Traffic Data pipeline with Airflow

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Executive Summary

The provided Airflow DAG (Directed Acyclic Graph) coordinates an Extract, Transform, Load (ETL) process for traffic data, automating the extraction and transformation from diverse sources, including CSV, TSV, and fixed-width text files. The primary functionalities encompass:

- Establishing a directory structure.
- Retrieving and extracting raw data from an AWS URL.
- Processing it into a cohesive and transformed dataset.

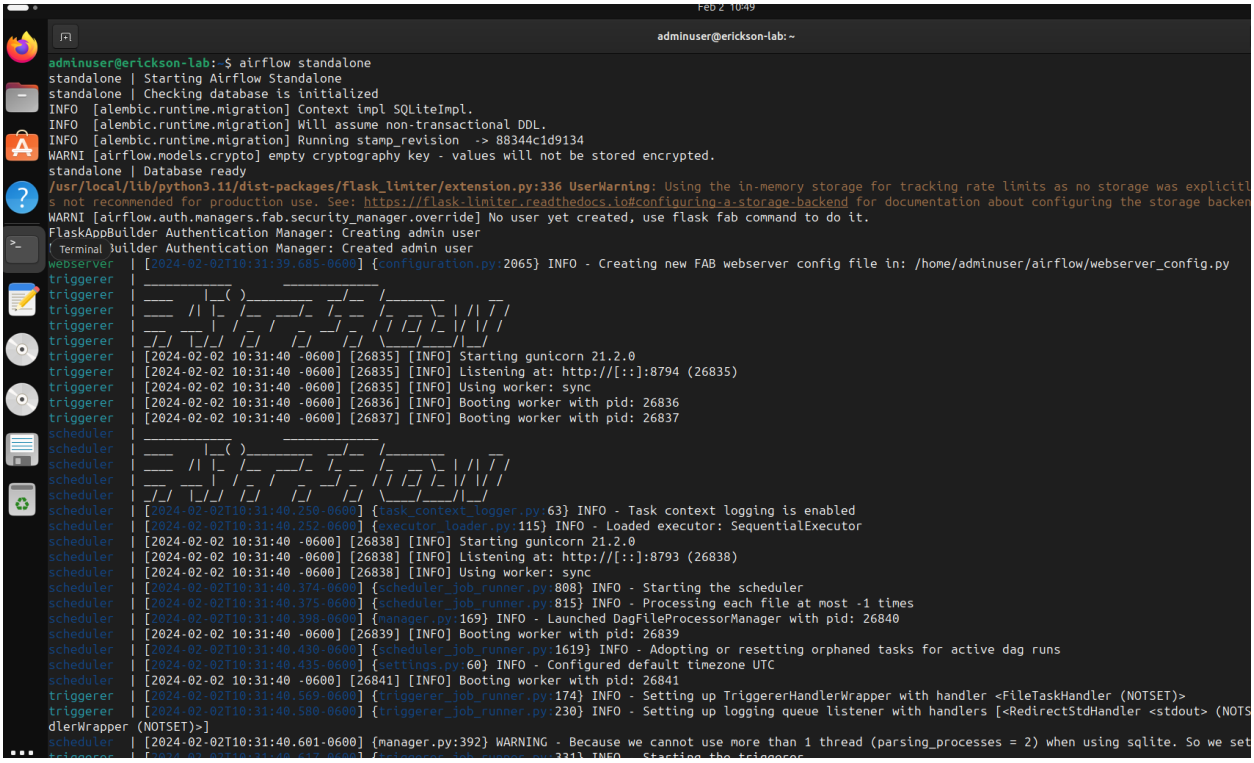
Key objectives of the ETL pipeline include:

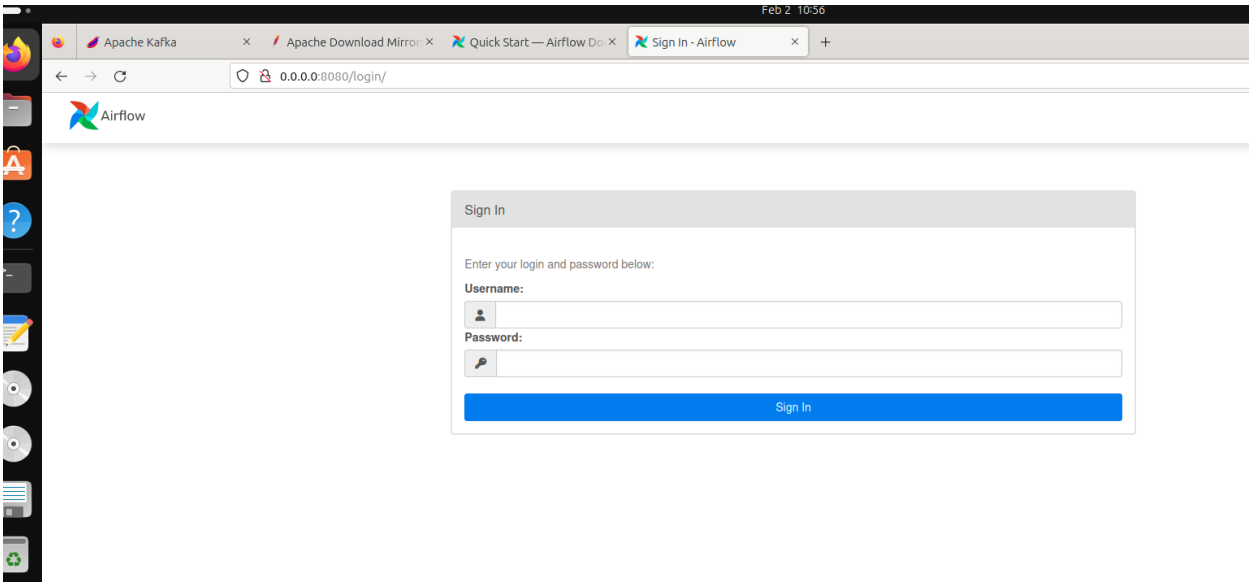
- Extracting specific columns from CSV and TSV files.
- Managing fixed-width text files.
- Merging the extracted datasets.
- Transforming the vehicle type column to uppercase.

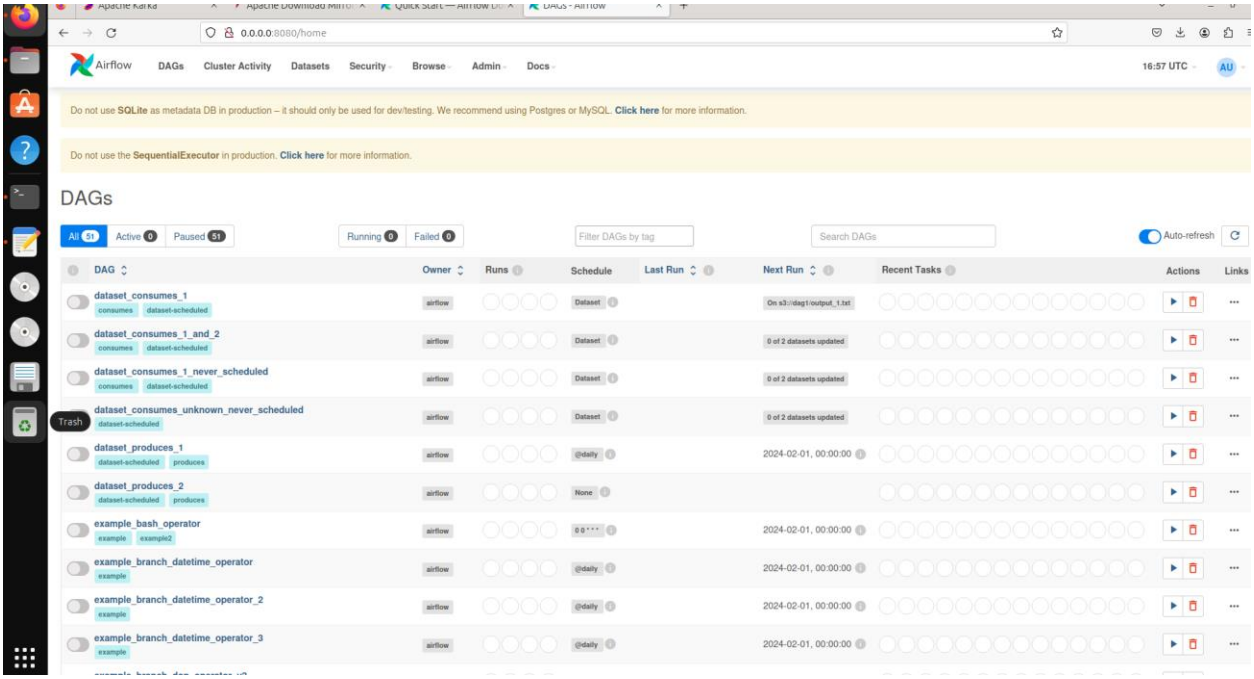
The DAG directs these tasks, utilizing Airflow's task dependencies for orderly execution.

The project improves data quality and uniformity by standardizing column names and formatting across various file types. The Airflow DAG streamlines scheduling and automation, facilitating periodic updates of the ETL process with new data. This scalable and modular approach ensures effective data management, preparing the dataset for subsequent analytics and reporting.

