Lecture 04:
Views and Constraints

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Guest lecturer: Dan Suciu

Views

Views are relations, except that they may not be 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
```

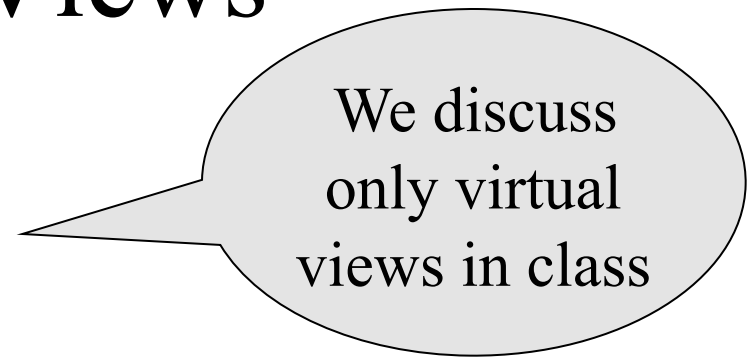
CustomerPrice(customer, price) "virtual table"

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
  - Indexes *are* materialized views (read book)

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

CustomerPrice(customer, price)

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
```

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

CustomerPrice(customer, price)

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
```

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

CustomerPrice(customer, price)

Queries Over Views: Query Modification

Modified and unnested 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
```

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

CustomerPrice(customer, price)

Another Example

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

??

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

CustomerPrice(customer, price)

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

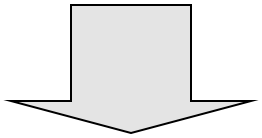
- Physical data independence. E.g.
  - Vertical data partitioning
  - Horizontal data partitioning

- Security
  - The view 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…

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 ?

Vertical Partitioning

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

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

Vertical Partitioning

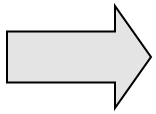
When to do this:

- 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

Horizontal Partitioning

Customers

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



CustomersInHuston

SSN	Name	City	Country
234234	Mary	Huston	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

Horizontal Partitioning

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

Horizontal Partitioning

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

Which tables are inspected by the system ?

WHY ???

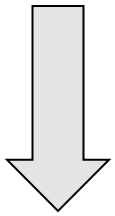
Horizontal Partitioning

Better:

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

Horizontal Partitioning

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



```
SELECT name
FROM   CusotmersInSeattle
```

Horizontal Partitioning

Applications:

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

Views and Security

Customers:

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

Fred is not allowed to see this

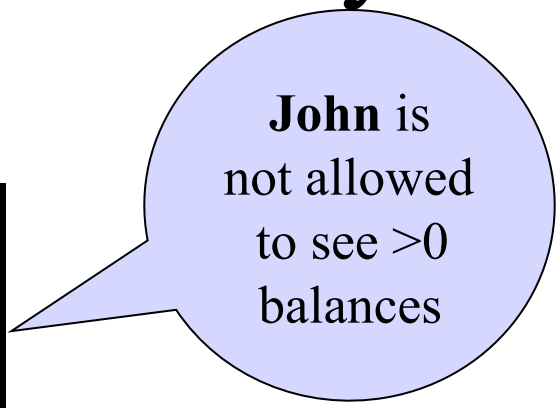
Fred is allowed to see this

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

Views and Security

Customers:

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

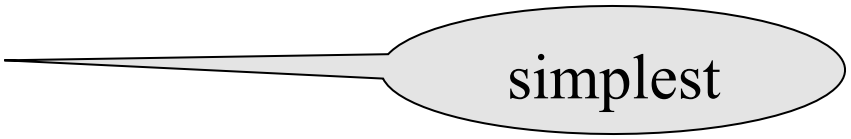


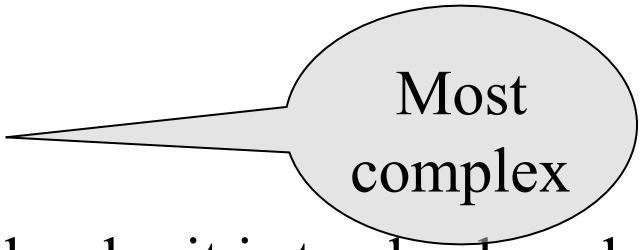

```
CREATE VIEW BadCreditCustomers
        SELECT *
        FROM Customers
        WHERE Balance < 0
```

