Design and implementation of data science pipelines

A new paradigm based on analytics engineers

Politecnico di Torino

Ferdinando Micco
Advisor : Clemente Cetera
Supervisor : Paolo Garza

Index

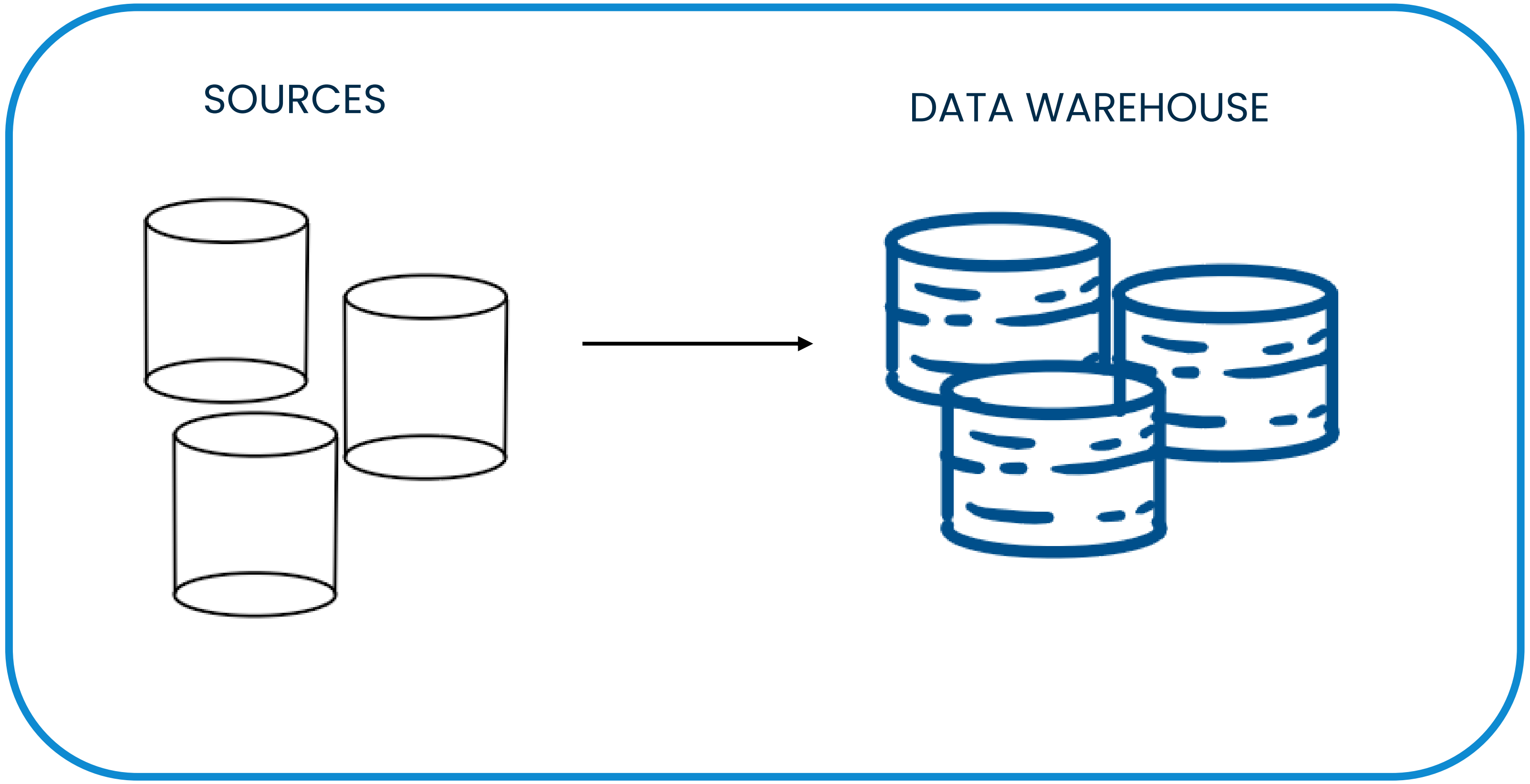
Problem

The gap between business and IT

Data engineer

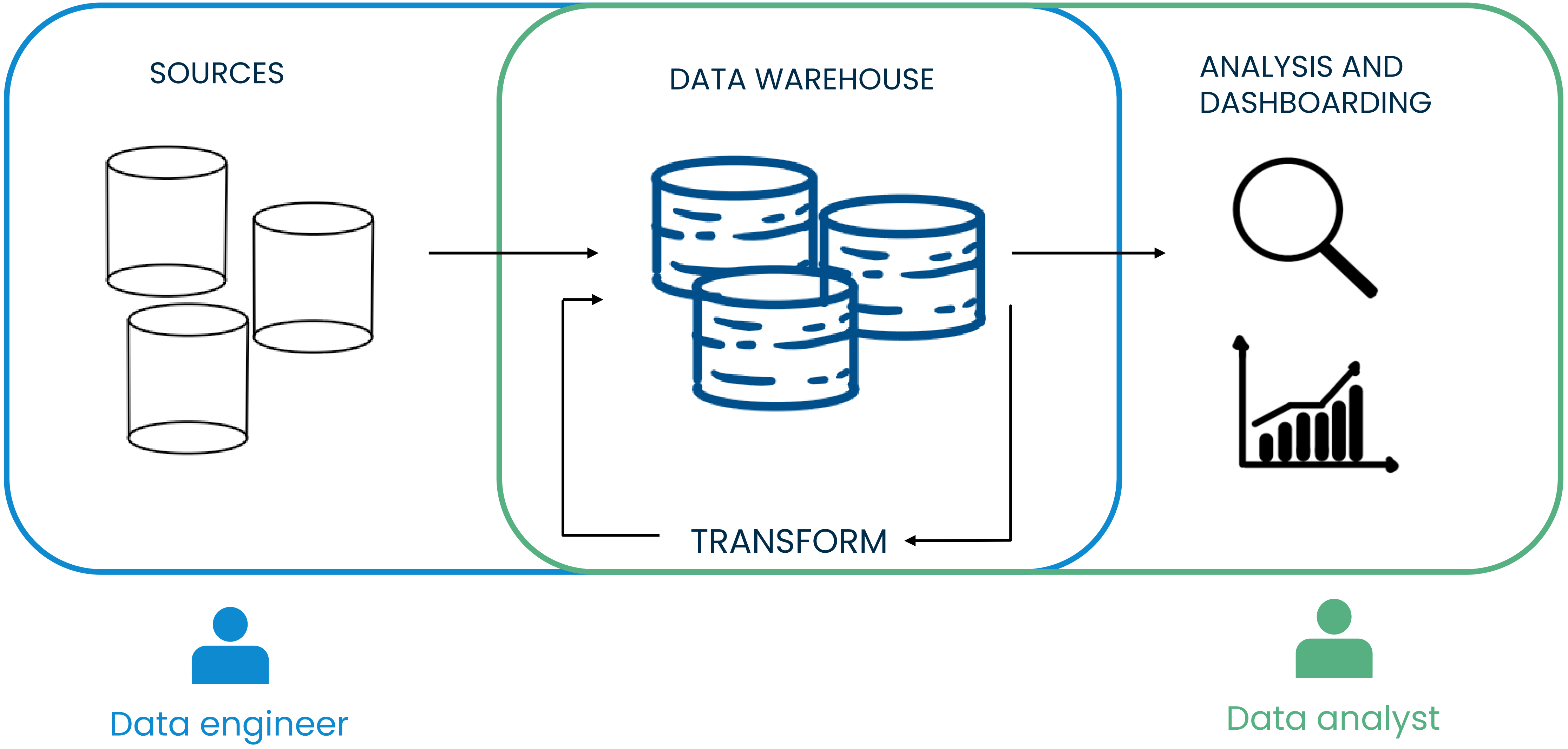
Data analyst

The gap between bussiness and IT



Data engineer

The gap between bussiness and IT



The gap between bussiness and IT

Technical expertise

Analysis skills

The gap between bussiness and IT

Technical expertise

Analysis skills

Data engineer

- Build and maintain the data platform
- Build custom data ingestion integration
- Develop and deploy machine learning algorithm
- Data warehouse performance optimization

The gap between bussiness and IT

Technical expertise

Data engineer

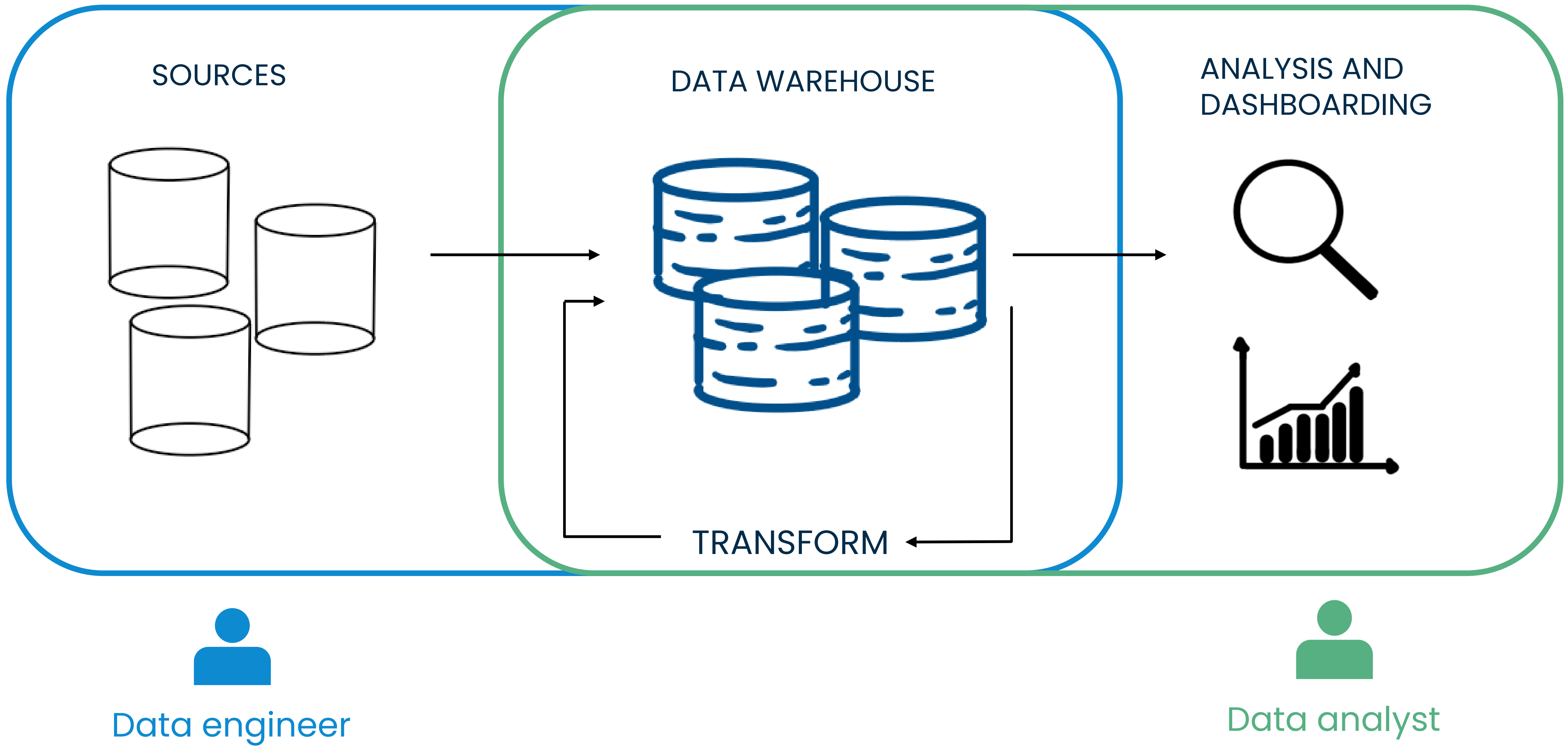
- Build and maintain the data platform
- Build custom data ingestion integration
- Develop and deploy machine learning algorithm
- Data warehouse performance optimization

