Query Performance in Snowflake

INTRODUCTION TO DATA MODELING IN SNOWFLAKE

Nuno Rocha
Director of Engineering

datacamp

Data storage

	Name	Age	Address	Points
	George	21	Art street 1	999-328-232
	Mary	32	Mia street 32	234-111-281
	Paul	44	Uma street 4	309-221-444
	Laura	39	York 9	082-028-042

Row-Based storage

Data storage (1)

	Name	Age	Address	Points
	George	21	Art street 1	999-328-232
	Mary	32	Mia street 32	234-111-281
	Paul	44	Uma street 4	309-221-444
	Laura	39	York 9	082-028-042

Row-Based storage

Data storage (2)

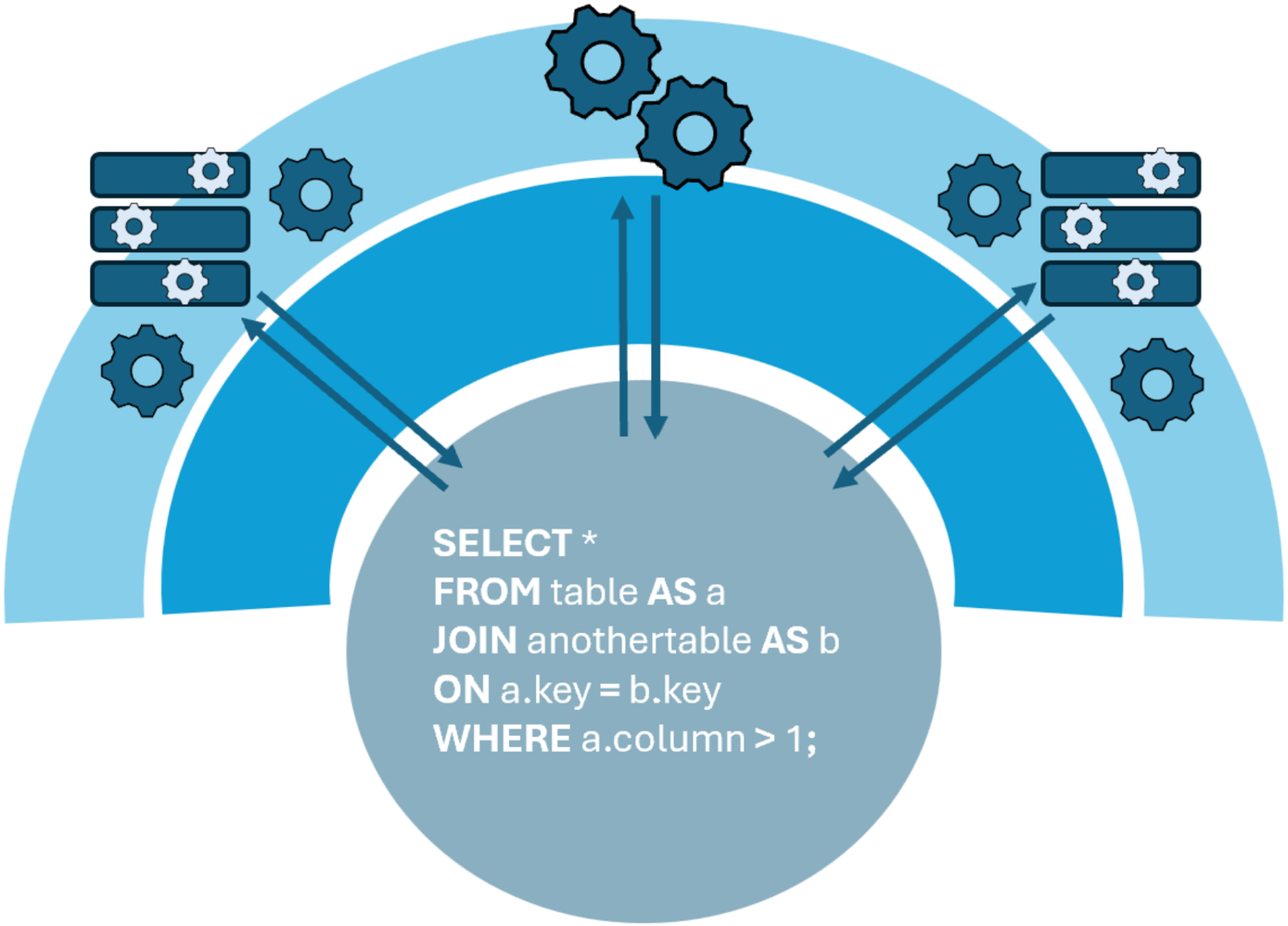
	Name	Age	Address	Points
	George	21	Art street 1	999-328-232
	Mary	32	Mia street 32	234-111-281
	Paul	44	Uma street 4	309-221-444
	Laura	39	York 9	082-028-042

Row-Based storage

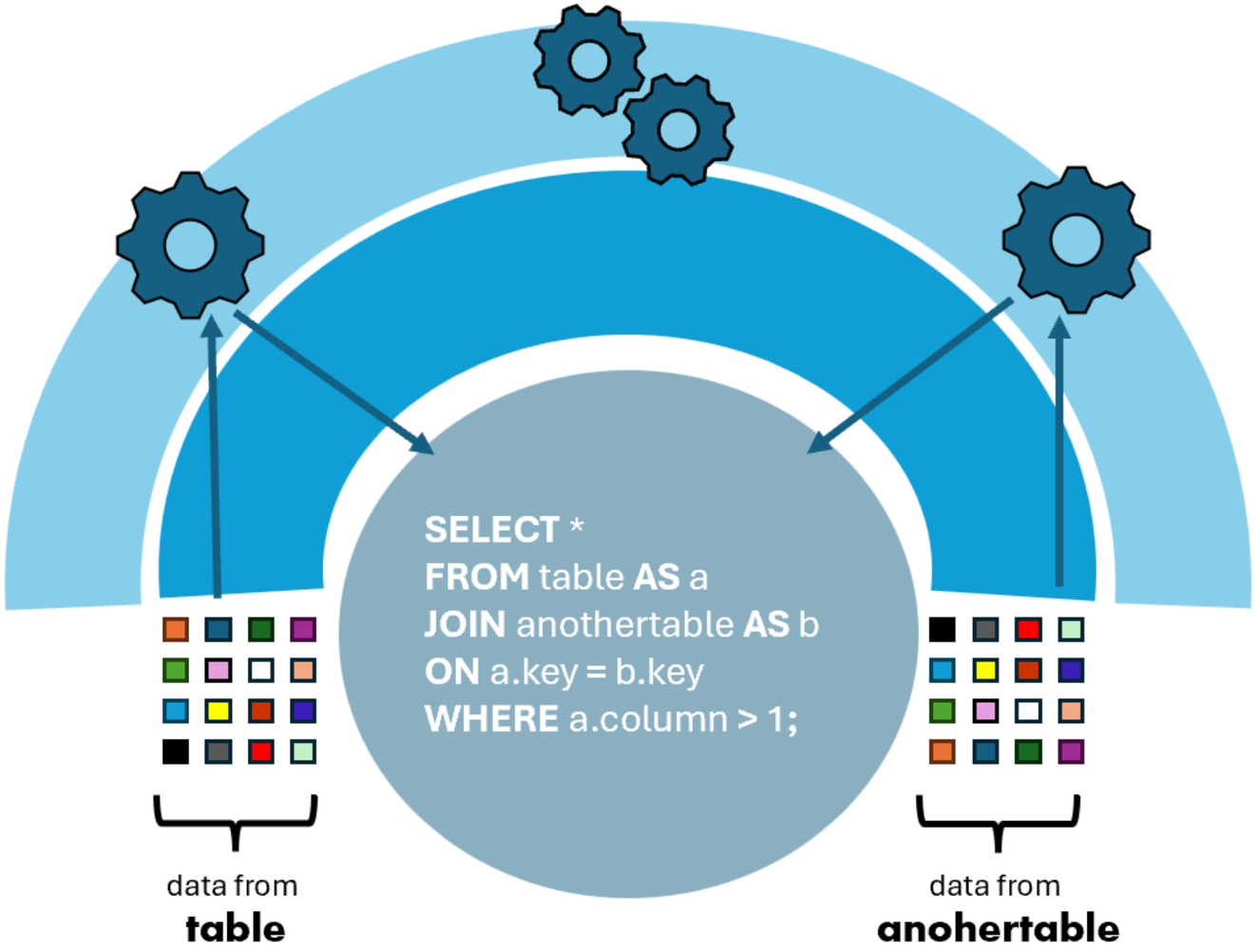
Name	George	Mary	Paul	Laura
Age	21	32	44	39
Address	Art street 1	Mia street 32	Uma street 4	York 9
Phone	999-328-232	234-111-281	309-221-444	082-028-042

