Case Study 1

Amazon Books Catalog Search

Data Cleansing, Analytics, Pipeline &Reporting using Apache Beam, Python pySpark on a Google Data Proc Cluster.

PROBLEM STATEMENT:

1. Find the average user rating for Fiction books in pyspark.
2. Find the average user rating for Non-fiction books and for all books together. Please write the result in separate files. – python (analytics), PySpark
3. Sort the last 5 books in alphabetical order and print the output – Pyspark

Kaggle Dataset - https://www.kaggle.com/sootersaalu/amazon-top-50-bestselling-books-2009-2019

Notes - This is a dataset on Amazon's Top 50 bestselling books from 2009 to 2019., it contains 550+ books, and has been categorized into fiction and non-fiction using Goodreads.

[Note, one can add/multiple the data set to about 5000+] books to utilize power of GCP Cluster, Analytics, Spark Job, BigQuery, BigTable capabilities.

Implementation Steps -

- **Pre-requisite** – One should download this csv and do data cleaning (replace the commas in the Name column with semicolons). [Upload this csv in the GCP bucket] – Pyspark, Hive [10% credits]
- One has to build a DataProc Cluster [at least 2 nodes] to run Python pySpark batch jobs [Kaggle dataset, from GCP bucket] on Google Cloud. – DataProc [15% credits]
- Advisable to connect to the nodes using CLI and provision the VMs with required configurations using [15% credits] o GCP Cloud SDK o gsutil tool
- **Create/Configure a pipeline** [10% credits] using Command Line
- Pipeline = Reading input + Transforming Data + Writing Output
- Output results should be stored as raw data in Hive[**BigQuery**] before stored finally into HBase[BigTable] for further processing & reporting to Analytics Engines. – Hbase, Hive [15% Credits]

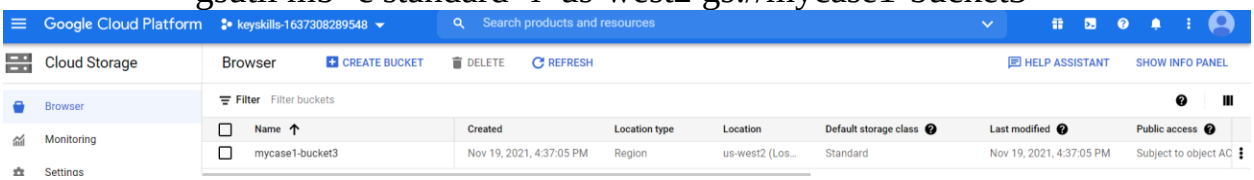
- **Run the pipeline – Apache Beam [10% credit]**
- Print the results to console and store for further analytics – Hbase [10% credits]
- Extract of the pipeline execution and output is here – (good to use HBase) – [10% credits]
- Engineering Best Practices to be followed [30% credits]

1. Logging has to be implemented in all the Python Components
2. Exception handling framework need to be implemented
3. Unit testing of each Python component/service using Pytest/UnitTest/Mock Objects
4. Unit Testing of Spark Cluster, Data Pipeline [is desirable]
5. Usage of 4 to 5 Big Data Design Patterns using Python [is desirable]

Answer:

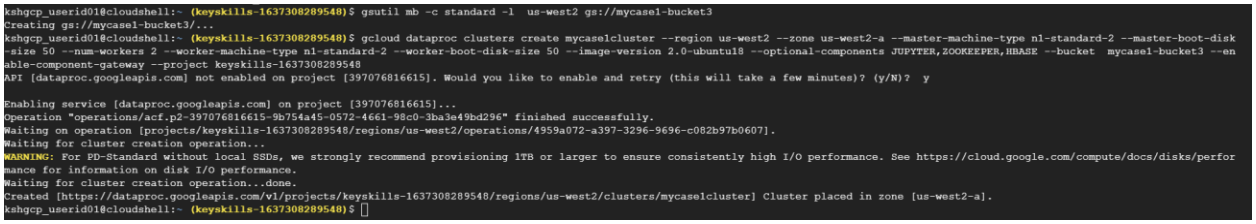
Bucket creation using CLI:

- gsutil mb -c standard -l us-west2 gs://mycase1-bucket3

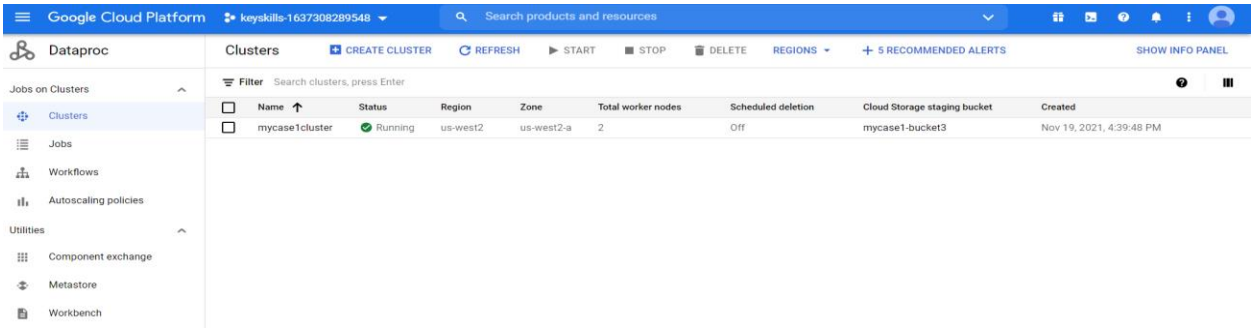


Cluster creation using CLI:

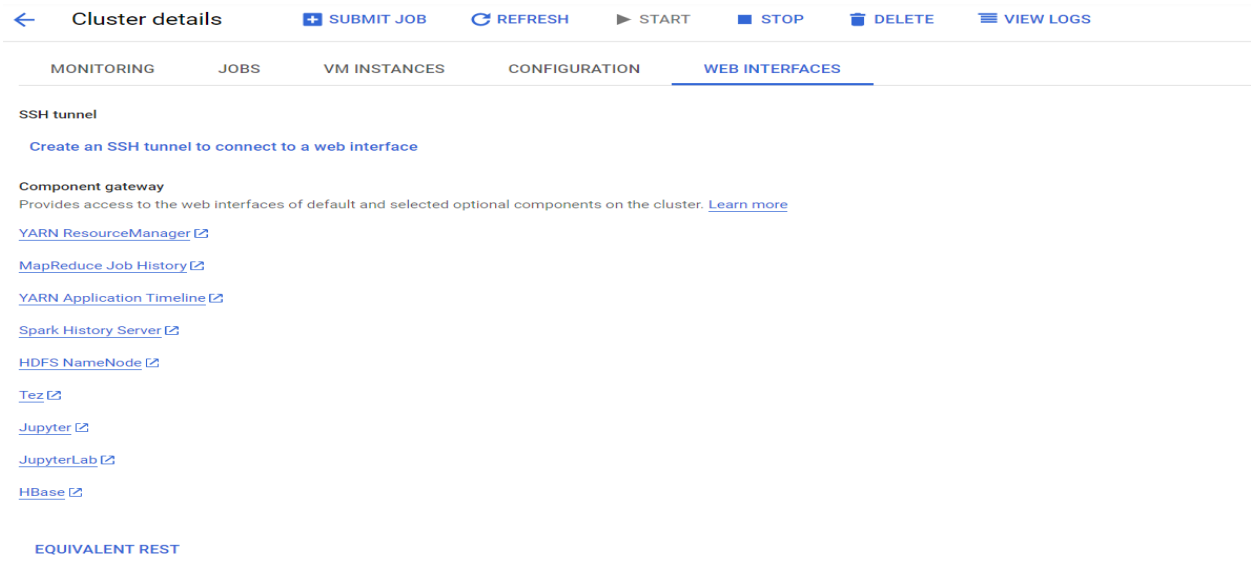
- gcloud dataproc clusters create mycase1cluster --region us-west2 --zone us-west2-a --master-machine-type n1-standard-2 --master-boot-disk-size 50 --num-workers 2 --worker-machine-type n1-standard-2 --worker-boot-disk-size 50 --image-version 2.0-ubuntu18 --optional-components JUPYTER,ZOOKEEPER,HBASE --bucket mycase1-bucket3 --enable-component-gateway --project keyskills-1637308289548



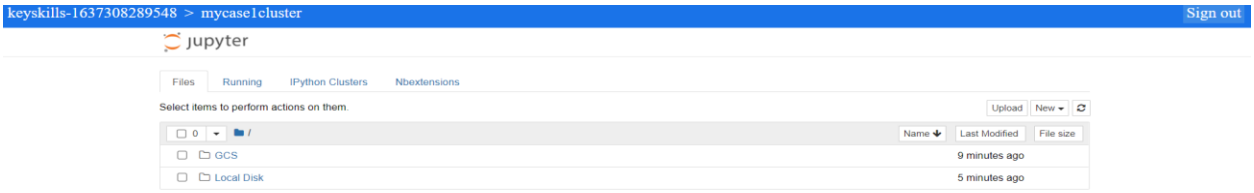
Cluster Created Using Dataproc



Cluster has all the web interfaces we opted

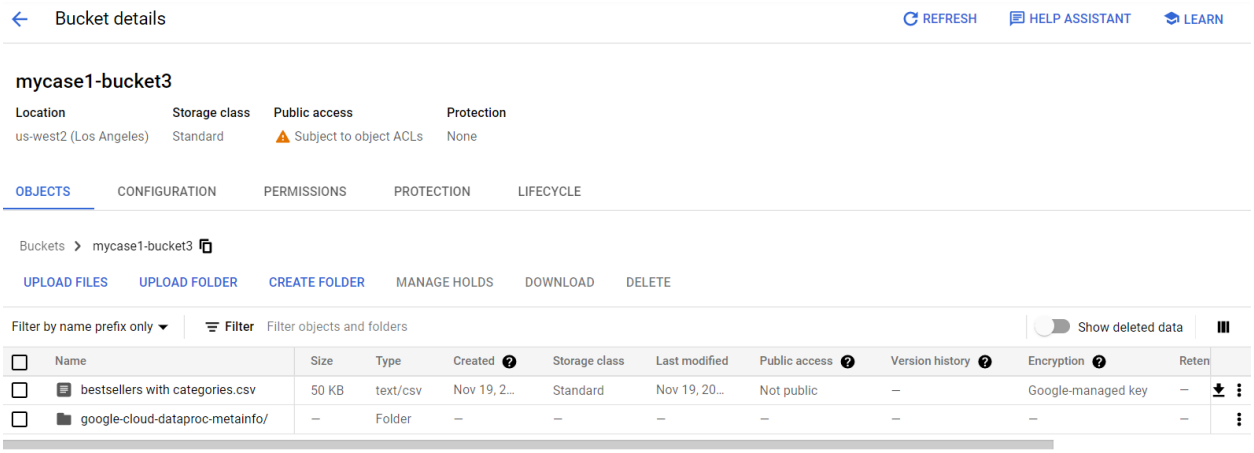


Click on Jupyter



Click on GCS and Select Pyspark

Upload the kaggle data set into the GCS bucket and copy its path



Upload the csv and perform data cleaning i.e replace the commas in the Name column with semicolons:

- import pyspark
- from pyspark.sql import SparkSession
- spark = SparkSession.builder.appName('temp').getOrCreate()
- df = spark.read.csv("gs://mycase1-bucket3/bestsellers with categories.csv", header=True, inferSchema = True)
- df.show(truncate=False)

