Introduction to Database Systems CSE 444

Lecture 05: Views, Constraints

October 8, 2007

Outline

- Views
  - Chapter 6.7
- Constraints
  - Chapter 7

Views

Views are relations, except that they are not physically stored.

For presenting different information to different users

Employee(ssn, name, department, project, salary)

```
CREATE VIEW  Developers AS
  SELECT name, project
  FROM  Employee
  WHERE department = 'Development'
```

Payroll has access to Employee, others only to Developers

Example

Purchase(customer, product, store)
Product(pname, price)

```
CREATE VIEW  CustomerPrice  AS
      SELECT  x.customer, y.price
      FROM    Purchase x, Product y
      WHERE   x.product = y.pname
```

CustomerPrice(customer, price) "virtual table"

Purchase(customer, product, store)
Product(pname, price)
CustomerPrice(customer, price)

We can later use the view:

```
SELECT  u.customer, v.store
FROM    CustomerPrice u, Purchase v
WHERE   u.customer = v.customer  AND
        u.price > 100
```


Types of Views

- Virtual views:
  - Used in databases
  - Computed only on-demand – slow at runtime
  - Always up to date
- Materialized views
  - Used in data warehouses
  - Pre-computed offline – fast at runtime
  - May have stale data

We discuss only virtual views in class

Queries Over Views: Query Modification

View:

```
CREATE VIEW CustomerPrice AS
    SELECT x.customer, y.price
    FROM   Purchase x, Product y
    WHERE  x.product = y.pname
```

Query:

```
SELECT u.customer, v.store
FROM   CustomerPrice u, Purchase v
WHERE  u.customer = v.customer AND
       u.price > 100
```


Queries Over Views: Query Modification

Modified query:

```
SELECT u.customer, v.store
FROM   (SELECT x.customer, y.price
        FROM   Purchase x, Product y
        WHERE  x.product = y.pname) u, Purchase v
WHERE  u.customer = v.customer AND
       u.price > 100
```


Queries Over Views: Query Modification

Modified and rewritten query:

```
SELECT x.customer, v.store
FROM   Purchase x, Product y, Purchase v,
WHERE  x.customer = v.customer AND
       y.price > 100 AND
       x.product = y.pname
```


But What About This ?

```
SELECT DISTINCT u.customer, v.store
FROM   CustomerPrice u, Purchase v
WHERE  u.customer = v.customer AND
       u.price > 100
```

↓

??

Answer

```
SELECT DISTINCT u.customer, v.store
FROM   CustomerPrice u, Purchase v
WHERE  u.customer = v.customer AND
       u.price > 100
```

↓

```
SELECT DISTINCT x.customer, v.store
FROM   Purchase x, Product y, Purchase v,
WHERE  x.customer = v.customer AND
       y.price > 100 AND
       x.product = y.pname
```


Applications of Virtual Views

- Logical data independence:
  - Vertical data partitioning
  - Horizontal data partitioning
- Security
  - Table (view) V reveals only what the users are allowed to know

Vertical Partitioning

Resumes

SSN	Name	Address	Resume	Picture
234234	Mary	Huston	Clob1…	Blob1…
345345	Sue	Seattle	Clob2…	Blob2…
345343	Joan	Seattle	Clob3…	Blob3…
234234	Ann	Portland	Clob4…	Blob4…

T1

SSN	Name	Address
234234	Mary	Huston
345345	Sue	Seattle
. . .		

T2

SSN	Resume
234234	Clob1…
345345	Clob2…

T3

SSN	Picture
234234	Blob1…
345345	Blob2…

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Vertical Partitioning

```
CREATE VIEW Resumes AS
    SELECT T1.ssn, T1.name, T1.address,
           T2.resume, T3.picture
    FROM   T1,T2,T3
    WHERE  T1.ssn=T2.ssn and T2.ssn=T3.ssn
```

When do we use vertical partitioning ?

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Vertical Partitioning

```
SELECT address
FROM   Resumes
WHERE  name = 'Sue'
```

Which of the tables T1, T2, T3 will be queried by the system ?

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Vertical Partitioning

Applications:

- When some fields are large, and rarely accessed
  - E.g. Picture
- In distributed databases
  - Customer personal info at one site, customer profile at another
- In data integration
  - T1 comes from one source
  - T2 comes from a different source

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Horizontal Partitioning

Customers

SSN	Name	City	Country
234234	Mary	Houston	USA
345345	Sue	Seattle	USA
345343	Joan	Seattle	USA
234234	Ann	Portland	USA
--	Frank	Calgary	Canada
--	Jean	Montreal	Canada

CustomersInHouston

SSN	Name	City	Country
234234	Mary	Houston	USA

CustomersInSeattle

SSN	Name	City	Country
345345	Sue	Seattle	USA
345343	Joan	Seattle	USA

CustomersInCanada

SSN	Name	City	Country
--	Frank	Calgary	Canada
--	Jean	Montreal	Canada

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Horizontal Partitioning

```
CREATE VIEW Customers AS
    CustomersInHouston
      UNION ALL
    CustomersInSeattle
      UNION ALL
          . . .
```

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Horizontal Partitioning

```
SELECT name
FROM   Customers
WHERE  city = 'Seattle'
```

Which tables are inspected by the system ?

