Case Study

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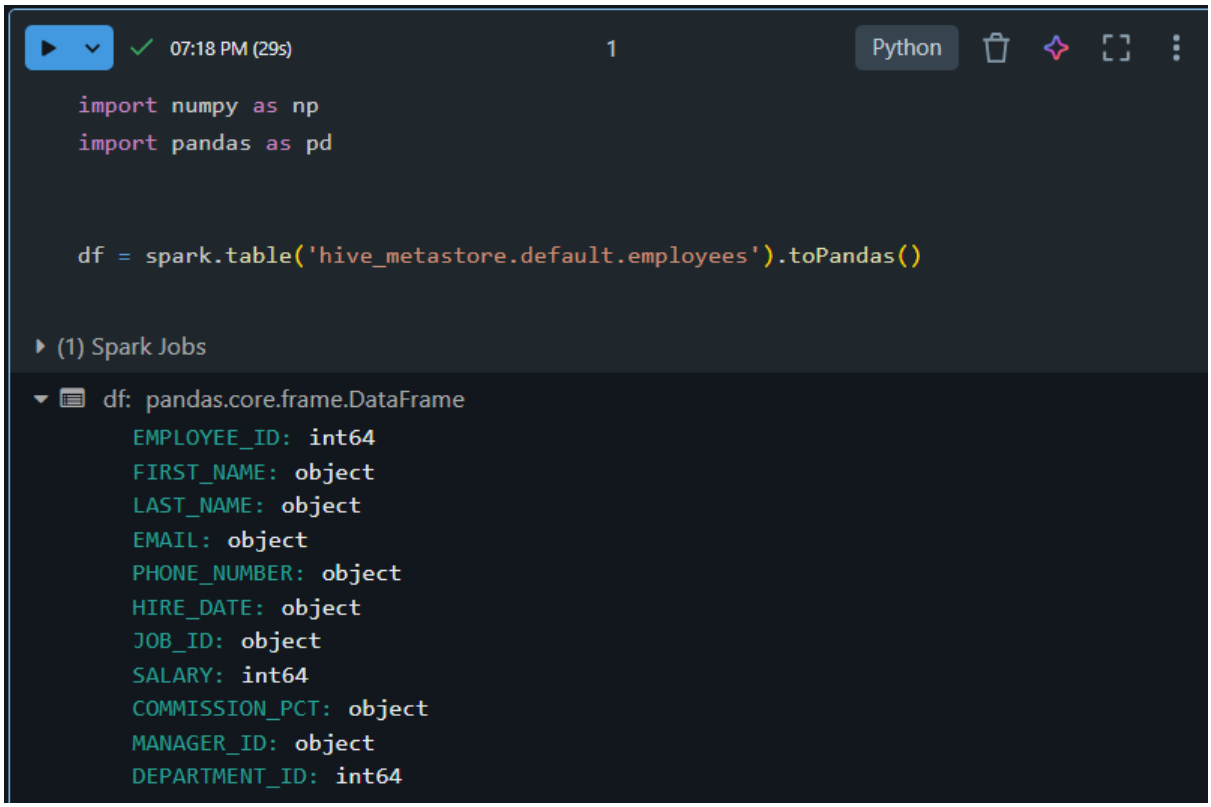
Load CSV file

Create a pandas DataFrame from the dataset for easier processing and visualization. Replace the file path below with your actual file location.

import numpy as np

import pandas as pd

df = spark.table('hive_metastore.default.employees').toPandas()



Use pandas for data insights

Check shape of the DataFrame

df.shape

The df.shape command returns the number of rows and columns.

```
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df.shape
(50, 11)
```

Generate descriptive statistics

df.describe()

The df.describe() command provides numerical summaries such as mean, standard deviation, min, max, and percentiles.

```
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df.describe()
```

	EMPLOYEE_ID	SALARY	DEPARTMENT_ID
count	50.000000	50.000000	50.00000
mean	134.760000	6182.320000	57.60000
std	33.631594	4586.181772	25.11687
min	100.000000	2100.000000	10.00000
25%	112.250000	2725.000000	50.00000
50%	124.500000	4600.000000	50.00000
75%	136.750000	8150.000000	60.00000
max	206.000000	24000.000000	110.00000

Generate a data profile

display(df)

This displays a full interactive table of the data for profiling.