File Edit View Insert Cell Kernel Widgets Help Trusted PySpark

In [1]:
```
import pyspark
from pyspark.sql import SparkSession
spark = SparkSession.builder.appName('temp').getOrCreate()
df = spark.read.csv("gs://mycase1-bucket3/bestsellers with categories.csv", header=True, inferSchema = True)
df.show(truncate=False)
```

```
+--------------------------------------------------------------------------------------------------------------------------------+--------
------------------+-----------+-------+-----+----+-----------+
|Name                                                                                                                            |Author
|User Rating|Reviews|Price|Year|Genre      |
+--------------------------------------------------------------------------------------------------------------------------------+--------
------------------+-----------+-------+-----+----+-----------+
|10-Day Green Smoothie Cleanse                                                                                                   |JJ Smith
|4.7        |17350  |8    |2016|Non Fiction|
|11/22/63: A Novel                                                                                                               |Stephen
King               |4.6        |2052   |22   |2011|Fiction    |
|12 Rules for Life: An Antidote to Chaos                                                                                         |Jordan
B. Peterson        |4.7        |18979  |15   |2018|Non Fiction|
|1984 (Signet Classics)                                                                                                          |George O
rwell              |4.7        |21424  |6    |2017|Fiction    |
|5,000 Awesome Facts (About Everything!) (National Geographic Kids)                                                              |National
Geographic Kids    |4.8        |7665   |12   |2019|Non Fiction|
|A Dance with Dragons (A Song of Ice and Fire)                                                                                   |George
R. R. Martin       |4.4        |12643  |11   |2011|Fiction    |
|A Game of Thrones / A Clash of Kings / A Storm of Swords / A Feast of Crows / A Dance with Dragons                              |George
R. R. Martin       |4.7        |19735  |30   |2014|Fiction    |
|A Gentleman in Moscow: A Novel                                                                                                  |Amor Tow
les                |4.7        |19699  |15   |2017|Fiction    |
|A Higher Loyalty: Truth, Lies, and Leadership                                                                                   |James Co
mey                |4.7        |5983   |3    |2018|Non Fiction|
|A Man Called Ove: A Novel                                                                                                       |Fredrik
Backman            |4.6        |23848  |8    |2016|Fiction    |
|A Man Called Ove: A Novel                                                                                                       |Fredrik
Backman            |4.6        |23848  |8    |2017|Fiction    |
|A Patriot's History of the United States: From Columbus's Great Discovery to the War on Terror                                  |Larry Sc
hweikart           |4.6        |460    |2    |2010|Non Fiction|
|A Stolen Life: A Memoir                                                                                                         |Jaycee D
ugard              |4.6        |4149   |32   |2011|Non Fiction|
|A Wrinkle in Time (Time Quintet)                                                                                                |Madelein
e L'Engle          |4.5        |5153   |5    |2018|Fiction    |
|Act Like a Lady, Think Like a Man: What Men Really Think About Love, Relationships, Intimacy, and Commitment                   |Steve Ha
```

- from pyspark.sql.functions import translate

- df = df.withColumn('Name', translate('Name', ',', ';'))
- df.show(truncate=False)

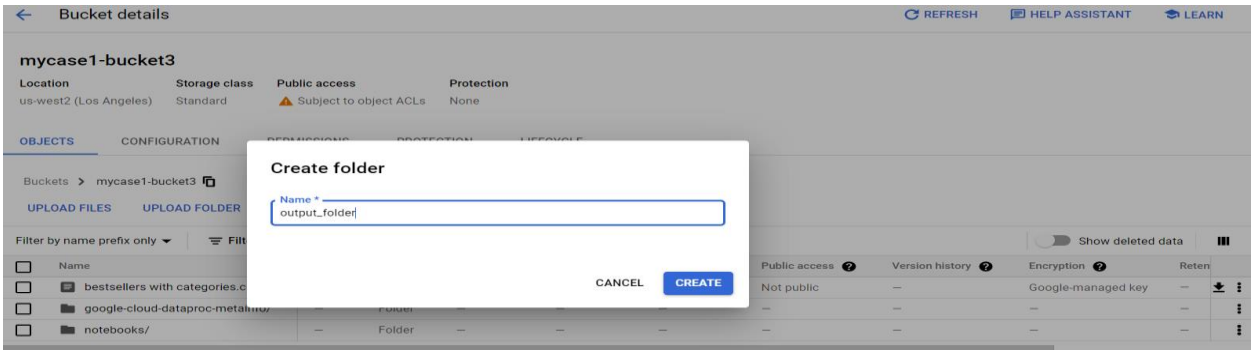
File Edit View Insert Cell Kernel Widgets Help Trusted PySpark

In [2]:
```
from pyspark.sql.functions import translate
df = df.withColumn('Name', translate('Name', ',', ';'))
df.show(truncate=False)
```

```
+--------------------------------------------------------------------------------------------------------------------------------+--------
------------------+-----------+-------+-----+----+-----------+
|Name                                                                                                                            |Author
|User Rating|Reviews|Price|Year|Genre      |
+--------------------------------------------------------------------------------------------------------------------------------+--------
------------------+-----------+-------+-----+----+-----------+
|10-Day Green Smoothie Cleanse                                                                                                   |JJ Smith
|4.7        |17350  |8    |2016|Non Fiction|
|11/22/63: A Novel                                                                                                               |Stephen
King               |4.6        |2052   |22   |2011|Fiction    |
|12 Rules for Life: An Antidote to Chaos                                                                                         |Jordan
B. Peterson        |4.7        |18979  |15   |2018|Non Fiction|
|1984 (Signet Classics)                                                                                                          |George O
rwell              |4.7        |21424  |6    |2017|Fiction    |
|5;000 Awesome Facts (About Everything!) (National Geographic Kids)                                                              |National
Geographic Kids   |4.8        |7665   |12   |2019|Non Fiction|
|A Dance with Dragons (A Song of Ice and Fire)                                                                                   |George
R. R. Martin       |4.4        |12643  |11   |2011|Fiction    |
|A Game of Thrones / A Clash of Kings / A Storm of Swords / A Feast of Crows / A Dance with Dragons                              |George
R. R. Martin       |4.7        |19735  |30   |2014|Fiction    |
|A Gentleman in Moscow: A Novel                                                                                                  |Amor Tow
les                |4.7        |19699  |15   |2017|Fiction    |
|A Higher Loyalty: Truth; Lies; and Leadership                                                                                   |James Co
mey                |4.7        |5983   |3    |2018|Non Fiction|
|A Man Called Ove: A Novel                                                                                                       |Fredrik
Backman            |4.6        |23848  |8    |2016|Fiction    |
|A Man Called Ove: A Novel                                                                                                       |Fredrik
Backman            |4.6        |23848  |8    |2017|Fiction    |
|A Patriot's History of the United States: From Columbus's Great Discovery to the War on Terror                                  |Larry Sc
hweikart           |4.6        |460    |2    |2010|Non Fiction|
|A Stolen Life: A Memoir                                                                                                         |Jaycee D
ugard              |4.6        |4149   |32   |2011|Non Fiction|
|A Wrinkle in Time (Time Quintet)                                                                                                |Madelein
e L'Engle          |4.5        |5153   |5    |2018|Fiction    |
|Act Like a Lady; Think Like a Man: What Men Really Think About Love; Relationships; Intimacy; and Commitment                   |Steve Ha
rvey               |4.6        |5013   |17   |2009|Non Fiction|
|Adult Coloring Book Designs: Stress Relief Coloring Book: Garden Designs; Mandalas; Animals; and Paisley Patterns               |Adult Co
loring Book Designs|4.5        |2313   |4    |2016|Non Fiction|
```

1. Finding average of user ratings for Genre = Fiction and saving the file in output_folder :

- df_fiction = df.filter("Genre == 'Fiction'")
- df_fiction.show(10)
- fiction_avg = df_fiction.agg({'User Rating': 'avg'})
- fiction_avg.show()
- fiction_avg.write.save("gs://mycase1-bucket3/output_folder/fiction_avg.csv", format = 'csv', header = True)



```
In [3]: df_fiction = df.filter("Genre == 'Fiction'")
        df_fiction.show(10)
        fiction_avg = df_fiction.agg({'User Rating': 'avg'})
        fiction_avg.show()
        fiction_avg.write.save("gs://mycase1-bucket3/output_folder/fiction_avg.csv", format = 'csv', header = True)
```

```
+--------------------+--------------------+-----------+-------+-----+----+-------+
|                Name|              Author|User Rating|Reviews|Price|Year|  Genre|
+--------------------+--------------------+-----------+-------+-----+----+-------+
|   11/22/63: A Novel|       Stephen King|        4.6|   2052|   22|2011|Fiction|
|1984 (Signet Clas...|      George Orwell|        4.7|  21424|    6|2017|Fiction|
|A Dance with Drag...|George R. R. Martin|        4.4|  12643|   11|2011|Fiction|
|A Game of Thrones...|George R. R. Martin|        4.7|  19735|   30|2014|Fiction|
|A Gentleman in Mo...|        Amor Towles|        4.7|  19699|   15|2017|Fiction|
|A Man Called Ove:...|    Fredrik Backman|        4.6|  23848|    8|2016|Fiction|
|A Man Called Ove:...|    Fredrik Backman|        4.6|  23848|    8|2017|Fiction|
|A Wrinkle in Time...|  Madeleine L'Engle|        4.5|   5153|    5|2018|Fiction|
|All the Light We ...|      Anthony Doerr|        4.6|  36348|   14|2014|Fiction|
|All the Light We ...|      Anthony Doerr|        4.6|  36348|   14|2015|Fiction|
+--------------------+--------------------+-----------+-------+-----+----+-------+
only showing top 10 rows

+-----------------+
| avg(User Rating)|
+-----------------+
|4.648333333333326|
+-----------------+
```

2. Finding average of user ratings for Genre =Non Fiction and saving the file in output_folder :

   - df_non_fiction = df.filter("Genre == 'Non Fiction'")
   - df_non_fiction.show(10)
   - non_fiction_avg = df_non_fiction.agg({'User Rating': 'avg'})
   - non_fiction_avg.show()
   - non_fiction_avg.write.save("gs://mycase1-bucket3/output_folder/non_fiction_avg.csv", format = 'csv', header = True)

```
In [4]: df_non_fiction = df.filter("Genre == 'Non Fiction'")
        df_non_fiction.show(10)
        non_fiction_avg = df_non_fiction.agg({'User Rating': 'avg'})
        non_fiction_avg.show()
        non_fiction_avg.write.save("gs://mycase1-bucket3/output_folder/non_fiction_avg.csv", format = 'csv', header = True)
```

```
+--------------------+--------------------+-----------+-------+-----+----+-----------+
|                Name|              Author|User Rating|Reviews|Price|Year|      Genre|
+--------------------+--------------------+-----------+-------+-----+----+-----------+
|10-Day Green Smoo...|           JJ Smith|        4.7|  17350|    8|2016|Non Fiction|
|12 Rules for Life...|  Jordan B. Peterson|        4.7|  18979|   15|2018|Non Fiction|
|5;000 Awesome Fac...|National Geograph...|        4.8|   7665|   12|2019|Non Fiction|
|A Higher Loyalty:...|         James Comey|        4.7|   5983|    3|2018|Non Fiction|
|A Patriot's Histo...|    Larry Schweikart|        4.6|    460|    2|2010|Non Fiction|
|A Stolen Life: A ...|       Jaycee Dugard|        4.6|   4149|   32|2011|Non Fiction|
|Act Like a Lady; ...|        Steve Harvey|        4.6|   5013|   17|2009|Non Fiction|
|Adult Coloring Bo...|Adult Coloring Bo...|        4.5|   2313|    4|2016|Non Fiction|
|Adult Coloring Bo...|  Blue Star Coloring|        4.6|   2925|    6|2015|Non Fiction|
|Adult Coloring Bo...|  Blue Star Coloring|        4.4|   2951|    6|2015|Non Fiction|
+--------------------+--------------------+-----------+-------+-----+----+-----------+
only showing top 10 rows

+-----------------+
| avg(User Rating)|
+-----------------+
|4.595161290322579|
+-----------------+
```

Finding average of user ratings for all the books and saving the file in output_folder :

- avg_of_all = df.agg({'User Rating': 'avg'})

- avg_of_all.show()
- avg_of_all.write.save("gs://mycase1-bucket3/output_folder/avg_of_all.csv", format = 'csv', header = True)

