

Lab 2: Building an end to end Data Analytics using Snowflake, Airflow, dbt, and a BI tool

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1. Introduction

1.1 Problem Statement

In modern data engineering, raw data is rarely ready for immediate analysis. The challenge addressed in this lab is to build a robust, automated End-to-End (E2E) data pipeline that ingests raw financial stock data, transforms it into meaningful technical indicators (like Moving Averages and RSI) using best-practice ELT methodologies, performs machine learning forecasting, and visualizes the results for business stakeholders. The system must ensure data quality, idempotency, and security while orchestrating dependencies between disparate tools (Airflow, Snowflake, dbt).

1.2 Requirements

- ETL: Automate the ingestion of stock data (OHLCV) from YFinance into Snowflake using Airflow.
- ELT: Use dbt (data build tool) to perform transformations within the data warehouse, creating abstract tables with technical indicators.
- Orchestration: Schedule ETL, ELT, and ML tasks sequentially using Airflow.
- Quality & Idempotency: Ensure data integrity using SQL transactions (**MERGE**) and dbt tests.
- Visualization: Create an interactive dashboard to monitor stock trends and buy/sell signals.

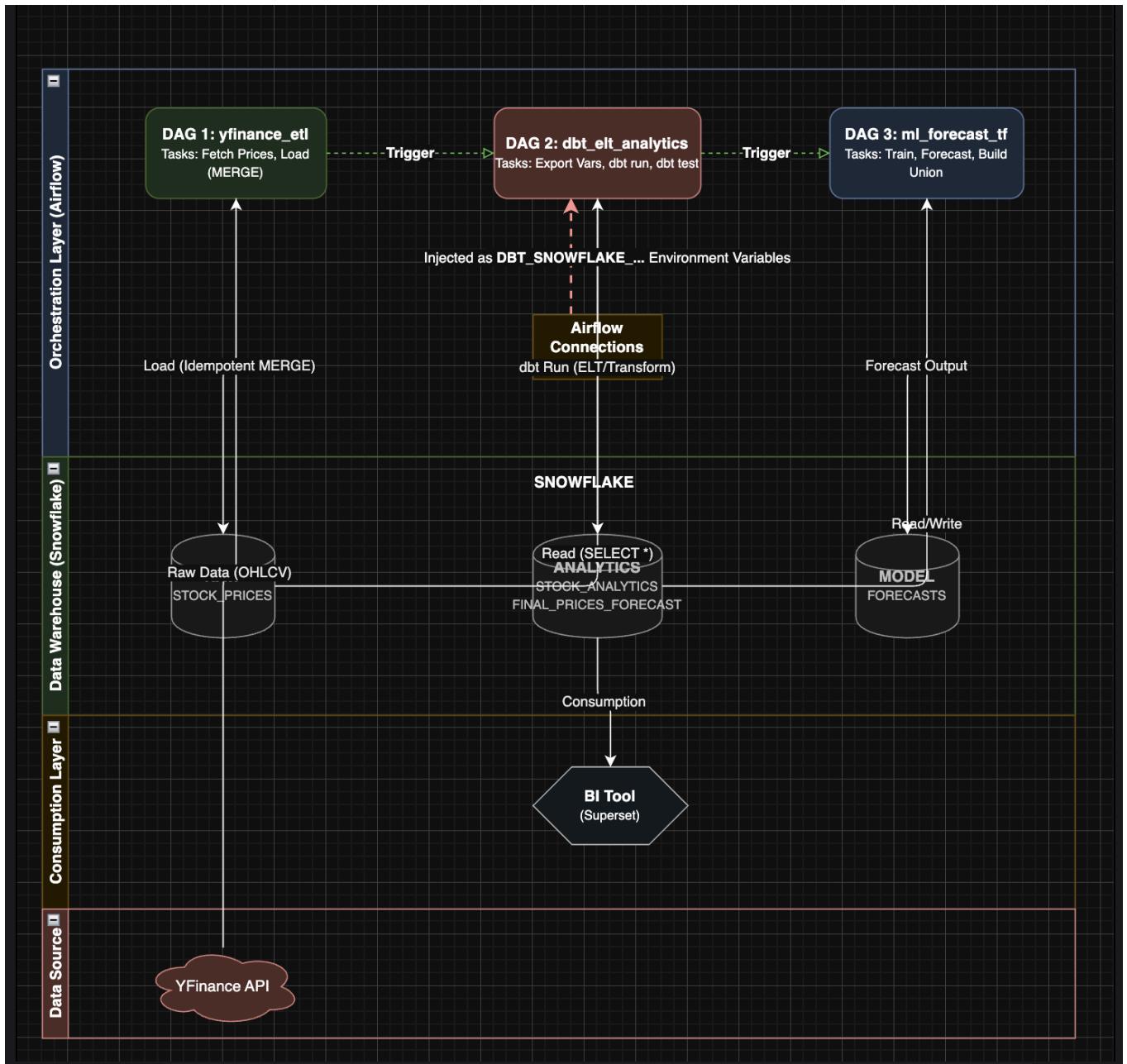
1.3 Specifications

- Cloud Data Warehouse: Snowflake (Schemas: **RAW**, **ANALYTICS**, **MODEL**)
- Orchestration: Apache Airflow (DAGs running in Docker)
- Transformation: dbt Core (running via **BashOperator**)
- BI Tool: [Superset / Preset]
- Language: Python 3.9+, SQL