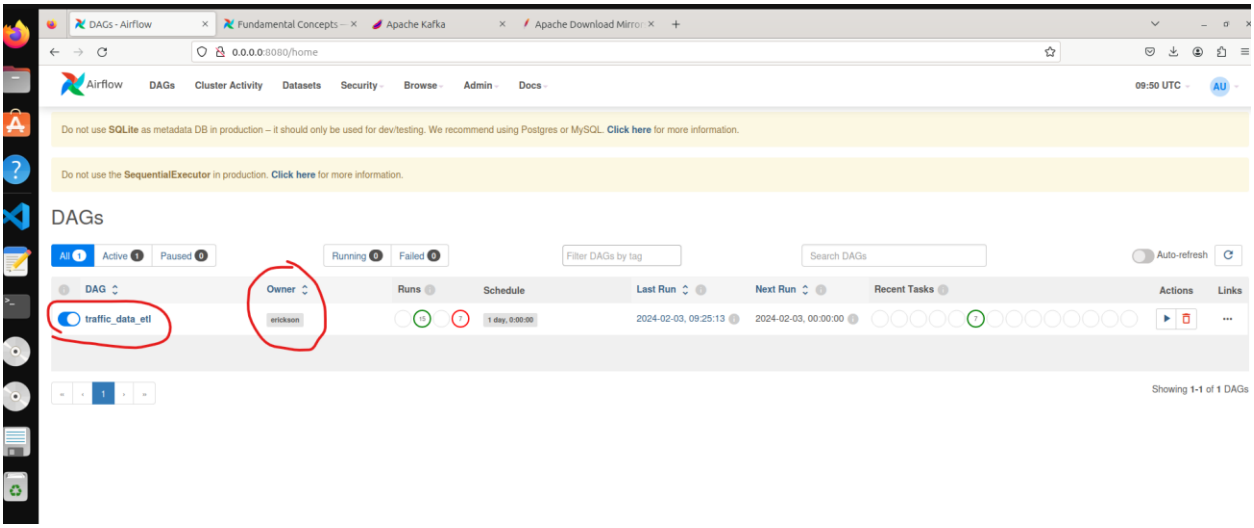
Airflow configured and installed successfully.



