

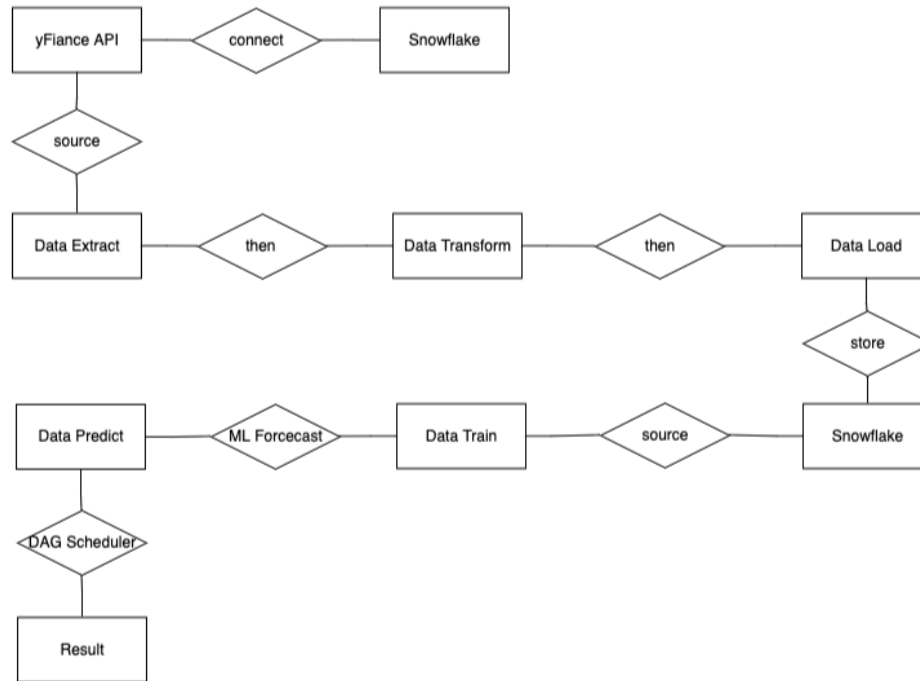
Data 226 Lab1

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About Our Project

The goal of our project is to develop a system that extracts stock price data for a specified stock symbol (i.e., AAPL) using the yFinance API, processes loaded data using an ETL pipeline, and then forecasts future stock prices (future 7 days) using machine learning models. The system is automated using Apache Airflow to orchestrate the ETL process and the machine learning forecast pipeline, and the results are stored in Snowflake for further analysis.

Overall System Diagram



Requirements and Specifications

- Data Extraction
 - Extract stock price data using the yFinance API
 - The API fetches stock data for a specified stock symbol over several days.
- Data Transformation
 - Transform the raw stock data into a structured format, including fields like stock symbol, date, open price, close price, high price, low price, and volume.
- Data Loading
 - Load the transformed data into a Snowflake table.
- Machine Learning Forecasting
 - Train a machine learning model to forecast future stock prices using historical data.
 - The model should be deployed in Snowflake, and predictions should be generated and stored in a new table.
- Integration
 - Using Apache Airflow to automate the ETL and machine learning forecasting pipeline.
 - Airflow DAGs should be defined for both the yFinance pipeline and the ML forecasting pipeline.
- SQL and Transactions:
 - Using SQL transactions with proper error handling (try/except) to ensure data integrity during the ETL and forecasting processes

Tables Structure

Stock Data Table (`lab1_stock_data`)

- symbol (STRING): Stock symbol (Primary Key)
- date (DATE): Date of the symbol stock data (Primary Key)
- open (FLOAT): Opening price of the stock on the given date
- close (FLOAT): Closing price of the stock on the given date
- high (FLOAT): Highest price during the day
- low (FLOAT): Lowest price during the day
- volume (BIGINT): Trading volume for the day

```
CREATE OR REPLACE TABLE DEV.RAW.LAB1_STOCK_DATA(  
  SYMBOL STRING,  
  DATE DATE,  
  OPEN FLOAT,  
  CLOSE FLOAT,  
  HIGH FLOAT,  
  LOW FLOAT,  
  VOLUME BIGINT,  
  PRIMARY KEY(SYMBOL, DATE)  
);
```