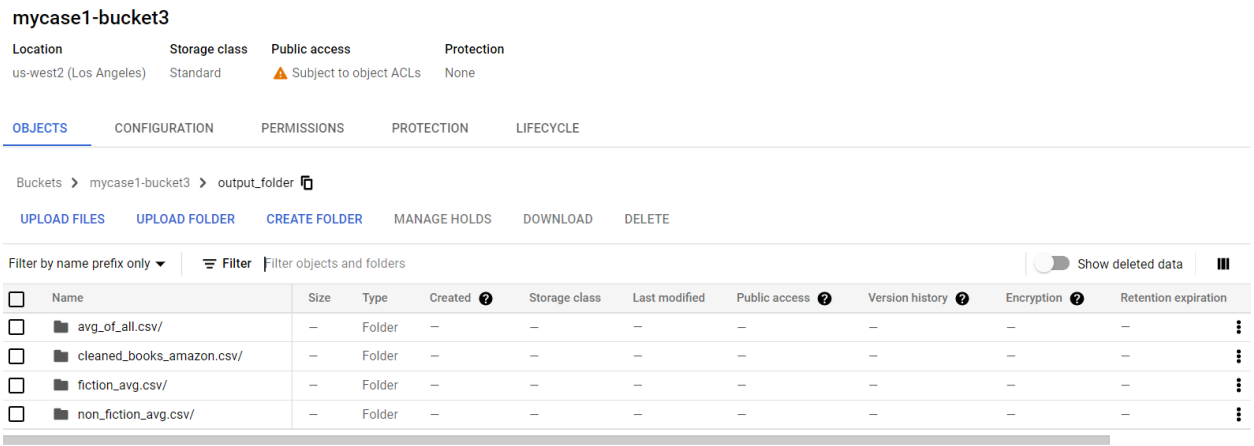
```
In [5]: avg_of_all = df.agg({'User Rating': 'avg'})
        avg_of_all.show()
        avg_of_all.write.save("gs://mycase1-bucket3/output_folder/avg_of_all.csv", format = 'csv', header = True)

+-----------------+
| avg(User Rating)|
+-----------------+
|4.618363636363641|
+-----------------+
```

3. Sorting the last 5 books in alphabetical order and printing the output:

    - df.orderBy(df.Name.desc()).limit(5).show()
    - df.write.csv('gs://mycase1-bucket3/output_folder/cleaned_books_amazon.csv')

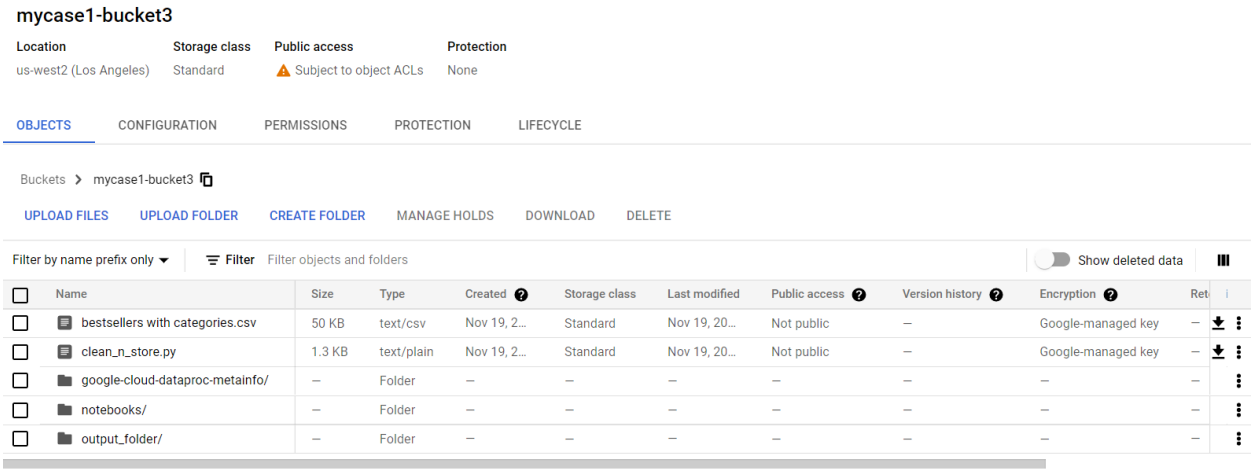
```
In [6]: df.orderBy(df.Name.desc()).limit(5).show()
        df.write.csv('gs://mycase1-bucket3/output_folder/cleaned_books_amazon.csv')

+--------------------+-----------+-----------+-------+-----+----+-----------+
|                Name|     Author|User Rating|Reviews|Price|Year|      Genre|
+--------------------+-----------+-----------+-------+-----+----+-----------+
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2018|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2016|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2017|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2019|Non Fiction|
|Wrecking Ball (Di...|Jeff Kinney|        4.9|   9413|    8|2019|    Fiction|
+--------------------+-----------+-----------+-------+-----+----+-----------+
```

Output folder with all the output files:



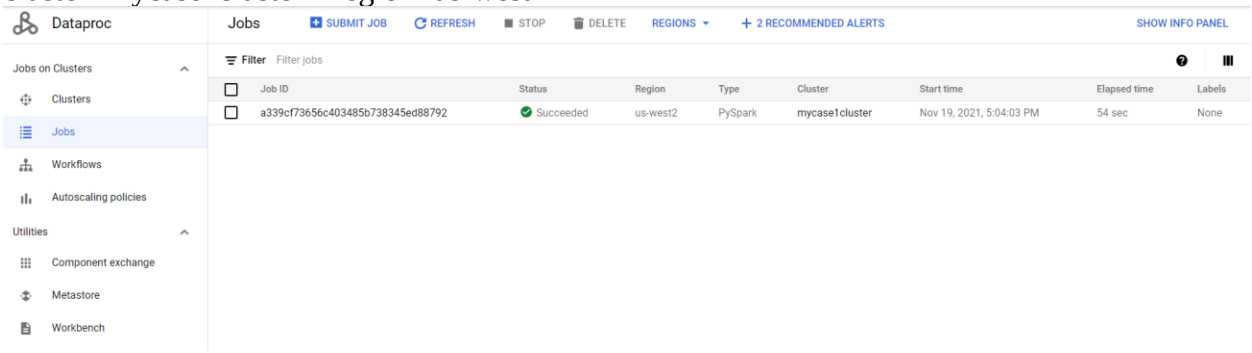
Job Running:

Save the Pyspark notebook file as clean_n_store.py and upload it in the mycase1-bucket3 bucket.



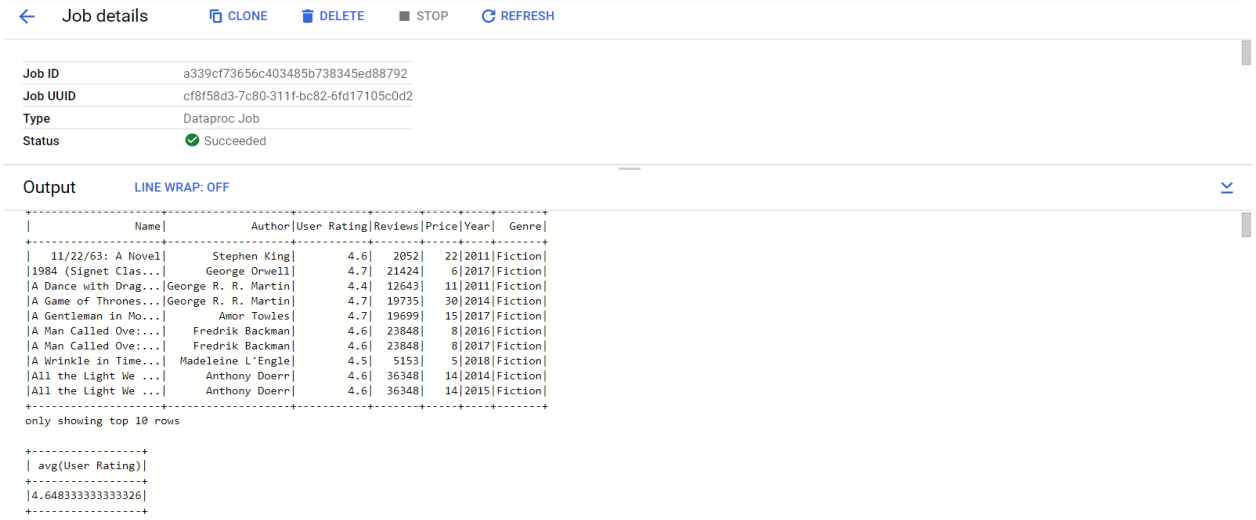
Running CLI command for Dataproc job:

- gcloud dataproc jobs submit pyspark gs://mycase1-bucket3/clean_n_store.py --cluster=mycase1cluster --region=us-west2



Outputs obtained from Dataproc job:

Average of Fiction:



Average of Non-Fiction:

Output LINE WRAP: OFF

```
+--------------------+--------------------+-----------+-------+-----+----+-----------+
|                Name|              Author|User Rating|Reviews|Price|Year|      Genre|
+--------------------+--------------------+-----------+-------+-----+----+-----------+
|10-Day Green Smoo...|           JJ Smith|        4.7|  17350|    8|2016|Non Fiction|
|12 Rules for Life...|  Jordan B. Peterson|        4.7|  18979|   15|2018|Non Fiction|
|5;000 Awesome Fac...|National Geograph...|        4.8|   7665|   12|2019|Non Fiction|
|A Higher Loyalty:...|        James Comey|        4.7|   5983|    3|2018|Non Fiction|
|A Patriot's Histo...|    Larry Schweikart|        4.6|    460|    2|2010|Non Fiction|
|A Stolen Life: A ...|       Jaycee Dugard|        4.6|   4149|   32|2011|Non Fiction|
|Act Like a Lady; ...|        Steve Harvey|        4.6|   5013|   17|2009|Non Fiction|
|Adult Coloring Bo...|Adult Coloring Bo...|        4.5|   2313|    4|2016|Non Fiction|
|Adult Coloring Bo...|  Blue Star Coloring|        4.6|   2925|    6|2015|Non Fiction|
|Adult Coloring Bo...|  Blue Star Coloring|        4.4|   2951|    6|2015|Non Fiction|
+--------------------+--------------------+-----------+-------+-----+----+-----------+
only showing top 10 rows

+-----------------+
| avg(User Rating)|
+-----------------+
|4.595161290322579|
+-----------------+
```

Average of all:

Output LINE WRAP: OFF

```
21/11/19 11:34:48 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageFileSystem: Successfully repaired 'gs://mycase1-bucket3/output_folder/non_fict
+-----------------+
| avg(User Rating)|
+-----------------+
|4.618363636363641|
+-----------------+

21/11/19 11:34:51 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageFileSystem: Successfully repaired 'gs://mycase1-bucket3/output_folder/avg_of_a
+--------------------+----------+-----------+-------+-----+----+-----------+
|                Name|    Author|User Rating|Reviews|Price|Year|      Genre|
+--------------------+----------+-----------+-------+-----+----+-----------+
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2018|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2016|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2017|Non Fiction|
|You Are a Badass:...|Jen Sincero|        4.7|  14331|    8|2019|Non Fiction|
|Wrecking Ball (Di...|Jeff Kinney|        4.9|   9413|    8|2019|    Fiction|
+--------------------+----------+-----------+-------+-----+----+-----------+

21/11/19 11:34:55 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageFileSystem: Successfully repaired 'gs://mycase1-bucket3/output_folder/cleaned_
21/11/19 11:34:55 INFO org.sparkproject.jetty.server.AbstractConnector: Stopped Spark@3fee8cd1{HTTP/1.1, (http/1.1)}{0.0.0.0:0}
```

Output files in the output folder:

mycase1-bucket3

Location	Storage class	Public access	Protection
us-west2 (Los Angeles)	Standard	Subject to object ACLs	None

OBJECTS CONFIGURATION PERMISSIONS PROTECTION LIFECYCLE

Buckets > mycase1-bucket3 > output_folder

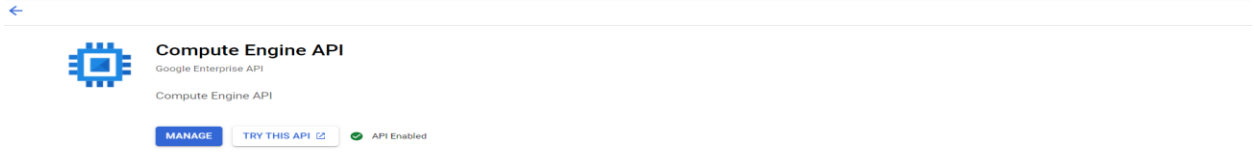
UPLOAD FILES UPLOAD FOLDER CREATE FOLDER MANAGE HOLDS DOWNLOAD DELETE

Filter by name prefix only | Filter | Filter objects and folders | Show deleted data

