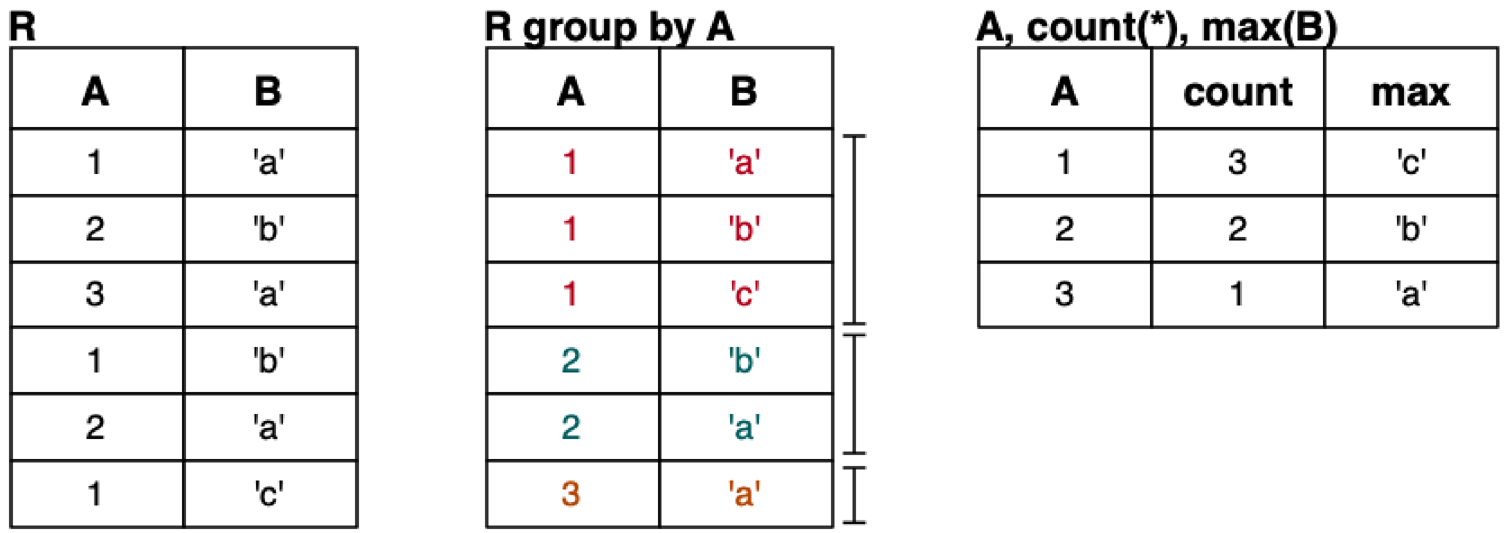
>>

SQL Queries (iv): Grouping

❖ Grouping

`SELECT-FROM-WHERE` can be followed by **`GROUP BY`** to:

- partition result relation into groups (according to values of specified attribute)
- summarise (aggregate) some aspects of each group
- output one tuple per group, with grouping attribute and aggregates



R

A	B
1	'a'
2	'b'
3	'a'
1	'b'
2	'a'
1	'c'

R group by A

A	B
1	'a'
1	'b'
1	'c'
2	'b'
2	'a'
3	'a'

A, count(*), max(B)

A	count	max
1	3	'c'
2	2	'b'
3	1	'a'

❖ Grouping (cont)

Example: How many different beers does each brewer make?

```
SELECT   brewer, COUNT(name) as nbeers
FROM     Beers
GROUP BY brewer;

       brewer         | nbeers
----------------------+--------
 West City            |      1
 James Squire         |      5
 Yullis               |      1
 Hop Nation           |      4
 Anderson Valley      |      1
 Beatnik              |      1
 Boatrocker           |      3
 Kizakura             |      1
 ...
```

❖ Grouping (cont)

`GROUP BY` is used as follows:

```
SELECT    attributes/aggregations
FROM      relations
WHERE     condition
GROUP BY  attributes
```

Semantics:

1. apply product and selection as for **`SELECT-FROM-WHERE`**
2. partition result into groups based on values of *attributes*
3. apply any aggregation separately to each group

Grouping is typically used in queries involving the phrase "for each".

❖ Restrictions on SELECT Lists

When using grouping, every attribute in the **SELECT** list must:

- have an aggregation operator applied to it OR
- appear in the **GROUP-BY** clause

Incorrect Example: Find the styles associated with each brewer

```
SELECT   brewer, style
FROM     Beers
GROUP BY brewer;
```

PostgreSQL's response to this query:

```
ERROR: column beers.style must appear in the GROUP BY
         clause or be used in an aggregate function
```

❖ Filtering Groups

In some queries, you can use the **WHERE** condition to eliminate groups.

Example: Average beer price by suburb excluding hotels in The Rocks.

```
SELECT   b.addr, AVG(s.price)
FROM     Sells s join Bars b on (s.bar=b.name)
WHERE    b.addr <> 'The Rocks'
GROUP BY b.addr;
```

For conditions on whole groups, use the **HAVING** clause.

❖ Filtering Groups (cont)

HAVING is used to qualify a **GROUP-BY** clause:

```
SELECT    attributes/aggregations
FROM      relations
WHERE     condition₁     (on tuples)
GROUP BY  attributes
HAVING    condition₂;    (on group)
```

Semantics of **HAVING**:

1. generate the groups as for **GROUP-BY**
2. discard groups not satisfying **HAVING** condition
3. apply aggregations to remaining groups

❖ Filtering Groups (cont)

Example: Number of styles from brewers who make at least 5 beers?

```
SELECT   brewer, count(name) as nbeers,
         count(distinct style) as nstyles
FROM     Beers
GROUP BY brewer
HAVING   count(name) > 4
ORDER BY brewer;

      brewer       | nbeers | nstyles
-------------------+--------+---------
 Bentspoke         |      9 |       7
 Carlton           |      5 |       2
 Frenchies         |      5 |       5
 Hawkers           |      5 |       5
 James Squire      |      5 |       4
 One Drop          |      9 |       7
 Sierra Nevada     |      5 |       5
 Tallboy and Moose |      5 |       5
```

`distinct` required, otherwise **`nbeers=nstyles`** for all brewers

❖ Filtering Groups (cont)

Alternative formulation of division using **`GROUP-BY`** and **`HAVING`**

Example: Find bars that each sell all of the beers Justin likes.

```
SELECT DISTINCT S.bar
FROM   Sells S, Likes L on (S.beer = L.beer)
WHERE  L.drinker = 'Justin'
GROUP  BY S.bar
HAVING count(S.beer) =
           (SELECT count(beer) FROM Likes
            WHERE drinker = 'Justin');
```

❖ Partitions

Sometimes it is useful to

- partition a table into groups
- compute results that apply to each group
- use these results with individual tuples in the group

Comparison with **`GROUP-BY`**

- **`GROUP-BY`** produces one tuple for each group
- **`PARTITION`** augments each tuple with group-based value(s)
- can use other functions than aggregates (e.g. ranking)
- can use attributes other than the partitioning ones

❖ Partitions (cont)

Syntax for **`PARTITION`**:

```
SELECT attr1, attr2, ...,
       aggregate1 OVER (PARTITION BY attri),
       aggregate2 OVER (PARTITION BY attrj), ...
FROM   Table
WHERE  condition on attributes
```

Note: the *condition* cannot include the *aggregate* value(s)

❖ Partitions (cont)

Example: show each city with daily temperature and temperature range

Schema: *Weather(city,date,temperature)*

```
SELECT city, date, temperature
       min(temperature) OVER (PARTITION BY city) as lowest,
       max(temperature) OVER (PARTITION BY city) as highest
FROM   Weather;
```

Output: *Result(city, date, temperature, lowest, highest)*

❖ Partitions (cont)

Example showing **`GROUP BY`** and **`PARTITION`** difference:

```
SELECT city, min(temperature) max(temperature)
FROM   Weather  GROUP BY city
```

Result: one tuple for each city *Result(city,min,max)*

```
SELECT city,  date,  temperature as temp,
       min(temperature) OVER (PARTITION BY city),
       max(temperature) OVER (PARTITION BY city)
FROM   Weather;
```

Result: one tuple for each temperature measurement.

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