Analysis skills

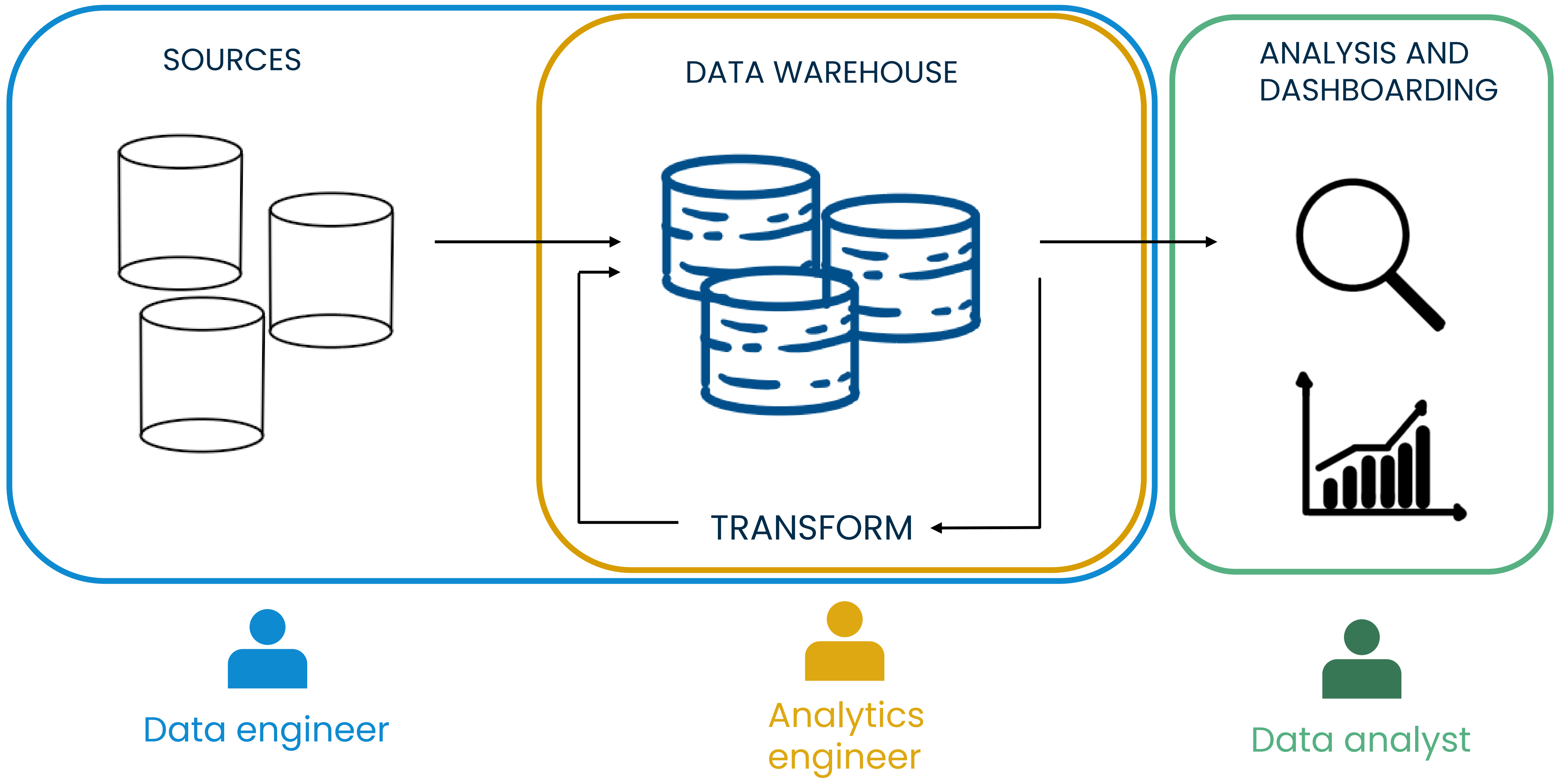
Data analyst

- Work with business users to understand data requirements
- Deep insights work
- Build critical dashboard
- Forecasting

The gap between bussiness and IT



The gap between bussiness and IT



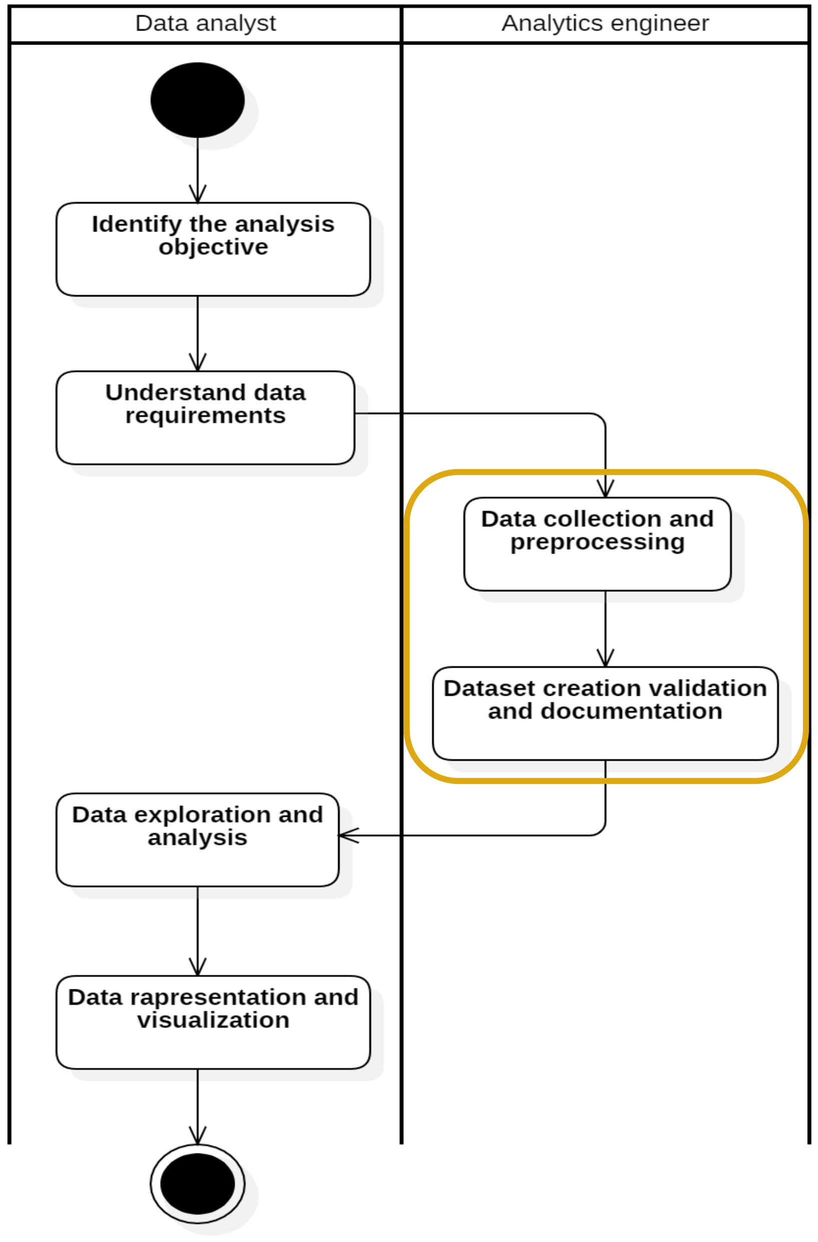
The gap between bussiness and IT

Data Specialist

Analytics engineer

- Provide clean, transformed data ready for analysis
- Apply Software engineering practices to analytics code (ex. Version control, testing, continuous integration)
- Mantain Data documentation and definitions
- Train business users on how to use a data platform data visualization tools

Data model creation process


Data analyst
Analytics engineer
Identify the analysis objective
Understand data requirements
Data collection and preprocessing
Dataset creation validation and documentation
Data exploration and analysis
Data rapresentation and visualization