Constraints in SQL

Constraints in SQL:

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





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

Keys

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

OR:

Product(<u>name</u>, category)

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

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(<u>name, category</u>, price)

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

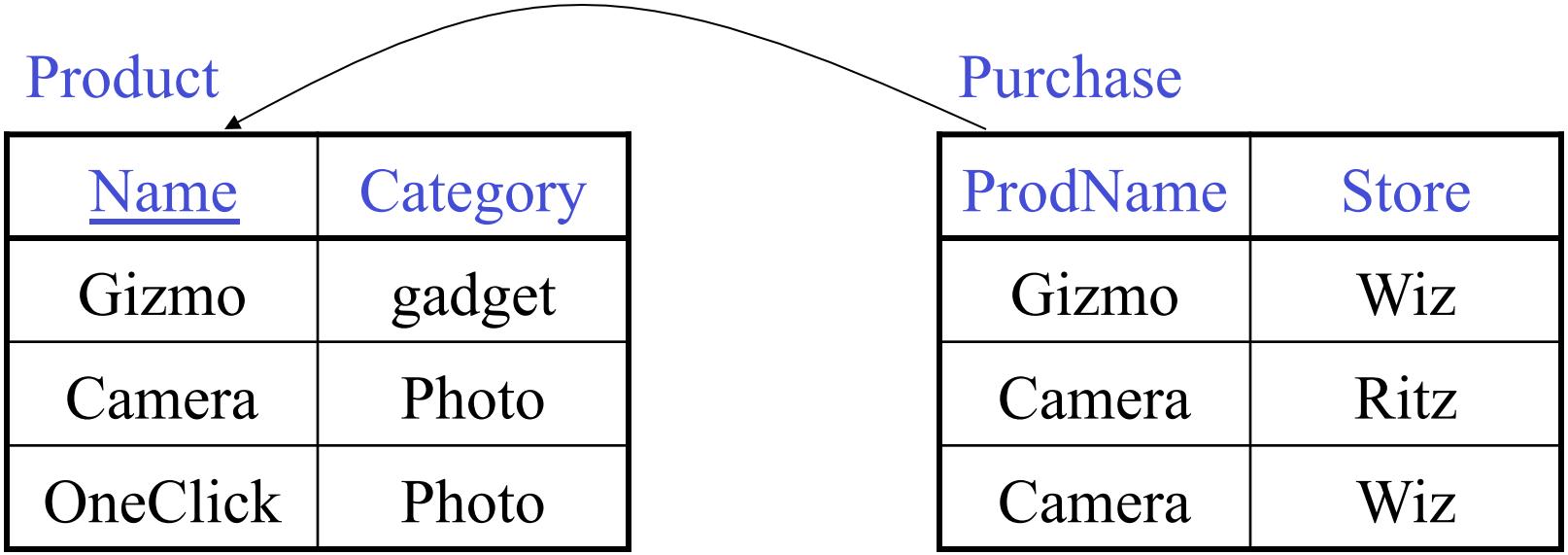
Foreign Key Constraints

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


Product
Name
Category
Gizmo
gadget
Camera
Photo
OneClick
Photo
Purchase
ProdName
Store
Gizmo
Wiz
Camera
Ritz
Camera
Wiz

