Big Data Analytics Techniques and Applications _ HW3

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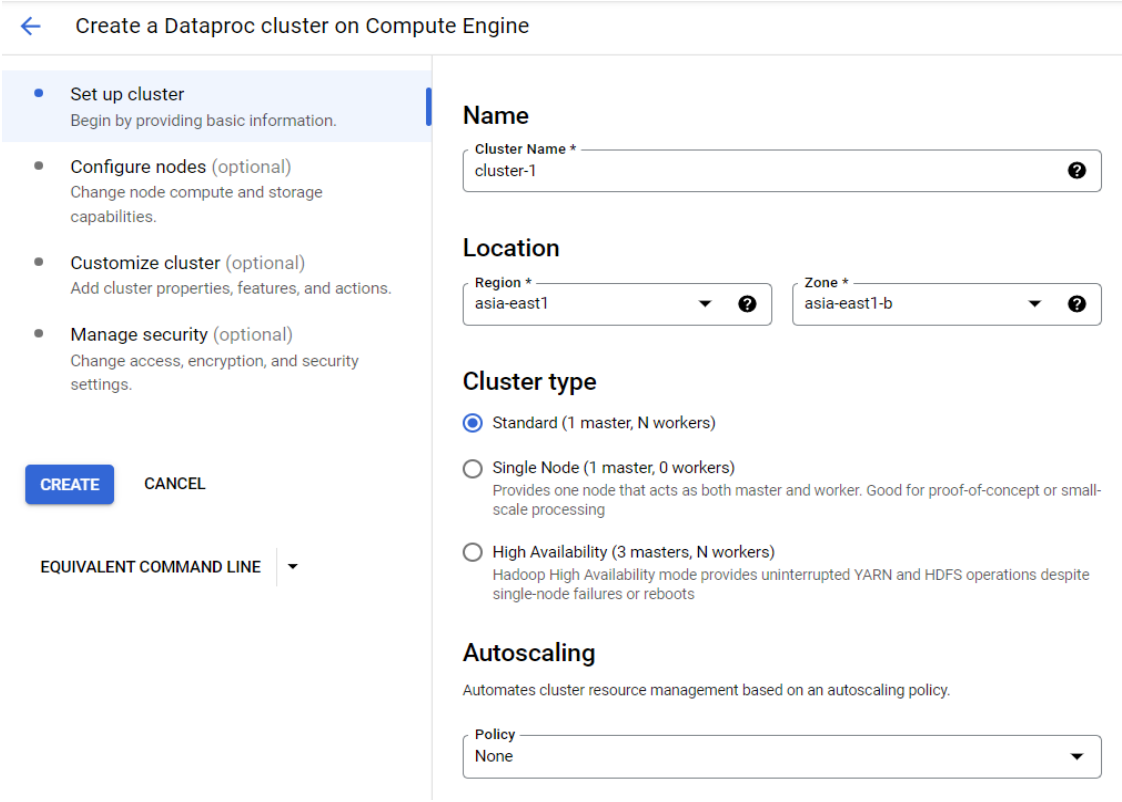
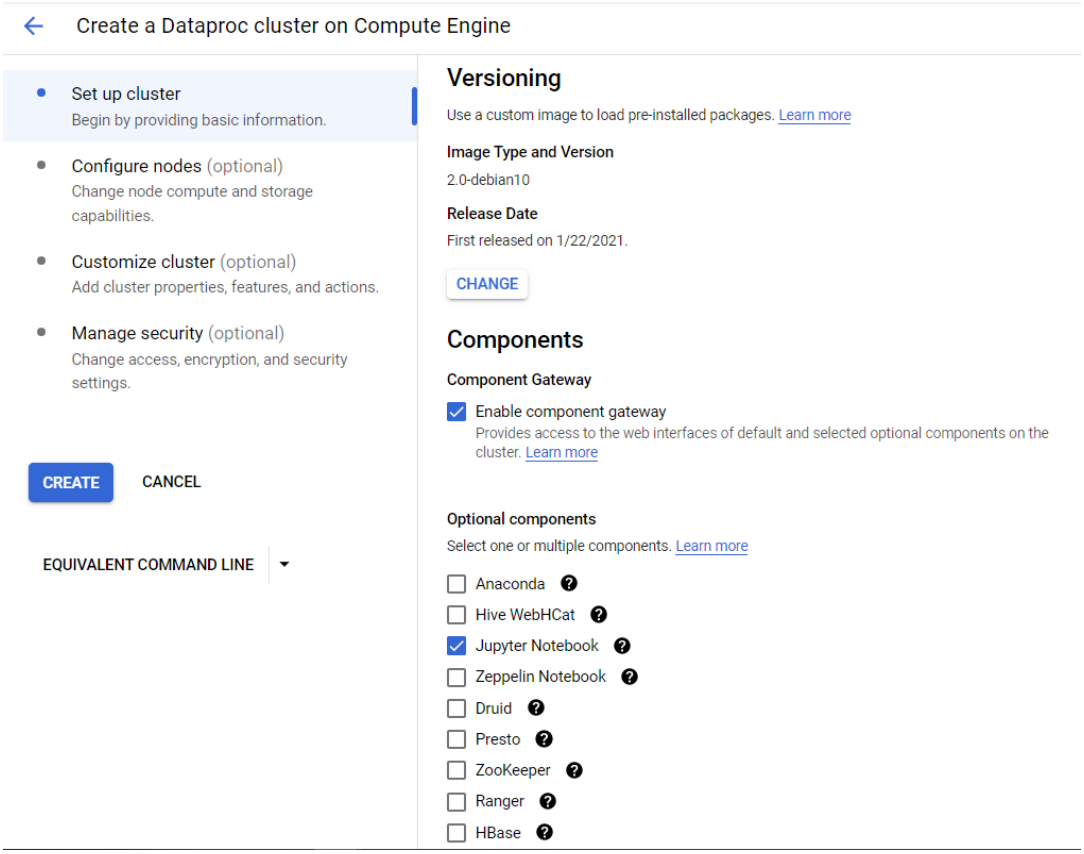
Environment Setup

