Announcements
Joining Tables
Reminder: John the Patriotic Dog Breeder

create table parents as

select "abraham" as parent, "barack" as child union
select "abraham" , "clinton" union
select "delano" , "herbert" union
select "fillmore" , "abraham" union
select "fillmore" , "delano" union
select "fillmore" , "grover" union
select "eisenhower" , "fillmore";

Parents:

<table>
<thead>
<tr>
<th>Parent</th>
<th>Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>abraham</td>
<td>barack</td>
</tr>
<tr>
<td>abraham</td>
<td>clinton</td>
</tr>
<tr>
<td>delano</td>
<td>herbert</td>
</tr>
<tr>
<td>fillmore</td>
<td>abraham</td>
</tr>
<tr>
<td>fillmore</td>
<td>delano</td>
</tr>
<tr>
<td>fillmore</td>
<td>grover</td>
</tr>
<tr>
<td>eisenhower</td>
<td>fillmore</td>
</tr>
</tbody>
</table>
Joining Two Tables

Two tables A & B are joined by a comma to yield all combos of a row from A & a row from B

```sql
create table dogs as
    select "abraham" as name, "long" as fur union
    select "barack" , "short" union
    select "clinton" , "long" union
    select "delano" , "long" union
    select "eisenhower" , "short" union
    select "fillmore" , "curly" union
    select "grover" , "short" union
    select "herbert" , "curly";

create table parents as
    select "abraham" as parent, "barack" as child union
    select "abraham" , "clinton" union
    select "abraham" , "clinton" union
    ...;
```

Select the parents of curly-furred dogs

```sql
select parent from [parents, dogs]
    where child = name and fur = "curly";

(Demo)```
Aliases and Dot Expressions
Joining a Table with Itself

Two tables may share a column name; dot expressions and aliases disambiguate column values

\[
\text{select [columns] from [table] where [condition] order by [order];}
\]

[table] is a comma-separated list of table names with optional aliases

Select all pairs of siblings

\[
\text{select a.child as first, b.child as second}
\]

\[
\text{from parents as a, parents as b}
\]

\[
\text{where a.parent = b.parent and a.child < b.child;}
\]

<table>
<thead>
<tr>
<th>First</th>
<th>Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>barack</td>
<td>clinton</td>
</tr>
<tr>
<td>abraham</td>
<td>delano</td>
</tr>
<tr>
<td>abraham</td>
<td>grover</td>
</tr>
<tr>
<td>delano</td>
<td>grover</td>
</tr>
</tbody>
</table>
Example: Grandparents

Which select statement evaluates to all grandparent, grandchild pairs?

1. `select a.grandparent, b.child from parents as a, parents as b
   where b.parent = a.child;`

2. `select a.parent, b.child from parents as a, parents as b
   where a.parent = b.child;`

3. `select a.parent, b.child from parents as a, parents as b
   where b.parent = a.child;`

4. `select a.grandparent, b.child from parents as a, parents as b
   where a.parent = b.child;`

5. None of the above
Joining Multiple Tables

Multiple tables can be joined to yield all combinations of rows from each

```sql
create table grandparents as
    select a.parent as grandog, b.child as granpup
    from parents as a, parents as b
    where b.parent = a.child;
```

Select all grandparents with the same fur as their grandchildren

Which tables need to be joined together?

```sql
select grandog from grandparents, dogs as c, dogs as d
    where grandog = c.name and
        granpup = d.name and
        c.fur = d.fur;
```
Numerical Expressions
Numerical Expressions

Expressions can contain function calls and arithmetic operators

```
[expression] as [name], [expression] as [name], ...
```

```
select [columns] from [table] where [expression] order by [expression];
```

Combine values: +, −, *, /, %, and, or

Transform values: abs, round, not, −

Compare values: <, <=, >, >=, <>, !=, =

(Demo)
Example: Dog Triples
Write a SQL query that selects all possible combinations of three dogs with the same fur and lists them in order of increasing height.

```sql
create table parents as
select "abraham" as parent, "barack" as child union
select "abraham", "clinton" union
select "delano", "herbert" union
select "fillmore", "abraham" union
select "fillmore", "delano" union
select "fillmore", "grover" union
select "eisenhower", "fillmore" union
select "delano", "jackson";

create table dogs as
select "abraham" as name, "long" as fur, 26 as height union
select "barack", "short", 52 union
select "clinton", "long", 47 union
select "delano", "long", 46 union
select "eisenhower", "short", 35 union
select "fillmore", "curly", 32 union
select "grover", "short", 28 union
select "herbert", "curly", 31 union
select "jackson", "long", 43;
```

Expected output:

```
abraham|delano|clinton
grover|eisenhower|barack
```
String Expressions
String Expressions

String values can be combined to form longer strings

```
sqlite> select "hello," || " world";
hello, world
```

Basic string manipulation is built into SQL, but differs from Python

```
sqlite> create table phrase as select "hello, world" as s;
sqlite> select substr(s, 4, 2) || substr(s, instr(s, " ")+1, 1) from phrase;
low
```

Strings can be used to represent structured values, but doing so is rarely a good idea

```
sqlite> create table lists as select "one" as car, "two,three,four" as cdr;
sqlite> select substr(cdr, 1, instr(cdr, ",")-1) as cadr from lists;
two
```

(Demo)
Database Management Systems
Database Management System Architecture

Architecture of a Database System by Hellerstein, Stonebreaker, and Hamilton
Query Planning

The manner in which tables are filtered, sorted, and joined affects execution time

Select the parents of curly-furred dogs:

```sql
select parent from parents, dogs
where child = name and fur = "curly";
```

Join all rows of parents to all rows of dogs, filter by `child = name` and `fur = "curly"

Join only rows of parents and dogs where `child = name`, filter by `fur = "curly"

Filter dogs by `fur = "curly"`, join result with all rows of parents, filter by `child = name`

Filter dogs by `fur = "curly"`, join only rows of result and parents where `child = name`