Forecast Table (`lab1_forecast_data`)

- symbol (STRING): Stock symbol (Primary Key)
- date (DATE): Date of the symbol stock data (Primary Key)
- forecast (FLOAT): Forecasted closing price
- lower_bound (FLOAT): Lower bound of the forecast
- upper_bound (FLOAT): Upper bound of the forecast

```
CREATE OR REPLACE TABLE DEV.ADHOC.LAB1_FORECAST_TABLE(  
  SYMBOL STRING,  
  DATE DATE,  
  FORECAST FLOAT,  
  LOWER_BOUND FLOAT,  
  UPPER_BOUND FLOAT  
);
```

Final Prediction Table (`lab1_prediction_results`)

- symbol (STRING): Stock symbol (Primary Key)
- date (DATE): Date of the symbol stock data (Primary Key)
- actual (FLOAT): actual closing price from stock data
- forecast (FLOAT): Forecasted closing price
- lower_bound (FLOAT): Lower bound of the forecast
- upper_bound (FLOAT): Upper bound of the forecast

```
CREATE OR REPLACE TABLE DEV.ANALYTICS.LAB1_PREDICTION_RESULTS(  
  SYMBOL STRING,  
  DATE DATE,  
  ACTUAL FLOAT,  
  FORECAST FLOAT,  
  LOWER_BOUND FLOAT,  
  UPPER_BOUND FLOAT  
);
```

`Extract` retrieves stock data for a specified number of days for a given stock symbol, interacts with the API to pull daily time series data for the stock, then filters and structures those data into a simplified format for future processing.

```
Def extract(apikey, num_of_days, stock_symbol):  
    {...}  
    if response.status_code == 200: {...}  
    else: {...}
```

`Transform` processes raw stock data to extract relevant fields(symbol, date, open, close, high, low, volume) for a specified number of days. Returns a simplified dataset ready for loading into a database.

```
Def transform(input_data, num_of_days, stock_symbol):  
    #initialize {...}  
    #populate {...}  
    For date, values in time_series.items():  
        if datetime.strptime({...})  
    return stock_data
```

`load` is responsible for taking the processed stock data and loading it into a target database table. It handles the creation of the target table and inserts the stock data into it.

```
Def load(cursor, target_table, stock_data_input):  
    try: cursor.execute("BEGIN;")/("DELETE FROM")/("COMMIT;"){...}  
    except: {...}
```

`Train` is responsible for creating a view in the database, which is used to prepare data for a forecasting model. It then creates and trains the ml model using the data from that view.

```
Def train(cur, train_input_table, train_view, forecast_function_name):  
    create_view_sql = {...}  
    create_model_sql = {...}  
    try: {...}  
    except: {...}
```

`Predict` is for generating future stock price predictions using a periously trained forecasting model. It then stores the predictions in a forecast table and combines them with the historical data to create a final table that includes both actual and forecasted values.

```
Def predict(cur, forecast_function_name, train_input_table, forecast_table, final_table)  
    make_prediction_sql = {...}  
    Create_final_table_sql =  
        {...} UNION ALL {...}  
    try: {...}  
    Except: {...}
```

Please see the Github link for more details.

