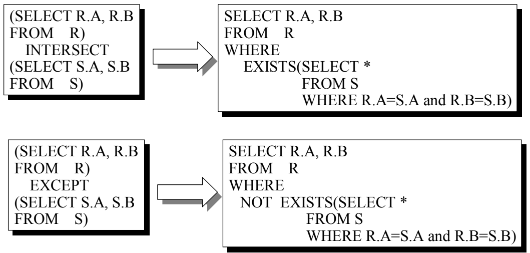
Lecture 04: SQL

Monday, October 7, 2002

Outline

- Getting around INTERSECT and EXCEPT
- Nulls (6.1.6)
- Outer joins (6.3.8)
- Database Modifications (6.5)
- Defining Relation Schema in SQL (6.6)
- Defining Views (6.7)

INTERSECT and EXCEPT: Not in SQL Server



```
(SELECT R.A, R.B
FROM    R)
   INTERSECT
(SELECT S.A, S.B
FROM    S)
```

```
SELECT R.A, R.B
FROM   R
WHERE
    EXISTS(SELECT *
               FROM S
               WHERE R.A=S.A and R.B=S.B)
```

```
(SELECT R.A, R.B
FROM    R)
   EXCEPT
(SELECT S.A, S.B
FROM    S)
```

```
SELECT R.A, R.B
FROM   R
WHERE
  NOT  EXISTS(SELECT *
               FROM S
               WHERE R.A=S.A and R.B=S.B)
```

Null Values and Outerjoins

- 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 and Outerjoins

- 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 and Outerjoins

Unexpected behavior:

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

Some Persons are not included !

Null Values and Outerjoins

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

Null Values and Outerjoins

Explicit joins in SQL:
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 !

Null Values and 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

Outer Joins

- Left outer join:
  - Incluce the left tuple even if there's no match
- Right outer join:
  - Incluce 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

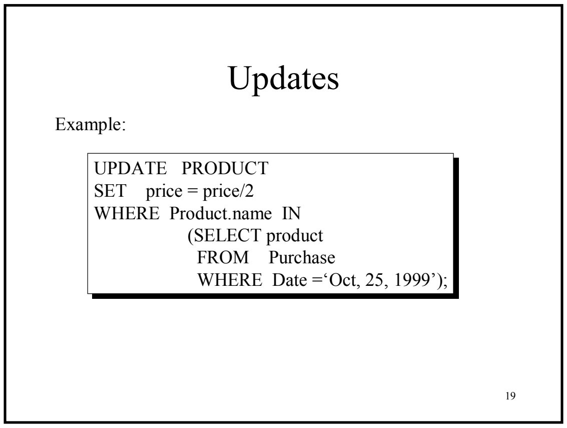
Deletions

Example:

```
DELETE    FROM    PURCHASE

WHERE    seller = ‘Joe’   AND
             product = ‘Brooklyn Bridge’
```

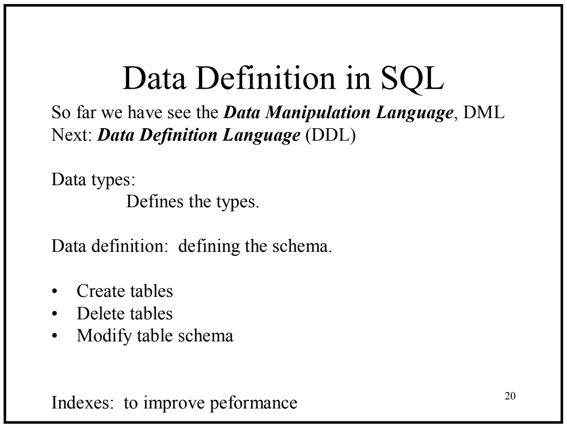
Factoid about SQL: there is no way to delete only a single occurrence of a tuple that appears twice in a relation.



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

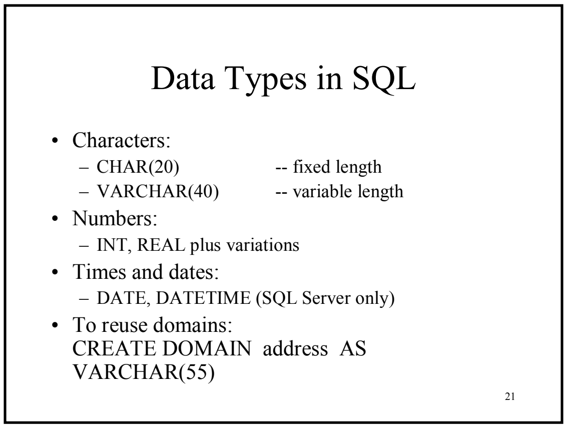
So far we have see the ***Data Manipulation Language***, DML
Next: ***Data Definition Language*** (DDL)

Data types:
Defines the types.

Data definition: defining the schema.