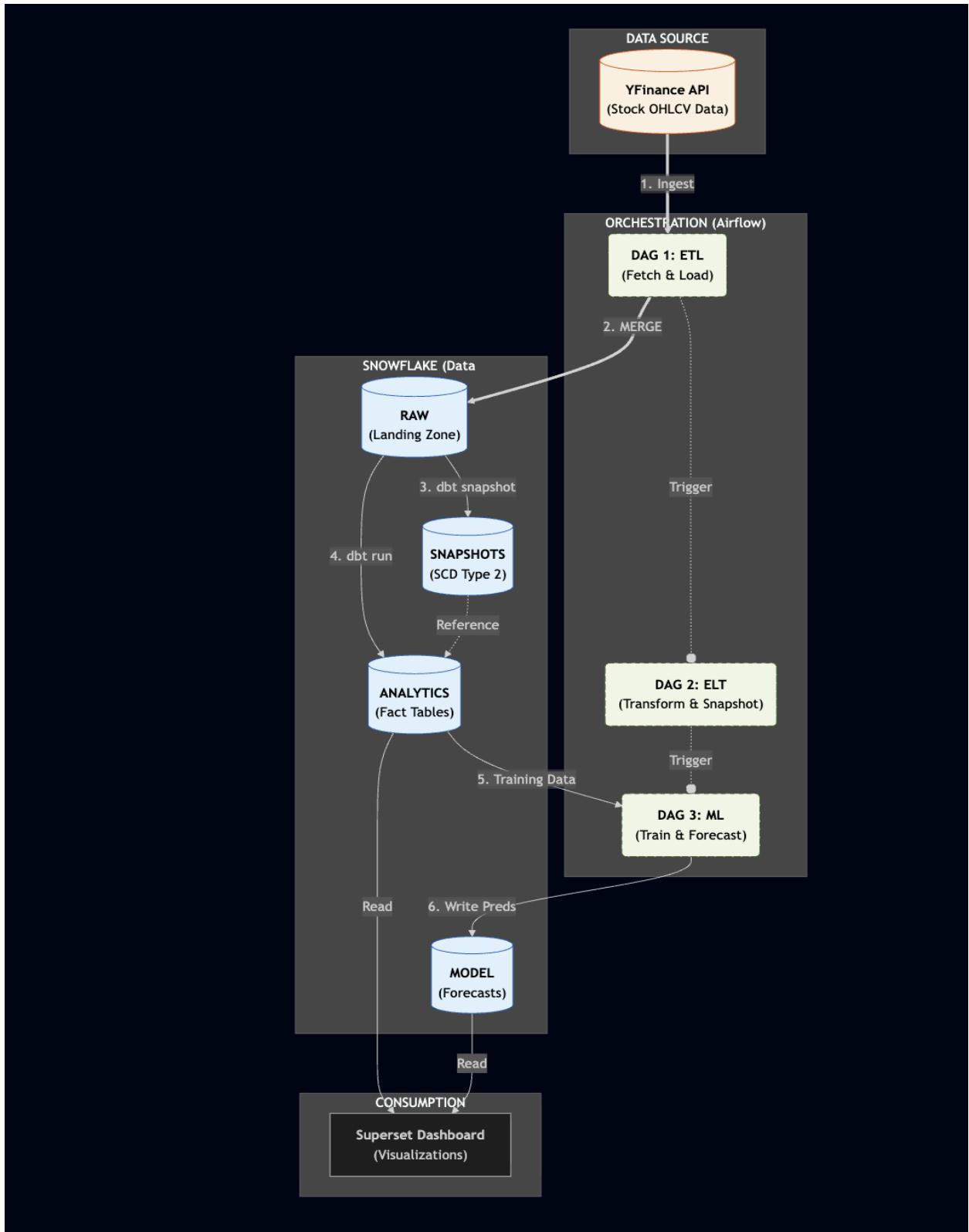
2. System Architecture

2.1 Overall System Diagram

The system follows a linear dependency chain: Ingest —> Transform —> Predict —> Visualize.



[System Diagram]



End To End work flow of the process as per system Diagram

2.2 Component Description

1. Airflow: Functions as the control plane. It manages three separate DAGs (`yfinance_etl`, `dbt_elt_analytics`, `ml_forecast_tf`) and handles the secure passing of credentials to dbt.
2. Snowflake: Acts as the storage and compute engine.
 - o RAW Schema: Stores immutable raw data loaded by the ETL process.
 - o ANALYTICS Schema: Stores the "Gold" layer data transformed by dbt for BI consumption.
3. dbt: Handles business logic transformations (Moving Averages, RSI) and data testing.
4. BI Tool(Preset): Connects to the `ANALYTICS` schema to display the final dashboard.

3. Detailed Table Structures

3.1 Source Schema: RAW

Table Name: STOCK_PRICES Description: Stores immutable raw data loaded by the ETL process.

- TRADE_DATE (Type: DATE) - *Primary Key (Composite)*. Date of the trading session.
- SYMBOL (Type: STRING) - *Primary Key (Composite)*. Stock Ticker (e.g., AAPL).
- OPEN (Type: DOUBLE) - Opening price.
- CLOSE (Type: DOUBLE) - Closing price.
- HIGH (Type: DOUBLE) - Highest price of the day.
- LOW (Type: DOUBLE) - Lowest price of the day.
- VOLUME (Type: NUMBER) - Number of shares traded.
- LOAD_TS (Type: TIMESTAMP_NTZ) - Time of insertion.

3.2 Destination Schema: ANALYTICS

Table Name: STOCK_ANALYTICS Description: Stores the "Gold" layer data transformed by dbt for BI consumption.

- TRADE_DATE (Type: DATE) - *Primary Key (Composite)*. Date of observation.
- SYMBOL (Type: STRING) - *Primary Key (Composite)*. Stock Ticker.
- CLOSE (Type: DOUBLE) - Closing price from source.
- MA_20 (Type: DOUBLE) - 20-Day Simple Moving Average. *Constraint: Not Null.*

- RSI_14 (Type: DOUBLE) - 14-Day Relative Strength Index. *Constraint: Check (0-100).*
- PRICE_MOMENTUM (Type: DOUBLE) - 10-Day price change.

