Lecture 04: SQL

Wednesday, October 4, 2006

Outline

- The Project
- Nulls (6.1.6)
- Outer joins (6.3.8)
- Database Modifications (6.5)

The Project

- Application:
  - Boutique online music and book store
- Project:
  - Create database, access through a Web interface
  - Import real data and develop inventory logic
  - Customer checkout
  - Advanced functionality (TBD)

The Project

- Team:
  - Two people
  - Find partner by Friday
- Tools:
  - SQL Server 2005
  - Visual Studio 2005
  - C# 2.0
  - ASP.NET 2.0

The Project

Phase 1: posted today, due October 18

- Find partner by Friday ("Phase 0")
- Create a schema
- Populate the database: fake data for now
- Access through a simple Web interface

NULLS in SQL

- Whenever we don't have a value, we can put a NULL
- Can mean many things:
  - Value does not exists
  - Value exists but is unknown
  - Value not applicable
  - Etc.
- The schema specifies for each attribute if can be null (*nullable* attribute) or not
- How does SQL cope with tables that have NULLs ?

Null Values

- If x= NULL then 4*(3-x)/7 is still NULL

- If x= NULL then x="Joe" is UNKNOWN
- In SQL there are three boolean values:

FALSE	=	0
UNKNOWN	=	0.5
TRUE	=	1

Null Values

- C1 AND C2 = min(C1, C2)
- C1 OR C2 = max(C1, C2)
- NOT C1 = 1 – C1

```
SELECT *
FROM Person
WHERE  (age < 25) AND
       (height > 6 OR weight > 190)
```

E.g.
age=20
heigth=NULL
weight=200

Rule in SQL: include only tuples that yield TRUE

Null Values

Unexpected behavior:

```
SELECT *
FROM   Person
WHERE  age < 25  OR  age >= 25
```

Some Persons are not included !

Null Values

Can test for NULL explicitly:

- x IS NULL
- x IS NOT NULL

```
SELECT *
FROM   Person
WHERE  age < 25  OR  age >= 25 OR age IS NULL
```

Now it includes all Persons

Outerjoins

Explicit joins in SQL = "inner joins":

Product(name, category)
Purchase(prodName, store)

```
SELECT Product.name, Purchase.store
FROM   Product JOIN Purchase ON
                    Product.name = Purchase.prodName
```

Same as:

```
SELECT Product.name, Purchase.store
FROM   Product, Purchase
WHERE  Product.name = Purchase.prodName
```

But Products that never sold will be lost !

Outerjoins

Left outer joins in SQL:

Product(name, category)

Purchase(prodName, store)

```
SELECT Product.name, Purchase.store
FROM   Product LEFT OUTER JOIN Purchase ON
                    Product.name = Purchase.prodName
```

Product

Name	Category
Gizmo	gadget
Camera	Photo
OneClick	Photo

Purchase

ProdName	Store
Gizmo	Wiz
Camera	Ritz
Camera	Wiz

Name	Store
Gizmo	Wiz
Camera	Ritz
Camera	Wiz
OneClick	NULL

Application

Compute, for each product, the total number of sales in 'September'

Product(name, category)

Purchase(prodName, month, store)

```
SELECT Product.name, count(*)
FROM   Product, Purchase
WHERE  Product.name = Purchase.prodName
       and  Purchase.month = 'September'
GROUP BY Product.name
```

What's wrong ?

Application

Compute, for each product, the total number of sales in ‘September’

Product(name, category)

Purchase(prodName, month, store)

```
SELECT Product.name, count(*)
FROM   Product LEFT OUTER JOIN Purchase ON
                    Product.name = Purchase.prodName
                and  Purchase.month = ‘September’
GROUP BY Product.name
```

Now we also get the products who sold in 0 quantity

Outer Joins

- Left outer join:
  - Include the left tuple even if there's no match
- Right outer join:
  - Include the right tuple even if there's no match
- Full outer join:
  - Include the both left and right tuples even if there's no match

Modifying the Database

Three kinds of modifications

- Insertions
- Deletions
- Updates

Sometimes they are all called “updates”

Insertions

General form:

```
INSERT INTO R(A1,…., An) VALUES (v1,…., vn)
```

Example: Insert a new purchase to the database:

```
INSERT INTO Purchase(buyer, seller, product, store)
        VALUES ('Joe', 'Fred', 'wakeup-clock-espresso-machine',
                'The Sharper Image')
```

Missing attribute → NULL.
May drop attribute names if give them in order.

Insertions

```
INSERT   INTO   PRODUCT(name)

    SELECT  DISTINCT  Purchase.product
    FROM      Purchase
    WHERE   Purchase.date > "10/26/01"
```

The query replaces the VALUES keyword.
Here we insert *many* tuples into PRODUCT

Insertion: an Example

Product(name, listPrice, category)
Purchase(prodName, buyerName, price)

prodName is foreign key in Product.name

Suppose database got corrupted and we need to fix it:

Product

name	listPrice	category
gizmo	100	gadgets

Purchase

prodName	buyerName	price
camera	John	200
gizmo	Smith	80
camera	Smith	225

Task: insert in Product all prodNames from Purchase

Insertion: an Example

```
INSERT  INTO  Product(name)

SELECT  DISTINCT  prodName
FROM    Purchase
WHERE   prodName  NOT IN (SELECT  name FROM  Product)
```

name	listPrice	category
gizmo	100	Gadgets
camera	-	-

Insertion: an Example

```
INSERT INTO Product(name, listPrice)

SELECT DISTINCT prodName, price
FROM Purchase
WHERE prodName NOT IN (SELECT name FROM Product)
```

name	listPrice	category
gizmo	100	Gadgets
camera	200	-
camera ??	225 ??	-

← Depends on the implementation

Deletions

Example:

```
DELETE    FROM    PURCHASE

WHERE     seller = 'Joe'    AND
          product = 'Brooklyn Bridge'
```

Factoid about SQL: there is no way to delete only a single occurrence of a tuple that appears twice in a relation.