Column-Based storage

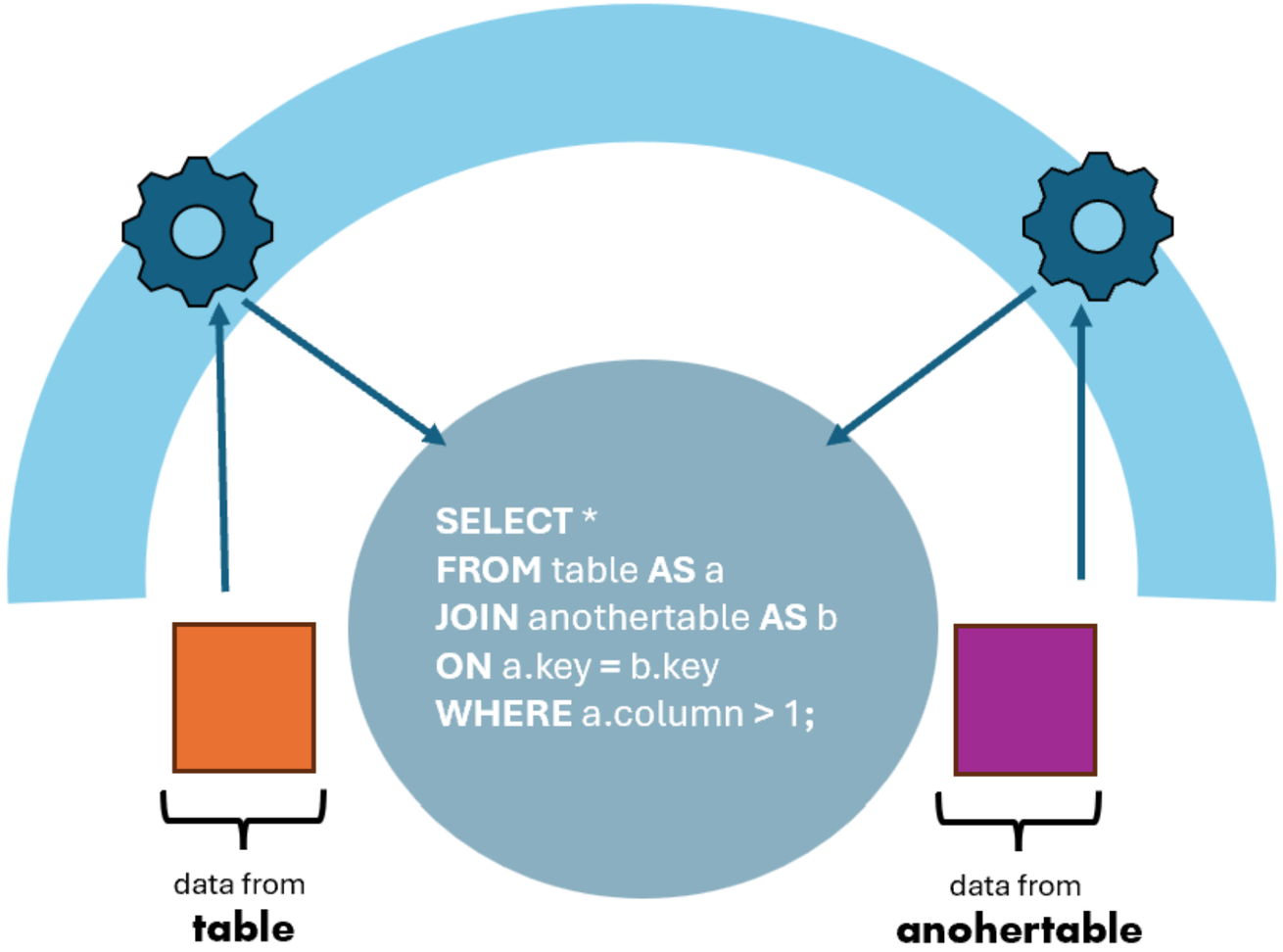
Massively parallel processing



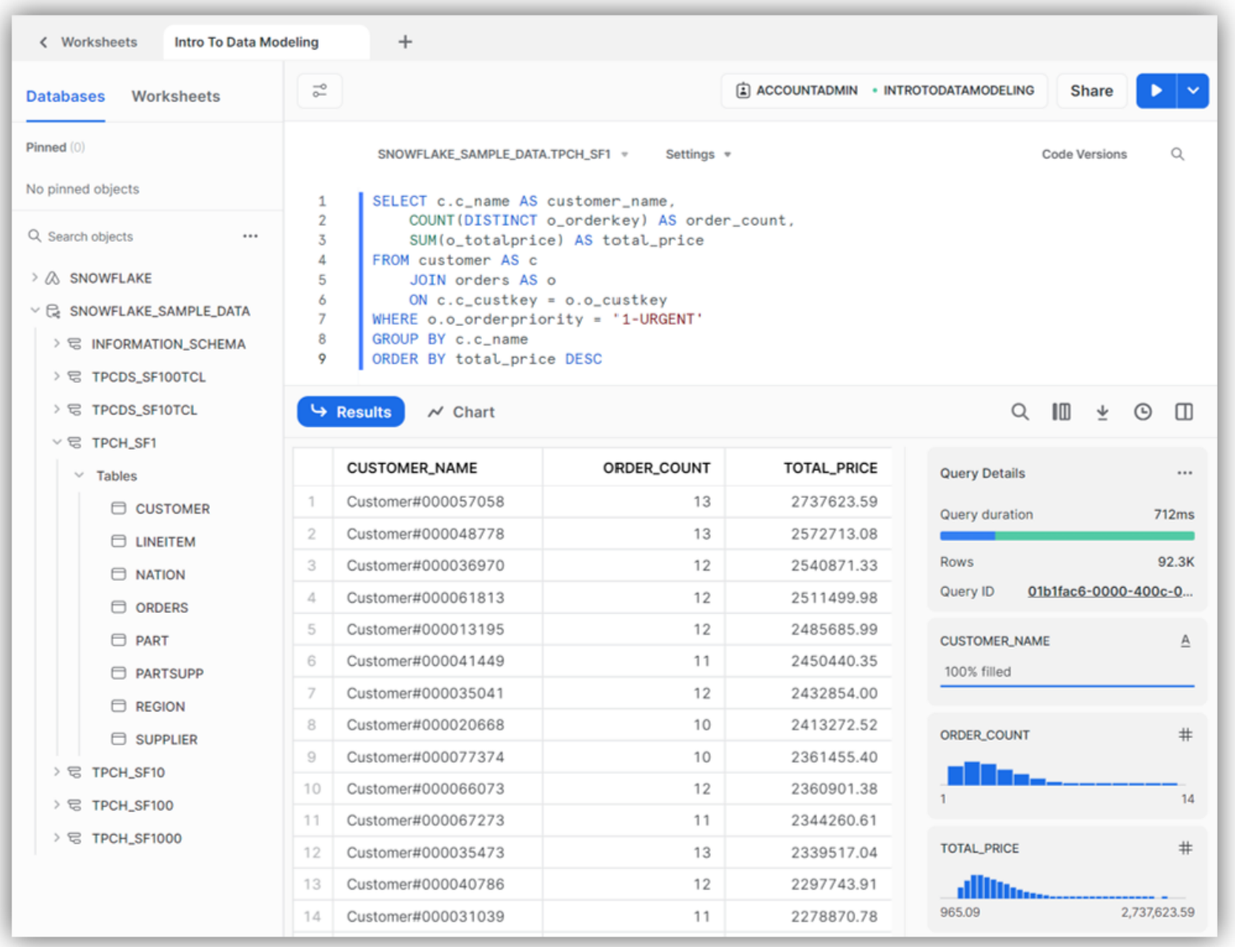
MPP's role in data storage



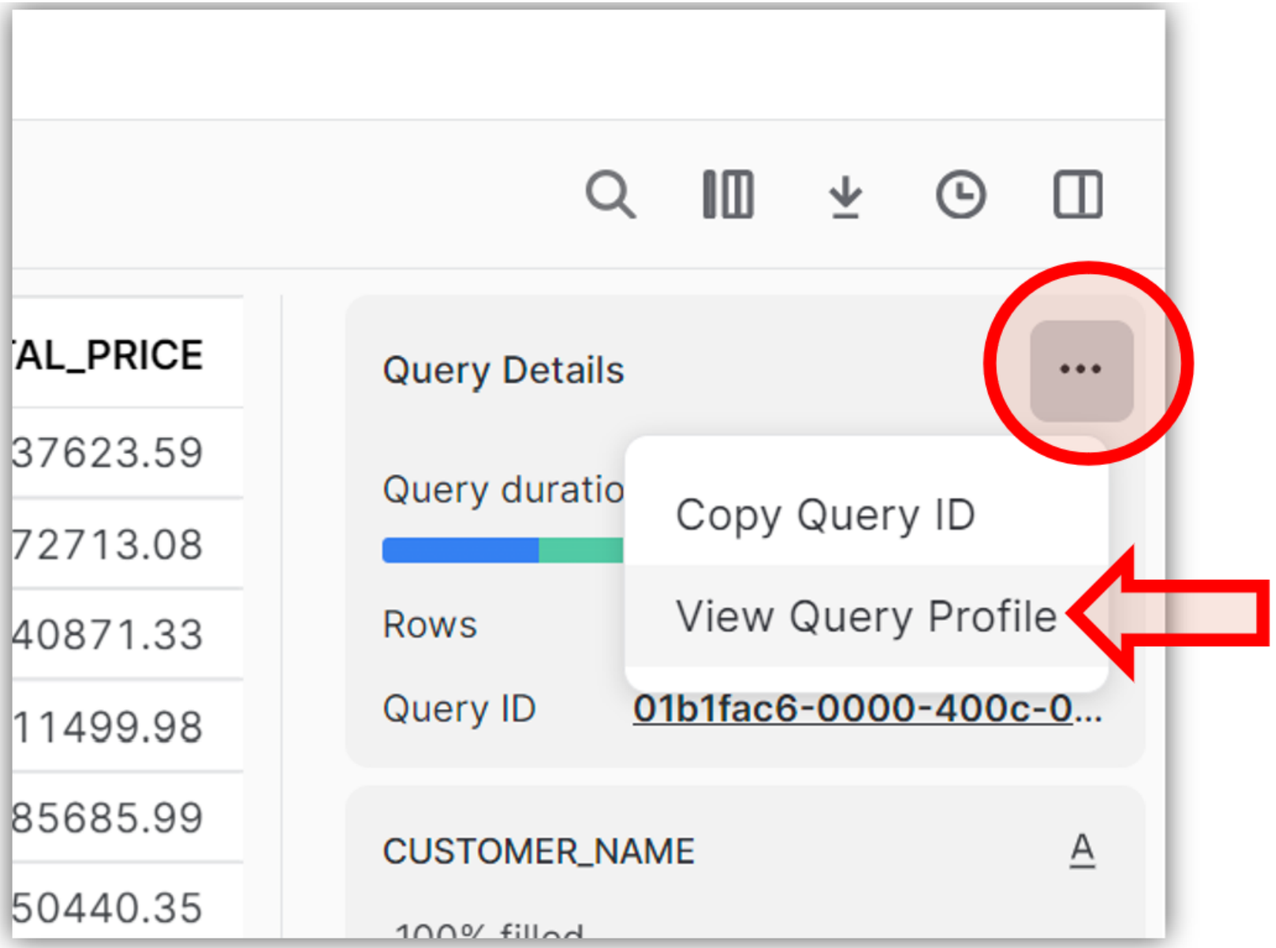
MPP's role in data storage (1)



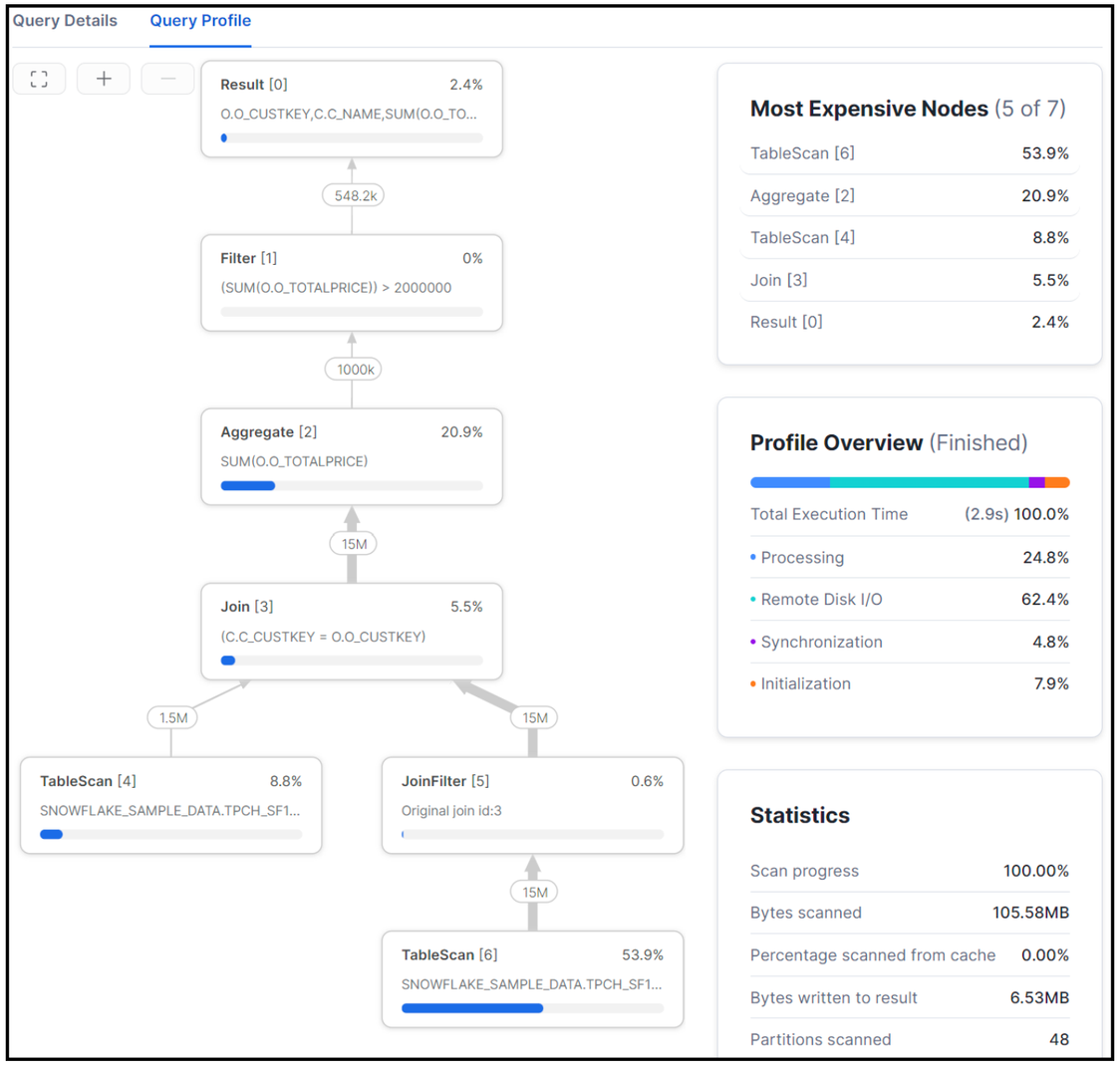
Visualizing query execution times



Visualizing query execution times (1)



Visualizing query execution times (2)



Terminology overview

- **Massively Parallel Processing (MPP)**: Snowflake's engine that processes data using multiple servers simultaneously.
- **Micro-partitions**: Small data storage segments in Snowflake that enhance retrieval speed.
- **Columnar Storage**: Data storage format that stores each column of data separately.
- **Row-based Storage**: Traditional data storage format where each row of data is stored sequentially.
- **PostgreSQL**: Open-source relational database system that uses row-based storage, commonly compared to Snowflake for performance benchmarking.
- **Query Profile**: Snowflake feature to visualize the steps and resource usage of query execution.

Let's practice!

INTRODUCTION TO DATA MODELING IN SNOWFLAKE

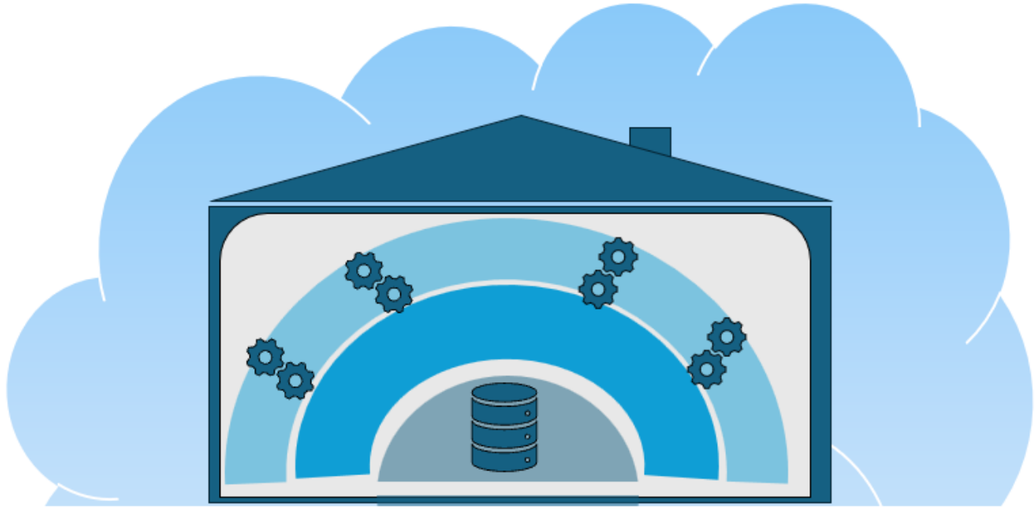
Snowflake Data Objects

INTRODUCTION TO DATA MODELING IN SNOWFLAKE

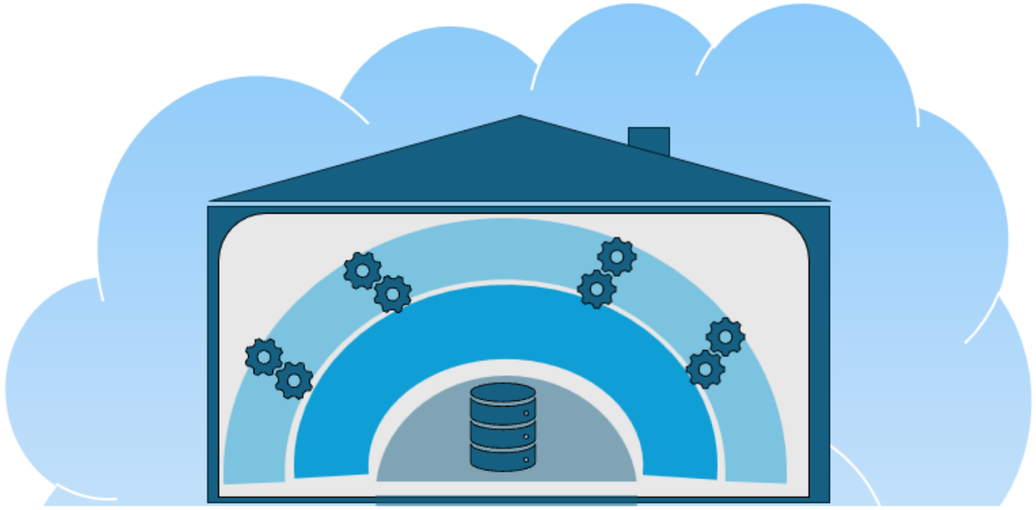
Nuno Rocha
Director of Engineering

Data warehouse

Traditional vs. virtual warehouse



Traditional vs. virtual warehouse (1)