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```
display(df)
```

Table

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PH
2	199	Douglas	Grant	DGRANT	650.50
3	200	Jennifer	Whalen	JWHALEN	515.12
4	201	Michael	Hartstein	MHARTSTE	515.12
5	202	Pat	Fay	PFAY	603.12
6	203	Susan	Mavris	SMAVRIS	515.12
7	204	Hermann	Baer	HBAER	515.12
8	205	Shelley	Higgins	SHIGGINS	515.12
9	206	William	Gietz	WGIETZ	515.12
10	100	Steven	King	SKING	515.12
11	101	Neena	Kochhar	NKOCHHAR	515.12
12	102	Lex	De Haan	LDEHAAN	515.12
13	103	Alexander	Hunold	AHUNOLD	590.42
14	104	Bruce	Ernst	BERNST	590.42

Clean the data

Remove duplicate data

duplicate_rows = df.duplicated().sum()

duplicate_columns = df.columns[df.columns.duplicated()].tolist()

print("Duplicate rows count:", duplicate_rows)

print("Duplicate columns:", duplicate_columns)

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```
duplicate_rows = df.duplicated().sum()
duplicate_columns = df.columns[df.columns.duplicated()].tolist()
print("Duplicate rows count:", duplicate_rows)
print("Duplicate columns:", duplicate_columns)
```

```
Duplicate rows count: 0
Duplicate columns: []
```

Handle null or missing values

df = df.replace('-', np.nan)

df = df.fillna(0)

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```
df = df.replace('-', np.nan)
df = df.fillna(0)
```

df: pandas.core.frame.DataFrame = [EMPLOYEE_ID: int64, FIRST_NAME: object ... 9 more fields]

Reformat dates

df['HIRE_DATE'] = pd.to_datetime(df['HIRE_DATE'], format='%d-%b-%y', errors='coerce')

display(df)

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```
df['HIRE_DATE'] = pd.to_datetime(df['HIRE_DATE'], format='%d-%b-%y',
errors='coerce')
display(df)
```

Table

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PH
1	198	Donald	OConnell	DOCONNEL	650.50
2	199	Douglas	Grant	DGRANT	650.50
3	200	Jennifer	Whalen	JWHALEN	515.12
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5	202	Pat	Fay	PFAY	603.12
6	203	Susan	Mavris	SMAVRIS	515.12
7	204	Hermann	Baer	HBAER	515.12
8	205	Shelley	Higgins	SHIGGINS	515.12
9	206	William	Gietz	WGIETZ	515.12
10	100	Steven	King	SKING	515.12

Filter for specific conditions

Employees with salary > 5000

high_salary = df[df['SALARY'] > 5000]

Employees in department 20

dept_20 = df[df['DEPARTMENT_ID'] == 20]