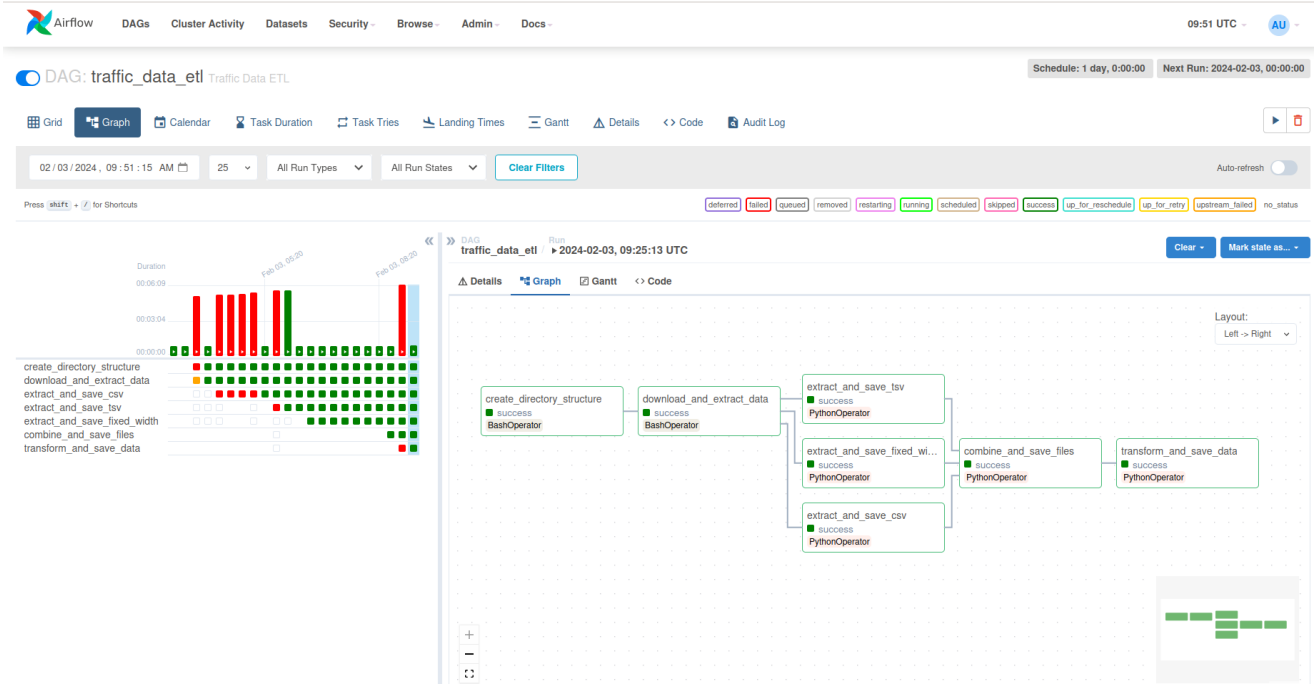




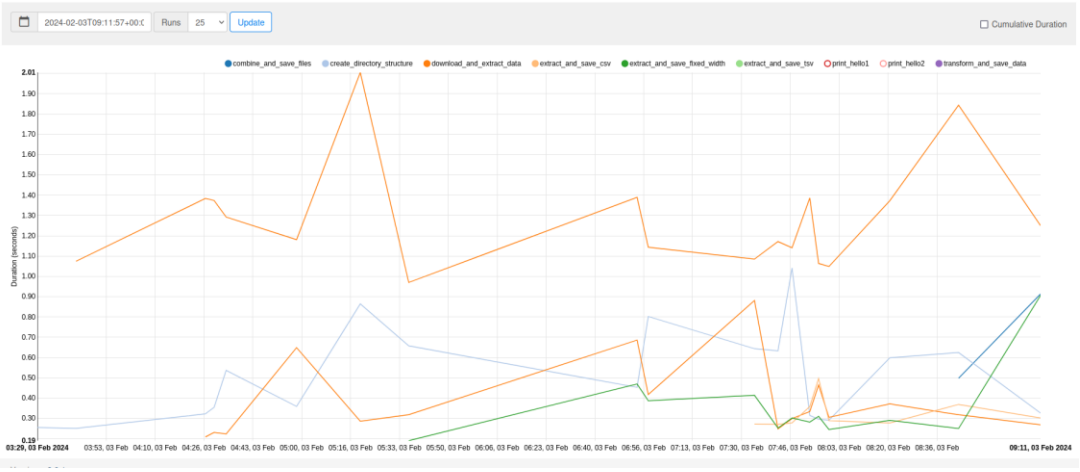
DAG project: traffic_data_etl



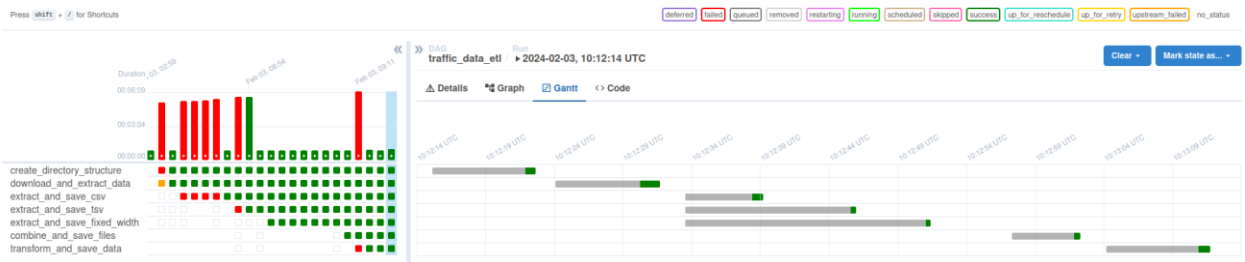
Graph view and schedule of all tasks