Google Cloud Platform (GCP) 中的 Dataproc 項下設置叢集(Cluster)

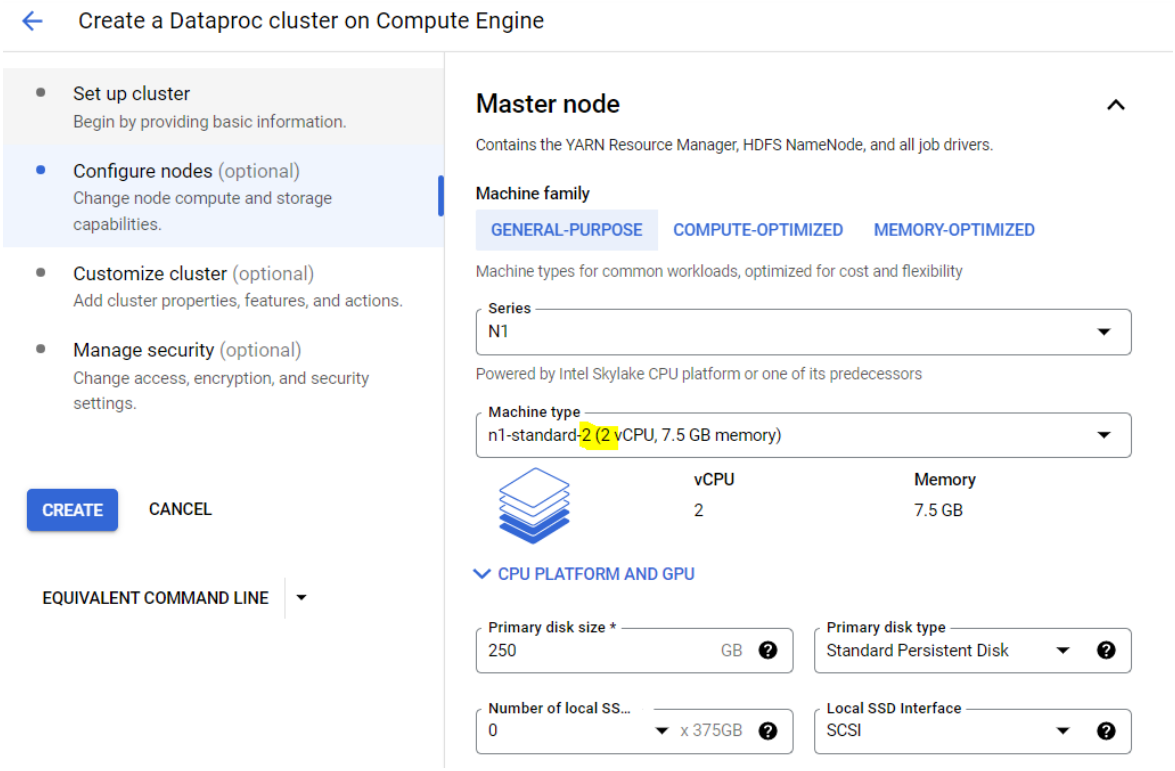
Step1: 將區域設為 asia-east1 (台灣)，並勾選設定元件(Componets)與選用 jupyter notebook