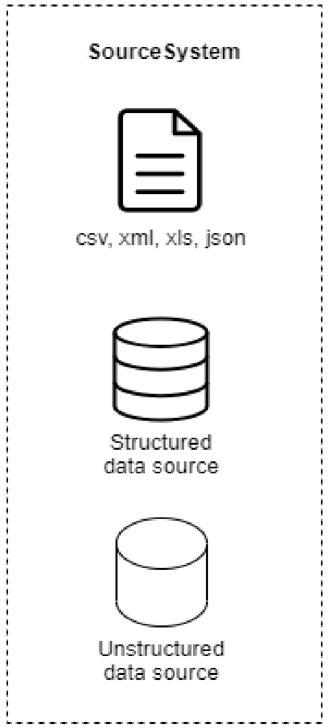
Proof of Concept

AWS Data pipeline with dbt

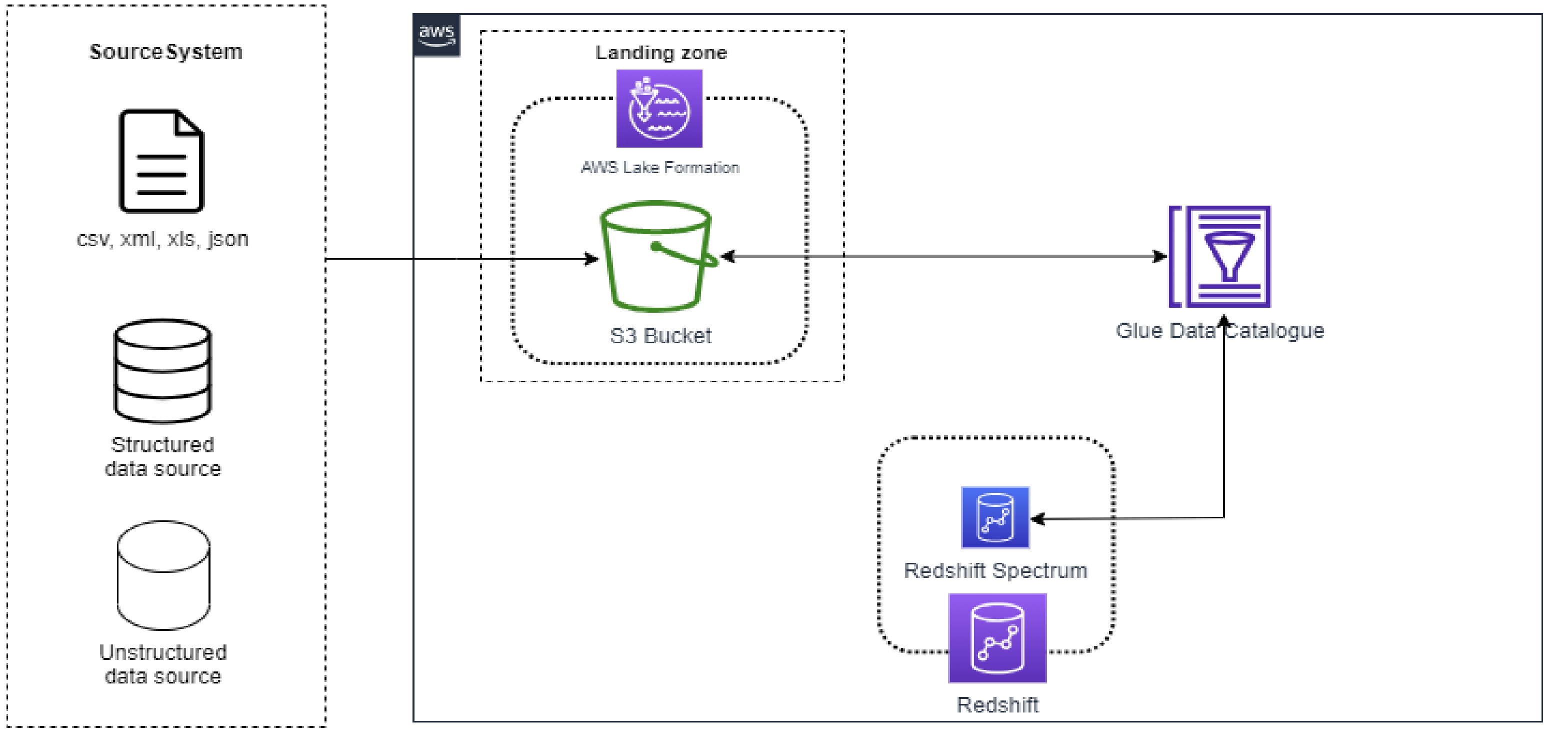
Dbt for data transformation

Full Data life cycle

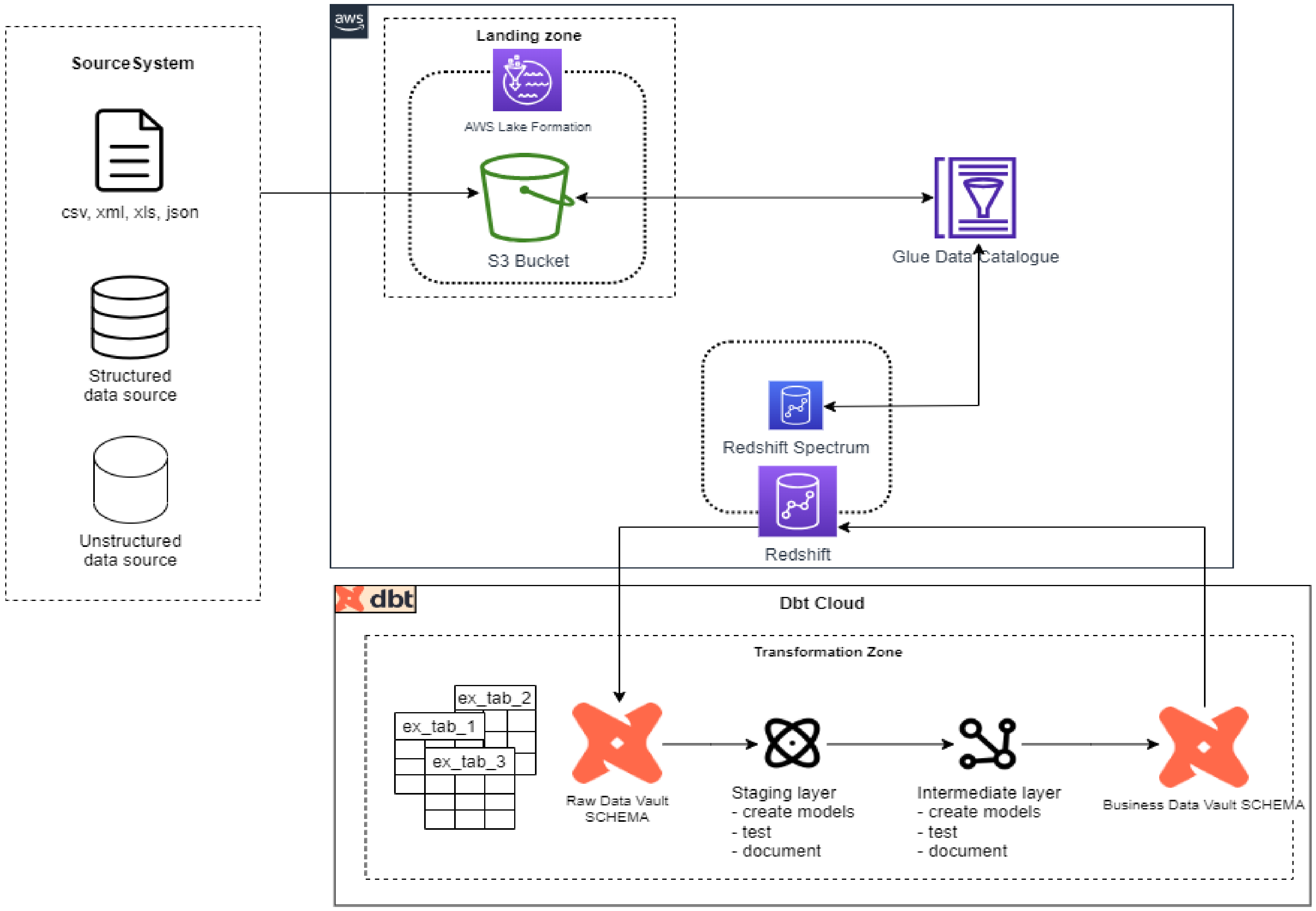
AWS Data pipeline with dbt



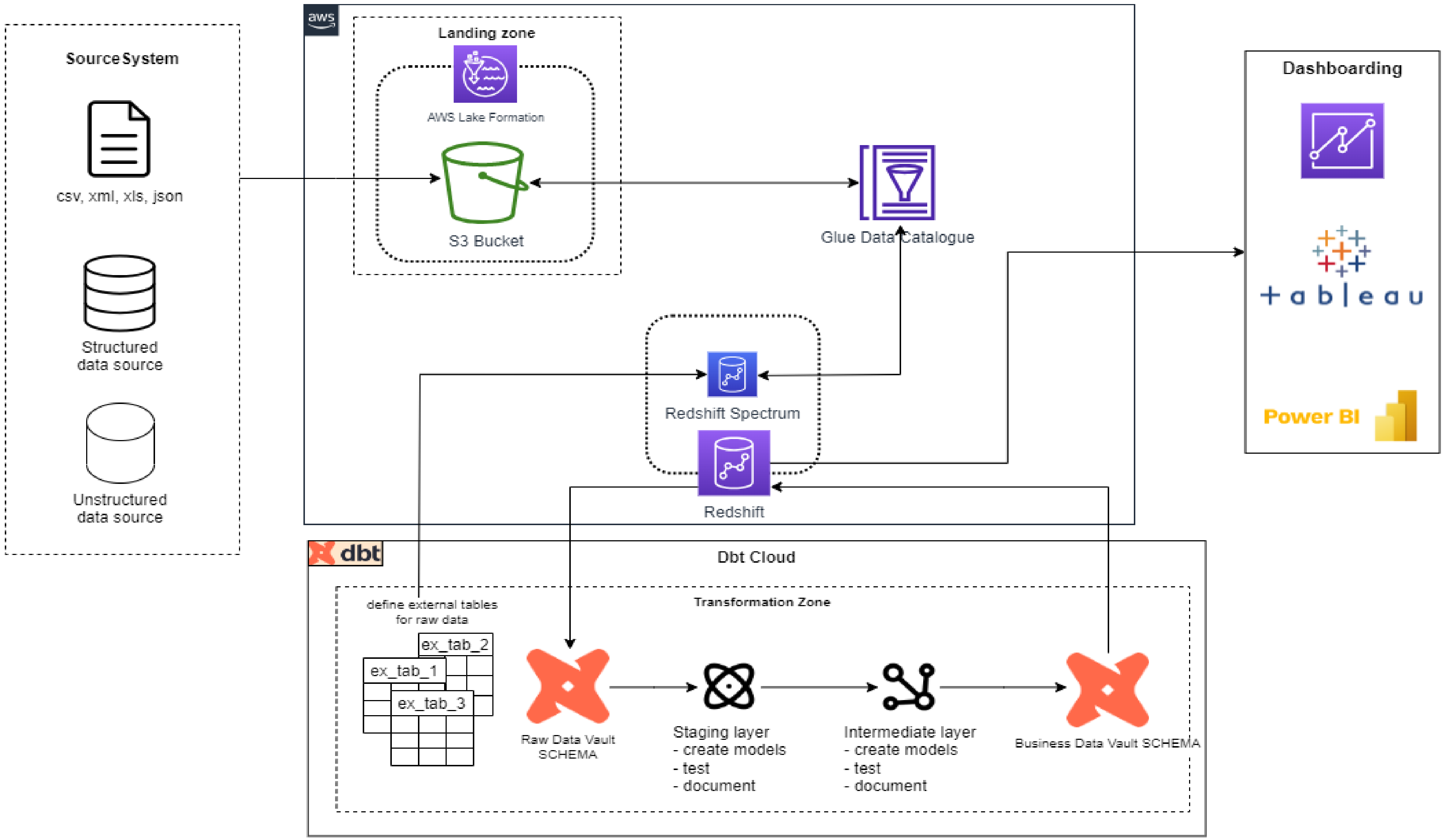
AWS Data pipeline with dbt