https://github.com/lea2105/DATA226LAB1_SUN_LI

Airflow session:
dags

DAGs

All 6Active 2Paused 4

Running 1Failed 1

Filter DAGs by tag

Search DAGs

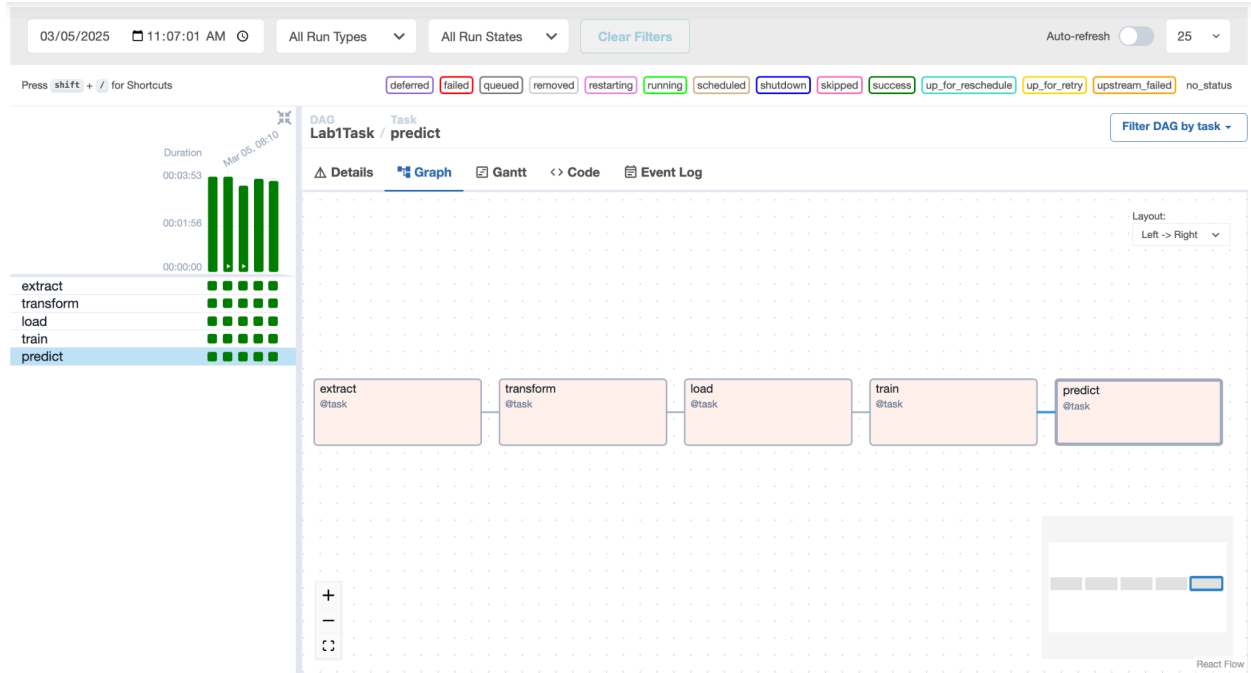
Auto-refresh

| DAG | Owner | Runs | Schedule | Last Run | Next Run | Recent Tasks | Action |
|---|-------|------|----------|----------------------|----------------------|--------------|--------|
| <div>CountryCapital</div> <div>ETL</div> <div>airflow</div> | | 4 | 0 2 *** | 2025-03-04, 02:00:00 | 2025-03-05, 02:00:00 | 3 | |
| <div>CountryCapital_v2</div> <div>ETL</div> <div>airflow</div> | | 2 | 30 2 *** | 2025-03-05, 05:28:55 | 2025-03-05, 02:30:00 | 3 | |
| <div>HelloWorld</div> <div>example</div> <div>keeyong</div> | | 3 | 0 2 *** | 2025-03-04, 02:00:00 | 2025-03-05, 02:00:00 | 3 | |
| <div>Lab1Task</div> <div>ELTpredict</div> <div>airflow</div> | | 51 | 10 *** | 2025-03-05, 10:10:00 | 2025-03-05, 11:10:00 | 13 | |
| <div>stock_data_pipeline</div> <div>ETLstock</div> <div>airflow</div> | | 1 | None | 2025-03-05, 08:07:52 | | 3 | |
| <div>TrainPredict</div> <div>ELTML</div> <div>airflow</div> | | 1 | 30 2 *** | 2025-03-04, 02:30:00 | 2025-03-05, 02:30:00 | 2 | |

