Writing optimal queries

INTRODUCTION TO REDSHIFT

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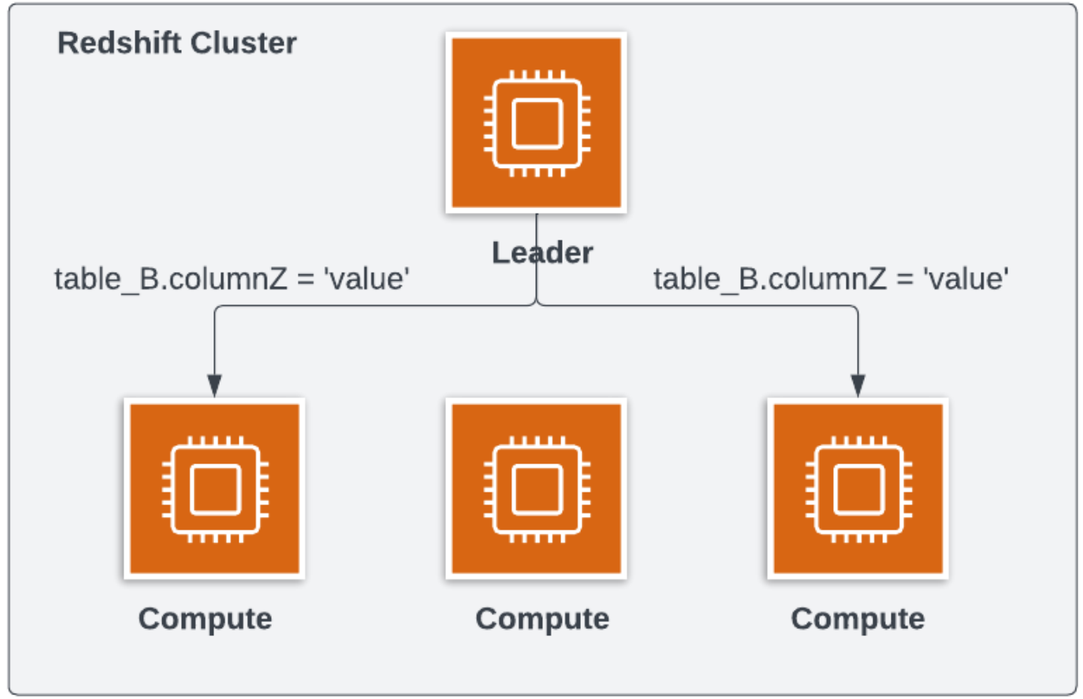
Limit columns

- Avoid `SELECT *`
- Don't select columns you don't need in the result
  - Remember that Redshift is columnar and pulls data by column

Use DISTKEY and SORTKEYs

Use in the following clauses whenever possible

- `JOIN`
- `WHERE`
- `GROUP BY`



Use `SORTKEYs` in order in `ORDER BY`

- Highly optimized
  `sortkey_1, sortkey_2, sortkey_3`
- Not optimized `sort_key_1, sort_key_3`

Building good predicates

- Use `DISTKEY` and `SORTKEY`
- Close to the table join
- Avoid using functions in them

```
SELECT receipts.cookie_id,
       sum(receipts.total)
FROM receipts
JOIN cookies ON receipts.cookie_id = cookies.cookie_id
  -- Keep cookies predicates in the join to push down to nodes holding the records for cookies
 AND cookies.available_on < '2023-11-14'
 AND cookies.end_of_sale IS null
-- Predicates that are not part of the join or on the joined table stay in the WHERE clause
WHERE receipts.order_time > '2023-11-13'
GROUP BY 1 ORDER BY 1;
```

Be consistent with column ordering

When using:

- `GROUP BY`
- `ORDER BY`

Bad

```
GROUP BY col_one, col_two, col_three
ORDER BY col_two, col_three, col_one
```

Good

```
GROUP BY col_two, col_three, col_one
ORDER BY col_two, col_three, col_one
```

Use subqueries wisely

- Use proper join strategies instead of just using a subquery
- Use `EXISTS` in your predicates when just checking for the truthfulness of a subquery result

```
SELECT column_name
FROM table_name
WHERE EXISTS
  (SELECT column_name
   FROM table_name
   WHERE active is True);
```

- If reusing subqueries, use CTEs to take advantage of caching

Let's practice!

