PyCon Australia 2023

Building 3D Trusted Data Pipelines With Dagster, Dbt, and Duckdb

Danh Phan

Adelaide, August 2023

https://github.com/danhphan/trusted-data-pipeline

About me

Danh Phan

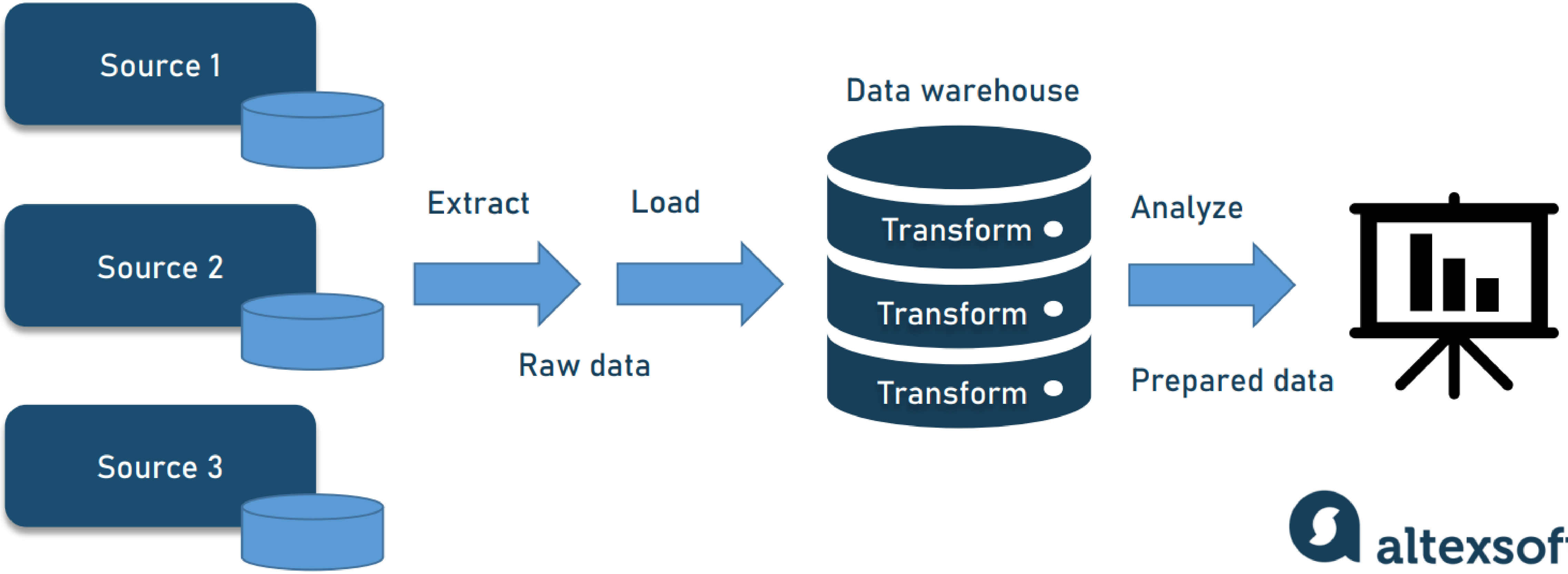
- Senior Data engineer at IDS, HESTA.
- An open-source contributor & a camper
- Ex. ML Researcher, Ex. Data analyst,
- Ex. Web dev, Ex. Database designer.
- https://danhphan.net

Views And Opinions Are My Own!

Overview

- Context
- Trusted data pipelines
- Demo

ELT PIPELINE



altexsoft

SHERIFF

Need robust/reliable pipelines

Interesting talks on this topic

- 2022 Open Data Science, **Sam Bail :** Building a Robust Data Pipeline with the "dag Stack": dbt, Airflow, and Great Expectations
- 2021 Bigeye, **Egor Gryaznov** : Data Reliability Engineering—Reliable Data Pipelines 101
- 2021 DataEngBytes, **Harmeet Sokhi** : Shift-left testing : Building reliable Data Pipelines
- 2019 DataBricks, **Steven Yu** : Building Robust Production Data Pipelines with Databricks Delta
- 2017 DataBricks, **Xiao Li** : Building Robust ETL Pipelines with Apache Spark
- 2016 Jfokus, **Lars Albertsson** : Data pipelines from zero to solid
- …

Lessons-learned

- Testing data pipelines (***)
- DevOps practice: code versioning, CI/CD
- Infrastructure as code (Terraform , CloudFormation, …)
- Container environment (Docker)
- Data lineage and monitoring
- Enhance data contracts from upstream
- …

Robust is not enough!

- Robust/reliable is not enough
- We absolutely need it
- But we also need to deliver the data quality to our data consumers (data analysts, BI developers, or Data scientists)

Trusted data pipelines also focus on data quality!