Updates

Example:

```
UPDATE   PRODUCT
SET    price = price/2
WHERE  Product.name  IN
                (SELECT product
                  FROM    Purchase
                  WHERE  Date ='Oct, 25, 1999');
```

Data Definition in SQL

So far we have see the ***Data Manipulation Language***, DML
Next: ***Data Definition Language*** (DDL)

Data types:

Defines the types.

Data definition: defining the schema.

- Create tables
- Delete tables
- Modify table schema

Indexes: to improve performance

Creating Tables

```
CREATE    TABLE Person(

        name                    VARCHAR(30),
        social-security-number  INT,
        age                     SHORTINT,
        city                    VARCHAR(30),
        gender                  BIT(1),
        Birthdate               DATE

 );
```

Deleting or Modifying a Table

Deleting:

Example:

```
DROP Person;
```

Exercise with care !!

Altering: (adding or removing an attribute).

Example:

```
ALTER TABLE Person
      ADD phone CHAR(16);

ALTER TABLE Person
      DROP age;
```

What happens when you make changes to the schema?

Default Values

Specifying default values:

```
CREATE  TABLE Person(
        name                    VARCHAR(30),
        social-security-number  INT,
        age          SHORTINT   DEFAULT 100,
        city      VARCHAR(30) DEFAULT   'Seattle',
        gender         CHAR(1)  DEFAULT  '?',
        Birthdate                DATE
```

The default of defaults: NULL

Indexes

REALLY important to speed up query processing time.

Suppose we have a relation

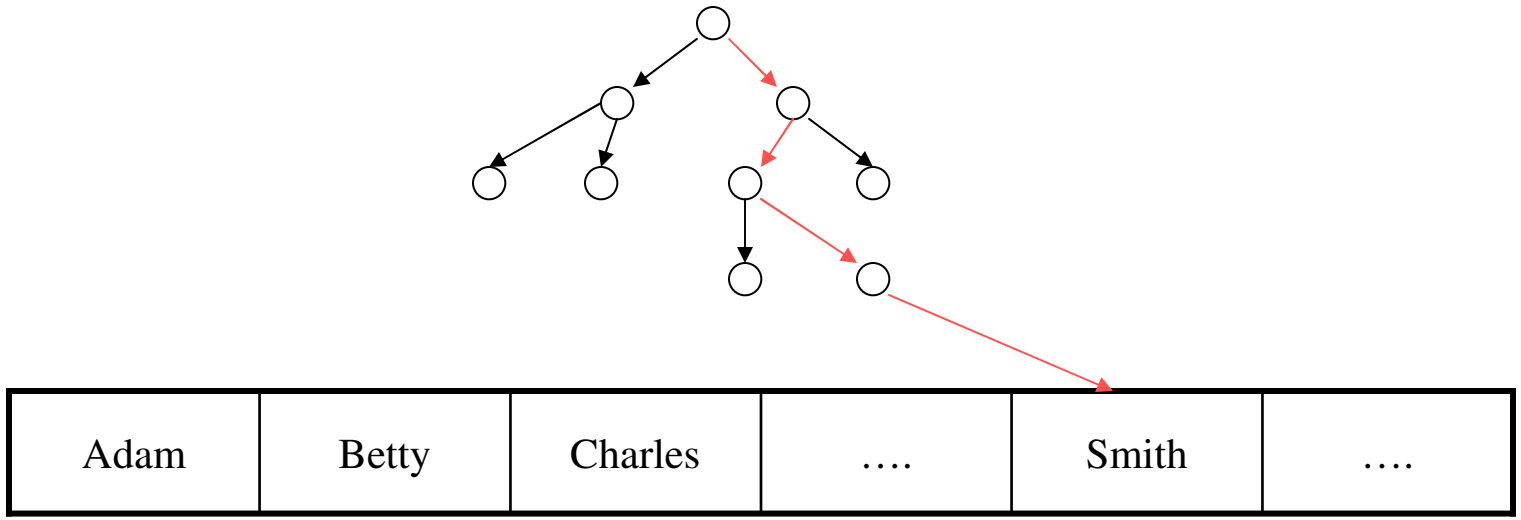
Person (name, age, city)

```
SELECT *
FROM   Person
WHERE  name = "Smith"
```

Sequential scan of the file Person may take long

Indexes

- Create an index on name:



B+ trees have fan-out of 100s: max 4 levels !

Will discuss in the second half of this course

Creating Indexes

Syntax:

```
CREATE INDEX  nameIndex ON Person(name)
```

Creating Indexes

Indexes can be useful in range queries too:

```
CREATE INDEX ageIndex ON  Person (age)
```

B+ trees help in:

```
SELECT *
FROM Person
WHERE age > 25 AND age < 28
```

Why not create indexes on everything?

Creating Indexes

Indexes can be created on more than one attribute:

Example:

```
CREATE INDEX doubleindex ON
                    Person (age, city)
```

Helps in:

```
SELECT *
FROM   Person
WHERE age = 55 AND city = "Seattle"
```

and even in:

```
SELECT *
FROM   Person
WHERE age = 55
```

But not in:

```
SELECT *
FROM   Person
WHERE city = "Seattle"
```

The Index Selection Problem

- Why not build an index on every attribute ? On every pair of attributes ? Etc. ?

- The index selection problem is hard: balance the query cost v.s. the update cost, in a large application workload