Large dataset: https://storage.googleapis.com/met-cs-777-data/taxi-data-sorted-large.csv.bz2

Top-10 Active Taxis

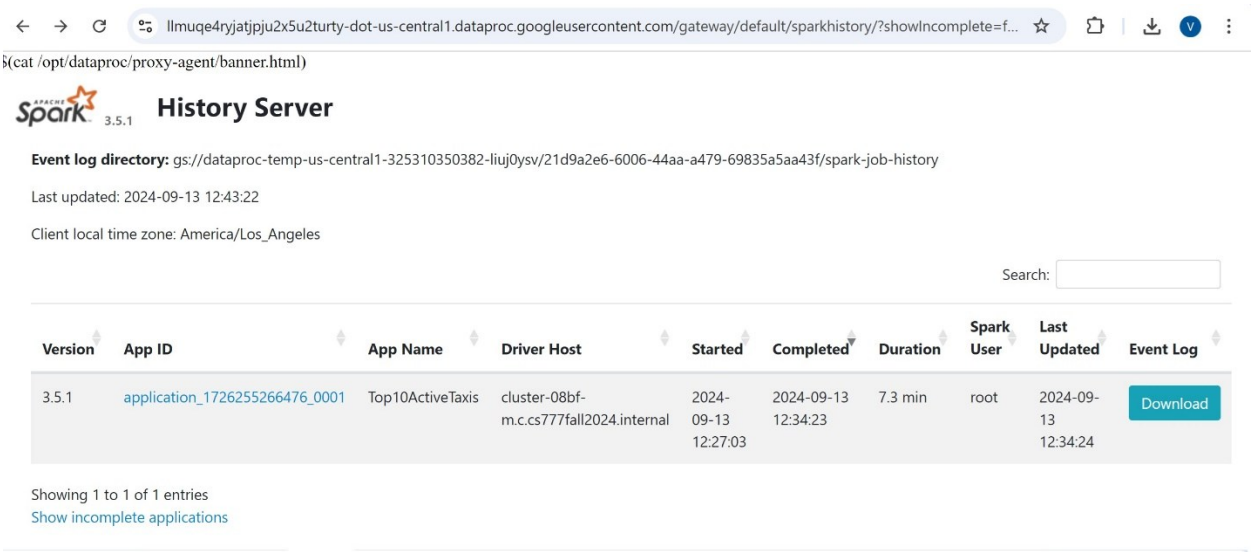
Many different taxis have had multiple drivers. Write and execute a Spark Python program that computes the top ten taxis that have had the largest number of drivers. Your output should be a set of (medallion, number of drivers) pairs.

Large dataset: https://storage.googleapis.com/met-cs-777-data/taxi-data-sorted-large.csv.bz2

***Note**: You should consider that this is a real-world data set that might include wrongly formatted data lines. You should clean up the data before the main processing, a line might not include all of the fields. If a data line is not correctly formatted, you should drop that line and do not consider it.*

- Print a list of top 10 taxis having the largest number of drivers, and the amount of drivers (taxi ID and count)

```
('11DC93DD66D8A9A3DD9223122CF99EFD', 352)
('EE06BD8A621CAC3B608ACFDF0585A76A', 348)
('6C1132EF70BC0A7DB02174592F9A64A1', 341)
('A10A65AFD9F401BF3BDB79C84D3549E7', 340)
('23DB792D3F7EBA03004E470B684F2738', 339)
('7DA8DF1E4414F81EBD3A0140073B2630', 337)
('0318F7BBB8FF48688698F04016E67F49', 335)
('B07944BF31699A169091D2B16597A4A9', 333)
('738A62EEE9EC371689751A864C5EF811', 333)
('7D93E7FC4A7E4615A34B8286D92FF57F', 333)
```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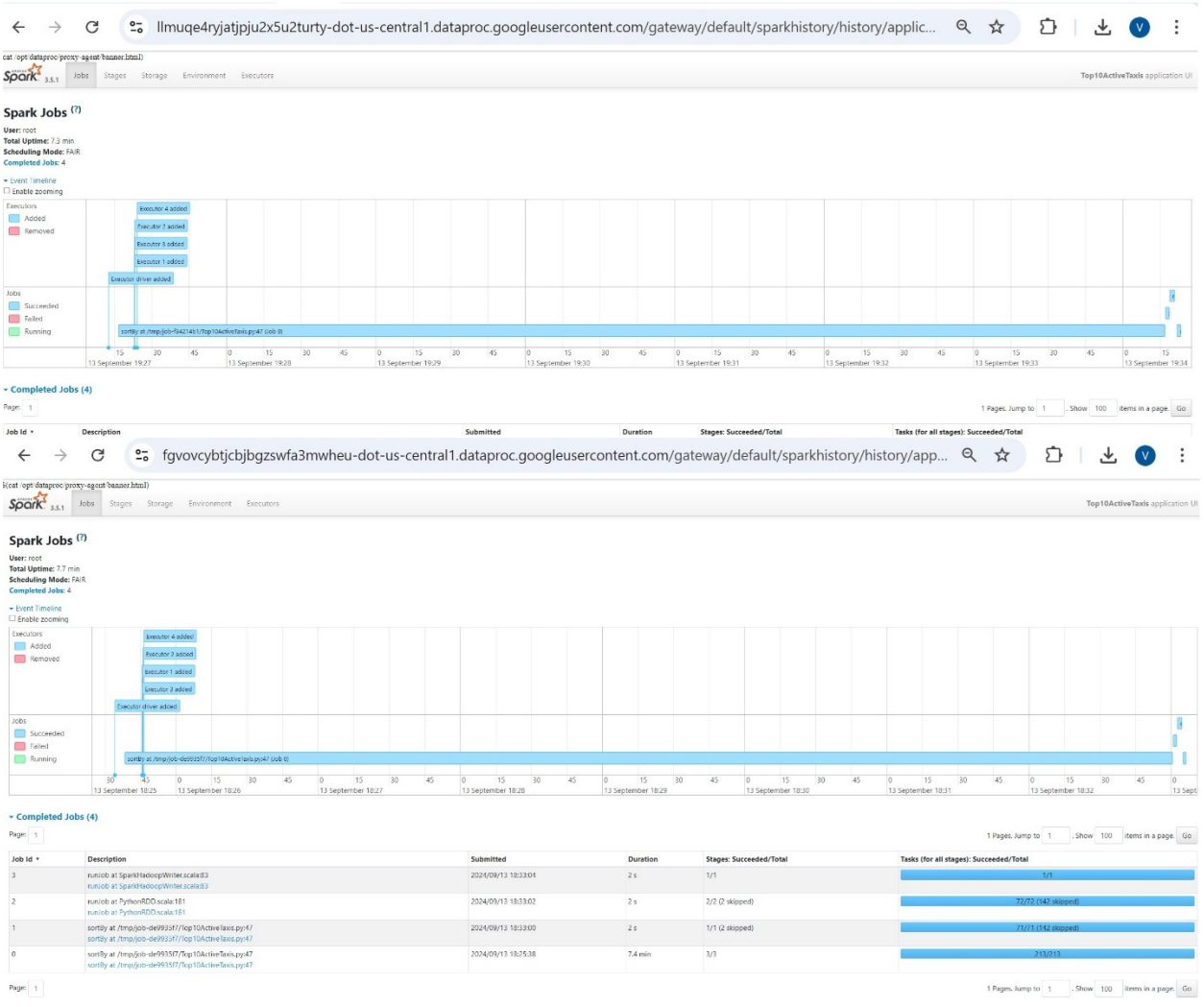
$(cat /opt/dataproc/proxy-agent/banner.html)
Spark 3.5.1
History Server
Event log directory: gs://dataproc-temp-us-central1-325310350382-liuj0ysv/21d9a2e6-6006-44aa-a479-69835a5aa43f/spark-job-history
Last updated: 2024-09-13 12:43:22
Client local time zone: America/Los_Angeles
Search:
Version
App ID
App Name
Driver Host
Started
Completed
Duration
Spark User
Last Updated
Event Log
3.5.1
application_1726255266476_0001
Top10ActiveTaxis
cluster-08bf-m.c.cs777fall2024.internal
2024-09-13 12:27:03
2024-09-13 12:34:23
7.3 min
root
2024-09-13 12:34:24
Download
Showing 1 to 1 of 1 entries
Show incomplete applications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Spark Jobs
User: root
Total Uptime: 7.3 min
Scheduling Mode: FAIR
Completed Jobs: 4
Completed Jobs (4)
fgvovcybtjcbjbgzswfa3mwheu-dot-us-central1.dataproc.googleusercontent.com/gateway/default/sparkhistory/history/app...
Spark Jobs
User: root
Total Uptime: 7.7 min
Scheduling Mode: FAIR
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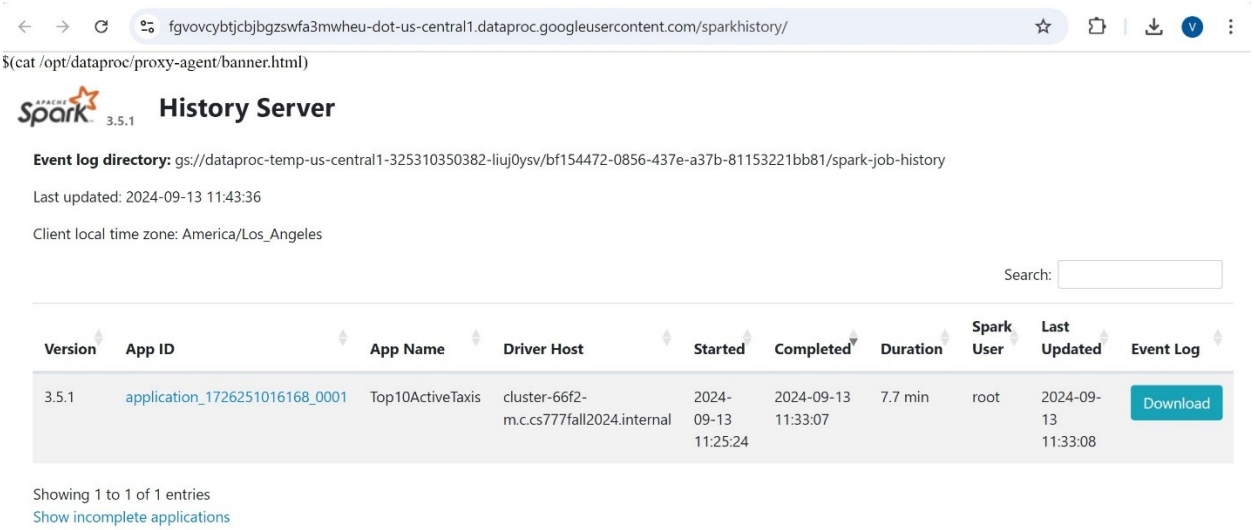
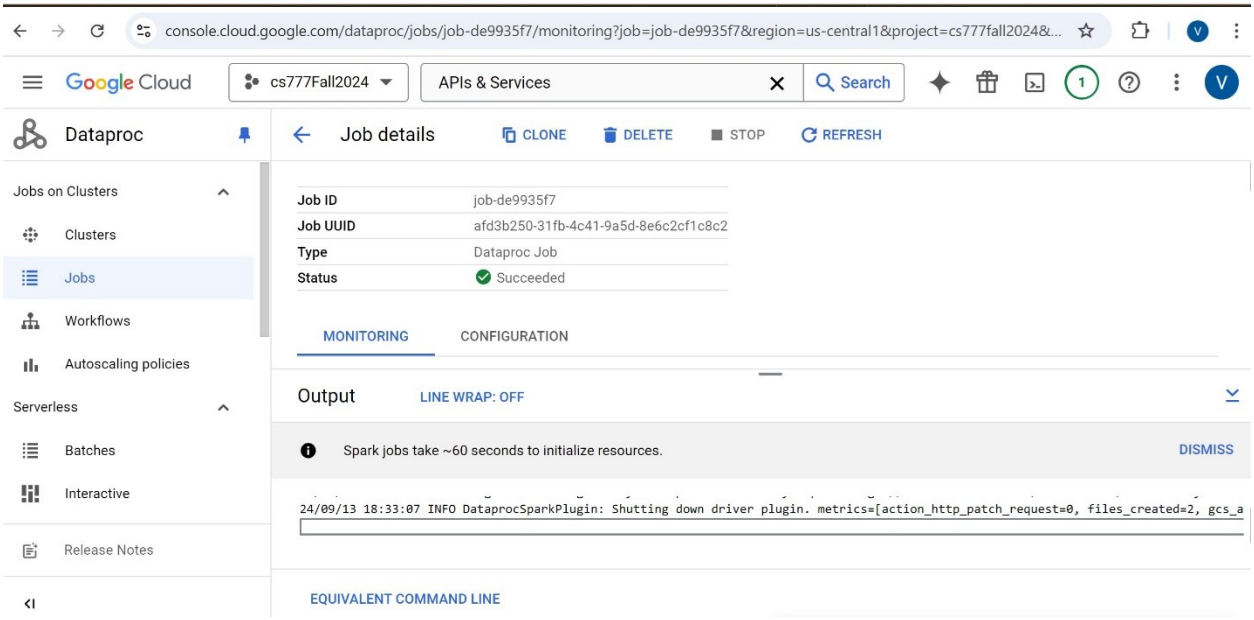
Completed Jobs (4)