Robust pipeline vs. Trusted pipeline

Engineering focus

@istockphoto

Data consumers' focus

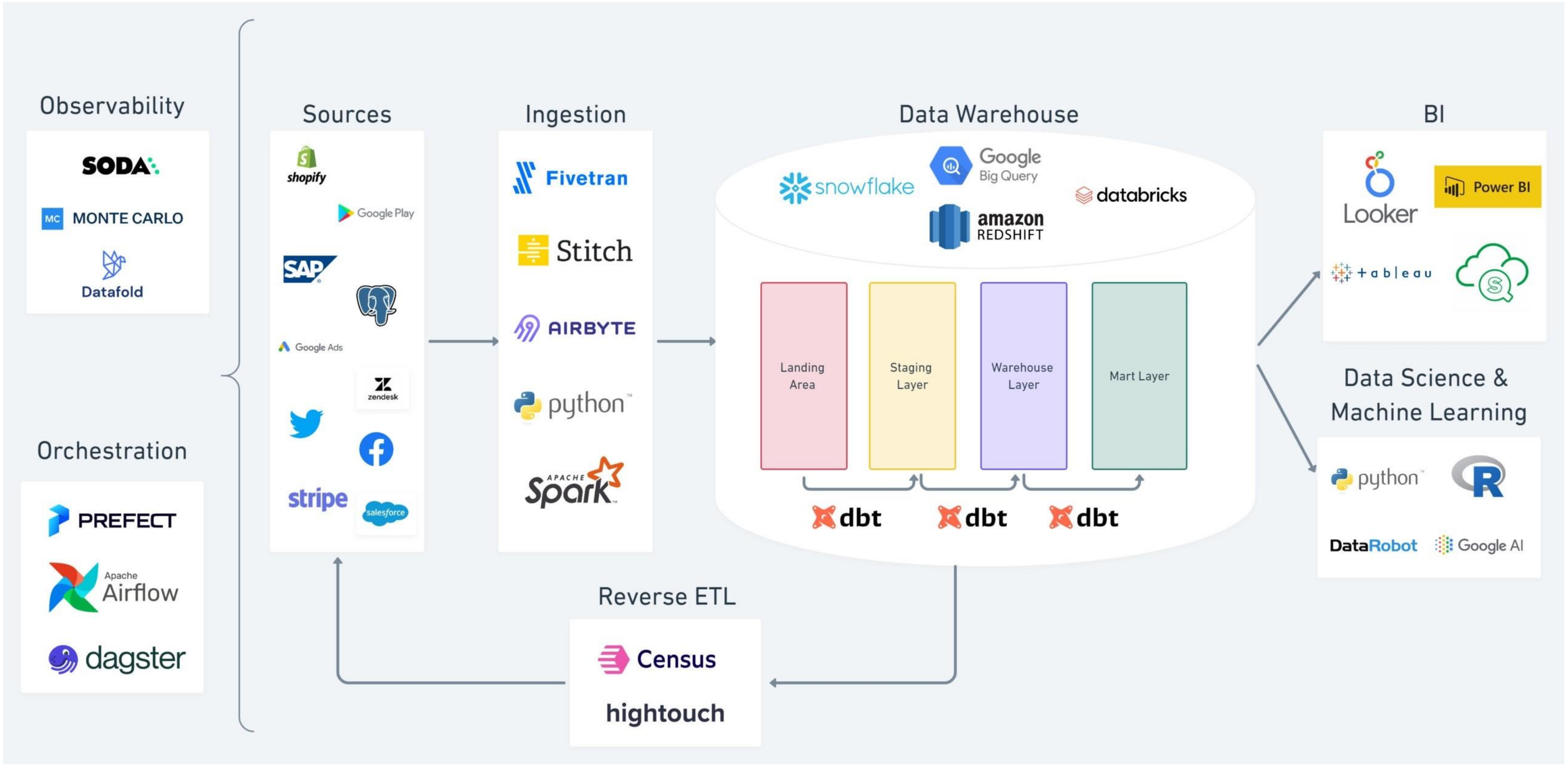
@UNICEFNigeria/2020

Data quality questions?

- Is that table the same compared to the upstream table?
- This table needs to have these columns
- Where this data come from?
- Is the data arrived late?
- Is the values of a numeric column in an expected range?
- Is the summary stats make sense?
- Seem to have outliers?
- We expect the column to have no null value?
- …

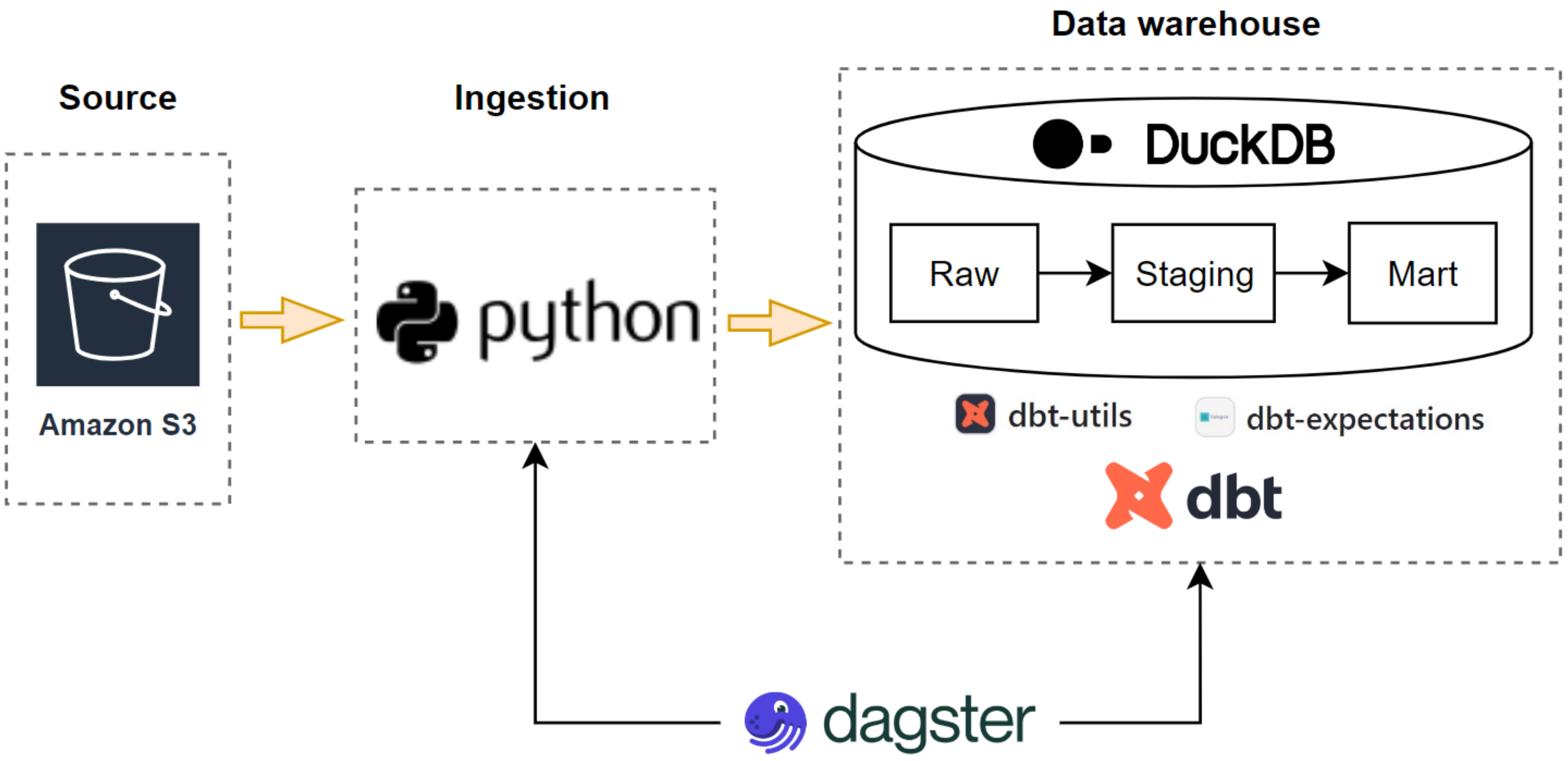
IN DATA
WE TRUST

It is critical to test and measure data quality!