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```
high_salary = df[df['SALARY'] > 5000]
display(high_salary)
dept_20 = df[df['DEPARTMENT_ID'] == 20]
```

dept_20: pandas.core.frame.DataFrame = [EMPLOYEE_ID: int64, FIRST_NAME: object ... 9 more fields]

high_salary: pandas.core.frame.DataFrame = [EMPLOYEE_ID: int64, FIRST_NAME: object ... 9 more fields]

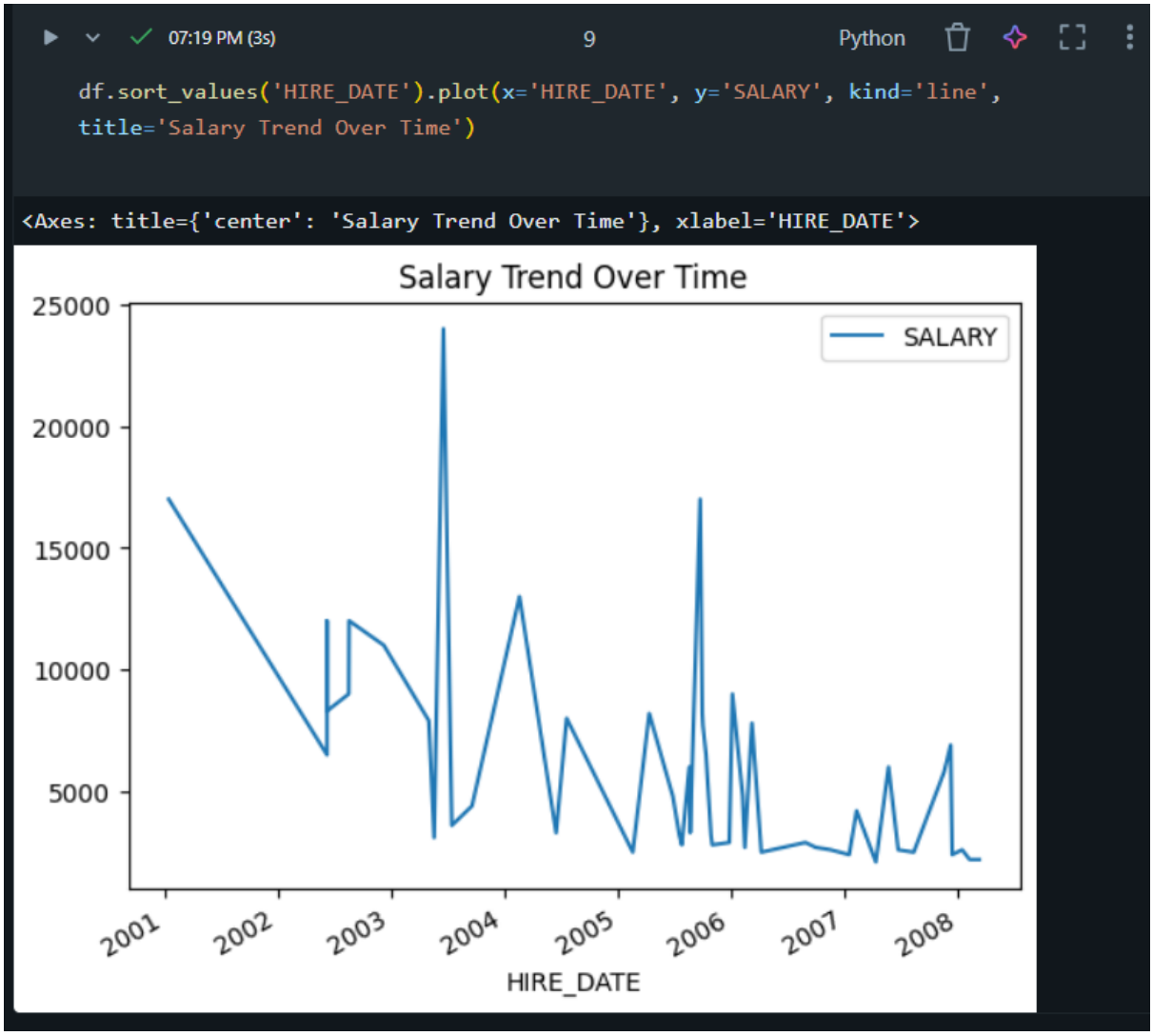
Table

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PH
1	201	Michael	Hartstein	MHARTSTE	515.12
2	202	Pat	Fay	PFAY	603.12
3	203	Susan	Mavris	SMAVRIS	515.12
4	204	Hermann	Baer	HBAER	515.12
5	205	Shelley	Higgins	SHIGGINS	515.12

Create visualizations using the dataset

Line Chart

df.sort_values('HIRE_DATE').plot(x='HIRE_DATE', y='SALARY', kind='line', title='Salary Trend Over Time')



Area Chart

df.groupby('DEPARTMENT_ID')['SALARY'].sum().plot(kind='area', title='Total Salary by Department')

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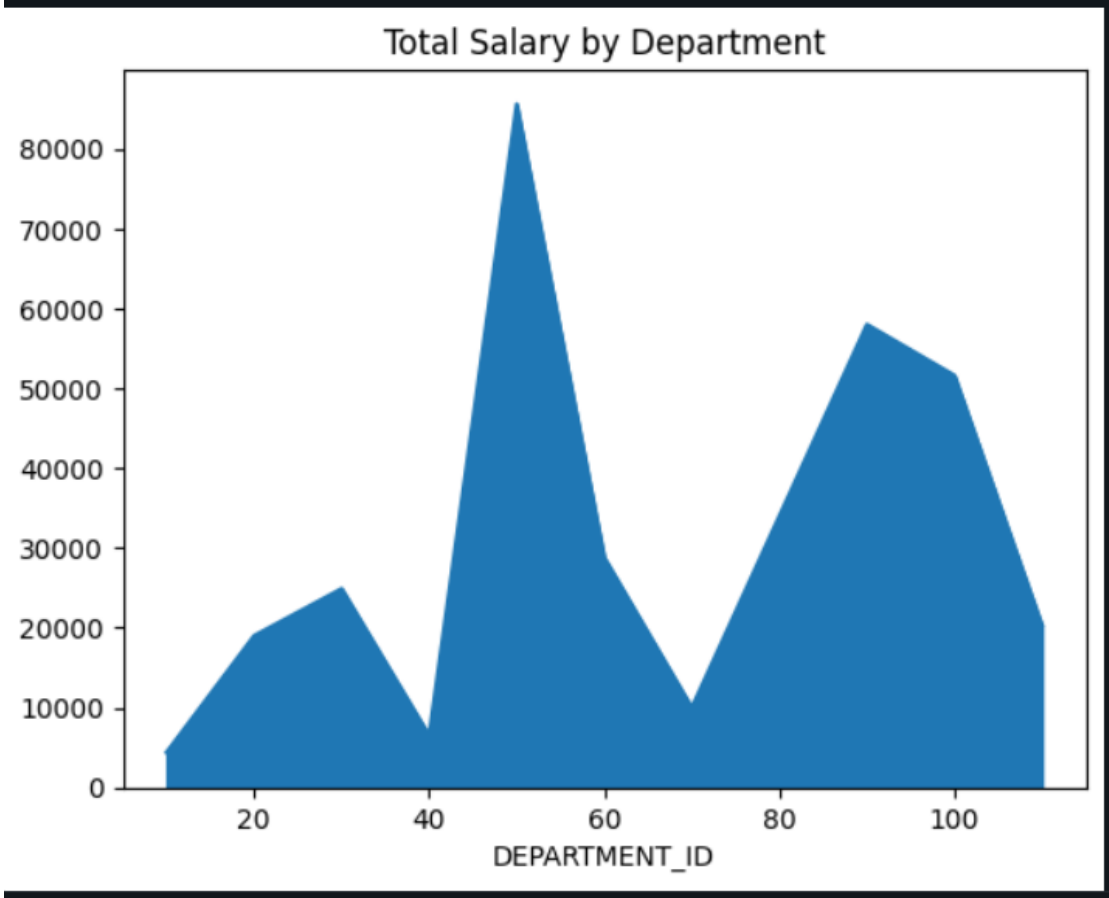
```
df.groupby('DEPARTMENT_ID')['SALARY'].sum().plot(kind='area', title='Total Salary
by Department')
```

