Declarative Languages

Database Management Systems

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.

Structured Query Language (SQL)

Cities:

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

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
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;

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

Getting Started with SQL

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

Use sqlite online: [http://kripken.github.io/sql.js/GUI/](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
select "abraham", "barack" union
select "fillmore", "clinton" union
select "fillmore", "delano" union
select "fillmore", "grover" union
select "eisenhower", "fillmore";
```

```
Wed, May 30 2007 12:34:56
...
```

Discussion Question

Given the table below that describes how to sum powers of 2 to form various integers:

<table>
<thead>
<tr>
<th>word</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>zero</td>
<td>0</td>
</tr>
<tr>
<td>one</td>
<td>1</td>
</tr>
<tr>
<td>two</td>
<td>2</td>
</tr>
<tr>
<td>four</td>
<td>4</td>
</tr>
<tr>
<td>eight</td>
<td>8</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

(A) Write a select statement for a two-column table of the word and value for each integer.

```
create table lift as
select "chair", 2 as single, 2 as couple union
select 102, 2 union
select 103, 1;
```

```
select chair, single + 2 * couple as total from lift;
```

(B) Write a select statement for the word names of the powers of two.

```
create table lift as
select "zero" as zero, "one" as one, "two" as two, "four" as four, "eight" as eight union
select "three" as three, "five" as five, "six" as six union
select "four" as four, "six" as six, "seven" as seven union
select "five" as five, "seven" as seven, "eight" as eight union
select "six" as six, "seven" as seven, "nine" as nine union
select "seven" as seven, "nine" as nine, "ten" as ten union
select "eight" as eight, "nine" as nine, "ten" as ten union
```

```
select "zero", "one", "two", "four", "eight" as [expression], [expression] as [expression];
```

```
create table lift as
select "chair", 2 as single, 2 as couple union
select 102, 2 union
select 103, 1;
```

```
select chair, single + 2 * couple as total from lift;
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create table lift as
select "zero" as zero, "one" as one, "two" as two, "four" as four, "eight" as eight union
select "three" as three, "five" as five, "six" as six union
select "four" as four, "six" as six, "seven" as seven union
select "five" as five, "seven" as seven, "eight" as eight union
select "six" as six, "seven" as seven, "nine" as nine union
select "seven" as seven, "nine" as nine, "ten" as ten union
```

```
select chair, single + 2 * couple as total from lift;
```
Prolog is a logic programming language developed about 1972 by Alain Colmerauer et al. Originally developed for computational linguistics and AI.

Programs consist of rules, which define relations, rather than functions.

\texttt{ succ(1, 2).  // A simple fact: successor of 1 is 2}

\texttt{ plus(X, 1, Z) :- succ(X, Z). // For any X and Z, X+1=Z if Z is successor of X.}

Demo