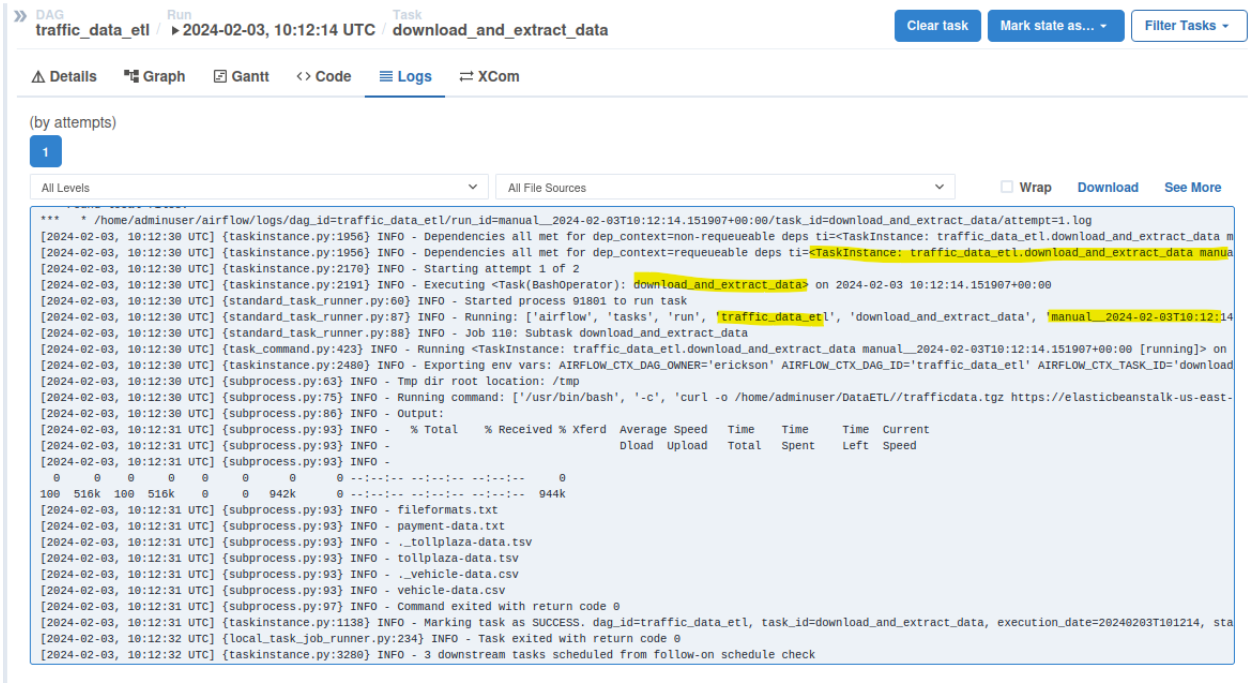
Task duration report



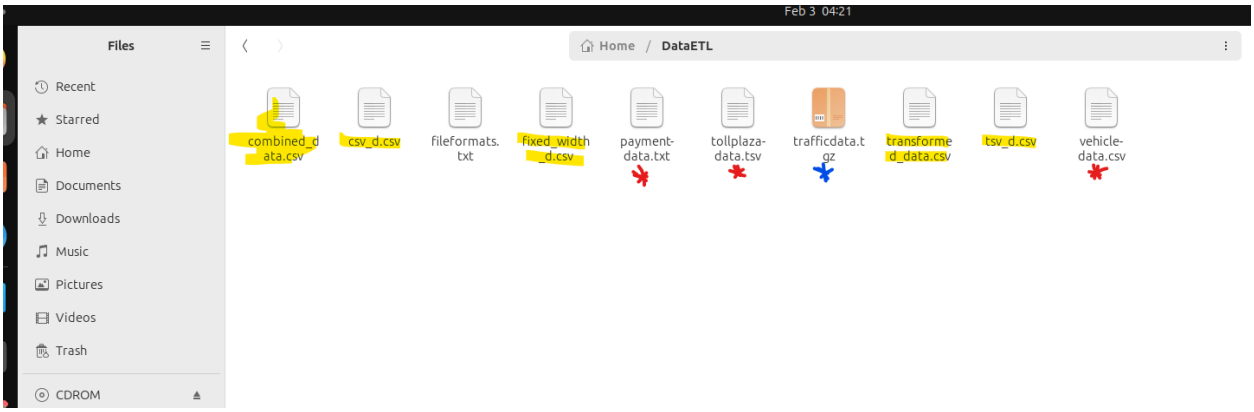
Gantt view (tasks)



Sample log file (download_and_extract_data task)