```
<Axes: title={'center': 'Total Salary by Department'}, xlabel='DEPARTMENT_ID'>
```



Delta Table Operations

Create a Delta Table

Convert pandas DataFrame to Spark DataFrame

spark_df = spark.createDataFrame(df)

Write as Delta table

spark_df.write.format("delta").mode("overwrite").saveAsTable("hive_metastore.default.employee_delta")

```
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# Convert pandas DataFrame to Spark DataFrame
spark_df = spark.createDataFrame(df)

# Write as Delta table
spark_df.write.format("delta").mode("overwrite").saveAsTable("hive_metastore.
default.employee_delta")

(1) Spark Jobs

spark_df: pyspark.sql.dataframe.DataFrame = [EMPLOYEE_ID: long, FIRST_NAME: string ... 9 more
fields]
```

Merge & Upsert to a Delta Table

```
from delta.tables import DeltaTable

from pyspark.sql.types import StructType, StructField, IntegerType, StringType, DoubleType,
DateType

from datetime import datetime


# Define schema explicitly

schema = StructType([

    StructField("EMPLOYEE_ID", IntegerType(), False),

    StructField("FIRST_NAME", StringType(), True),

    StructField("LAST_NAME", StringType(), True),

    StructField("EMAIL", StringType(), True),

    StructField("PHONE_NUMBER", StringType(), True),

    StructField("HIRE_DATE", DateType(), True),

    StructField("JOB_ID", StringType(), True),

    StructField("SALARY", DoubleType(), True),

    StructField("COMMISSION_PCT", DoubleType(), True),

    StructField("MANAGER_ID", IntegerType(), True),

    StructField("DEPARTMENT_ID", IntegerType(), True)

