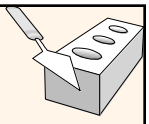
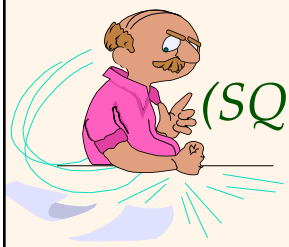
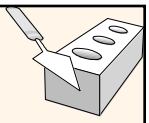


Introduction to Data Management



Lecture #17
(SQL, the Never Ending Story…)

Instructor: Mike Carey
mjcarey@ics.uci.edu



It's time again for....

Friday Nights with Databases...

Brought to you by…

Announcements

- First SQL query HW is now underway
  - Hopefully everyone has MySQL working
  - Get the latest version of the questions! (*Sorry…!* ☹)
- Grading is in progress for many things
  - HW #2 is done and back (!)
  - Other HW's are in progress
  - Midterm #1 will be back by Monday

Example Data in MySQL

Sailors

sid	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	4	25.5
95	Bob	3	63.5
101	Joan	3	NULL
107	Johan…	NULL	35.0

Reserves

sid	bid	date
22	101	1998-10-10
22	102	1998-10-10
22	103	1998-10-08
22	104	1998-10-07
31	102	1998-11-10
31	103	1998-11-06
31	104	1998-11-12
64	101	1998-09-05
64	102	1998-09-08
74	103	1998-09-08
NULL	103	1998-09-09
1	NULL	2001-01-11
1	NULL	2002-02-02

Boats

bid	bname	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

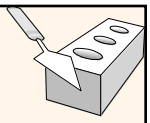
Trigger Example (MySQL)

```
DELIMITER $$      -- Necessary to make semicolons great again... ☺
                  -- (Prevents them from ending the input statement!)

CREATE TRIGGER youngSailorUpdate
AFTER INSERT ON Sailors
FOR EACH ROW
BEGIN
   IF NEW.age < 18 THEN
      INSERT INTO YoungSailors (sid, sname, age, rating)
      VALUES (NEW.sid, NEW.sname, NEW.age, NEW.rating);
   END IF;
END;
```

Note: ***FOR EACH ROW*** provides less power than ***FOR EACH STATEMENT*** (e.g., can't compute average new age)

Trigger Example (MySQL, cont'd.)

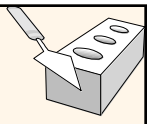


☐ INSERT INTO Sailors(sid, sname, rating, age)
VALUES (777, 'Lucky', 7, 77);

☑ INSERT INTO Sailors(sid, sname, rating, age)
VALUES (778, 'Lucky Jr', 7, 7);

*(NOTE: Look at **YoungSailors** table content after each one!)*

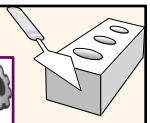
Another Trigger Example (MySQL)



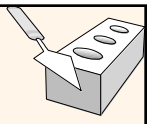
```
-- Let's implement a poor man's CHECK constraint!
DELIMITER $$

CREATE TRIGGER checkSailorAge
AFTER INSERT ON Sailors
FOR EACH ROW
BEGIN
   IF NEW.age < 18 THEN
      SIGNAL SQLSTATE '02000'
         SET MESSAGE_TEXT =
            'Warning: Sailors can not be under 18!';
   END IF;
END;
```


Stored Procedures in SQL

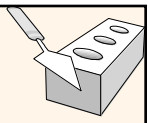


- What is a stored procedure?
  - A program executed via a single SQL statement
  - Executes in the process space of the **server**
- Advantages:
  - Can encapsulate application logic while staying "close" to the data
  - Supports the reuse (sharing) of application logic by different users
  - Can be used to help secure database applications, as we will see a bit later on



Stored Procedures: More Detail

- A ***stored procedure*** is a function or procedure written in a *general-purpose* programming language that executes *within* the DBMS.
- These can perform computations that *cannot* be expressed in SQL – i.e., they go *beyond* the limits of relational completeness.
- Procedure execution is requested through a single SQL statement (***CALL***).
- Executes on the (usually *remote*!) DBMS server.
- SQL ***PSM*** (*Persistent Stored Modules*) extends SQL with concepts from general-purpose PLs.



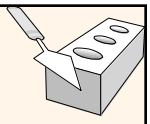
Stored Procedures: Functions

Ex: Let's define a simple function that we might want:

```
CREATE PROCEDURE
    ShowNumReservations(bid INT(11))
BEGIN
    SELECT S.sid, S.sname, COUNT(*)
    FROM Sailors S, Reserves R
    WHERE S.sid = R.sid AND R.bid = bid
    GROUP BY S.sid, S.sname;
END;
```

Q: *What does this "**function**" do?*

Then: CALL ShowNumReservations(102);



Stored Procedures: Procedures

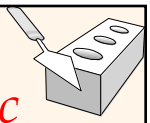
Ex: Let's define a procedure that might be useful:

- (Possible modes for parameters: IN, OUT, INOUT)

```
CREATE PROCEDURE IncreaseRating(
    IN sailor_sid INT(11), IN increase INT(11))
BEGIN
  UPDATE Sailors
  SET rating = rating + increase
  WHERE sid = sailor_sid;
END;
```

Q: *How is this "**procedure**" different?*

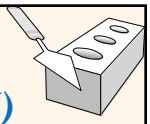
Then: CALL IncreaseRating(95,1);



Stored Procedures: External Logic

Stored procedures can also be written outside of the SQL language:

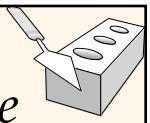
```
CREATE PROCEDURE RecklessSailors( )
LANGUAGE JAVA
EXTERNAL NAME file:///c:/storedProcs/sailorprocs.jar;
```



Main SQL/PSM Constructs (FYI)

- Supports FUNCTIONs and PROCEDUREs
- Local variables (DECLARE)
- RETURN values for FUNCTION
- Assign variables with SET
- Branches and loops:
  - IF (condition) THEN statements; ELSEIF (condition) statements; … ELSE statements; END IF;
  - LOOP statements; END LOOP
- Queries can be parts of expressions
- Cursors available to iterate over query results

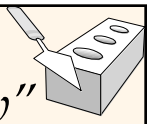
Note: *SQL PSM is the SQL standard's language for S.P.'s; **not** supported by all vendors (due to **late** standardization...!)*



A (random ☺) SQL/PSM Example

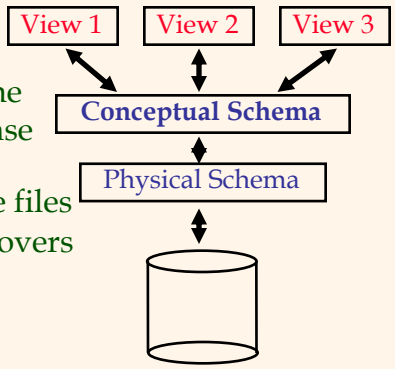
```
CREATE FUNCTION ResvRateSailor(IN sailorId INT(11))
    RETURNS INT(11)
BEGIN
    DECLARE resvRating INT(11)
    DECLARE numResv INT(11)
    SET numResv = (SELECT COUNT(*)
                   FROM Reserves R
                   WHERE R.sid = sailorId)
    IF (numResv > 10) THEN resvRating = 1;
                      ELSE resvRating = 0;
    END IF;
    RETURN resvRating;
END;
```

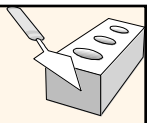
Note: *See your chosen RDBMS's docs for info about its procedural extension to SQL...*



Layers of Schemas: Brief "Re-View"

- Many *views* of one *conceptual (logical) schema* and an underlying *physical schema*
  - Views describe how different users see the data.
  - Conceptual schema defines the logical structure of the database
  - Physical schema describes the files and indexes used under the covers



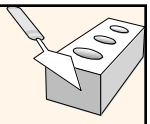


Views in SQL

- Uses of views
  - Logical data independence (to some extent)
  - Simplified view of data (for users/groups)
  - Unit of authorization (for access control)
- Views can
  - Rename/permute columns
  - Change units/representations of columns
  - Select/project/join/etc. tables

★ ***Virtual tables**, defined via (SQL) queries*

Views in SQL (cont'd.)



Provided View

```
CREATE VIEW RegionalSales(category,sales,state)
        AS SELECT P.category, S.sales, L.state
           FROM Products P, Sales S, Locations L
           WHERE P.pid=S.pid AND S.locid=L.locid
```

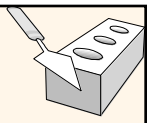
User's Query

```
SELECT R.category, R.state, SUM(R.sales)
FROM RegionalSales AS R GROUP BY R.category, R.state
```

Modified Query (System)

```
SELECT R.category, R.state, SUM(R.sales)
FROM (SELECT P.category, S.sales, L.state
      FROM Products P, Sales S, Locations L
      WHERE P.pid=S.pid AND S.locid=L.locid) AS R
GROUP BY R.category, R.state
```


*A Simple **View** Example (MySQL)*

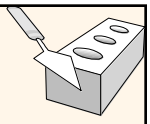


```
CREATE VIEW YoungSailorsView (yid, yname, yage, yrating)
  AS
SELECT sid, sname, age, rating
FROM Sailors
WHERE age < 18;
```

```
SELECT * FROM YoungSailorsView;
```

```
SELECT yname
FROM YoungSailorsView
WHERE yrating > 5;
```

Another View Example (MySQL)



```
CREATE VIEW ActiveSailors (sid, sname, rating)
  AS
SELECT S.sid, S.sname, S.rating
FROM Sailors S WHERE EXISTS
   (SELECT * FROM Reserves R WHERE R.sid = S.sid);
```

```
SELECT * FROM ActiveSailors;
```

```
UPDATE ActiveSailors
SET rating = 11
WHERE sid = 22;
```