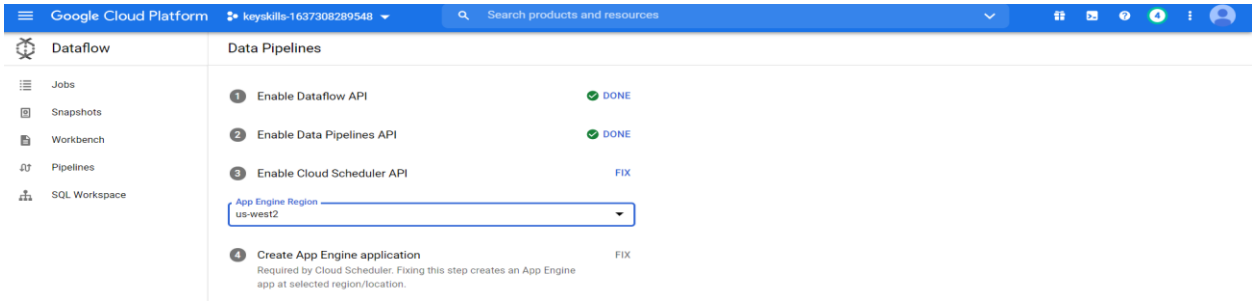
Name	Size	Type	Created	Storage class	Last modified	Public access	Version history	Encryption	Retention expiration
avg_of_all.csv/	–	Folder	–	–	–	–	–	–	–
avg_of_all.csv2/	–	Folder	–	–	–	–	–	–	–
cleaned_books_amazon.csv/	–	Folder	–	–	–	–	–	–	–
cleaned_books_amazon2.csv/	–	Folder	–	–	–	–	–	–	–
fiction_avg.csv/	–	Folder	–	–	–	–	–	–	–
fiction_avg2.csv/	–	Folder	–	–	–	–	–	–	–
non_fiction_avg.csv/	–	Folder	–	–	–	–	–	–	–
non_fiction_avg2.csv/	–	Folder	–	–	–	–	–	–	–

Create/Configure a pipeline:

Enable the compute engine API:

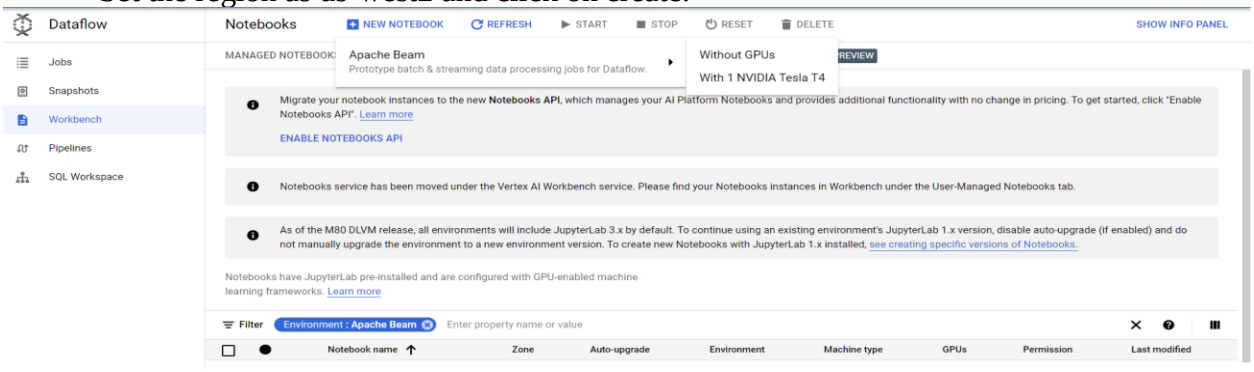


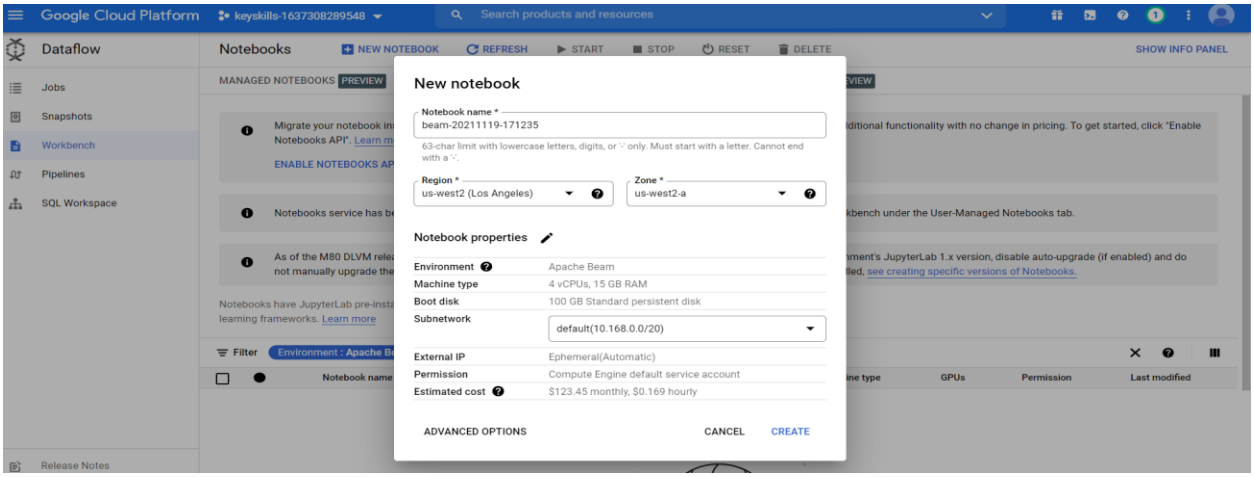
Enable the Dataflow API:



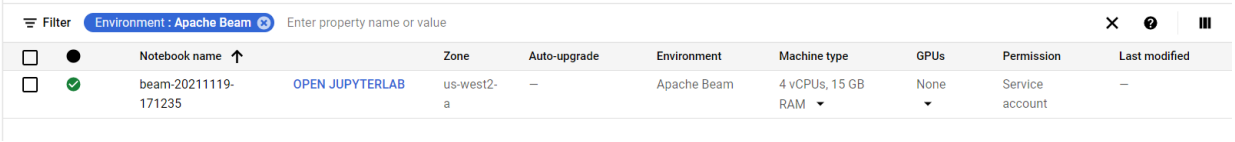
Configuring the Data Pipeline:

- Go to dataflow, click on workbench.
- Click on new notebook →Apache Beam →Without GPUs.
- Set the region as us-west2 and click on create.



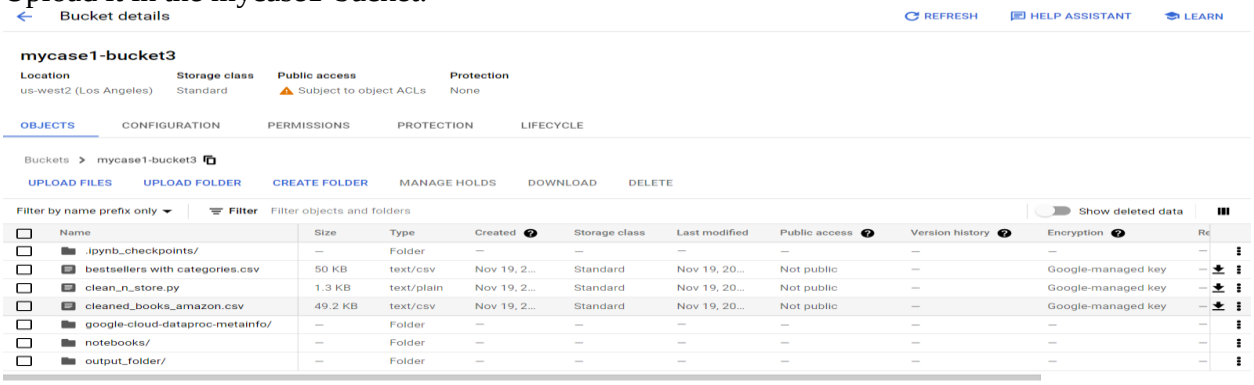


Click on open Jupyter lab:

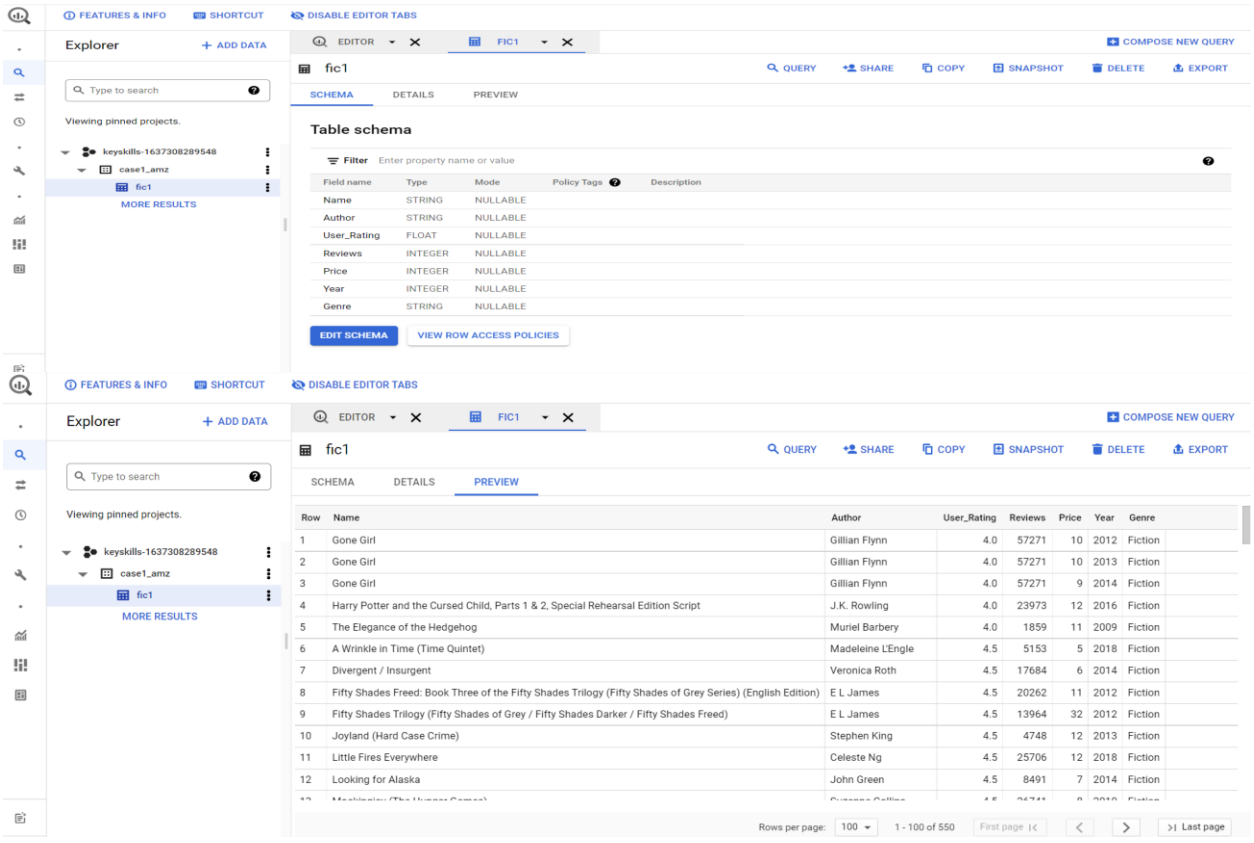


Before running the pipeline code we need to create a BigQuery view of the given dataset.

- Download the cleaned dataset file obtained in the output_folder after running the PySpark commands in notebook.
- Upload it in the mycase1-bucket.



- Go to BigQuery and create a dataset with dataset id case1_amz.
- Create table view for bestsellers with categories.csv file. Here the table name is set at fic1.



- Create a output bucket to store the outputs by name case_output_bucket1.