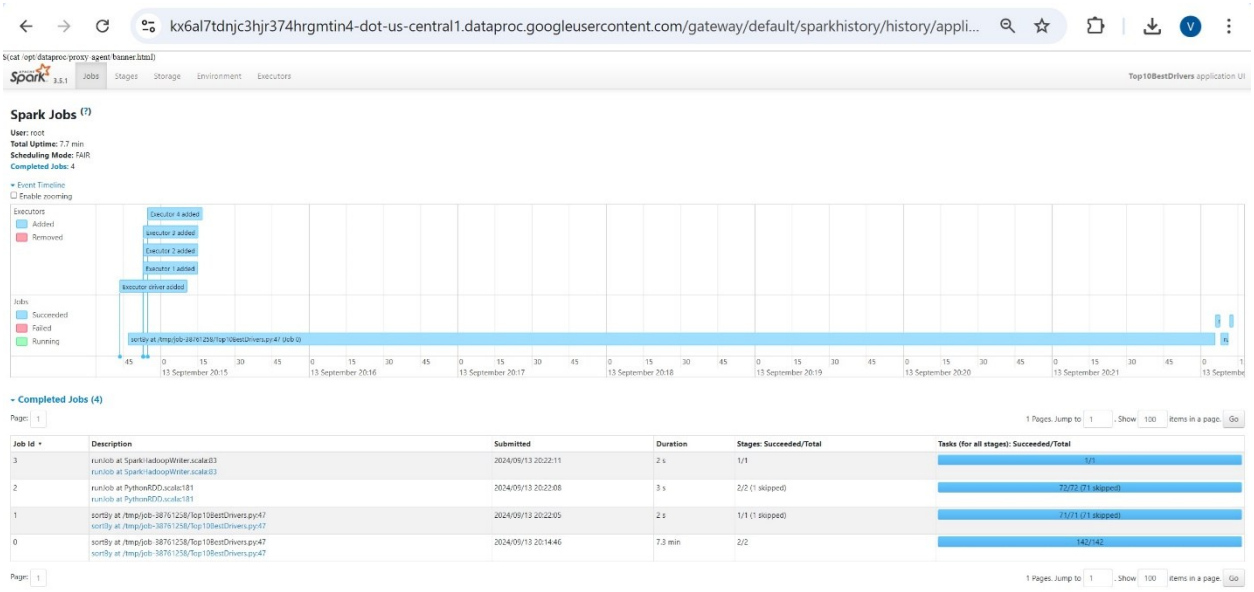
Top-10 Best Drivers

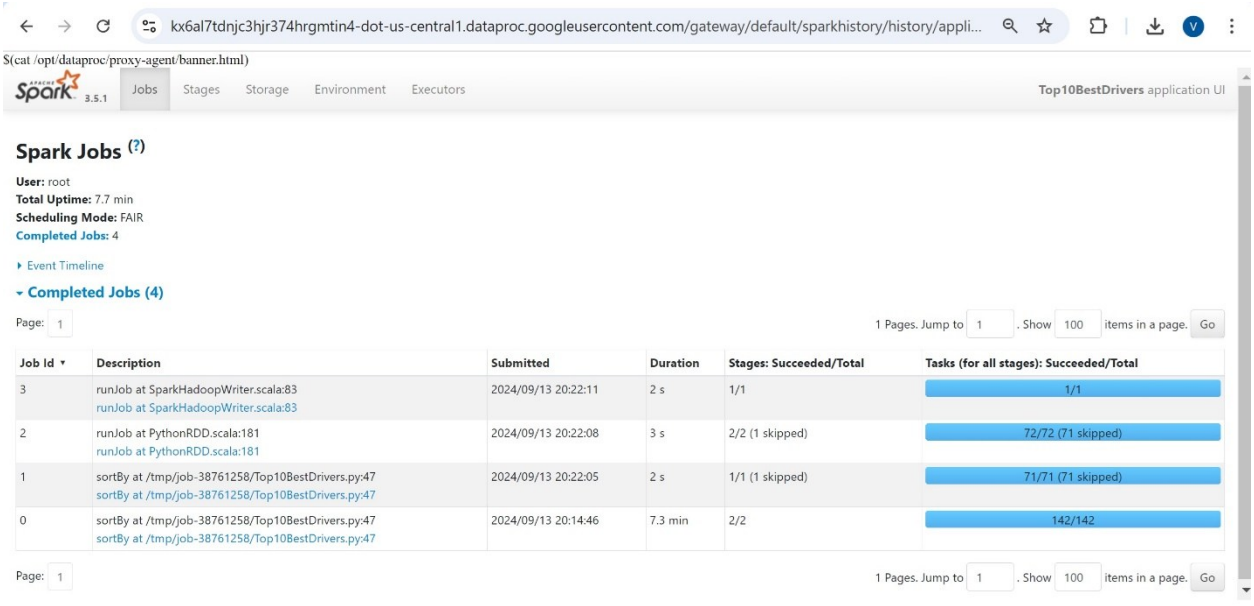
We would like to figure out who the top 10 best drivers are in terms of their average earned money per minute spent carrying a customer. The total amount field is the total money earned on a trip. In the end, we are interested in computing a set of (driver, money per minute) pairs.

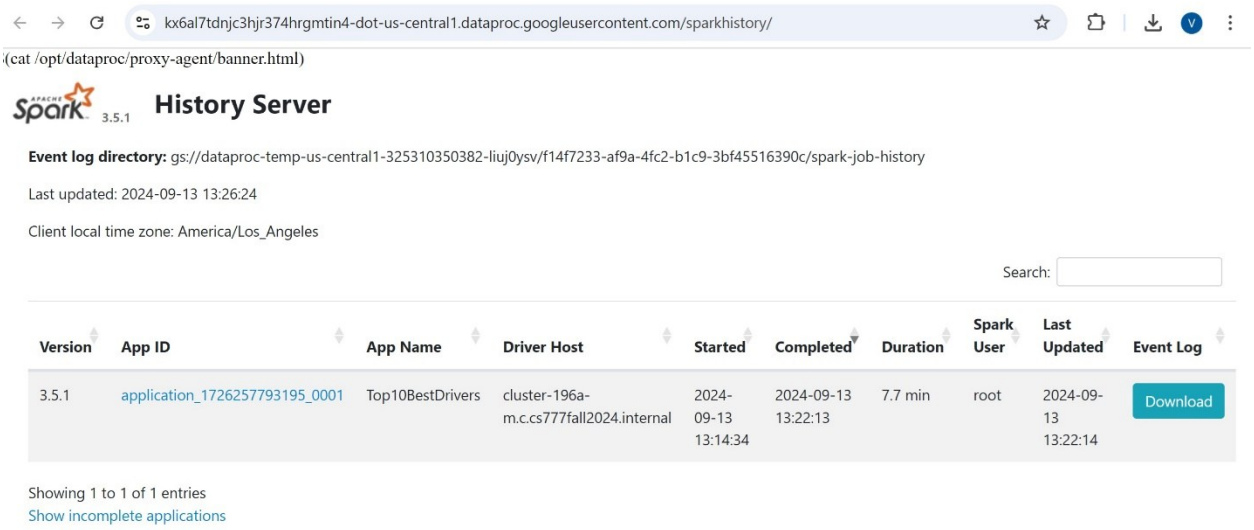
- Print a list of top 10 best drivers based on earned money per minute carrying a customer (Driver ID and average earning)