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Understanding query performance

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Query optimization process

1. Check the `STL_ALERT_EVENT_LOG` table
2. Run `EXPLAIN` on your query
3. Check the `SVL_QUERY_SUMMARY` and `SVL_QUERY_REPORT` tables

STL_ALERT_EVENT_LOG table

Contains any Redshift alerts triggered by a query

```
SELECT *
  FROM stl_alert_event_log
 WHERE query = 1337;
```

```
 query |              event                |          solution          |     event_time
=======+===================================+============================+====================
  1337 | Missing query planner statist | Run the ANALYZE command | 2023-11-13 18:20:58
```

EXPLAINing the query execution plan

- Shows all the steps of a query and their relative costs and rows scanned
- Works on all Data Manipulation Language (DML) statements:
  - `SELECT`
  - `SELECT INTO`
  - `CREATE TABLE AS`
  - `INSERT`
  - `UPDATE`
  - `DELETE`

Explain example

```
-- Running EXPLAIN on our top ten divisions by
-- revenue query
EXPLAIN WITH top_ten_divisions_by_rev AS
(
  SELECT division_id,
         SUM(revenue) AS revenue_total
    FROM sales_data
   GROUP BY division_id
   ORDER BY revenue_total DESC
   LIMIT 10
),
```

```
division_names AS
(
  SELECT id AS division_id,
         name AS division_name
    FROM division_names
)
SELECT division_name,
       revenue_total
  FROM top_ten_divisions_by_rev
  JOIN division_names USING (DIVISION_ID)
 WHERE revenue_total > 100000;
```

Explain results

```
|QUERY PLAN                                                                                                  |
+------------------------------------------------------------------------------------------------------------+
|Hash Join  (cost=47.11..58.89 rows=3 width=524)                                                             |
|  Hash Cond: (division_names.id = top_ten_divisions_by_rev.division_id)                                     |
|  ->  Seq Scan on division_names  (cost=0.00..11.40 rows=140 width=520)                                     |
|  ->  Hash  (cost=47.07..47.07 rows=3 width=12)                                                             |
|        ->  Subquery Scan on top_ten_divisions_by_rev  (cost=46.92..47.07 rows=3 width=12)                  |
|              Filter: (top_ten_divisions_by_rev.revenue_total > 100000)                                     |
|              ->  Limit  (cost=46.92..46.95 rows=10 width=12)                                               |
|                    ->  Sort  (cost=46.92..47.42 rows=200 width=12)                                         |
|                          Sort Key: (sum(sales_data.revenue)) DESC                                          |
|                          ->  HashAggregate  (cost=40.60..42.60 rows=200 width=12)                          |
|                                Group Key: sales_data.division_id                                           |
|                                ->  Seq Scan on sales_data  (cost=0.00..30.40 rows=2040 width=8)|
```

[1] https://www.postgresql.org/docs/current/using-explain.html

Let's practice!

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Redshift security

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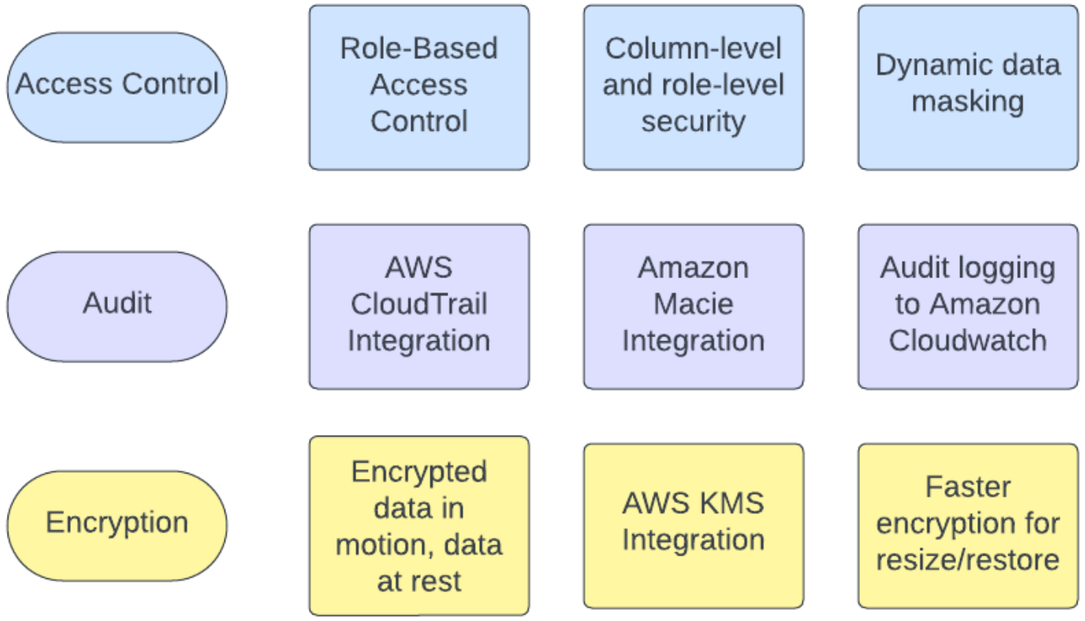
Redshift security

