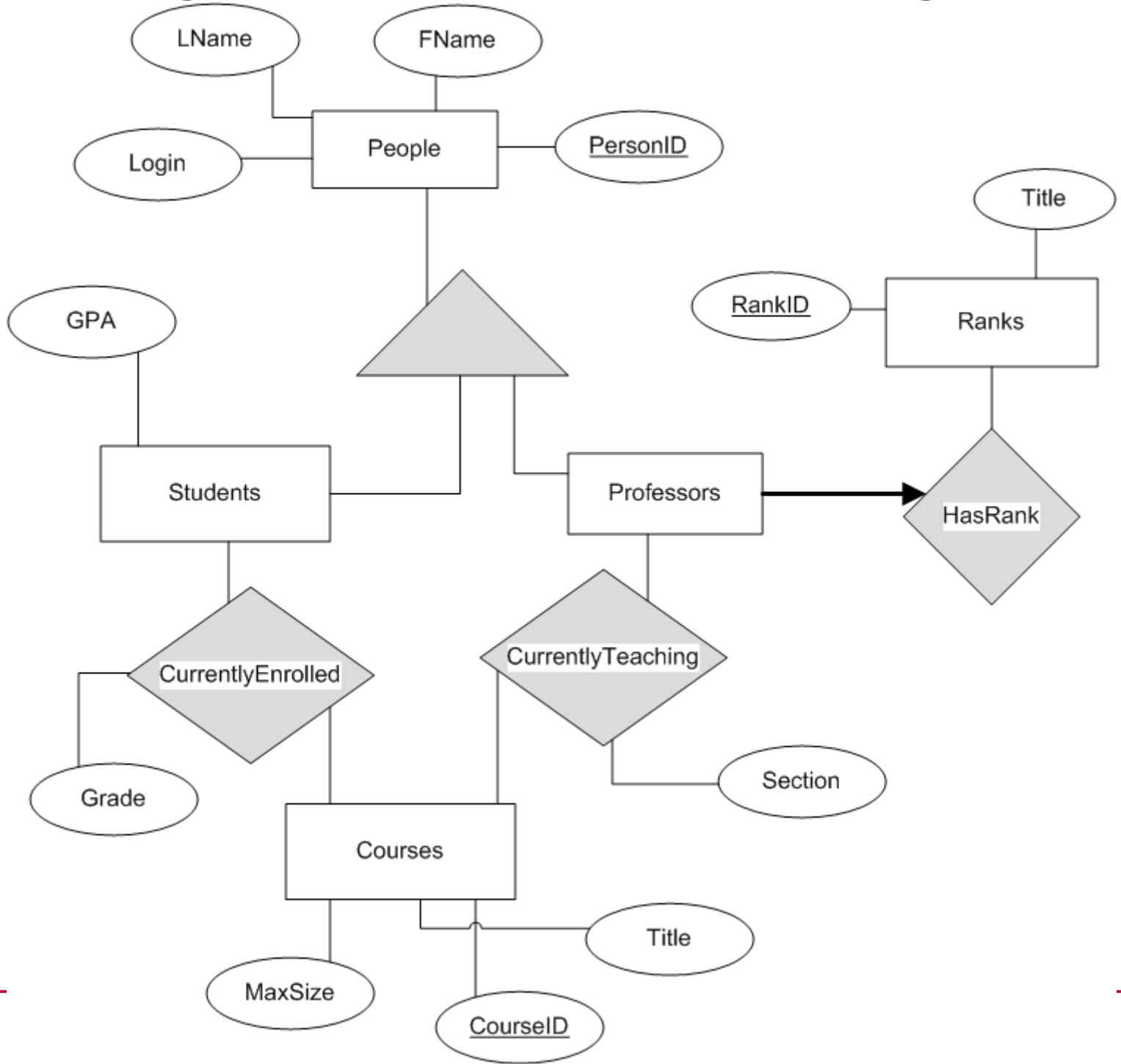
Introduction to MySQL and SQL Basics

Feb 13, 2013
Read Chapter 3!

http://dev.mysql.com/doc/refman/5.5/en/

College Database E-R Diagram



MySQL tasks

http://dev.mysql.com/doc/refman/5.5/en/

- start MySQL
  - setup user passwords
- shutdown MySQL
- create database
- create table
  - primary key
  - index
  - foreign key
- insert data
  - source a file
- delete data
  - drop
- query data
  - where
  - join
  - group
  - order
  - subquery