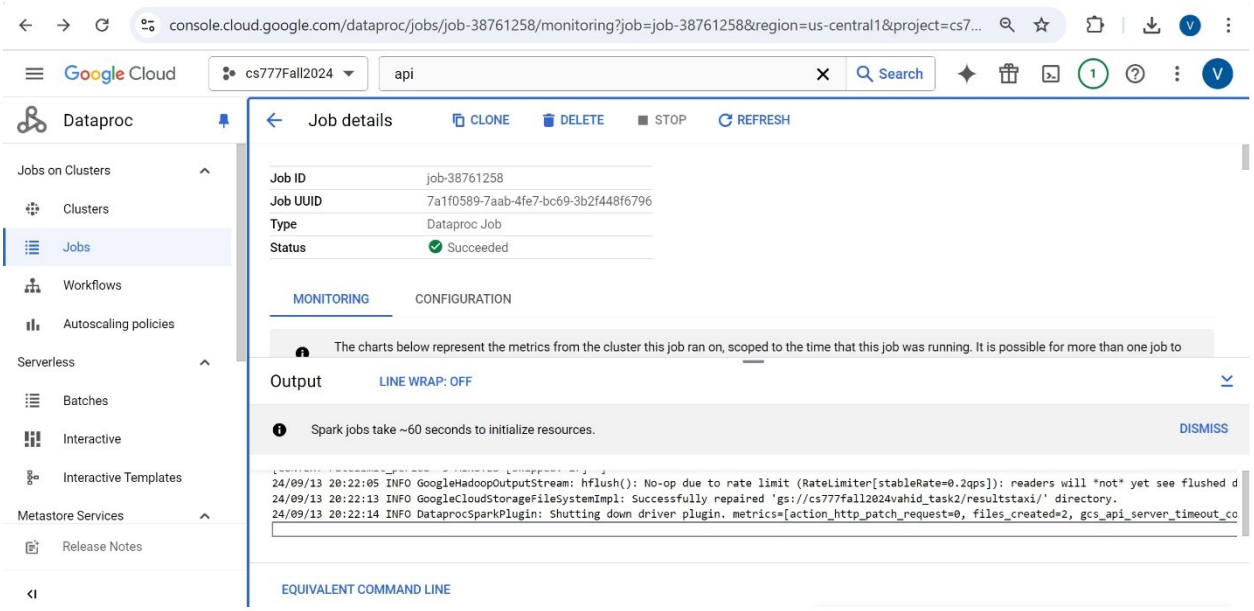
('E4F99C9ABE9861F18BCD38BC63D007A9', 62103.18601982026)
('664927CDE376A32789BA48BF55DFB7E3', 32075.6481781048)
('51C1BE97280A80EBFA8DAD34E1956CF6', 22412.519037907998)

('D85749E8852FCC66A990E40605607B2F', 21838.61138628341)
('23DF80C977D15141F11DD713C523C311', 20791.02908617619)
('3D757E111C78F5CAC83D44A92885D490', 20555.115544088956)
('BE047851D97506885B99BDDFA7A13360', 19584.744671992667)
('3AAB94CA53FE93A64811F65690654649', 19575.05448827395)
('74CC809D28AE726DDB32249C044DA4F8', 19558.588651912727)
('3578782ABD6492CEB927B2A8EBCF1402', 19321.71774748813)









The best time of the day to Work on Taxi (For Advanced Students - no points)

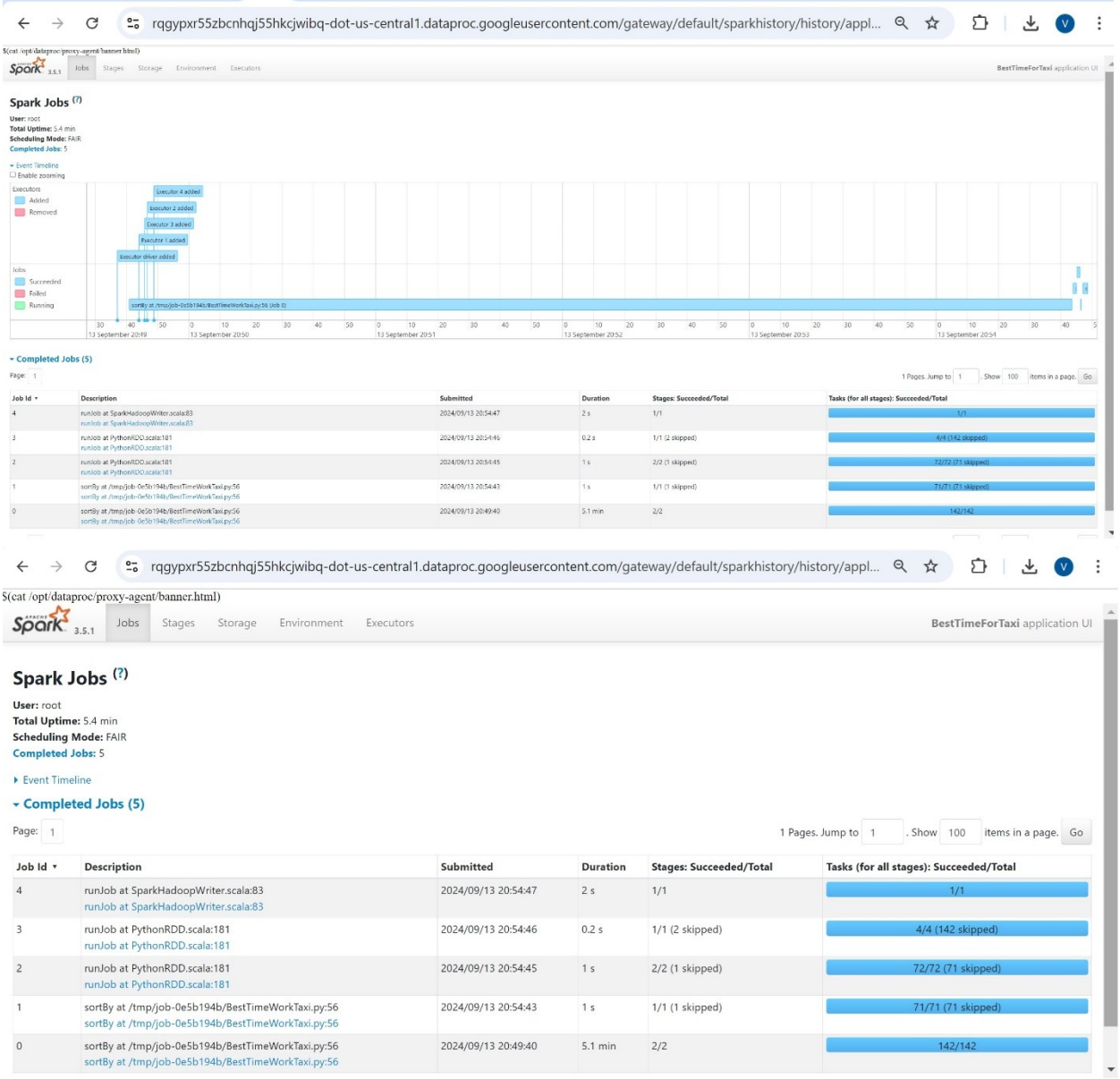
We would like to know which hour of the day is the best time for drivers that has the highest profit per mile. Consider the surcharge amount in dollars for each taxi ride (without tip amount) and the distance in miles, and sum up the rides for each hour of the day (24 hours) – consider the pickup time for your calculation. The profit ratio is the ration surcharge in dollars divided by the travel distance in miles for each specific time of the day.

Profit Ratio = (Surcharge Amount in US Dollar) / (Travel Distance in miles)

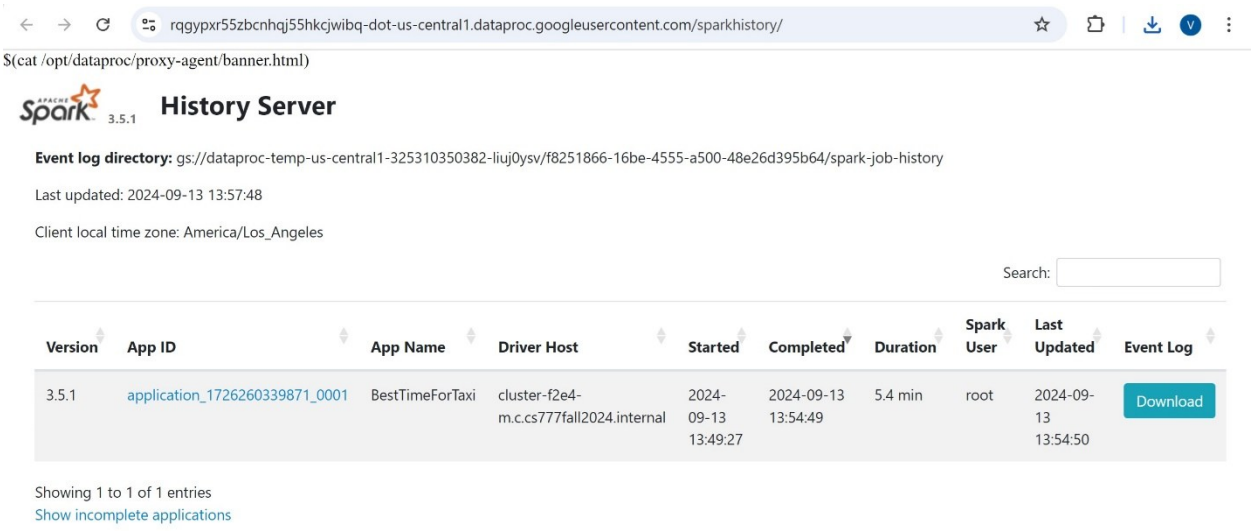
We are interested to know the time of the day that has the highest profit ratio.