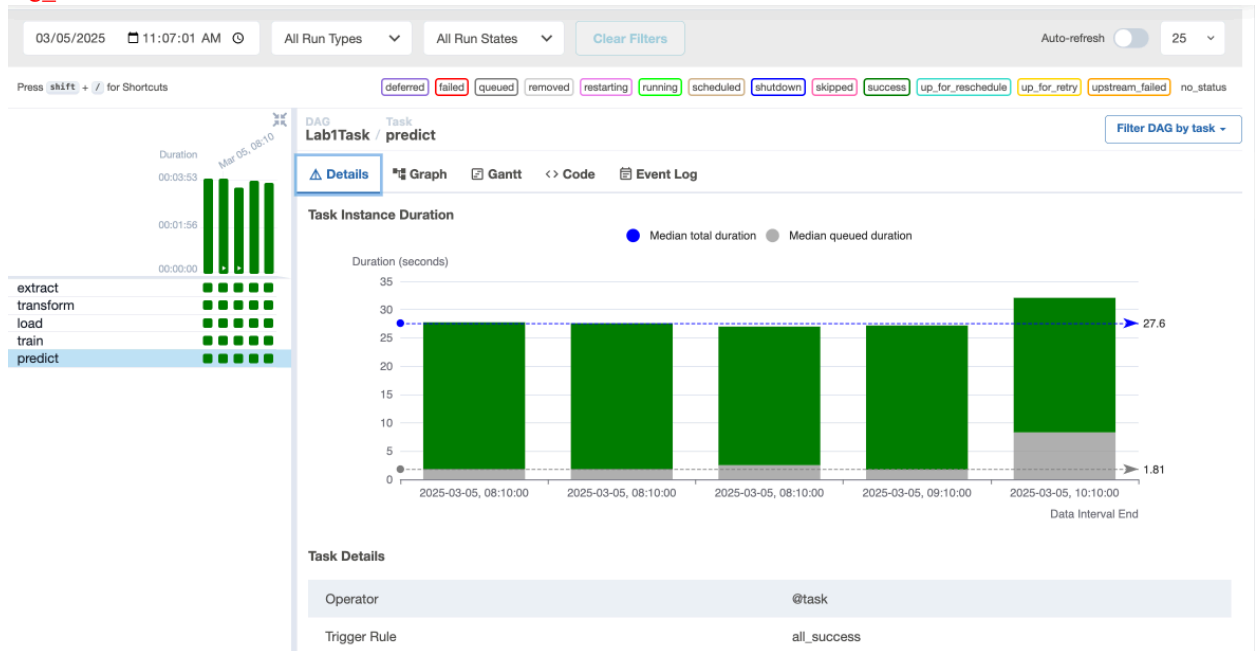
«1»

