61A Lecture 31

Wednesday, April 15

Announcements

Announcements

- Homework 8 due Wednesday 4/17 @ 11:59pm

Announcements

- Homework 8 due Wednesday 4/17 @ 11:59pm
- Please complete the course survey on resources! **http://goo.gl/ajEBkT**

Announcements

- Homework 8 due Wednesday 4/17 @ 11:59pm
- Please complete the course survey on resources! **http://goo.gl/ajEBkT**
- Project 4 due Thursday 4/23 @ 11:59pm

Announcements

- Homework 8 due Wednesday 4/17 @ 11:59pm
- Please complete the course survey on resources! **http://goo.gl/ajEBkT**
- Project 4 due Thursday 4/23 @ 11:59pm
  - Early point #1: Questions 1–12 submitted (correctly) by Friday 4/17 @ 11:59pm

Announcements

- Homework 8 due Wednesday 4/17 @ 11:59pm
- Please complete the course survey on resources! **http://goo.gl/ajEBkT**
- Project 4 due Thursday 4/23 @ 11:59pm
  - Early point #1: Questions 1–12 submitted (correctly) by Friday 4/17 @ 11:59pm
  - Early point #2: All questions (including Extra Credit) by Wednesday 4/22 @ 11:59pm

Information Hiding

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1


    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1


    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

```
>>> fibs = FibIter()
>>> [next(fibs) for _ in range(10)]
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
```

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1

    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

"Please don't reference these directly. They may change."

```
>>> fibs = FibIter()
>>> [next(fibs) for _ in range(10)]
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
```

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1

    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

"Please don't reference these directly. They may change."

```
>>> fibs = FibIter()
>>> [next(fibs) for _ in range(10)]
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
```

This naming convention is not enforced, but is typically respected

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1
    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

"Please don't reference these directly. They may change."

```
>>> fibs = FibIter()
>>> [next(fibs) for _ in range(10)]
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
```

This naming convention is not enforced, but is typically respected

A programmer who designs and maintains a public module may change internal-use names

Attributes for Internal Use

An attribute name that starts with one underscore is not meant to be referenced externally.

```
class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
        self._addend = 1

    def __next__(self):
        result = self._next
        self._addend, self._next = self._next, self._addend + self._next
        return result
```

"Please don't reference these directly. They may change."

```
>>> fibs = FibIter()
>>> [next(fibs) for _ in range(10)]
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
```

This naming convention is not enforced, but is typically respected

A programmer who designs and maintains a public module may change internal-use names

Starting a name with *two underscores* enforces restricted access from outside the class

Names in Local Scope

A name bound in a local frame is not accessible to other environments, except those that extend the frame

Names in Local Scope

A name bound in a local frame is not accessible to other environments, except those that extend the frame

```
def fib_generator():
    """A generator function for Fibonacci numbers.

    >>> fibs = fib_generator()
    >>> [next(fibs) for _ in range(10)]
    [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
    """
    yield 0
    previous, current = 0, 1
    while True:
        yield current
        previous, current = current, previous + current
```

Names in Local Scope

A name bound in a local frame is not accessible to other environments, except those that extend the frame

```
def fib_generator():
    """A generator function for Fibonacci numbers.

    >>> fibs = fib_generator()
    >>> [next(fibs) for _ in range(10)]
    [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
    """
    yield 0
    previous, current = 0, 1
    while True:
        yield current
        previous, current = current, previous + current
```

There is no way to access values bound to "previous" and "current" externally

Singleton Objects

Singleton Objects

A singleton class is a class that only ever has one instance

Singleton Objects

A singleton class is a class that only ever has one instance

NoneType, the class of None, is a singleton class; None is its only instance

Singleton Objects

A singleton class is a class that only ever has one instance

NoneType, the class of None, is a singleton class; None is its only instance

For user-defined singletons, some programmers re-bind the class name to the instance

Singleton Objects

A singleton class is a class that only ever has one instance

NoneType, the class of None, is a singleton class; None is its only instance

For user-defined singletons, some programmers re-bind the class name to the instance

```
class empty_iterator:
    """An iterator over no values."""
    def __next__(self):
        raise StopIteration
empty_iterator = empty_iterator()
```

Singleton Objects

A singleton class is a class that only ever has one instance

NoneType, the class of None, is a singleton class; None is its only instance

For user-defined singletons, some programmers re-bind the class name to the instance

```
class empty_iterator:
    """An iterator over no values."""
    def __next__(self):
        raise StopIteration
empty_iterator = empty_iterator()
```

The class

Singleton Objects

A singleton class is a class that only ever has one instance

NoneType, the class of None, is a singleton class; None is its only instance

For user-defined singletons, some programmers re-bind the class name to the instance

```
class empty_iterator:
    """An iterator over no values."""
    def __next__(self):
        raise StopIteration
empty_iterator = empty_iterator()
```

The instance

The class

Stream Implementation

Stream Implementation

Stream Implementation

A stream is a linked list with an *explicit* first element and a rest-of-the-list that is computed lazily

Stream Implementation

A stream is a linked list with an *explicit* first element and a rest-of-the-list that is computed lazily

```
class Stream:
    """A lazily computed linked list."""
```

Stream Implementation

A stream is a linked list with an *explicit* first element and a rest-of-the-list that is computed lazily

```
class Stream:
    """A lazily computed linked list."""
    class empty:
        def __repr__(self):
            return 'Stream.empty'
    empty = empty()
```

Stream Implementation

A stream is a linked list with an *explicit* first element and a rest-of-the-list that is computed lazily

```
class Stream:
    """A lazily computed linked list."""
    class empty:
        def __repr__(self):
            return 'Stream.empty'
    empty = empty()

    def __init__(self, first, compute_rest=lambda: Stream.empty):
        assert callable(compute_rest), 'compute_rest must be callable.'
        self.first = first
        self._compute_rest = compute_rest
```

