>>

SQL: Queries on One Table

❖ Queries

A query is a declarative program that retrieves data from a database.

declarative = say what we want, not method to get it

Queries are used in two ways in RDBMSs:

- interactively (e.g. in **`psql`**)
  - the entire result is displayed in tabular format on the output
- by a program (e.g. in a PLpgSQL function)
  - the result tuples are consumed one-at-a-time by the program

SQL is based on the relational algebra, which we discuss elsewhere

<< ^ >>

❖ SQL Query Language

An SQL query consists of a sequence of clauses:

```
SELECT    projectionList     which attributes do you want from the tuples?
FROM      relations/joins    retrieve tuples from which tables?
WHERE     condition          eliminate some of the tuples based on the condition
GROUP BY  groupingAttributes group the tuples based on an attribute
HAVING    groupCondition     eliminate some of the groups based on the condition
```

`FROM`, **`WHERE`**, **`GROUP BY`**, **`HAVING`** clauses are optional.

Result of query: a relation, typically displayed as a table.

Result could be just one tuple with one attribute (i.e. one value) or even empty

❖ SQL Query Language (cont)

Functionality provided by SQL ...

Filtering: extract attributes from tuples, extract tuples frm tables

```
SELECT b,c FROM R(a,b,c,d) WHERE a > 5
```

Combining: merging related tuples from different tables

```
... FROM R(x,y,z) JOIN S(a,b,c) ON R.y = S.a
```

Summarising: aggregating values in a single column

```
SELECT avg(mark) FROM ...
```
sum, count etc.

Set operations: union, intersection, difference

❖ SQL Query Language (cont)

More functionality provided by SQL ...

Grouping: forming subsets of tuples sharing some property

```
... GROUP BY R.a
```

(forms groups of tuples from **R** sharing the same value of **a**)

Group Filtering: selecting only groups satisfying a condition

```
... GROUP BY R.a HAVING max(R.a) < 75
```

Renaming: assign a name to a component of a query

```
SELECT a as name
FROM Employee(a,b,c) e WHERE e.b > 50000
```

this one renames the column a to name in the output

this one allows you to reference this employee instance via the letter e

❖ SQL Query Language (cont)

Schema:

- *Students(id, name, ...)*
- *Enrolments(student, course, mark, grade)*

Example SQL query on this schema:

```
SELECT   s.id, s.name, avg(e.mark) as avgMark
FROM     Students s
         JOIN Enrolments e on (s.id = e.student)
GROUP BY s.id, s.name
-- or --
SELECT   s.id, s.name, avg(e.mark) as avgMark
FROM     Students s, Enrolments e
WHERE    s.id = e.student
GROUP BY s.id, s.name
```

<< ∧ >>

❖ SQL Query Language (cont)

How the example query is computed:

- produce all pairs of *Students,Enrolments* tuples which satisfy condition *(Students.id = Enrolments.student)*
- each tuple has $(\overbrace{id,name,...}^{S},\overbrace{student,course,mark,grade}^{E})$
- form groups of tuples with same *(id,name)* values
- for each group, compute average mark
- form result tuples *(id,name,avgMark)*

❖ Problem-solving in SQL

Starts with an information request:

- (informal) description of the information required from the database

Ends with:

- a list of tuples that meet the requirements in the request

Pre-req: know your schema

Look for keywords in request to identify required data :

- tell me the names of all students...
- how many students failed ...
- what is the highest mark in ...
- which courses are ... (course codes?)

<< ∧ >>

❖ Problem-solving in SQL (cont)

Developing SQL queries ...

- relate required data to attributes in schema
- identify which tables contain these attributes
- combine data from relevant tables (**`FROM`**, **`JOIN`**)
- specify conditions to select relevant data (**`WHERE`**)
- [optional] define grouping attributes (**`GROUP BY`**)
- develop expressions to compute output values (**`SELECT`**)

❖ Problem-solving in SQL (cont)

Example: just the beers that John likes

- which table contains info about beers that are liked?
- `Likes(drinker,beers)`
- only want tuples where drinker is John (`WHERE`)
- only want beer names (`SELECT beer`)

... giving ...

```
select beer from Likes where drinker='John';
```

❖ Views

A view associates a name with a query:

- **CREATE VIEW** *viewName* [**(** *attributes* **)**] **AS** *Query*

Each time the view is invoked (in a **FROM** clause):

- the *Query* is evaluated, yielding a set of tuples
- the set of tuples is used as the value of the view

A view can be treated as a "virtual table".

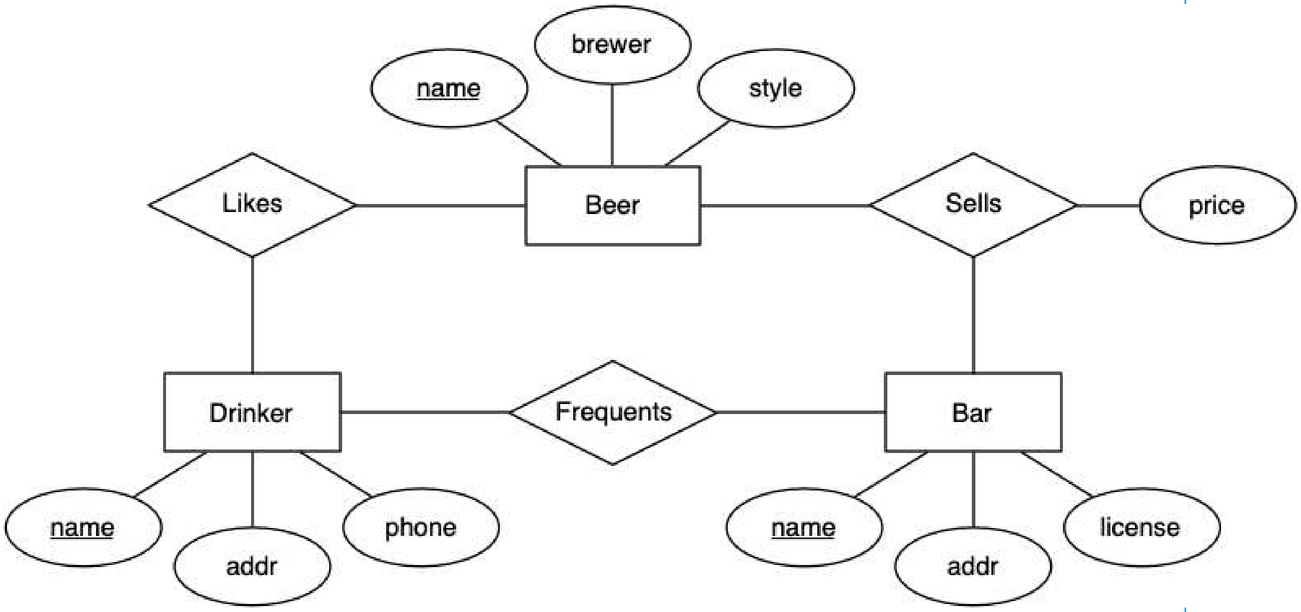
Views are useful for "packaging" a complex query to use in other queries.

cf. writing functions to package computations in programs

you can think of views being analogous to functions in programming - you use them when you want to repeat that same logic over and over again and it's too expensive to write it out every time you want it.

❖ Exercise: Queries on Beer Database

ER design for Beer database:



<< ^

❖ Exercise: Queries on Beer Database (cont)

Answer these queries on the Beer database:

1. What beers are made by Toohey's?
2. Show beers with headings "Beer", "Brewer".
3. How many different beers are there?
4. How many different brewers are there?
5. Which beers does John like?
6. Find pairs of beers by the same manufacturer.
7. How many beers does each brewer make?
8. Which brewers make only one beer?
9. Which brewer makes the most beers?

Produced: 28 Sep 2020