Showing 1-6 of 6 DAGs

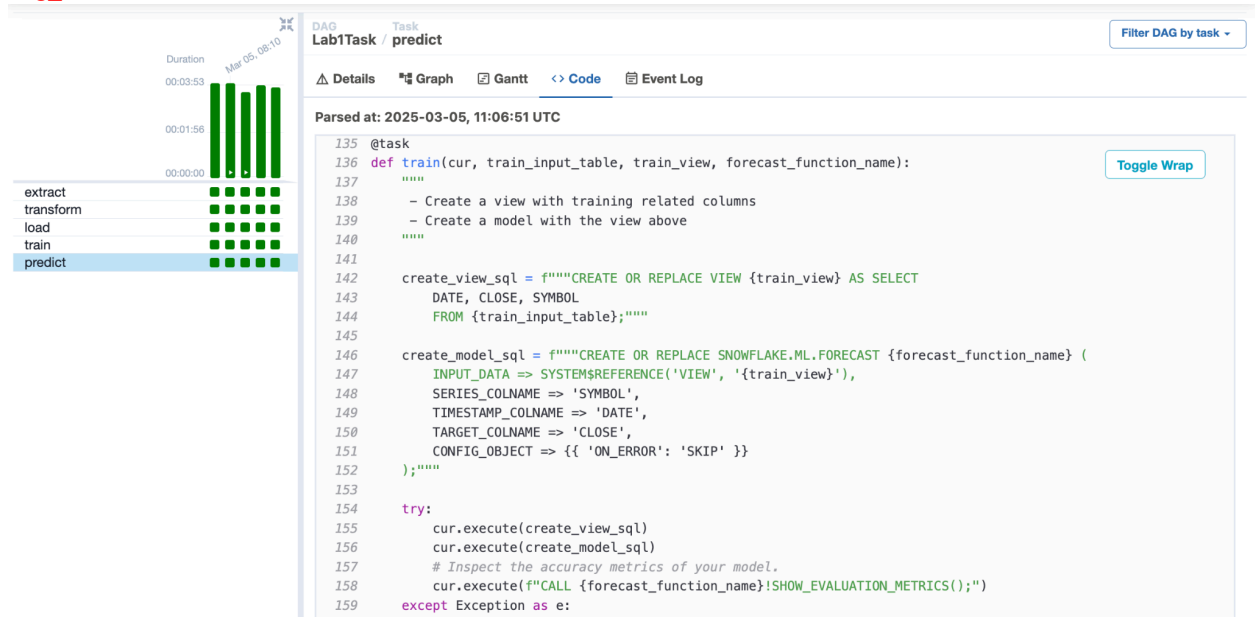
Dag_graph



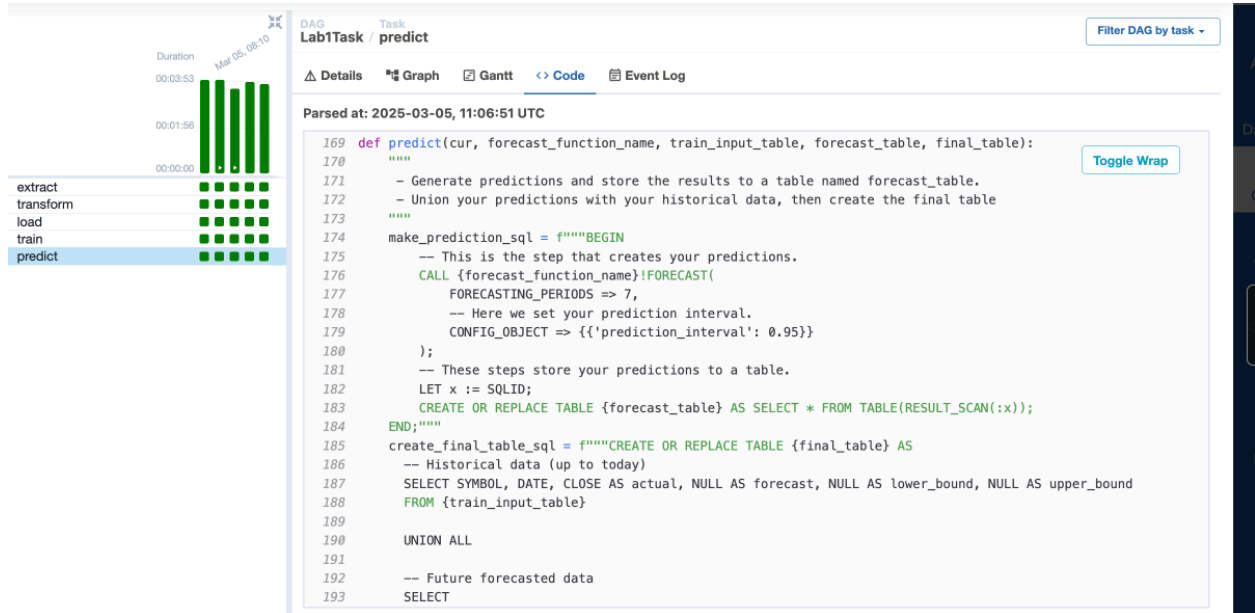
dag_details



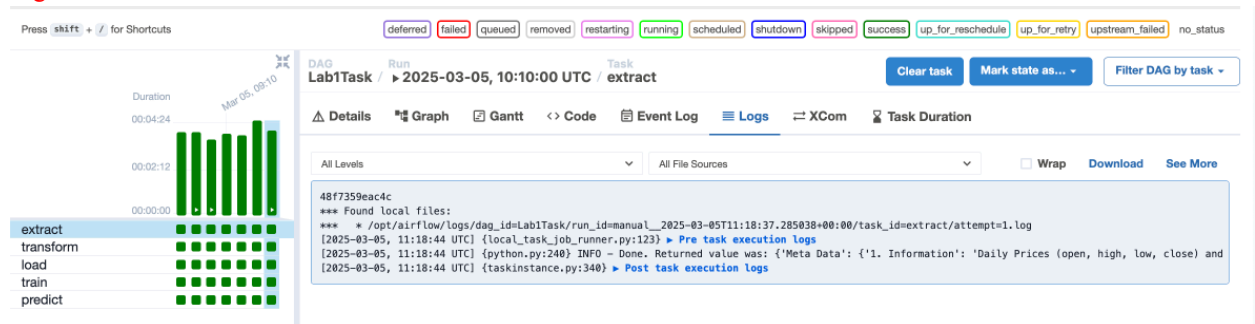
Dag_train



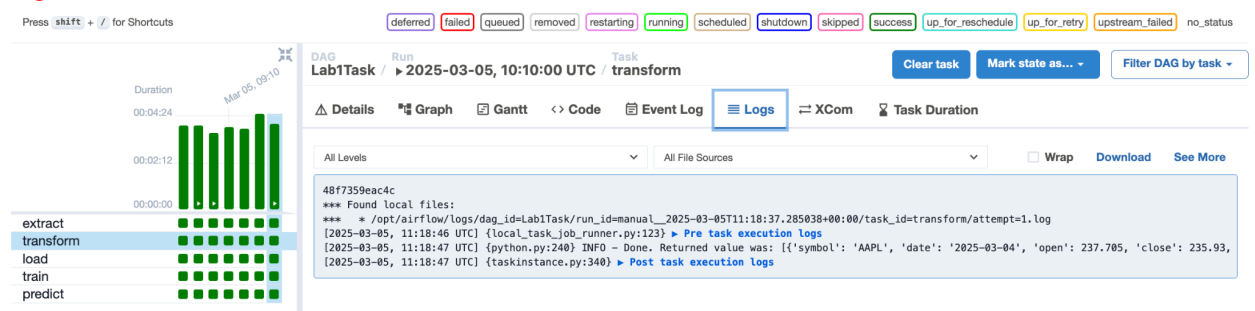
dag_predict



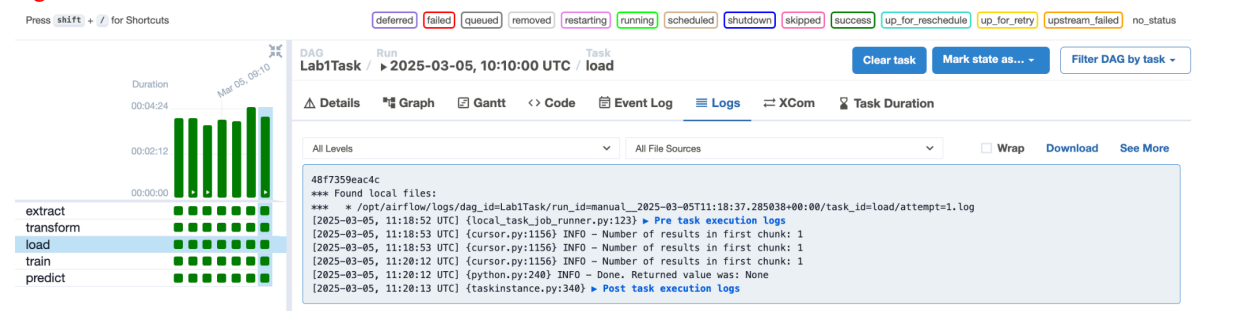
Log for extract



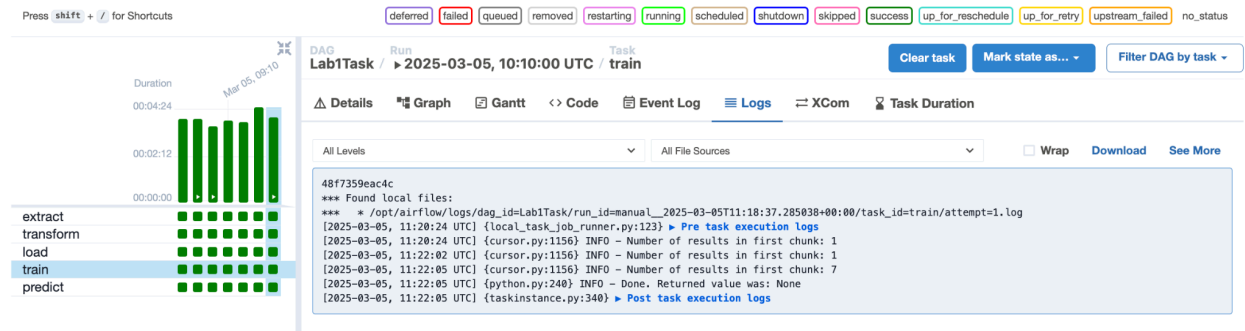
Log for transform



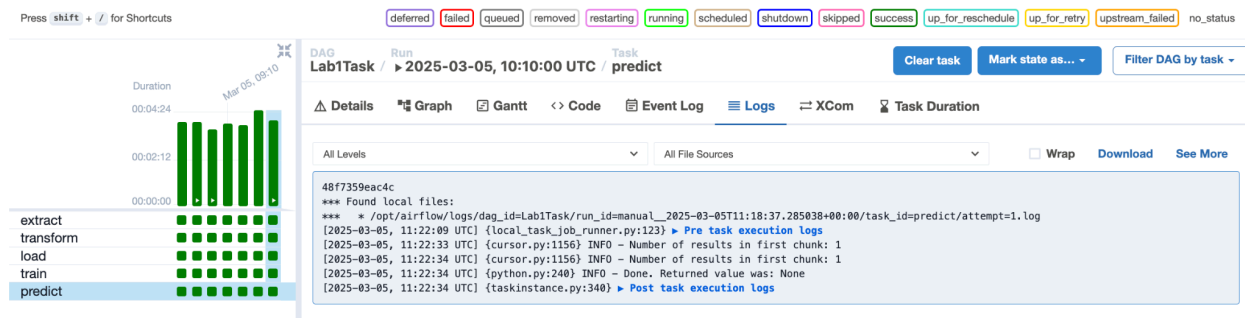
Log for load



Log for train



Log for predict



Snowflake session:

Databases, Worksheets

ACCOUNTADMIN, COMPUTE_WH (X)

Pinned (1)