MySQL

- ssh to gray.cs.pacificu.edu (64.59.233.246)

```
ssh -X gray.cs.pacificu.edu

[you@gray ~]# $ mysql -u PUNetID -p

mysql> set password = PASSWORD('NEWPASSWORD');

mysql> show databases;


mysql> use PUNetID_test;
```

MySQL Data types

http://dev.mysql.com/doc/refman/5.5/en/data-types.html

- TINYINT/SMALLINT/INT/BIGINT SIGNED/UNSIGNED
- BIT
- FLOAT/DOUBLE
- BOOLEAN
- CHAR / BINARY
- VARCHAR(###) / VARBINARY(###)
- DATE / TIME / DATETIME / TIMESTAMP
- [TINY|MEDIUM|LONG]TEXT
- [TINY|MEDIUM|LONG]BLOB
- ENUM
- SET

Create a Table

```
CREATE TABLE People (
        PersonID INT NOT NULL AUTO_INCREMENT,
        FName VARBINARY(50),
        LName VARBINARY(50),
        Login VARBINARY(20) NOT NULL,
        CONSTRAINT People_PersonID_PK
           PRIMARY KEY (PersonID),
        CONSTRAINT People_Login_U UNIQUE (Login)
) Engine=InnoDB;
mysql> show tables;
mysql> show create table People;
```

Insert

```
INSERT INTO People ( FName, LName,
Login) VALUES ( "Chadd",
"Williams","chadd");

INSERT INTO People ( FName, LName,
Login) VALUES ( "Doug", "Ryan","ryand");

INSERT INTO People ( FName, LName,
Login) VALUES ("Shereen",
"Khoja","shereen");


mysql> SELECT * FROM People;
```

MySQL

```
mysql> SELECT * FROM People WHERE PersonID > 2;

mysql> SELECT * FROM People WHERE LName = “Ryan”;


mysql> SELECT * FROM People WHERE FName like “%a%”;

mysql> SELECT FName, LName FROM People
   WHERE PersonID > 1;
```

Create a table

- Create another table

```
CREATE TABLE Professors (
        ProfID INT NOT NULL,

        Rank ENUM ('Assistant', 'Associate',
         'Full', 'Emeritus') NOT NULL,


        CONSTRAINT Professors_ProfID_PK
         PRIMARY KEY (ProfID)

) Engine=InnoDB;
```

Constraints

```
mysql> ALTER TABLE Professors
 ADD CONSTRAINT Professors_ProfID_FK
 FOREIGN KEY (ProfID) REFERENCES
 People(PersonID) ON DELETE CASCADE;
```

MySQL

- Insert some data

```
INSERT INTO Professors (ProfID, Rank) VALUES
(1, 'Associate'); -- chadd


INSERT INTO Professors (ProfID, Rank) VALUES
(2, 'Full'); -- doug


INSERT INTO Professors (ProfID, Rank) VALUES
(3, 'Associate'); -- shereen
```

Let's make this go faster

- Load data from a SQL script
  This file is full of **`INSERT and CREATE`** statements.

  `mysql> source /tmp/CreateDatabase.sql;`

  `Let's look at that file.`

Deleting Data

- Let's delete some data

```
mysql> SELECT * FROM People;
mysql> SELECT * FROM CurrentlyTeaching;

mysql> DELETE FROM People WHERE PersonID=1;

mysql> SELECT * FROM People;

mysql> SELECT * FROM CurrentlyTeaching;

mysql> SHOW TABLES;

mysql> DROP TABLE People;
mysql> source /tmp/CreateDatabase.sql;
```

Queries

- What Courses have a MaxSize of greater than 5?

```
mysql> SELECT *
       FROM Courses
       WHERE
       MaxSize > 5;
```

Order By

- Let's sort the output

```
mysql> SELECT *
       FROM Courses
       ORDER BY MaxSize;

mysql> SELECT *
       FROM Courses
       ORDER BY MaxSize DESC ;


mysql> SELECT *
       FROM People
       ORDER BY LName, FName;
```

Group By

- Aggregate selected rows

```
mysql> SELECT LName
       FROM People ;

mysql> SELECT LName, COUNT(*)
       FROM People
       GROUP BY LName;

mysql> SELECT AVG(MaxSize)
       FROM Courses;

mysql> SELECT AVG(Grade)
       FROM CurrentlyEnrolled
       GROUP BY CourseID;
```

- Other useful functions: **AVG(), STDDEV(), MAX(), SUM()**

Let's Query the Data

- List all the Full professors in our database (ProfID).