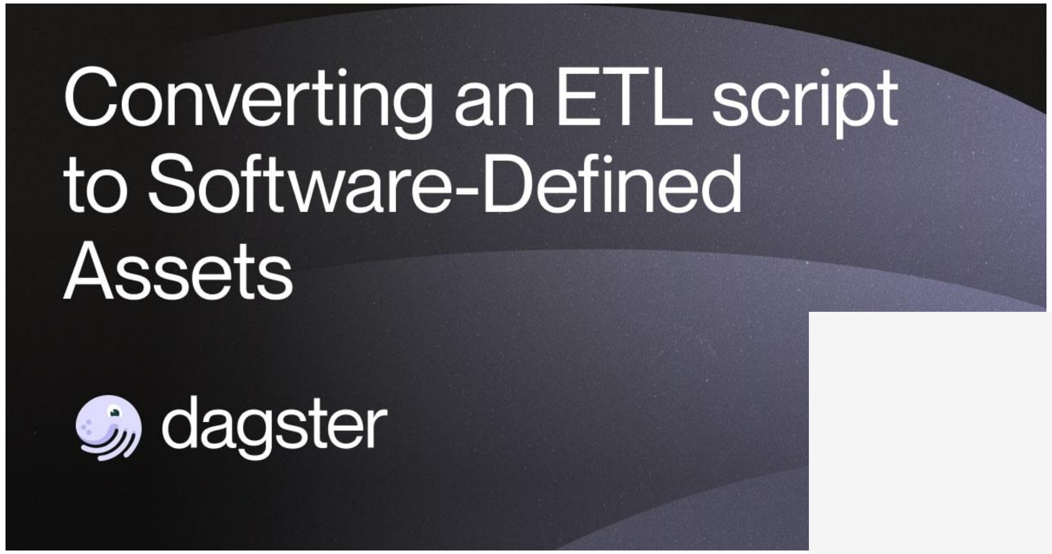


https://bitestreams.com/nl/blog/modern_data_stack/

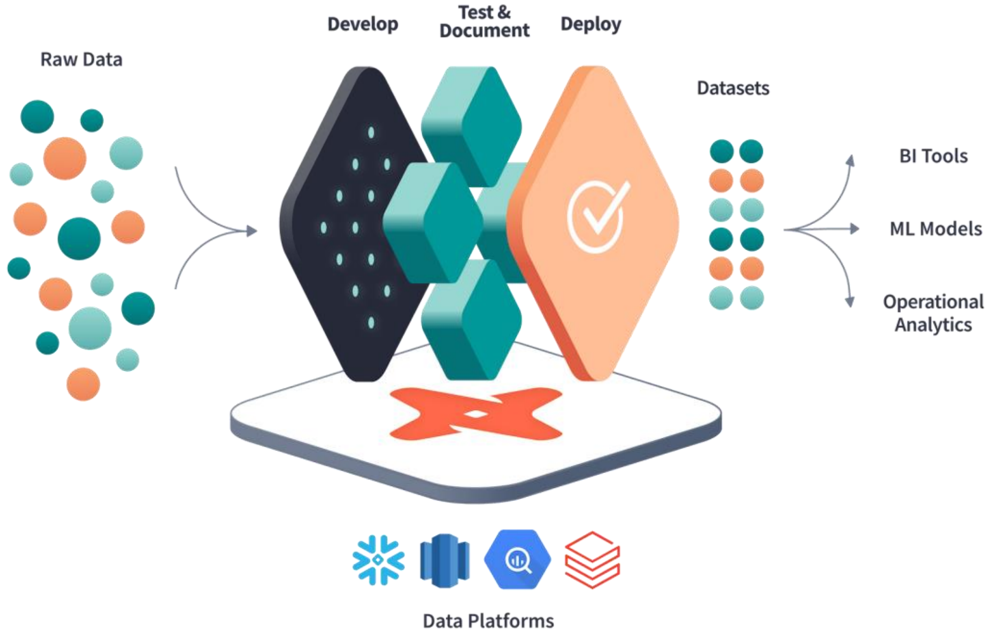
3D (Dagster, Dbt, and Duckdb) trusted pipeline

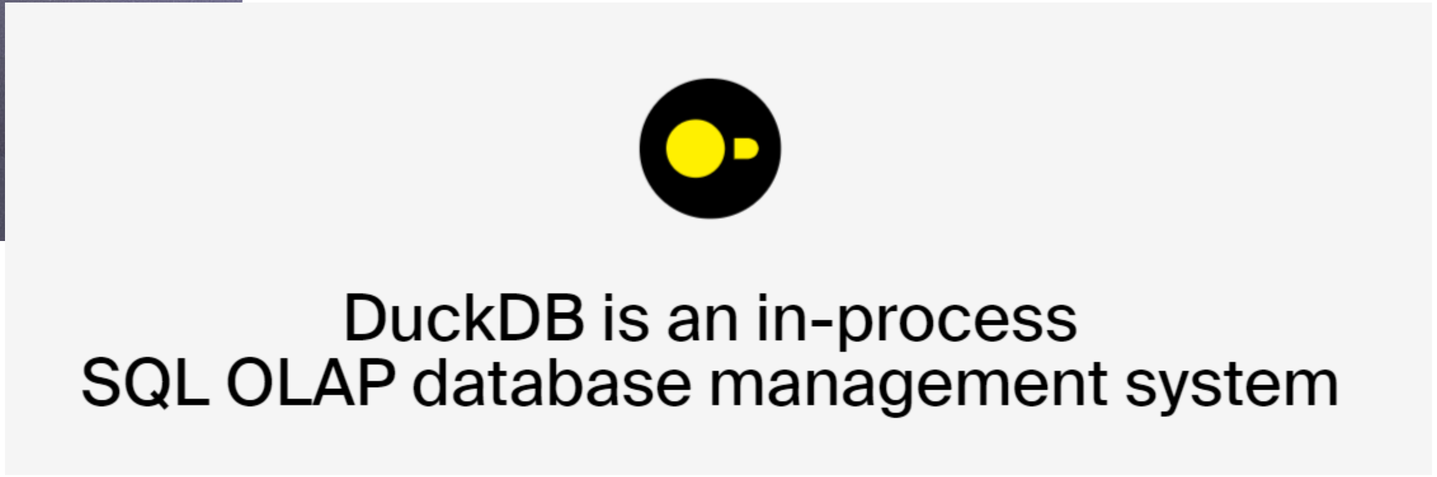


The 3Ds


Converting an ETL script to Software-Defined Assets

dagster




DuckDB is an in-process
SQL OLAP database management system

Testing data quality

- **Between tables**
  - Relationships
  - Raw (unprocessed) truth vs processed truth

