Optimizing Queries on SQL-Level

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Guided Research

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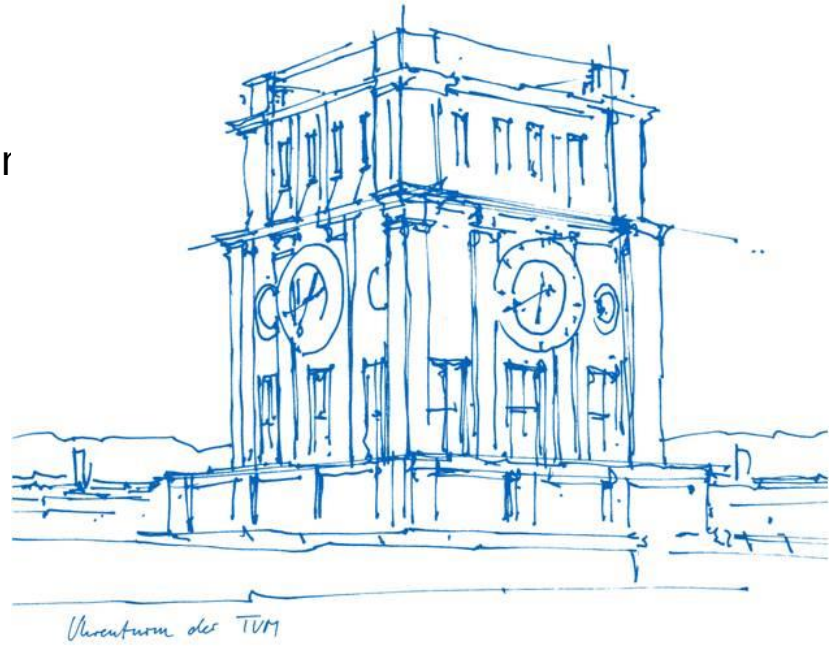
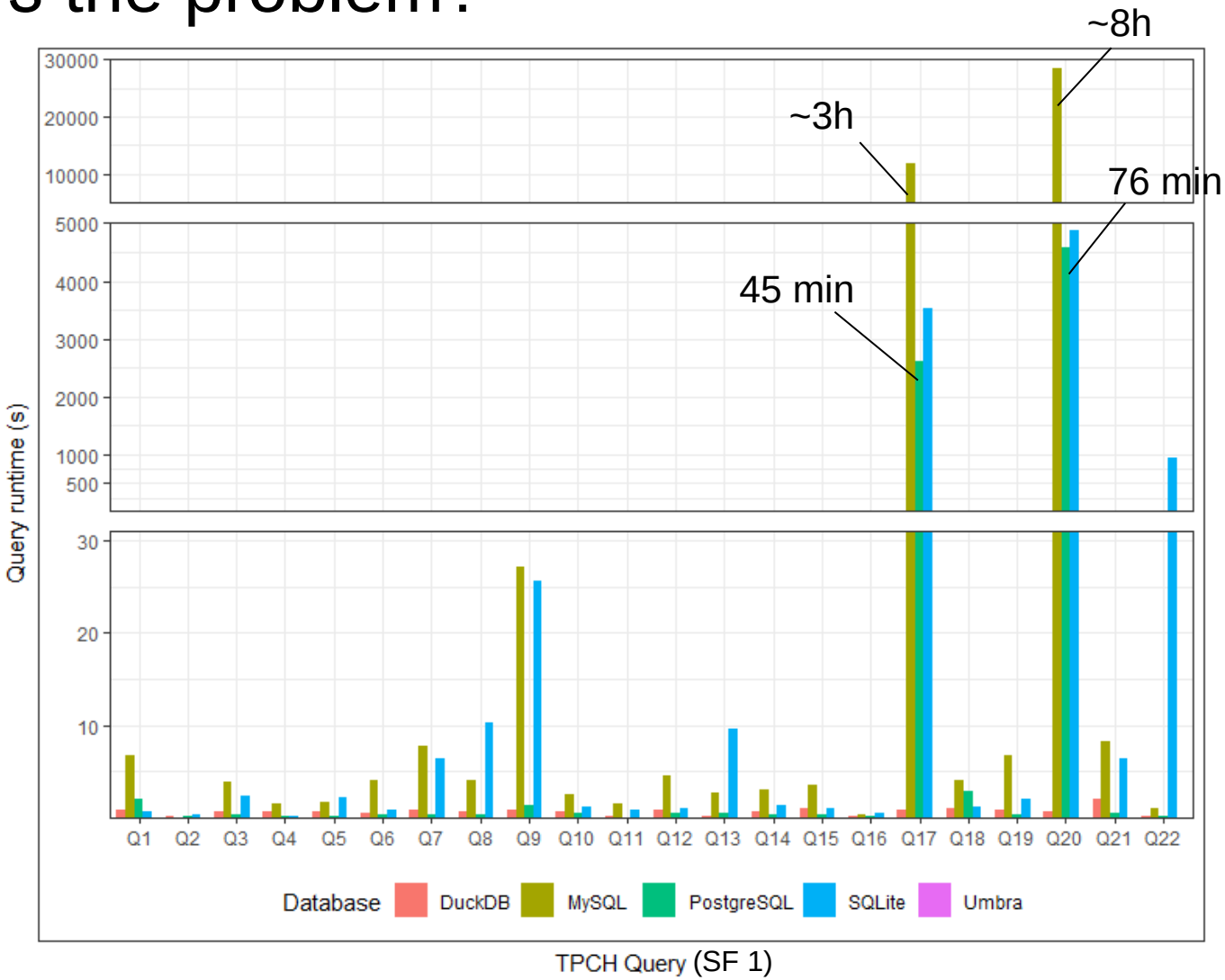


