Introduction "Structured Query Language" (SQL)

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Why use SQL?

- Provides the tools needed to manage relational databases including:
  - Creating Tables
  - Adding Data
  - Queries / Searches
- It's a STANDARD! – multiple vendors produce products that support SQL queries

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Standards – A Caveat

- Just because there are standards for SQL implementations does not mean that all databases will have all the capabilities in the SQL standard.
- Most relational databases implement some non-standard extensions or lack some features of the full standard

Examples of Variation

- MiniSQL - implements only a critical subset of SQL commands
- MySQL – fairly compatible - no sub-selects (nested selects)
- Postgres – not fully standardized, object extensions
- **“The wonderful thing about standards is that there are so many of them to choose from” - anonymous**

Critical SQL Commands

- Table Management
  - Create Table
  - Drop Table
- Editing
  - Insert
  - Update
  - Delete
- Query
  - Select

There are many other commands, but these six will allow you to do almost anything you need to do

Create Table

```
CREATE TABLE mytable (
name CHAR(40) NOT NULL,
age  INT )
```

- Creates a table named “mytable” with two fields
  - A required character field called “name”
  - An optional numeric (integer) field called “age”

Insert

```
INSERT INTO mytable (name,age)
VALUES ('George',20)
```

- Inserts a data row into the table
  - "name" is set to "George"
  - "age" is set to 20

Select

```
SELECT name,age FROM mytable WHERE
age = 20
```

- Searches the table for rows where "age" is 20 and returns the associated name and age. This query resulted in:

```
+--------+------+
| name   | age  |
+--------+------+
| George |   20 |
+--------+------+
1 row in set (0.02 sec)
```

Update

```
UPDATE mytable SET age=21
  WHERE name LIKE 'George'
```

- Searches the table for rows where "name" is "George" and sets age to 21. Note: if we had more than one row with name "George" all would be set to age=21.

```
+--------+------+
| name   | age  |
+--------+------+
| George |   21 |
+--------+------+
1 row in set (0.02 sec)
```

Delete (a row from a table)

```
DELETE FROM mytable WHERE name
  LIKE 'George'AND age = 21
```

- Searches the table for rows where "name" is "George" and age is 21 and deletes them

Drop Table (delete a table)

```
DROP TABLE mytable
```

- Completely eliminates table "mytable." All data in the table is lost.

Putting the Relations in Relational Database

- SELECT statements are not restricted to single tables. For example:

```
SELECT DISTINCT
mytable.age, yourtable.address
FROM mytable, yourtable
WHERE mytable.name LIKE
  yourtable.name
```

Multi-table selects create a “join”

Relational SELECT

```
SELECT DISTINCT
mytable.age, yourtable.address
FROM mytable, yourtable
WHERE mytable.name LIKE yourtable.name
```

- Accesses two different tables: “mytable” and “yourtable”
- Returns “age” from mytable, and “address” from yourtable where the “name” field in the two tables match.
- DISTINCT means that if the same age and address shows up in multiple rows, only the first instance will be displayed.

Why SQL?

- Despite its power to manipulate data, SQL makes a poor user interface
  - Few ecologists will want to take the time to learn SQL
  - Effective use also requires knowledge of the underlying fields and tables
- For this reason, most SQL is imbedded into programs where it is hidden from the users

Example Program

- This example program uses PHP to talk to a MYSQL relational database
- The details of each step will differ between databases and languages, but will share many similarities
- Here we insert information from a web form into a database and retrieve an observation number for later use.

A Brief Orientation to PHP

- PHP is a language that can be embedded in web pages
- Variables start with $
  - E.g., **`$myVariable`**
- Arguments to Functions are in parentheses
  - E.g., **`sin($theta)`** returns the sine of the value stored in the variable **$theta**
- Statements end with a semicolon **;**
  - Lines don't matter

PHP Orientation

- `$_REQUEST[myFieldName]`
  returns the value of the web form field called: myFieldName

Sample program

```
$hello1="Hello";
$hello2= $hello1 . " World";
print($hello2);
```

Period (.) is a string concatenation operator in PHP

Steps in a PHP Program

- Make a Connection to the database server

```
$link =
  mysql_connect("data.vcrlter.virginia.edu
  “, “myID") or die("Could not connect");
```

- Select the Database on that server to use

```
mysql_select_db("www") or die("Could not
  select database");
```

Steps in a Program

- Prepare a query (here an INSERT statement) for execution:

```
$query = "insert into waiver
  (date_req,station,name,isVert,healthtype)
values('" . date("Y-m-d") . "',
 '$_REQUEST[station]',
 '$_REQUEST[fullname]',
 'Y',
 $_REQUEST[health])";
```

Note: **Date** is a function that returns the current date in the format specified

Steps in a Program

- Run the query we stored earlier:

```
$result = mysql_query($query) or
  die("Unable to log waiver
  creation, Query failed");
```

- The variable $result contains the query results in a complex form that includes all the rows and field values

Steps in a Program

- Prepare and run a query to get a copy of the “waiver_num” value. Here we use the MYSQL “max” function to return the highest value of waiver_num

```
$query = "select max(waiver_num) as
waiver_num from waiver";

$result = mysql_query($query) or
die("Unable to get waiver number, Query
failed");
```

Steps in a Program

- Convert the $result of the query into variables that PHP can use

```
extract(mysql_fetch_assoc($result));
```

- This creates the variable $waiver_num for use in PHP programs

Steps in Program

- Close our link to the MYSQL server

```
mysql_close($link);
```

```
/* Connecting, selecting database */
   $link = mysql_connect("data.vcrlter.virginia.edu", “myID")
       or die("Could not connect");
   mysql_select_db("www") or die("Could not select
database");

   /* Performing SQL query */
$query = "insert into waiver
(date_req,station,name,isVert,healthtype)
values('" . date("Y-m-d") . ','$_REQUEST[station]',
‘$_REQUEST[fullname]','Y', $_REQUEST[health])";

   $result = mysql_query($query) or die("Unable to log waiver
creation, Query failed");

$query = "select max(waiver_num) as waiver_num from
waiver";
$result = mysql_query($query) or die("Unable to get waiver
number, Query failed");
extract(mysql_fetch_assoc($result));
   mysql_close($link);
```

Open connection

Select database

Set up insert

Run Insert Query

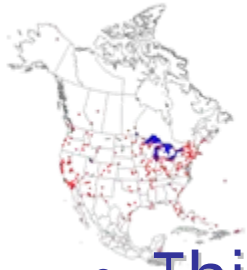
Set up query

Run Query

Store result as PHP variable

SQL Exercise

- Now it's time for you to try out your SQL skills using the web pages:
- http://www.sqlcourse.com/
  - Do all
- http://www.sqlcourse2.com
  - Do part 10 (table joins)



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