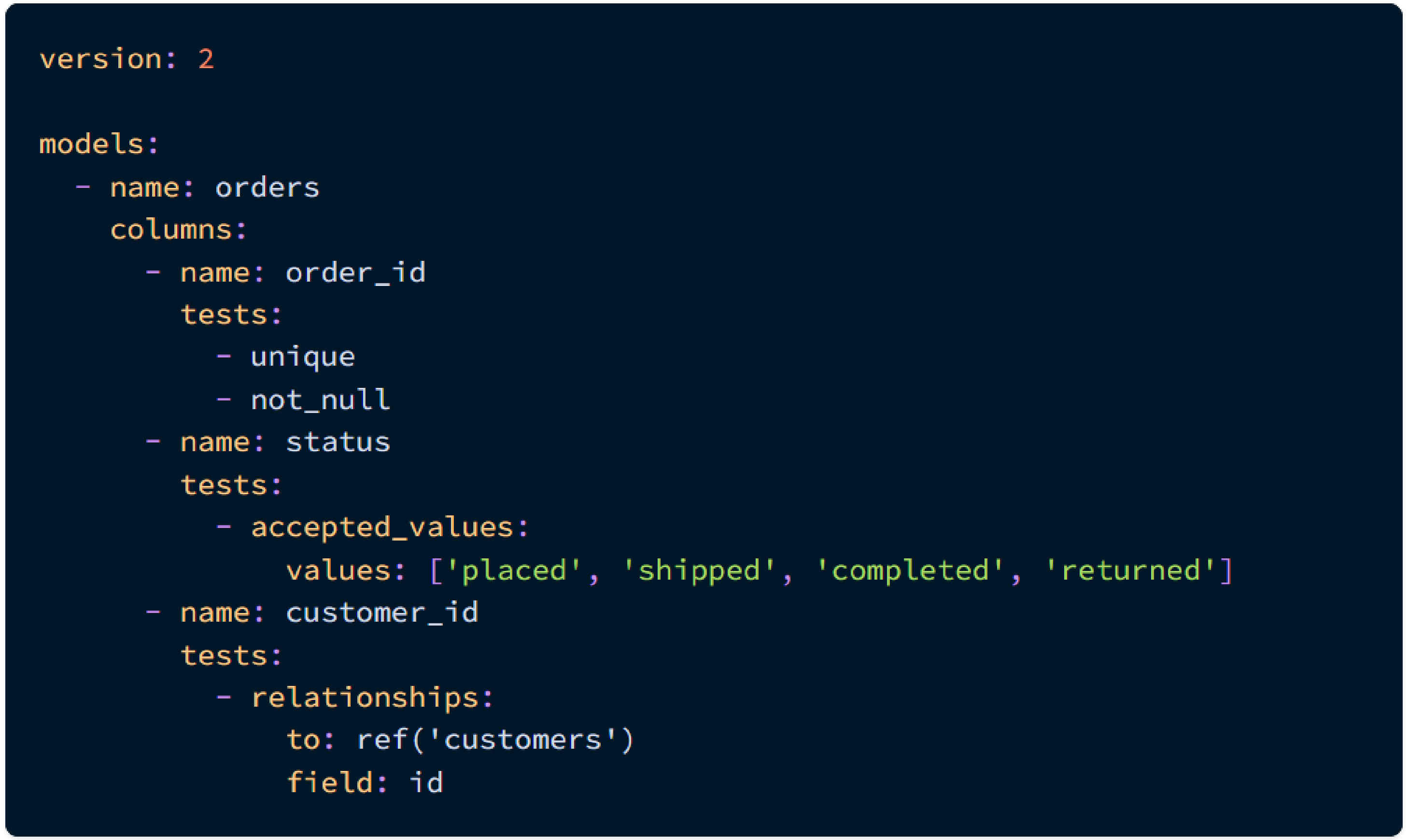
- **In a table**
  - Row counts
  - Column counts
  - Column exist
  - …

- **Column level:**
  - Generic test:
    - Not null (with a threshold level)
    - Unique
  - Text data:
    - Following a pattern?
    - Accepted values?
  - Numeric data:
    - Min, max, mean, median
    - Outliers
  - Date:
    - Recency, range, latest, min, max

Testing data quality

Four generic tests already defined in Dbt:

- unique,
- not_null,
- accepted_values
- relationships.

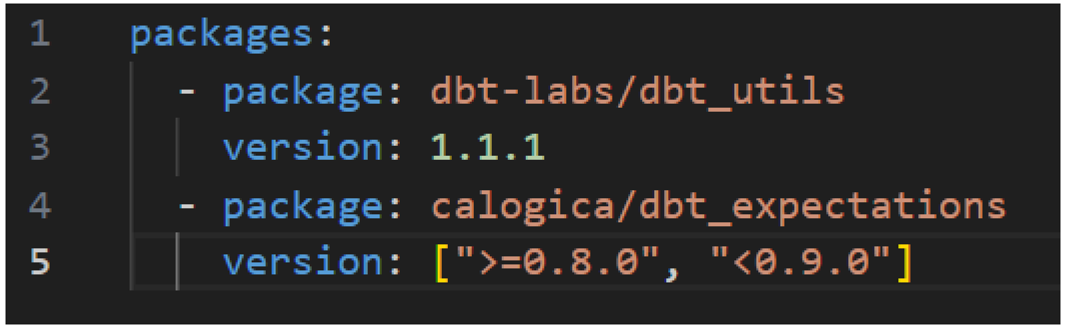


```yaml
version: 2

models:
  - name: orders
    columns:
      - name: order_id
        tests:
          - unique
          - not_null
      - name: status
        tests:
          - accepted_values:
              values: ['placed', 'shipped', 'completed', 'returned']
      - name: customer_id
        tests:
          - relationships:
              to: ref('customers')
              field: id
```

Testing data quality

- Add testing packages into dbt *packages.yml* file:



```yaml
packages:
  - package: dbt-labs/dbt_utils
    version: 1.1.1
  - package: calogica/dbt_expectations
    version: [">=0.8.0", "<0.9.0"]
```

- Install dbt packages: **`dbt deps`**
- Run test: **`dbt test`**

Testing data quality

- **Dbt-utils** Generic Tests

https://github.com/dbt-labs/dbt-utils#generic-tests

  - equal_rowcount (source)
  - fewer_rows_than (source)
  - equality (source)
  - expression_is_true (source)
  - recency (source)
  - at_least_one (source)
  - not_constant (source)
  - not_empty_string (source)
  - cardinality_equality (source)
  - not_null_proportion (source)
  - not_accepted_values (source)
  - relationships_where (source)
  - mutually_exclusive_ranges (source)
  - sequential_values (source)
  - unique_combination_of_columns (source)
  - accepted_range (source)
  - Grouping in tests