- List every student with a GPA less than 1.0 (StudentID)

Joins

- List all the Full professors in our database (FName, LName).

```
mysql> SELECT FName, LName
       FROM People, Professors
       WHERE
       People.PersonID=Professors.ProfID
       AND
       Rank=”Full”;
```

- List every student with a GPA less than 1.0

  (StudentID, FName, LName)

Joins

- Inner Join
  - matching records in each table

```
SELECT * FROM People, Students WHERE
(People.PersonID=Students.StudentID);
```

- Outer Join
  - all records in each table (maybe not matching)
  - may produce NULL values for some columns

```
SELECT * FROM People LEFT JOIN Students ON
(People.PersonID=Students.StudentID);
```

Let's Query the Data

- List all the courses in our database taught by an Associate professor. (CourseID) (CourseID, Title)

- How many courses are taught by each rank of professor?

- How many professors teach zero courses?

Joins

- Three table joins, show all courses taught by Assistant Profs (Title, FName, LName)

```
mysql> SELECT *
       FROM Courses, CurrentlyTeaching, Professors
       WHERE

       and Rank = “Assistant”;
```

Joins

- A join looks a one row at a time
- Some queries need more information
- Who is in a class with Bart Simpson?

Subqueries

- Who was in class with Bart Simpson?

```
mysql> SELECT *
FROM Students, CurrentlyEnrolled, People
WHERE
(Students.StudentID=CurrentlyEnrolled.StudentID
) AND
EXISTS
(
   SELECT *
   FROM CurrentlyEnrolled AS BSClass
   WHERE
  (CurrentlyEnrolled.CourseID=BSClass.CourseID)
   AND
   BSClass.StudentID=5 -- Bart Simpson
 ) AND (Students.StudentID = People.PersonID)
AND (FName != “Bart” or LName != “Simpson”);
```

Subquries

- Who has the maximum grade in each class? (Fname, Lname, grade, class name)
  - Does this require a subquery?

Views

- A View is a logical table backed up by a query
  - Changes automatically when the results of the query change

```
mysql> CREATE VIEW CS150_VW AS
  SELECT LName, FName, Grade, StudentID
  FROM Courses, CurrentlyEnrolled, People
  WHERE
  Courses.CourseID=CurrentlyEnrolled.Cours
  eID and People.PersonID=StudentID and
  Title like “CS150%”;

mysql> SELECT * FROM CS150_VW;

mysql> DELETE FROM People WHERE
  PersonID=5;

mysql> SELECT * FROM CS150_VW Order by Grade;

mysql> DROP VIEW CS150_VW;
```

Exercise

- Rebuild CS150_VW
- Determine how closely a student's grade in CS150 matches their GPA. (1.0 = perfect match, 0.5 = Grade is half the GPA, 1.5 Grade is 50% better than GPA)
- GPA goes from 0.0 to 4.0, Grade goes from 0.0 to 100.0

Control Flow

```
IF( condition, trueValue, falseValue)
```

```
SELECT Title, IF( MaxSize > 50, 1, 0)
FROM  Courses;
```

```
IFNULL(Value, returnIfValueIsNULL)
```

```
SELECT IFNULL(Title, “ITISNULL”)
FROM  Courses;
```

There is also a case (switch) statement

GROUP BY and HAVING

- Allows SQL to filter on calculated/aggregate values
- Similar to **WHERE**
- must be last

```
SELECT StudentID, avg(Grade) as AvgGrade,
count(*) as NumberRows
FROM CurrentlyEnrolled
WHERE Grade > 20
GROUP BY StudentID
HAVING AvgSalary > 60 and NumberRows > 1;
```

Limit – only show some results

```
SELECT StudentID, count(*) as Total
FROM WasIn
GROUP BY StudentID
HAVING Total > 1
LIMIT 2; -- show only first two rows

LIMIT 2,4; -- skip the first two
rows, then show the next 4

LIMIT 3; is equivalent to LIMIT 0, 3
```

Backup Your Database!