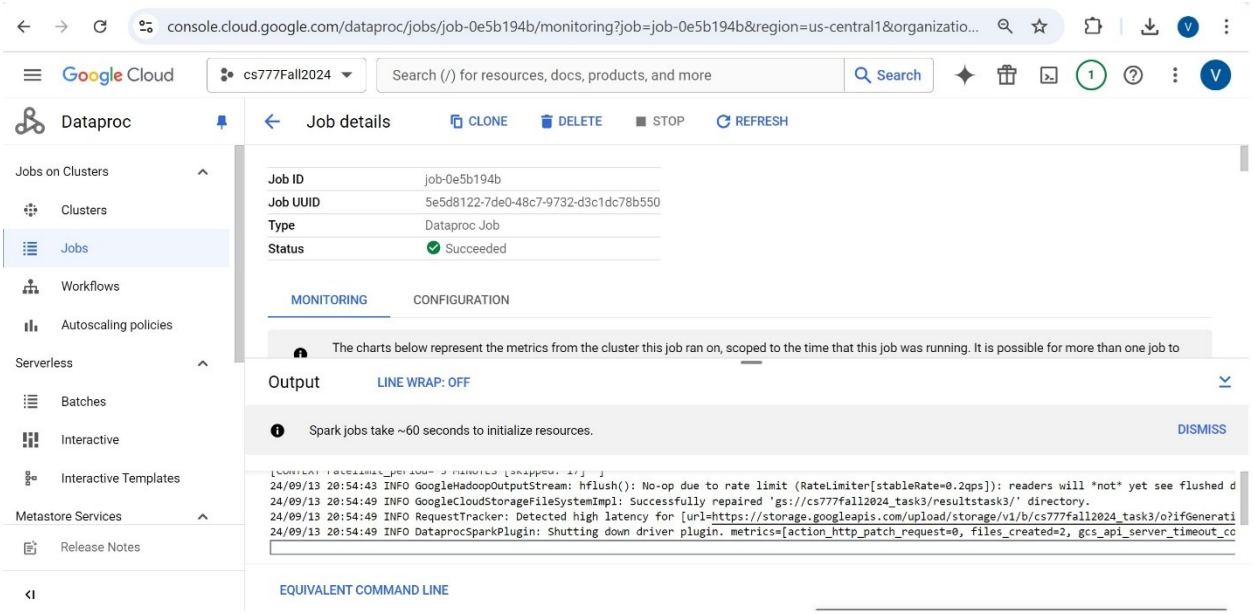
- Print the profit ratio for the best hour of the day exhibiting the highest profit per mile

(18, 0.5998318861259467)



rqgypxr55zbcnhqj55hkcjwibq-dot-us-central1.dataproc.googleusercontent.com/gateway/default/sparkhistory/history/appl...
$(cat /opt/dataproc/proxy-agent/banner.html)
Spark 3.5.1
Jobs
Stages
Storage
Environment
Executors
BestTimeForTaxi application UI
Spark Jobs (?)
User: root
Total Uptime: 5.4 min
Scheduling Mode: FAIR
Completed Jobs: 5
Event Timeline
Completed Jobs (5)
Page: 1
1 Pages. Jump to 1 . Show 100 items in a page. Go
Job Id
Description
Submitted
Duration
Stages: Succeeded/Total
Tasks (for all stages): Succeeded/Total
4
runJob at SparkHadoopWriter.scala:83
runJob at SparkHadoopWriter.scala:83
2024/09/13 20:54:47
2 s
1/1
1/1
3
runJob at PythonRDD.scala:181
runJob at PythonRDD.scala:181
2024/09/13 20:54:46
0.2 s
1/1 (2 skipped)
4/4 (142 skipped)
2
runJob at PythonRDD.scala:181
runJob at PythonRDD.scala:181
2024/09/13 20:54:45
1 s
2/2 (1 skipped)
72/72 (71 skipped)
1
sortBy at /tmp/job-0e5b194b/BestTimeWorkTaxi.py:56
sortBy at /tmp/job-0e5b194b/BestTimeWorkTaxi.py:56
2024/09/13 20:54:43
1 s
1/1 (1 skipped)
71/71 (71 skipped)
0
sortBy at /tmp/job-0e5b194b/BestTimeWorkTaxi.py:56
sortBy at /tmp/job-0e5b194b/BestTimeWorkTaxi.py:56
2024/09/13 20:49:40
5.1 min
2/2
142/142





Advanced Part

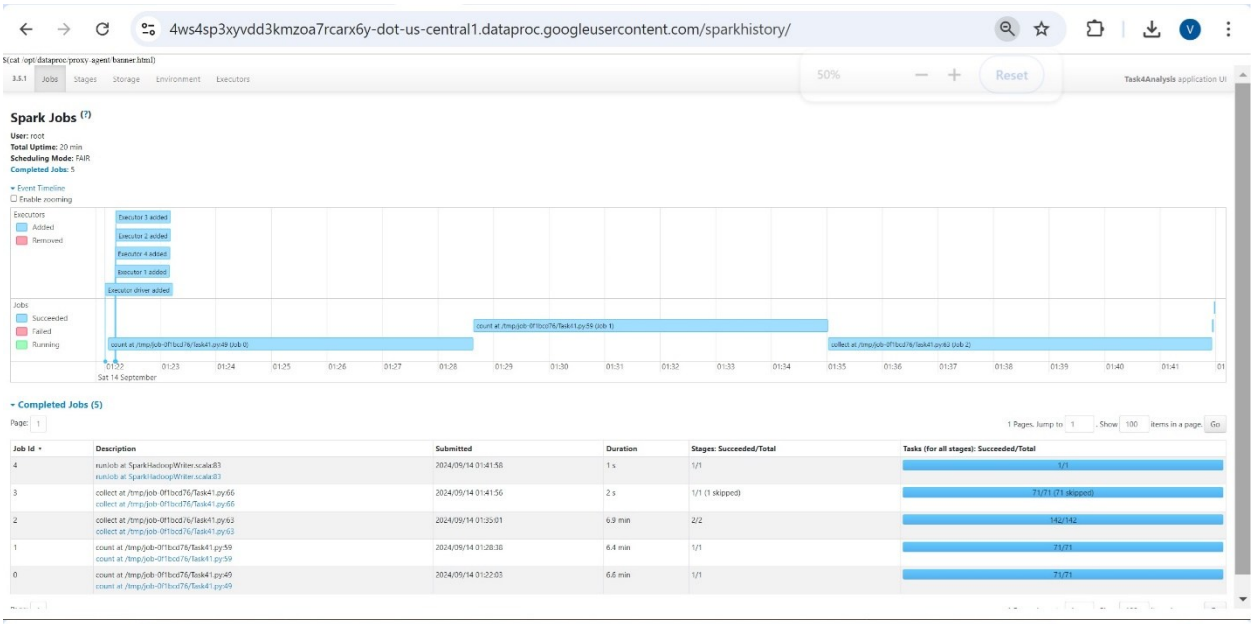
Here are some further tasks for advanced groups.

a) How many percent of taxi customers pay with cash, and how many percent use electronic cards? Analyze these payment methods for different times of the day and provide a list of percent for each time of the day? As a result, provide two numbers for total percentages and a list like: hour of the day, percent paid card.

- For each hour of the day, provide percentages of customers paying with cash and cards

(0, 56.56) *(1, 56.16)*

(2, 55.82)
(3, 54.43)
(4, 48.83)
(5, 51.68)
(6, 54.85)
(7, 57.59)
(8, 59.93)
(9, 57.88)
(10, 52.75)
(11, 50.95)
(12, 50.63)
(13, 50.07)
(14, 49.75)
(15, 49.19)
(16, 49.46)
(17, 51.5)
(18, 54.12)
(19, 55.76)
(20, 57.8)
(21, 57.52)
(22, 57.34)
(23, 57.18)



4ws4sp3xyvdd3kmzoa7rcarx6y-dot-us-central1.dataproc.googleusercontent.com/sparkhistory/

$(cat /opt/dataproc/proxy-agent/banner.html)

Spark 3.5.1 **History Server**

Event log directory: gs://dataproc-temp-us-central1-325310350382-liuj0ysv/3e14acf7-9166-460f-aac3-2dd4947ce40f/spark-job-history

Last updated: 2024-09-13 18:58:57

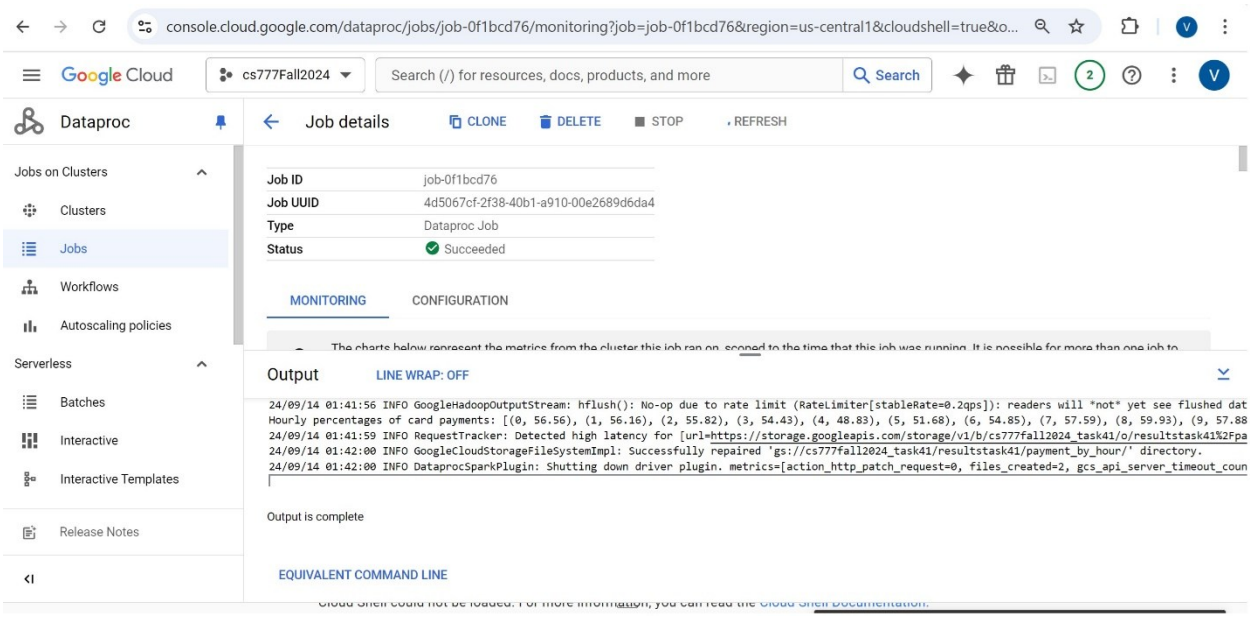
Client local time zone: America/Los_Angeles

Search:

Version	App ID	App Name	Driver Host	Started	Completed	Duration	Spark User	Last Updated	Event Log
3.5.1	application_1726276589183_0001	Task4Analysis	cluster-4f9a-m.c.cs777fall2024.internal	2024-09-13 18:21:51	2024-09-13 18:42:00	20 min	root	2024-09-13 18:42:00	Download