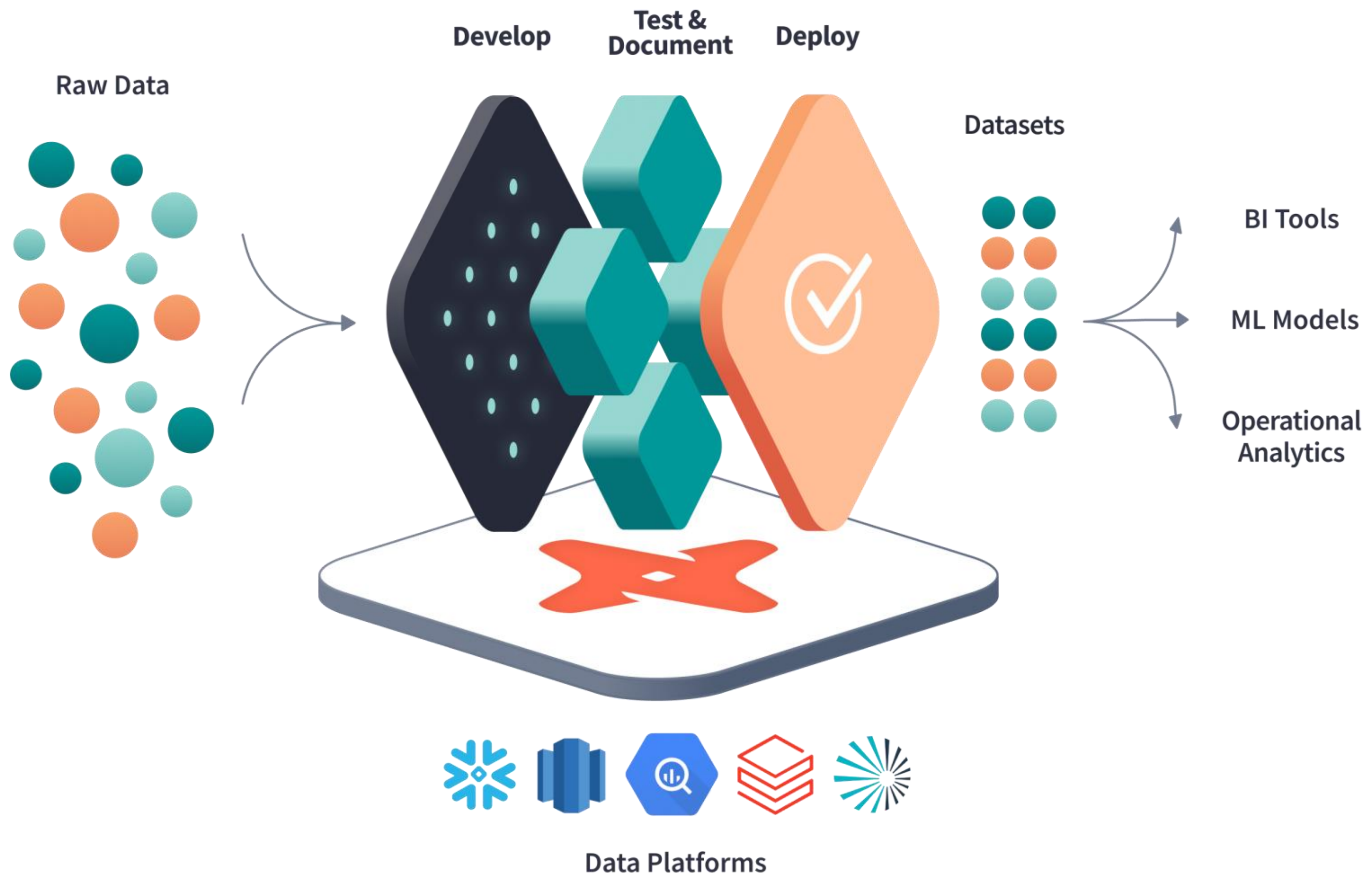
AWS Data pipeline with dbt



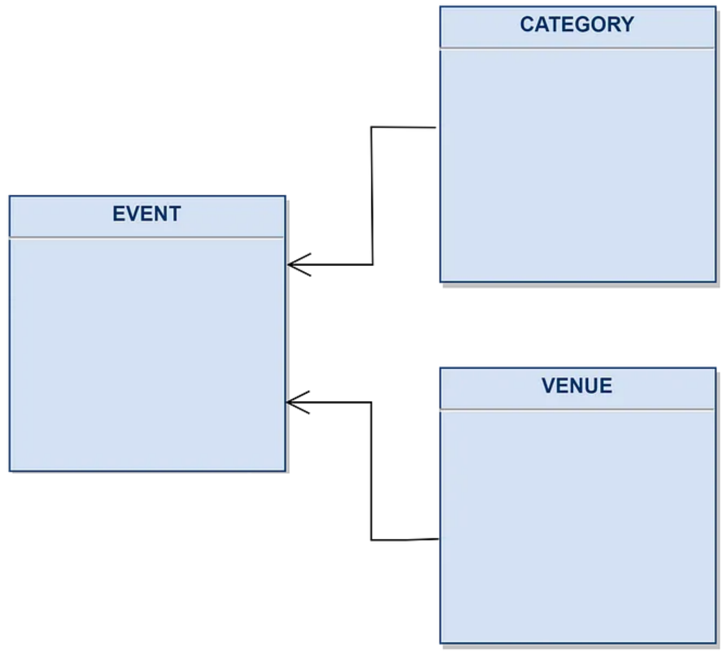
AWS Data pipeline with dbt



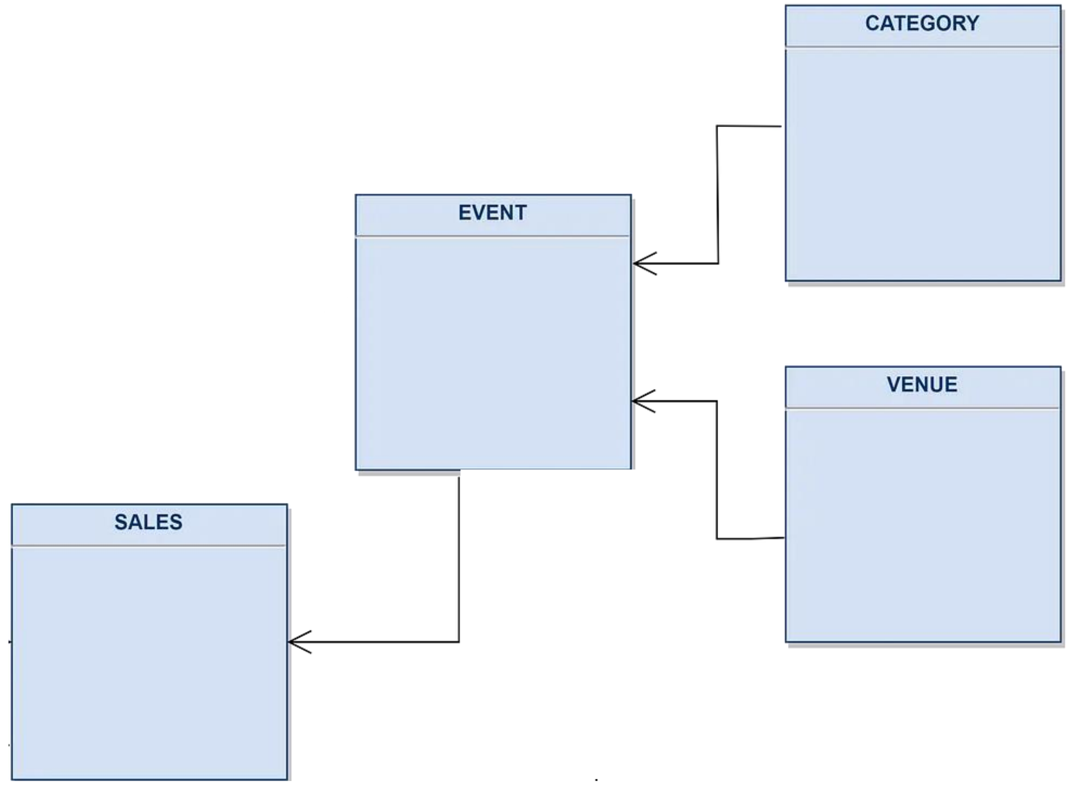
What is dbt


Raw Data
Develop
Test & Document
Deploy
Datasets
BI Tools
ML Models
Operational Analytics
Data Platforms

