Announcements

- Course survey due Monday 4/28 @ 11:59pm
- If 85% of students complete the course survey on resources, everyone gets 1 bonus point!
  
  \[\text{http://goo.gl/ajEBkT}\]
- Project 4 due Thursday 4/23 @ 11:59pm
- Early point #2: All questions (including Extra Credit) by Wednesday 4/22 @ 11:59pm
- Recursive Art Contest Entries due Monday 4/27 @ 11:59pm
  
  Email your code & a screenshot of your art to cs61a-tae@imail.eecs.berkeley.edu (Albert)
- Homework 9 merged with Homework 10; both are due Wednesday 4/29 @ 11:59pm

Local Tables

A create table statement names a table globally

```
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";
```

Example: Relationships

(A) What are appropriate names for the columns in this result?
(B) How many rows will result?

```
with what(first, second) as
  (select a.child, b.child
   from parents as a, parents as b
   where a.parent = b.parent
   and a.child != b.child)
select child as _______________,
  second as _______________ from parents, what
where parent = first;
```

Recursive Local Tables

An ancestor is your parent or an ancestor of your parent

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

with ancestors(ancestor, descendent) as
  (select parent, child from parents union
   select ancestor, child from ancestors, parents
   where parent = descendent)
select ancestor from ancestors where descendent="herbert";
```
Global Names for Recursive Tables

To create a table with a global name, you need to select the contents of the local table.

```
create table odds
with
    odds(n)
as
    (select 1 union select n+2 from odds where n < 15)

select n from odds;
```

Which names above can change without affecting the result?

Limits on Recursive Select Statements

Recursive table definitions are only possible within a with clause.

No mutual recursion: two or more tables cannot be defined in terms of each other.

```
with
    odds(x)
as
    (select 1 union select x+1 from evens)

    evens(x)
as
    (select x+1 from odds)

select x from odds
```

No tree recursion: the table being defined can only appear once in a from clause.

```
with
    ints(x)
as
    (select 1 union select x-1 from ints union select x+1 from ints)

select x from ints
```

Language is Recursive

Noun phrases can contain relative pronouns that introduce relative clauses.

```
The dog chased the cat
that chased the bird
```

Input-Output Tables

A table containing the inputs to a function can be used to map from output to input.

```
create table pairs
with
    i(n)
as
    (select 1 union select n+1 from i where n < 50)

select a.n as x, b.n as y from i as a, i as b
where a.n <= b.n;
```

What integers can I add/multiply together to get 24?

Example: Pythagorean Triples

All triples a, b, c such that $a^2 + b^2 = c^2$

```
create table fibs
with
    fib(previous, current)
as
    (select 0, 1 union select current, previous+current from fib
where current <= __________________)

select __________________ as n from fib;
```

Example: Fibonacci Sequence

Computing the next Fibonacci number requires both the previous and current numbers.

```
create table fibs
with
    fib(previous, current) as
    (select 0, 1 union select current, previous+current from fib
where current <= __________________)

select previous as n from fib;
```

Example: Bulldog Fight

Bulldogs bulldogs bulldogs fight fight fight

(Demo)
The mathematician G. H. Hardy once remarked to the mathematician Srinivasa Ramanujan...