What‘s the problem?



Correlated Subqueries…

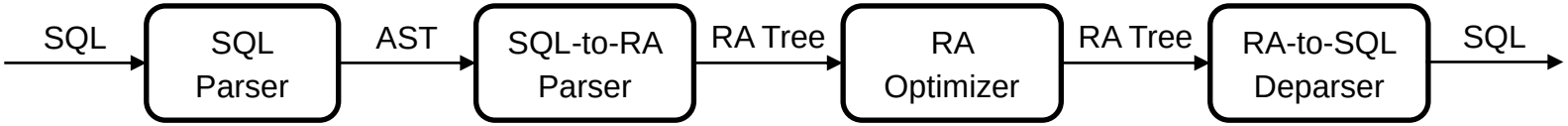
```sql
-- TPC-H Query 17
select
        sum(l_extendedprice) / 7.0 as avg_yearly
from
        lineitem,
        part
where
        p_partkey = l_partkey
        and p_brand = 'Brand#23'
        and p_container = 'MED BOX'
        and l_quantity < (
                select
                        0.2 * avg(l_quantity)
                from
                        lineitem
                where
                        l_partkey = p_partkey
        )
```

We can decorrelate this query in SQL

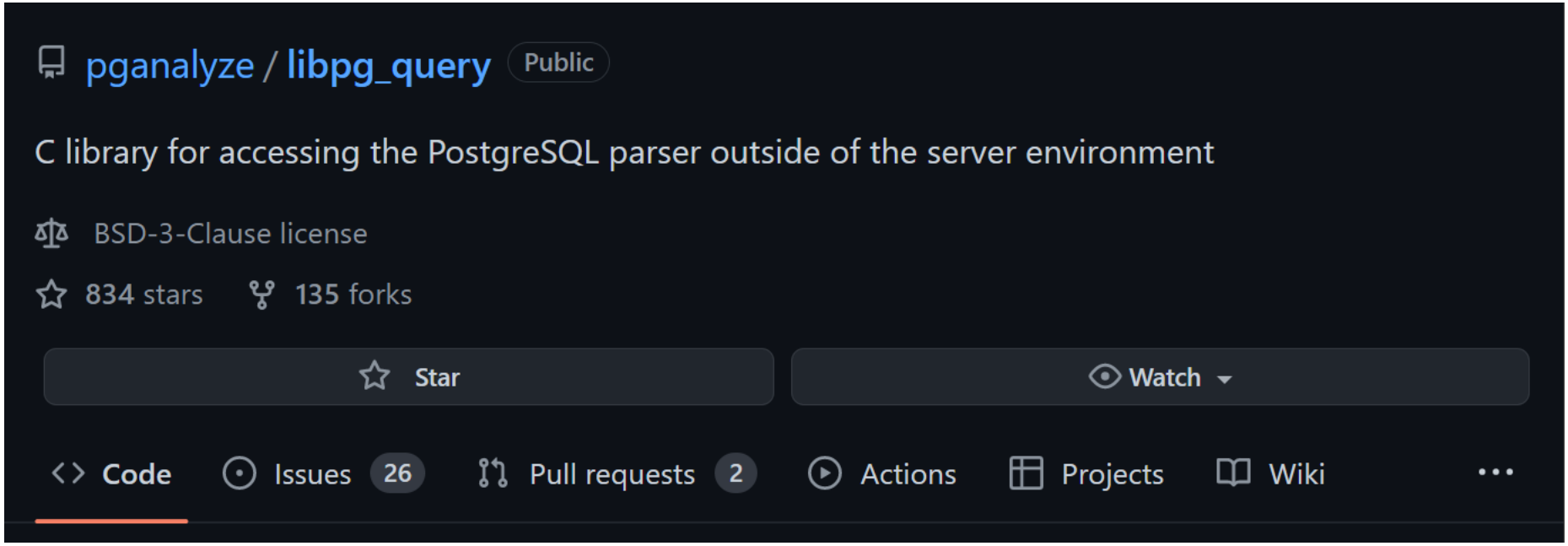
```sql
-- TPC-H Query 17
select
        sum(l_extendedprice) / 7.0 as avg_yearly
from
        lineitem,
        part
where
        p_partkey = l_partkey
        and p_brand = 'Brand#23'
        and p_container = 'MED BOX'
        and l_quantity < (
                select
                        0.2 * avg(l_quantity)
                from
                        lineitem
                where
                        l_partkey = p_partkey
        )
```