3.3 Model Schema: MODEL

Table Name: FORECASTS Description: Stores machine learning predictions.

- SYMBOL (Type: STRING) - *Primary Key*.
- TS (Type: DATE) - *Primary Key*. Forecast timestamp.
- PREDICTED_CLOSE (Type: FLOAT) - The predicted value.
- MODEL_NAME (Type: STRING) - *Primary Key*. Name of model used (e.g., 'SNOWFLAKE_ML').

3.4 Data Validation

To verify the successful execution of the ELT pipeline, the following SQL query was executed in the Snowflake Worksheet against the final transformed table **ANALYTICS STOCK_ANALYTICS**.

Query:

```
SELECT * FROM ANALYTICS.STOCK_ANALYTICS
ORDER BY TRADE_DATE DESC
LIMIT 10;
```

Observation: The screenshot below confirms that the table is populated with calculated fields, including the **20-day Moving Average (MA_20)** and **RSI (RSI_14)**, demonstrating that the dbt models transformed the raw data correctly.

My Workspace > Untitled 6.sql

```

1  SELECT * FROM ANALYTICS STOCK_ANALYTICS
2  ORDER BY TRADE_DATE DESC
3  LIMIT 10;

```

Results (just now)

Table Chart

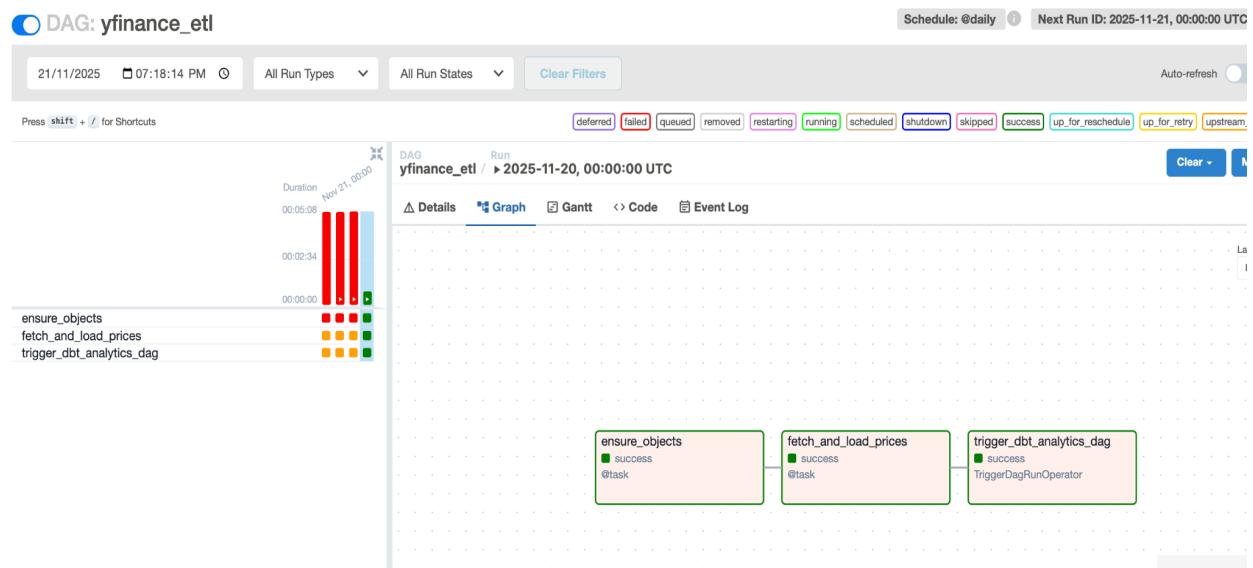
TRADE_DATE SYMBOL CLOSE MA_20 PRICE_MOMENTUM RSI_14 LOAD_TS

	TRADE_DATE	SYMBOL	CLOSE	MA_20	PRICE_MOMENTUM	RSI_14	LOAD_TS
1	2025-11-20	MSFT	478.429992676	511.044003296	-18.670013428	25.929088778	2025-11-21 12:54:55.218 -0800
2	2025-11-20	AAPL	266.25	269.639500427	-3.519989014	40.678759525	2025-11-21 12:54:55.218 -0800
3	2025-11-20	TSLA	395.230010986	434.308502197	-50.679992676	32.101800756	2025-11-21 12:54:55.218 -0800
4	2025-11-19	AAPL	268.559997559	269.305999756	-1.58001709	43.179656158	2025-11-21 12:54:55.218 -0800
5	2025-11-19	MSFT	487.119995117	513.15050354	-20.040008545	26.165793355	2025-11-21 12:54:55.218 -0800
6	2025-11-19	TSLA	403.989990234	436.996002197	-58.08001709	39.915096966	2025-11-21 12:54:55.218 -0800
7	2025-11-18	MSFT	493.790008545	514.821502686	-20.540008545	23.519627806	2025-11-21 12:54:55.218 -0800
8	2025-11-18	TSLA	401.25	438.745002747	-43.010009766	34.759740151	2025-11-21 12:54:55.218 -0800
9	2025-11-18	AAPL	267.440002441	268.800500488	-2.600006104	44.719609375	2025-11-21 12:54:55.218 -0800
10	2025-11-17	TSLA	408.920013428	440.812503052	-59.449981689	36.483598027	2025-11-21 12:54:55.218 -0800