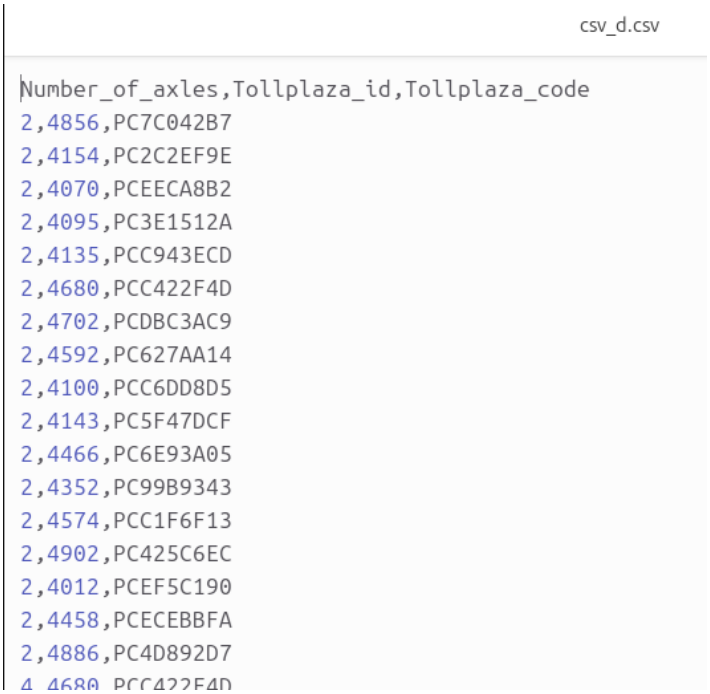
File directory



csv_d.csv


```
Rowid,Timestamp,Anonymized_Vehicle_number,Vehicle_type
1,Thu Aug 19 21:54:38 2021,125094,car
2,Sat Jul 31 04:09:44 2021,174434,car
3,Sat Aug 14 17:19:04 2021,8538286,car
4,Mon Aug  2 18:23:45 2021,5521221,car
5,Thu Jul 29 22:44:20 2021,3267767,car
6,Sat Aug 14 03:57:47 2021,8411850,car
7,Thu Aug 12 03:41:22 2021,6064250,car
8,Sun Aug 22 10:29:58 2021,6871937,van
9,Fri Aug  6 14:23:08 2021,2055930,car
10,Sun Aug 15 13:43:51 2021,8775910,car
11,Wed Aug  4 15:52:13 2021,4525747,car
12,Wed Aug 18 02:22:15 2021,5276143,van
13,Thu Aug 19 16:01:02 2021,5405144,van
14,Tue Aug  3 14:55:00 2021,9309466,car
15,Thu Aug  5 04:00:30 2021,6494070,van
16,Sun Aug  8 13:08:17 2021,4880588,car
17,Wed Aug  4 04:56:15 2021,6964507,car
18,Sun Aug 15 11:22:44 2021,5740782,truck
19,Fri Jul 30 11:20:47 2021,1060261,van
20,Sun Aug  8 21:22:56 2021,6599783,car
21 Wed Aug 11 10:33:15 2021 4573378 car
```

Tsv_d.csv




```
Number_of_axles,Tollplaza_id,Tollplaza_code
2,4856,PC7C042B7
2,4154,PC2C2EF9E
2,4070,PCEECA8B2
2,4095,PC3E1512A
2,4135,PCC943ECD
2,4680,PCC422F4D
2,4702,PCDBC3AC9
2,4592,PC627AA14
2,4100,PCC6DD8D5
2,4143,PC5F47DCF
2,4466,PC6E93A05
2,4352,PC99B9343
2,4574,PCC1F6F13
2,4902,PC425C6EC
2,4012,PCEF5C190
2,4458,PCECEBBFA
2,4886,PC4D892D7
4 4680 PCC422F4D
```

fixed_width_d.csv

Open — fixed_width_d.csv — ~/DataETL

```
Type_Of_Payment_Code,Vehicle_Code
PTE,VC965
PTP,VC965
PTE,VC965
PTP,VC965
PTE,VC965
PTE,VC965
PTE,VC965
PTE,VCD2F
PTP,VC965
PTC,VC965
PTE,VC965
PTC,VCD2F
PTP,VCD2F
PTE,VC965
PTC,VCD2F
PTE,VC965
PTC,VC965
PTP,VCB43
PTP,VCD2F
PTP,VC965
PTC,VC965
```

combined_data.csv

Open — combined_data.csv — ~/DataETL

```
Rowid,Timestamp,Anonymized_Vehicle_number,Vehicle_type,Number_of_axles,Tollplaza_id,Tollplaza_code,Type_Of_Payment_Code,Vehicle_Code
1.0,Thu Aug 19 21:54:38 2021,125094.0,car,,,,,
2.0,Sat Jul 31 04:09:44 2021,174434.0,car,,,,,
3.0,Sat Aug 14 17:19:04 2021,8538286.0,car,,,,,
4.0,Mon Aug  2 18:23:45 2021,5521221.0,car,,,,,
5.0,Thu Jul 29 22:44:20 2021,3267767.0,car,,,,,
6.0,Sat Aug 14 03:57:47 2021,8411850.0,car,,,,,
7.0,Thu Aug 12 03:41:22 2021,6064250.0,car,,,,,
8.0,Sun Aug 22 10:29:58 2021,6871937.0,van,,,,,
9.0,Fri Aug  6 14:23:08 2021,2055930.0,car,,,,,
10.0,Sun Aug 15 13:43:51 2021,8775910.0,car,,,,,
11.0,Wed Aug  4 15:52:13 2021,4525747.0,car,,,,,
12.0,Wed Aug 18 02:22:15 2021,5276143.0,van,,,,,
13.0,Thu Aug 19 16:01:02 2021,5405144.0,van,,,,,
14.0,Tue Aug  3 14:55:00 2021,9309466.0,car,,,,,
15.0,Thu Aug  5 04:00:30 2021,6494070.0,van,,,,,
16.0,Sun Aug  8 13:08:17 2021,4880588.0,car,,,,,
17.0,Wed Aug  4 04:56:15 2021,6964507.0,car,,,,,
18.0,Sun Aug 15 11:22:44 2021,5740782.0,truck,,,,,
19.0,Fri Jul 30 11:20:47 2021,1060261.0,van,,,,,
20.0,Sun Aug  8 21:22:56 2021,6599783.0,car,,,,,
21.0,Wed Aug 11 10:33:15 2021,4573378.0,car
```