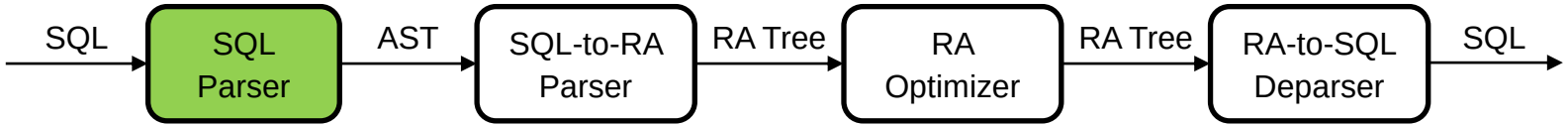
```sql
select
        sum(l_extendedprice)/7.0 as avg_yearly
from
        part,
        lineitem,
        (
                select 0.2*avg(l_quantity),
                        l_partkey
                from
                        lineitem
                group by
                        l_partkey
                ) as t1(m,t1_p_partkey)
where
        l_quantity<t1.m
        and p_partkey=t1.t1_p_partkey
        and p_partkey=l_partkey
        and p_brand='Brand#23'
        and p_container='MED BOX';
```

Architecture



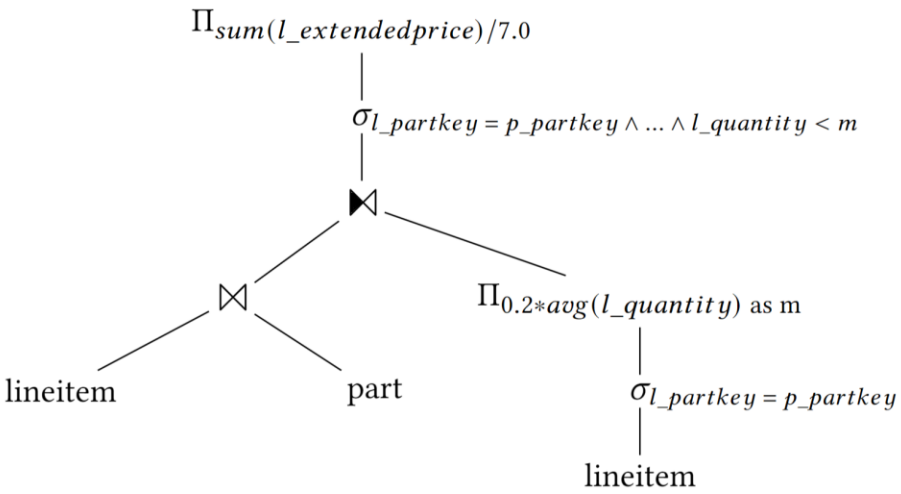
SQL Parser

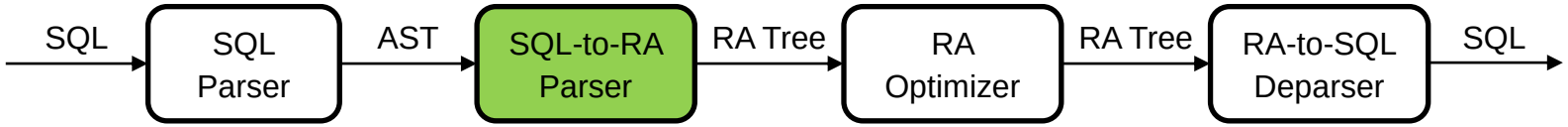

pganalyze / libpg_query
Public
C library for accessing the PostgreSQL parser outside of the server environment