Testing data quality

- **Dbt-expectations**

https://github.com/calogica/dbt-expectations

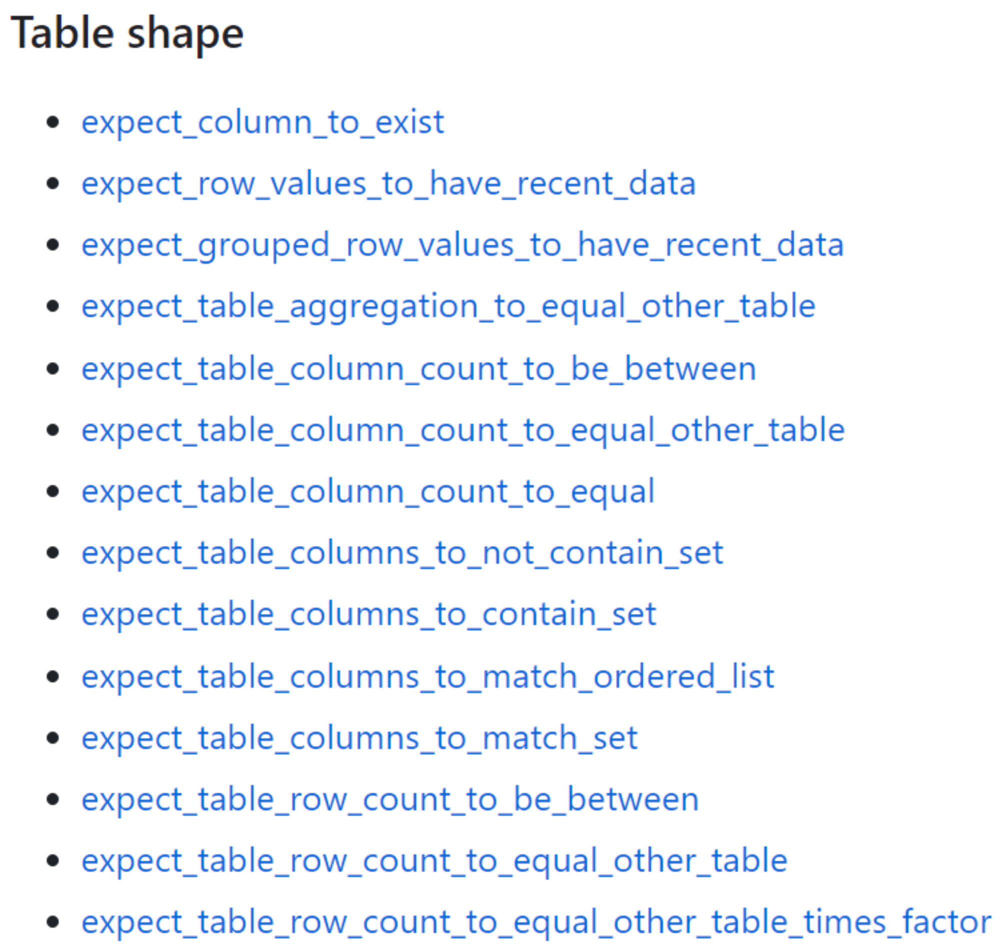
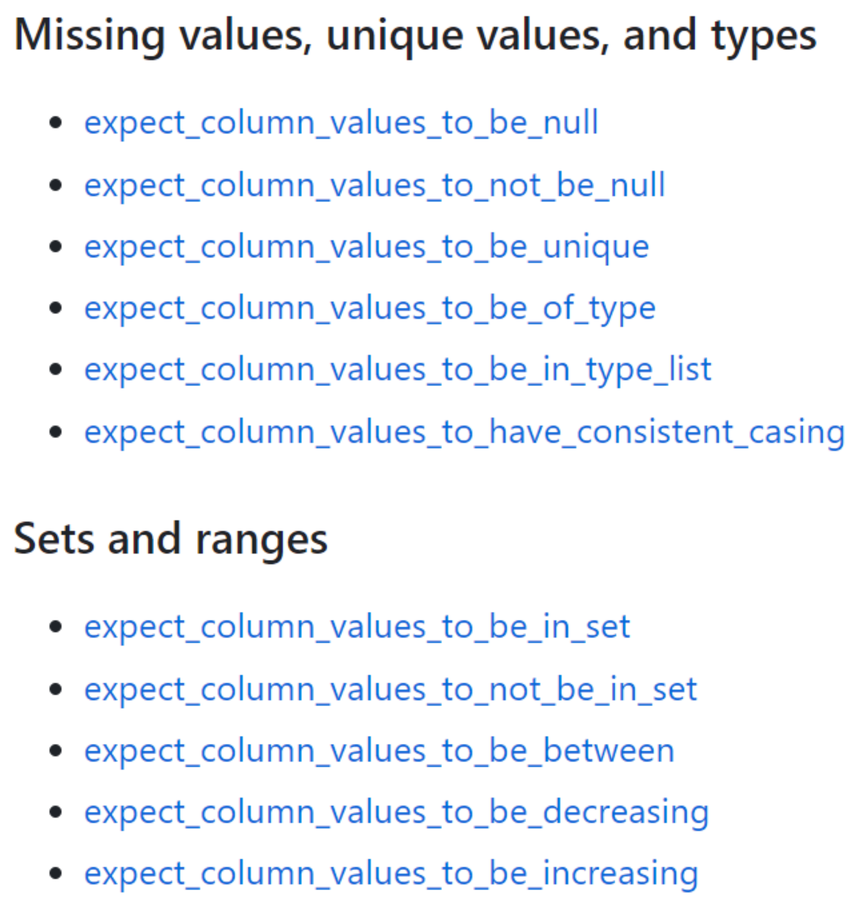


Table shape

- expect_column_to_exist
- expect_row_values_to_have_recent_data
- expect_grouped_row_values_to_have_recent_data
- expect_table_aggregation_to_equal_other_table
- expect_table_column_count_to_be_between
- expect_table_column_count_to_equal_other_table
- expect_table_column_count_to_equal
- expect_table_columns_to_not_contain_set
- expect_table_columns_to_contain_set
- expect_table_columns_to_match_ordered_list
- expect_table_columns_to_match_set
- expect_table_row_count_to_be_between
- expect_table_row_count_to_equal_other_table
- expect_table_row_count_to_equal_other_table_times_factor



Missing values, unique values, and types

- expect_column_values_to_be_null
- expect_column_values_to_not_be_null
- expect_column_values_to_be_unique
- expect_column_values_to_be_of_type
- expect_column_values_to_be_in_type_list
- expect_column_values_to_have_consistent_casing