Stream Implementation

A stream is a linked list with an *explicit* first element and a rest-of-the-list that is computed lazily

```
class Stream:
    """A lazily computed linked list."""
    class empty:
        def __repr__(self):
            return 'Stream.empty'
    empty = empty()

    def __init__(self, first, compute_rest=lambda: Stream.empty):
        assert callable(compute_rest), 'compute_rest must be callable.'
        self.first = first
        self._compute_rest = compute_rest

    @property
    def rest(self):
        """Return the rest of the stream, computing it if necessary."""
        if self._compute_rest is not None:
            self._rest = self._compute_rest()
            self._compute_rest = None
        return self._rest
```

Declarative Languages

Database Management Systems

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

A table is a collection of records, which are rows that have a value for each column

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

A table is a collection of records, which are rows that have a value for each column

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge
45	93	Minneapolis

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

A table is a collection of records, which are rows that have a value for each column

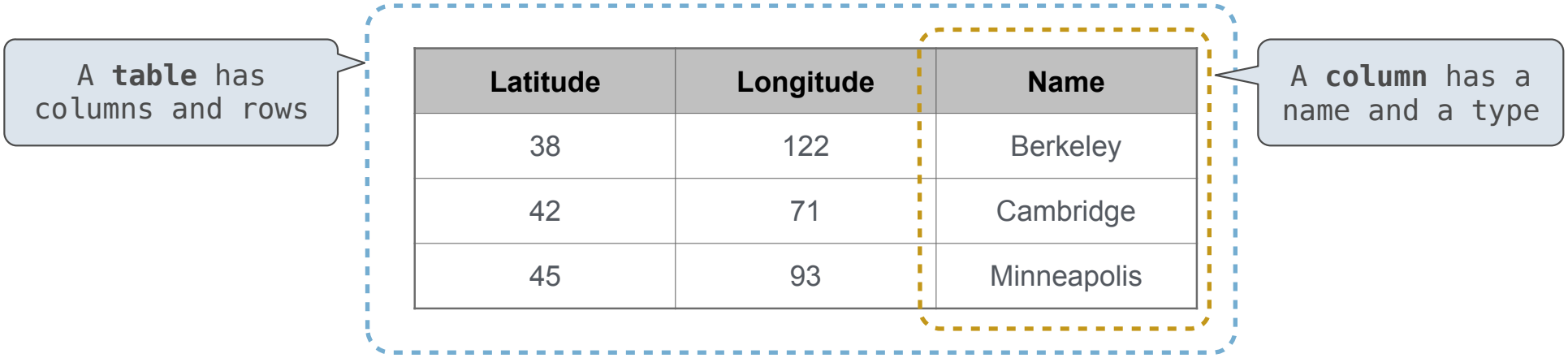
A **table** has columns and rows

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge
45	93	Minneapolis

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

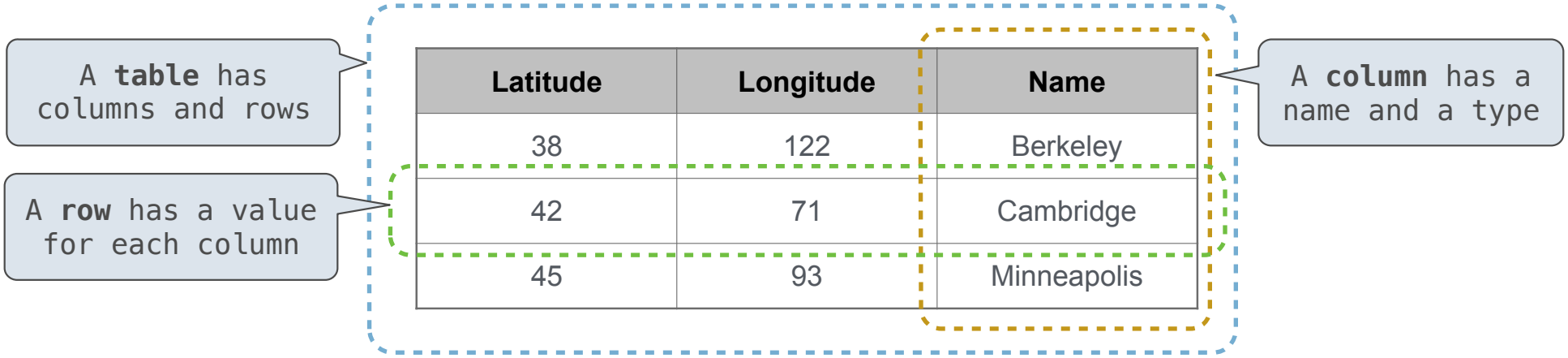
A table is a collection of records, which are rows that have a value for each column



Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

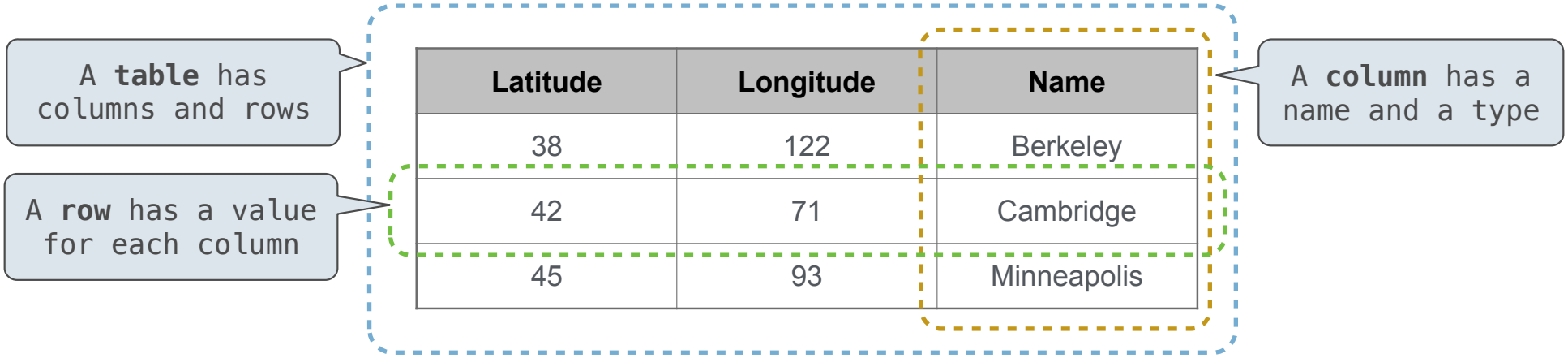
A table is a collection of records, which are rows that have a value for each column



Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

A table is a collection of records, which are rows that have a value for each column

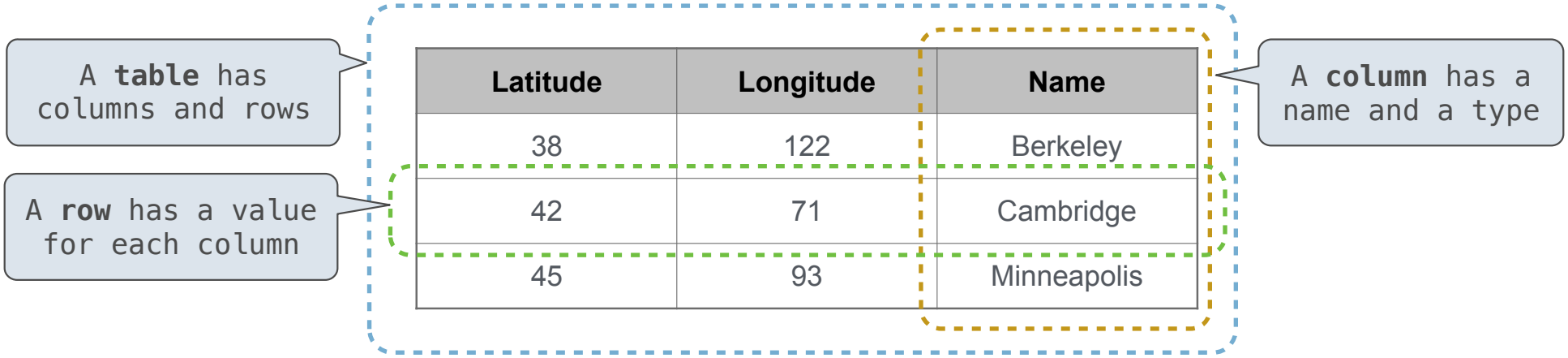


The Structured Query Language (SQL) is perhaps the most widely used programming language

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

A table is a collection of records, which are rows that have a value for each column



The Structured Query Language (SQL) is perhaps the most widely used programming language

SQL is a *declarative* programming language

Declarative Programming

Declarative Programming

In **declarative languages** such as SQL & Prolog:

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

```
create table cities as
```

Cities:

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Cities:

Latitude	Longitude	Name
38	122	Berkeley

```
create table cities as
  select 38 as latitude, 122 as longitude, "Berkeley" as name union
```

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Cities:

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge

```
create table cities as
  select 38 as latitude, 122 as longitude, "Berkeley" as name union
  select 42,             71,               "Cambridge"       union
```

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Cities:

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge
45	93	Minneapolis

```
create table cities as
  select 38 as latitude, 122 as longitude, "Berkeley" as name union
  select 42,             71,               "Cambridge"       union
  select 45,             93,               "Minneapolis";
```

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Cities:

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge
45	93	Minneapolis

```
create table cities as
  select 38 as latitude, 122 as longitude, "Berkeley" as name union
  select 42,             71,               "Cambridge"        union
  select 45,             93,               "Minneapolis";

select "west coast" as region, name from cities where longitude >= 115 union
select "other",                name from cities where longitude <  115;
```

Declarative Programming

In **declarative languages** such as SQL & Prolog:

- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

In **imperative languages** such as Python & Scheme:

- A "program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Cities:

Latitude	Longitude	Name
38	122	Berkeley
42	71	Cambridge
45	93	Minneapolis

```
create table cities as
  select 38 as latitude, 122 as longitude, "Berkeley" as name union
  select 42,             71,               "Cambridge"       union
  select 45,             93,               "Minneapolis";
```

Region	Name
west coast	Berkeley
other	Minneapolis
other	Cambridge

```
select "west coast" as region, name from cities where longitude >= 115 union
select "other",                name from cities where longitude <  115;
```

Structured Query Language (SQL)

SQL Overview

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table
- Lots of other statements exist: **analyze**, **delete**, **explain**, **insert**, **replace**, **update**, etc.

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table
- Lots of other statements exist: **analyze**, **delete**, **explain**, **insert**, **replace**, **update**, etc.
- Most of the important action is in the **select** statement

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table
- Lots of other statements exist: **analyze**, **delete**, **explain**, **insert**, **replace**, **update**, etc.
- Most of the important action is in the **select** statement
- The code for executing **select** statements fits on a single sheet of paper (next lecture)

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table
- Lots of other statements exist: **analyze**, **delete**, **explain**, **insert**, **replace**, **update**, etc.
- Most of the important action is in the **select** statement
- The code for executing **select** statements fits on a single sheet of paper (next lecture)

Today's theme:

SQL Overview

The SQL language is an ANSI and ISO standard, but DBMS's implement custom variants

- A **select** statement creates a new table, either from scratch or by projecting a table
- A **create table** statement gives a global name to a table
- Lots of other statements exist: **analyze**, **delete**, **explain**, **insert**, **replace**, **update**, etc.
- Most of the important action is in the **select** statement
- The code for executing **select** statements fits on a single sheet of paper (next lecture)

Today's theme:

http://awhimsicalbohemian.typepad.com/.a/6a00e5538b84f3883301538dfa8f19970b-800wi

Getting Started with SQL

Install sqlite (version 3.8.3 or later): http://sqlite.org/download.html

Use sqlite online: http://kripken.github.io/sql.js/GUI/

Use the SQL example from the textbook: http://composingprograms.com/examples/sql/sql.zip