PUBLIC

Search objects

- ADHOC
- ANALYTICS
- CURATION
- INFORMATION_SCHEMA
- PUBLIC
- RAW
 - Tables

LAB1_STOCK_DATA 100 Rows

| SYMBOL | DATE | OPEN | CLOSE | HIGH | LOW | VOLUME |
|--------|------|------|-------|------|------|--------|
| VAR | DATE | DATE | DATE | DATE | DATE | DATE |

DEV.ADHOC Settings

```
4
5
6 --create raw stock data table
7 CREATE or replace table dev.raw.lab1_stock_data(
8     symbol STRING,
9     date DATE,
10    open FLOAT,
11    close FLOAT,
12    high FLOAT,
13    low FLOAT,
14    volume BIGINT,
15    PRIMARY KEY(symbol, date)
16 );
17
18 create or replace view dev.adhoc.lab1_train_view AS
19 SELECT DATE, CLOSE, SYMBOL
20 FROM dev.raw.lab1_stock_data;
21
22 create or replace table dev.adhoc.lab1_forecast_table(
23     symbol string,
24     date date,
25     forecast float,
26     lower_bound float,
27     upper_bound float
28 );
29
30 create or replace table dev.analytics.lab1_prediction_results(
31     symbol STRING,
32     date date,
33     actual float,
34     forecast float,
35     lower_bound float,
36     upper_bound float
37 );
```