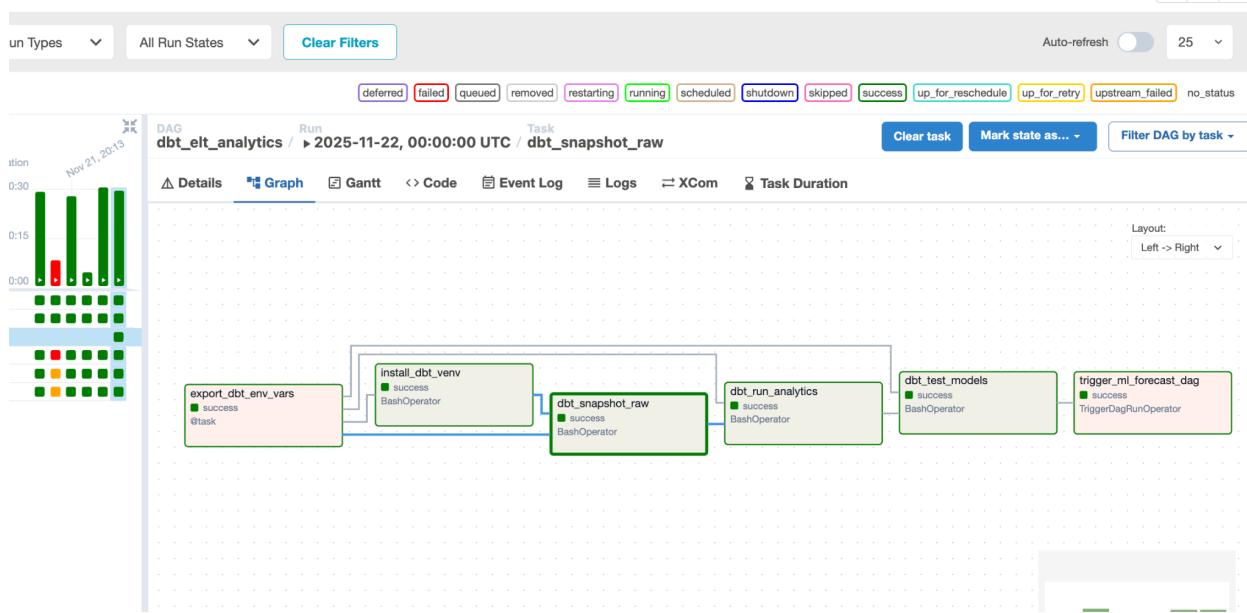
4. Airflow Implementation

4.1 Airflow Data Pipeline Code

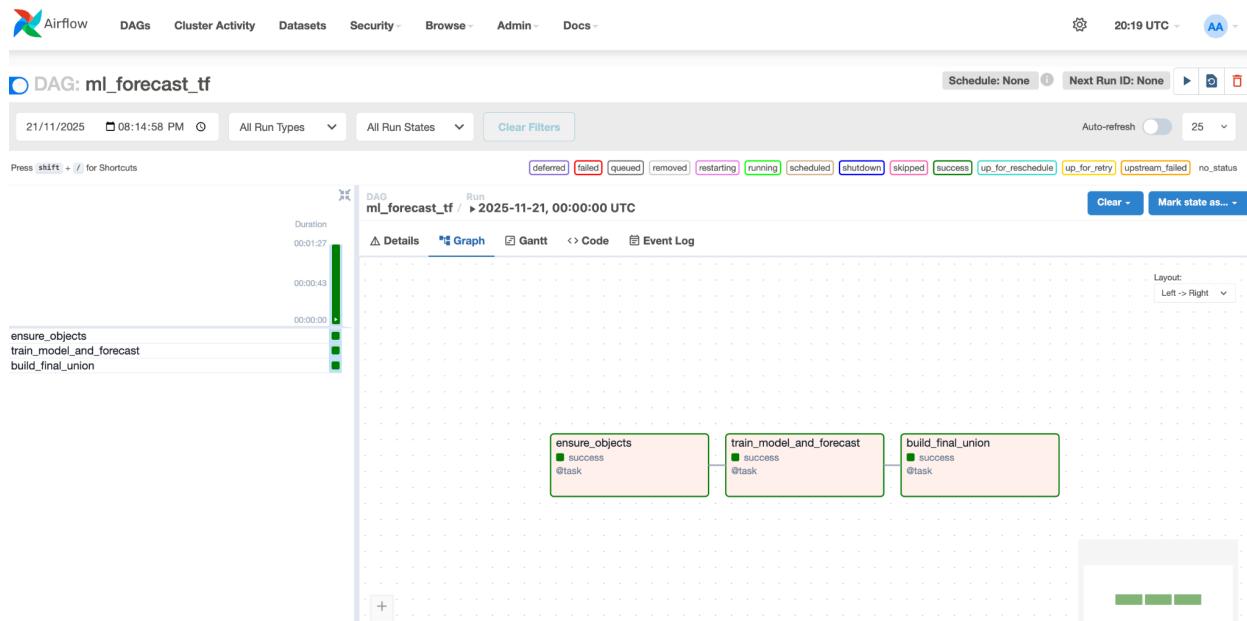
DAG 1: ETL (dags/dag_yfinance_etl.py) This DAG handles data ingestion from YFinance to Snowflake using the SnowflakeHook and MERGE logic for idempotency.



DAG 2: ELT (dags/dag_dbt_elt.py) This DAG securely exports credentials and runs dbt transformations.



DAG 3: ML Forecast (dags/dag_ml_forecast.py) Code manages schema creation and Snowflake ML forecasting logic using the SnowflakeHook.



(Code omitted here for report length, refer to attached file)

<https://github.com/abhinitasanabada-web/Lab2/tree/main/dags>

4.2 Airflow Web UI Screenshot

Screenshot of Airflow Grid View here showing `yfinance_etl`, `dbt_elt_analytics`, and `ml_forecast_tf` and connections

	Conn Id	Conn Type	Description	Host	Port	Is Encrypted
	snowflake_catfish	snowflake				False

DAG	Owner	Runs	Schedule	Last Run	Next Run	Recent Tasks	Actions	Links
dbt_elt_analytics	airflow	21	None	2025-11-20, 00:00:00	2025-11-21, 00:00:00	1	[Run, Edit, Delete]	[...]
ml_forecast_tf	airflow	2	None	2025-11-20, 00:00:00		1	[Run, Edit, Delete]	[...]
yfinance_etl	airflow	42	@daily	2025-11-20, 00:00:00	2025-11-21, 00:00:00	2	[Run, Edit, Delete]	[...]