Selecting Value Literals

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name]
```

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name]
```

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

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

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

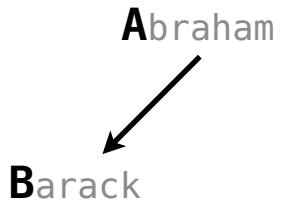
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child;
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

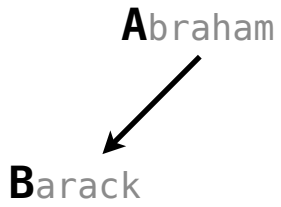
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child union
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

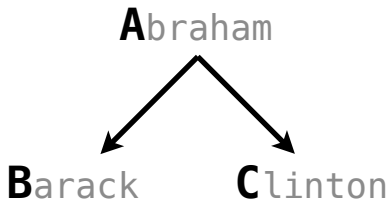
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child union
select "abraham"          , "clinton"         union
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

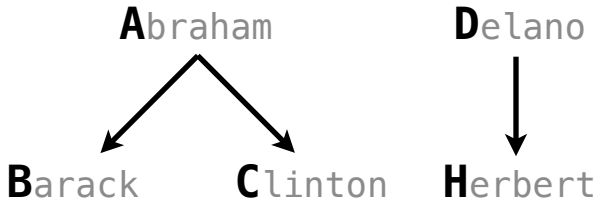
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child union
select "abraham"          , "clinton"        union
select "delano"           , "herbert"        union
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

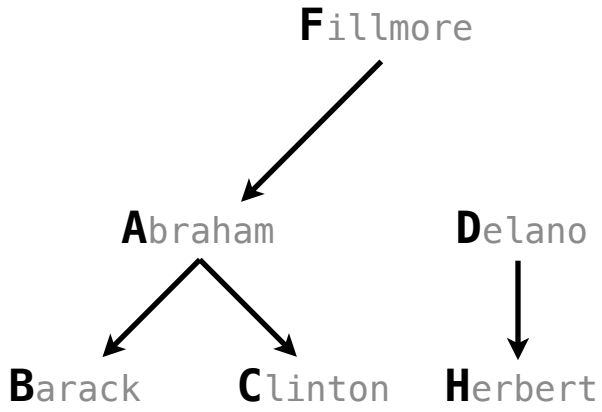
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child union
select "abraham"          , "clinton"         union
select "delano"           , "herbert"         union
select "fillmore"         , "abraham"         union
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

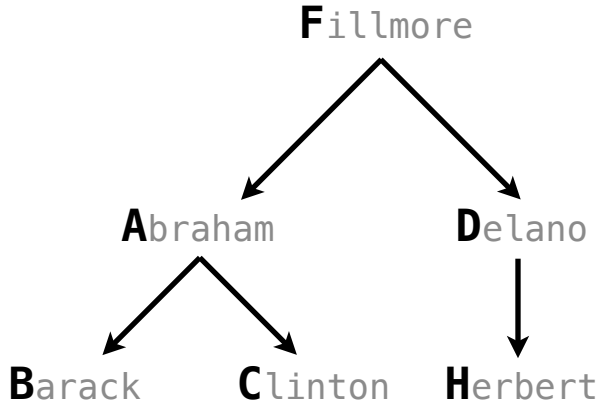
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
select "abraham" as parent, "barack" as child union
select "abraham"          , "clinton"         union
select "delano"           , "herbert"         union
select "fillmore"         , "abraham"         union
select "fillmore"         , "delano"          union
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

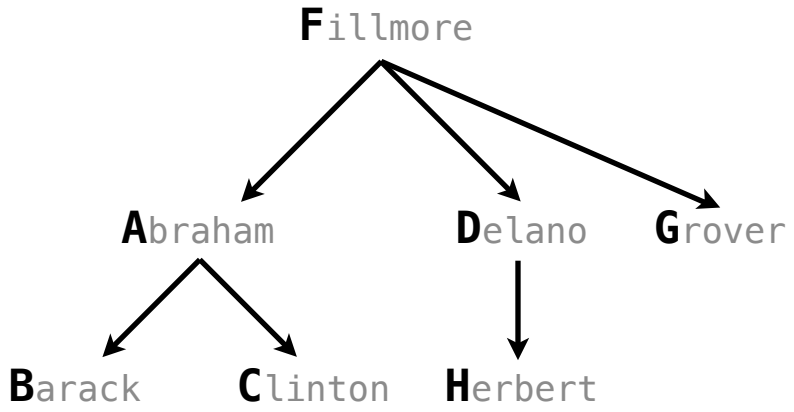
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

The union of two select statements is a table
containing the rows of both of their results

```
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
```



Selecting Value Literals

A **select** statement always includes a comma-separated list of column descriptions

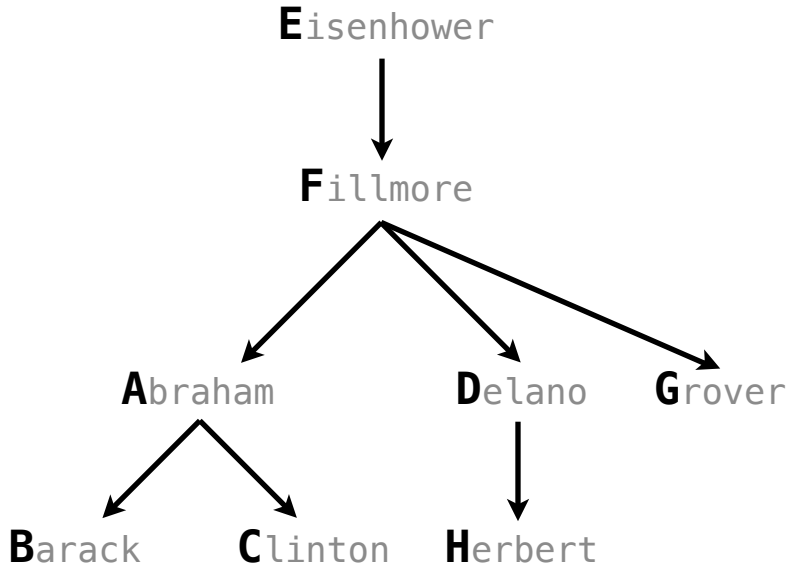
A column description is an expression, optionally followed by **as** and a column name

```
select [expression] as [name], [expression] as [name];
```