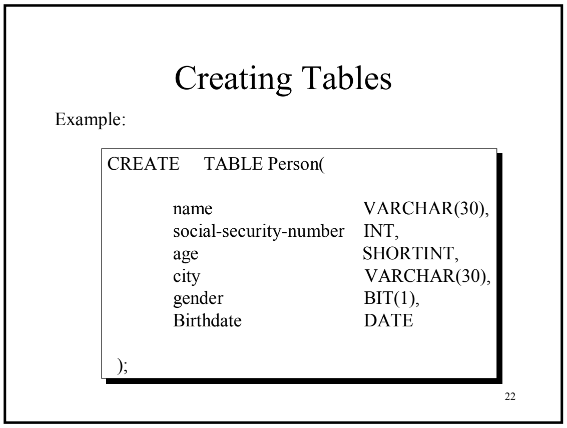
- Create tables
- Delete tables
- Modify table schema

Indexes: to improve peformance



Data Types in SQL

- Characters:
  - CHAR(20) -- fixed length
  - VARCHAR(40) -- variable length
- Numbers:
  - INT, REAL plus variations
- Times and dates:
  - DATE, DATETIME (SQL Server only)
- To reuse domains:
  CREATE DOMAIN address AS VARCHAR(55)



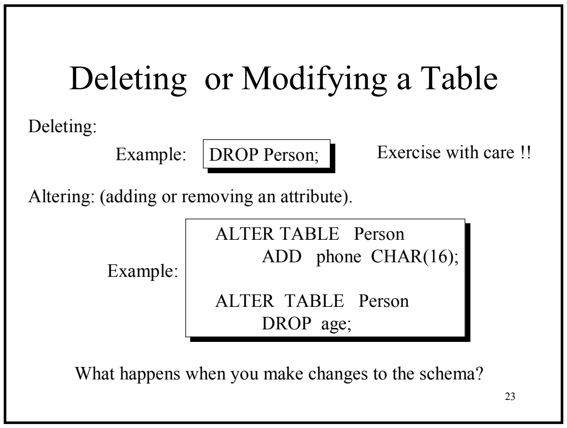
Creating Tables

Example:

```
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 !!

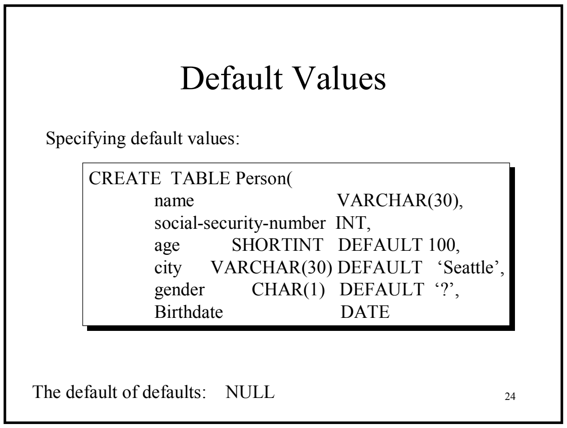
Altering: (adding or removing an attribute).

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

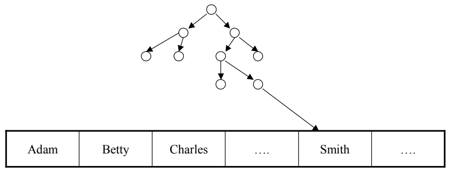
Person (name, age, city)

```
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 !

Creating Indexes

Syntax:

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

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”
```

But not in:

```
SELECT *
FROM    Person
WHERE city = “Seattle”
```

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?

Defining Views

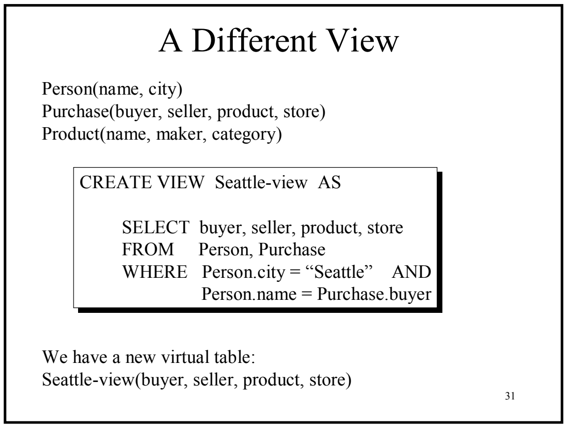
Views are relations, except that they are not physically stored.

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



A Different View

Person(name, city)
Purchase(buyer, seller, product, store)
Product(name, maker, category)

```
CREATE VIEW  Seattle-view  AS

       SELECT  buyer, seller, product, store
       FROM     Person, Purchase
       WHERE   Person.city = “Seattle”    AND
                    Person.name = Purchase.buyer
```

We have a new virtual table:
Seattle-view(buyer, seller, product, store)

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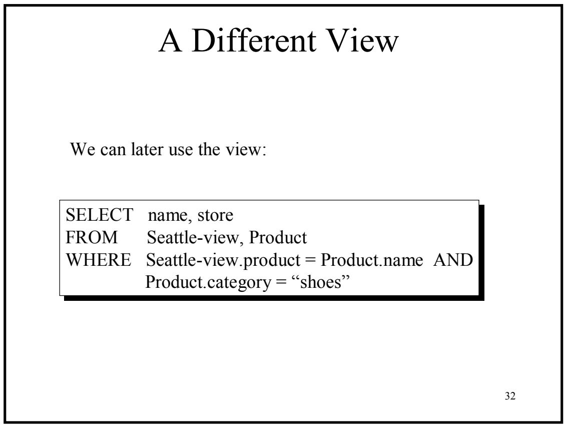

A Different View

We can later use the view:

```
SELECT   name, store
FROM      Seattle-view, Product
WHERE    Seattle-view.product = Product.name  AND
             Product.category = “shoes”
```

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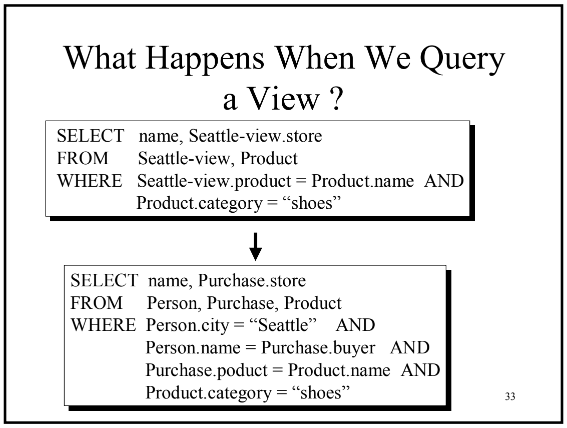

What Happens When We Query a View ?

```
SELECT   name, Seattle-view.store
FROM      Seattle-view, Product
WHERE   Seattle-view.product = Product.name  AND
             Product.category = “shoes”
```

↓

```
SELECT  name, Purchase.store
FROM     Person, Purchase, Product
WHERE  Person.city = “Seattle”    AND
            Person.name = Purchase.buyer   AND
            Purchase.poduct = Product.name  AND
            Product.category = “shoes”
```

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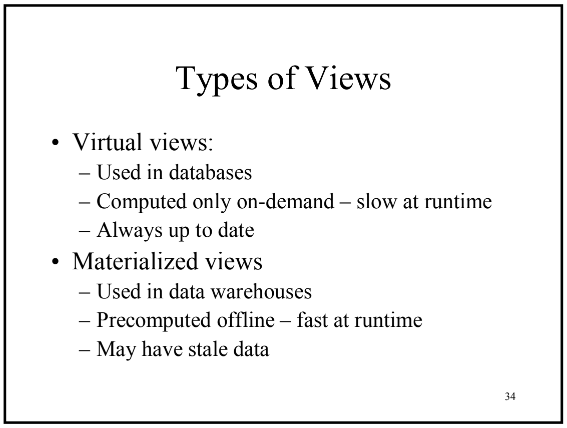

Types of Views

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

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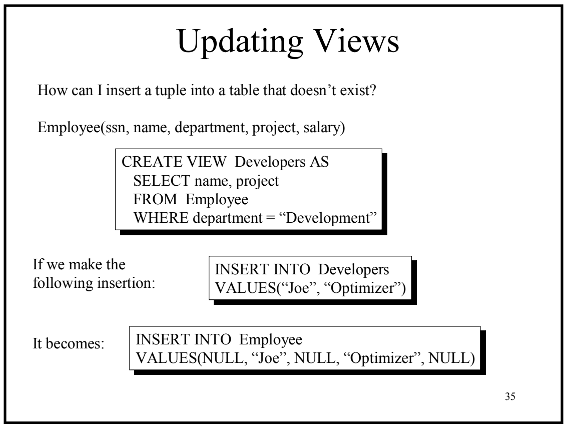

Updating Views

How can I insert a tuple into a table that doesn’t exist?

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

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

If we make the following insertion:

```
INSERT INTO  Developers
VALUES(“Joe”, “Optimizer”)
```

It becomes:

```
INSERT INTO  Employee
VALUES(NULL, “Joe”, NULL, “Optimizer”, NULL)
```

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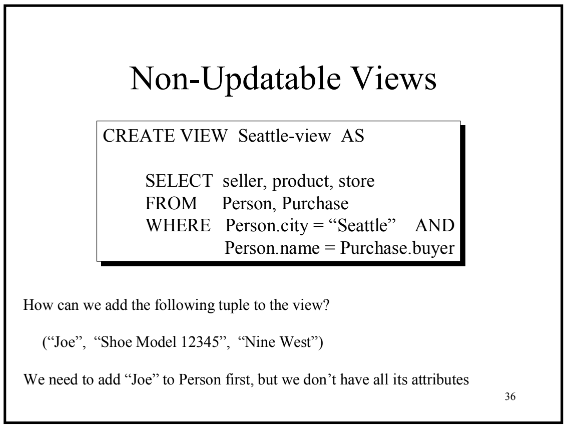

Non-Updatable Views

```
CREATE VIEW  Seattle-view  AS

       SELECT  seller, product, store
       FROM     Person, Purchase
       WHERE   Person.city = “Seattle”    AND
                    Person.name = Purchase.buyer
```

How can we add the following tuple to the view?

(“Joe”, “Shoe Model 12345”, “Nine West”)

We need to add “Joe” to Person first, but we don’t have all its attributes

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