Step2: 將主要節點(Master node)進行設定，系列(Series)設為”N1”；機型類型設為 n1-standard-2

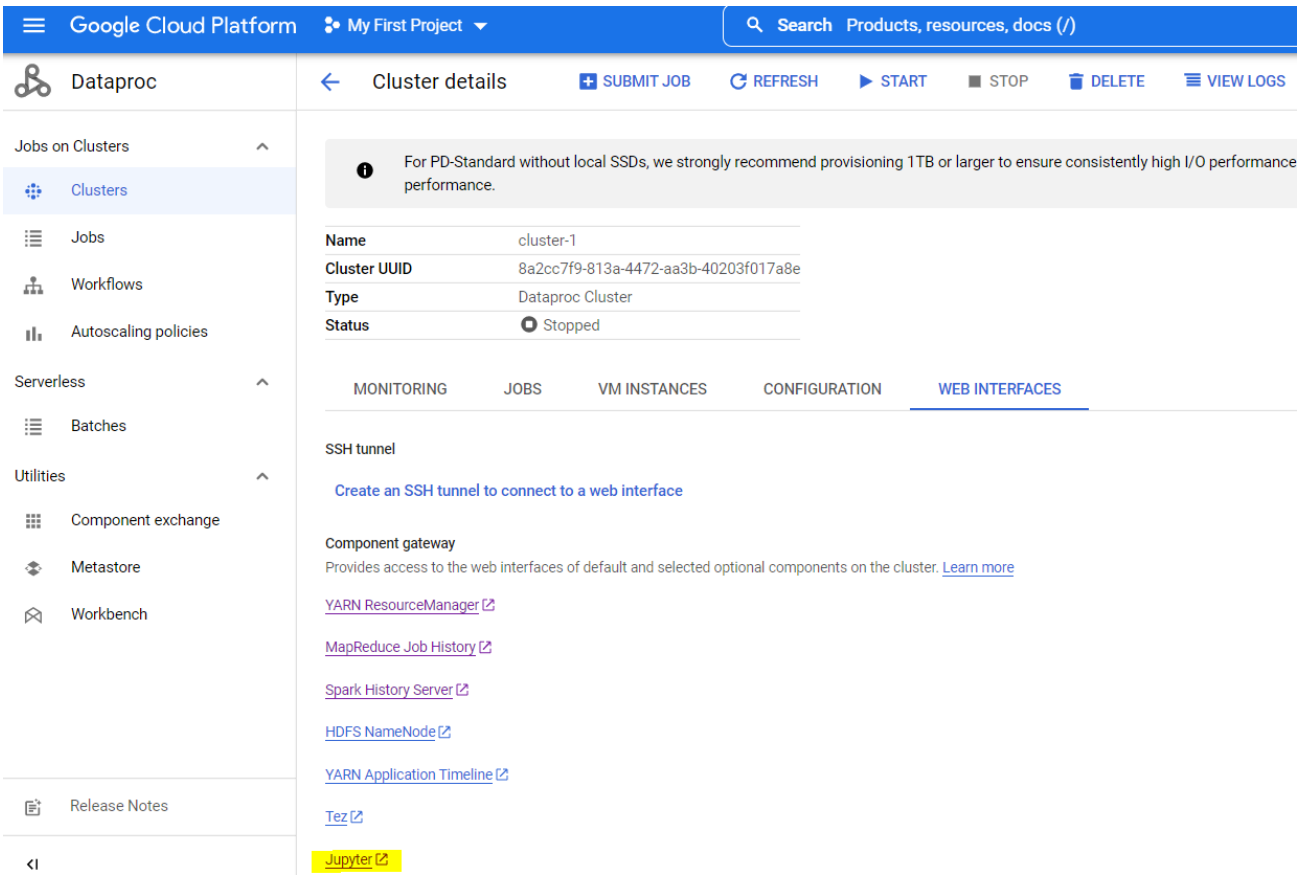
Note: Customize cluster 與 Manage security 維持原本預設即可。