Showing 1 to 1 of 1 entries

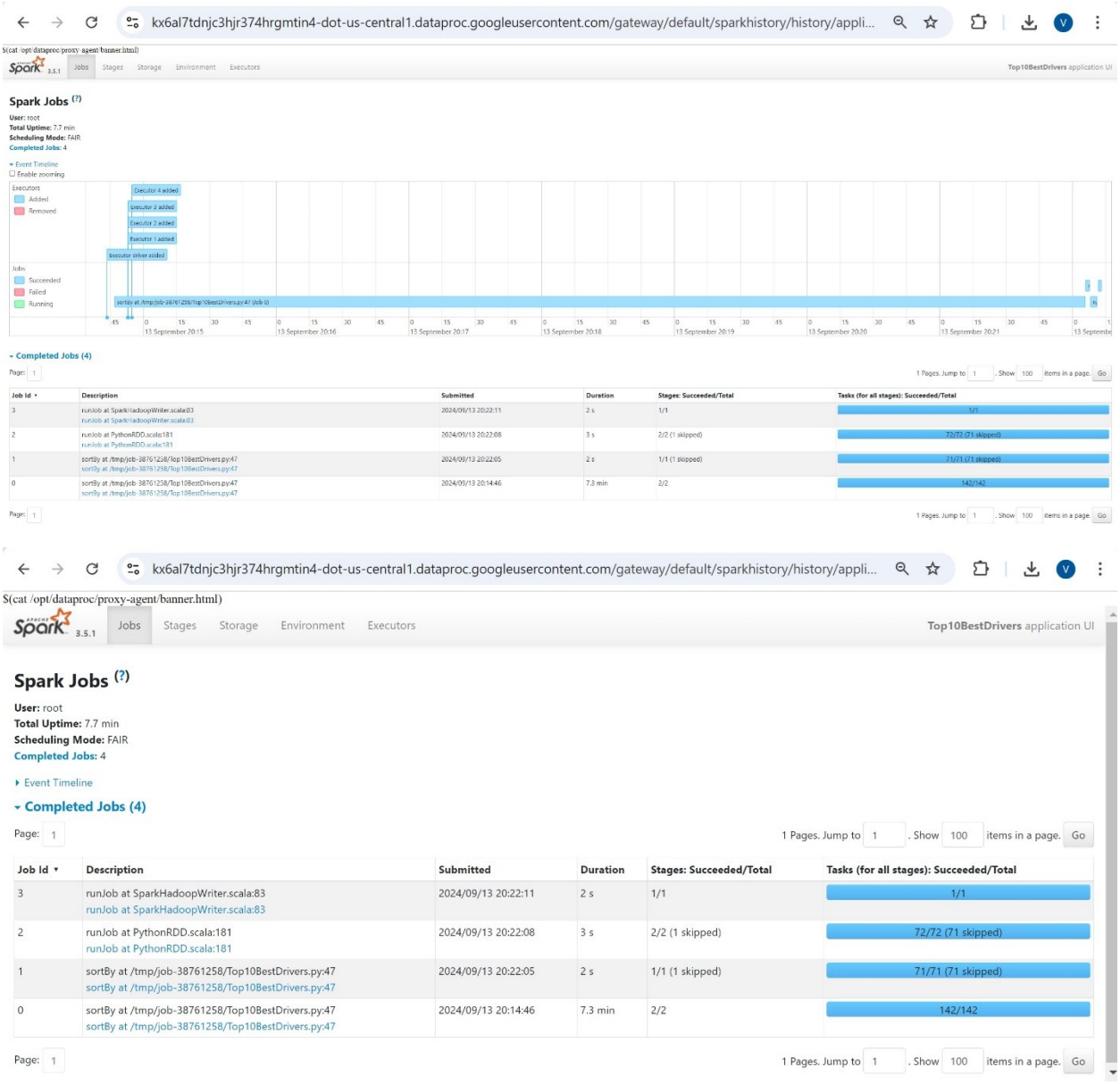
Show incomplete applications



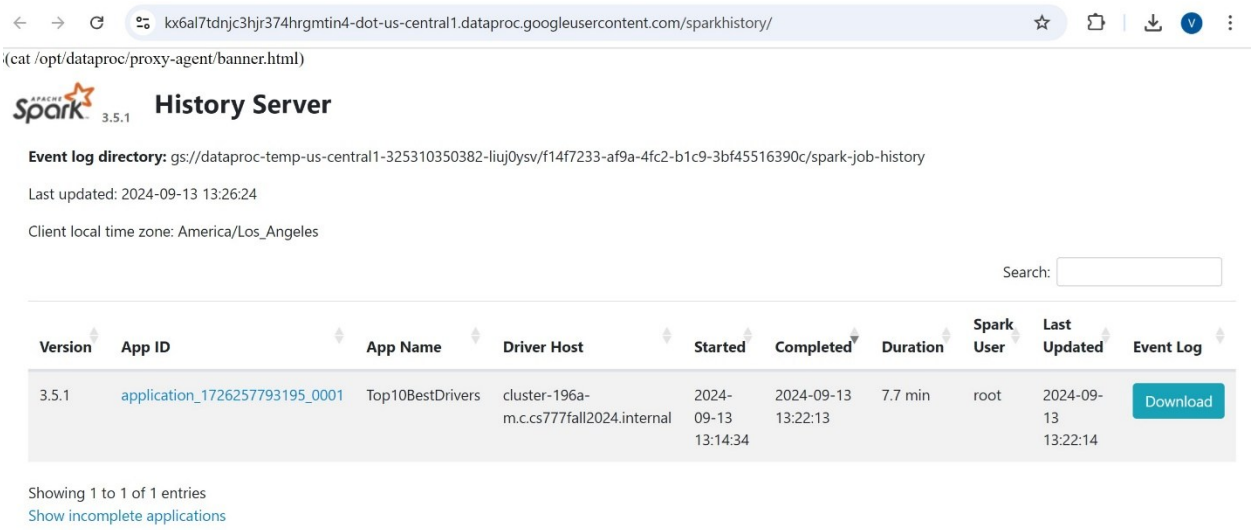
b) We would like to measure the efficiency of taxi drivers by finding out their average earned money per mile. (Consider the total amount, which includes tips, as their earned money) Implement a Spark job that can find out the top-10 efficient taxi drivers.

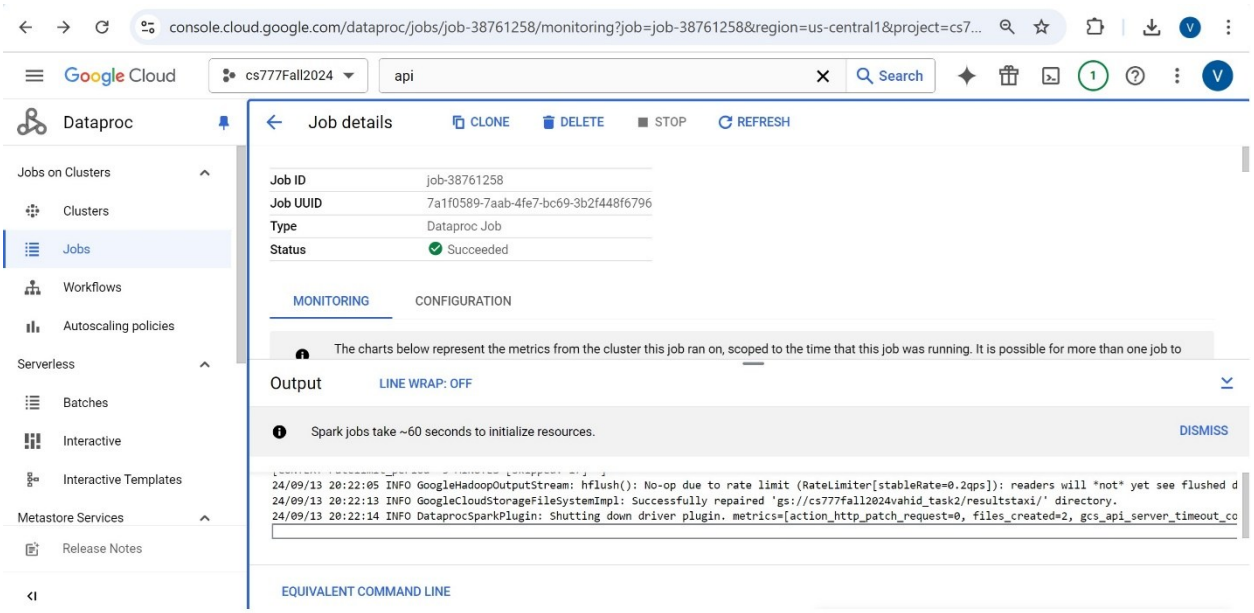
- Find the top 10 taxi drivers with highest average earned money per mile

('E4F99C9ABE9861F18BCD38BC63D007A9', 62103.18601982026)
('664927CDE376A32789BA48BF55DFB7E3', 32075.6481781048)
('51C1BE97280A80EBFA8DAD34E1956CF6', 22412.519037907998)
('D85749E8852FCC66A990E40605607B2F', 21838.61138628341)
('23DF80C977D15141F11DD713C523C311', 20791.02908617619)
('3D757E111C78F5CAC83D44A92885D490', 20555.115544088956)
('BE047851D97506885B99BDDFA7A13360', 19584.744671992667)
('3AAB94CA53FE93A64811F65690654649', 19575.05448827395)
('74CC809D28AE726DDB32249C044DA4F8', 19558.588651912727)
('3578782ABD6492CEB927B2A8EBCF1402', 19321.71774748813)



kx6al7tdnjc3hjr374hrgmtin4-dot-us-central1.dataproc.googleusercontent.com/gateway/default/sparkhistory/history/appli...
$(cat /opt/dataproc/proxy-agent/banner.html)
Spark 3.5.1 Jobs Stages Storage Environment Executors Top10BestDrivers application UI
Spark Jobs (?)
User: root
Total Uptime: 7.7 min
Scheduling Mode: FAIR
Completed Jobs: 4
Event Timeline
Completed Jobs (4)
Page: 1
1 Pages. Jump to 1 . Show 100 items in a page. Go
Job Id | Description | Submitted | Duration | Stages: Succeeded/Total | Tasks (for all stages): Succeeded/Total
3 | runJob at SparkHadoopWriter.scala:83 runJob at SparkHadoopWriter.scala:83 | 2024/09/13 20:22:11 | 2 s | 1/1 | 1/1
2 | runJob at PythonRDD.scala:181 runJob at PythonRDD.scala:181 | 2024/09/13 20:22:08 | 3 s | 2/2 (1 skipped) | 72/72 (71 skipped)
1 | sortBy at /tmp/job-38761258/Top10BestDrivers.py:47 sortBy at /tmp/job-38761258/Top10BestDrivers.py:47 | 2024/09/13 20:22:05 | 2 s | 1/1 (1 skipped) | 71/71 (71 skipped)
0 | sortBy at /tmp/job-38761258/Top10BestDrivers.py:47 sortBy at /tmp/job-38761258/Top10BestDrivers.py:47 | 2024/09/13 20:14:46 | 7.3 min | 2/2 | 142/142
Page: 1
1 Pages. Jump to 1 . Show 100 items in a page. Go