WHY ???

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Horizontal Partitioning

Better:

```
CREATE VIEW  Customers  AS
   (SELECT * FROM CustomersInHouston
    WHERE city = 'Houston')
      UNION ALL
   (SELECT * FROM CustomersInSeattle
    WHERE city = 'Seattle')
      UNION ALL
   . . .
```

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Horizontal Partitioning

```
SELECT name
FROM   Customers
WHERE  city = 'Seattle'
```

```
SELECT name
FROM   CustomersInSeattle
```

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Horizontal Partitioning

Applications:

- Optimizations:
  - E.g. archived applications and active applications
- Distributed databases
- Data integration

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Views and Security

Customers:

Name	Address	Balance
Mary	Houston	450.99
Sue	Seattle	-240
Joan	Seattle	333.25
Ann	Portland	-520

Fred is not allowed to see this

Fred is allowed to see this

```
CREATE VIEW PublicCustomers
      SELECT Name, Address
      FROM Customers
```

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Views and Security

Customers:

Name	Address	Balance
Mary	Houston	450.99
Sue	Seattle	-240
Joan	Seattle	333.25
Ann	Portland	-520

John is allowed to see only <0 balances

```
CREATE VIEW BadCreditCustomers
      SELECT *
      FROM Customers
      WHERE Balance < 0
```

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Constraints in SQL

Constraints in SQL:

- Keys, foreign keys
- Attribute-level constraints
- Tuple-level constraints
- Global constraints: assertions

simplest

Most complex

The more complex the constraint, the harder it is to check and to enforce

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Keys

```
CREATE TABLE Product (
        name CHAR(30) PRIMARY KEY,
        category VARCHAR(20))
```

OR:

Product(name, category)

```
CREATE TABLE Product (
        name CHAR(30),
        category VARCHAR(20)
PRIMARY KEY (name))
```

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Keys with Multiple Attributes

```
CREATE TABLE Product (
        name CHAR(30),
        category VARCHAR(20),
        price INT,
    PRIMARY KEY (name, category))
```

Name	Category	Price
Gizmo	Gadget	10
Camera	Photo	20
Gizmo	Photo	30
~~Gizmo~~	~~Gadget~~	~~40~~

Product(name, category, price)

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Other Keys

```
CREATE TABLE Product (
        productID  CHAR(10),
        name CHAR(30),
        category VARCHAR(20),
        price INT,
        PRIMARY KEY (productID),
        UNIQUE (name, category))
```

There is at most one PRIMARY KEY;
there can be many UNIQUE

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Foreign Key Constraints

Referential integrity constraints

```
CREATE TABLE Purchase (
        prodName CHAR(30)
                REFERENCES Product(name),
        date DATETIME)
```

May write just Product (why ?)

prodName is a **foreign key** to Product(name)
name must be a **key** in Product

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Product

Name	Category
Gizmo	gadget
Camera	Photo
OneClick	Photo

Purchase

ProdName	Store
Gizmo	Wiz
Camera	Ritz
Camera	Wiz

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Foreign Key Constraints

- OR

```
CREATE TABLE Purchase (
      prodName CHAR(30),
      category VARCHAR(20),
      date DATETIME,
      FOREIGN KEY (prodName, category)
        REFERENCES  Product(name, category)
```

- (name, category) must be a PRIMARY KEY

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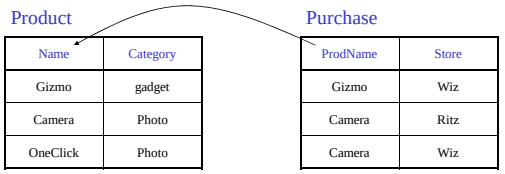
What happens during updates ?

Types of updates:

- In Purchase: insert/update
- In Product: delete/update



Name	Category
Gizmo	gadget
Camera	Photo
OneClick	Photo

ProdName	Store
Gizmo	Wiz
Camera	Ritz
Camera	Wiz

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What happens during updates ?

- SQL has three policies for maintaining referential integrity:
- Reject violating modifications (default)
- Cascade: after a delete/update do a delete/update
- Set-null set foreign-key field to NULL

READING ASSIGNMENT: 7.1.5, 7.1.6

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Constraints on Attributes and Tuples

- Constraints on attributes:
  NOT NULL -- obvious meaning...
  CHECK condition -- any condition !
- Constraints on tuples
  CHECK condition

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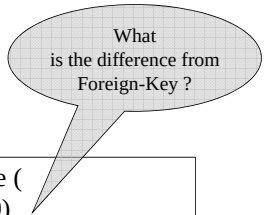


```
CREATE TABLE Purchase (
      prodName CHAR(30)
            CHECK (prodName IN
                  SELECT Product.name
                  FROM Product),
      date DATETIME NOT NULL)
```

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General Assertions

```
CREATE ASSERTION myAssert CHECK
 NOT EXISTS(
      SELECT Product.name
      FROM Product, Purchase
      WHERE Product.name = Purchase.prodName
      GROUP BY Product.name
      HAVING count(*) > 200)
```

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