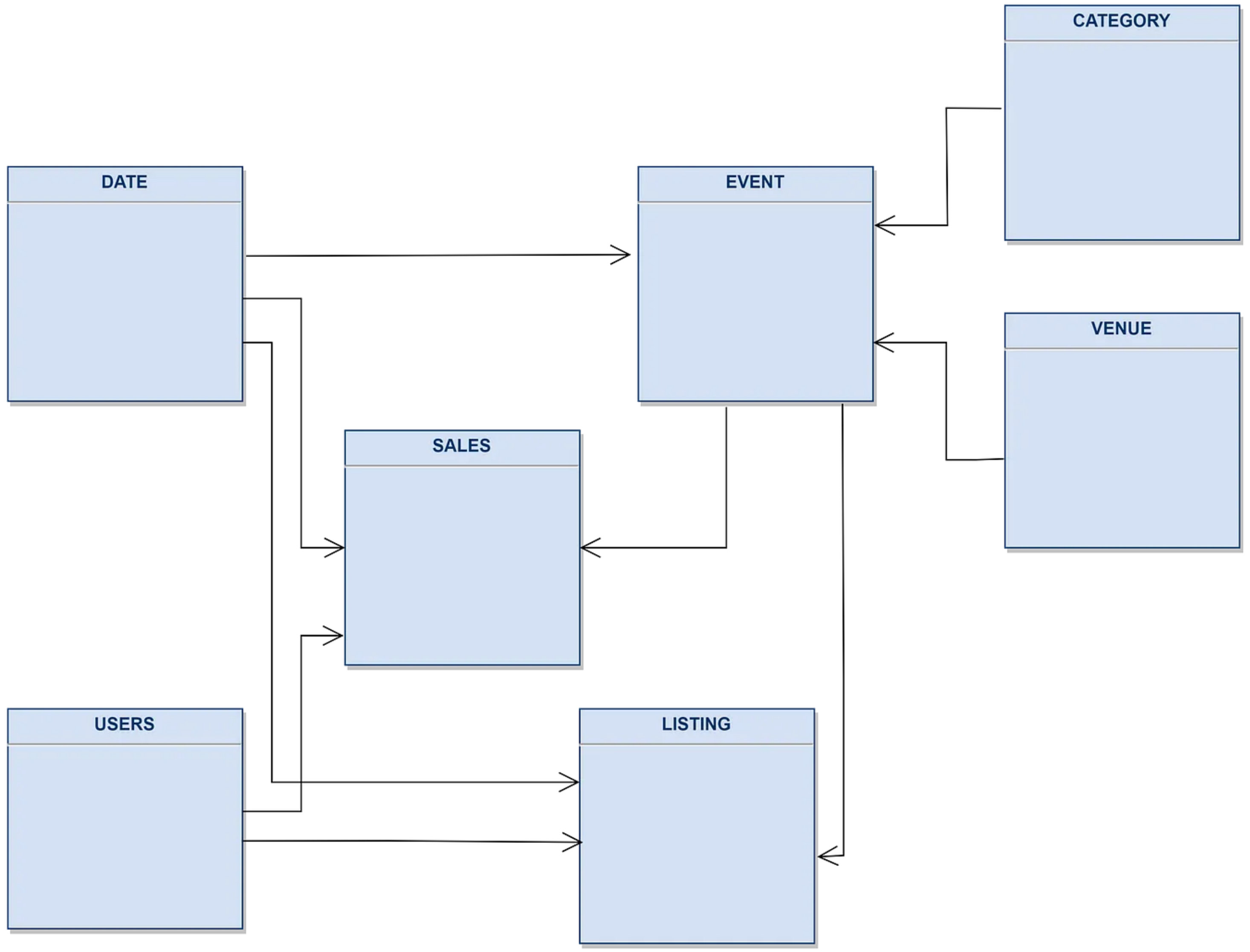
Full data life cycle – raw data



Full data life cycle – raw data



Full data life cycle – raw data

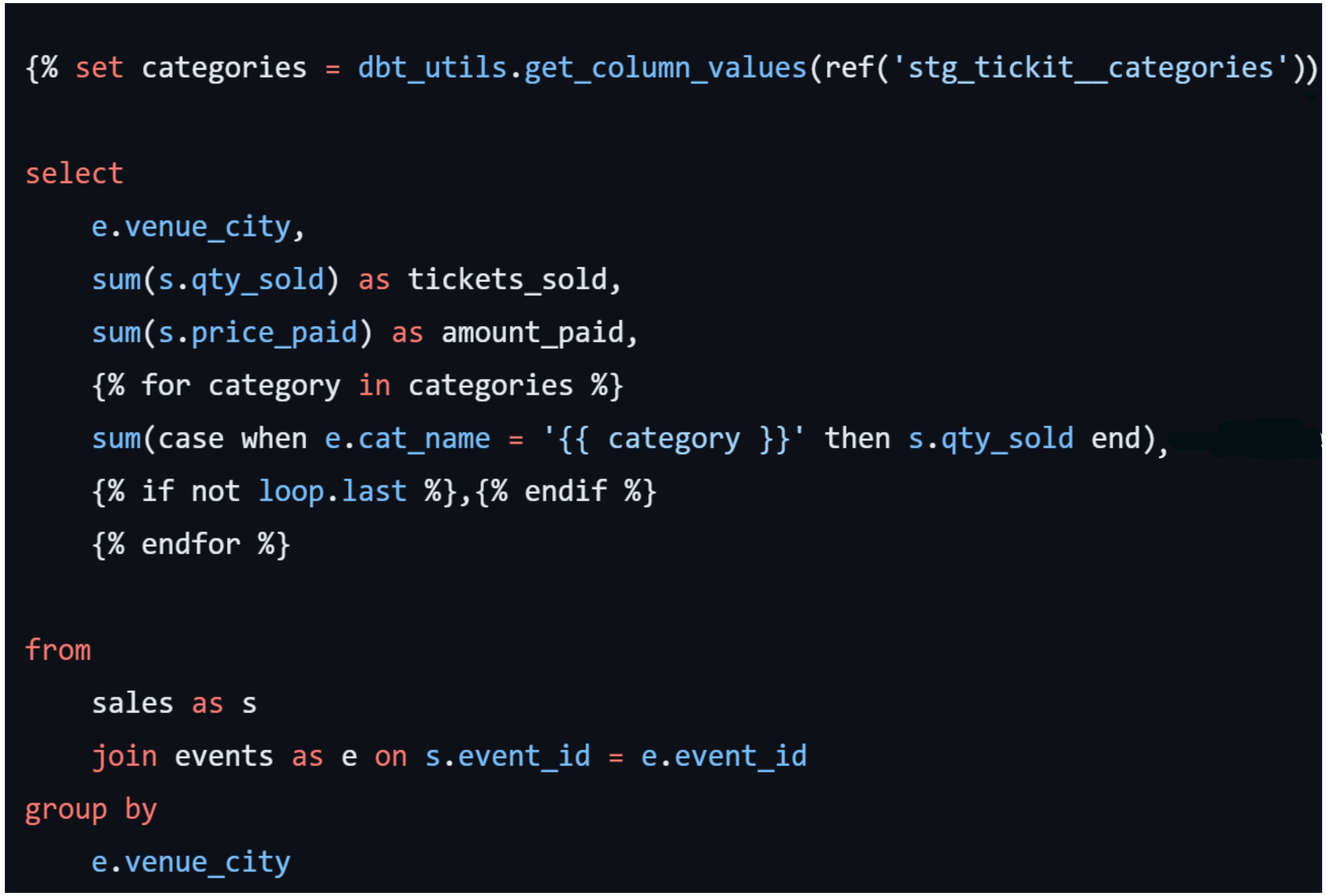


Full data life cycle - Development

Data models are SQL select statments

No DDL and DML code

SQL enpowered with Jinja



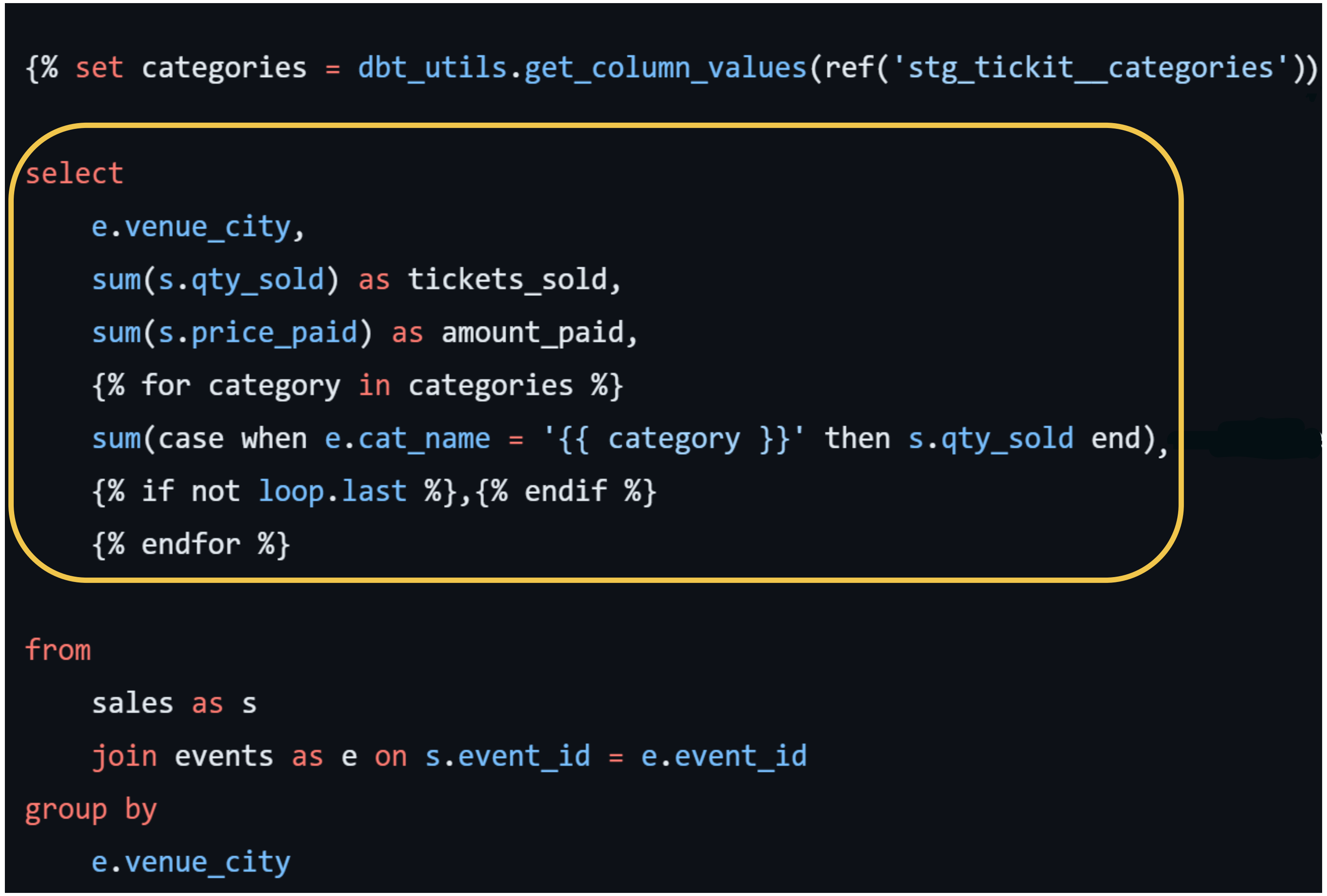
```
{% set categories = dbt_utils.get_column_values(ref('stg_tickit__categories'))

select
    e.venue_city,
    sum(s.qty_sold) as tickets_sold,
    sum(s.price_paid) as amount_paid,
    {% for category in categories %}
    sum(case when e.cat_name = '{{ category }}' then s.qty_sold end), [redacted]
    {% if not loop.last %},{% endif %}
    {% endfor %}

from
    sales as s
    join events as e on s.event_id = e.event_id
group by
    e.venue_city
```