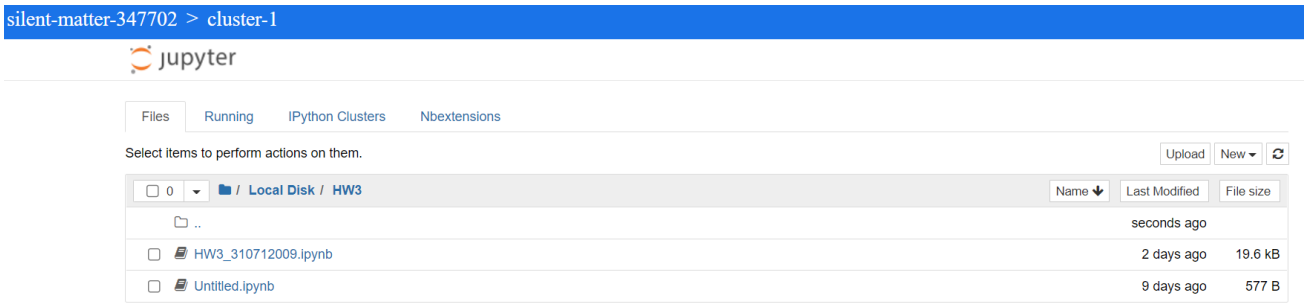
Step3: 將資料放在值區(cloud storage)中，之後可以直接呼叫。

Note: 資料放到值區(cloud storage)中會被收費的。

Step4: 接下來回到 Dataproc 中的 Cluster (叢集) 頁面，點“Web interfaces (網路介面)”，再點 Jupyter。



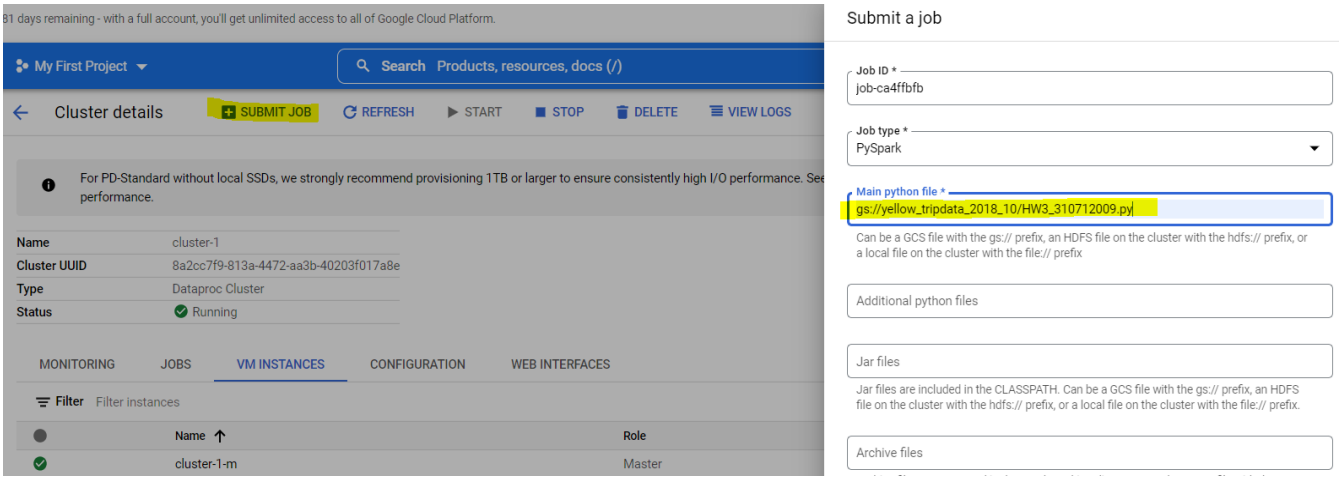
Step5: 再將程式匯入或是建立一個新的 Notebook，就可以運作了。



Other approach

另外，也可以使用“Submit Job”來執行程式，先把程式上傳到值區，點選 Submit Job 後選擇 Job Type (Pyspark, Python) 檔案。

Note: 路徑為 gs://程式位置/程式名稱



Q1: Implement a program to calculate the average occurrences of each word in a sentence in the attached article (Youvegottofindwhatyoulove.txt).