transformed_data.csv

Open — transformed_data.csv — ~/DataETL

```
Rowid,Timestamp,Anonymized_Vehicle_number,Vehicle_type,Number_of_axles,Tollplaza_id,Tollplaza_code,Type_Of_Payment_Code,Vehicle_Code
1.0,Thu Aug 19 21:54:38 2021,125094.0,CAR,,,,,
2.0,Sat Jul 31 04:09:44 2021,174434.0,CAR,,,,,
3.0,Sat Aug 14 17:19:04 2021,8538286.0,CAR,,,,,
4.0,Mon Aug  2 18:23:45 2021,5521221.0,CAR,,,,,
5.0,Thu Jul 29 22:44:20 2021,3267767.0,CAR,,,,,
6.0,Sat Aug 14 03:57:47 2021,8411850.0,CAR,,,,,
7.0,Thu Aug 12 03:41:22 2021,6064250.0,CAR,,,,,
8.0,Sun Aug 22 10:29:58 2021,6871937.0,VAN,,,,,
9.0,Fri Aug  6 14:23:08 2021,2055930.0,CAR,,,,,
10.0,Sun Aug 15 13:43:51 2021,8775910.0,CAR,,,,,
11.0,Wed Aug  4 15:52:13 2021,4525747.0,CAR,,,,,
12.0,Wed Aug 18 02:22:15 2021,5276143.0,VAN,,,,,
13.0,Thu Aug 19 16:01:02 2021,5405144.0,VAN,,,,,
14.0,Tue Aug  3 14:55:00 2021,9309466.0,CAR,,,,,
15.0,Thu Aug  5 04:00:30 2021,6494070.0,VAN,,,,,
16.0,Sun Aug  8 13:08:17 2021,4880588.0,CAR,,,,,
17.0,Wed Aug  4 04:56:15 2021,6964507.0,CAR,,,,,
18.0,Sun Aug 15 11:22:44 2021,5740782.0,TRUCK,,,,,
19.0,Fri Jul 30 11:20:47 2021,1060261.0,VAN,,,,,
```