Full data life cycle - Development

Data models are SQL select statments

No DDL and DML code

SQL enpowered with Jinja



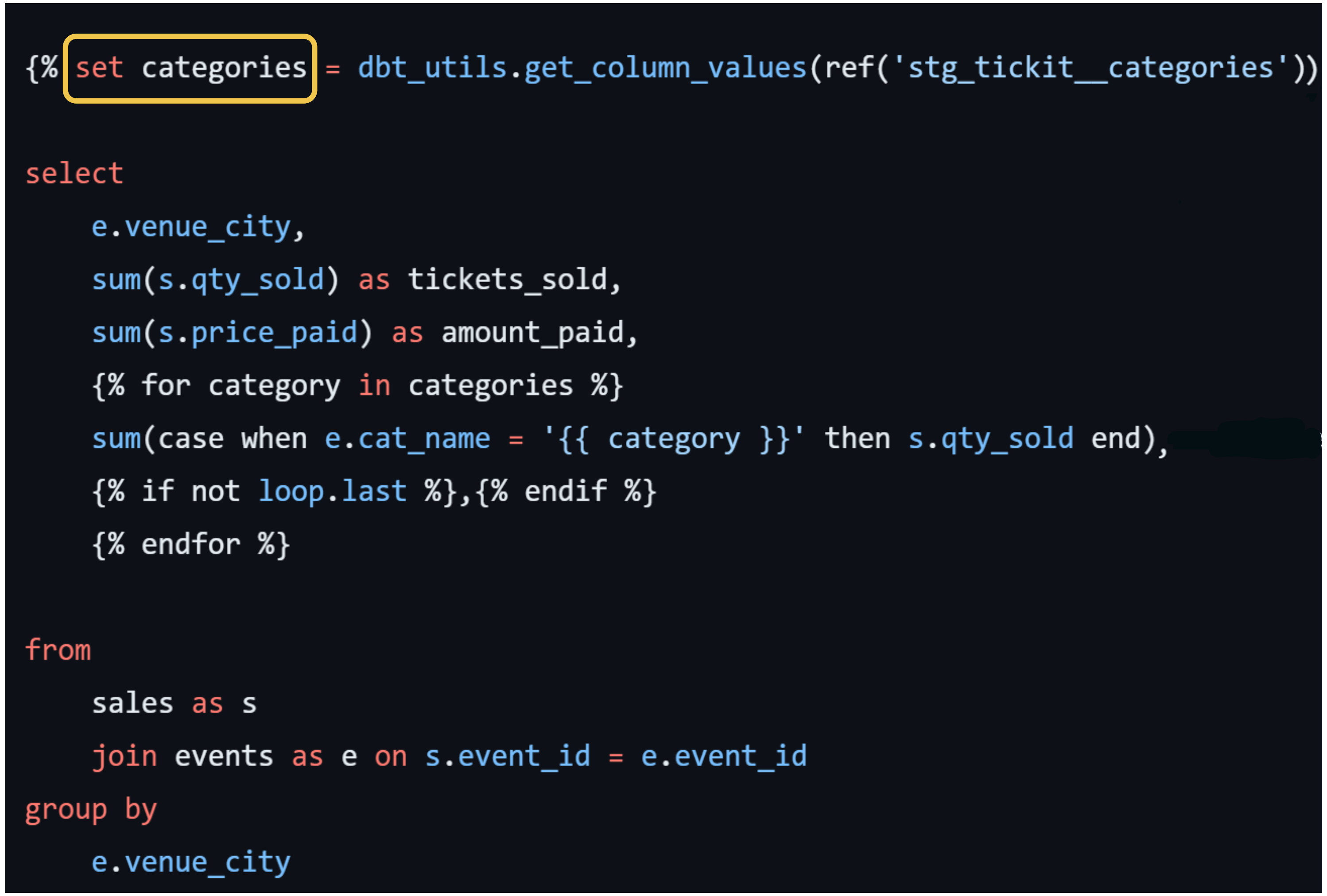
```
{% set categories = dbt_utils.get_column_values(ref('stg_tickit__categories'))

select
    e.venue_city,
    sum(s.qty_sold) as tickets_sold,
    sum(s.price_paid) as amount_paid,
    {% for category in categories %}
    sum(case when e.cat_name = '{{ category }}' then s.qty_sold end),
    {% if not loop.last %},{% endif %}
    {% endfor %}

from
    sales as s
    join events as e on s.event_id = e.event_id
group by
    e.venue_city
```

Full data life cycle - Development

Data models are SQL select statments

No DDL and DML code

SQL enpowered with Jinja



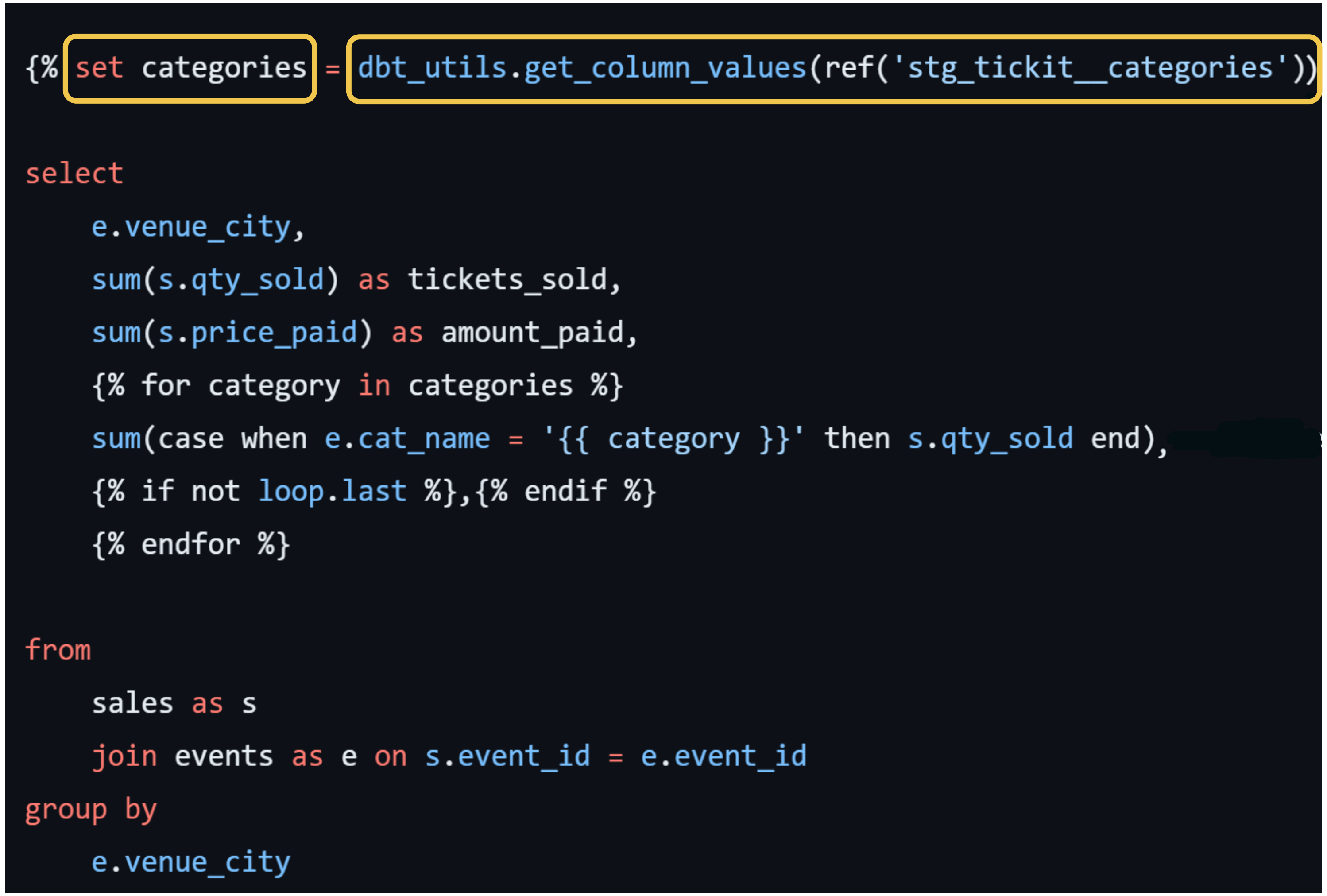
```
{% set categories = dbt_utils.get_column_values(ref('stg_tickit__categories'))

select
    e.venue_city,
    sum(s.qty_sold) as tickets_sold,
    sum(s.price_paid) as amount_paid,
    {% for category in categories %}
    sum(case when e.cat_name = '{{ category }}' then s.qty_sold end), [redacted]
    {% if not loop.last %},{% endif %}
    {% endfor %}

from
    sales as s
    join events as e on s.event_id = e.event_id
group by
    e.venue_city
```

Full data life cycle - Development

Data models are SQL select statments

No DDL and DML code

SQL enpowered with Jinja



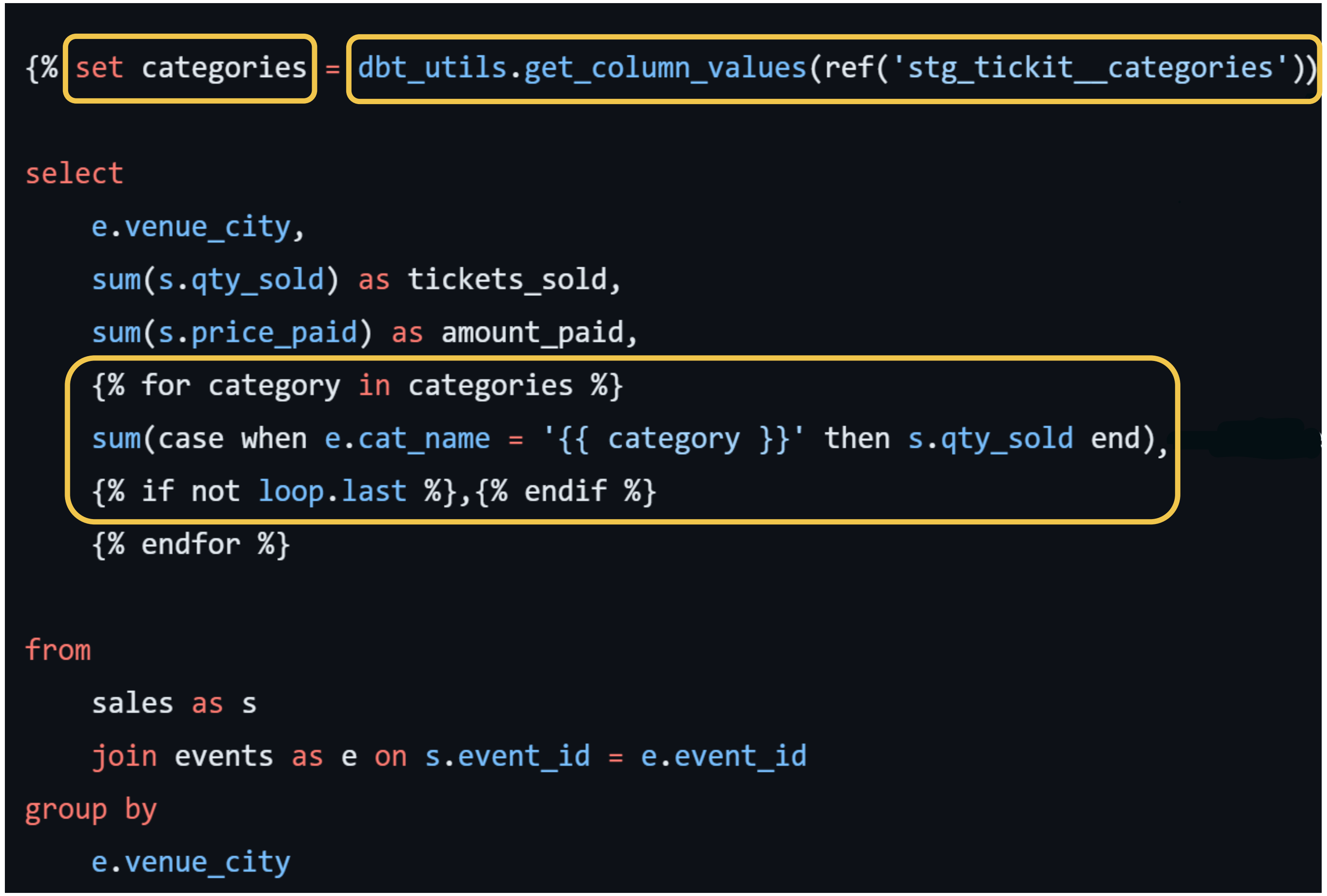
```
{% set categories = dbt_utils.get_column_values(ref('stg_tickit__categories')) %}

select
    e.venue_city,
    sum(s.qty_sold) as tickets_sold,
    sum(s.price_paid) as amount_paid,
    {% for category in categories %}
    sum(case when e.cat_name = '{{ category }}' then s.qty_sold end),[redacted]
    {% if not loop.last %},{% endif %}
    {% endfor %}

from
    sales as s
    join events as e on s.event_id = e.event_id
group by
    e.venue_city
```