Run the pipeline code in jupyter lab:

```
from __future__ import absolute_import

import argparse

import logging

import re

import apache_beam as beam

from apache_beam.options.pipeline_options import PipelineOptions

import os

import google.auth

from apache_beam.options import pipeline_options

from apache_beam.options.pipeline_options import GoogleCloudOptions

from apache_beam.runners import DataflowRunner

from google.cloud import bigquery


def Split(element):

    return element.split(",")

#outputs text in a readable format

def FormatText(elem):

    return 'AVERAGE RATING OF BOOKS:'+str(elem[1])

#finds the average of given list of sets

class AverageFn(beam.CombineFn):

    def create_accumulator(self):

        return (0.0, 0)   # initialize (sum, count)

    def add_input(self, sum_count, inputt):
```

```
        (summ, count) = sum_count

        (summ2, c2) = inputt

        return summ + float(summ2)*c2, count + c2

options = PipelineOptions()

#p = beam.Pipeline(options=options)

p = beam.Pipeline(InteractiveRunner())

p2 = beam.Pipeline(InteractiveRunner())

# Setting up the Apache Beam pipeline options.

options = pipeline_options.PipelineOptions(flags=[])

# Sets the project to the default project in your current Google Cloud environment.

_, options.view_as(GoogleCloudOptions).project = google.auth.default()

# Sets the Google Cloud Region in which Cloud Dataflow runs.

options.view_as(GoogleCloudOptions).region = 'us-west2'

dataflow_gcs_location = 'gs://case_output_bucket1/dataflow'

options.view_as(GoogleCloudOptions).staging_location = '%s/staging' % dataflow_gcs_location

# Dataflow Temp Location. This location is used to store temporary files or intermediate results before finally outputting to the sink.

options.view_as(GoogleCloudOptions).temp_location = '%s/temp' % dataflow_gcs_location

client = bigquery.Client()

dataset_id = "keyskills-1637308289548.case1_amz"

#dataset = bigquery.Dataset(dataset_id)

dataset.location = "us-west2"

dataset.description = "dataset books"

#dataset_ref = client.create_dataset(dataset, timeout = 30)

# split and Convert to json

def to_json(csv_str):

    fields = csv_str.split(',')
```

```
    json_str = {"Name":fields[0],
                "Author": fields[1],
                "User_Rating": fields[2],
                "Reviews": fields[3],
                "Price": fields[4],
                "Year": fields[5],
                "Genre": fields[6]
                }
    return json_str

table_schema =
'Name:STRING,Author:STRING,User_Rating:FLOAT,Reviews:INTEGER,Price:Integer,Year:Integer,Genre:STRING'

bs = (p2 | beam.io.ReadFromText("gs://mycase1-bucket3/cleaned_books_amazon.csv"))

(bs | 'cleaned_data to json' >> beam.Map(to_json)

| 'write to bigquery' >> beam.io.WriteToBigQuery(

"keyskills-1637308289548:case1_amz.fic1",

schema=table_schema,

create_disposition=beam.io.BigQueryDisposition.CREATE_IF_NEEDED,

write_disposition=beam.io.BigQueryDisposition.WRITE_APPEND,

custom_gcs_temp_location="gs://case_output_bucket1/dataflow/temp"

) )

from apache_beam.runners.runner import PipelineState

ret = p2.run()

if ret.state == PipelineState.DONE:

    print('Success!!!')

else:

    print('Error Running beam pipeline')

#read data and split based on ‘,’
```

```
books = ( p | beam.io.ReadFromText("gs://mycase1-bucket3/cleaned_books_amazon.csv") | beam.Map(Split) )

#Filter records having fiction , map each rating as a set (rating,1), use combineperkey to count the number of each rating, run the average function, write result to Fiction_avg

res1 = (

   books

   | beam.Filter(lambda rec : rec[6]=="Fiction")

   | beam.Map(lambda rec: (rec[2], 1))

   | "Grouping keys" >> beam.CombinePerKey(sum)

   | "Combine Globally" >> beam.CombineGlobally(AverageFn())

   | "write" >> beam.io.WriteToText("gs://case_output_bucket1/Fiction_avg") )

#Filter records having Non Fiction , map each rating as a set (rating,1), use combineperkey to count the number of each rating, run the average function, write result to N_Fiction_avg

Res2 = (

   books

   | beam.Filter(lambda rec : rec[6]=="Non Fiction")

   | beam.Map(lambda rec: (rec[2], 1))

   | "Grouping keys" >> beam.CombinePerKey(sum)

   | "Combine Globally" >> beam.CombineGlobally(AverageFn())

   | "write" >> beam.io.WriteToText("gs://case_output_bucket1/N_Fiction_avg")

)

# map each rating as a set (rating,1), use combineperkey to count the number of each rating, run the average function, write result to All_avg

Res3 = (

   books

   | beam.Map(lambda rec: (rec[2], 1))

   | "Grouping keys" >> beam.CombinePerKey(sum)

   | "Combine Globally" >> beam.CombineGlobally(AverageFn())

   | "write" >> beam.io.WriteToText("gs://case_output_bucket1/All_avg") )
```

#map each record’s 0th column that is name with value 1 , run distinct function to get the distinct values of name, run top.of(5) to sort and get the last5 books alphabetically and store in storage bucket last5

f_res = (books | beam.Map(lambda rec: (rec[0], 1)) | beam.Distinct() | beam.combiners.Top.Of(5) | beam.io.WriteToText("gs://case_output_bucket1/Last_5_books"))

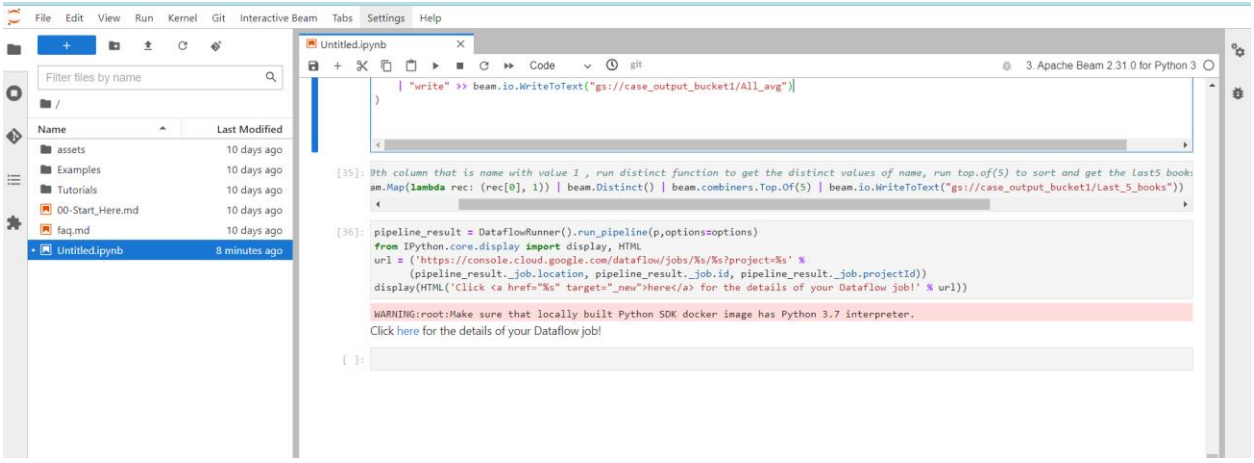
pipeline_result = DataflowRunner().run_pipeline(p,options=options)

from IPython.core.display import display, HTML

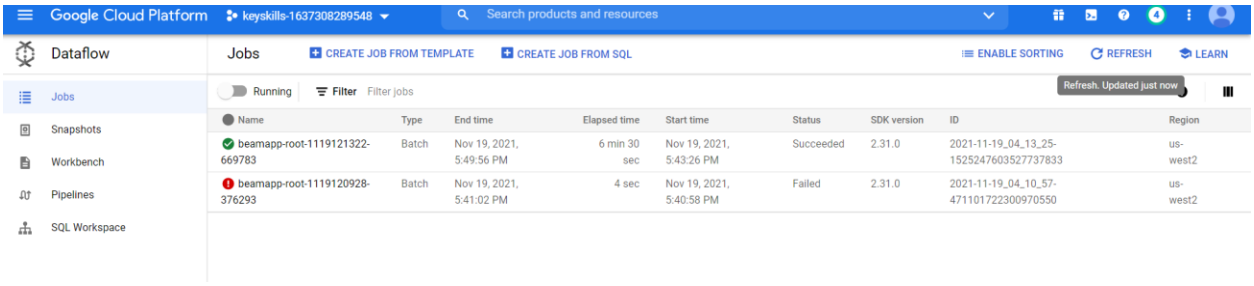
url = ('https://console.cloud.google.com/dataflow/jobs/%s/%s?project=%s' %

(pipeline_result._job.location, pipeline_result._job.id, pipeline_result._job.projectId))

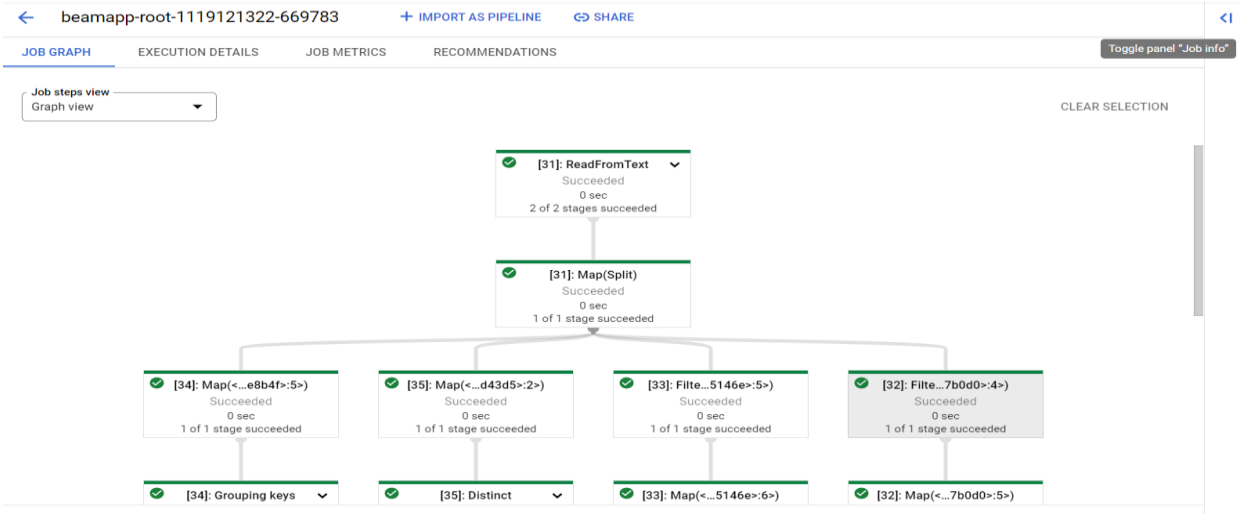
display(HTML('Click here for the details of your Dataflow job!' % url))

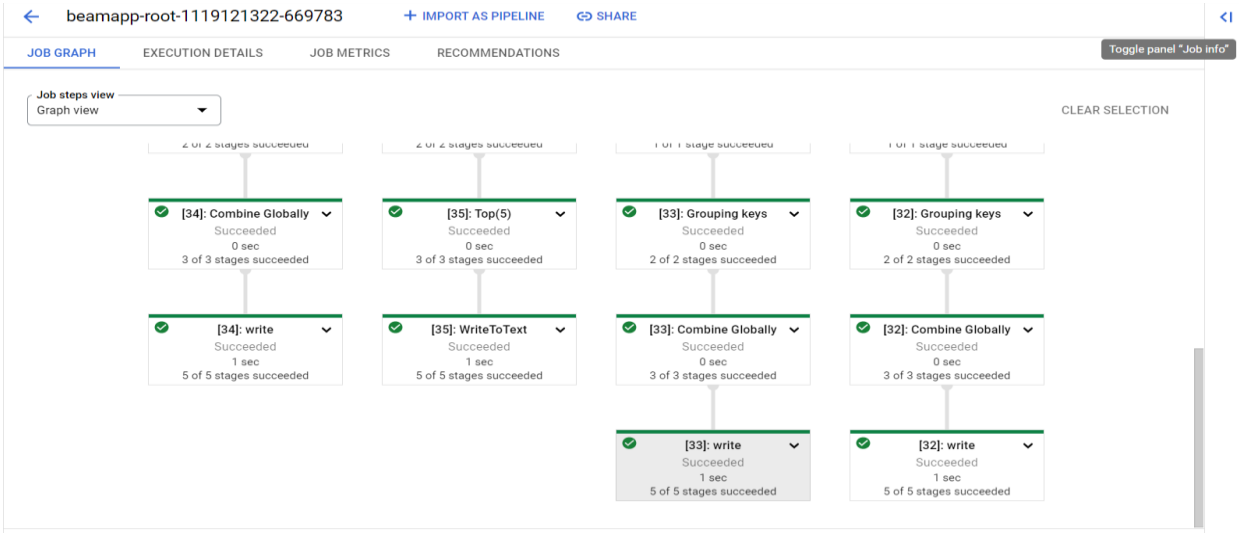


Dataflow job succeeded:

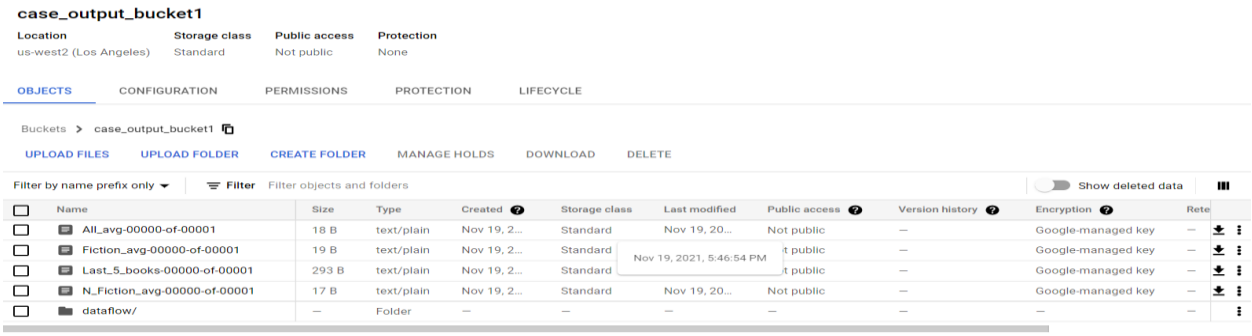


Below figures show the dataflow pipeline obtained after running the pipeline code in Apache beam for Python environment in Jupyter Lab.