Foreign Key Constraints

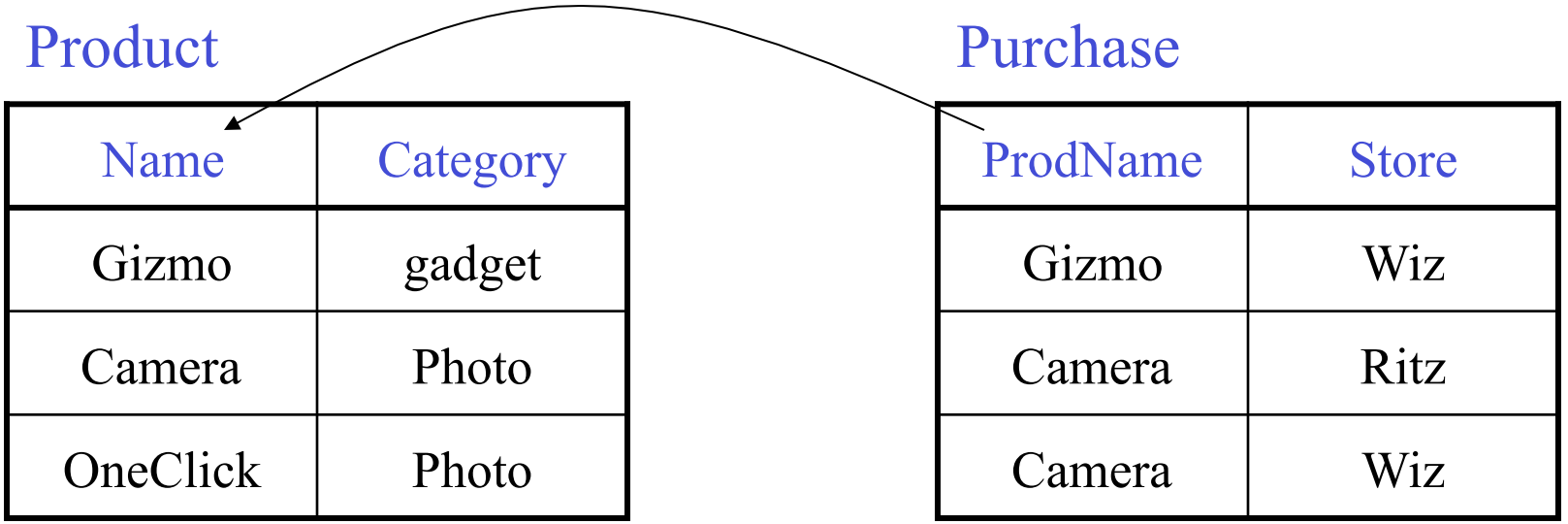
```
CREATE TABLE Purchase (
        prodName CHAR(30),
        category VARCHAR(20),
        date DATETIME,
        FOREIGN KEY (prodName, category)
          REFERENCES  Product(name, category)
```

- (name, category) must be a PRIMARY KEY

What happens during updates ?

Types of updates:

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



Product

Name	Category
Gizmo	gadget
Camera	Photo
OneClick	Photo

Purchase

ProdName	Store
Gizmo	Wiz
Camera	Ritz
Camera	Wiz

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 ASSIGNEMNT: 7.1.5, 7.1.6

Constraints on Attributes and Tuples

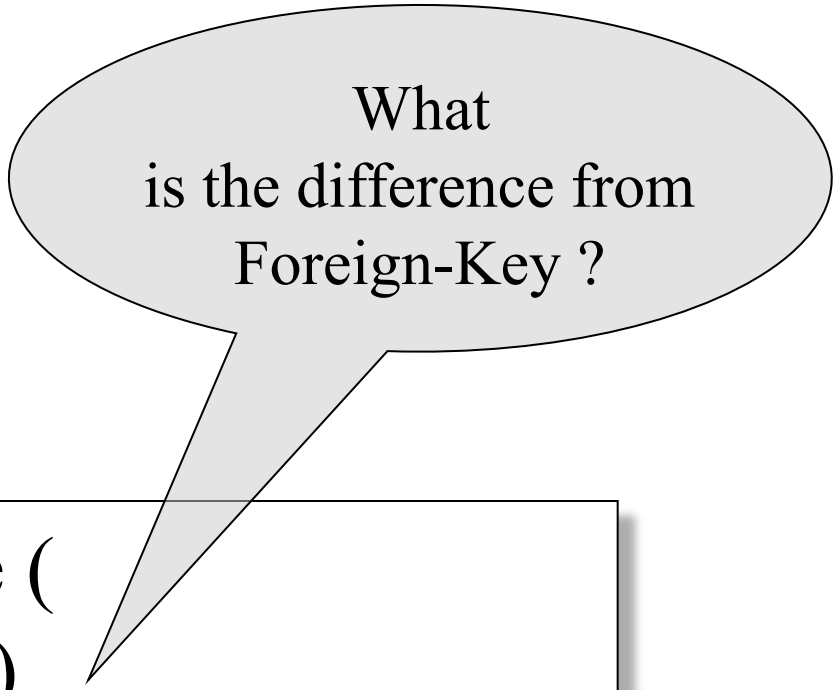
- Constraints on attributes:

  NOT NULL -- obvious meaning...

  CHECK condition -- any condition !

- Constraints on tuples

  CHECK condition




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

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)
```