Upper Case

Source Code

```
# Importing libraries
from airflow.models.dag import DAG
from airflow.operators.python import PythonOperator
from airflow.utils.dates import days_ago
from datetime import datetime, timedelta
from airflow.operators.bash import BashOperator
import pandas as pd


# Folder path
folder_path = "/home/adminuser/DataETL/"

# Data source from the following url
url = 'https://elasticbeanstalk-us-east-2-340729127361.s3.us-east-
2.amazonaws.com/trafficdata.tgz'


# Function to extract the csv file
def extract_and_save_csv():
    input_file = f'{folder_path}/vehicle-data.csv'
    output_file = f'{folder_path}/csv_d.csv'

    # Read the CSV file, select columns 1, 2, 3, 4
    df = pd.read_csv(input_file, header=None, usecols=[0, 1, 2, 3])

    # Rename columns
    df.columns = ['Rowid', 'Timestamp', 'Anonymized_Vehicle_number',
'Vehicle_type']

    # Save the result to a new CSV file
    df.to_csv(output_file, index=False)


# Function to extract the tsv file
def extract_and_save_tsv():
    tsv_input_file = f'{folder_path}/tollplaza-data.tsv'
    tsv_output_file = f'{folder_path}/tsv_d.csv'

    # Read the TSV file, select columns 5, 6, 7
    tsv_df = pd.read_csv(tsv_input_file, sep='\t', header=None, usecols=[4, 5,
6])

    # Rename columns
    tsv_df.columns = ['Number_of_axles', 'Tollplaza_id', 'Tollplaza_code']

    # Save the result to a new CSV file
    tsv_df.to_csv(tsv_output_file, index=False)
```

```
# Function to extract the txt fixed-width file
def extract_and_save_fixed_width():
    fixed_width_input_file = f'{folder_path}/payment-data.txt'
    fixed_width_output_file = f'{folder_path}/fixed_width_d.csv'

    # Fixed-column positions for Type of Payment code and Vehicle Code
    column_positions = [(58,61), (61, 68)]

    # Read the fixed-width file
    fixed_width_df = pd.read_fwf(fixed_width_input_file,
colspecs=column_positions, header=None)

    # Rename columns
    fixed_width_df.columns = ['Type_Of_Payment_Code', 'Vehicle_Code']

    # Save the result to a new CSV file
    fixed_width_df.to_csv(fixed_width_output_file, index=False)


# Function to combine the extracted files
def combine_and_save_files():
    # Load the three CSV files
    csv_df = pd.read_csv(f'{folder_path}/csv_d.csv')
    tsv_df = pd.read_csv(f'{folder_path}/tsv_d.csv')
    fixed_width_df = pd.read_csv(f'{folder_path}/fixed_width_d.csv')

    # Concatenate the DataFrames along the rows (axis=0)
    combined_df = pd.concat([csv_df, tsv_df, fixed_width_df], axis=0,
ignore_index=True)

    # Save the combined DataFrame to a new CSV file
    combined_output_file = f'{folder_path}/combined_data.csv'
    combined_df.to_csv(combined_output_file, index=False)


# Function to tranform the data
# vehicle type as uppercase
def transform_and_save_data():
    # Load the combined data file
    combined_df = pd.read_csv(f'{folder_path}/combined_data.csv')

    # Convert "Vehicle type" column to uppercase
    combined_df['Vehicle_type'] = combined_df['Vehicle_type'].str.upper()

    # Save the transformed DataFrame to a new CSV file
    transformed_output_file = f'{folder_path}/transformed_data.csv'
    combined_df.to_csv(transformed_output_file, index=False)
```

```
# Dictionary to default args
default_args = {
    'owner': 'erickson',
    'depends_on_past': False,
    'start_date': datetime(2024, 2, 3),
    'schedule':'@daily',
    'email_on_failure': False,
    'email_on_retry': False,
    'retries': 1,
    'retry_delay': timedelta(minutes=5),
    'catchup':False
}


# Instantiate the DAG
dag = DAG(
    dag_id='traffic_data_etl',
    default_args=default_args,
    description='Traffic Data ETL',
    schedule_interval=timedelta(days=1),
)


# Task to create the directory using BashOperator
create_directory_structure_task = BashOperator(
    task_id='create_directory_structure',
    bash_command=f'mkdir -p {folder_path}',
    dag=dag,
)


# Task to download and extract the files using BashOperator
download_and_extract_data_task = BashOperator(
    task_id='download_and_extract_data',
    bash_command=f'curl -o {folder_path}/trafficdata.tgz {url} && tar -xzvf
{folder_path}/trafficdata.tgz -C {folder_path}',
    dag=dag,
)


# Task to save csv file using PythonOperator
extract_and_save_csv_task = PythonOperator(
    task_id='extract_and_save_csv',
    python_callable=extract_and_save_csv,
    dag=dag,
)
```

```
# Task to save tsv file using PythonOperator
extract_and_save_tsv_task = PythonOperator(
    task_id='extract_and_save_tsv',
    python_callable=extract_and_save_tsv,
    dag=dag,
)

# Task to save fixed-width file using PythonOperator
extract_and_save_fixed_width_task = PythonOperator(
    task_id='extract_and_save_fixed_width',
    python_callable=extract_and_save_fixed_width,
    dag=dag,
)

# Task to combine and save files using PythonOperator
combine_and_save_files_task = PythonOperator(
    task_id='combine_and_save_files',
    python_callable=combine_and_save_files,
    dag=dag,
)

# Task to transform and save data using PythonOperator
transform_and_save_data_task = PythonOperator(
    task_id='transform_and_save_data',
    python_callable=transform_and_save_data,
    dag=dag,
)


#----------------------------------------
#-- Set up task dependencies execution --#
#----------------------------------------#

# Runs first to create the necessary directory structure.
create_directory_structure_task >> download_and_extract_data_task

# The three taskscan run in parallel as they depend on the
# completion of download_and_extract_data_task.
download_and_extract_data_task >> [extract_and_save_csv_task,
                                   extract_and_save_tsv_task,
                                   extract_and_save_fixed_width_task]

# Combine task, depends on the completion of the three extraction tasks.
[extract_and_save_csv_task,
 extract_and_save_tsv_task,
 extract_and_save_fixed_width_task] >> combine_and_save_files_task

# Tranform task, depends on the completion of combine task
combine_and_save_files_task >> transform_and_save_data_task
```