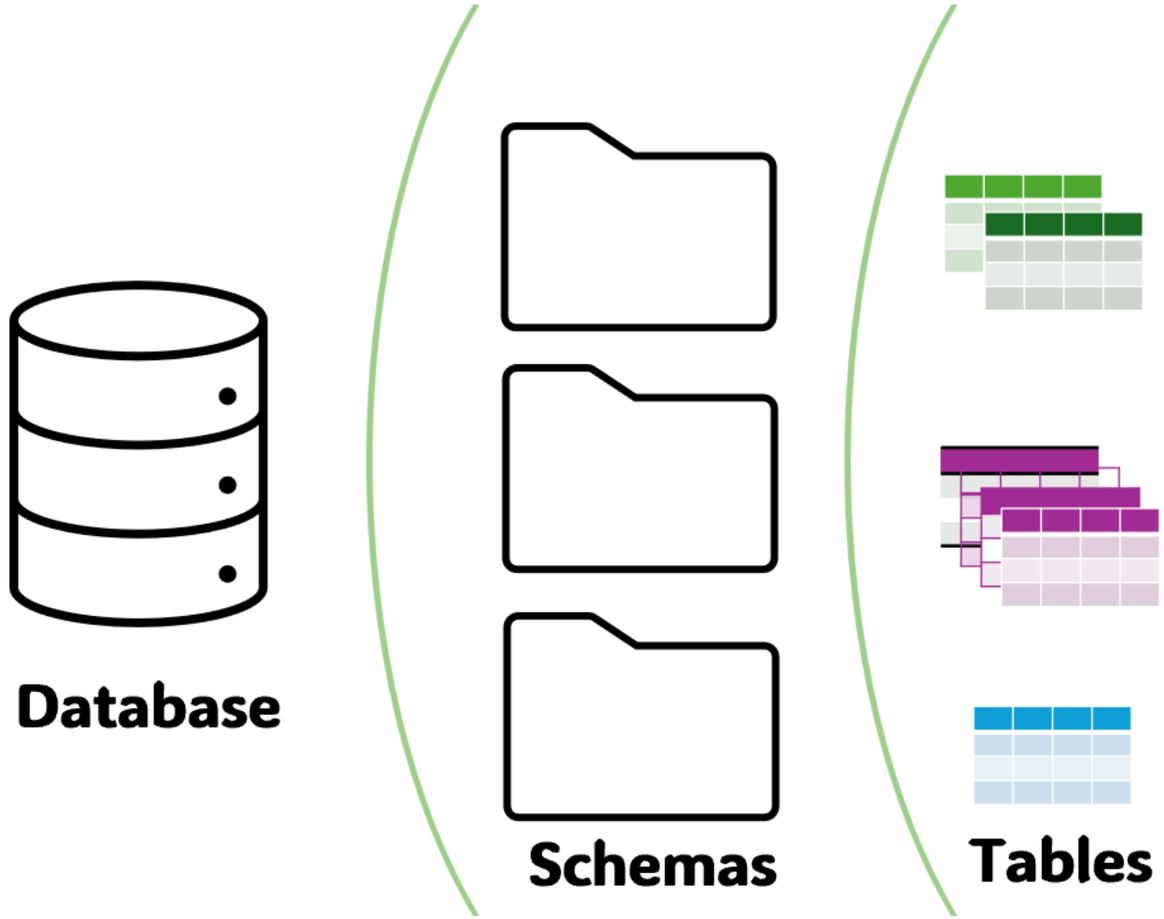


VS.

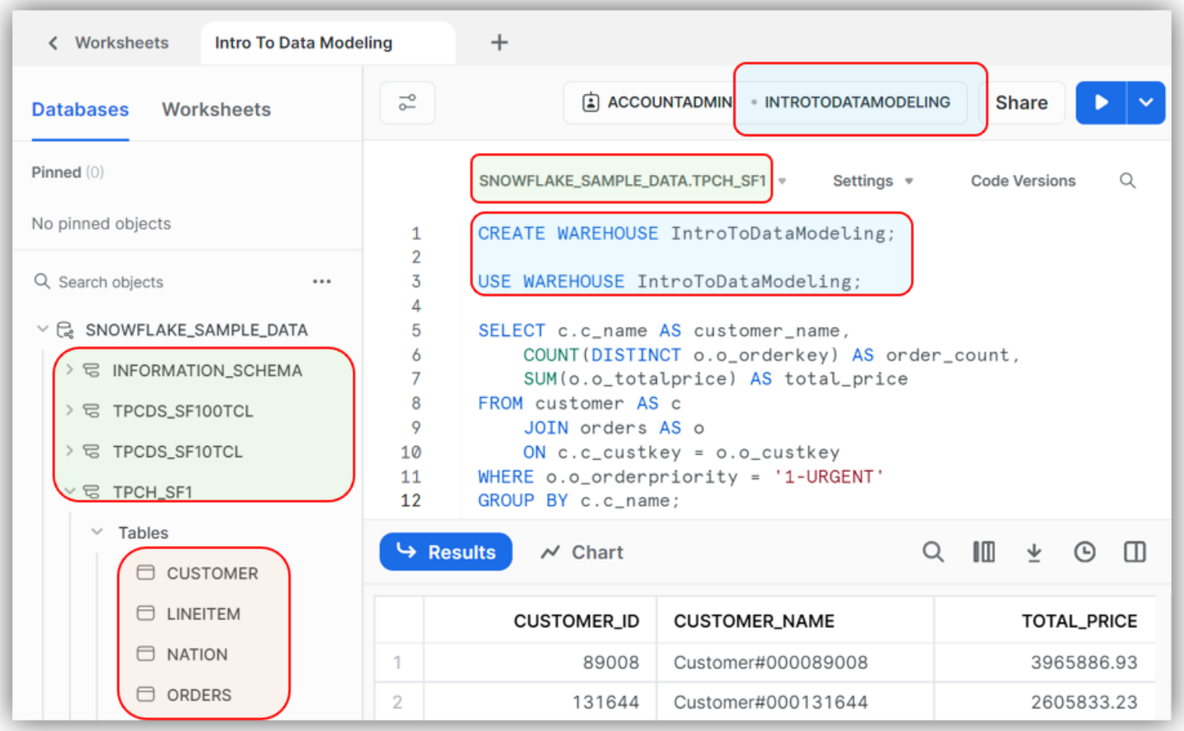
Traditional vs. virtual warehouse (2)

- `CREATE WAREHOUSE` : Snowflake clause that establishes a virtual computing resource for data processing tasks.
- `USE WAREHOUSE` : Snowflake clause that designates the active data warehouse for the current session.

Schemas and tables

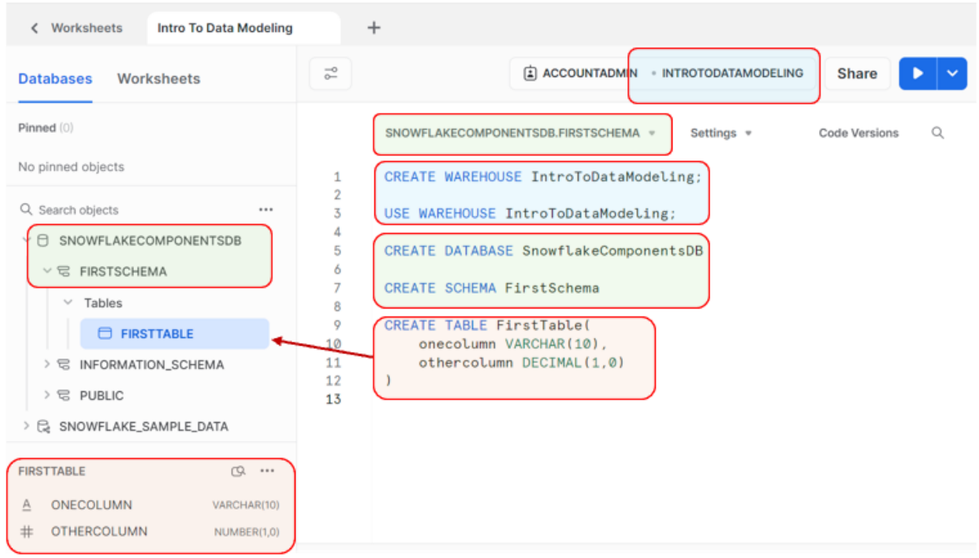


Schemas and tables (1)

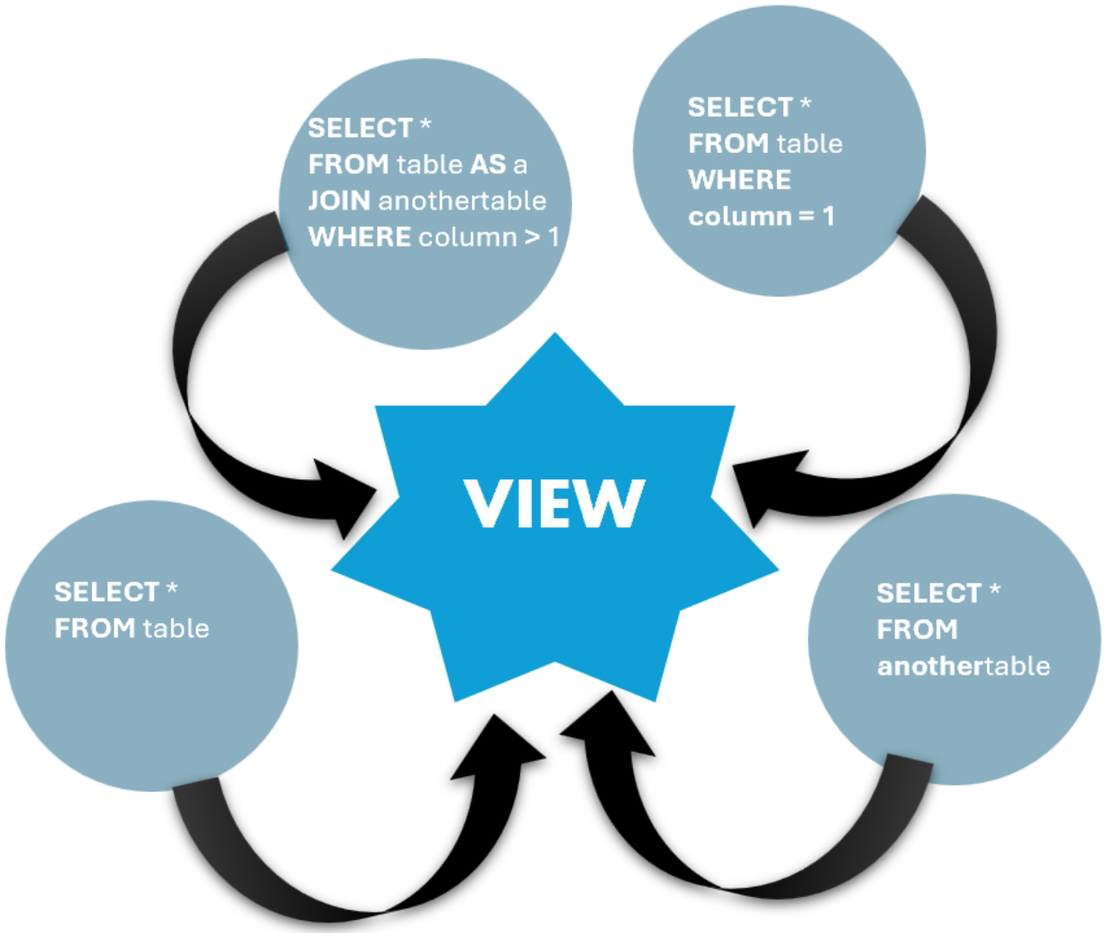


Schemas and tables (2)

- `CREATE DATABASE` : Snowflake clause to create a new database for organizing data objects.
- `CREATE SCHEMA` : Snowflake clause to define a container for grouping tables and views.
- `CREATE TABLE` : Snowflake command to create a new table structure and data columns within a specified schema.