lab1_stock_data

Q Search

DEV

ADHOC

ANALYTICS

Tables

Dynamic Tables

BOOK_DY_TBL

Stages

Streams

Tasks

CURATION

INFORMATION_SCHEMA

PUBLIC

RAW

Tables

COUNTRY_CAPITAL

LAB1_STOCK_DATA

PROB_HST_TBL

STOCK_DATA

STOCK_DATA_FORECAST

TEMP_COUNTRY_CAPITAL

TEMP_STOCK_DATA

DEV / RAW / LAB1_STOCK_DATA

Table

ACCOUNTADMIN

just now

56

4.5KB

Table Details

Columns

Data Preview

Copy History

Lineage

COMPUTE_WH

61 Rows • Updated just now

| | SYMBOL | DATE | OPEN | CLOSE | HIGH | |
|----|--------|------------|---------|--------|----------|---|
| 1 | AAPL | 2025-03-04 | 237.705 | 235.93 | 240.07 | |
| 2 | AAPL | 2025-03-03 | 241.79 | 238.03 | 244.0272 | |
| 3 | AAPL | 2025-02-28 | 236.95 | 241.84 | 242.09 | |
| 4 | AAPL | 2025-02-27 | 239.41 | 237.3 | 242.46 | |
| 5 | AAPL | 2025-02-26 | 244.33 | 240.36 | 244.98 | |
| 6 | AAPL | 2025-02-25 | 248 | 247.04 | 250 | |
| 7 | AAPL | 2025-02-24 | 244.925 | 247.1 | 248.86 | |
| 8 | AAPL | 2025-02-21 | 245.95 | 245.55 | 248.69 | |
| 9 | AAPL | 2025-02-20 | 244.94 | 245.83 | 246.78 | |
| 10 | AAPL | 2025-02-19 | 244.66 | 244.87 | 246.01 | 2 |
| 11 | AAPL | 2025-02-18 | 244.15 | 244.47 | 245.18 | |
| 12 | AAPL | 2025-02-14 | 241.25 | 244.6 | 245.55 | |
| 13 | AAPL | 2025-02-13 | 236.91 | 241.53 | 242.3399 | |
| 14 | AAPL | 2025-02-12 | 231.2 | 236.87 | 236.96 | |

lab1_forecast_table

Q Search

DEV

ADHOC

Tables

LAB1_FORECAST_TABLE

Views

ANALYTICS

Tables

LAB1_PREDICTION_RESULTS

PROB_HST_TBL

Dynamic Tables

BOOK_DY_TBL

Stages

Streams

Tasks

CURATION

INFORMATION_SCHEMA

PUBLIC

RAW

Tables

COUNTRY_CAPITAL

LAB1_STOCK_DATA

DEV / ADHOC / LAB1_FORECAST_T...

Table

ACCOUNTADMIN

5 minutes ago

7

2.5KB

Table Details

Columns

Data Preview

Copy History

Lineage

COMPUTE_WH

7 Rows • Updated just now

| | TS | FORECAST | LOWER_BOUND | UPPER_BOUND |
|---|------------------|---------------|---------------|-------------|
| 1 | -03-05T00:00:00Z | 235.203408897 | 229.629801858 | 241.55 |
| 2 | -03-06T00:00:00Z | 234.912584129 | 225.887759189 | 243.56 |
| 3 | -03-07T00:00:00Z | 234.693066034 | 223.518546871 | 244.74 |
| 4 | -03-10T00:00:00Z | 234.969396517 | 222.270243197 | 248.32 |
| 5 | -03-11T00:00:00Z | 236.242959181 | 222.31265472 | 249.7 |
| 6 | -03-12T00:00:00Z | 235.481096403 | 221.458783136 | 248.87 |
| 7 | -03-13T00:00:00Z | 235.189862807 | 218.842160196 | 251.23 |

Lab1_train_view

Q Search

DEV

ADHOC

Tables

LAB1_FORECAST_TABLE

Views

LAB1_TRAIN_VIEW

ANALYTICS

Tables

LAB1_PREDICTION_RESULTS

PROB_HST_TBL

Dynamic Tables

BOOK_DY_TBL

Stages

Streams

Tasks

CURATION

INFORMATION_SCHEMA

PUBLIC

RAW

Tables

COUNTRY_CAPITAL

DEV / ADHOC / LAB1_TRAIN_VIEW

View ACCOUNTADMIN just now

View Details Columns Data Preview Lineage

COMPUTE_WH Updated just now

| | DATE | CLOSE | SYMBOL |
|----|------------|--------|--------|
| 1 | 2025-03-04 | 235.93 | AAPL |
| 2 | 2025-03-03 | 238.03 | AAPL |
| 3 | 2025-02-28 | 241.84 | AAPL |
| 4 | 2025-02-27 | 237.3 | AAPL |
| 5 | 2025-02-26 | 240.36 | AAPL |
| 6 | 2025-02-25 | 247.04 | AAPL |
| 7 | 2025-02-24 | 247.1 | AAPL |
| 8 | 2025-02-21 | 245.55 | AAPL |
| 9 | 2025-02-20 | 245.83 | AAPL |
| 10 | 2025-02-19 | 244.87 | AAPL |
| 11 | 2025-02-18 | 244.47 | AAPL |
| 12 | 2025-02-14 | 244.6 | AAPL |
| 13 | 2025-02-13 | 241.53 | AAPL |
| 14 | 2025-02-12 | 236.87 | AAPL |