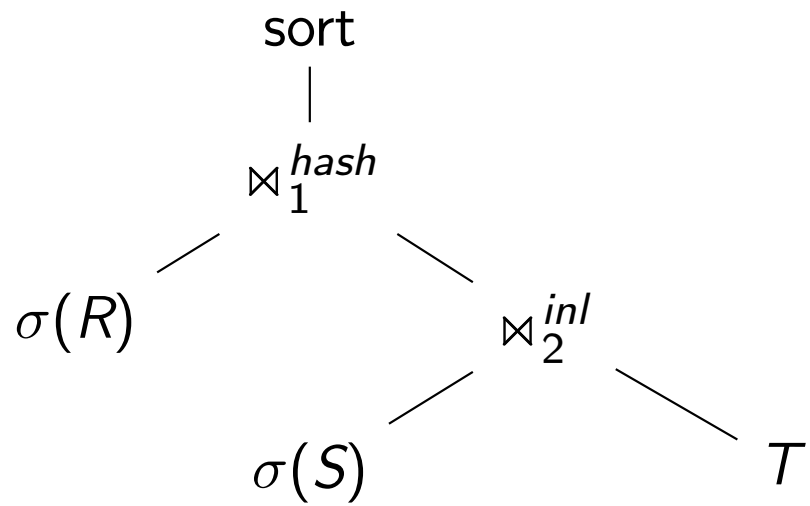
SQL Subqueries

Background: execution model

Iterator model:

- open()
- next()
- close()



Background: aggregation

```
select max(age)
from students
```

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from students
```

$$\Gamma_{max(age)}$$
$$|$$
$$students$$

Example (1)

```
select *
from students
where age = (select max(age)
             from students)
```

How to execute it?

Example (2)

```
select *
from R
where R.a in (select S.b
              from S
              where S.c = R.d)
```

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select *
from R
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How to execute it?
Correlated subquery.
Subquery unnesting – getting rid of subqueries.

Type A subqueries

```
select *
from students
where age = (select max(age)
             from students)
```

Evaluate inner block only once – build side of a join.
Outer query becomes the probe side of a join

Type N subqueries

```
select *
from students
where student_id in (select student_id
                     from students
                     where semester = 1)
```

Same technique. Subquery becomes a build side of a *semi-join*

Type JA subqueries

```
select *
from students s1
where s1.age = (select max(s2.age)
                from students s2
                where s2.dept_id = s1.dept_id)
```

Type JA subqueries

```
select *
from students s1
where s1.age = (select max(s2.age)
                from students s2
                where s2.dept_id = s1.dept_id)
```

Group by `s2.dept_id`, compute `max(s2.age)`.
Then join wiht the `s1`

Type JA subqueries: COUNT bug

```
select d.name
from department d
where d.num_prof > (select count(s.id)
            from students s
            where s.dept_id = d.id)
```

Type JA subqueries: COUNT bug