- **A. Show the top 30 most frequent occurring words and their average occurrences in a sentence.**
- **B. According to the result, what are the characteristics of these words?**

Step1: 讀取已上傳到 cloud storage 的檔案

```
path0 = 'gs://yellow_tripdata_2018_10/Youvegottofindwhatyoulove.txt'
text1 = pd.read_table(path0, header = None)
```

Step2: 將 txt 檔中文章放入 list 中，先查看檔案內容來決定如何將句子做處理，依序分段切出來，並將空值移除，如下圖。

```
rdd = sc.parallelize(text1.loc[:,0].tolist())
lines = rdd.collect()
lines
```

```
['I am honored to be with you today at your commencement from one of the finest universities in th
e world. I never graduated from college. Truth be told, this is the closest I've ever gotten to a
college graduation. Today I want to tell you three stories from my life. That's it. No big deal. J
ust three stories.',
 'I dropped out of Reed College after the first 6 months, but then stayed around as a drop-in for
another 18 months or so before I really quit. So why did I drop out?',
 'It started before I was born. My biological mother was a young, unwed college graduate student,
and she decided to put me up for adoption. She felt very strongly that I should be adopted by coll
```

```
lines1 = []
for l in lines:
  s1 = l.split('.')
  for i in range(len(s1)):
    lines1.append(s1[i])

lines1
```

```
lines_clean = []
for i in lines1:
  if i != '':
    lines_clean.append(i)

lines_clean
```

```
['I am honored to be with you today at your commencement from one of the finest universities in the world',
 ' I never graduated from college',
 ' Truth be told, this is the closest I've ever gotten to a college graduation',
 ' Today I want to tell you three stories from my life',
 ' That's it',
 ' No big deal',
 ' Just three stories',
 'I dropped out of Reed College after the first 6 months, but then stayed around as a drop-in for another 18 months or so before I really quit',
 ' So why did I drop out?',
 'It started before I was born',
 ' My biological mother was a young, unwed college graduate student, and she decided to put me up for adoption',
 ' She felt very strongly that I should be adopted by college graduates, so everything was all set for me to be adopted at birth by a lawyer and his wife',
 ' Except that when I popped out they decided at the last minute that they really wanted a girl',
 ' So my parents, who were on a waiting list, got a call in the middle of the night asking: "We have an unexpected baby boy; do you want him?" They said: "Of course',
'" My biological mother later found out that my mother had never graduated from college and that my father had never graduated from high school',
 ' She refused to sign the final adoption papers',
 ' She only relented a few months later when my parents promised that I would someday go to college',
'And 17 years later I did go to college',
```

Step3: 這次對於字串的處理，將標點符號用空格區分，將字串中的標點符號做清理。

Note: 標點符號相關的清理也可以使用 re 這個 library 來做正規化的處理。

```
# function for cleaning the data
def clean_data(data):
    data.replace("[^a-zA-Z]", " ", regex=True, inplace=True)
    return data
```

Step4: 最後來計算每個字出現的次數，及出線的頻率，由多到少 print 出結果(words、出現次數、出現頻率)，如下圖右側。

```
# Create an empty dictionary
d = dict()

# Loop through each line of the file
for line in lines_1:
    # Remove the leading spaces and newline character
    line = line.strip()

    # Convert the characters in line to
    # lowercase to avoid case mismatch
    line = line.lower()

    # Split the line into words
    words = line.split(" ")

    # Iterate over each word in line
    for word in words:
        # Check if the word is already in dictionary
        if word in d:
            # Increment count of word by 1
            d[word] = d[word] + 1
        else:
            # Add the word to dictionary with count 1
            d[word] = 1
```

```
from collections import Counter
d1 = Counter(d)
d1.most_common()
for k, v in d1.most_common(30):
  print('%s: %i: %i' % (k, v, v/len(lines_1)))
```

Answer:

```
the: 96: 0.67
i: 86: 0.60
to: 71: 0.49
and: 66: 0.46
it: 52: 0.36
was: 48: 0.33
a: 46: 0.32
of: 41: 0.28
that: 38: 0.26
in: 34: 0.24
you: 30: 0.21
my: 30: 0.21
is: 28: 0.19
had: 22: 0.15
with: 18: 0.12
out: 18: 0.12
for: 17: 0.12
so: 17: 0.12
have: 17: 0.12
your: 16: 0.11
all: 16: 0.11
as: 15: 0.10
me: 15: 0.10
on: 15: 0.10
what: 15: 0.10
but: 14: 0.10
be: 13: 0.09
from: 13: 0.09
college: 13: 0.09
life: 13: 0.09
```