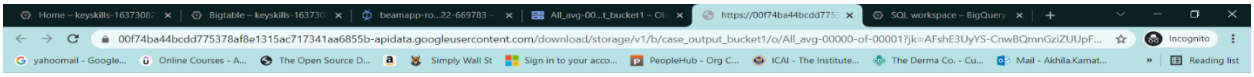




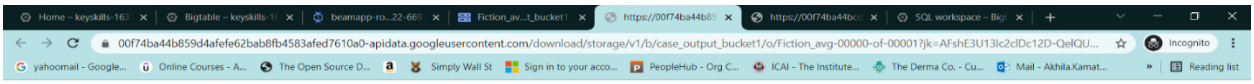
Output files obtained in the case_output_bucket1:



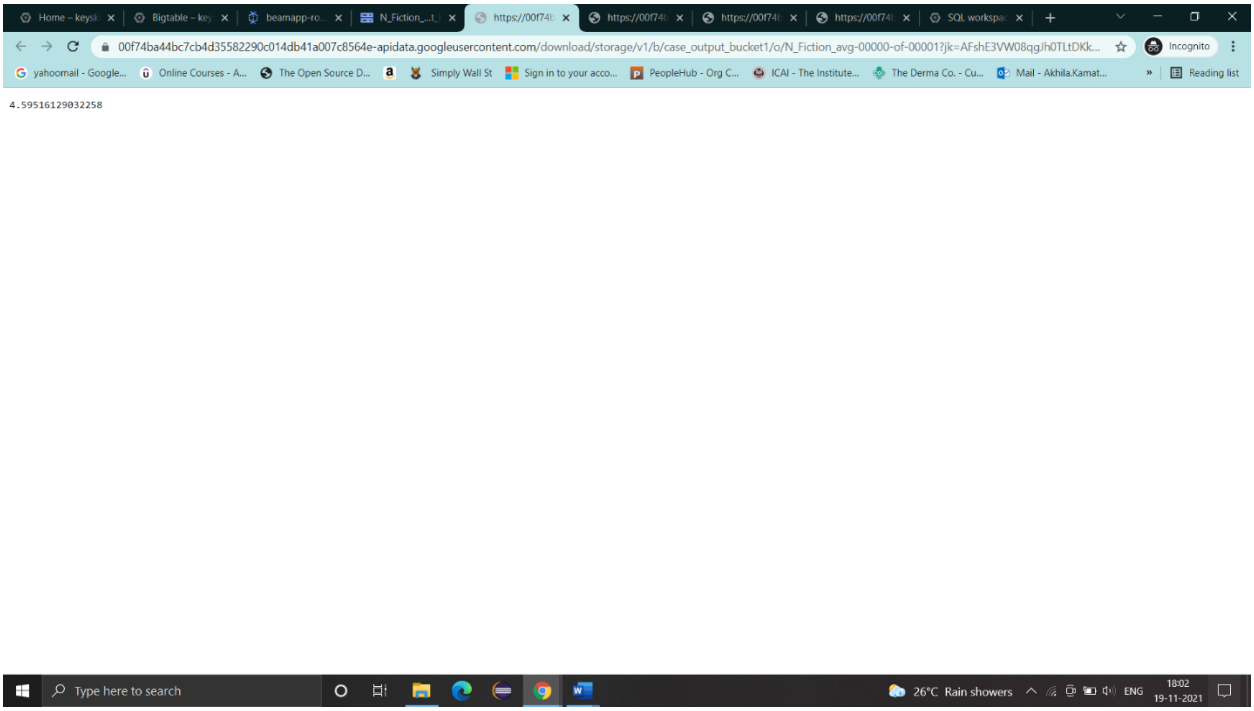
Average of all books :



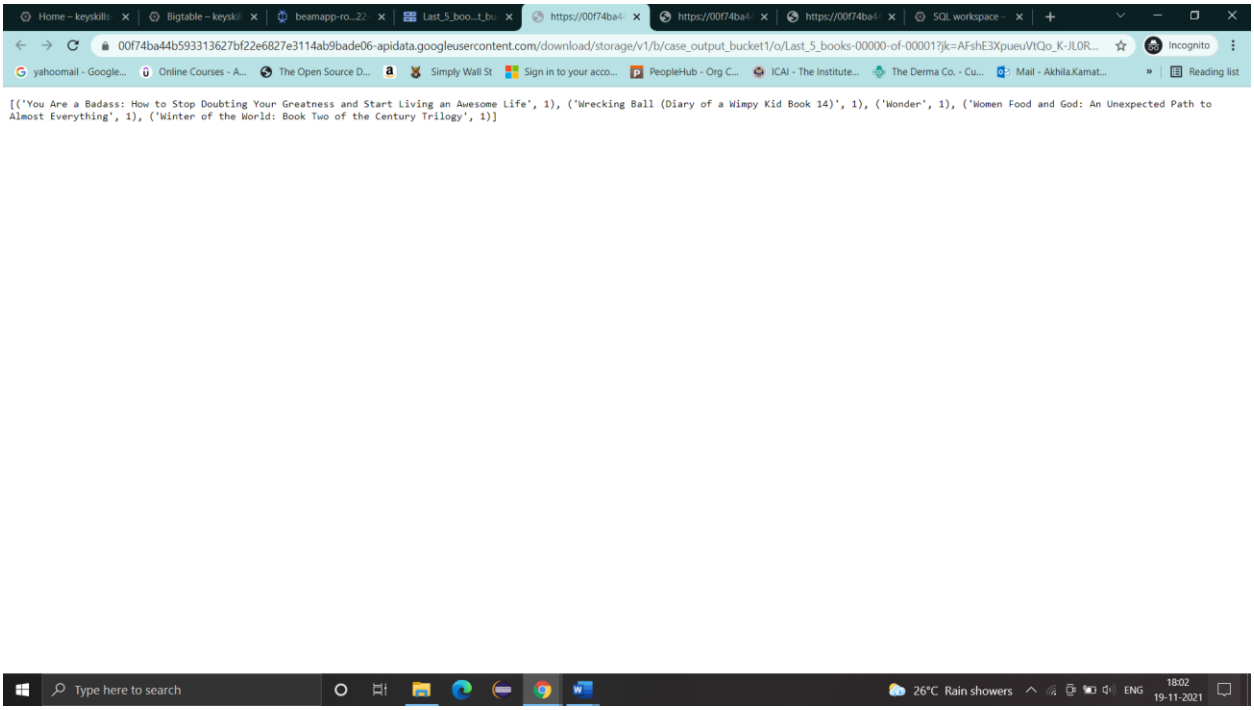
Average of Fiction Books:



Average of Non Fiction Books:



Last 5 Books:



Case study 2:

Big Data Analytics with Java using Cloud Dataproc, Google's Fully-Managed Spark and Hadoop Service, IBRD Statement Of Loans Data dataset, from Kaggle is used as input.

The International Bank for Reconstruction and Development (IBRD) loans are public and publicly guaranteed debt extended by the World Bank Group. IBRD loans are made to, or guaranteed by, countries that are members of IBRD. This dataset contains historical snapshots of the Statement of Loans including the latest available snapshots.

There are two data files available. The Statement of Loans latest available snapshots data file contains 8,713 rows of loan data (~3 MB), ideal for development and testing. The Statement of Loans historic data file contains approximately 750,000 rows of data (~265

MB). Although not exactly 'big data', the historic dataset is large enough to sufficiently explore Dataproc. Both IBRD files have an identical schema with 33 columns of data

PROBLEM STATEMENT:

For the analysis, one has to

1. Ascertain the top 25 historic IBRD borrower;
2. Determine their total disbursements, current obligations, and the average interest rates they were charged.
3. Output/Persist the results in asked target endpoints*

Implementation Steps –

- Note – To show the capabilities of Cloud Dataproc, one has to create a three-node cluster, upload Java- analytics jobs and data to Google Cloud Storage, and execute the jobs on the Spark cluster. One has use Stackdriver for monitoring and notifications for the Dataproc clusters and the jobs running on the clusters. [15% credits]
- One has to demonstrate the use of the Google Cloud Console, as well as Google's Cloud SDK's command line tools, for all tasks.[5% credits] Analysis has to be done using Spark's SQL capabilities. The results of the

analysis, a Spark DataFrame containing 25 Rows, will be saved as a CSV file then to be pushed to HBase [BigTable] for further processing and reporting [20% credits]

- One has to leverage Google Cloud Storage to load local Spark Jobs before submitting to DataProc for running in Cluster.
- Ensure we are using the dataproc clusters create command, to create the 3 node cluster using CLI. [10% Credits]
- Cluster details – The three node Linux cluster [a single master node and two worker nodes]. All three nodes use the n1-standard-4 machine type, with 4 vCPU and 15 GB of memory. Although still considered a minimally-sized cluster, this cluster represents a significant increase in compute power

1. Uploading Job Resources to Cloud Storage [10% credits]

In total, we need to upload four items to the new Cloud Storage bucket. The items include the two Kaggle IBRD CSV files, the compiled Java JAR file from the dataproc-java project, and any dataset needed to support the work. Using the Google Cloud Console, upload the four files to the new Google Storage bucket, as shown below. Make sure you unzip the two Kaggle IRBD CSV data files before uploading.

2. Running Jobs on Dataproc[15% credits]

The easiest way to run a job on the Dataproc cluster is by submitting a job through the Dataproc Jobs UI, part of the Google Cloud Console.

3. Spark Jobs [15% credits]

To run a Spark job using the JAR file, select Job type Spark. The Region will match your Dataproc cluster and bucket locations, us-east-1 in my case. You should have a choice of both clusters in your chosen region..

4. File Output [Most critical step to follow][10% credits]

During development and testing, outputting results to the console is useful. However, in Production, the output from jobs is most often written to Apache Avro, CSV, JSON, or XML format files, persisted Apache Hive, SQL, or NoSQL database, or streamed to another system for post-processing, using technologies such as Apache Kafka.

*Target endpoints - [one has to demonstrate usage of Apache Avro, JSON, Apache Hive[BigQuery], SQL or a NoSQL DB.]

Once the Java jobs have run successfully on the Dataproc cluster, you should observe the results have been saved back to the Storage bucket as a CSV file.