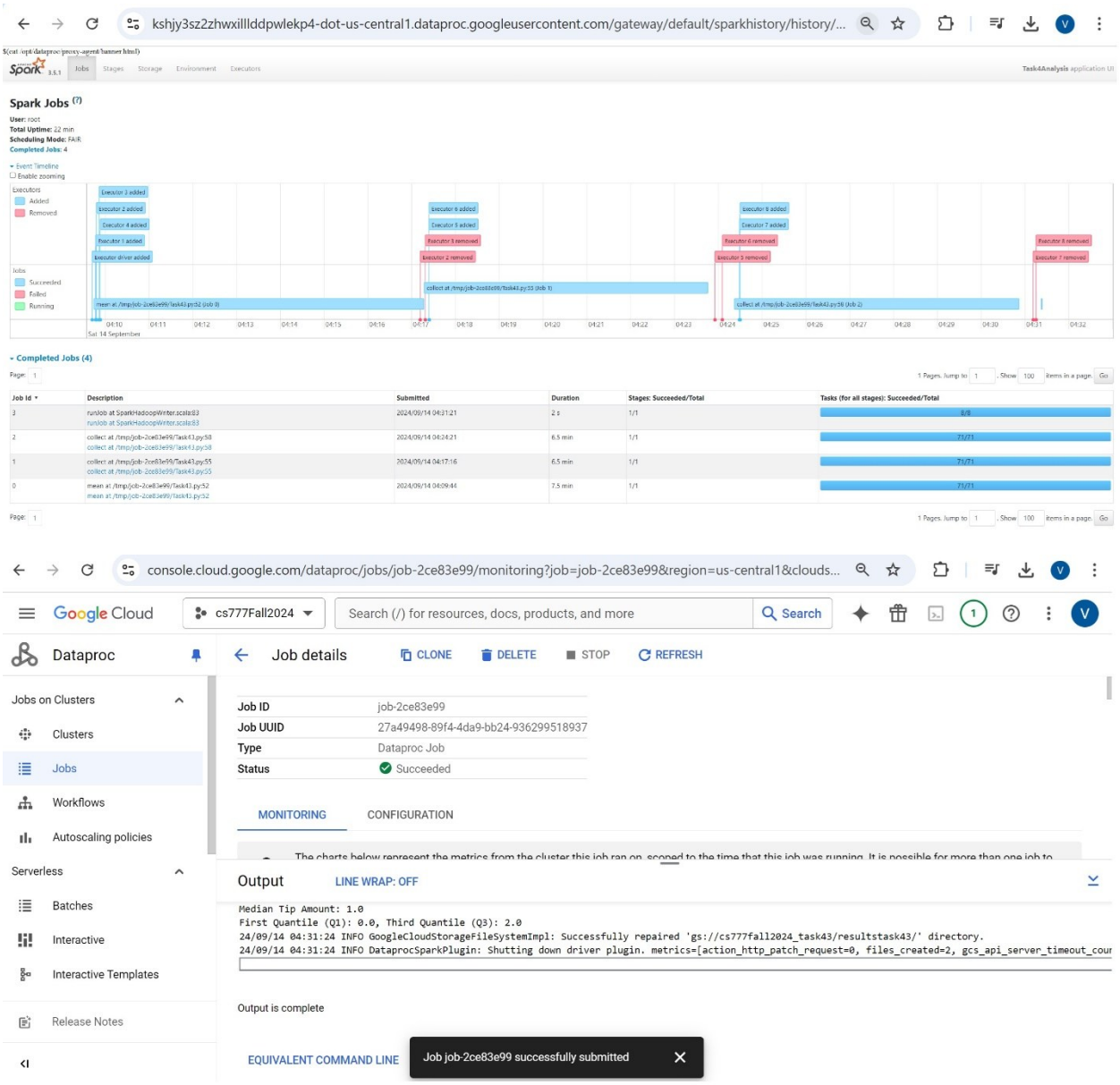




c) What are the mean, median, first, and third quantiles of tip amount? How do you find the median?

- Print the mean, median, first and third quantiles of the tip amount

Mean Tip: 1.365121487449525 *Median Tip: 1.0* *Q1: 0.0* *Q3: 2.0*



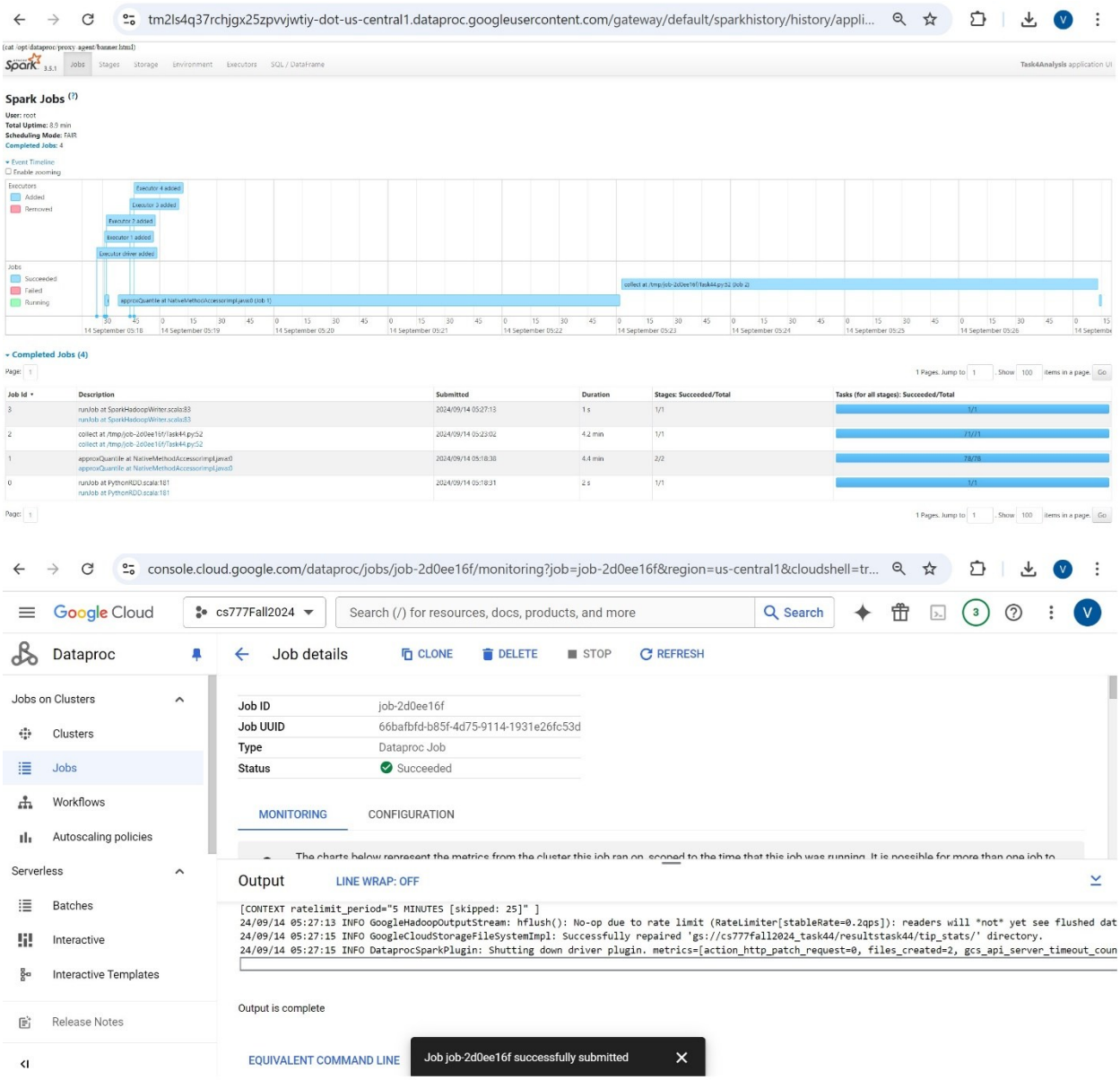
- Explain how do you find the median

the median is calculated using PySpark's approxQuantile function. The median is calculated as the 50th percentile (or second quartile, Q2) of the "tip_amount" column using the approxQuantile function. This method is efficient for large datasets and provides an approximate result with a specified error tolerance (0.01 in this case, meaning a 1% tolerance).

d) Using the IQR outlier detection method, find out the top-10 outliers.

- Find the top 10 outliers

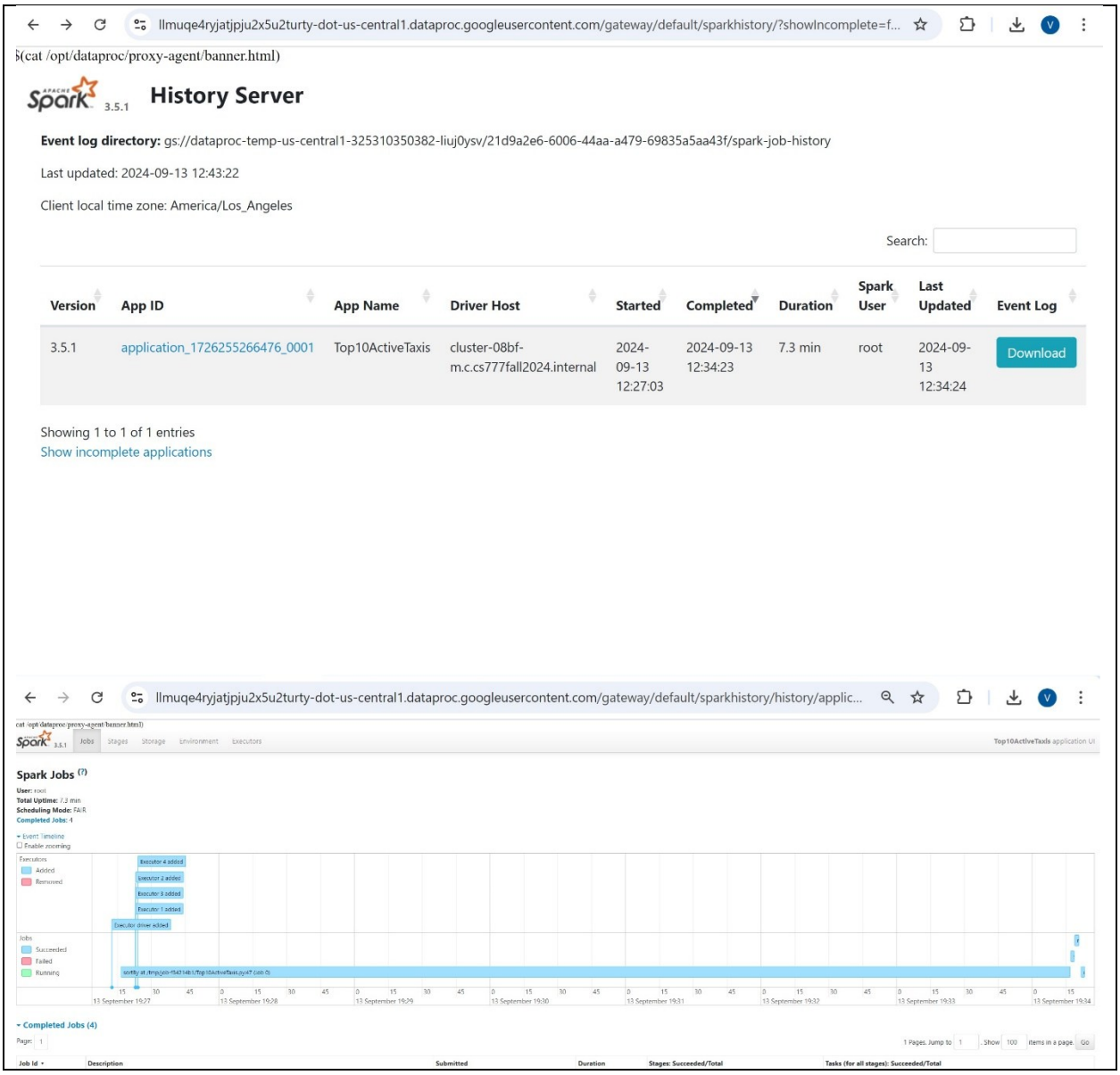
Top 10 Outliers: [685908.1, 541432.56, 159001.16, 82241.97, 61553.03, 9000.65, 7683.47, 7659.17, 7658.47, 5661.47]



Spark History Output:

To demonstrate that you did execute your code on the cloud it is important to include URLs in the screenshots. Otherwise, there is no way for us to verify if the code was executed in your cloud account.