Conclusion:

可以從 answer 中得知，需多較常出現的字多為都是介系詞或連接詞，如過要做進一步的 NLP processing 建議要 import nltk 中的 stopwords 可以過濾經常出現但不是那麼重要的字。

Q2: In YARN cluster mode, implement a program to calculate the average amount ("Total_amount") in credit card trip and cash trip for different numbers of passengers, which are from one to four passengers in 2018/10 NYC Yellow Taxi trip data. In NYC Taxi data, the "Passenger_count" is a driver-entered value. Explain also how you deal with the data loss issue

Step1: 設置 YARN cluster mode，Import Library

```
In [1]: import pandas as pd
        from pyspark.sql import SparkSession
        from pyspark import SparkConf, SparkContext
```

```
In [2]: # yarn cluster
        # spark = SparkSession.builder.master("local[*]").appName("HW").getOrCreate()
        spark = SparkSession.builder.master("yarn").appName("user").getOrCreate()
        sparkcontext = spark.sparkContext

        Setting default log level to "WARN".
        To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
        22/04/29 04:30:17 INFO org.apache.spark.SparkEnv: Registering MapOutputTracker
        22/04/29 04:30:17 INFO org.apache.spark.SparkEnv: Registering BlockManagerMaster
        22/04/29 04:30:17 INFO org.apache.spark.SparkEnv: Registering BlockManagerMasterHeartbeat
        22/04/29 04:30:17 INFO org.apache.spark.SparkEnv: Registering OutputCommitCoordinator
```

Step2: 讀取 cloud storage 中的檔案，並取所需要的藍未來做後續處理。

```
: path1 = 'gs://yellow_tripdata_2018_10/yellow_tripdata_2018-10.csv'

  # data
  data_1 = spark.read.csv(path1, header=True, inferSchema=True)
```

```
: import pyspark.sql.functions as f

  data_q2 = data_1.select("total_amount", "passenger_count", "payment_type")
```

Step3: 計算兩中不同付款方式 credit card(i = 1) 和 cash(i = 2) 下，Passenger_count 中各人數區間(1~4 人)的 total amount 之平均值分別計算出來。

```
passenger_count = [1,2,3,4]
Credit_card_agv = []
Cash_agv = []

for i in range(1,3):
  for j in range(1, 5):
    d1 = data_q2.filter((data_q2.payment_type == i) & (data_q2.passenger_count == j)).agg({'total_amount': 'avg'}).collect()[0]['
    if i == 1:
      Credit_card_agv.append(d1)
    else:
      Cash_agv.append(d1)

print(Credit_card_agv)
print(Cash_agv)
```

```
[Stage 23:==================================================>        (5 + 1) / 6]

[18.095616294838994, 18.82315922602104, 18.397956039882864, 18.679751424181198]
[13.682682121839113, 14.729072956250409, 14.810038897804315, 15.506981138430348]
```