BSD-3-Clause license
834 stars
135 forks
Star
Watch
Code
Issues 26
Pull requests 2
Actions
Projects
Wiki


SQL
SQL Parser
AST
SQL-to-RA Parser
RA Tree
RA Optimizer
RA Tree
RA-to-SQL Deparser
SQL

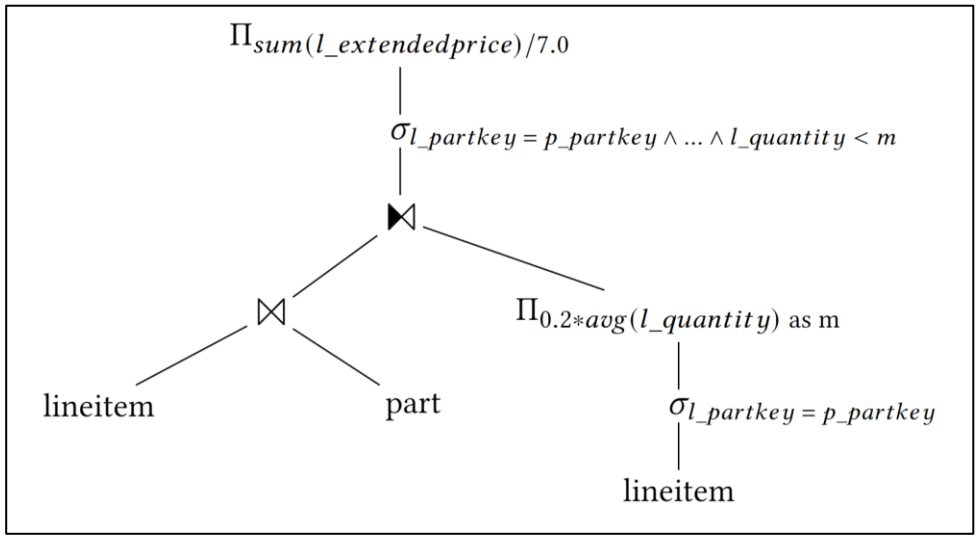
SQL-to-RA Parser

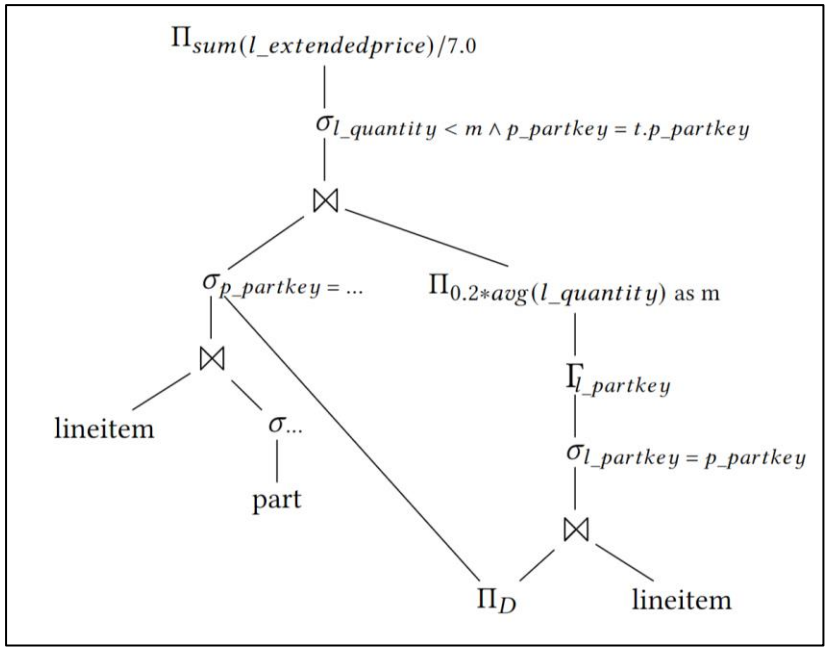
```sql
-- TPC-H Query 17
select
        sum(l_extendedprice) / 7.0 as avg_yearly
from
        lineitem,
        part
where
        p_partkey = l_partkey
        and p_brand = 'Brand#23'
        and p_container = 'MED BOX'
        and l_quantity < (
                select
                        0.2 * avg(l_quantity)
                from
                        lineitem
                where
                        l_partkey = p_partkey
        )
```

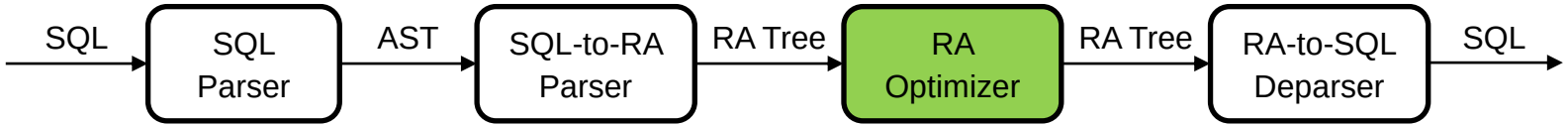




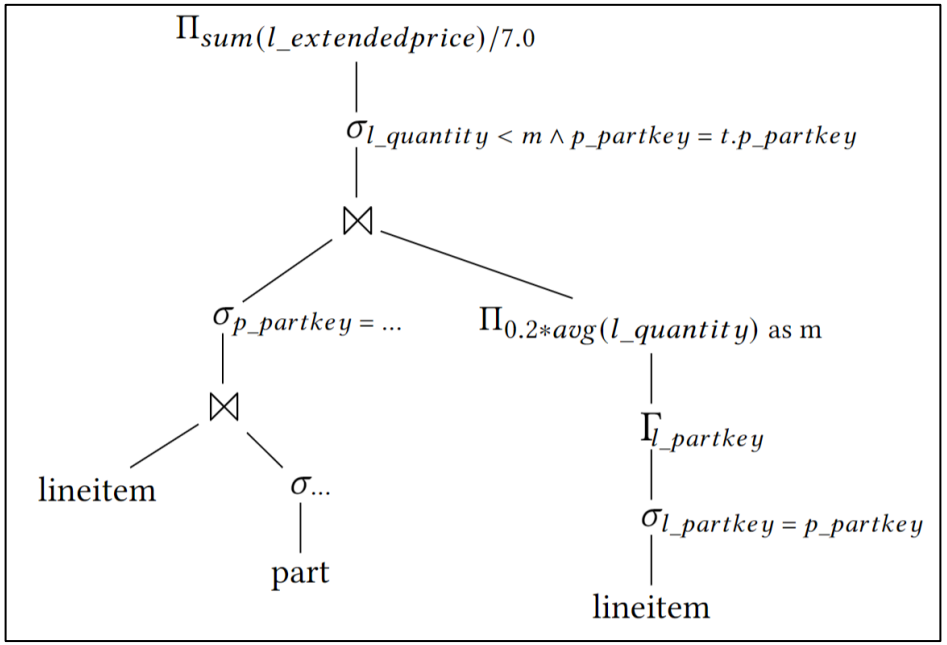
RA Optimizer



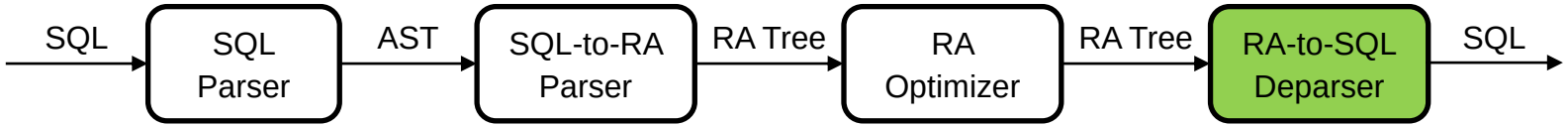




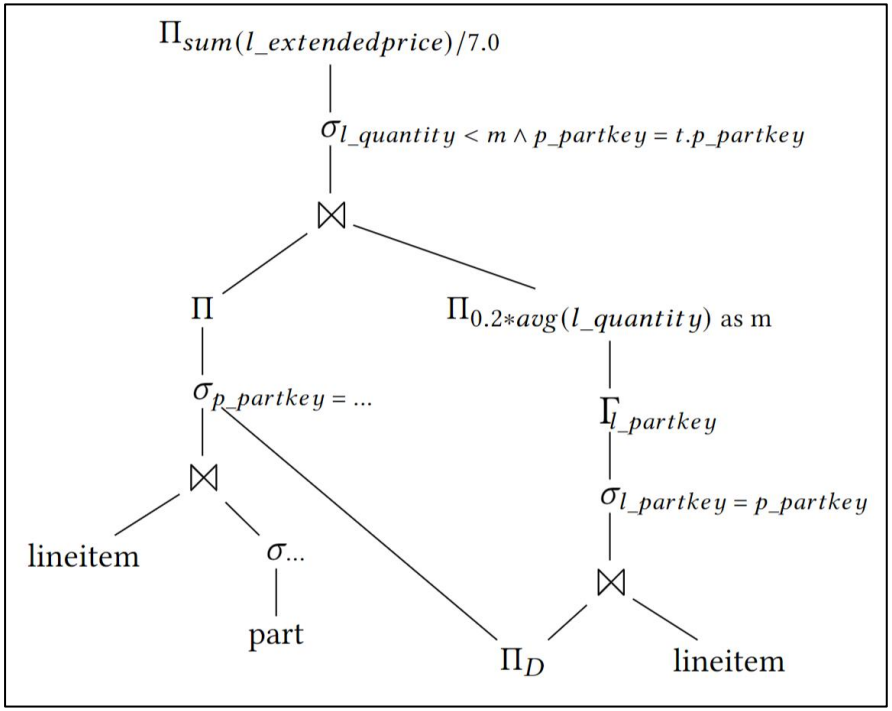
RA-to-SQL Deparser




```
1   select
2           sum(l_extendedprice)/7.0 as avg_yearly
3   from
4           part,
5           lineitem,
6           (
7                   select 0.2*avg(l_quantity),
8                           l_partkey
9                   from
10                          lineitem
11                  group by
12                          l_partkey
13                  ) as t1(m,t1_p_partkey)
14  where
15          l_quantity<t1.m
16          and p_partkey=t1.t1_p_partkey
17          and p_partkey=l_partkey
18          and p_brand='Brand#23'
19          and p_container='MED BOX';
```



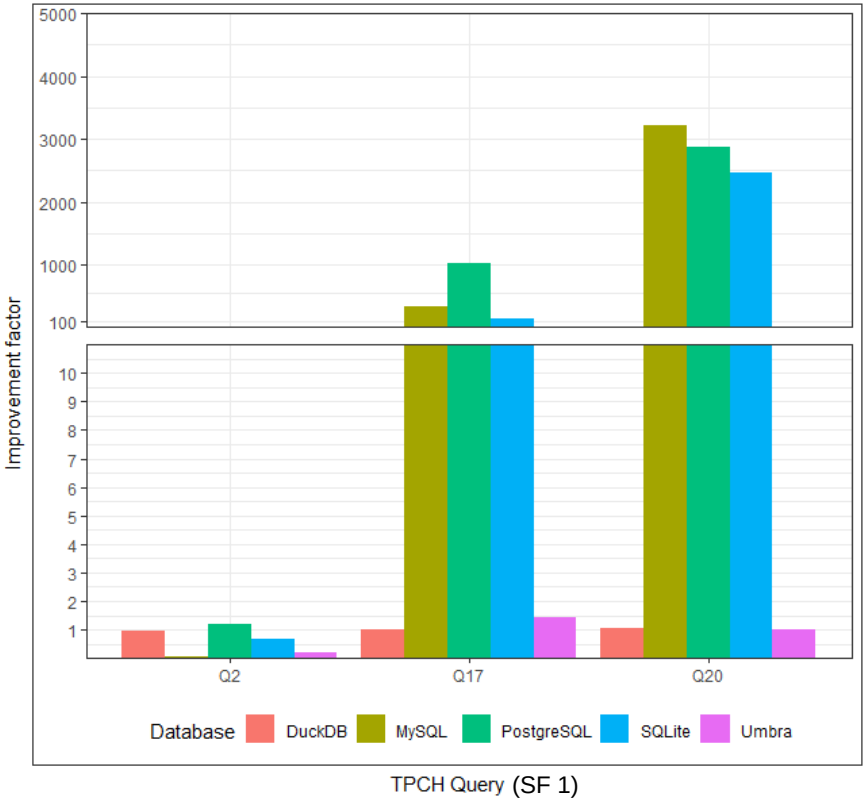
To decouple, or not to decouple



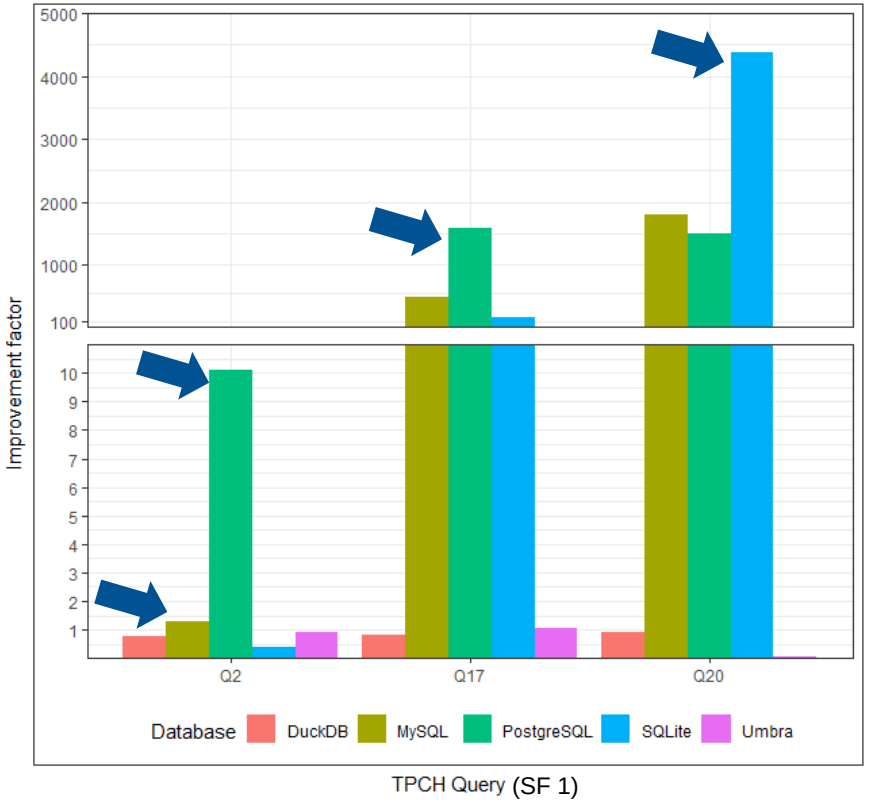

```sql
-- TPC-H Query 17
with cte_2 as (
        select
                l_extendedprice,
                l_quantity,
                p_partkey,
                l_partkey
        from
                part,
                lineitem
        where
                p_partkey=l_partkey
                and (p_brand='Brand#23' and p_container='MED BOX')
)
select
        (sum(l_extendedprice)/7.0) as avg_yearly
from
        cte_2,
        (select
                (0.2*avg(l_quantity)),
                d.p_partkey
        from    (select
                        p_partkey
                from cte_2
                ) as d(p_partkey), lineitem
        where l_partkey=d.p_partkey
        group by d.p_partkey
        ) as t1(m,t1_p_partkey)
where
        l_quantity<t1.m
        and p_partkey=t1.t1_p_partkey;
```

To decouple, or not to decouple

Decoupled



Not decoupled



Correlated *exists* and *in* subqueries

```
select ...
from   lineitem l1 ...
where  exists (select *
               from lineitem l2
               where l2.l_orderkey = l1.l_orderkey)
```