@gray:~> mysqldump PUNetID_test -u PUNetID -p > backup_test.sql

Database Name
Output file

To see what this file looks like:

@gray:~> cat backup_test.sql | less

Copy to Zeus for safe keeping!

@gray:~> scp backup_test.sql PUNetID@zeus:

Don't forget the colon!

Practice

- List all Course titles and CourseID. For each Course, display the CourseID if Chadd teaches it and “Not A Chadd Course” otherwise.
- Find all courses whose maximum and minimum grade is at least 50 points different.
- Display each student name, course title, and student's grade in that course and the string “passing” or “not passing” if the student is not passing the course.
- Find each course that does not contain a Simpson.
- Display all students whose grade for a class is above the average grade for that class.

Explain

```
mysql> SHOW CREATE TABLE People;

mysql> SHOW CREATE TABLE CurrentlyTeaching;


mysql> EXPLAIN SELECT * FROM People,
  CurrentlyTeaching WHERE (PersonID=ProfID);

mysql> EXPLAIN SELECT * FROM People,
  CurrentlyTeaching WHERE (PersonID=ProfID)
  AND FName like '%a%';
```

EXPLAIN

- TYPE: system, const, eq_ref, ref, index, all
- ROWS: number of rows scanned

Indexes

```
mysql> USE chadd_test;
mysql> SHOW TABLE STATUS LIKE  'EnronVocab';
mysql> SHOW TABLE STATUS LIKE  'EnronWordCount';
mysql> SHOW CREATE TABLE EnronVocab;
mysql> SHOW CREATE TABLE EnronWordCount;
mysql> SHOW PROCESSLIST;
```

```
mysql> EXPLAIN SELECT WordCount FROM
EnronWordCount WHERE DocID = ??;
```

```
mysql> EXPLAIN SELECT WordCount FROM
EnronWordCount WHERE WordID = ??;
```

- 1 to 39861 DocID
- 1 to 28102 WordID

http://archive.ics.uci.edu/ml/datasets/Bag+of+Words

Practice

- How many students are in each class?

- For each class, what was the min, max, average grade ?
  - do this with and without using the AVG() function.

- Who took a class with Bart Simpson and received a higer grade than Bart? Lower Grade?

INTO OUTFILE

- Save a query to a text file

```
SELECT StudenID, count(*) as Total
FROM CurrentlyEnrolled
GROUP BY StudentID
HAVING Total > 1
INTO OUTFILE '/tmp/PUNETID.txt';

-- writes data on the server

gray> scp /tmp/PUNETID.txt c@zeus:


mysql -u user -p -D database -e
“select ... “ > outfile
```

LOAD DATA INFILE

```
mysql> source /tmp/createTest.sql;

mysql> ALTER TABLE test DISABLE KEYS;
mysql> SET FOREIGN_KEY_CHECKS=0;

mysql> LOAD DATA INFILE '/tmp/test.txt' INTO
TABLE test COLUMNS TERMINATED BY ',';

mysql> SET FOREIGN_KEY_CHECKS=1;
mysql> ALTER TABLE test ENABLE KEYS;

Query OK, 69679427 rows affected (21 min 34.26 sec)
```

- with a well tuned MySQL (innodb_buffer_pool_size, innodb_log_*)

Triggers

```
CREATE TRIGGER name BEFORE INSERT ON table
  FOR EACH ROW BEGIN
    -- SQL Statements  or control flow (IF)
    INSERT INTO test2 SET a2 = NEW.a1;
  END
;
```

The row being inserted

BEFORE | AFTER

INSERT | DELETE | UPDATE

Cannot stop an insert!

Trigger

```
CREATE TRIGGER name BEFORE INSERT ON table
  FOR EACH ROW BEGIN

    SIGNAL SQLSTATE '99991'
     SET MESSAGE_TEXT = 'ERROR MESSAGE';
  END
;


DROP TRIGGER name;
```

Stored Procedures

Control Flow

- CASE
- IF()
- IFNULL()
- NULLIF()

Advanced SQL

- Control Flow Functions
  - http://dev.mysql.com/doc/refman/5.5/en/control-flow-functions.html
- Trigger
  - http://dev.mysql.com/doc/refman/5.5/en/create-trigger.html
- http://dev.mysql.com/doc/refman/5.5/en/select.html
  - Having
  - Limit
  - into outfile
- load data
  - http://dev.mysql.com/doc/refman/5.5/en/load-data.html
- Binary Data
- Stored Procedures