Defining a Database Schema

`CREATE TABLE` name (list of elements).

- Principal elements are attributes and their types, but key declarations and constraints also appear.
- Similar `CREATE` X commands for other schema elements X: views, indexes, assertions, triggers, domains.
  - ❖ Assertions and domains not in Oracle.
- "`DROP` X name" deletes the created element of kind X with that name.

Example

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

DROP TABLE Sells;
```

Types

1. `INT` or `INTEGER`.
2. `REAL` or `FLOAT`.
3. `CHAR(`n`)` = fixed length character string, padded with "pad characters."
4. `VARCHAR(`n`)` = variable-length strings up to n characters.
   - Oracle uses `VARCHAR2(`n`)` as well. Difference: storage for `VARCHAR2` is truly varying length; `VARCHAR` uses fixed array with endmarker.
   - `VARCHAR` in Oracle is "deprecated" (they may discontinue it in the future), so they suggest you always use `VARCHAR2`.

5. Dates. SQL2 form is `DATE 'yyyy-mm-dd'`
   - ❖ Oracle uses a different format — to be explained.
6. Times. Form is `TIME 'hh:mm:ss[.ss...]'` in SQL2.
7. In Oracle: `NUMBER` is either integer or floating point as appropriate.

Oracle Default Dates (Used at Stanford)

Format `'dd-mon-yy'`

Example

```
CREATE TABLE Days (
    d DATE
);

INSERT INTO Days
VALUES('06-nov-97');
```

- Oracle function `to_date` converts a specified format into default format.

```
INSERT INTO Days
VALUES(to_date('2000-01-01',
        'yyyy-mm-dd'));
```

- Stored in our system as `'01-jan-00'`.
  - ❖ Now do you believe there is a "year 2000" problem?

Declaring Keys

Use `PRIMARY KEY` or `UNIQUE`.

- Oracle treats these as synonyms.
- But only one primary key, many "uniques" allowed.
- SQL2 allows implementations to create an index (data structure to speed access given a key value) only in response to `PRIMARY KEY`.
  - ❖ But Oracle creates indexes for both.
- Two places to declare:
  1. After an attribute's type, if the attribute is a key by itself.
  2. As a separate element.
  - ❖ Essential if key is > 1 attribute.

Example

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

- On the Stanford Oracle system for this class, there is a separate data area on a separate disk for indexes.
  - ❖ Speeds access — two heads are better than one.
  - ❖ Thus, you must follow any implicit index-creating statement like "primary key," by:

```
USING INDEX TABLESPACE indexes
```

Example

```
CREATE TABLE Beers (
    name CHAR(20) UNIQUE
        USING INDEX TABLESPACE indexes,
    manf CHAR(20)
);
```

Other Properties You Can Give to Attributes

1. `NOT NULL` = every tuple must have a real value for this attribute.
2. `DEFAULT` value = a value to use whenever no other value of this attribute is known.

Example

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

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

results in the following tuple:

name	addr	phone
Sally	123 Sesame St.	NULL

- Primary key is by default not `NULL`.
- This insert is legal.
  - ❖ OK to list a subset of the attributes and values for only this subset.
- But if we had declared

  ```
  phone CHAR(16) NOT NULL
  ```

  then the insertion could not be made.

Changing Columns

Add an attribute of relation R with

`ALTER TABLE` R `ADD` <column declaration>`;`

Example

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

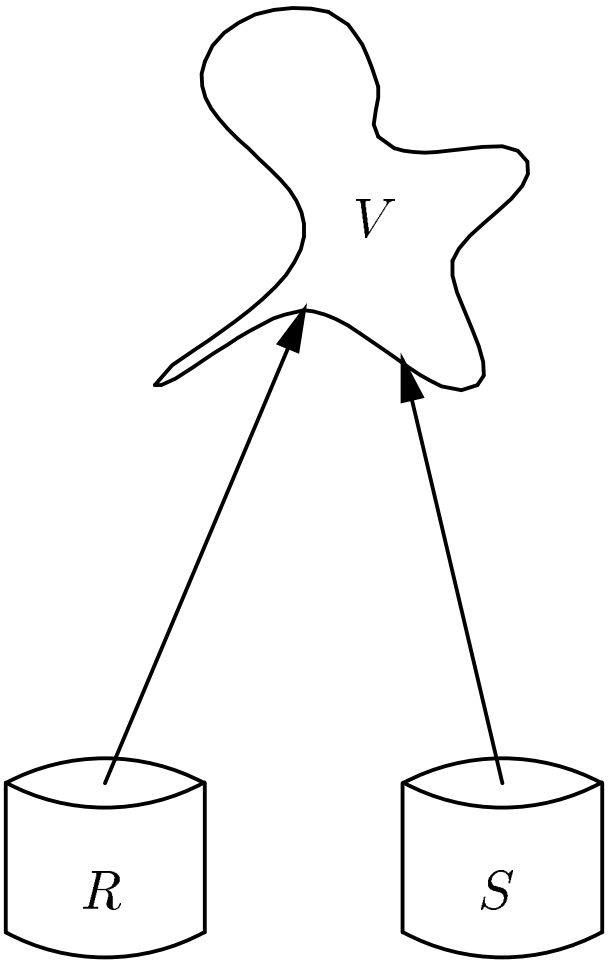
- SQL2 allows columns to be dropped, e.g.,

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

- However, this statement is illegal in Oracle.

Views

An expression that describes a table without creating it.



- View definition form is:

  `CREATE VIEW` <name> `AS`
  <query>`;`

Example

The view `CanDrink` is the set of 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;
```

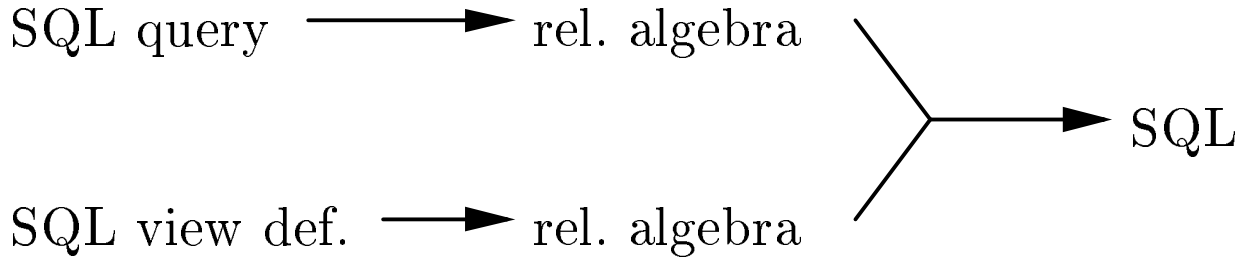
Querying Views

Treat the view as if it were a materialized relation.

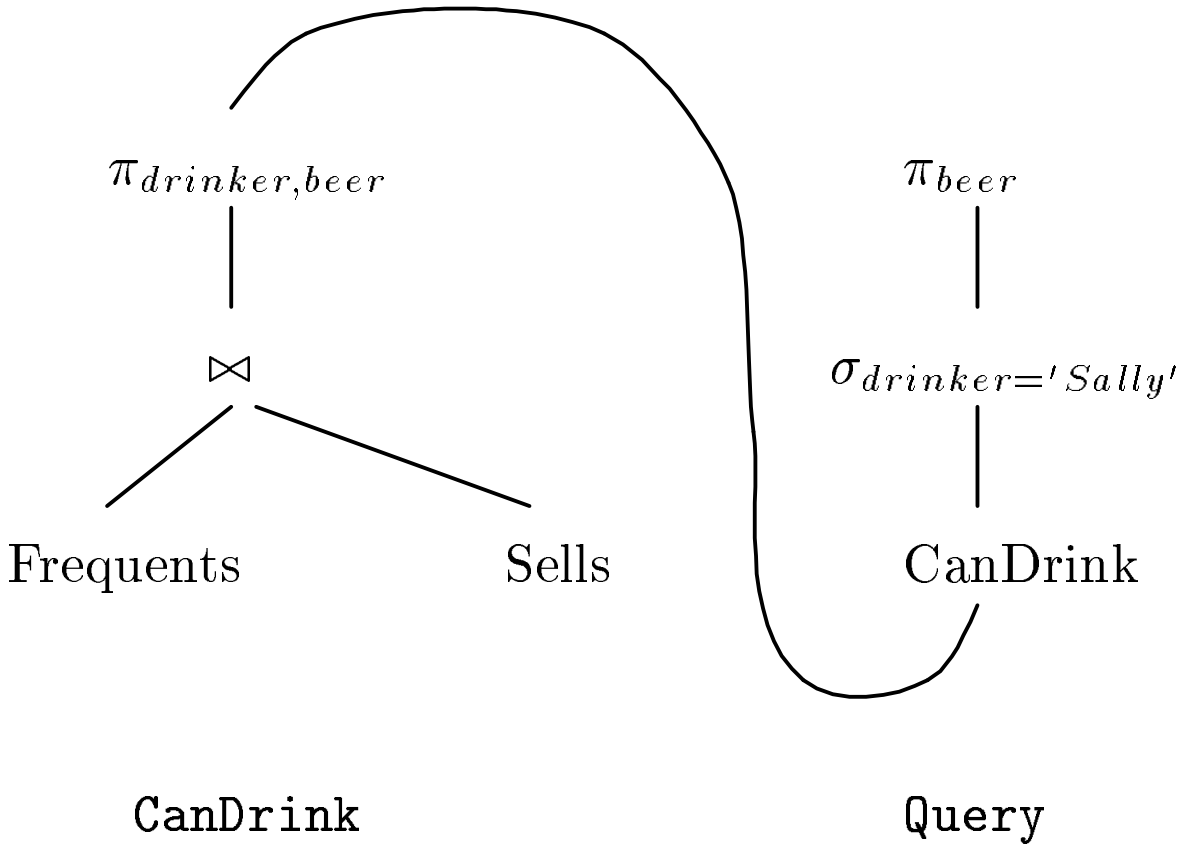
Example

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

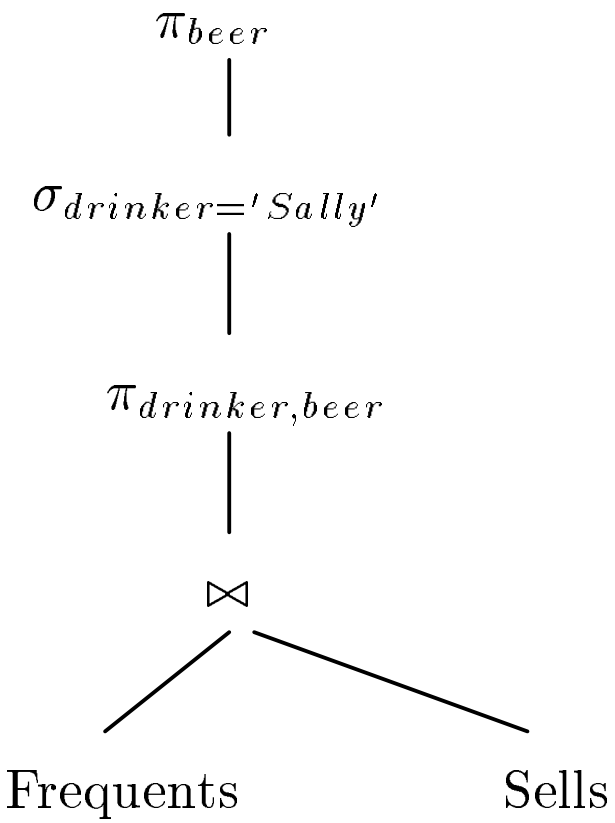
Semantics of View Use

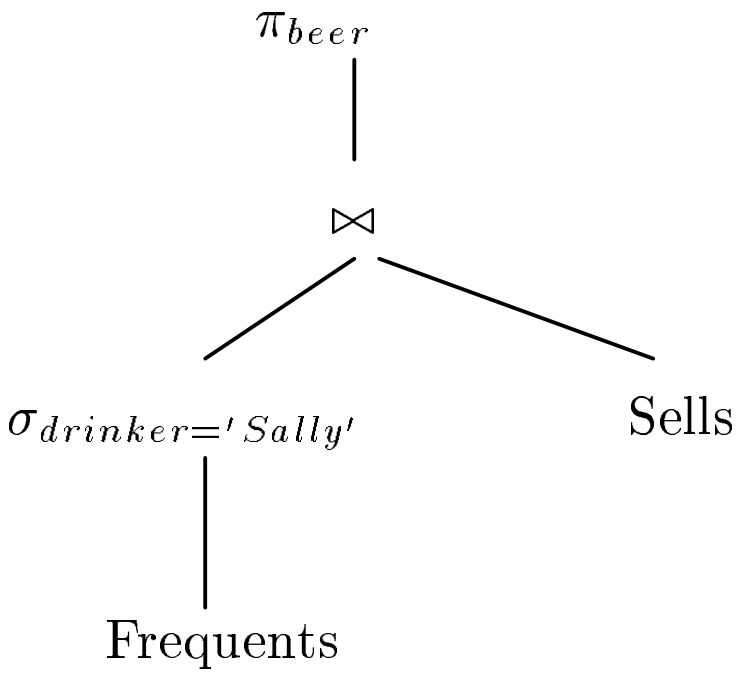


Example



Compose


π_{beer}
$\sigma_{drinker='Sally'}$
$\pi_{drinker,beer}$
$\bowtie$
Frequents
Sells

Optimize Query

1. Push selections down tree.
2. Eliminate unnecessary projections.