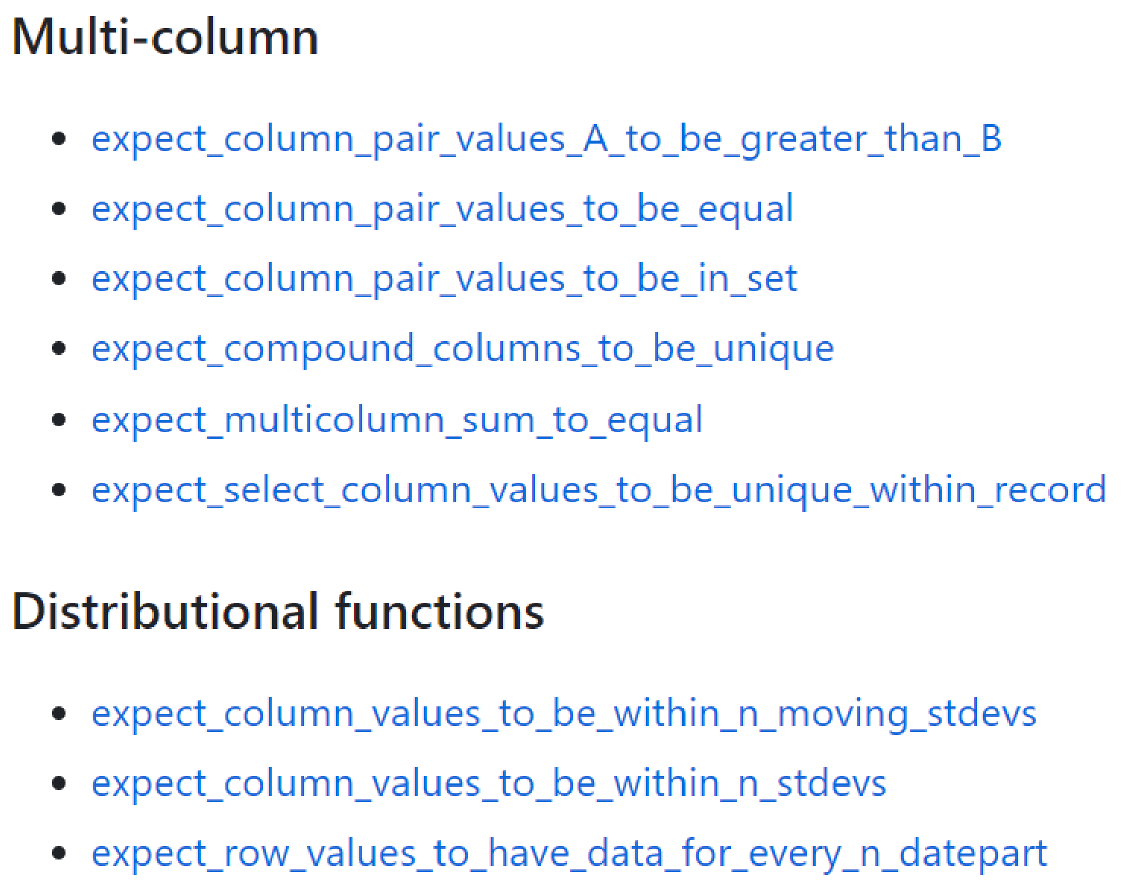
Sets and ranges

- expect_column_values_to_be_in_set
- expect_column_values_to_not_be_in_set
- expect_column_values_to_be_between
- expect_column_values_to_be_decreasing
- expect_column_values_to_be_increasing

Testing data quality

- **Dbt-expectations**

https://github.com/calogica/dbt-expectations

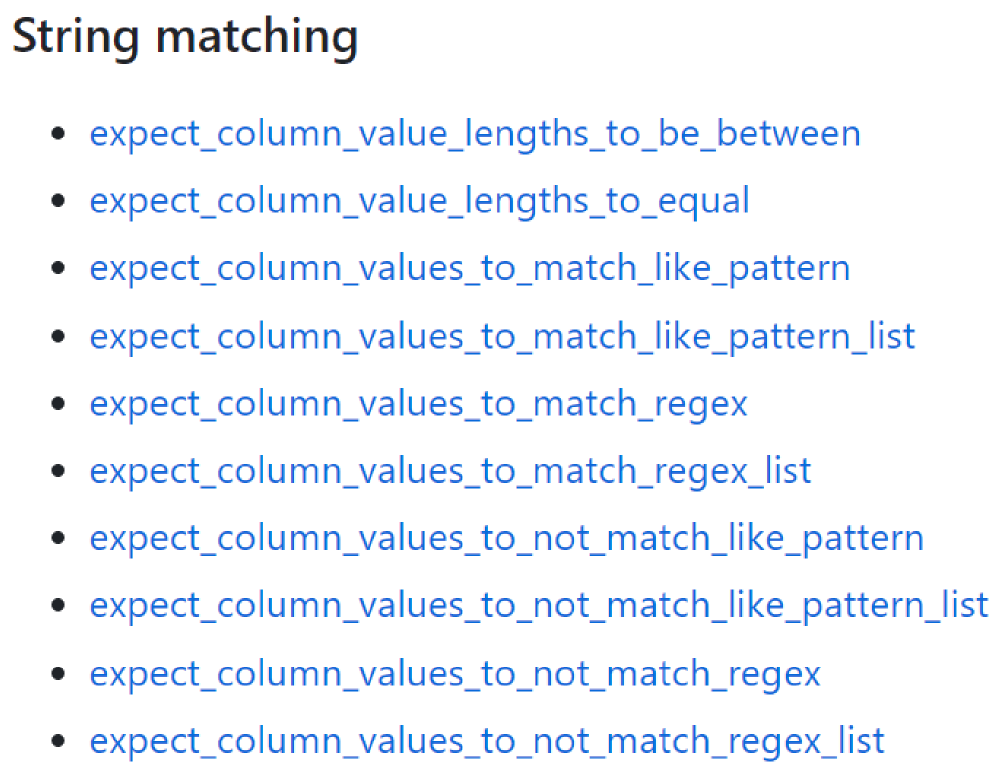


Multi-column

- expect_column_pair_values_A_to_be_greater_than_B
- expect_column_pair_values_to_be_equal
- expect_column_pair_values_to_be_in_set
- expect_compound_columns_to_be_unique
- expect_multicolumn_sum_to_equal
- expect_select_column_values_to_be_unique_within_record

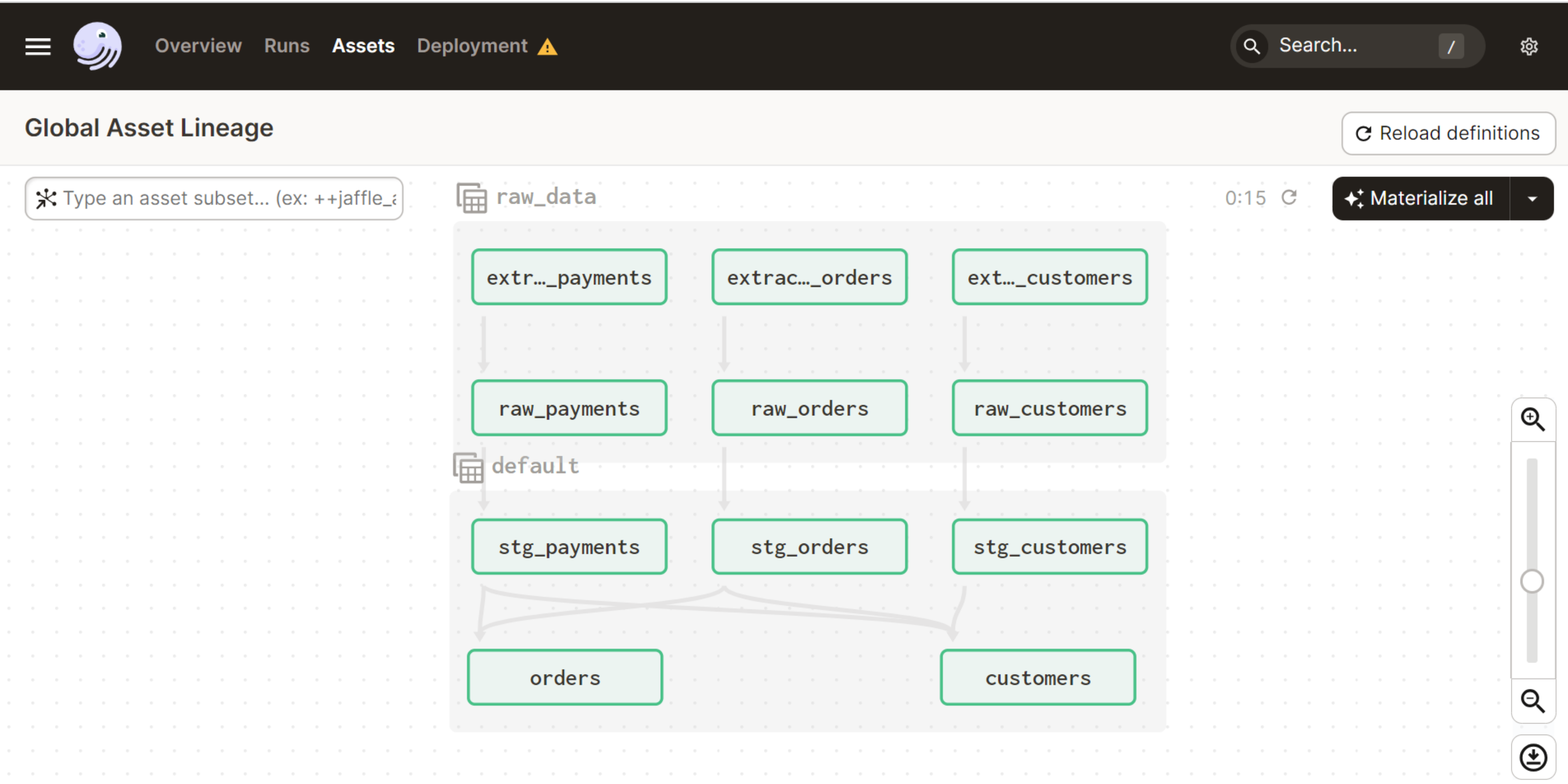
Distributional functions

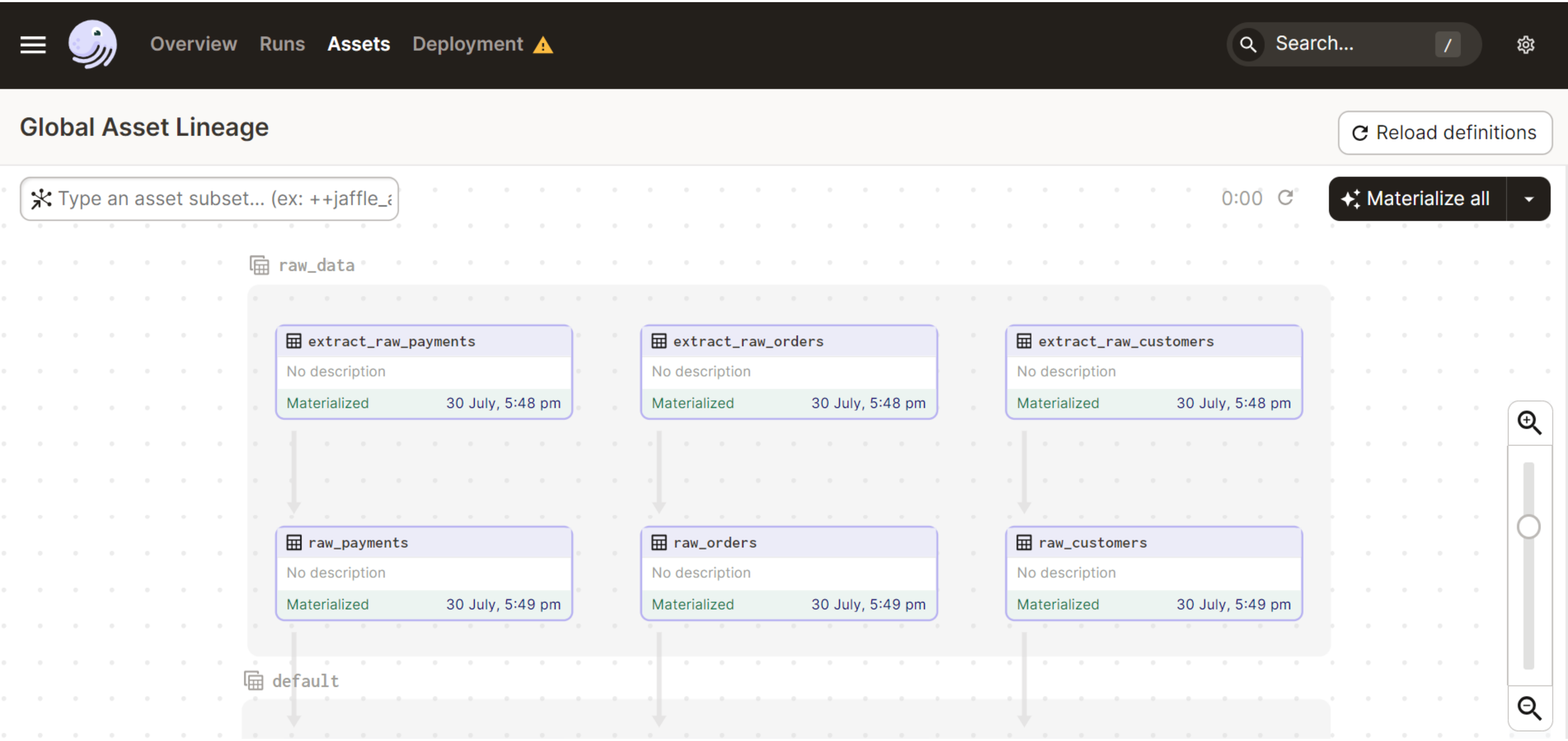
- expect_column_values_to_be_within_n_moving_stdevs
- expect_column_values_to_be_within_n_stdevs
- expect_row_values_to_have_data_for_every_n_datepart



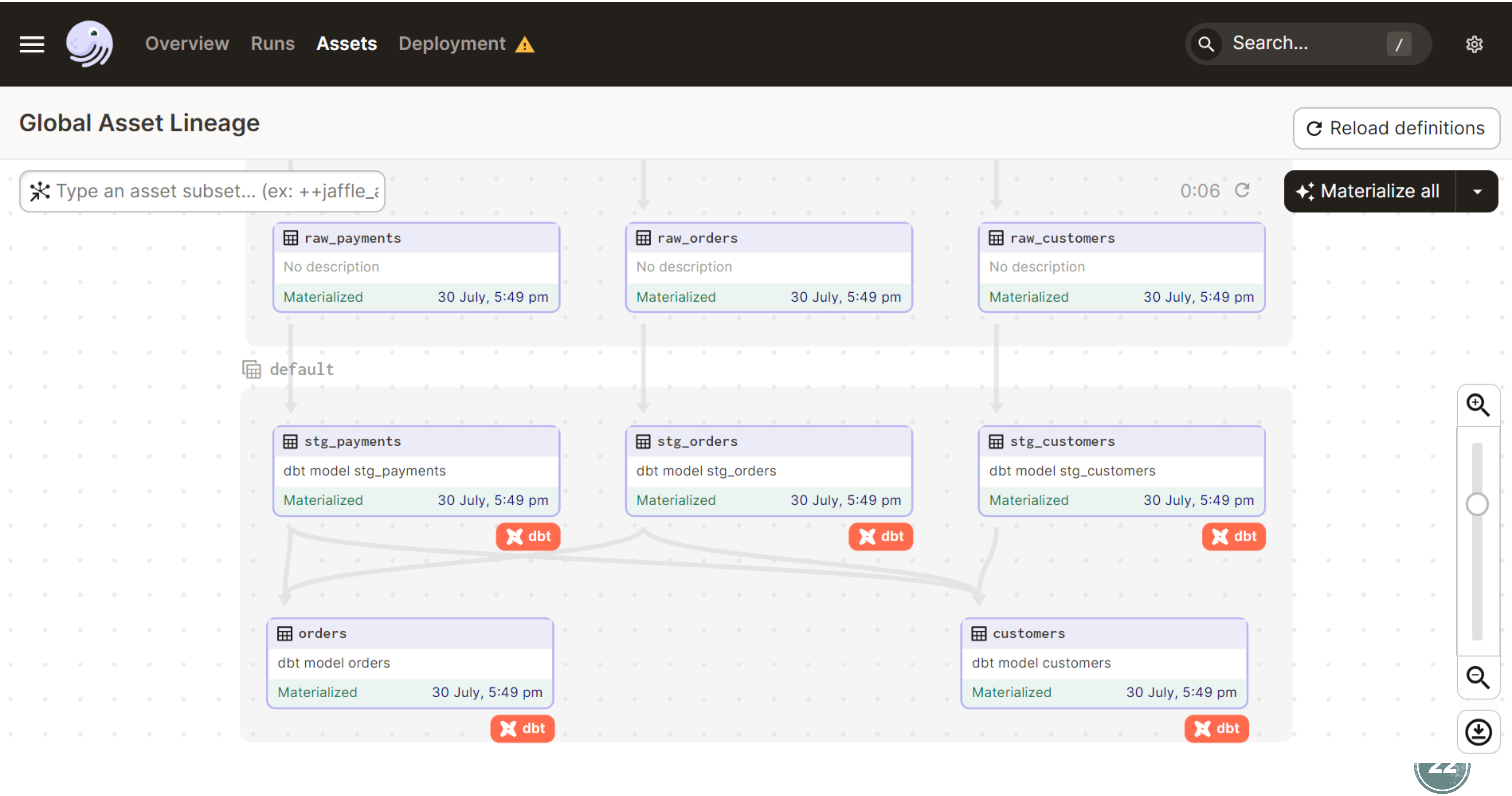
String matching

- expect_column_value_lengths_to_be_between
- expect_column_value_lengths_to_equal
- expect_column_values_to_match_like_pattern
- expect_column_values_to_match_like_pattern_list
- expect_column_values_to_match_regex
- expect_column_values_to_match_regex_list
- expect_column_values_to_not_match_like_pattern
- expect_column_values_to_not_match_like_pattern_list
- expect_column_values_to_not_match_regex
- expect_column_values_to_not_match_regex_list


Overview
Runs
Assets
Deployment
Search...
Global Asset Lineage
Reload definitions
Type an asset subset... (ex: ++jaffle_
raw_data
0:15
Materialize all
extr..._payments
extrac..._orders
ext..._customers
raw_payments
raw_orders
raw_customers
default
stg_payments
stg_orders
stg_customers
orders
customers



extract_raw_payments	No description	Materialized 30 July, 5:48 pm
extract_raw_orders	No description	Materialized 30 July, 5:48 pm
extract_raw_customers	No description	Materialized 30 July, 5:48 pm
raw_payments	No description	Materialized 30 July, 5:49 pm
raw_orders	No description	Materialized 30 July, 5:49 pm
raw_customers	No description	Materialized 30 July, 5:49 pm



Global Asset Lineage

raw_payments
No description
Materialized 30 July, 5:49 pm

raw_orders
No description
Materialized 30 July, 5:49 pm

raw_customers
No description
Materialized 30 July, 5:49 pm

default

stg_payments
dbt model stg_payments
Materialized 30 July, 5:49 pm

stg_orders
dbt model stg_orders
Materialized 30 July, 5:49 pm

stg_customers
dbt model stg_customers
Materialized 30 July, 5:49 pm

orders
dbt model orders
Materialized 30 July, 5:49 pm

customers
dbt model customers
Materialized 30 July, 5:49 pm

Demo

Building trust is a journey!

- Building trusted data is a journey, which needs a good road map
- And strong leaderships with a right data strategy
- And buy-in of data stakeholders and data customers

- Well designed data schema
- Control data quality from upstream (data contract), on the way (data warehouse / data lake), and downstream

References

- The Demo Project repo : https://github.com/danhphan/trusted-data-pipeline
- Dbt tests: https://docs.getdbt.com/docs/build/tests
- Dbt Workshop: Advanced Testing: https://www.youtube.com/watch?v=fo7lUn6vgtg
- Build a poor man's data lake from scratch with DuckDB : https://dagster.io/blog/duckdb-data-lake
- Building a robust data pipeline with Dbt, Airflow, and Great Expectations: https://www.getdbt.com/coalesce-2020/building-a-robust-data-pipeline-with-dbt-airflow-and-great-expectations/
- Dagster repo: https://github.com/dagster-io/dagster
- Dbt repo: https://github.com/dbt-labs/dbt-core
- Duckdb repo: https://github.com/duckdb/duckdb
- Dbt-utils repo: https://github.com/dbt-labs/dbt-utils
- Dbt-expectation repo: https://github.com/calogica/dbt-expectations

Thank you!