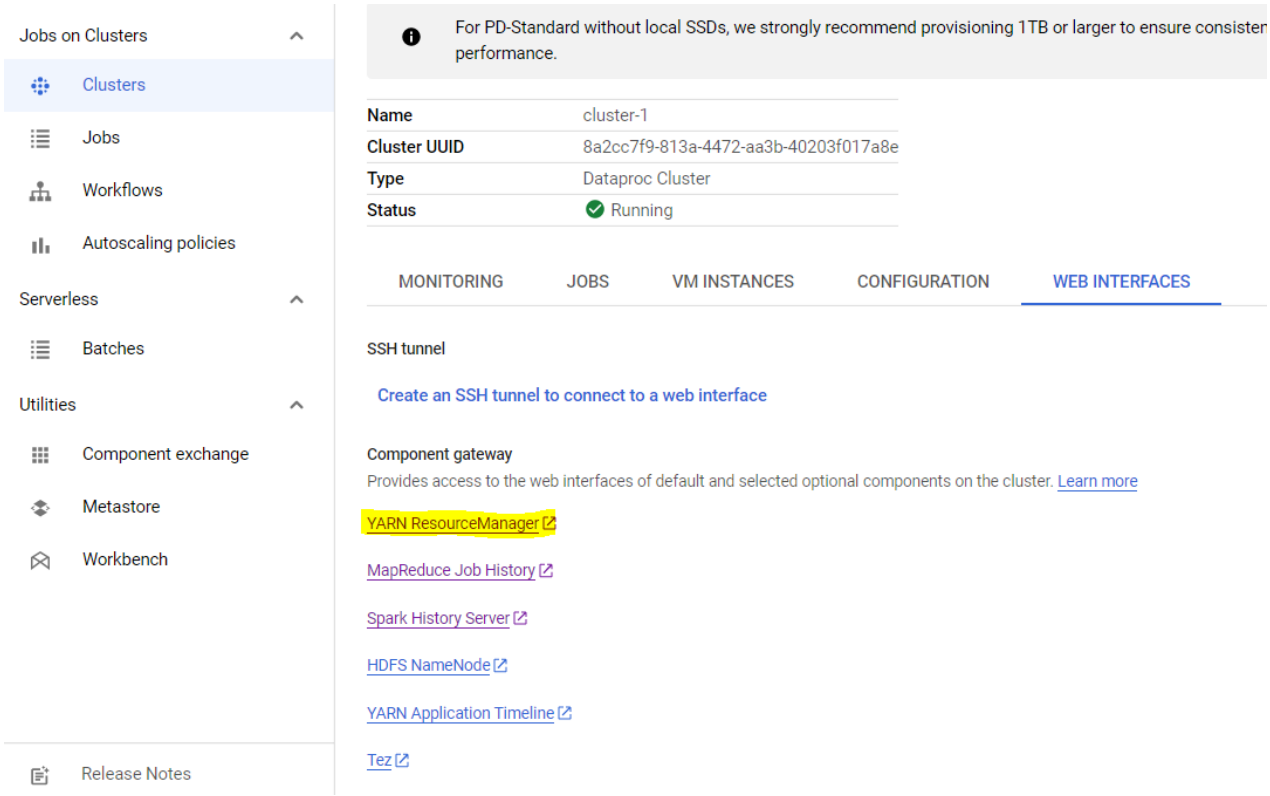
Step4: 將計算出來的資料作整理放入 dataframe 中展示出來，即可清楚看到不同人數的 Passenger_count 以及所對應的 total amount 之平均值。

```
# specify column names
columns = ['passenger_count', 'Credit_card_agv', 'Cash_agv']

# creating a dataframe by zipping the two lists
dataframe = spark.createDataFrame(zip(passenger_count, Credit_card_agv, Cash_agv), columns)

# show data frame
dataframe.show()
```

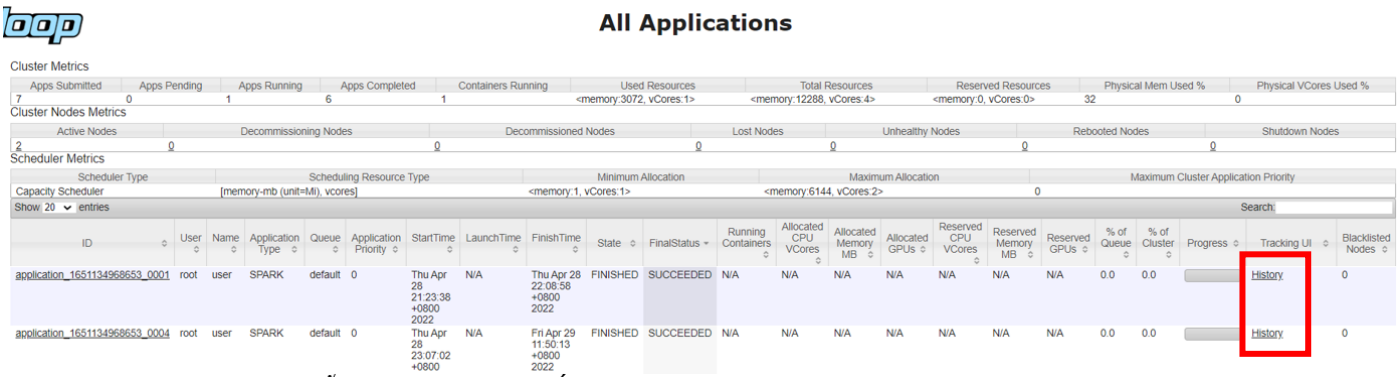
```
[Stage 27:===================>                                    (1 + 2) / 3]

+---------------+------------------+------------------+
|passenger_count|   Credit_card_agv|          Cash_agv|
+---------------+------------------+------------------+
|              1| 18.09561629483899|13.682682121839113|
|              2|18.823159226021037|14.729072956250409|
|              3|18.397956039882864|14.810038897804311|
|              4|18.679751424181198|15.506981138430348|
+---------------+------------------+------------------+
```

Q3: Referring to Q2, monitor HDFS and YARN metrics through HTTP API; collect MapReduce counters-related information through the web UI. Please provide screenshots and observations regarding the metrics in your report. (Read through this guide to finish the question). Anything else worth mentioning (e.g. other valuable observations, or difficulties encountered in this work and how you resolve them).