Selecting literals creates a one-row table

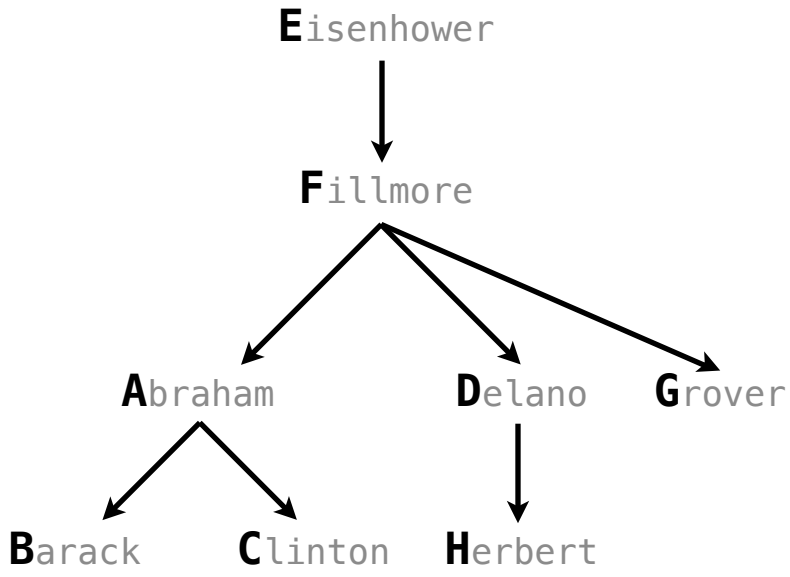
The union of two select statements is a table containing the rows of both of their results

```
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";
```



Naming Tables

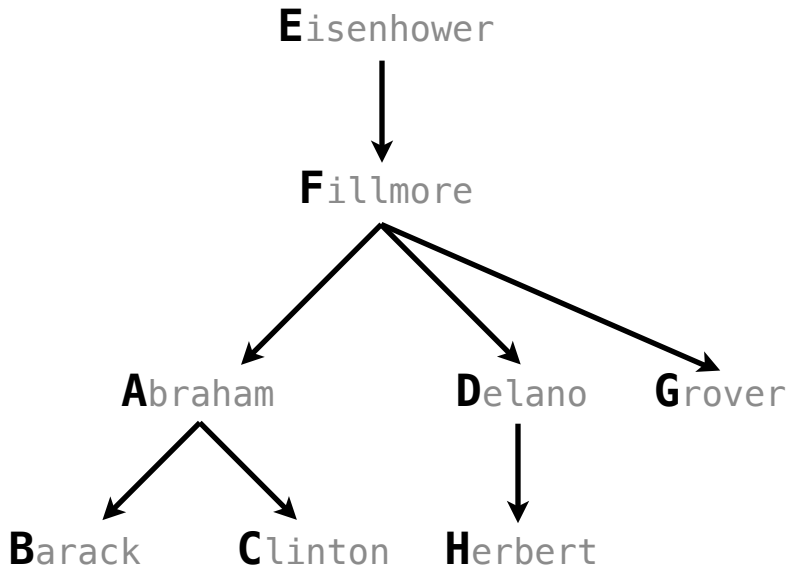
```
select "abraham" as parent, "barack" as child union
select "abraham"          , "clinton"         union
select "delano"           , "herbert"         union
select "fillmore"         , "abraham"         union
select "fillmore"         , "delano"          union
select "fillmore"         , "grover"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



Naming Tables

SQL is often used as an interactive language

```
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";
```

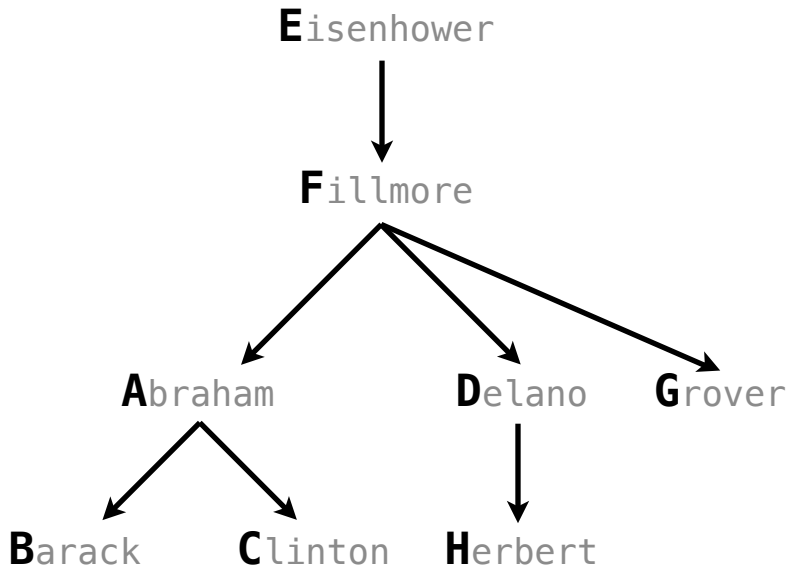


Naming Tables

SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

```
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";
```



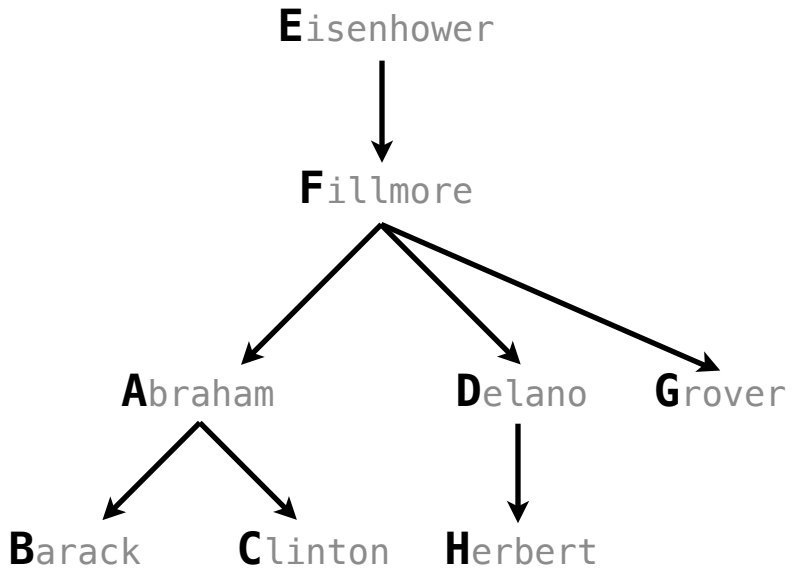
Naming Tables

SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

A **create table** statement gives the result a name

```
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";
```



Naming Tables

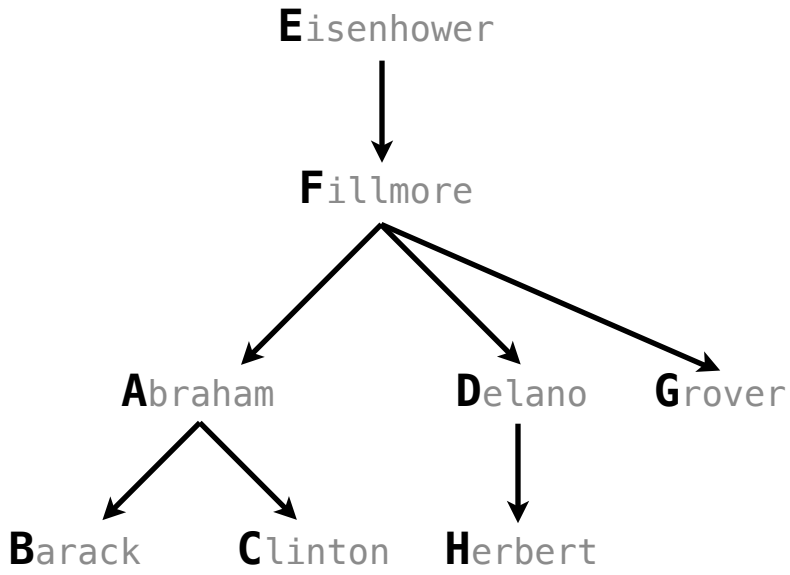
SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

A **create table** statement gives the result a name

```
create table [name] as [select statement];
```

```
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";
```



Naming Tables

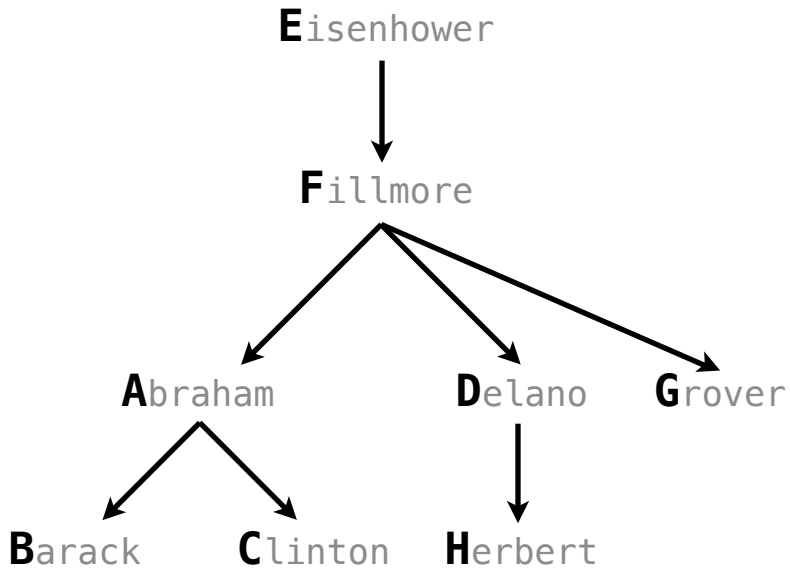
SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

A **create table** statement gives the result a name

```
create table [name] as [select statement];
```

```
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";
```



Naming Tables

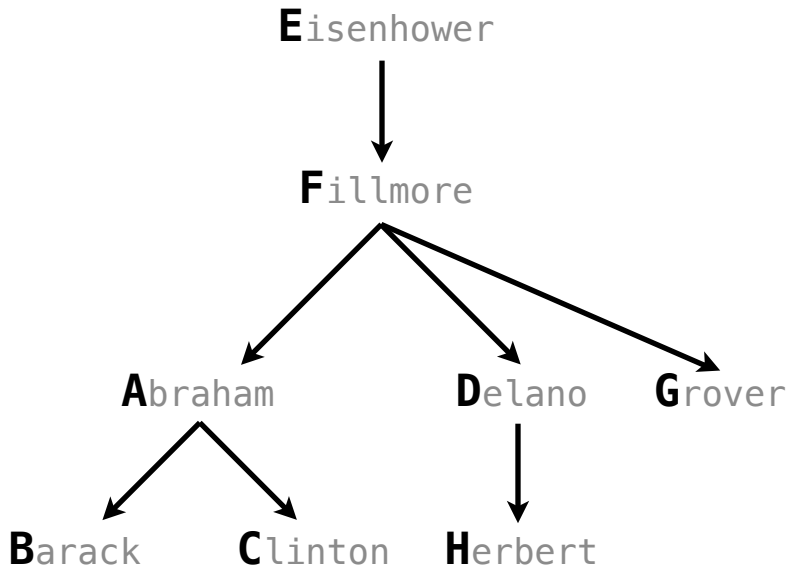
SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

A **create table** statement gives the result a name

```
create table [name] as [select statement];
```

```
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";
```



Naming Tables

SQL is often used as an interactive language

The result of a **select** statement is displayed to the user, but not stored

A **create table** statement gives the result a name

```
create table [name] as [select statement];
```

```
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

Projecting Tables

Select Statements Project Existing Tables

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

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

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

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

```
select [columns]                                           ;
```

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

```
select [expression] as [name], [expression] as [name], ... ;
select [columns] from [table]                              ;
```

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

```
select [expression] as [name], [expression] as [name], ...;
select [columns] from [table]                                ;
```

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

```
select [expression] as [name], [expression] as [name], ...;
select [columns] from [table] where [condition]                ;
```

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

```
select [expression] as [name], [expression] as [name], ... ;
select [columns] from [table] where [condition]                ;
```

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

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

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

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

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

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

Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

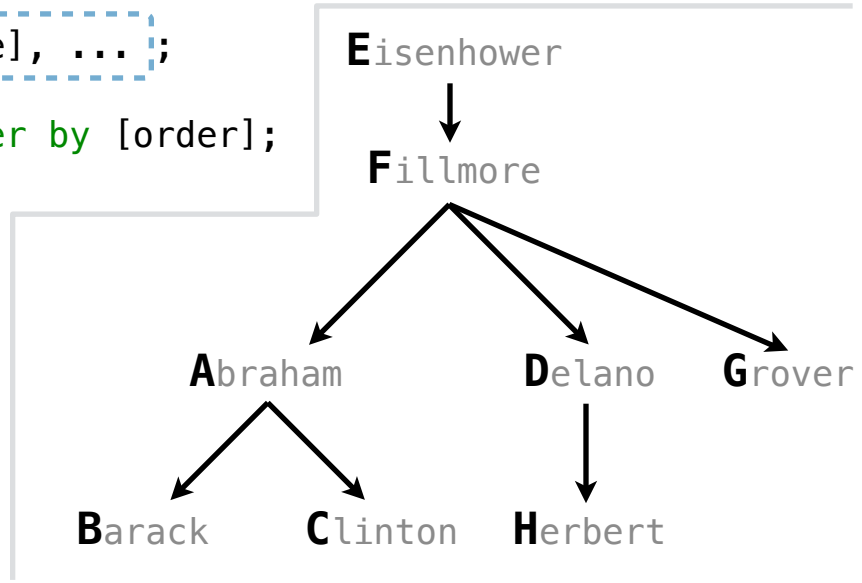
A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

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

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



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

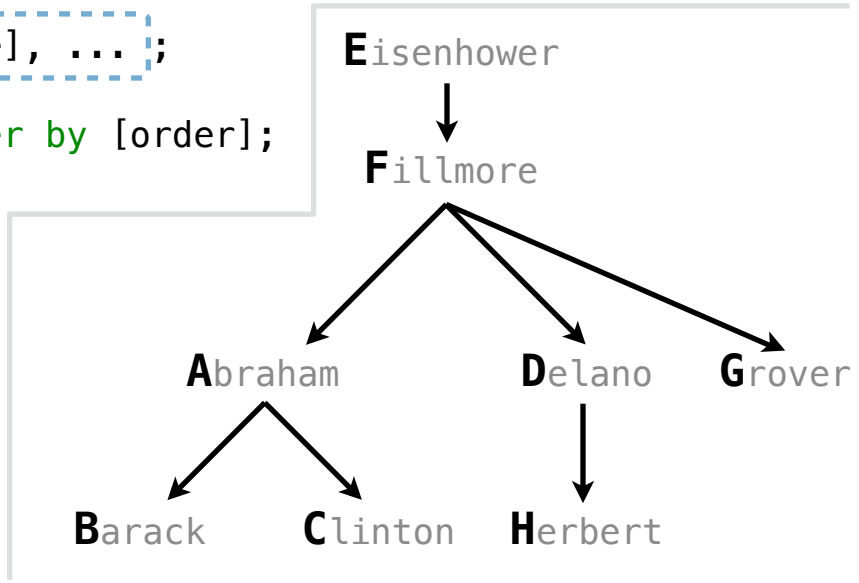
An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

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

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

```
select child from parents where parent = "abraham";
```



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

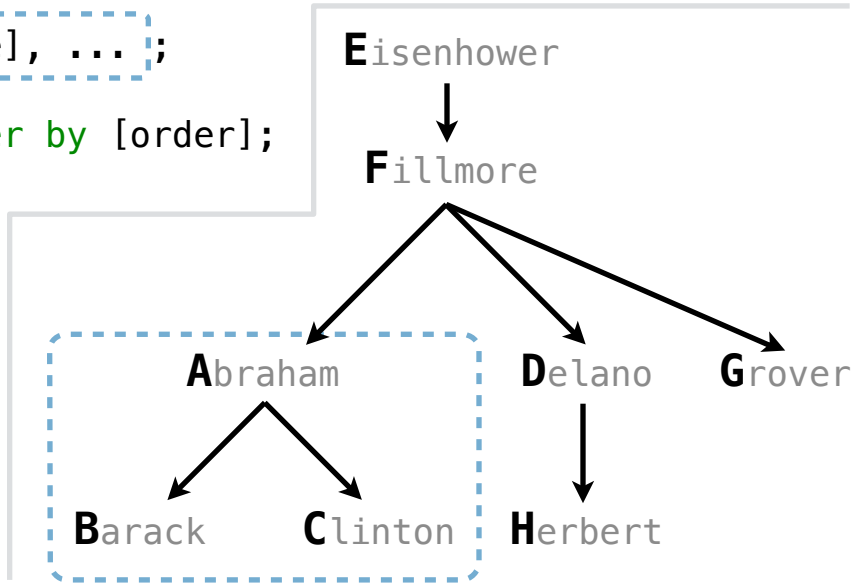
An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

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

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

```
select child from parents where parent = "abraham";
```



