WHERE att IS NULL
WHERE att IS NOT NULL
```

According to the SQL standard:

If the `WHERE` clause evaluates to false or unknown for a tuple, that tuple is not returned.

If `UNIQUE` is used, then nulls evaluate to unequal tuples, so evaluate as unique

If the `SELECT DISTINCT` is used, then all null values are considered identical, and are returned as a single distinct value; similarly for set operations when duplicates are eliminated

One more thing: CASE

Cases allow you to break down conditionals easily:

```
SELECT
     CASE
          WHEN att1 = x THEN a
          WHEN att2 = y THEN b
          ELSE z
     END
FROM rel
```

Practice problem 1

DB Schema:

employee(emp_id, name, dept_id, mgr_id, salary)

department(dept_id, name)

1. For each department with an average salary of greater than $70,000, find the number of its employees, using the HAVING clause

Practice problem 1 solution

1. For each department with an average salary of greater than $70,000, find the number of its employees, using the HAVING clause

```
select count(emp_id)
from employee
group by dept_id
having avg(salary) > $70,000
```

Practice problem 2

employee(emp_id, name, dept_id, mgr_id, salary)

department(dept_id, name)

2. Find managers with a salary greater than the average manager's salary, using the WITH clause

Practice problem 2 solution

2. Find managers with a salary greater than the average manager's salary, using the WITH clause

```
with avg_mgr_salary as (
     select avg(salary) as average
     from employees
     where manager_id is null)
select name
from employee
where mgr_id is null
     and salary > (
          select average
          from avg_mgr_salary)
```

Practice problems 3 and 4: for you to answer

employee(emp_id, name, dept_id, mgr_id, salary)

department(dept_id, name)

3. Find all departments with more than 1 employee, using the UNIQUE clause

(Hint: see textbook p. 95)

4. Find all employees making at least 3 times more than some other employee in their department using the SOME clause.

Questions?

Happy coding :)