Full data life cycle - Development

Data models are SQL select statments

No DDL and DML code

SQL enpowered with Jinja



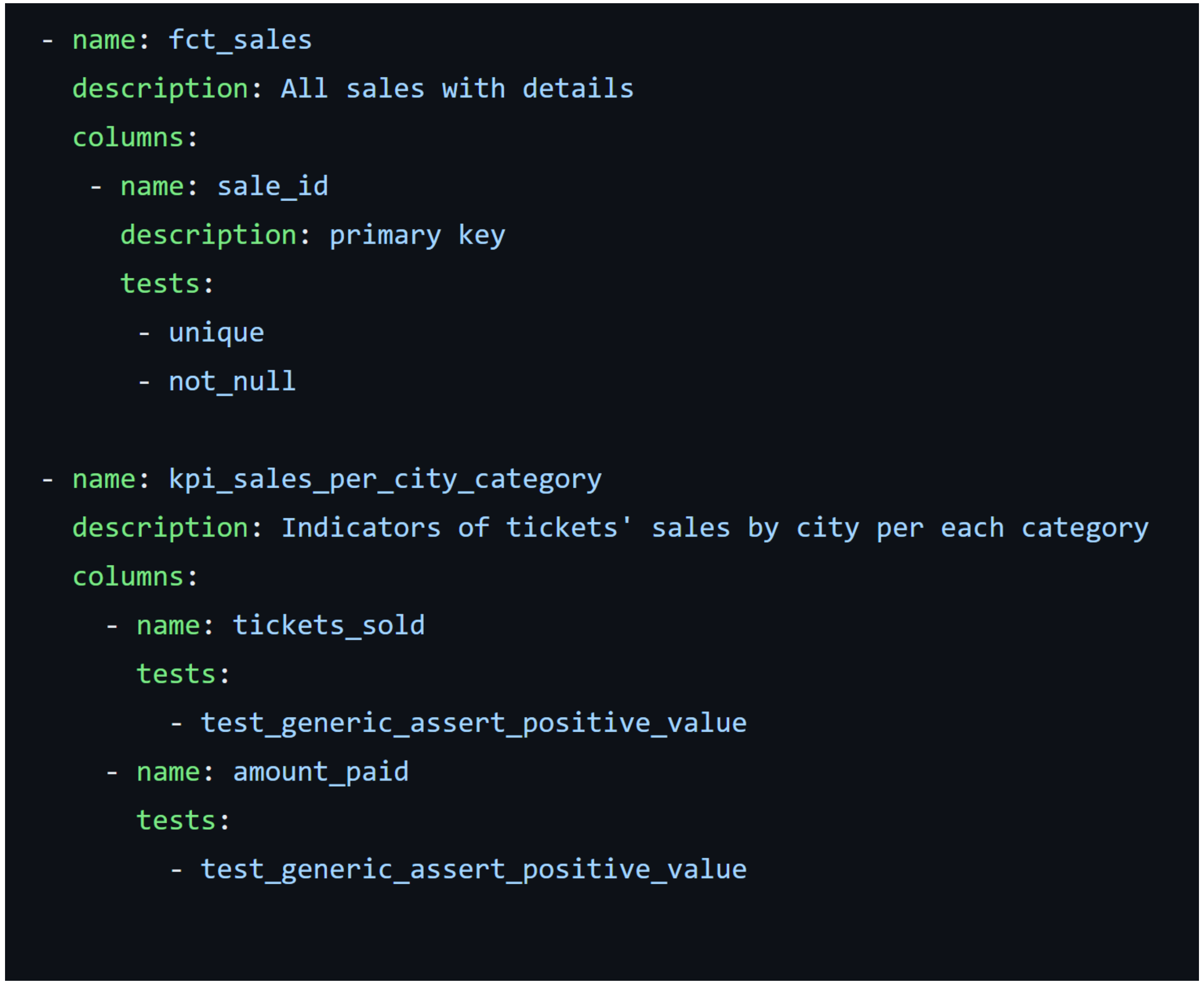
```
{% set categories = dbt_utils.get_column_values(ref('stg_tickit__categories')) %}

select
    e.venue_city,
    sum(s.qty_sold) as tickets_sold,
    sum(s.price_paid) as amount_paid,
    {% for category in categories %}
    sum(case when e.cat_name = '{{ category }}' then s.qty_sold end),
    {% if not loop.last %},{% endif %}
    {% endfor %}

from
    sales as s
    join events as e on s.event_id = e.event_id
group by
    e.venue_city
```

Full data life cycle – Testing and validation

Built-in test

Singular test

Generic test



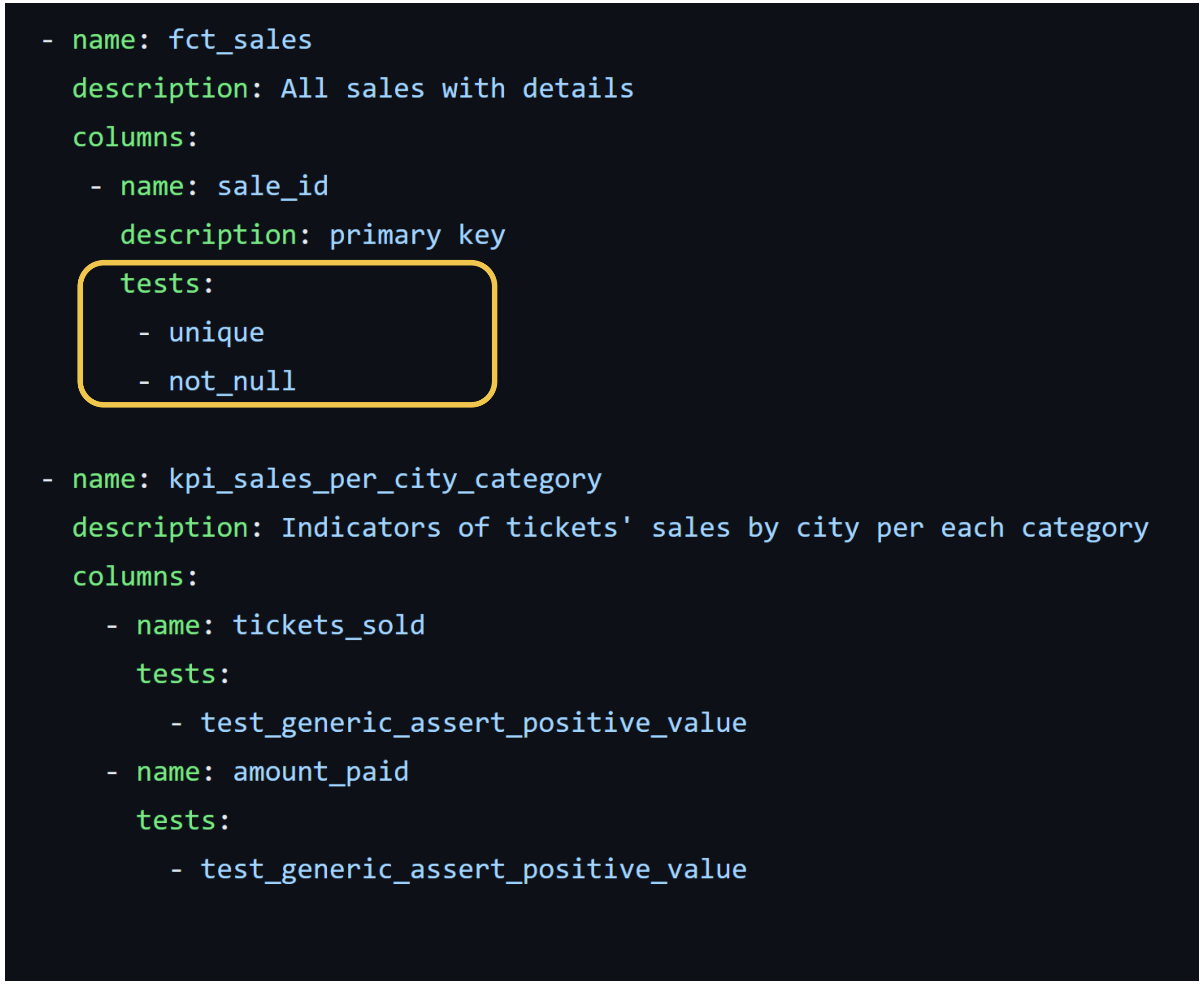
```yaml
- name: fct_sales
  description: All sales with details
  columns:
   - name: sale_id
     description: primary key
     tests:
      - unique
      - not_null

- name: kpi_sales_per_city_category
  description: Indicators of tickets' sales by city per each category
  columns:
    - name: tickets_sold
      tests:
        - test_generic_assert_positive_value
    - name: amount_paid
      tests:
        - test_generic_assert_positive_value
```

