61A Lecture 32

Announcements

Local Tables

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";
```

parents:

Parent	Child
abraham	barack
abraham	clinton
delano	herbert
fillmore	abraham
fillmore	delano
fillmore	grover
eisenhower	fillmore

Local Tables

A create table statement names a table globally

A with clause of a select statement names a table that is local to the statement

```
create table parents as
  select "abraham" as parent, "barack" as child union
  ...
with
  best(dog) as (
    select "eisenhower" union
    select "barack"
  )
select parent from parents, best where child=dog;
```

Part of the select statement

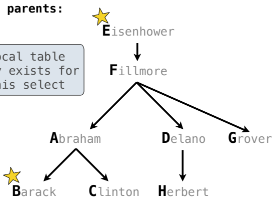
Local table only exists for this select

best:

dog
eisenhower
barack

parent
abraham

parents:



(Demo)

Example: Relationships

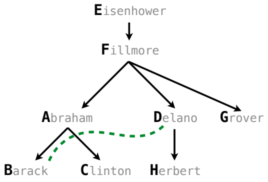
(A) What are appropriate names for the columns in this result?

(B) How many rows and columns will result?

```
with
 siblings
  ~~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 ____nephew____, second as ____uncle____
                  siblings
       from parents, ~~what~~ where parent=first;
```

	nephew		uncle
parent	~~child~~	first	~~second~~
abraham	barack	abraham	delano

parents:



Recursive Local Tables

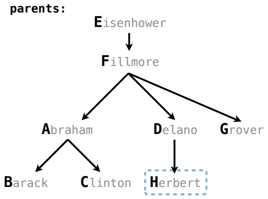
Local Tables can be Declared Recursively

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";
```

parents:



ancestor
delano
fillmore
eisenhower

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

odds:

n
1
3
5
7
9
11
13
15

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
```

Nope!

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;
```

Nope!

```
with
  ints(x) as (
    select 1 union
    select a.x + b.x
           from ints as a, ints as b
  )
select x from ints;
```

Nope!

String Examples

Language is Recursive

Noun phrases can contain relative pronouns that introduce relative clauses

The dog chased the cat

that chased the bird

The dog chased the cat

that the bird chased

The dog chased the cat

the bird chased

The dog the bird the cat chased chased chased me

Bulldogs bulldogs bulldogs fight fight fight

(Demo)

Integer Examples

Input-Output Tables

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

```
create table pairs as
  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?

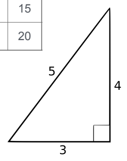
(Demo)

Example: Pythagorean Triples

All triples a, b, c such that a² + b² = c²

```
with
  i(n) as (
    select 1 union select n+1 from i where n < 20
  )
select a.n as a, b.n as b, c.n as c
      from ___i as a, i as b, i as c___
      where ___a.n < b.n___ and a.n*a.n + b.n*b.n = c.n*c.n;
```

a	b	c
3	4	5
5	12	13
6	8	10
8	15	17
9	12	15
12	16	20



Example: Fibonacci Sequence

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

```
create table fibs as
  with
    fib(previous, current) as (
      select 0, 1 union
      select current, previous+current from fib
      where current <= ___14.15926535___
    )
  select ___previous___ as n from fib;
```

fibs:

n
0
1
1
2
3
5
8
13

A Very Interesting Number

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

(Demo)