4.3 Connection and Variable Usage

- Connections: All Snowflake interactions utilize `SnowflakeHook(snowflake_conn_id="snowflake_catfish")`. Credentials are never hardcoded. In the dbt DAG, these credentials are dynamically extracted and passed as environment variables.

- Variables: Configuration such as `stock_symbols` and `target_schema_raw` are managed via Airflow Variables, allowing parameter changes without code deployment.

4.4 Idempotency and Transactions

- Idempotency: The ETL DAG uses the `MERGE INTO` SQL command. This ensures that running the pipeline multiple times for the same date does not create duplicate records; it updates existing rows and inserts new ones.
- Transactions: All database operations are wrapped in `try/except` blocks with `conn.autocommit(False)`. If any step fails, `conn.rollback()` is triggered to prevent partial data loads.

5. dbt Implementation

5.1 dbt Project Code

Model: `models/analytics/stock_analytics.sql`

SQL

```
{{ config(materialized='table', schema='ANALYTICS', unique_key=['symbol', 'trade_date']) }}

WITH base AS (
    SELECT trade_date, symbol, close,
           close - LAG(close, 1) OVER (PARTITION BY symbol ORDER BY trade_date) AS price_change
    FROM {{ source('raw', 'stock_prices') }}
),
gains_losses AS (
    SELECT *,
           CASE WHEN price_change > 0 THEN price_change ELSE 0 END AS gain,
           CASE WHEN price_change < 0 THEN ABS(price_change) ELSE 0 END AS loss
    FROM base
```

```

),
indicators AS (
    SELECT t1.*,
        AVG(t1.close) OVER (PARTITION BY t1.symbol ORDER BY t1.trade_date ROWS BETWEEN 19
PRECEDING AND CURRENT ROW) AS ma_20,
        AVG(t2.gain) OVER (PARTITION BY t1.symbol ORDER BY t1.trade_date ROWS BETWEEN 13
PRECEDING AND CURRENT ROW) AS avg_gain,
        AVG(t2.loss) OVER (PARTITION BY t1.symbol ORDER BY t1.trade_date ROWS BETWEEN 13
PRECEDING AND CURRENT ROW) AS avg_loss
    FROM base t1
    INNER JOIN gains_losses t2 ON t1.symbol = t2.symbol AND t1.trade_date = t2.trade_date
)
SELECT trade_date, symbol, close, ma_20,
CASE WHEN avg_loss = 0 THEN 100.0 ELSE 100.0 - (100.0 / (1.0 + (avg_gain / avg_loss))) END AS
rsi_14
FROM indicators
ORDER BY symbol, trade_date

```

Tests: models/schema.yml

YAML

```
version: 2
```

```
models:
```

- name: stock_analytics

```
columns:
```

- name: trade_date

```
tests: [not_null, unique: {group_by: [symbol]}]
```

- name: rsi_14

```
tests:
```

- not_null

- check: {expression: "rsi_14 >= 0 AND rsi_14 <= 100"}

5.2 dbt Command Evidence

Screenshot of terminal showing successful dbt run, dbt snapshots and dbt test execution

DAG dbt_elt_analytics / Run 2025-11-21, 20:13:43 UTC / Task dbt_run_analytics

Duration: 0:00:31 Nov 21, 19:38

Logs

```
7b1ffadd349
*** Found local files:
*** * /opt/airflow/logs/dag_id=dbt_elt_analytics/run_id=manual_2025-11-21T20:13:43.292248+00:00/task_id=dbt_run_analytics/attempt=1.log
[2025-11-21, 20:13:51 UTC] {local_task_job_runner.py:123} > Pre task execution logs
[2025-11-21, 20:13:51 UTC] {subprocess.py:63} INFO - Tmp dir root location: /tmp
[2025-11-21, 20:13:51 UTC] {subprocess.py:75} INFO - Running command: ['/usr/bin/bash', '-c', '/opt/**/dbt_venv/bin/dbt run --project-dir /opt/**/dbt --profiles-dir /opt',
[2025-11-21, 20:13:51 UTC] {subprocess.py:86} INFO - Output:
[2025-11-21, 20:13:52 UTC] {subprocess.py:93} INFO - 20:13:53 Running with dbt=1.7.13
[2025-11-21, 20:13:52 UTC] {subprocess.py:93} INFO - 20:13:53 Registered adapter: snowflake=1.7.2
[2025-11-21, 20:13:54 UTC] {subprocess.py:93} INFO - 20:13:54 Found 1 model, 4 tests, 1 source, 0 exposures, 0 metrics, 430 macros, 0 groups, 0 semantic models
[2025-11-21, 20:13:54 UTC] {subprocess.py:93} INFO - 20:13:54 Concurrency: 4 threads (target='dev')
[2025-11-21, 20:13:55 UTC] {subprocess.py:93} INFO - 20:13:59
[2025-11-21, 20:14:00 UTC] {subprocess.py:93} INFO - 20:14:00 1 of 1 START sql table model ANALYTICS.stock_analytics ..... [RUN]
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02 1 of 1 OK created sql table model ANALYTICS.stock_analytics ..... [SUCCESS 1 in 2.28s]
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02 Finished running 1 table model in 0 hours 0 minutes and 8.12 seconds (8.12s).
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02 Completed successfully
[2025-11-21, 20:14:02 UTC] {subprocess.py:93} INFO - 20:14:02 Done. PASS=1 WARN=0 ERROR=0 SKIP=0 TOTAL=1
[2025-11-21, 20:14:03 UTC] {subprocess.py:97} INFO - Command exited with return code 0
```

