Information Hiding

Attributes for Internal Use

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

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

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.

```python
def fib_generator):
    # A generator function for Fibonacci numbers.
    yield 0
    prevous, current = 0, 1
    while True:
        yield current
        previous, current = current, previous + current
```

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.

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

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.

<table>
<thead>
<tr>
<th>Name</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkeley</td>
<td>38</td>
<td>122</td>
</tr>
<tr>
<td>Cambridge</td>
<td>42</td>
<td>71</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>45</td>
<td>93</td>
</tr>
</tbody>
</table>

A column has a name and a type.

A row has 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

In declarative programming such as SQL & Prolog:
- A "program" is a description of the desired result
- The interpreter figures out how to generate the result

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 the result a name
- Lots of other statements exist: analyze, delete, explain, insert, replace, update, etc.
- Most of the important action is in the select statement

Structured Query Language (SQL)

Getting Started with SQL

Install sqlite (version 3.8.3 or later): http://sqlite.org/download.html
Use sqlite online: http://kleinman.github.io/sqllite07/

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 literals creates a one-row table
Selecting the union of two select statements is a table containing the rows of both of their results

In imperative languages such as Python & Scheme:
- "A program" is a description of computational processes
- The interpreter carries out execution/evaluation rules

Names of 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 Statements Project Existing Tables

A select statement can specify an input table using a from clause
A subset of the rows of the input can be selected using a where clause
An ordering over the remaining rows can be declared using an order by clause