Views



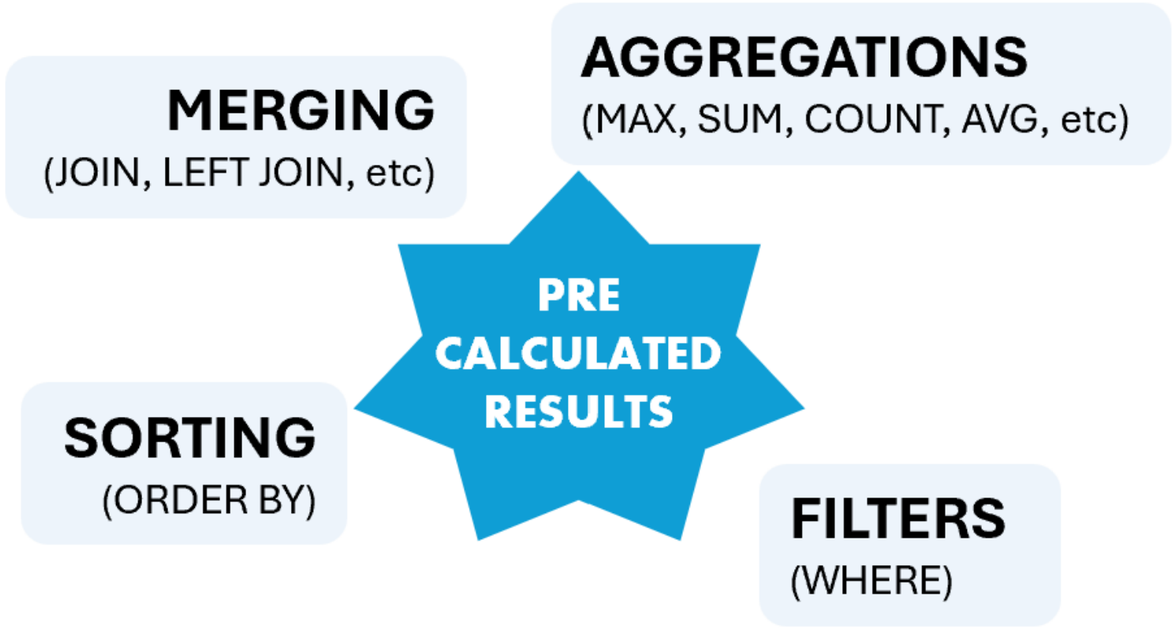
- **VIEWS:**
  - Acts like a virtual entity.
  - Avoid data duplicates.
  - Saves storage space and ensures data consistency.
  - Dynamically present data based on query logic.

Views (1)

- Example VIEW summarizing customers' urgent order

```
CREATE OR REPLACE VIEW customer_urgent_orders AS
SELECT c.c_name AS customer_name,
    COUNT(DISTINCT o_orderkey) AS order_count,
    SUM(o_totalprice) AS total_price
FROM customer AS c
    JOIN orders AS o
    ON c.c_custkey = o.o_custkey
WHERE o.o_orderpriority = '1-URGENT'
GROUP BY c.c_name;
ORDER BY total_price DESC;
```

Materialized views



- **MATERIALIZED VIEWS:**
  - Store pre-calculated results.
  - Improve query performance by storing computed operations.
  - Reduces query processing time.
  - Maintain a refreshed data snapshot for retrieval at any time.
  - Encapsulate complex operations for streamlined data modeling.

Materialized views (1)

```
CREATE OR REPLACE MATERIALIZED VIEW top_customers AS
SELECT o.o_custkey AS customer_id,
    c.c_name AS customer_name,
    CASE
        WHEN SUM(o.o_totalprice) > 5000000 THEN 'Over Price'
        WHEN SUM(o.o_totalprice) > 3000000 THEN 'Top Price'
        WHEN SUM(o.o_totalprice) > 2000000 THEN 'Average Price'
        ELSE 'Review Price'
    END AS total_price
FROM customer AS c
    JOIN orders AS o ON c.c_custkey = o.o_custkey
GROUP BY o.o_custkey, c.c_name
HAVING total_price > 2000000;
```

```
CREATE OR REPLACE VIEW customer_financial_summary AS
SELECT c.customerid,
 -- Create a new conditional attribute
   CASE
      WHEN AVG(c.estimatedsalary) > 150000 THEN 'Top Income'
      WHEN AVG(c.estimatedsalary) > 90000 THEN 'High Income'
      THEN AVG(c.estimatedsalary) > 20000 THEN 'Average Income'
      ELSE 'Low Income'
   END AS customer_category,
   -- Add aggregation to the attributes
   COUNT(DISTINCT cp.productid) AS product_count
FROM customers AS c
 LEFT JOIN customerproducts AS cp
 ON c.customerid = cp.customerid
-- Group the results
GROUP BY c.customerid;
```

Terminology overview

- **Data warehouse (traditional)**: A centralized system for storing and analyzing large volumes of data using a single server setup.
- **Virtual data warehouse (in Snowflake)**: A flexible, scalable set of cloud-based computing resources used explicitly for processing and analyzing data.
- **Database**: In Snowflake, a database is the primary container for data, holding schemas.
- **Schema**: Collection of logical structures,that contain tables, views, etc.
- **Table**: Representation of an entity in the database; fundamental data storage structure, organized in rows and columns within schemas.
- **View**: Saved query that presents data as a virtual entity without storing the data separately.
- **Materialized View**: A stored version of a view that physically saves the query result for faster access.

Functions overview

```
CREATE OR REPLACE WAREHOUSE data_warehouse_name;
```

```
USE WAREHOUSE data_warehouse_name;
```

```
CREATE OR REPLACE DATABASE database_name;
```

```
CREATE OR REPLACE SCHEMA schema_name;
```

```
CREATE OR REPLACE TABLE table_name(
    column_name datatype,
    other_columns datatype);
```

Exemplary (materialized) view template

```
CREATE OR REPLACE VIEW view_name AS
SELECT column_name,
    SUM(column_name2) AS sum_alias,
    CASE WHEN column_name5   condition   value THEN assigned_value
        ELSE another_assigned_value
    END AS case_alias
FROM table_name AS table_alias
    JOIN other_table AS other_alias ON table_alias.FK = other_alias.PK
    LEFT JOIN another_table AS another_alias ON table_alias.FK = other_alias.PK
GROUP BY column_name;
```

Let's practice!

