More SQL

Defining a Database Schema
Views

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Defining a Database Schema

- A database schema comprises declarations for the relations ("tables") of the database.
- Many other kinds of elements may also appear in the database schema, including views, indexes, and triggers, which we'll introduce later.

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Declaring a Relation

- Simplest form is:

```
CREATE TABLE <name> (
    <list of elements>
);
```

- And you may remove a relation from the database schema by:

```
DROP TABLE <name>;
```

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Elements of Table Declarations

- The principal element is a pair consisting of an attribute and a type.
- The most common types are:
  - INT or INTEGER (synonyms).
  - REAL or FLOAT (synonyms).
  - CHAR(*n*) = fixed-length string of *n* characters.
  - VARCHAR(*n*) = variable-length string of up to *n* characters.

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Example: Create Table

```
CREATE TABLE Sells (
    bar     CHAR(20),
    beer    VARCHAR(20),
    price   REAL
);
```

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Dates and Times

- DATE and TIME are types in SQL.
- The form of a date value is:

  DATE 'yyyy-mm-dd'
  - Example: DATE '2002-09-30' for Sept. 30, 2002.

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Times as Values

- The form of a time value is:
  TIME 'hh:mm:ss'

with an optional decimal point and fractions of a second following.

  - Example: TIME '15:30:02.5' = two and a half seconds after 3:30PM.

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Declaring Keys

- An attribute or list of attributes may be declared PRIMARY KEY or UNIQUE.
- These each say the attribute(s) so declared functionally determine all the attributes of the relation schema.
- There are a few distinctions to be mentioned later.

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Declaring Single-Attribute Keys

- Place PRIMARY KEY or UNIQUE after the type in the declaration of the attribute.
- Example:

```
CREATE TABLE Beers (
    name    CHAR(20) UNIQUE,
    manf    CHAR(20)
);
```

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Declaring Multiattribute Keys

- A key declaration can also be another element in the list of elements of a CREATE TABLE statement.
- This form is essential if the key consists of more than one attribute.
  - May be used even for one-attribute keys.

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Example: Multiattribute Key

- The bar and beer together are the key for Sells:

```
CREATE TABLE Sells (
    bar     CHAR(20),
    beer    VARCHAR(20),
    price   REAL,
    PRIMARY KEY (bar, beer)
);
```

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PRIMARY KEY Versus UNIQUE

- The SQL standard allows DBMS implementers to make their own distinctions between PRIMARY KEY and UNIQUE.
  - Example: some DBMS might automatically create an *index* (data structure to speed search) in response to PRIMARY KEY, but not UNIQUE.

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Required Distinctions

- However, standard SQL requires these distinctions:
  1. There can be only one PRIMARY KEY for a relation, but several UNIQUE attributes.
  2. No attribute of a PRIMARY KEY can ever be NULL in any tuple. But attributes declared UNIQUE may have NULL's, and there may be several tuples with NULL.

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Other Declarations for Attributes

- Two other declarations we can make for an attribute are:
  1. NOT NULL means that the value for this attribute may never be NULL.
  2. DEFAULT <value> says that if there is no specific value known for this attribute's component in some tuple, use the stated <value>.

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Example: Default Values

```
CREATE TABLE Drinkers (
   name CHAR(30) PRIMARY KEY,
   addr CHAR(50)
      DEFAULT '123 Sesame St.',
   phone CHAR(16)
);
```

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Effect of Defaults -- 1

- Suppose we insert the fact that Sally is a drinker, but we know neither her address nor her phone.
- An INSERT with a partial list of attributes makes the insertion possible:

```
INSERT INTO Drinkers(name)
VALUES('Sally');
```

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Effect of Defaults -- 2

- But what tuple appears in Drinkers?

name	addr	phone
Sally	123 Sesame St	NULL

- If we had declared phone NOT NULL, this insertion would have been rejected.

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Adding Attributes

- We may change a relation schema by adding a new attribute ("column") by:

  ALTER TABLE <name> ADD
  <attribute declaration>;

- Example:

```
ALTER TABLE Bars ADD
phone CHAR(16)DEFAULT 'unlisted';
```

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Deleting Attributes

- Remove an attribute from a relation schema by:

  ALTER TABLE <name>

  DROP <attribute>;
- Example: we don't really need the license attribute for bars:

```
ALTER TABLE Bars DROP license;
```

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Views

- A view is a "virtual table," a relation that is defined in terms of the contents of other tables and views.
- Declare by:

  CREATE VIEW <name> AS <query>;
- In contrast, a relation whose value is really stored in the database is called a *base table*.

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Example: View Definition

- CanDrink(drinker, beer) is a view "containing" the drinker-beer pairs such that the drinker frequents at least one bar that serves the beer:

```
CREATE VIEW CanDrink AS
   SELECT drinker, beer
   FROM Frequents, Sells
   WHERE Frequents.bar = Sells.bar;
```

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Example: Accessing a View

- You may query a view as if it were a base table.
  - There is a limited ability to modify views if the modification makes sense as a modification of the underlying base table.
- Example:

```
SELECT beer FROM CanDrink
WHERE drinker = 'Sally';
```

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What Happens When a View Is Used?

- The DBMS starts by interpreting the query as if the view were a base table.
  - Typical DBMS turns the query into something like relational algebra.
- The queries defining any views used by the query are also replaced by their algebraic equivalents, and "spliced into" the expression tree for the query.

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Example: View Expansion

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DMBS Optimization

- It is interesting to observe that the typical DBMS will then "optimize" the query by transforming the algebraic expression to one that can be executed faster.
- Key optimizations:
  1. Push selections down the tree.
  2. Eliminate unnecessary projections.

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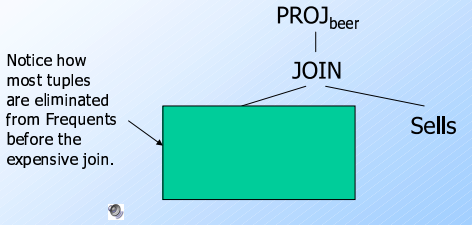
Example: Optimization



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