Engineering Best Practices to be followed [20% credits]

6. Logging has to be implemented in all the Java Components

7. Exception handling framework need to be implemented

8. Unit testing of each component/service using JUnit/Mokito Framework

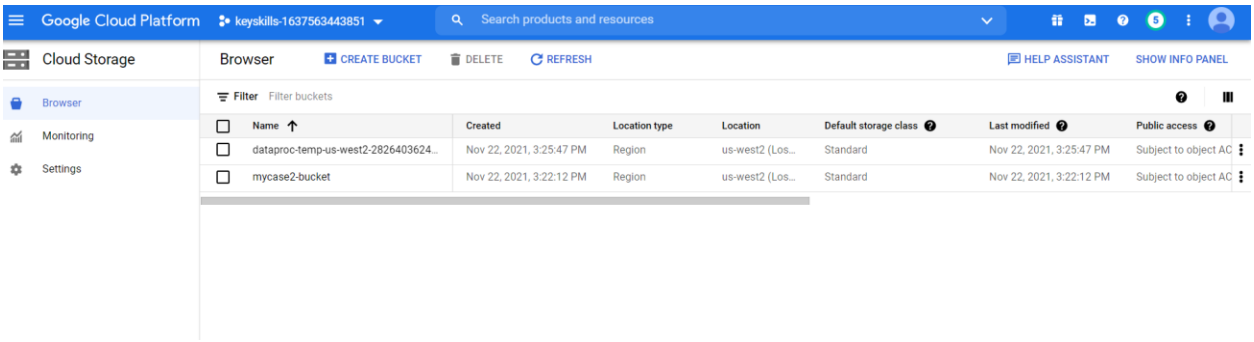
9. Unit Testing of Spark Cluster, Data Pipeline [is desirable]

10. Usage of 4 to 5 Big Data Design Patterns using Java [is desirable]

Answer:

Bucket creation using CLI:

- gsutil mb -c standard -l us-west2 gs://mycase2-bucket

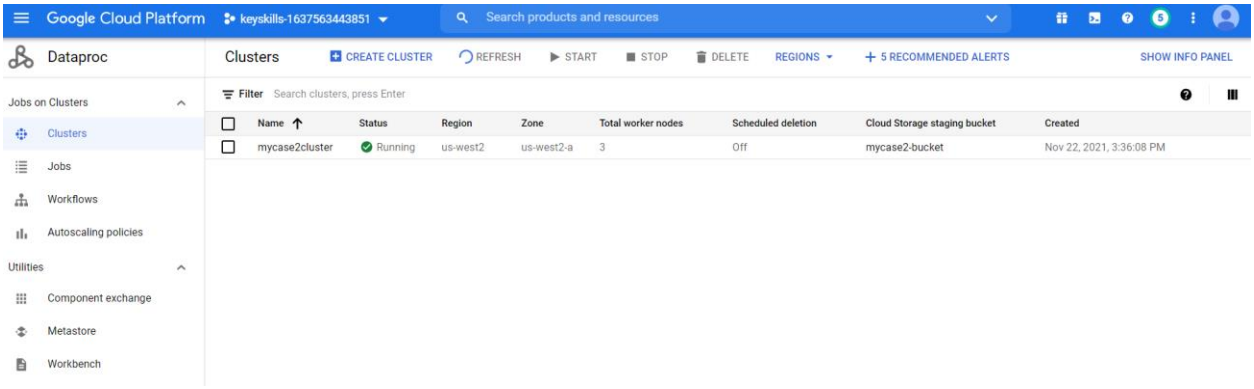


Cluster creation using CLI:

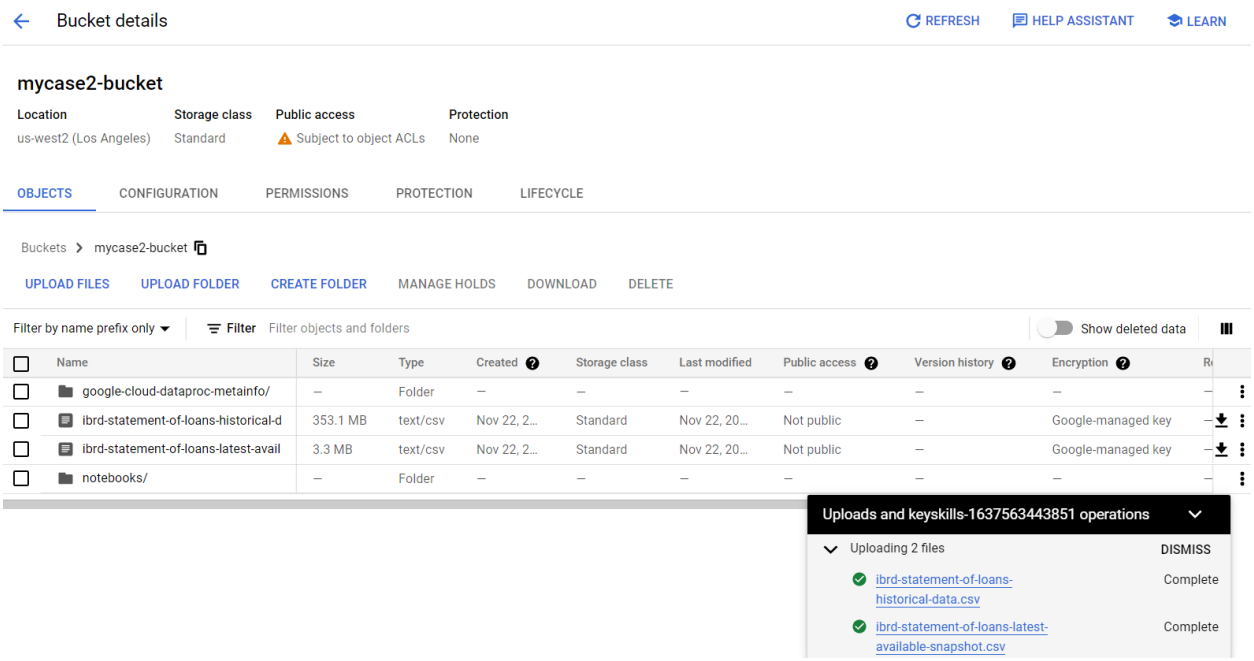
- gcloud dataproc clusters create mycase2cluster --bucket mycase2-bucket --region us-west2 --zone us-west2-a --master-machine-type n1-standard-4 --master-boot-disk-size 50 --num-workers 3 --worker-machine-type n1-standard-4 --worker-boot-disk-size 50 --image-version 1.4-ubuntu18 --optional-components ANACONDA,JUPYTER,ZOOKEEPER --enable-component-gateway --project keyskills-1637563443851

```
kshgcp_userid01@cloudshell:~ (keyskills-1637563443851)$ gcloud dataproc clusters create mycase2cluster --bucket mycase2-bucket --region us-west2 --zone us-west2-a --master-machine-type n1-stand
ard-4 --master-boot-disk-size 50 --num-workers 3 --worker-machine-type n1-standard-4 --worker-boot-disk-size 50 --image-version 1.4-ubuntu18 --optional-components ANACONDA,JUPYTER,ZOOKEEPER --e
nable-component-gateway --project keyskills-1637563443851
Waiting on operation [projects/keyskills-1637563443851/regions/us-west2/operations/3e4089c9-b95a-38f6-b12d-8c316f760951].
Waiting for cluster creation operation...
WARNING: For PD-Standard without local SSDs, we strongly recommend provisioning 1TB or larger to ensure consistently high I/O performance. See https://cloud.google.com/compute/docs/disks/perfor
mance for information on disk I/O performance.
Waiting for cluster creation operation...done.
Created [https://dataproc.googleapis.com/v1/projects/keyskills-1637563443851/regions/us-west2/clusters/mycase2cluster] Cluster placed in zone [us-west2-a].
kshgcp_userid01@cloudshell:~ (keyskills-1637563443851)$
```

Dataproc cluster with 3 worker nodes:



Uploading the required csv files into the bucket:



Creating the JAR file:

- Java code:

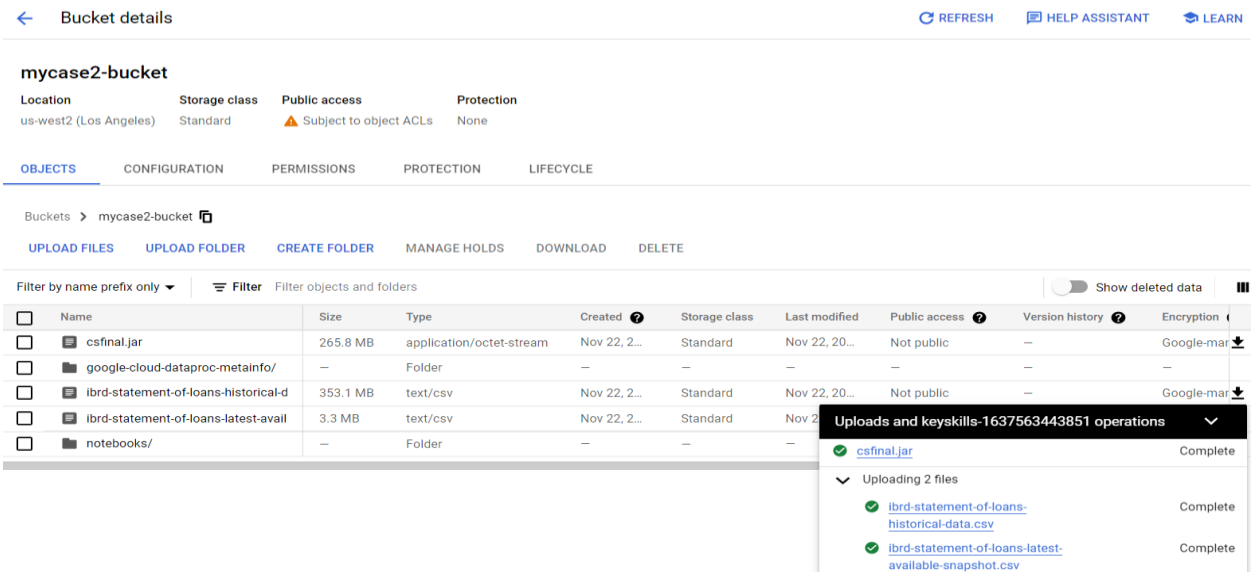
```
package dataproc;

import org.apache.spark.sql.Dataset;

import org.apache.spark.sql.Row;
```

```
import org.apache.spark.sql.SaveMode;

import org.apache.spark.sql.SparkSession;


public class InternationalLoansAppDataprocLarge {

   public static void main(String[] args) {              InternationalLoansAppDataprocLarge app = new
InternationalLoansAppDataprocLarge();

 app.start();

   }

   private void start() {

      SparkSession spark = SparkSession.builder()

            .appName("my-java-dataproc")

            .master("yarn")

            .getOrCreate();

      spark.sparkContext().setLogLevel("WARN");




// Loading the CSV file from GCS Bucket

      Dataset<Row> dfLoans = spark.read()

            .format("csv")

            .option("header", "true")

            .option("inferSchema", true)

            .load("gs://mycase2-bucket/ibrd-statement-of-loans-historical-data.csv");


      // Creates temporary view using DataFrame

      dfLoans.withColumnRenamed("Country", "country")

            .withColumnRenamed("Country Code", "country_code")

            .withColumnRenamed("Disbursed Amount", "disbursed")

            .withColumnRenamed("Borrower's Obligation", "obligation")

            .withColumnRenamed("Interest Rate", "interest_rate")

            .createOrReplaceTempView("loans");


 // Performs basic analysis of dataset

      Dataset<Row> dfDisbursement = spark.sql(
```

```
            "SELECT country, country_code, "
                + "format_number(total_disbursement, 0) AS total_disbursement, "
                + "format_number(ABS(total_obligation), 0) AS total_obligation, "
                + "format_number(avg_interest_rate, 2) AS avg_interest_rate "
                + "FROM ( "
                + "SELECT country, country_code, "
                + "SUM(disbursed) AS total_disbursement, "
                + "SUM(obligation) AS total_obligation, "
                + "AVG(interest_rate) AS avg_interest_rate "
                + "FROM loans "
                + "GROUP BY country, country_code "
                + "ORDER BY total_disbursement DESC "
                + "LIMIT 25)"
        );
        // Saves results to single CSV file in GCS Bucket
        dfDisbursement.repartition(1)
            .write()
            .mode(SaveMode.Overwrite)
            .format("csv")
            .option("header", "true")
            .save("gs://mycase2-bucket/ibrd-loan-summary-large");
        System.out.println("Results successfully written to CSV file");
    }
}
```