INTRODUCTION TO DATA MODELING IN SNOWFLAKE

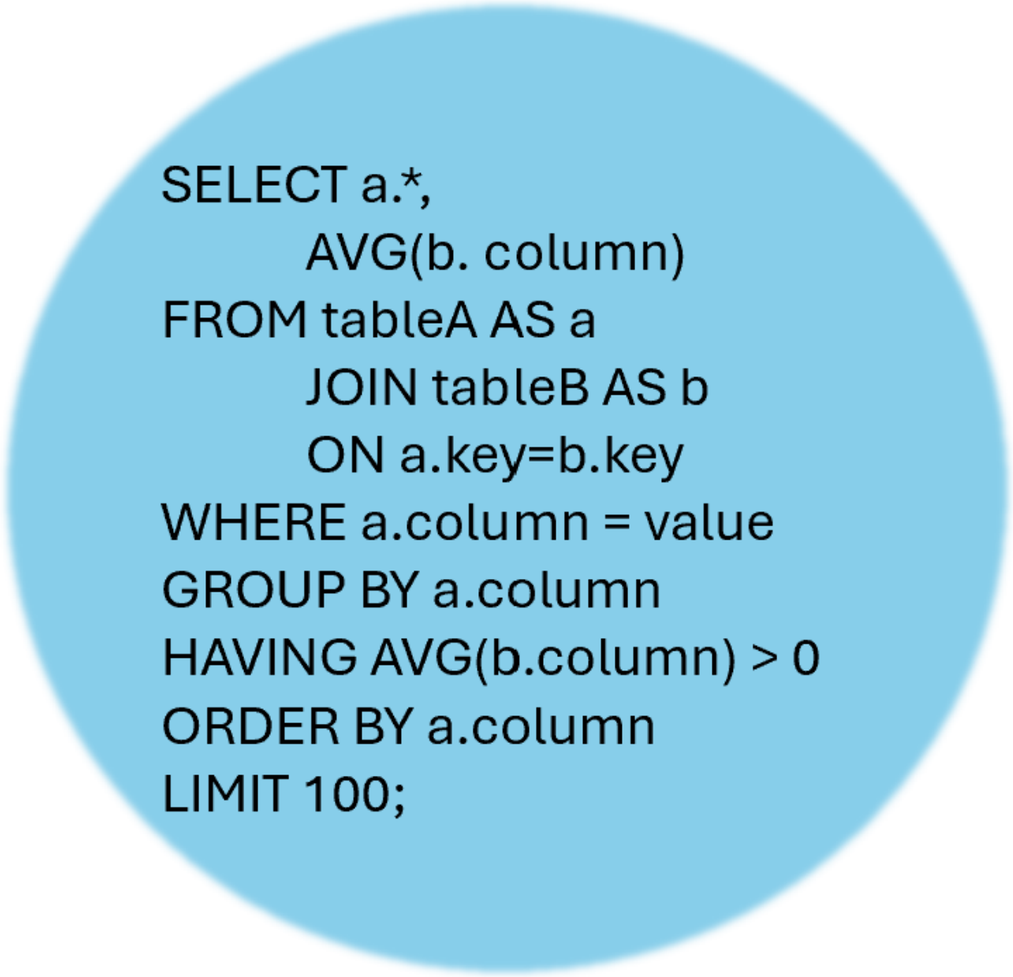
Query Optimization

INTRODUCTION TO DATA MODELING IN SNOWFLAKE

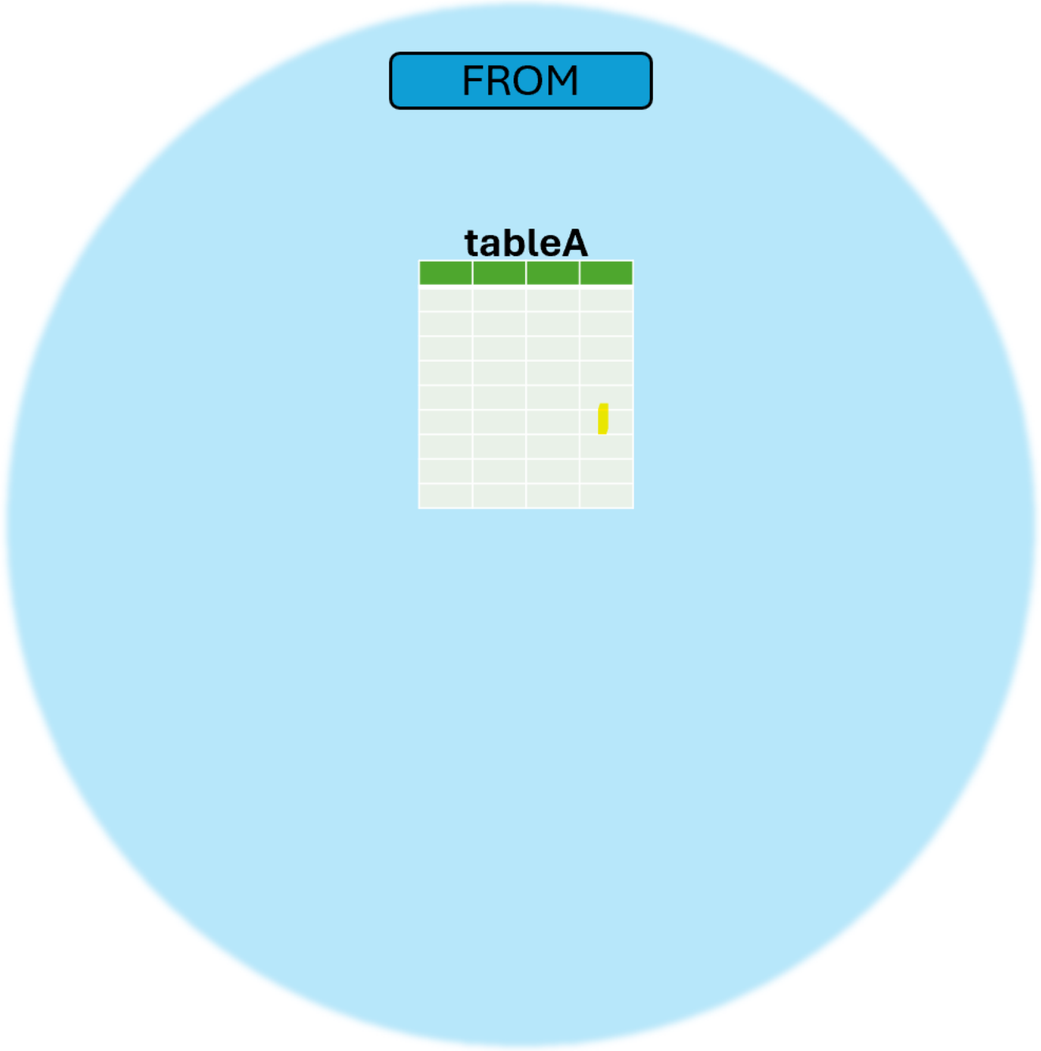
Nuno Rocha
Director of Engineering

datacamp

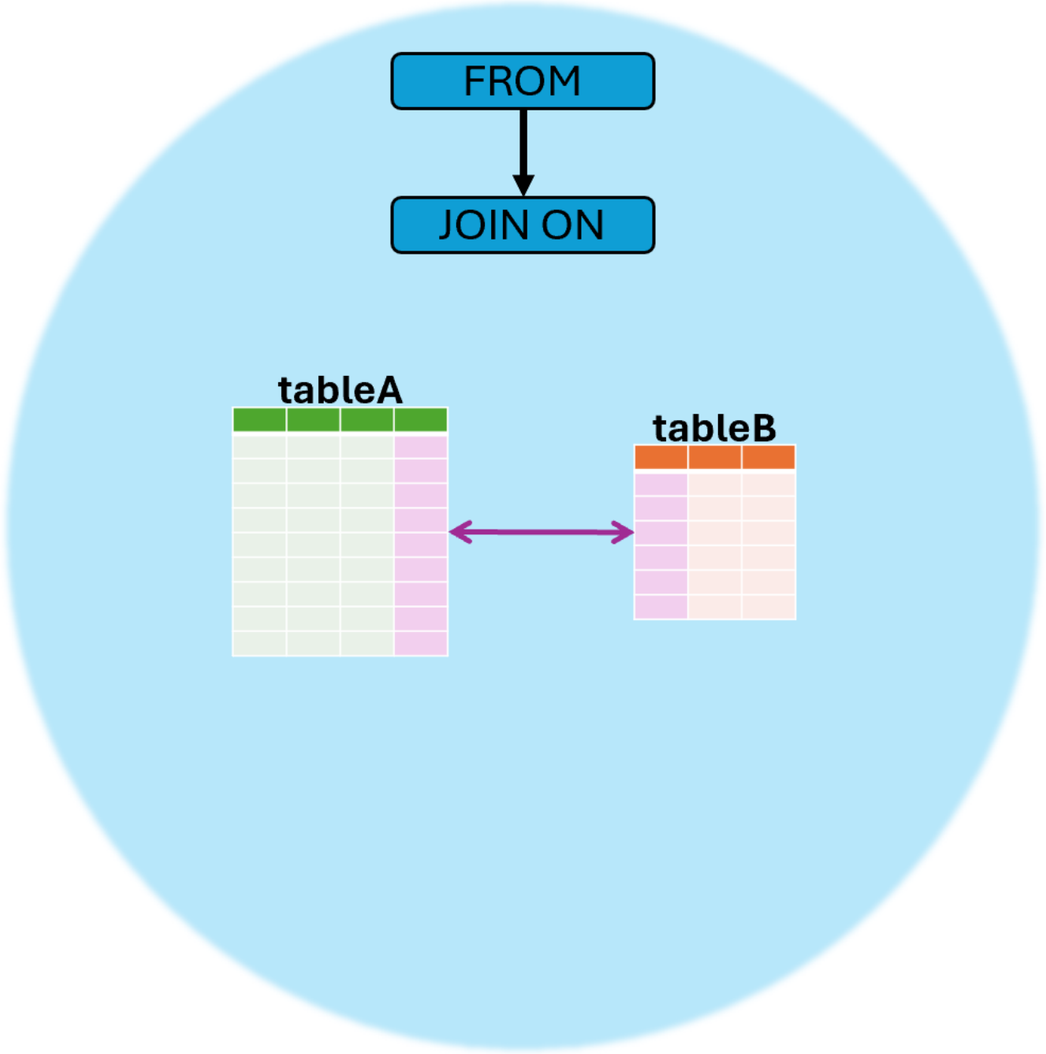
Query execution order



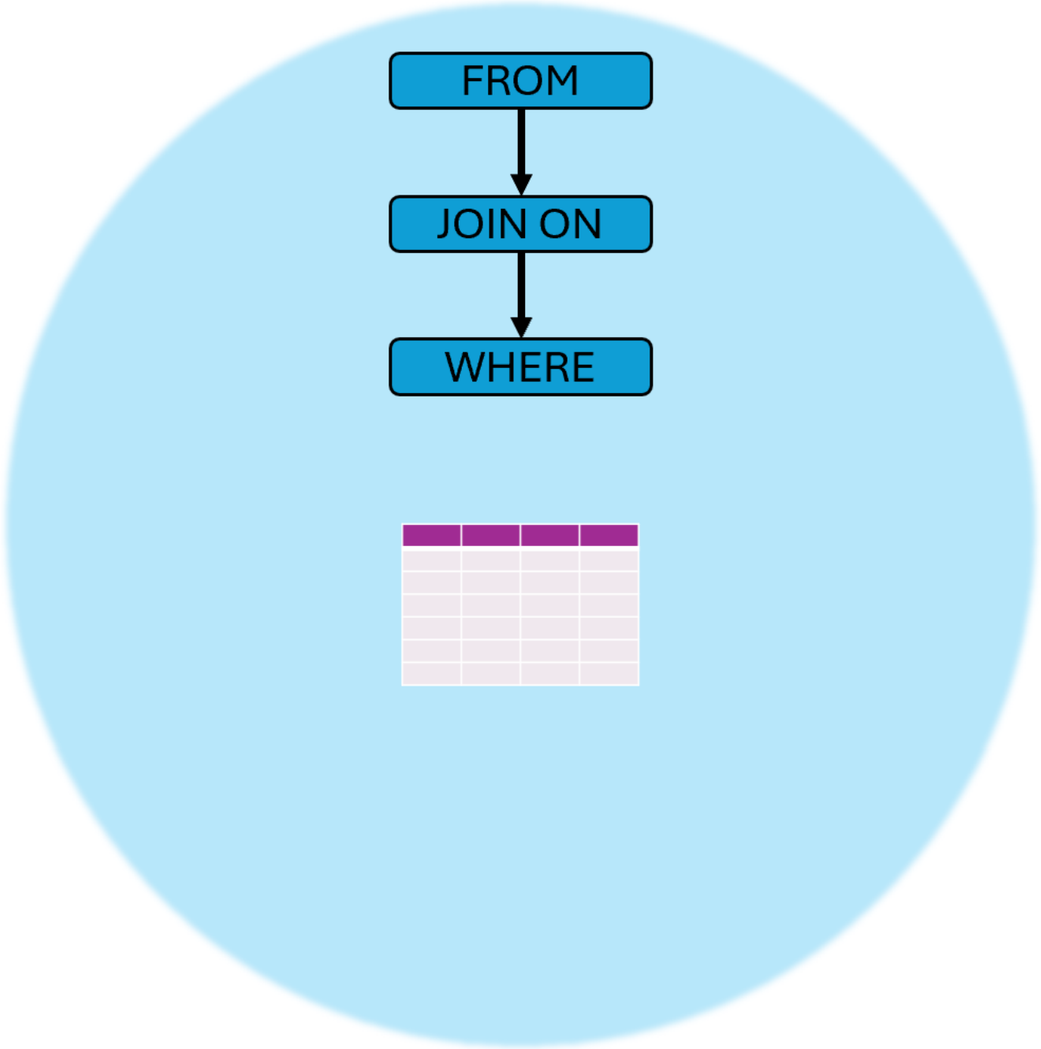
Query execution order (1)



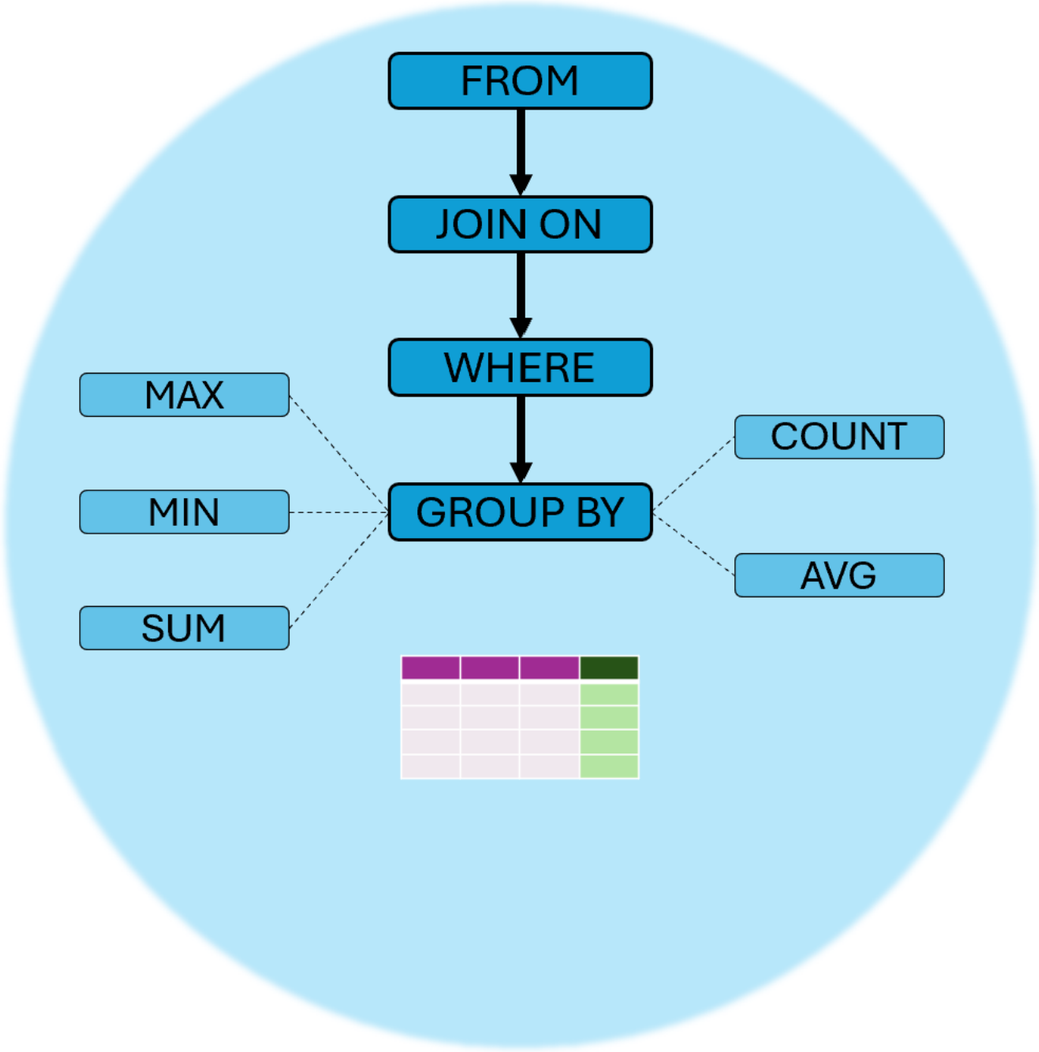
Query execution order (2)



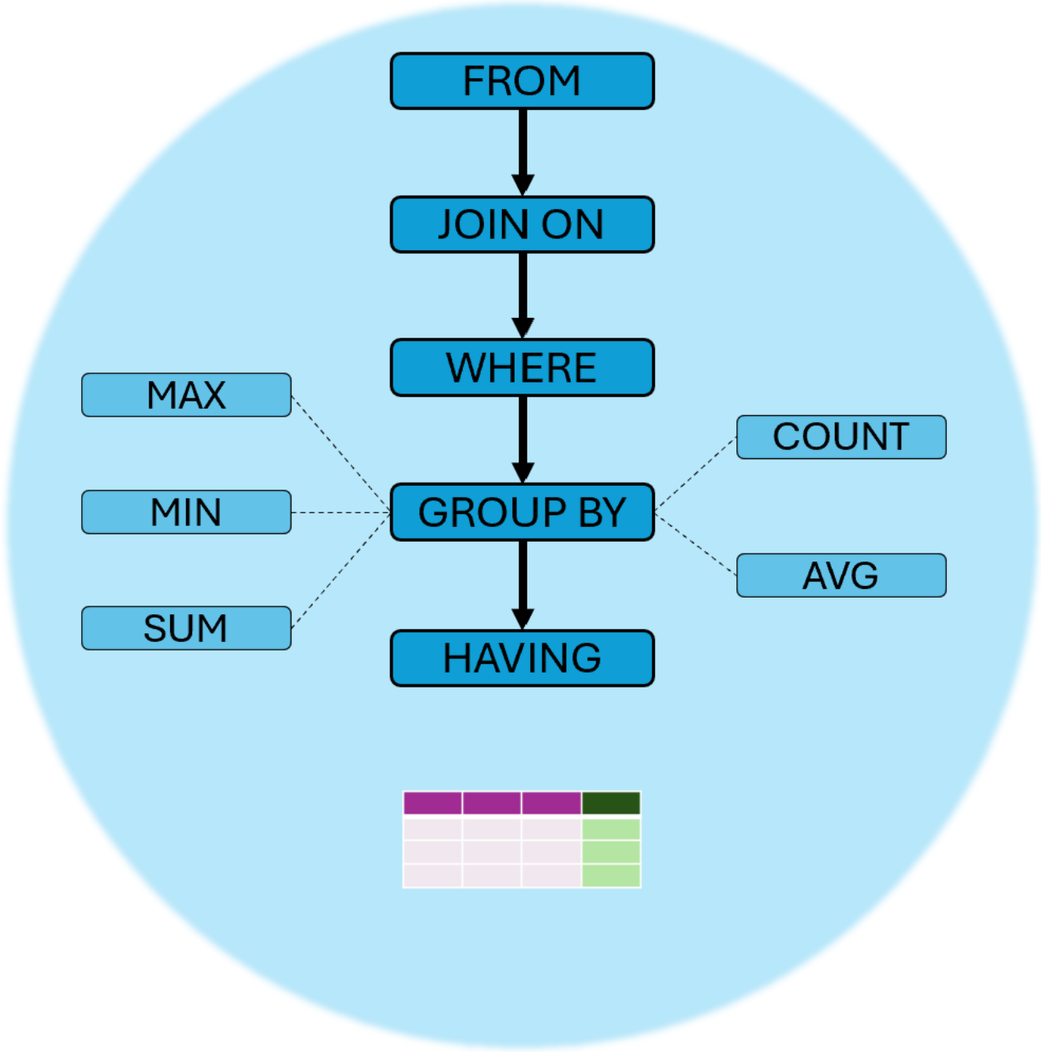
Query execution order (3)



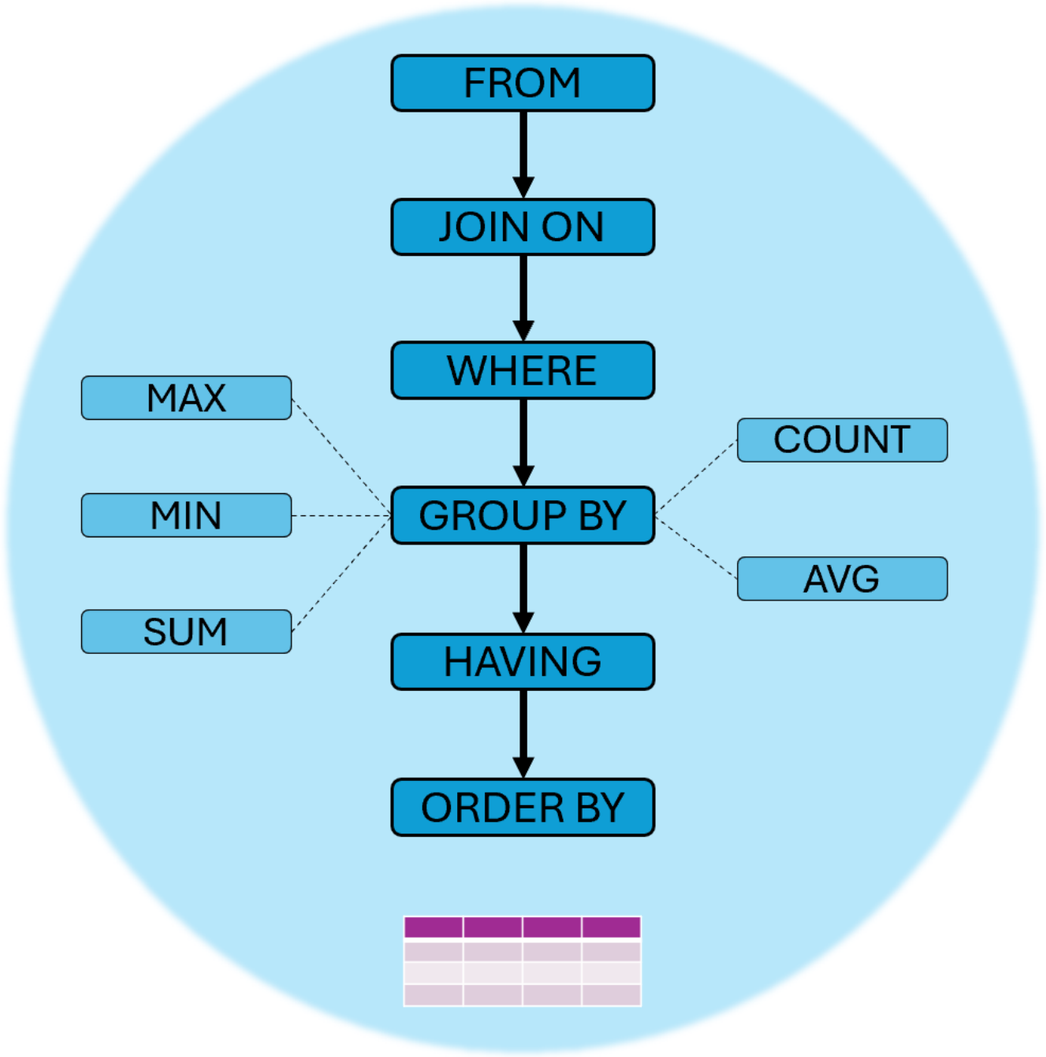
Query execution order (4)



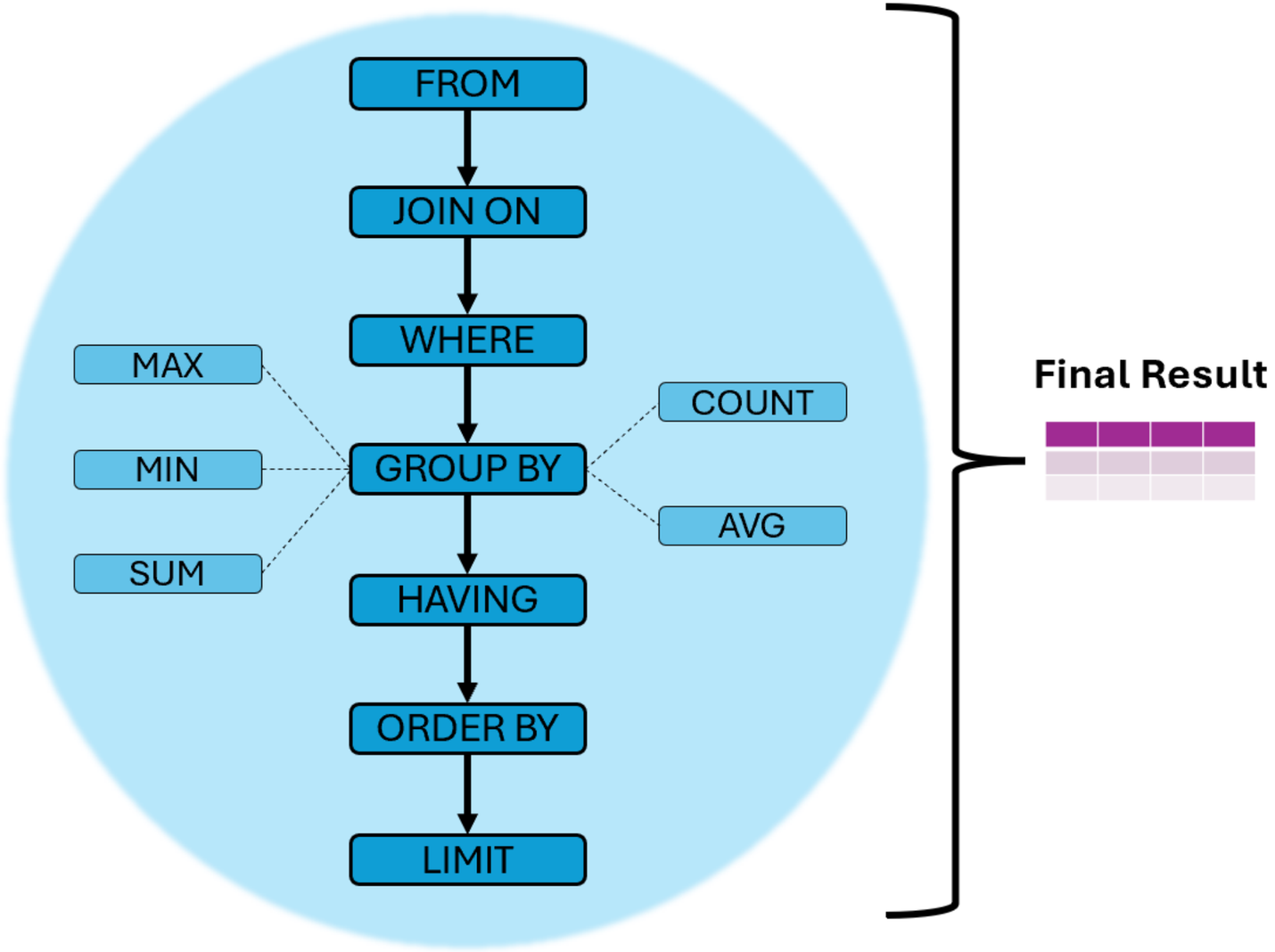
Query execution order (5)



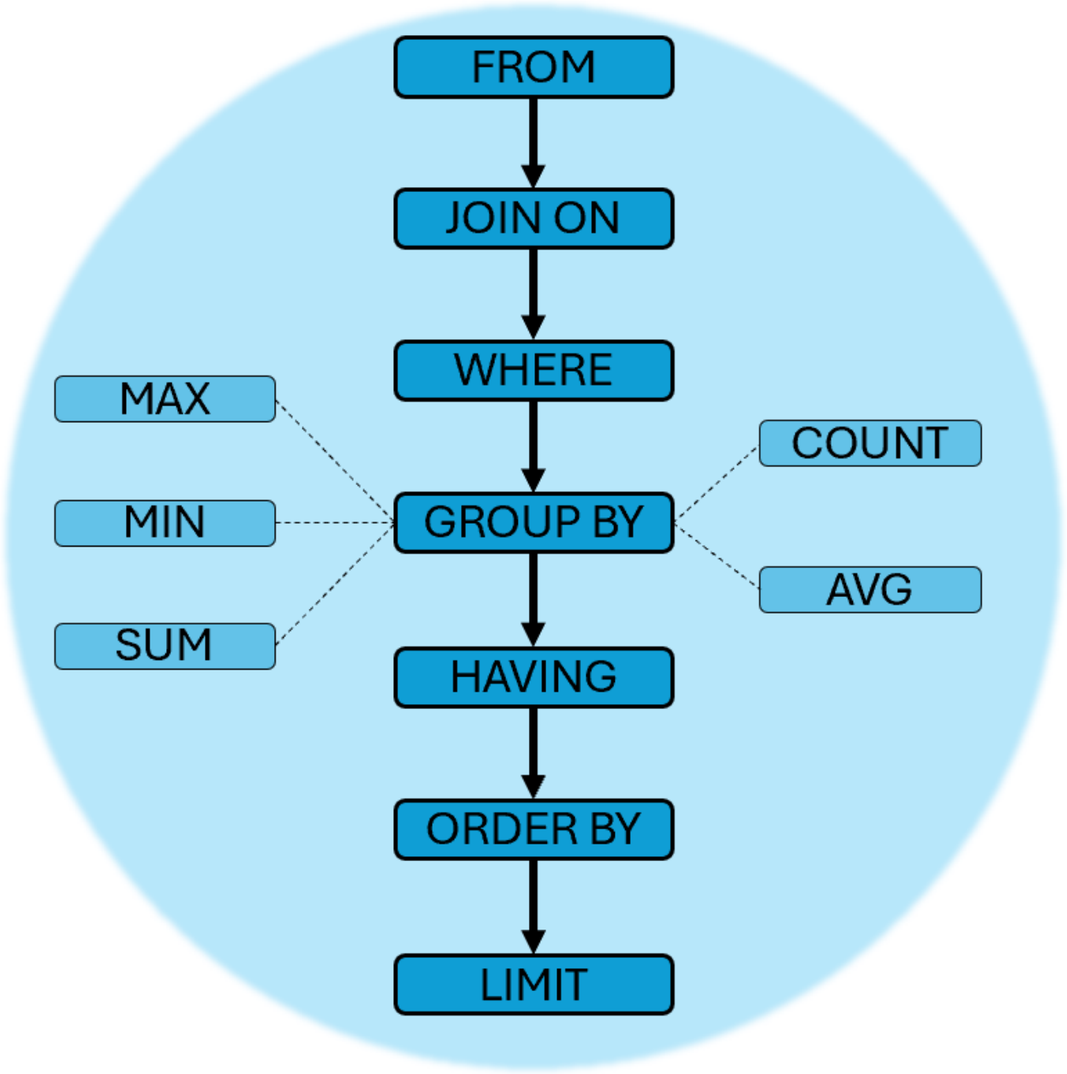
Query execution order (6)



Query execution order (7)



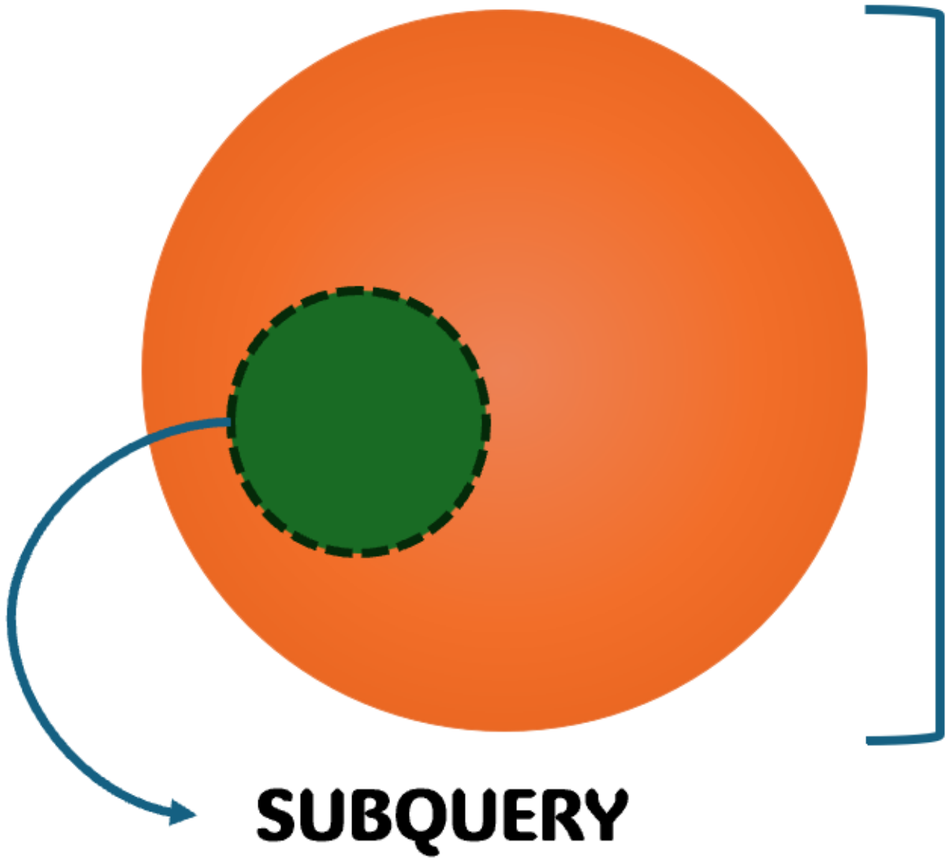
Query execution order (8)



- **BEST PRACTICES:**
  - Avoid using SELECT *; specify only necessary columns
  - Implement LIMIT filtering to reduce data volume
  - Use the WHERE clause early for row filtering and memory conservation
  - Employ GROUP BY with aggregations on narrowed datasets to optimize processing

Subqueries

```
WITH customer_status AS (
 SELECT c.customerid,
    c.age,
        c.tenure,
        CASE
            WHEN ch.customerid IS NOT NULL THEN 'Churned'
            ELSE 'Active'
        END AS status
    FROM customers AS c
     LEFT JOIN churn AS ch
    ON c.customerid = ch.customerid
    GROUP BY c.customerid, c.age, c.tenure, status
)
SELECT status,
 COUNT(customerid) AS unique_customers,
    -- Calculate averages
    AVG(age) AS average_age,
    AVG(tenure) AS average_tenure
FROM customer_status
WHERE customerid IN (SELECT customerid
                     FROM customers
                     WHERE estimatedsalary > 175000)
GROUP BY status
-- Filter data
HAVING average_tenure > 2;
```

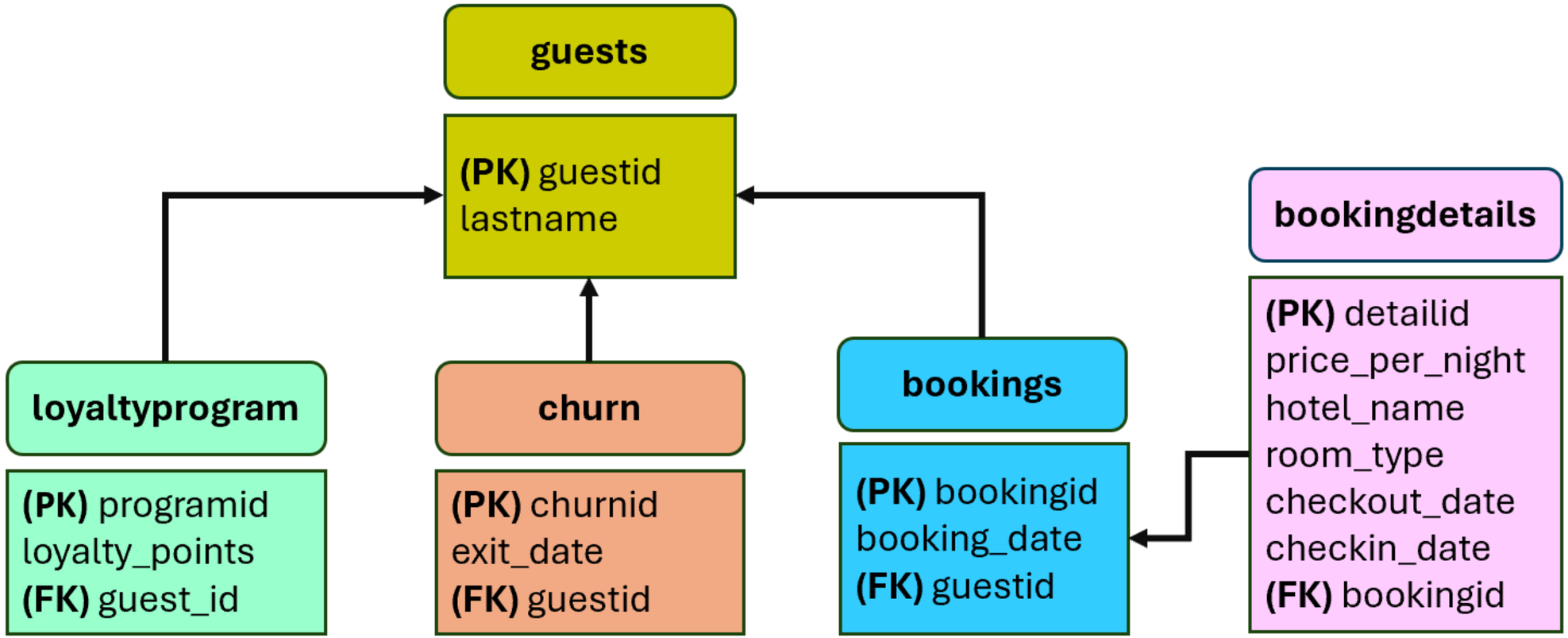



```
WITH customer_status AS (
 SELECT c.customerid,
    c.age,
        c.tenure,
        CASE
            WHEN ch.customerid IS NOT NULL THEN 'Churned'
            ELSE 'Active'
        END AS status
    FROM customers AS c
     LEFT JOIN churn AS ch
    ON c.customerid = ch.customerid
    GROUP BY c.customerid, c.age, c.tenure, status
)
SELECT status,
 -- Count customers
 COUNT(customerid) AS unique_customers
FROM customer_status
WHERE customerid IN (SELECT customerid
                     FROM customers
                     WHERE estimatedsalary > 175000)
-- Aggregate values
GROUP BY status;
```

QUERY

```
WITH customer_status AS (
 SELECT c.customerid,
    c.age,
        c.tenure,
        CASE
            WHEN ch.customerid IS NOT NULL THEN 'Churned'
            ELSE 'Active'
        END AS status
    FROM customers AS c
     LEFT JOIN churn AS ch
    ON c.customerid = ch.customerid
    GROUP BY c.customerid, c.age, c.tenure, status
)
-- Extract attribute from CTE
SELECT status
FROM customer_status
-- Filter results
WHERE customerid IN (SELECT customerid
                     FROM customers
                     WHERE estimatedsalary > 175000);
```

Subqueries

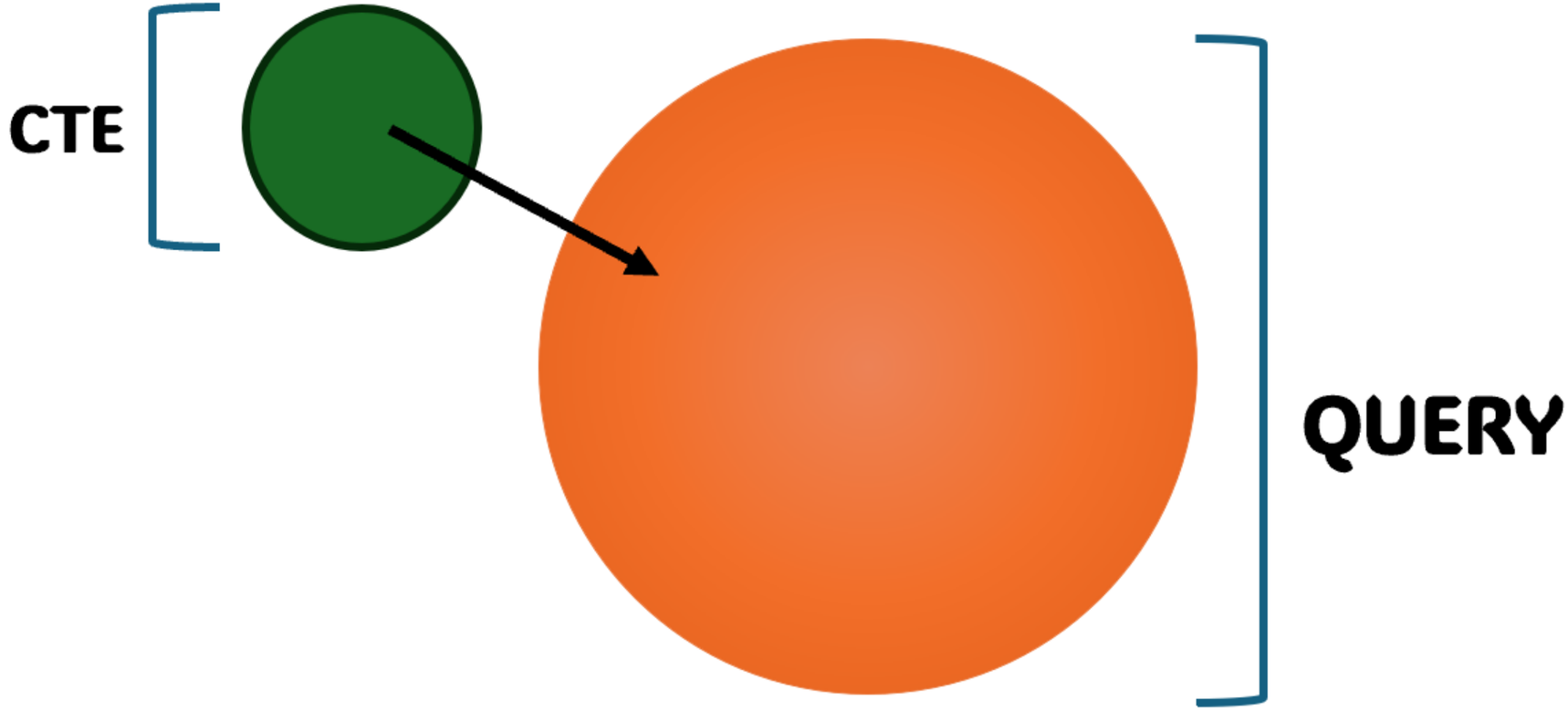

guests
(PK) guestid
lastname
loyaltyprogram
(PK) programid
loyalty_points
(FK) guest_id
churn
(PK) churnid
exit_date
(FK) guestid
bookings
(PK) bookingid
booking_date
(FK) guestid
bookingdetails
(PK) detailid
price_per_night
hotel_name
room_type
checkout_date
checkin_date
(FK) bookingid

Subqueries

- Query all guests that have more than 1000 loyalty points

```
SELECT *
FROM guests
WHERE id IN (SELECT guest_id
                    FROM loyalty_program
                    WHERE loyalty_points > 1000);
```

Common table expressions



Common table expressions

- Query the latest booking details

```
WITH latest_booking AS (
    SELECT guest_id,
           MAX(checkout_date) AS latest_checkout
    FROM booking_details
    GROUP BY guest_id
)
SELECT bd.*,
       bd.checkout_date AS latest_booking_date
FROM booking_details bd
    JOIN latest_booking lb
        ON bd.guest_id = lb.guest_id
        AND bd.checkout_date = lb.latest_checkout;
```

CTEs and subqueries

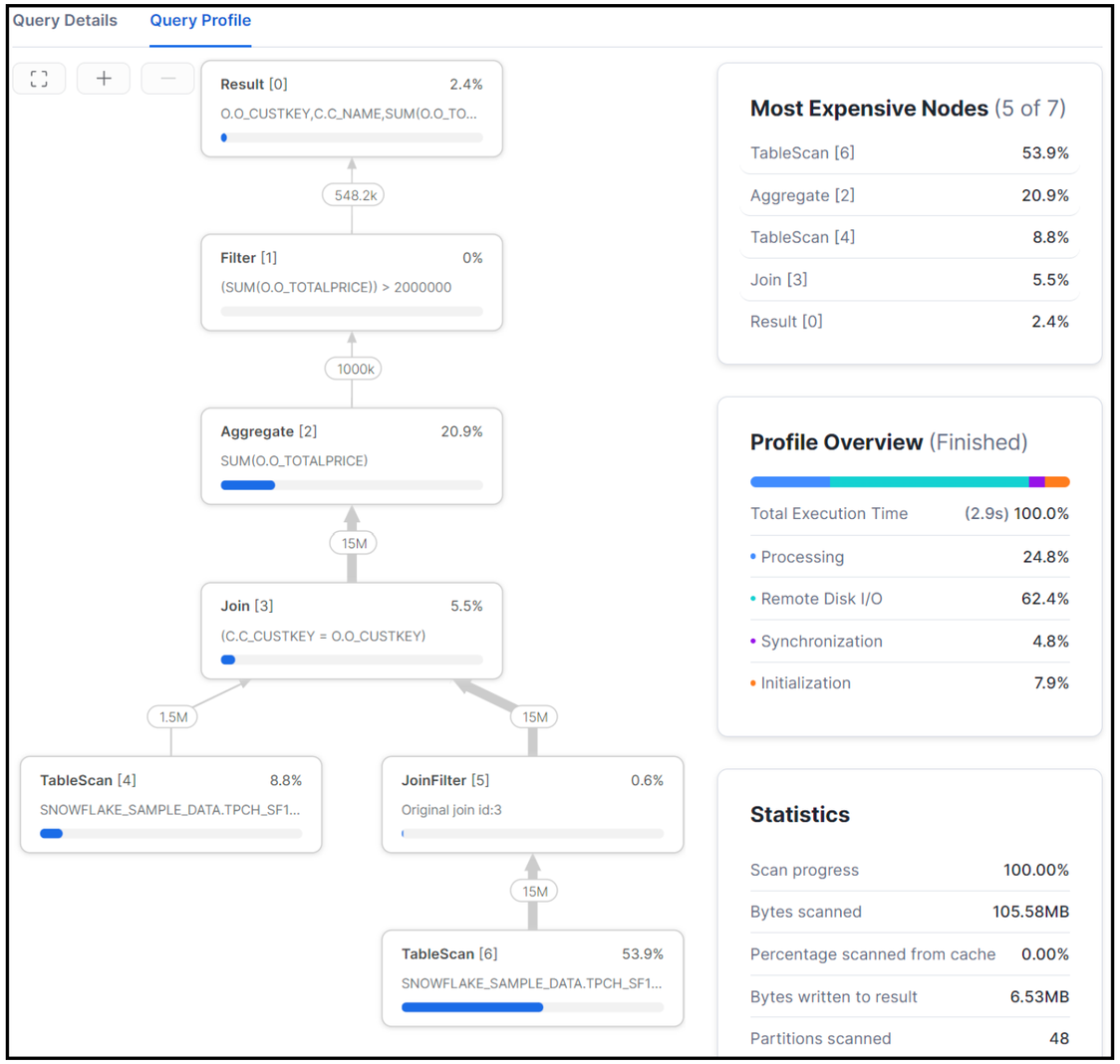
CTEs

- **Pros**
  - Enhances readability for complex queries
  - Enables reusability in the same query
  - Improves organization of SQL queries
- **Cons**
  - Can introduce performance overhead
  - Limited to the scope of a single query

Subqueries

- **Pros**
  - Simple and direct for single-use cases
  - Flexible in various parts of a SQL statement
- **Cons**
  - It can reduce readability with complexity
  - Potential performance issues with nested instances

Visualizing query execution times



Terminology and functions overview

- **Query Optimization:** Fine-tuning queries to maximize efficiency and performance
- **Subquery:** A smaller query inside a main query that helps focus on specific data
- **Common Table Expressions (CTEs):** Temporary virtual table during a query
- `WITH .. AS` : SQL command to define a CTE
- `LIMIT` : SQL clause constraining the number of rows in query results
- `HAVING` : SQL clause used to filter data that aggregated with functions like SUM, MAX, etc
- `WHERE` : SQL clause used to filter rows before grouping, enhancing query efficiency

Exemplary CTE and subquery template

- Subquery

```
SELECT *
FROM table_name
WHERE column_name IN (SELECT column_name
                      FROM table_name
                      WHERE column_name condition value);
```

- CTE

```
WITH latest_booking_dates AS (
    SELECT column_name
    FROM table_name)
SELECT *
FROM table_name a
    JOIN other_table_name b
    ON a.key_column = b.key_column;
```

Let's practice!