- Column level access control
- Row level security via policies
- Data masking via policies



Column level permissions

- Hides a column completely
- Can verify via `SVV_COLUMN_PRIVILEGES`

```
SELECT *
  FROM SVV_COLUMN_PRIVILEGES
 WHERE relation_name = 'products';
```

```
relation_name | column_name  | privilege_type | identity_name | identity_type
==============|==============|================|===============|==============
products      | product_name | SELECT         | amelia        | user
products      | product_name | SELECT         | analytics     | role
```

Row-level security

- Policies that prefilter data

```
CREATE RLS POLICY policy_books
WITH (category VARCHAR(255))
USING (category = 'Dark Academia');
```

```
SELECT product_line, category, product_name
FROM products;
```

```
product_line | category      | product_name
=============|===============|====================
Books        | Dark Academia | A Deadly Education
```

Row-level security

- SVV_RLS_POLICY to view policies

```
SELECT polname AS policy_name,
       polatts AS column_details,
       polqual AS condition
  FROM SVV_RLS_POLICY;
```

```
policy_name  | column_details                                    | condition
 ============|===================================================|==========================
policy_books | [{"colname":"category","type":"VARCHAR(255)"}] | category = 'Dark Academia'
```

Row-level security admin view

- SVV_RLS_APPLIED_POLICY can be used by Superusers to see affected queries

```
SELECT username,
       command,
       relschema,
       relname,
       polname,
FROM SVV_RLS_APPLIED_POLICY;
```

```
username | command | relschema | relname  | polname
=========|=========|===========|==========|=============
aashvi   |    s    | public    | products | policy_books
```

Dynamic Masking overview

- Policy that obscures values returned by a query
- Only a super user or someone granted can see them
- Uses
  - National ID numbers (e.g. Social Security Number)
  - Credit cards

```
SELECT name, social_security_number
  FROM customers;
```

```
name     | social_security_number
======== | ======================
John Doe | XXX-XX-1234
Jane Doe | XXX-XX-5678
```

Let's practice!

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Congratulations

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Architecture and Data

Redshift Architecture

- Cluster node types
- How queries execute
- Spectrum Internal/external schemas

Data Types

- Standard types
- Semistructured data with the super type
- Conversions

Queries, Performance and Security

Redshift SQL and Functions

- Common Table Expressions
- Time traveling date functions
- Window functions for analysis
- Lead and Lag

Performance & Security

- Writing performant queries
- Investigating query performance issues
- Column level
- Row level
- Data masking

Tables and Views

Table Name	Description
SVV_ALL_SCHEMAS	View schema details
SVV_ALL_TABLES	View table details
SVV_ALL_COLUMNS	View table columns details
STV_PARTITIONS	View details about data across the cluster
SVV_TABLE_INFO	View all details about tables like DISTKEY, SORTKEY, and skew
STL_ALERT_EVENT_LOG	Queries that trigger alerts and possible resolutions
SVL_QUERY_SUMMARY	View query details like size, rows, and time
SVV_COLUMN_PRIVILEGES	View details about column-level security
SVV_RLS_POLICY	View row-level security policy details
SVV_RLS_APPLIED_POLICY	View show queries affected by row-level security policies

Next Steps

- Datacamp Redshift Projects
- AWS Redshift Immersion Labs
- Transactions and Error Handling Datacamp Course

Thank you and Congratulations!

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