])


# Create source DataFrame with explicit schema
```

```
source = spark.createDataFrame([
    (205, "Alex", "Smith", "ASMITH", "650.123.9999", datetime.strptime("12-Jan-09", "%d-%b-%y"), "IT_PROG", 9000.0, None, 101, 60)
], schema=schema)

# Merge into Delta table
target = DeltaTable.forName(spark, "hive_metastore.default.employee_delta")

(
    target.alias("t")
    .merge(source.alias("s"), "t.EMPLOYEE_ID = s.EMPLOYEE_ID")
    .whenMatchedUpdateAll()
    .whenNotMatchedInsertAll()
    .execute()
)
```

```python
from delta.tables import DeltaTable
from pyspark.sql.types import StructType, StructField, IntegerType, StringType,
DoubleType, DateType
from datetime import datetime

# Define schema explicitly
schema = StructType([
    StructField("EMPLOYEE_ID", IntegerType(), False),
    StructField("FIRST_NAME", StringType(), True),
    StructField("LAST_NAME", StringType(), True),
    StructField("EMAIL", StringType(), True),
    StructField("PHONE_NUMBER", StringType(), True),
    StructField("HIRE_DATE", DateType(), True),
    StructField("JOB_ID", StringType(), True),
    StructField("SALARY", DoubleType(), True),
    StructField("COMMISSION_PCT", DoubleType(), True),
    StructField("MANAGER_ID", IntegerType(), True),
    StructField("DEPARTMENT_ID", IntegerType(), True)
])

# Create source DataFrame with explicit schema
source = spark.createDataFrame([
    (205, "Alex", "Smith", "ASMITH", "650.123.9999", datetime.strptime
    ("12-Jan-09", "%d-%b-%y"), "IT_PROG", 9000.0, None, 101, 60)
], schema=schema)
```

```python
# Merge into Delta table
target = DeltaTable.forName(spark, "hive_metastore.default.employee_delta")

(
    target.alias("t")
    .merge(source.alias("s"), "t.EMPLOYEE_ID = s.EMPLOYEE_ID")
    .whenMatchedUpdateAll()
    .whenNotMatchedInsertAll()
    .execute()
)
```

▸ (8) Spark Jobs

▸ source: pyspark.sql.dataframe.DataFrame = [EMPLOYEE_ID: integer, FIRST_NAME: string ... 9 more fields]

Read a Delta Table

df_delta = spark.read.format("delta").table("hive_metastore.default.employee_delta")

display(df_delta)

07:22 PM (1s) 13

```
df_delta = spark.read.format("delta").table("hive_metastore.default.
employee_delta")
display(df_delta)
```

(2) Spark Jobs

df_delta: pyspark.sql.dataframe.DataFrame = [EMPLOYEE_ID: long, FIRST_NAME: string ... 9 more fields]

Table

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PH
1	198	Donald	OConnell	DOCONNEL	650.50
2	199	Douglas	Grant	DGRANT	650.50
3	200	Jennifer	Whalen	JWHALEN	515.12
4	201	Michael	Hartstein	MHARTSTE	515.12
5	202	Pat	Fay	PFAY	603.12
6	203	Susan	Mavris	SMAVRIS	515.12
7	204	Hermann	Baer	HBAER	515.12
8	206	William	Gietz	WGIETZ	515.12
9	100	Steven	King	SKING	515.12

Write to a Delta Table

spark_df.write.format("delta").mode("append").saveAsTable("hive_metastore.default.employee_delta")

07:22 PM (2s) 14

```
spark_df.write.format("delta").mode("append").saveAsTable("hive_metastore.default.
employee_delta")
```

(1) Spark Jobs

Update a Delta Table

target.update(

condition="DEPARTMENT_ID = 50",

set={"SALARY": "SALARY + 500"}

)

07:23 PM (4s) 15