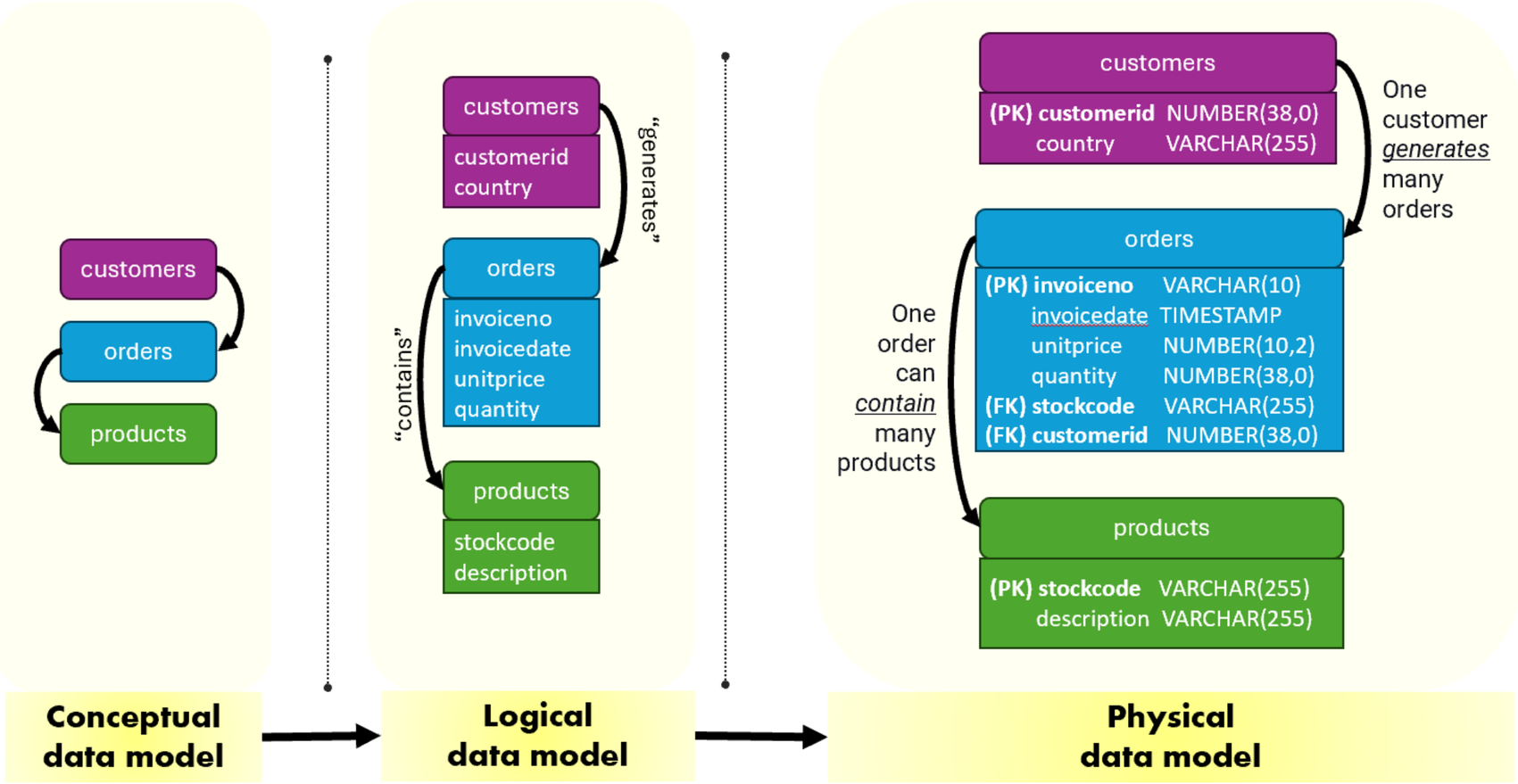
INTRODUCTION TO DATA MODELING IN SNOWFLAKE

Wrap-up

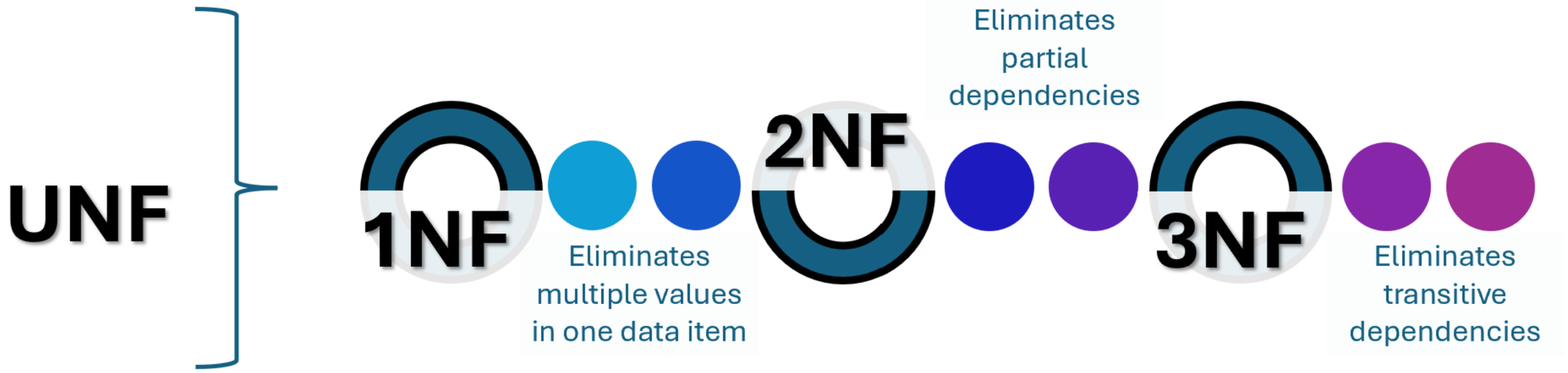
INTRODUCTION TO DATA MODELING IN SNOWFLAKE

Nuno Rocha
Director of Engineering

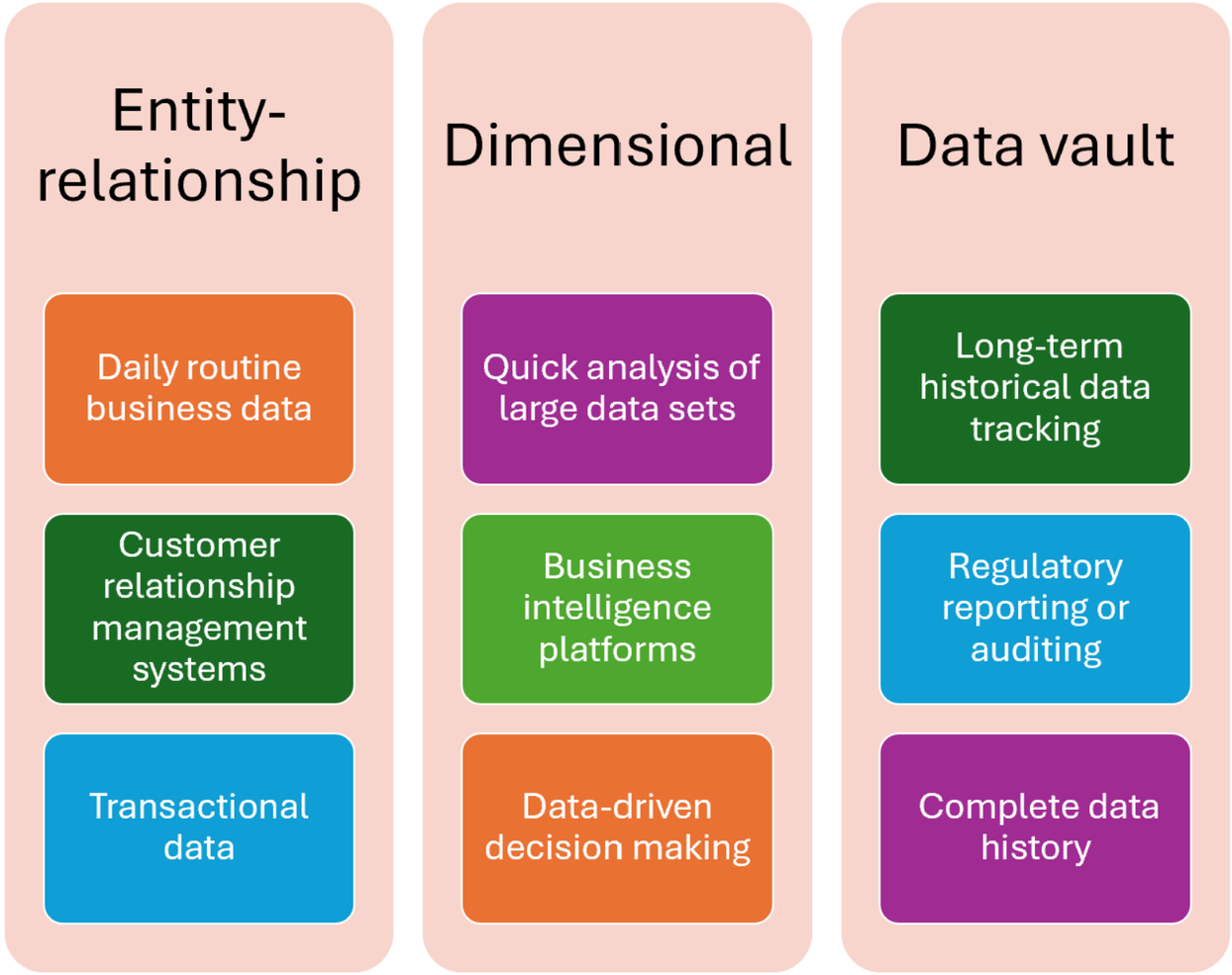
Chapter 1 - Fundamentals of Data Modeling



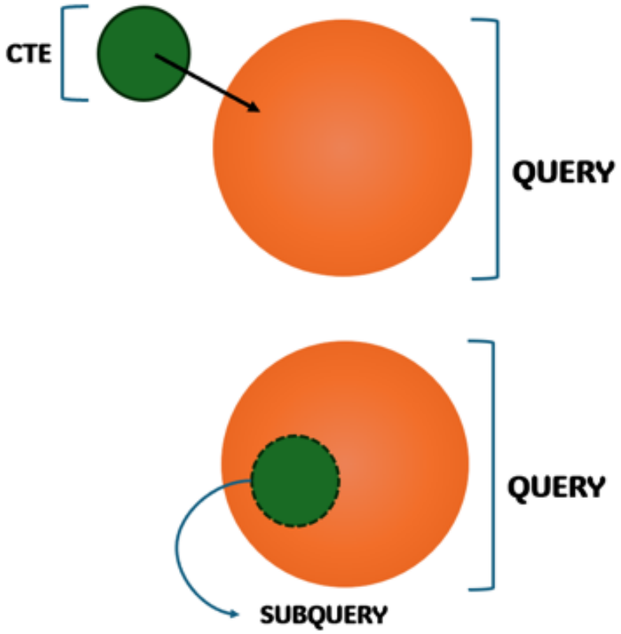
Chapter 2 - Beginning of Relationships and Normalization

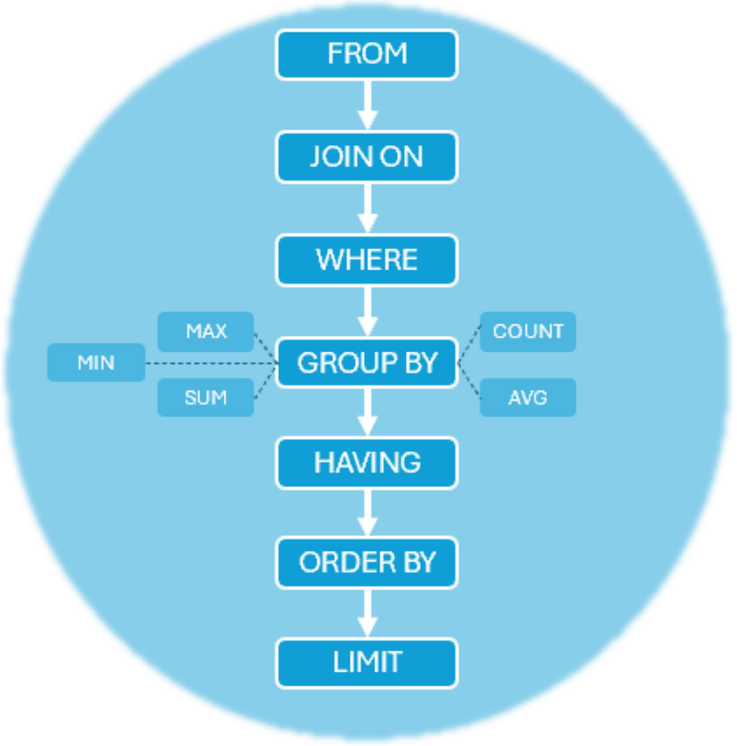


Chapter 3 - Data Modeling Techniques



Chapter 4 - Snowflake Components





Congratulations!!

INTRODUCTION TO DATA MODELING IN SNOWFLAKE