Database Lab
Queries

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Dr. Andreas Geppert
geppert@acm.org

Topics

- conceptual design
- logical design
- consistency constraints
- data manipulation
- **queries**
- transactions
- views
- stored procedures and user-defined functions
- triggers
- database applications with Java (JDBC)

(Query) Performance

- Query evaluation:
  - Bring data onto server (main memory)
  - Evaluate query
- Query optimization
  - Done by the optimizer (planner in Postgres)
  - Searches „optimal“ query execution plan
  - Input:
    - Query
    - Access paths like indexes
    - Statistics
    - Cost parameters
    - (Implementation alternatives)

(Query) Performance

- Example: select resnumber from reservation order by resnumber
  1.
     - read all rows from disk (full table scan)
     - Sort rows
  2.
     - Use (B-tree) index on table reservation over column resnumber (index scan)
- Multiple alternatives exist for operators
     - e.g. join: nested loop, sort/merge, hash, ...

(Query) Performance

- Taking the time of query execution

```
cashdb=> \timing
Timing is on.
cashdb=> select * from reservation order by resnumber;
Time: 6.286 ms
```

- Investigating execution plans in Postgres
- Explain operator:

```
cashdb=> explain select * from reservation order by reservation;
                          QUERY PLAN
---------------------------------------------------------------
 Sort  (cost=212.14..217.64 rows=2200 width=130)
   Sort Key: reservation.*
   ->  Seq Scan on reservation  (cost=0.00..90.00 rows=2200 width=130)
(3 rows)
```

(Query) Performance

- Explain analyze:

```
cashdb=> explain analyze select * from reservation order by reservation;
                                                    QUERY PLAN
-------------------------------------------------------------------------------------------------------------------
 Sort  (cost=212.14..217.64 rows=2200 width=130) (actual time=34.370..34.452 rows=2200 loops=1)
   Sort Key: reservation.*
   Sort Method: quicksort  Memory: 681kB
   ->  Seq Scan on reservation  (cost=0.00..90.00 rows=2200 width=130) (actual time=12.275..22.053
rows=2200 loops=1)
 Planning Time: 0.104 ms
 Execution Time: 34.664 ms
(6 rows)
```

Plan Visualization

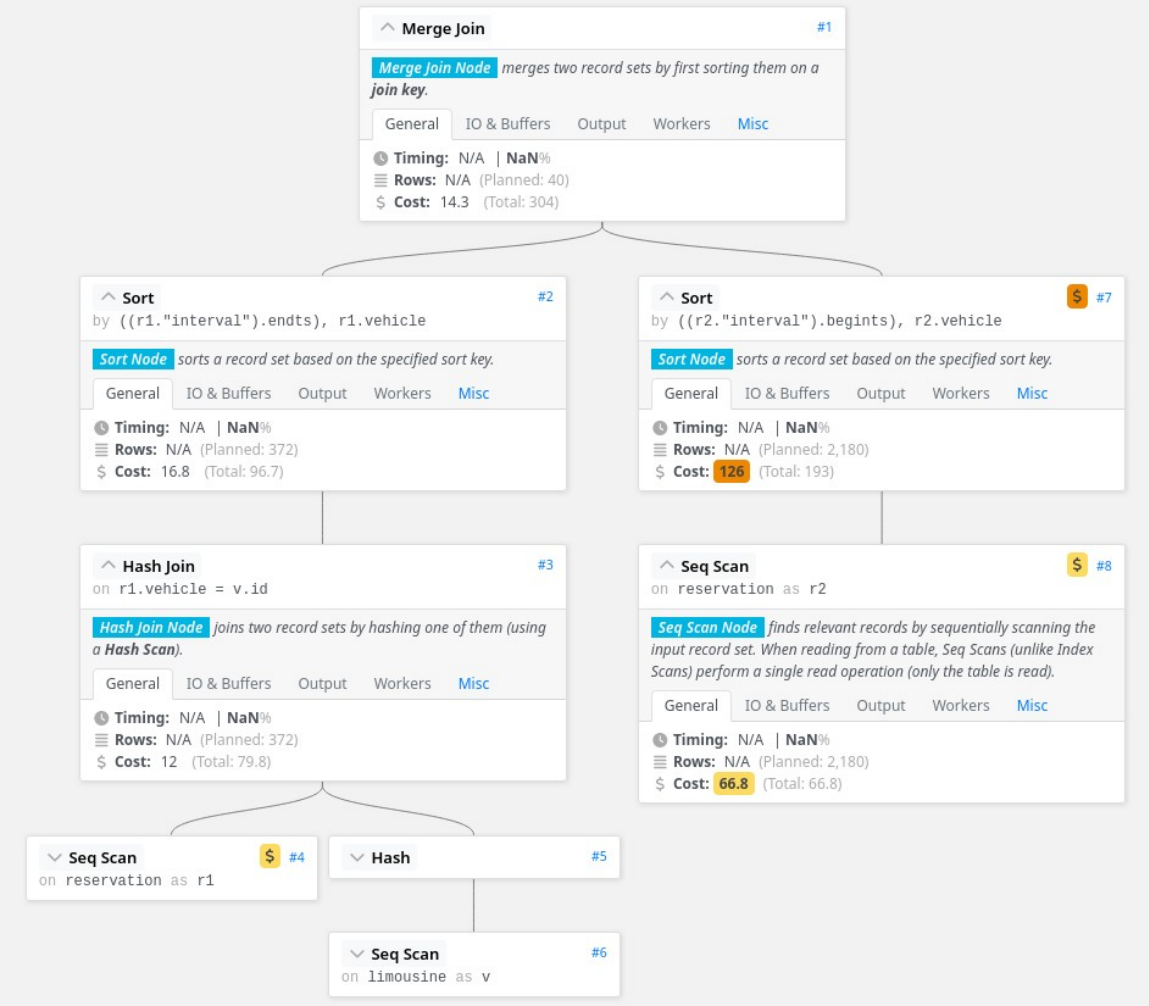
- Sample query: all adjacent pairs of reservations of the same vehicle
-
```
select v.licenseplate,
       (r1.interval).begints,
       (r2.interval).begints
  from reservation r1 join
       reservation r2 on
           (r1.interval).endts = (r2.interval).begints
           and r1.vehicle = r2.vehicle join
       limousine v on r1.vehicle = v.id
 where r1.id < r2.id;
```

Plan Visualization
Execution Plan

```
• Merge Join  (cost=283.42..304.07 rows=40 width=54)
     Merge Cond: ((((r1."interval").endts) = ((r2."interval").begints)) AND (r1.vehicle
  = r2.vehicle))
     Join Filter: (r1.id < r2.id)
     ->  Sort  (cost=95.74..96.67 rows=372 width=87)
           Sort Key: ((r1."interval").endts), r1.vehicle
           ->  Hash Join  (cost=1.16..79.85 rows=372 width=87)
                 Hash Cond: (r1.vehicle = v.id)
                 ->  Seq Scan on reservation r1  (cost=0.00..66.80 rows=2180 width=45)
                 ->  Hash  (cost=1.07..1.07 rows=7 width=42)
                       ->  Seq Scan on limousine v  (cost=0.00..1.07 rows=7 width=42)
     ->  Sort  (cost=187.68..193.13 rows=2180 width=45)
           Sort Key: ((r2."interval").begints), r2.vehicle
           ->  Seq Scan on reservation r2  (cost=0.00..66.80 rows=2180 width=45)
```

Plan Visualization
Visualization Using Dalibo

- Paste execution plan at https://explain.dalibo.com/



Plan Visualization
Visualization Using PGAdmin4