Full data life cycle - Testing and validation

Built-in test

Singular test

Generic test



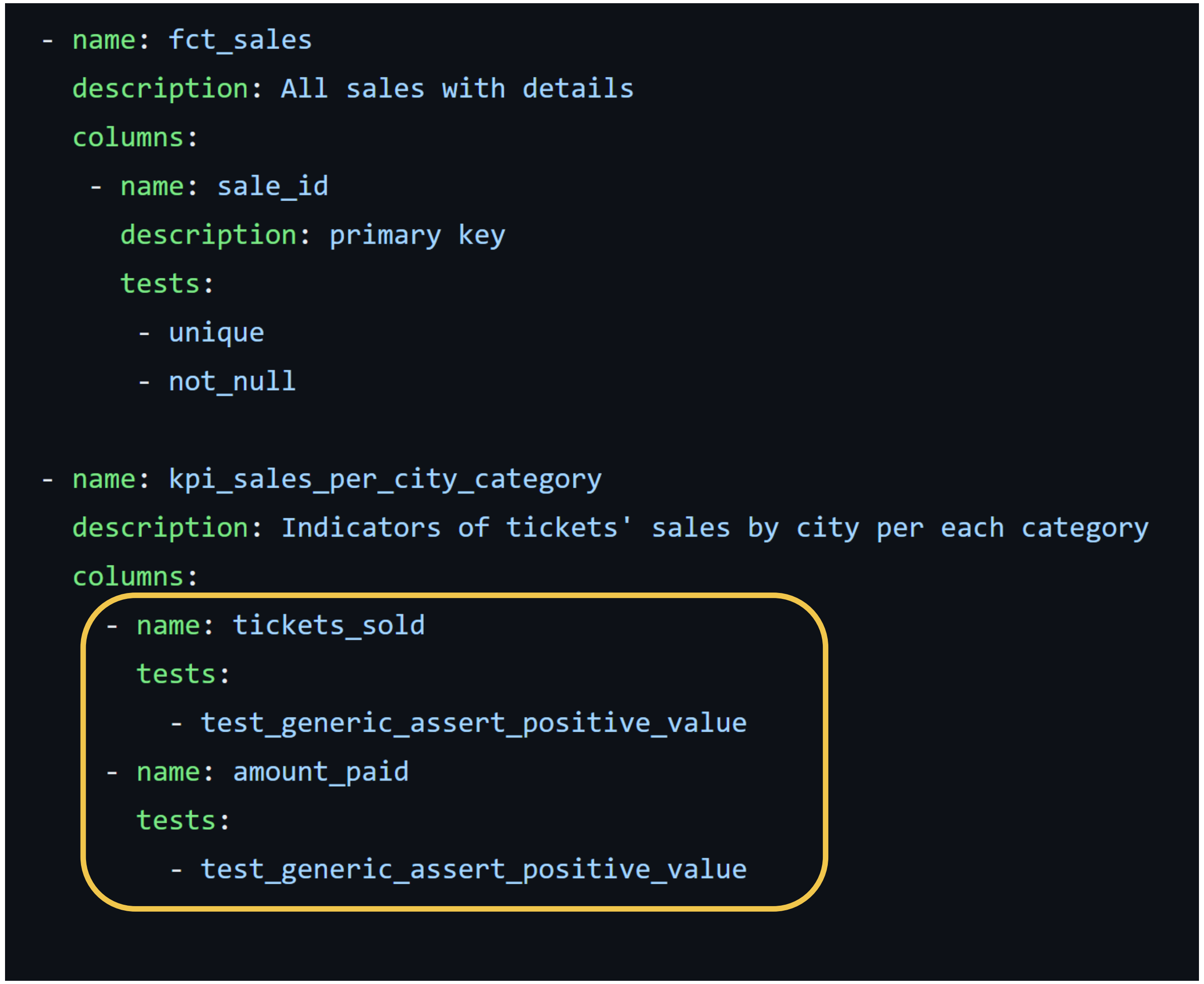
```yaml
- name: fct_sales
  description: All sales with details
  columns:
   - name: sale_id
     description: primary key
     tests:
      - unique
      - not_null

- name: kpi_sales_per_city_category
  description: Indicators of tickets' sales by city per each category
  columns:
    - name: tickets_sold
      tests:
        - test_generic_assert_positive_value
    - name: amount_paid
      tests:
        - test_generic_assert_positive_value
```

Full data life cycle – Testing and validation

Built-in test

Singular test

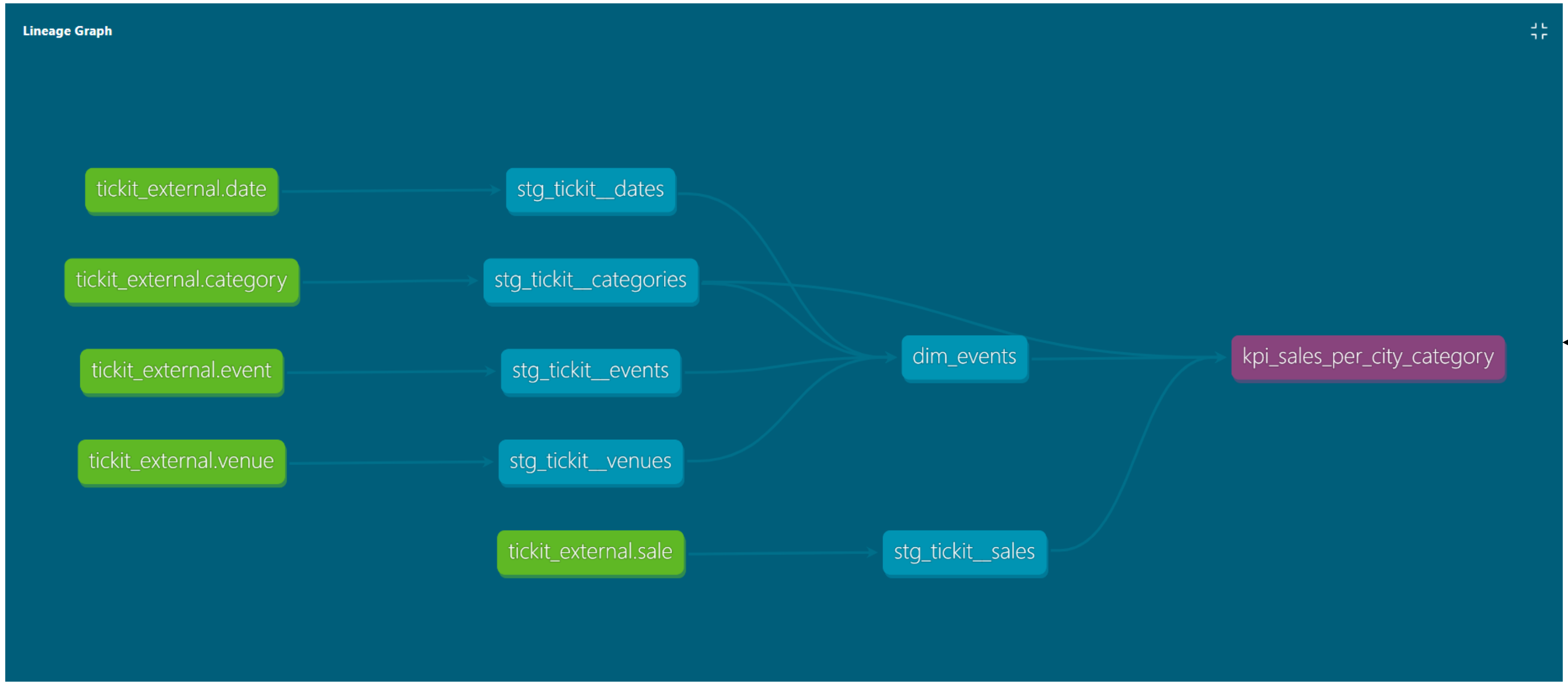
Generic test



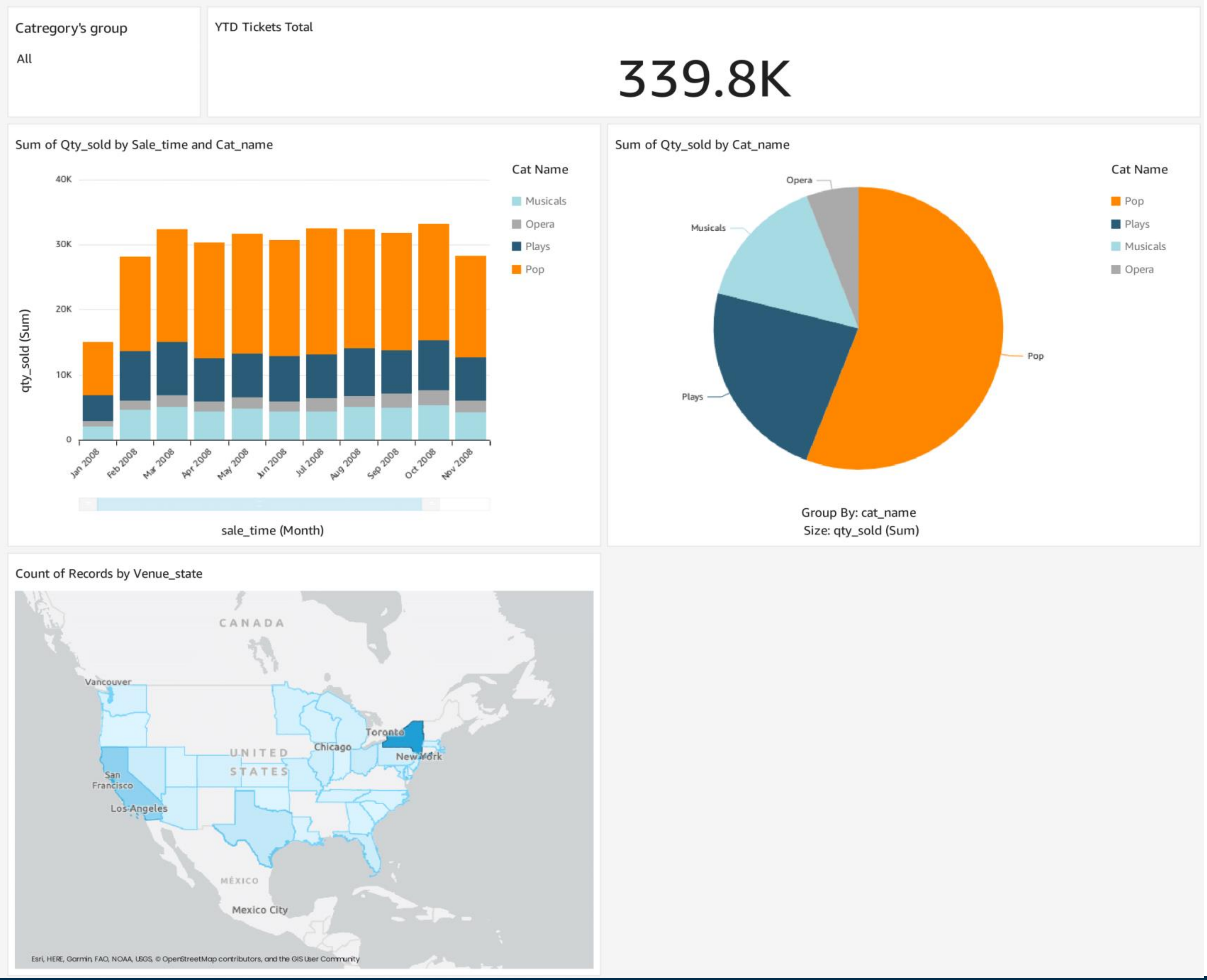
```
- name: fct_sales
  description: All sales with details
  columns:
   - name: sale_id
     description: primary key
     tests:
      - unique
      - not_null

- name: kpi_sales_per_city_category
  description: Indicators of tickets' sales by city per each category
  columns:
    - name: tickets_sold
      tests:
        - test_generic_assert_positive_value
    - name: amount_paid
      tests:
        - test_generic_assert_positive_value
```

Full data life cycle - Documentation

«dbt docs generate» → Dbt extract model's dependency and fields description from all .yml file and .sql models → automatically generate documentation and Lineage Graph



Data analysis and visualization



Catregory's group

All

YTD Tickets Total

339.8K

Sum of Qty_sold by Sale_time and Cat_name

Sum of Qty_sold by Cat_name

Count of Records by Venue_state

CANADA
Vancouver
Toronto
Chicago
UNITED STATES
New York
San Francisco
Los Angeles
MÉXICO
Mexico City
Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Achievements

Process diagram analysis between traditional and proposed paradigm

Design and implementation of a cloud data pipeline on AWS

Build a mature dbt project for data transformation

Simulate with a fictional database the data life cycle from source ingestion to analysis and dashboarding

Thank you for your attention!

Politecnico di Torino