$$l_1 \ltimes (\sigma_{l_1.okey=l_2.okey}(l_2))$$

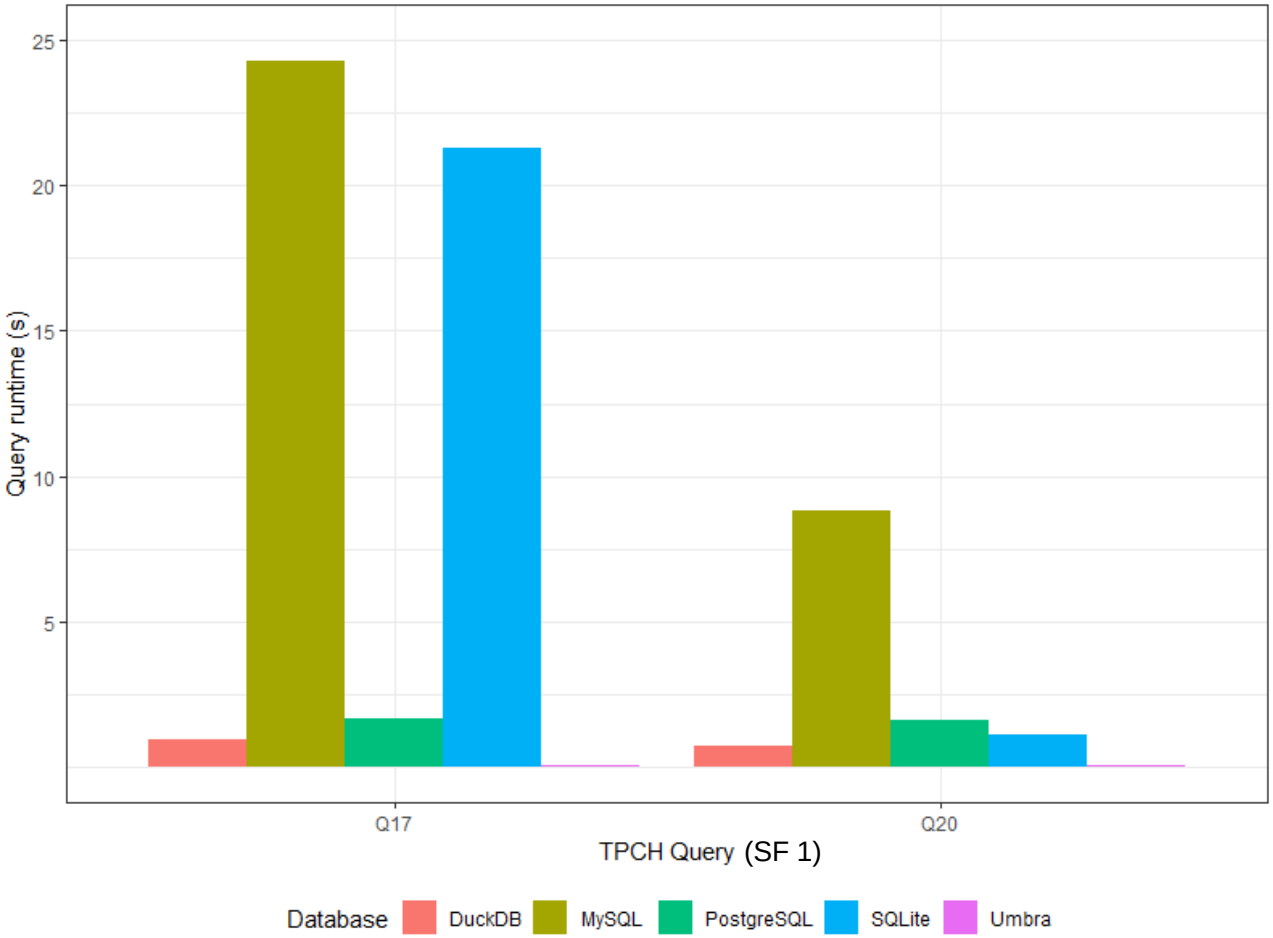
$$l_1 \ltimes_{l_1.okey=l_2.okey} (l_2)$$

Correlated *exists* and *in* subqueries

```sql
-- TPC-H Query 4
select
        o_orderpriority,
        count(*) as order_count
from
        orders
where
        o_orderdate >= date '1993-07-01'
        and o_orderdate < date '1993-07-01' + interval '3' month
        and exists (
                select
                        *
                from
                        lineitem
                where
                        l_orderkey = o_orderkey
                        and l_commitdate < l_receiptdate
        )
group by
        o_orderpriority
order by
        o_orderpriority
```

```sql
with cte_1(l_orderkey) as (
        select l_orderkey
        from lineitem
        where l_commitdate<l_receiptdate
)
select
        o_orderpriority,
        count(*) as order_count
from orders
where exists (
                select *
                from cte_1
                where cte_1.l_orderkey=o_orderkey
        )
        and o_orderdate>=date '1993-07-01'
        and o_orderdate<date '1993-07-01'+interval '3' month
group by o_orderpriority
order by o_orderpriority;
```

Results


25
20
15
10
5
Query runtime (s)
Q17
Q20
TPCH Query (SF 1)
Database
DuckDB
MySQL
PostgreSQL
SQLite
Umbra