Top-10 Active Taxis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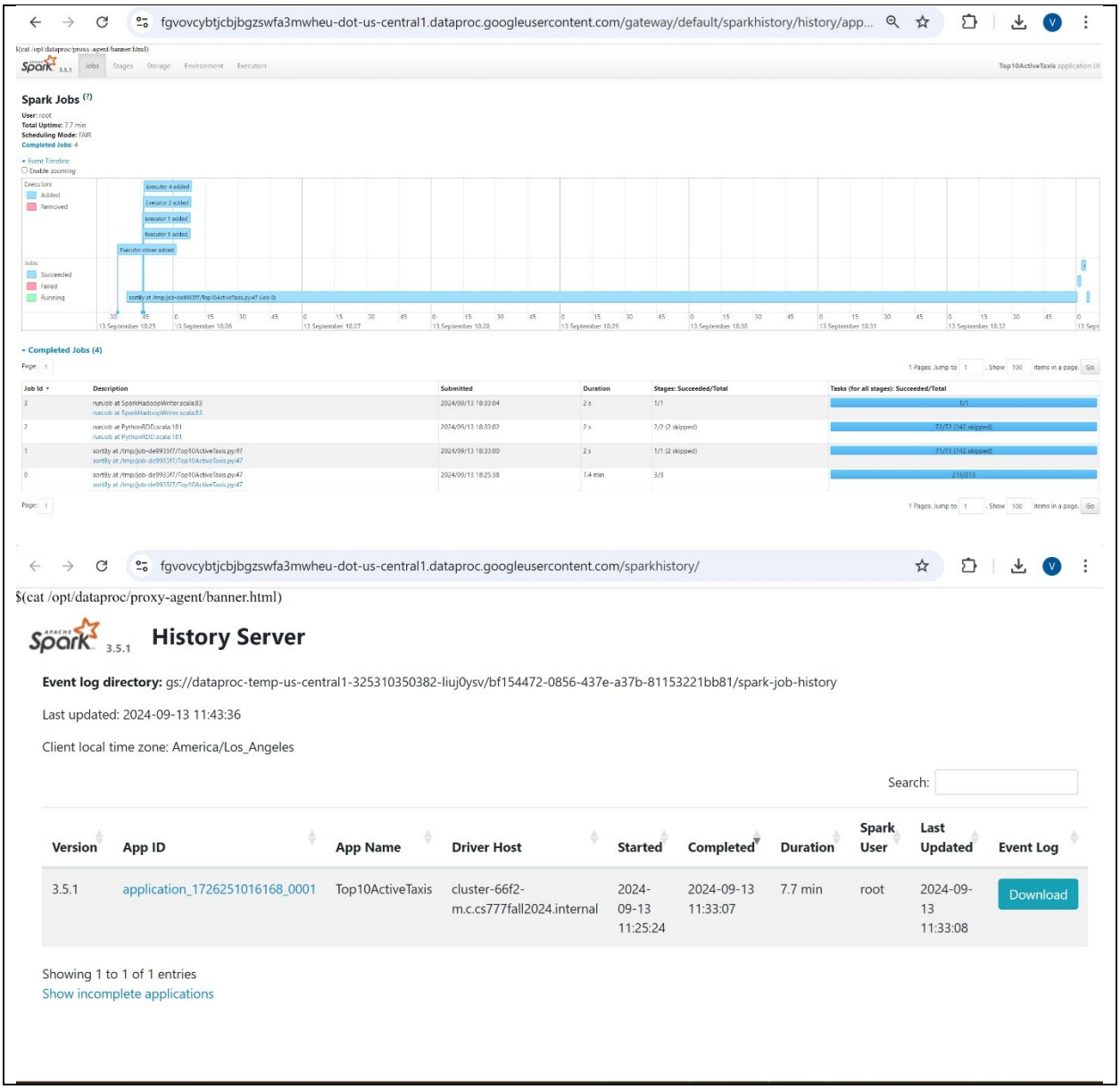
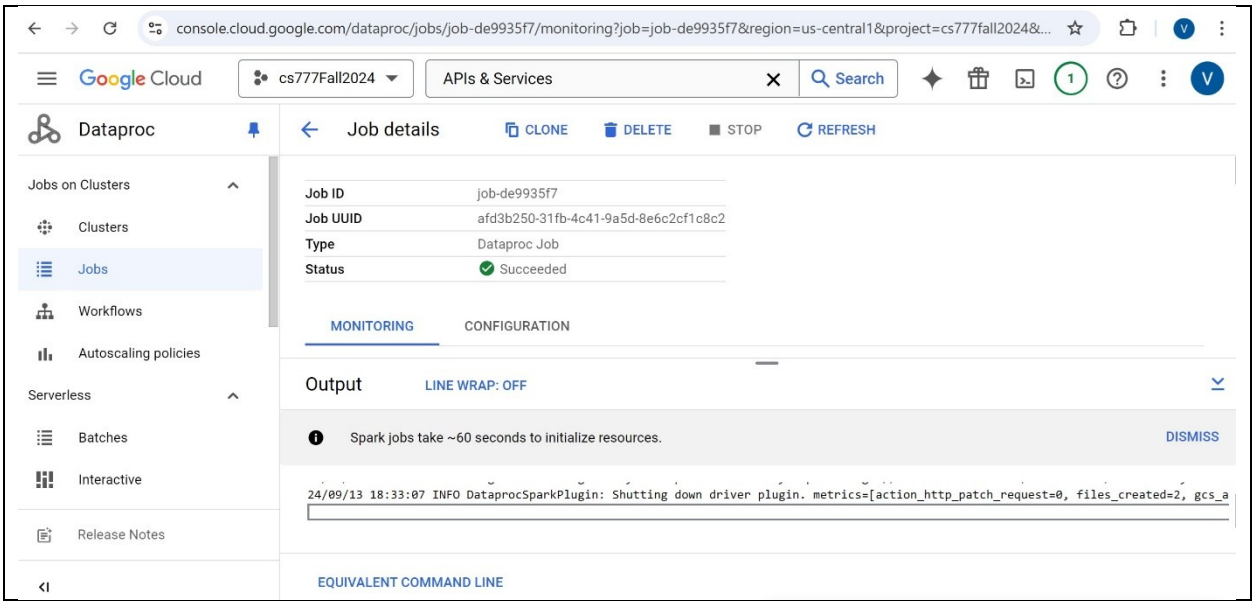
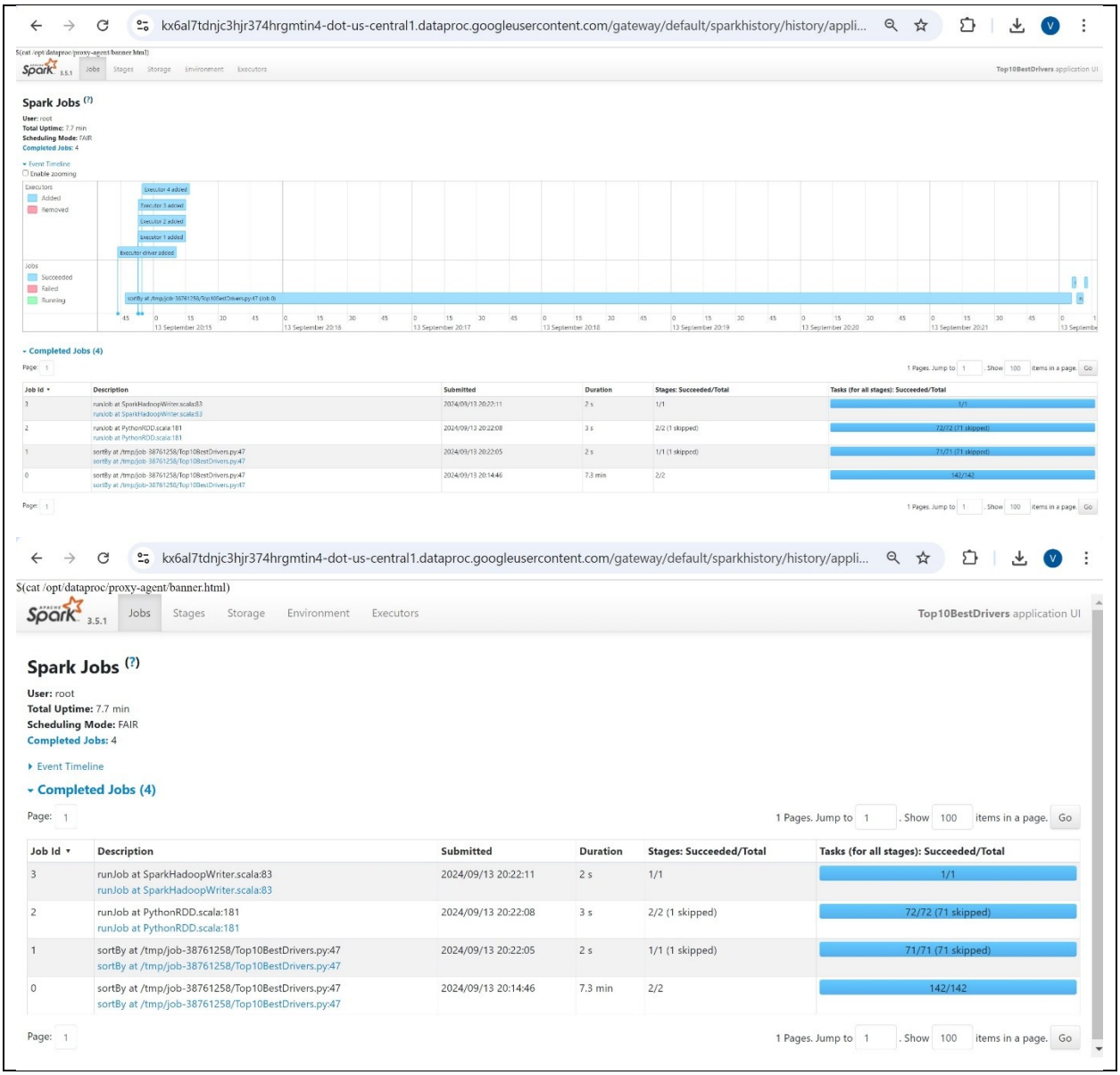
$(cat /opt/dataproc/proxy-agent/banner.html)
3.5.1
History Server
Event log directory: gs://dataproc-temp-us-central1-325310350382-liuj0ysv/21d9a2e6-6006-44aa-a479-69835a5aa43f/spark-job-history
Last updated: 2024-09-13 12:43:22
Client local time zone: America/Los_Angeles
Search:
Version
App ID
App Name
Driver Host
Started
Completed
Duration
Spark User
Last Updated
Event Log
3.5.1
application_1726255266476_0001
Top10ActiveTaxis
cluster-08bf-m.c.cs777fall2024.internal
2024-09-13 12:27:03
2024-09-13 12:34:23
7.3 min
root
2024-09-13 12:34:24
Download
Showing 1 to 1 of 1 entries
Show incomplete applications
llmuqe4ryjatjpju2x5u2turty-dot-us-central1.dataproc.googleusercontent.com/gateway/default/sparkhistory/history/applic...
Spark Jobs
User: root
Total Uptime: 7.3 min
Scheduling Mode: FAIR
Completed Jobs: 4
Event Timeline
Enable zooming
Executors
Added
Removed
Executor 4 added
Executor 2 added
Executor 3 added
Executor 1 added
Executor driver added
Jobs
Succeeded
Failed
Running
Completed Jobs (4)
Job Id
Description
Submitted
Duration
Stages: Succeeded/Total
Tasks (for all stages): Succeeded/Total