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

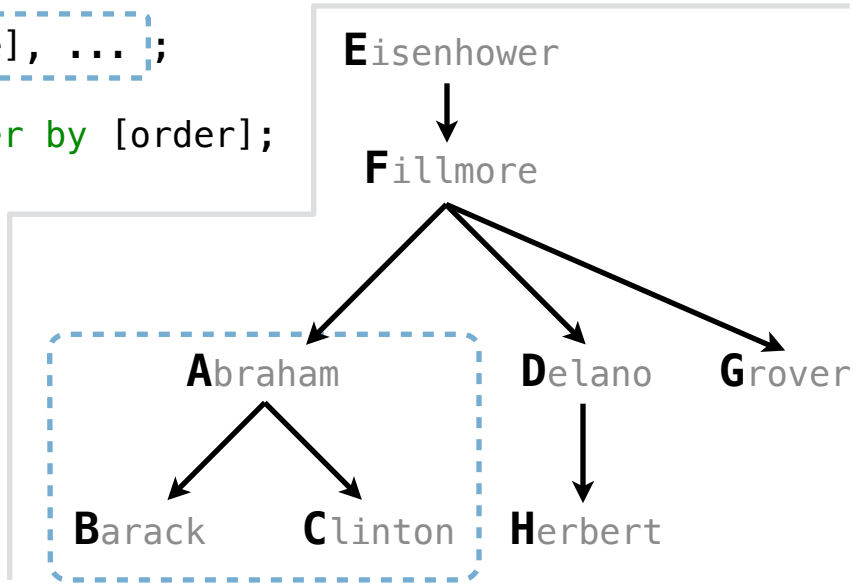
A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

```
select [expression] as [name], [expression] as [name], ...;
select [columns] from [table] where [condition] order by [order];
select child from parents where parent = "abraham";
```

Child
barack
clinton



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

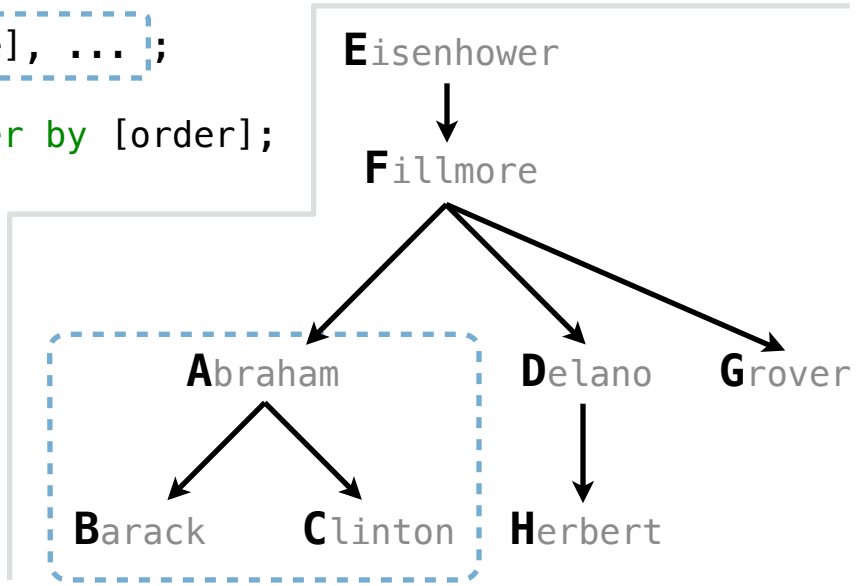
A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

```
select [expression] as [name], [expression] as [name], ...;
select [columns] from [table] where [condition] order by [order];
select child from parents where parent = "abraham";
select parent from parents where parent > child;
```

Child
barack
clinton



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

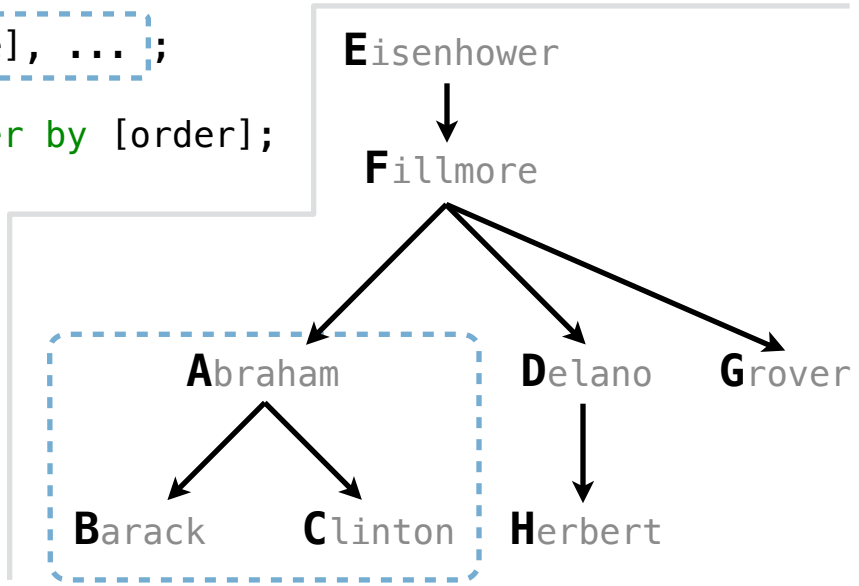
An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

```
select [expression] as [name], [expression] as [name], ... ;
select [columns] from [table] where [condition] order by [order];
select child from parents where parent = "abraham";
select parent from parents where parent > child;
```

Child
barack
clinton

Parent
fillmore
fillmore



Select Statements Project Existing Tables

A **select** statement can specify an input table using a **from** clause

A subset of the rows of the input table can be selected using a **where** clause

An ordering over the remaining rows can be declared using an **order by** clause

Column descriptions determine how each input row is projected to a result row

```
select [expression] as [name], [expression] as [name], ... ;
select [columns] from [table] where [condition] order by [order];
select child from parents where parent = "abraham";
select parent from parents where parent > child;
```

Child
barack
clinton

Parent
fillmore
fillmore

(Demo)