Test Cases for dbt test:

DAG dbt_elt_analytics / Run 2025-11-21, 20:13:43 UTC / Task dbt_test_models

Duration: 0:00:31 Nov 21, 19:38

Logs

```
7b1ffadd349
*** Found local files:
*** * /opt/airflow/logs/dag_id=dbt_elt_analytics/run_id=manual_2025-11-21T20:13:43.292248+00:00/task_id=dbt_test_models/attempt=1.log
[2025-11-21, 20:14:04 UTC] {local_task_job_runner.py:123} > Pre task execution logs
[2025-11-21, 20:14:04 UTC] {subprocess.py:63} INFO - Tmp dir root location: /tmp
[2025-11-21, 20:14:04 UTC] {subprocess.py:75} INFO - Running command: ['/usr/bin/bash', '-c', '/opt/**/dbt_venv/bin/dbt test --project-dir /opt/**/dbt --profiles-dir /opt',
[2025-11-21, 20:14:04 UTC] {subprocess.py:86} INFO - Output:
[2025-11-21, 20:14:05 UTC] {subprocess.py:93} INFO - 20:14:06 Running with dbt=1.7.13
[2025-11-21, 20:14:05 UTC] {subprocess.py:93} INFO - 20:14:06 Registered adapter: snowflake=1.7.2
[2025-11-21, 20:14:06 UTC] {subprocess.py:93} INFO - 20:14:06 Found 1 model, 4 tests, 1 source, 0 exposures, 0 metrics, 430 macros, 0 groups, 0 semantic models
[2025-11-21, 20:14:06 UTC] {subprocess.py:93} INFO - 20:14:06
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07 Concurrency: 4 threads (target='dev')
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07 1 of 4 START test not_null_stock_analytics_ma_20 ..... [RUN]
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07 2 of 4 START test not_null_stock_analytics_rsi_14 ..... [RUN]
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07 3 of 4 START test not_null_stock_analytics_symbol ..... [RUN]
[2025-11-21, 20:14:07 UTC] {subprocess.py:93} INFO - 20:14:07 4 of 4 START test not_null_stock_analytics_trade_date ..... [RUN]
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 3 of 4 PASS not_null_stock_analytics_symbol ..... [PASS in 0.93s]
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 1 of 4 PASS not_null_stock_analytics_ma_20 ..... [PASS in 0.95s]
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 2 of 4 PASS not_null_stock_analytics_rsi_14 ..... [PASS in 1.02s]
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 4 of 4 PASS not_null_stock_analytics_trade_date ..... [PASS in 1.08s]
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 Finished running 4 tests in 0 hours 0 minutes and 1.96 seconds (1.96s).
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08 Completed successfully
[2025-11-21, 20:14:08 UTC] {subprocess.py:93} INFO - 20:14:08
```

For dbt snapshots:

```

7b1ffdadd349
*** Found local files:
*** * /opt/airflow/logs/dag_id=dbt_elt_analytics/run_id=manual_2025-11-22T00:00:00+00:00/task_id=dbt_snapshot_raw/attempt=4.log
[2025-11-22, 06:43:50 UTC] {local_task_job_runner.py:123} > Pre task execution logs
[2025-11-22, 06:43:50 UTC] {subprocess.py:63} INFO - Tmp dir root location: /tmp
[2025-11-22, 06:43:50 UTC] {subprocess.py:75} INFO - Running command: ['/usr/bin/bash', '-c', '/opt/**/dbt_venv/bin/dbt snapshot --project-dir /opt/**/dbt --profiles-dir
[2025-11-22, 06:43:50 UTC] {subprocess.py:86} INFO - Output:
[2025-11-22, 06:43:52 UTC] {subprocess.py:93} INFO - 06:43:52 Running with dbt=1.7.13
[2025-11-22, 06:43:52 UTC] {subprocess.py:93} INFO - 06:43:52 Registered adapter: snowflake=1.7.2
[2025-11-22, 06:43:52 UTC] {subprocess.py:93} INFO - 06:43:52 Found 1 model, 4 tests, 1 snapshot, 1 source, 0 exposures, 0 metrics, 430 macros, 0 groups, 0 semantic models
[2025-11-22, 06:43:52 UTC] {subprocess.py:93} INFO - 06:43:52
[2025-11-22, 06:43:59 UTC] {subprocess.py:93} INFO - 06:43:59 Concurrency: 4 threads (target='dev')
[2025-11-22, 06:43:59 UTC] {subprocess.py:93} INFO - 06:43:59
[2025-11-22, 06:43:59 UTC] {subprocess.py:93} INFO - 06:43:59 1 of 1 START snapshot DEV.SNAPSHOTS.stock_snapshot ..... [RUN]
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00 1 of 1 OK snapshotted DEV.SNAPSHOTS.stock_snapshot ..... [SUCCESS 1 in 1.30s]
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00 Finished running 1 snapshot in 0 hours 0 minutes and 8.38 seconds (8.38s).
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00 Completed successfully
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00
[2025-11-22, 06:44:00 UTC] {subprocess.py:93} INFO - 06:44:00