fgvovcybtjcbjbgzswfa3mwheu-dot-us-central1.dataproc.googleusercontent.com/gateway/default/sparkhistory/history/app...
Spark Jobs
Completed Jobs (4)
fgvovcybtjcbjbgzswfa3mwheu-dot-us-central1.dataproc.googleusercontent.com/sparkhistory/
$(cat /opt/dataproc/proxy-agent/banner.html)
History Server
Event log directory: gs://dataproc-temp-us-central1-325310350382-liuj0ysv/bf154472-0856-437e-a37b-81153221bb81/spark-job-history
Last updated: 2024-09-13 11:43:36
Client local time zone: America/Los_Angeles
Search:
Version
App ID
App Name
Driver Host
Started
Completed
Duration
Spark User
Last Updated
Event Log
3.5.1
application_1726251016168_0001
Top10ActiveTaxis
cluster-66f2-m.c.cs777fall2024.internal
2024-09-13 11:25:24
2024-09-13 11:33:07
7.7 min
root
2024-09-13 11:33:08
Download
Showing 1 to 1 of 1 entries
Show incomplete applications



Top-10 Best Drivers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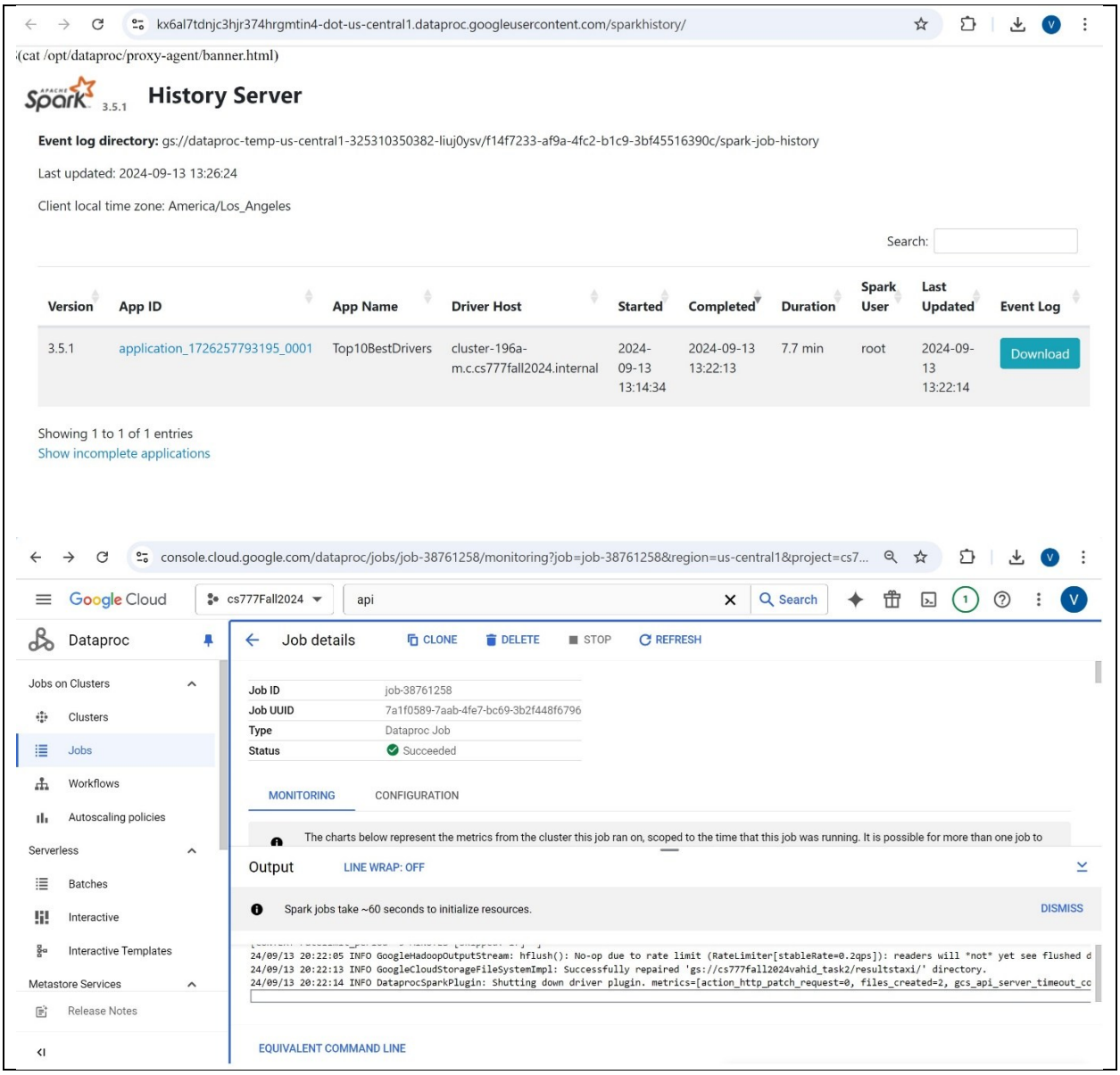
$(cat /opt/dataproc/proxy-agent/banner.html)
Spark 3.5.1
Jobs
Stages
Storage
Environment
Executors
Top10BestDrivers application UI
Spark Jobs (?)
User: root
Total Uptime: 7.7 min
Scheduling Mode: FAIR
Completed Jobs: 4
Event Timeline
Completed Jobs (4)
Page: 1
1 Pages. Jump to 1 . Show 100 items in a page. Go
Job Id
Description
Submitted
Duration
Stages: Succeeded/Total
Tasks (for all stages): Succeeded/Total
3
runJob at SparkHadoopWriter.scala:83
2024/09/13 20:22:11
2 s
1/1
1/1
2
runJob at PythonRDD.scala:181
2024/09/13 20:22:08
3 s
2/2 (1 skipped)
72/72 (71 skipped)
1
sortBy at /tmp/job-38761258/Top10BestDrivers.py:47
2024/09/13 20:22:05
2 s
1/1 (1 skipped)
71/71 (71 skipped)
0
sortBy at /tmp/job-38761258/Top10BestDrivers.py:47
2024/09/13 20:14:46
7.3 min
2/2
142/142


kx6al7tdnjc3hjr374hrgmtin4-dot-us-central1.dataproc.googleusercontent.com/sparkhistory/
(cat /opt/dataproc/proxy-agent/banner.html)
History Server
Event log directory: gs://dataproc-temp-us-central1-325310350382-liuj0ysv/f14f7233-af9a-4fc2-b1c9-3bf45516390c/spark-job-history
Last updated: 2024-09-13 13:26:24
Client local time zone: America/Los_Angeles
Search:
Version
App ID
App Name
Driver Host
Started
Completed
Duration
Spark User
Last Updated
Event Log
3.5.1
application_1726257793195_0001
Top10BestDrivers
cluster-196a-m.c.cs777fall2024.internal
2024-09-13 13:14:34
2024-09-13 13:22:13
7.7 min
root
2024-09-13 13:22:14
Download
Showing 1 to 1 of 1 entries
Show incomplete applications
console.cloud.google.com/dataproc/jobs/job-38761258/monitoring?job=job-38761258&region=us-central1&project=cs7...
Google Cloud
cs777Fall2024
api
Search
Dataproc
Job details
CLONE
DELETE
STOP
REFRESH
Jobs on Clusters
Clusters
Jobs
Workflows
Autoscaling policies
Serverless
Batches
Interactive
Interactive Templates
Metastore Services
Release Notes
Job ID
job-38761258
Job UUID
7a1f0589-7aab-4fe7-bc69-3b2f448f6796
Type
Dataproc Job
Status
Succeeded
MONITORING
CONFIGURATION
The charts below represent the metrics from the cluster this job ran on, scoped to the time that this job was running. It is possible for more than one job to
Output
LINE WRAP: OFF
Spark jobs take ~60 seconds to initialize resources.
DISMISS
24/09/13 20:22:05 INFO GoogleHadoopOutputStream: hflush(): No-op due to rate limit (RateLimiter[stableRate=0.2qps]): readers will *not* yet see flushed d
24/09/13 20:22:13 INFO GoogleCloudStorageFileSystemImpl: Successfully repaired 'gs://cs777fall2024vahid_task2/resultstaxi/' directory.
24/09/13 20:22:14 INFO DataprocSparkPlugin: Shutting down driver plugin. metrics=[action_http_patch_request=0, files_created=2, gcs_api_server_timeout_cc
EQUIVALENT COMMAND LINE