```
select d.name
from department d
where d.num_prof > (select count(s.id)
                    from students s
                    where s.dept_id = d.id)
```

$\text{COUNT}(\emptyset) = 0$

Use outer-join for unnesting COUNT queries

Dealing with quantifiers

- `... < ANY (select ...)` $\Rightarrow$ `...< (select max() ...)`
- `... < ALL (select ...)`

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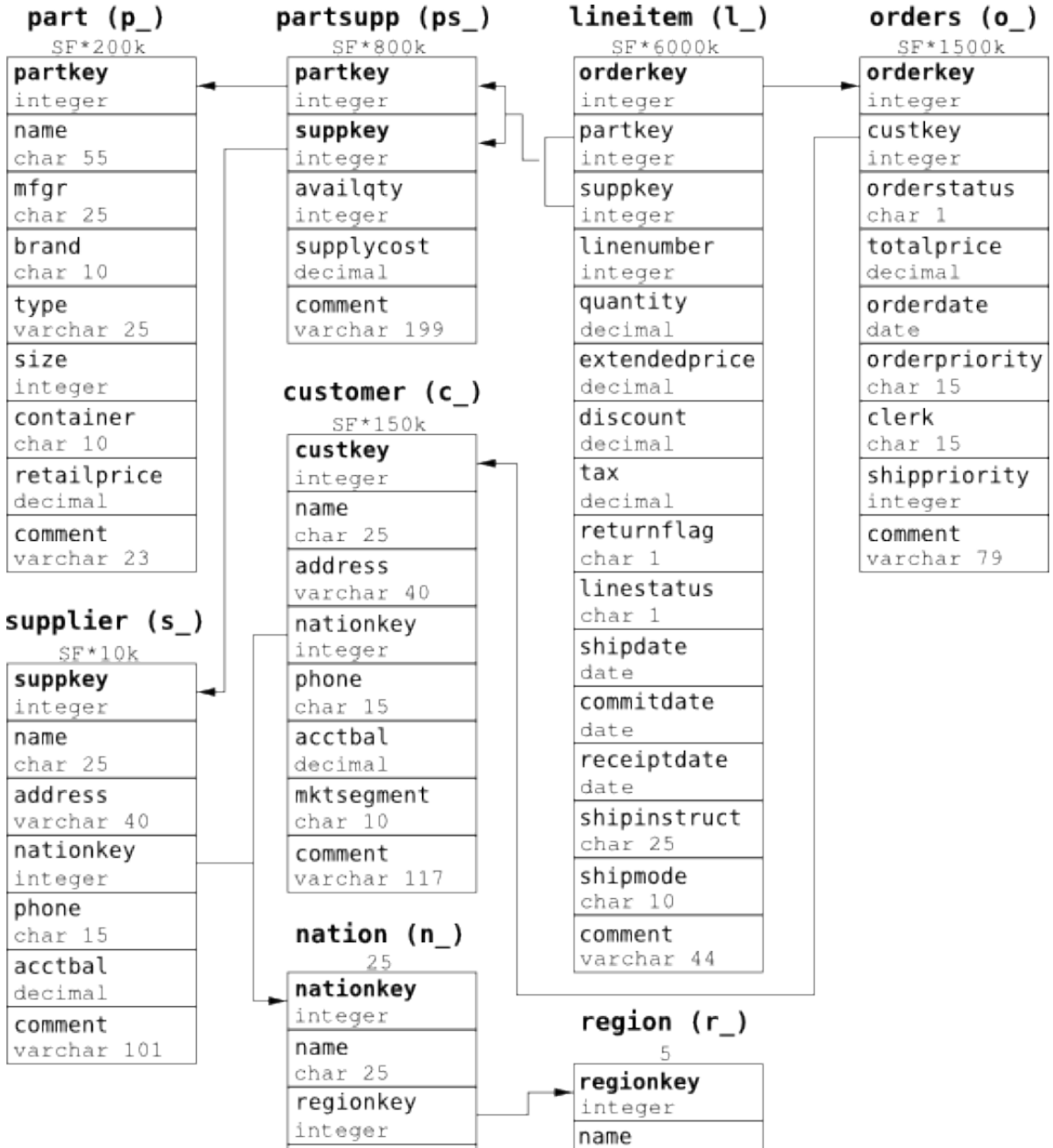
- `... < ANY (select ...)` $\Rightarrow$ `...< (select max() ...)`
- `... < ALL (select ...)` $\Rightarrow$ `...< (select min() ...)`
- for $>$: flip the rules
- `EXISTS` (correlated): semi-join

TPC-H

TPC-H - "22 most well studied SQL queries in history"



TPC-H Query 4

```
select
        o_orderpriority,
        count(*) as order_count
from
        orders
where
        o_orderdate >= date '1993-07-01'
        and o_orderdate < date '1993-10-01'
        and exists (
                select   *
                from lineitem
                where l_orderkey = o_orderkey
                        and l_commitdate < l_receiptdate
        )
group by o_orderpriority
order by o_orderpriority
```

TPC-H Query 16

```
select p_brand, p_type, p_size,
        count(distinct ps_suppkey) as supplier_cnt
from partsupp, part
where   p_partkey = ps_partkey
        and p_brand <> 'Brand#45'
        and p_type not like 'MEDIUM POLISHED%'
        and p_size in (49, 14, 23, 45, 19, 3, 36, 9)
        and ps_suppkey not in (
                select s_suppkey
                from supplier
                where s_comment like '%Customer%Complaints%
group by  p_brand, p_type, p_size
order by  supplier_cnt desc,  p_brand, p_type, p_size
```

TPC-H Query 17

```
select  sum(l_extendedprice) / 7.0 as avg_yearly
from
        lineitem,
        part
where
        p_partkey = l_partkey
        and p_brand = 'Brand#23'
        and p_container = 'MED BOX'
        and l_quantity < (
                select
                        0.2 * avg(l_quantity)
                from
                        lineitem
                where
                        l_partkey = p_partkey
        )
```