```

From Docker terminal:

```

airflow-1 | 151.101.192.223 - - [21/Nov/2025:20:24:29 +0000] "GET /api/v1/dags/dbt_elt_analytics/dagRuns/manual_2025-1
1-21T20:13:43.292248+00:00/taskInstances/dbt_test_models HTTP/1.1" 200 1282 "http://localhost:8081/dags/dbt_elt_analytics/gri
d?dag_run_id=manual_2025-11-21T20%3A13%3A43.292248%2B00%3A00&tab=logs&task_id=dbt_test_models" "Mozilla/5.0 (Macintosh; Intel
Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/142.0.0.0 Safari/537.36"
airflow-1 | 151.101.192.223 - - [21/Nov/2025:20:24:29 +0000] "GET /api/v1/dags/dbt_elt_analytics/dagRuns/manual_2025-1
1-21T20:13:43.292248+00:00/taskInstances/dbt_test_models/logs/1?full_content=false HTTP/1.1" 200 5945 "http://localhost:8081/
dags/dbt_elt_analytics/grid?dag_run_id=manual_2025-11-21T20%3A13%3A43.292248%2B00%3A00&tab=logs&task_id=dbt_test_models" "Mo
zilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/142.0.0.0 Safari/537.36"
airflow-1 | 127.0.0.1 - - [21/Nov/2025:20:24:58 +0000] "GET /health HTTP/1.1" 200 283 "-" "curl/7.88.1"
airflow-1 | 127.0.0.1 - - [21/Nov/2025:20:25:28 +0000] "GET /health HTTP/1.1" 200 283 "-" "curl/7.88.1"
airflow-1 | 127.0.0.1 - - [21/Nov/2025:20:25:58 +0000] "GET /health HTTP/1.1" 200 283 "-" "curl/7.88.1"
airflow-1 | 127.0.0.1 - - [21/Nov/2025:20:26:29 +0000] "GET /health HTTP/1.1" 200 283 "-" "curl/7.88.1"
airflow-1 | 127.0.0.1 - - [21/Nov/2025:20:26:59 +0000] "GET /health HTTP/1.1" 200 283 "-" "curl/7.88.1"
airflow-1 | [2025-11-21T20:27:03.686+0000] {scheduler_job_runner.py:1846} INFO - Adopting or resetting orphaned tasks f
or active dag runs

```

5.3 Scheduling Strategy

The dbt DAG is scheduled with `schedule=None` and is triggered strictly by the `TriggerDagRunOperator` located at the end of the ETL DAG. This ensures dbt only attempts to transform data after the raw data has been successfully updated.

6. BI Tool Visualization

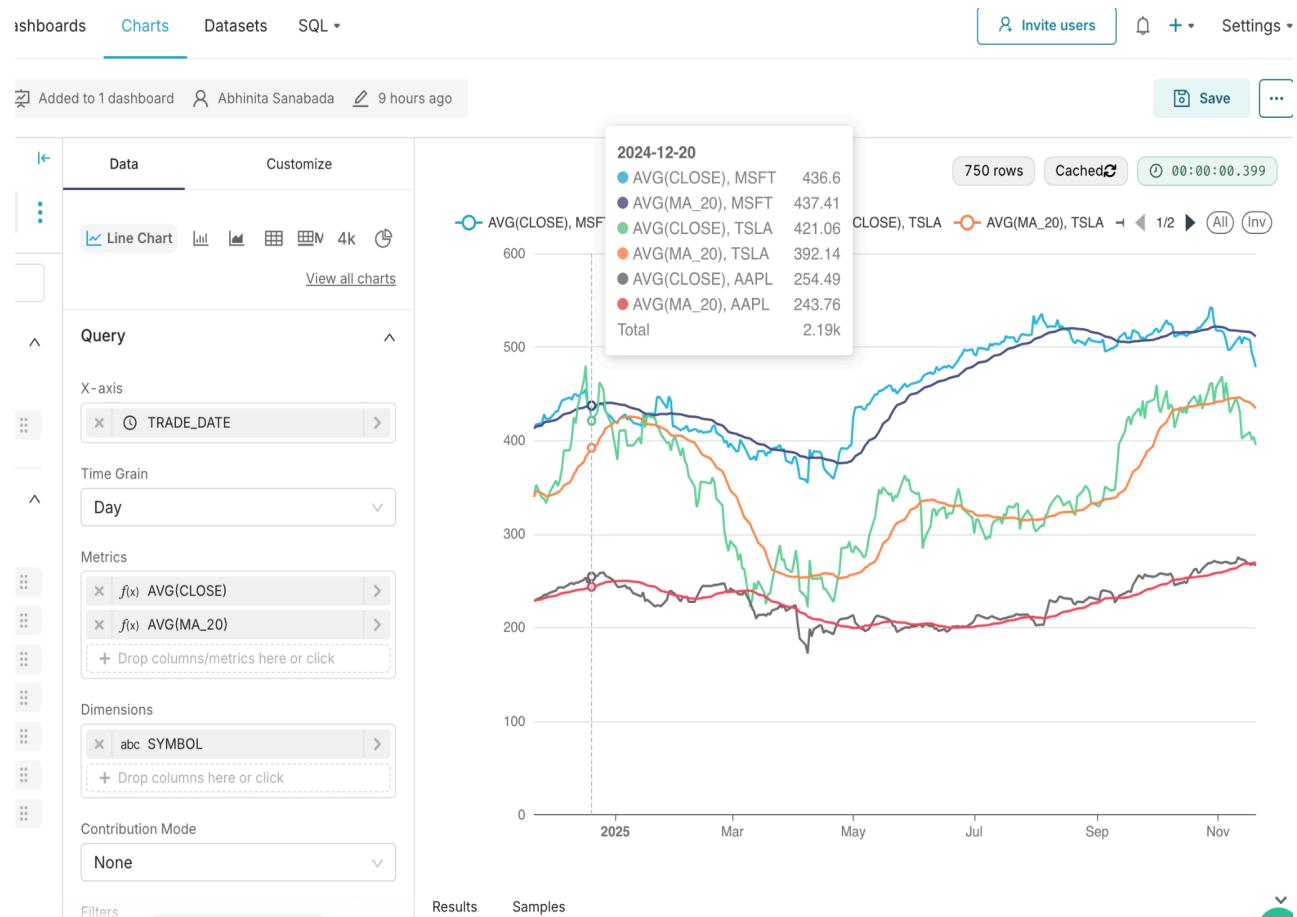
Tool Used: Apache Superset / Preset

6.1 Dashboard Description

- Purpose: To provide financial analysts with real-time technical indicators for buy/sell decision-making.
- Dataset: ANALYTICS STOCK_ANALYTICS
- Key Metrics:
 - MA_20 (Moving Average): Used to identify trend direction.
 - RSI_14 (Relative Strength Index): Used to identify overbought (>70) or oversold (<30) conditions.