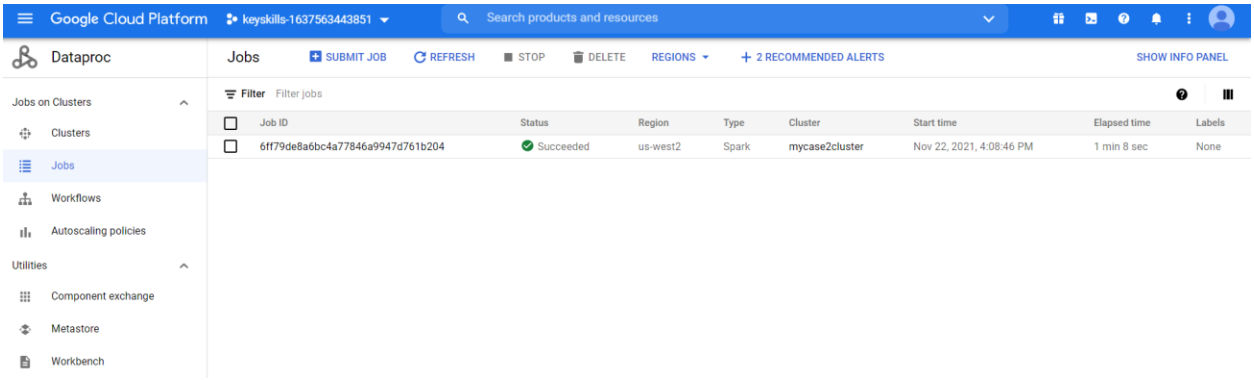
- The java code is saved as csfinal and exported as a jar file

Uploading the JAR file in the bucket:



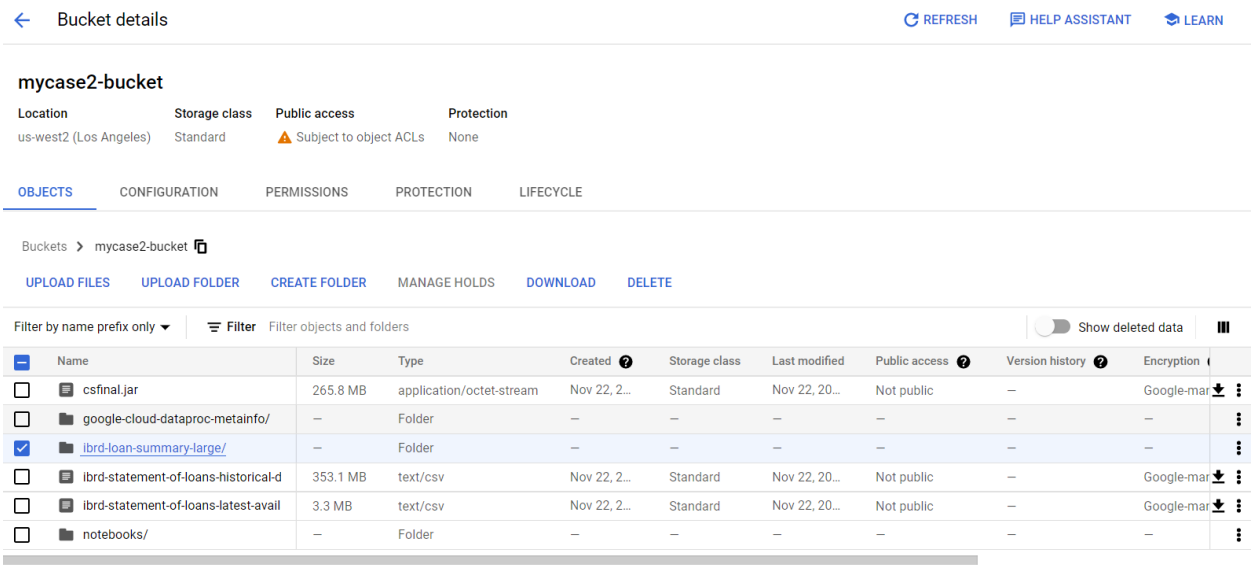
Submitting Dataproc job using CLI command:

- gcloud dataproc jobs submit spark --cluster=mycase2cluster --region=us-west2 --class=dataproc.InternationalLoansAppDataprocLarge --jars=gs://mycase2-bucket/csfinal.jar



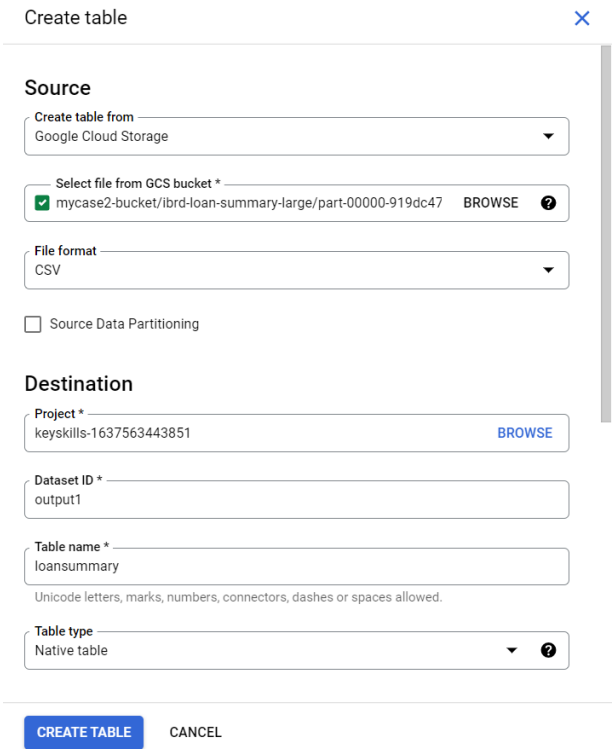
Dataproc job succeeded and the data is saved in the CSV file:

Output file added to the bucket:

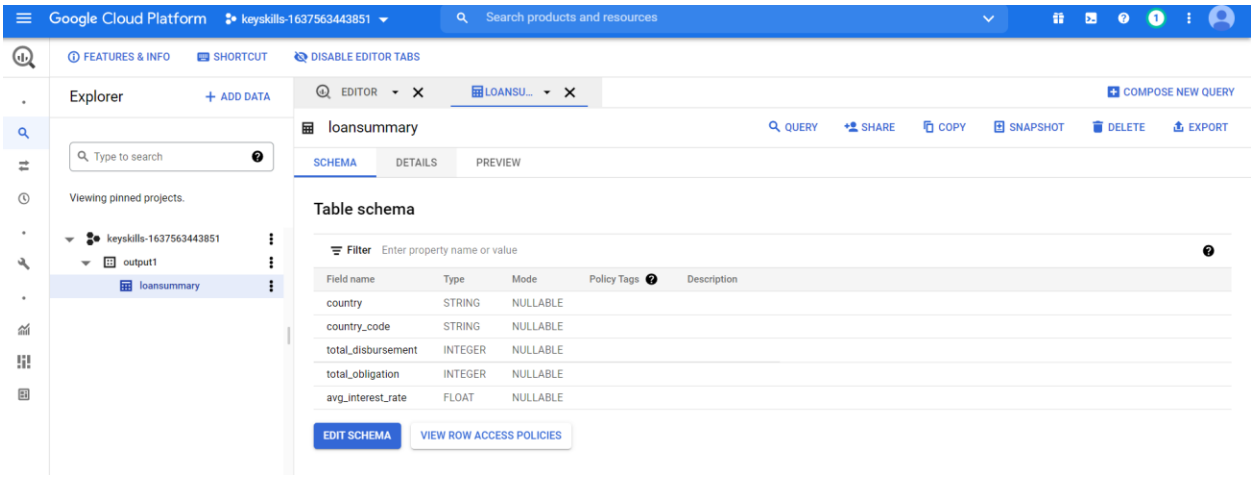


Creating a BigQuery table:

- Go to BigQuery and create a table under the project name's dataset (i.e output1) and select the output file from GCS and load it into table.
- Give the table name, in this case its loansummary.

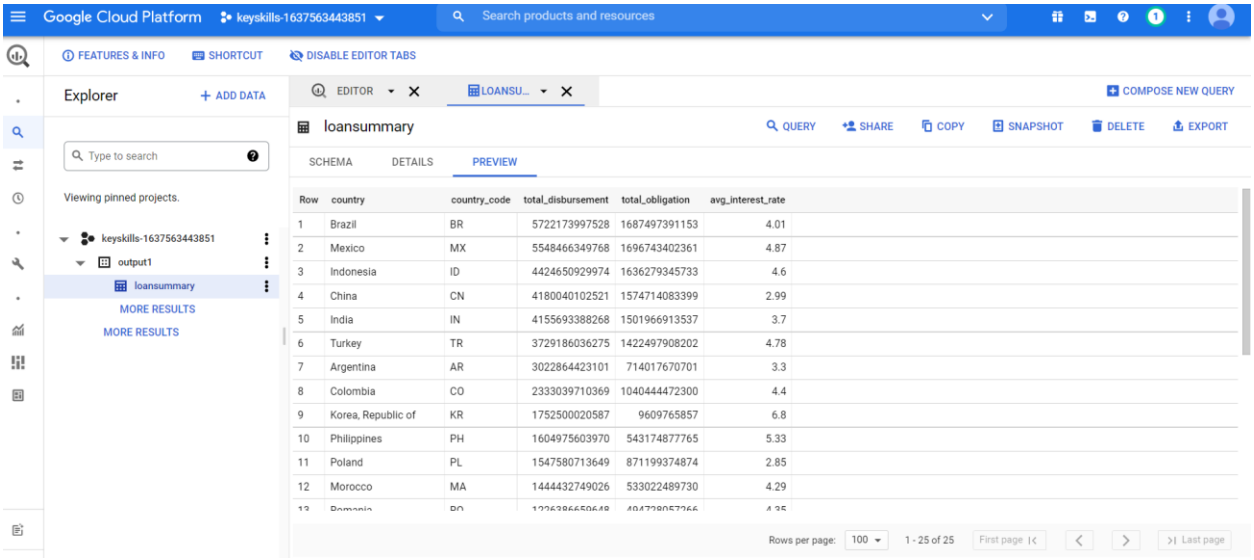


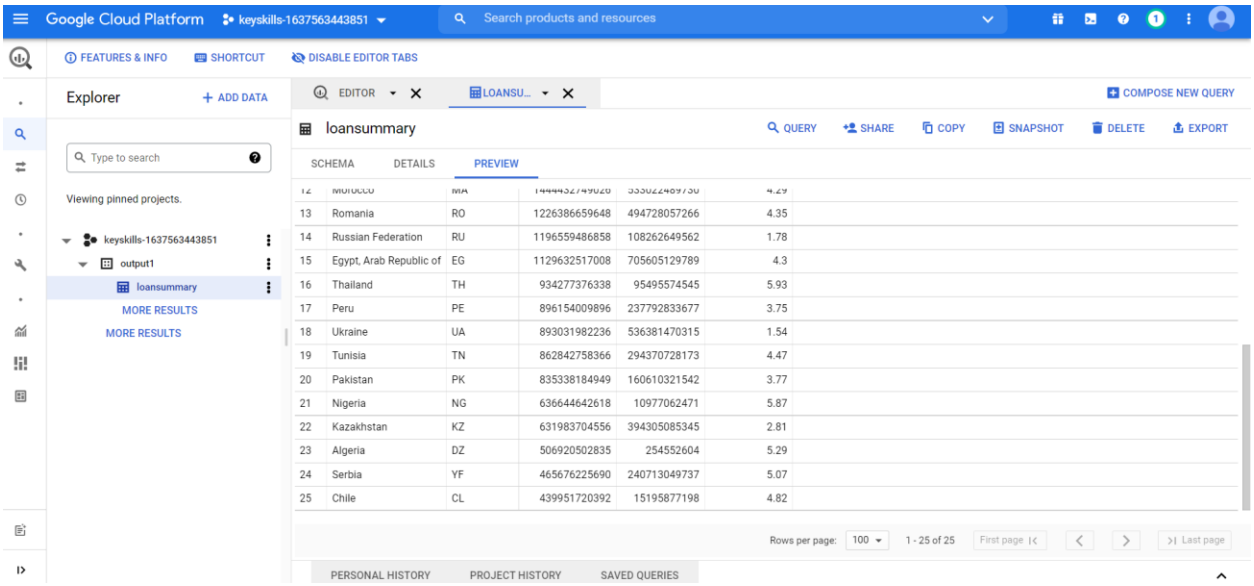
BigQuery table for output file is created:



Click on preview to see the output:

- Output showing the top 25 historic IBRD borrowers.
- Also shows the total disbursements, current obligations, and the average interest rates they were charged.





Output downloaded and viewed in XML format: