61A Lecture 30

Announcements

Information Hiding

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. The names 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

```
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

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

Declarative Languages

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

A **row** has a value for each column

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

A **column** has a name and a type

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

SQL is a *declarative* programming language

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;
```

Region	Name
west coast	Berkeley
other	Minneapolis
other	Cambridge

Structured Query Language (SQL)

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

Today's theme:

http://awhimsicalbohemian.typepad.com/.a/6a00e5538b84f38833015386fa8f19970b-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/

Selecting Value Literals

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

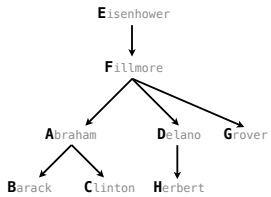
A column description is an expression, optionally followed by **as** and a column name

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

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)