6.2 Dashboard Screenshots

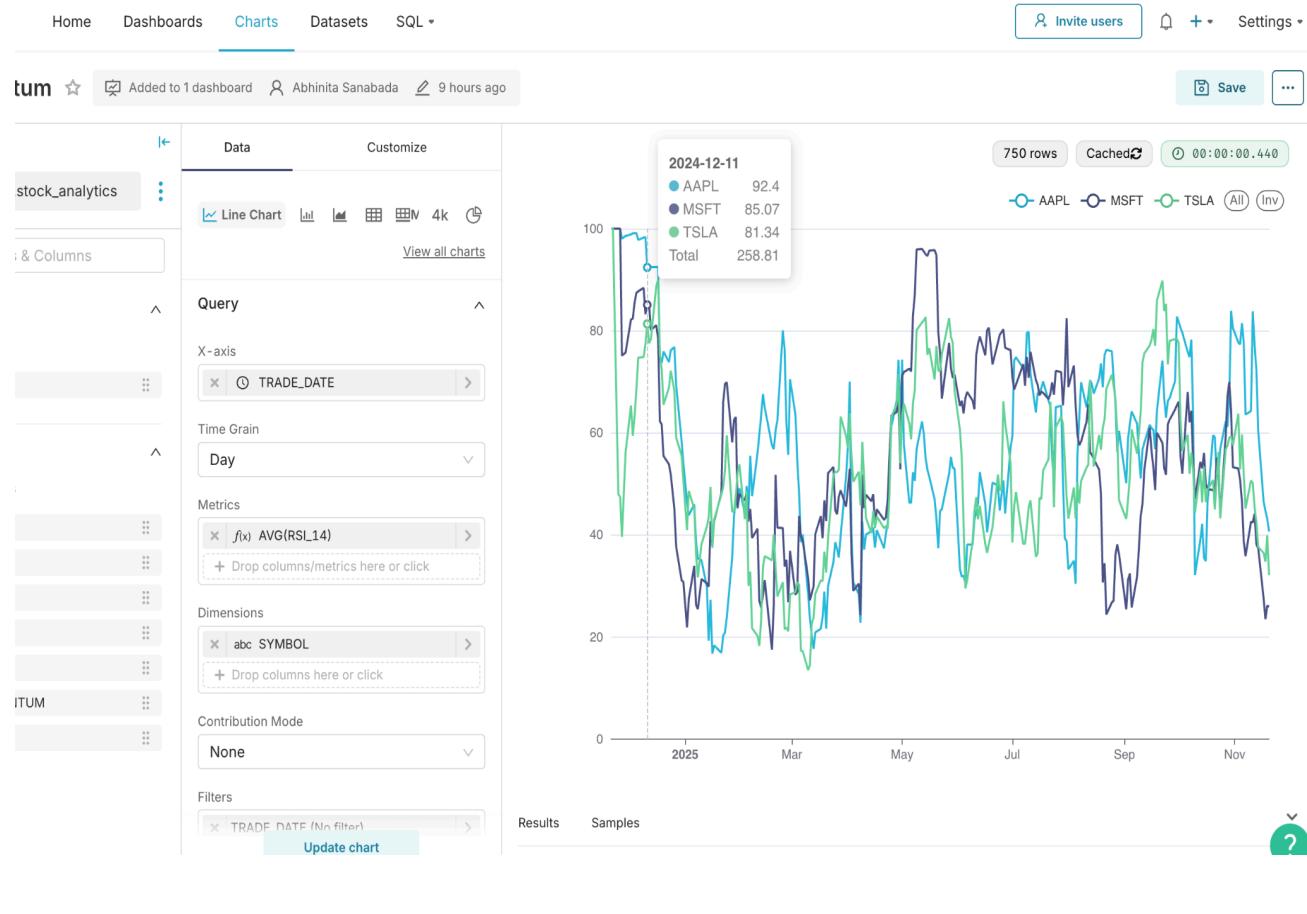
Screenshot 1: Filtered Dashboard View limiting analysis to Q1 2024, demonstrating dynamic interactivity.



Dashboard URL:

https://b774b44d.us2a.app.preset.io/superset/dashboard/8/?native_filters_key=O3jBF_Dt2fwhlQQN6BwB5xBXtYjnf8VpTHEI8yys5IAcumLefR9NQk-aqKXrfdu

Screenshot 2: Comprehensive Stock Analytics Dashboard showing RSI and Moving Averages.



7. Conclusion

This lab successfully implemented a modular, scalable data pipeline. By decoupling Ingestion (Airflow/Python), Transformation (dbt), and Consumption (BI/ML), the system achieves high maintainability. The use of `SnowflakeHook` and `MERGE` logic ensured security and data integrity, meeting all functional requirements.

8. References

1. dbt Documentation. (n.d.). Retrieved from <https://docs.getdbt.com/>
2. Apache Airflow Providers: Snowflake. (n.d.). Retrieved from <https://airflow.apache.org/>
3. Keeyong Han. (2025). Week 10 ELT Deepdive (dbt). [Course Lecture Notes]. San Jose State University.

9. GitHub repo:

<https://github.com/abhinitasanabada-web/Lab2>