```
target.update(
    condition="DEPARTMENT_ID = 50",
    set={"SALARY": "SALARY + 500"}
)
```

(6) Spark Jobs

Display Table History

display(spark.sql("DESCRIBE HISTORY hive_metastore.default.employee_delta"))

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```
display(spark.sql("DESCRIBE HISTORY hive_metastore.default.employee_delta"))
```

(1) Spark Jobs

Table

	version	timestamp	userId	userName
2	4	2025-08-12T13:53:08.000+00:...	141397643554594	azuser4022_mml.local@techa
3	3	2025-08-12T13:52:47.000+00:...	141397643554594	azuser4022_mml.local@techa
4	2	2025-08-12T13:51:49.000+00:...	141397643554594	azuser4022_mml.local@techa
5	1	2025-08-12T13:50:08.000+00:...	141397643554594	azuser4022_mml.local@techa
6	0	2025-08-12T12:26:07.000+00:...	141397643554594	azuser4022_mml.local@techa

6 rows | 1.39s runtime Refreshed 17 minutes ago

Query Earlier Version (Time Travel)

df_old = spark.read.format("delta").option("versionAsOf", 0).table("hive_metastore.default.employee_delta")

display(df_old)

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```python
df_old = spark.read.format("delta").option("versionAsOf", 0).table("hive_metastore.
default.employee_delta")
display(df_old)
```

(1) Spark Jobs

df_old: pyspark.sql.dataframe.DataFrame = [EMPLOYEE_ID: long, FIRST_NAME: string ... 9 more fields]

Table

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PH
1	198	Donald	OConnell	DOCONNEL	650.50
2	199	Douglas	Grant	DGRANT	650.50
3	200	Jennifer	Whalen	JWHALEN	515.12
4	201	Michael	Hartstein	MHARTSTE	515.12
5	202	Pat	Fay	PFAY	603.12
6	203	Susan	Mavris	SMAVRIS	515.12
7	204	Hermann	Baer	HBAER	515.12
8	205	Shelley	Higgins	SHIGGINS	515.12
9	206	William	Gietz	WGIETZ	515.12
10	100	Steven	King	SKING	515.12
11	101	Neena	Kochhar	NKOCHHAR	515.12

Optimize a Delta Table

spark.sql("OPTIMIZE hive_metastore.default.employee_delta")

07:25 PM (2s) 18 Python

```python
spark.sql("OPTIMIZE hive_metastore.default.employee_delta")
```

(3) Spark Jobs

```
>,partitionsOptimized:bigint,zOrderStats:struct<strategyName:string,inputCubeFiles:str
uct<num:bigint,size:bigint>,inputOtherFiles:struct<num:bigint,size:bigint>,inputNumCub
es:bigint,mergedFiles:struct<num:bigint,size:bigint>,numOutputCubes:bigint,mergedNumCu
bes:bigint>,clusteringStats:struct<inputZCubeFiles:struct<numFiles:bigint,size:bigint
>,inputOtherFiles:struct<numFiles:bigint,size:bigint>,inputNumZCubes:bigint,mergedFile
s:struct<numFiles:bigint,size:bigint>,numOutputZCubes:bigint>,numBins:bigint,numBatche
s:bigint,totalConsideredFiles:bigint,totalFilesSkipped:bigint,preserveInsertionOrder:b
oolean,numFilesSkippedToReduceWriteAmplification:bigint,numBytesSkippedToReduceWriteAm
plification:bigint,startTimeMs:bigint,endTimeMs:bigint,totalClusterParallelism:bigint,
totalScheduledTasks:bigint,autoCompactParallelismStats:struct<maxClusterActiveParallel
ism:bigint,minClusterActiveParallelism:bigint,maxSessionActiveParallelism:bigint,minSe
ssionActiveParallelism:bigint>,deletionVectorStats:struct<numDeletionVectorsRemoved:bi
gint,numDeletionVectorRowsRemoved:bigint>,recompressionCodec:string,numTableColumns:bi
```

Clean Up Snapshots with VACUUM

spark.sql("VACUUM hive_metastore.default.employee_delta RETAIN 168 HOURS")

```
07:26 PM (51s)                    20

spark.sql("VACUUM hive_metastore.default.employee_delta RETAIN 168 HOURS")

(18) Spark Jobs

DataFrame[path: string]
```