Step1: 程式執行完之後，回到 Dataproc 的 cluster 中的 Webinterfaces，並點選“YARN ResourceManager”



Step2: 這裡有你執行的所有紀錄，可以點選 History 了解更多詳細內容。



Step3: 這裡會進到 Spark History Service(也可以直接點選 Web Interfaces 項下的 Spark History Service 進入)，找到你對應的 App id 可以查看各項執行的數據。

History Server

Event log directory: gs://dataproc-temp-asia-east1-969376720804-lazhx3mm/8a2cc7f9-813a-4472-aa3b-40203f017a8e/spark-job-history

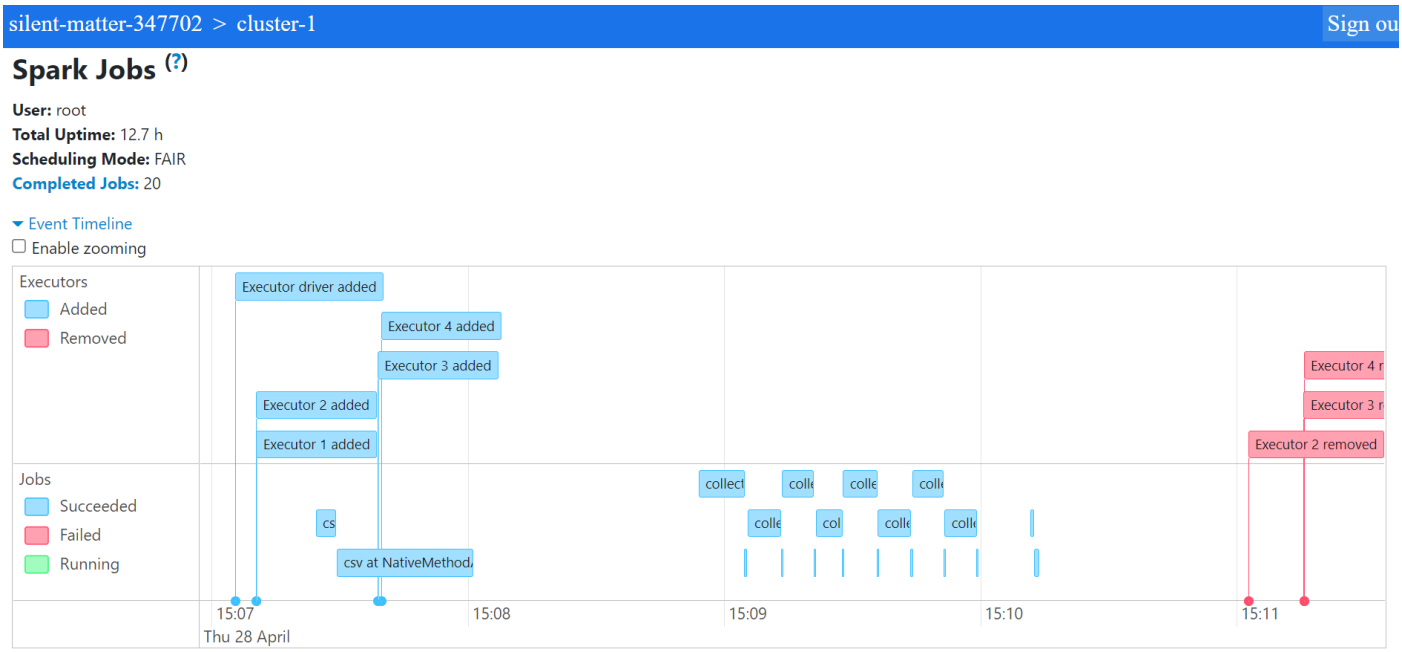
Last updated: 2022-04-29 14:08:58

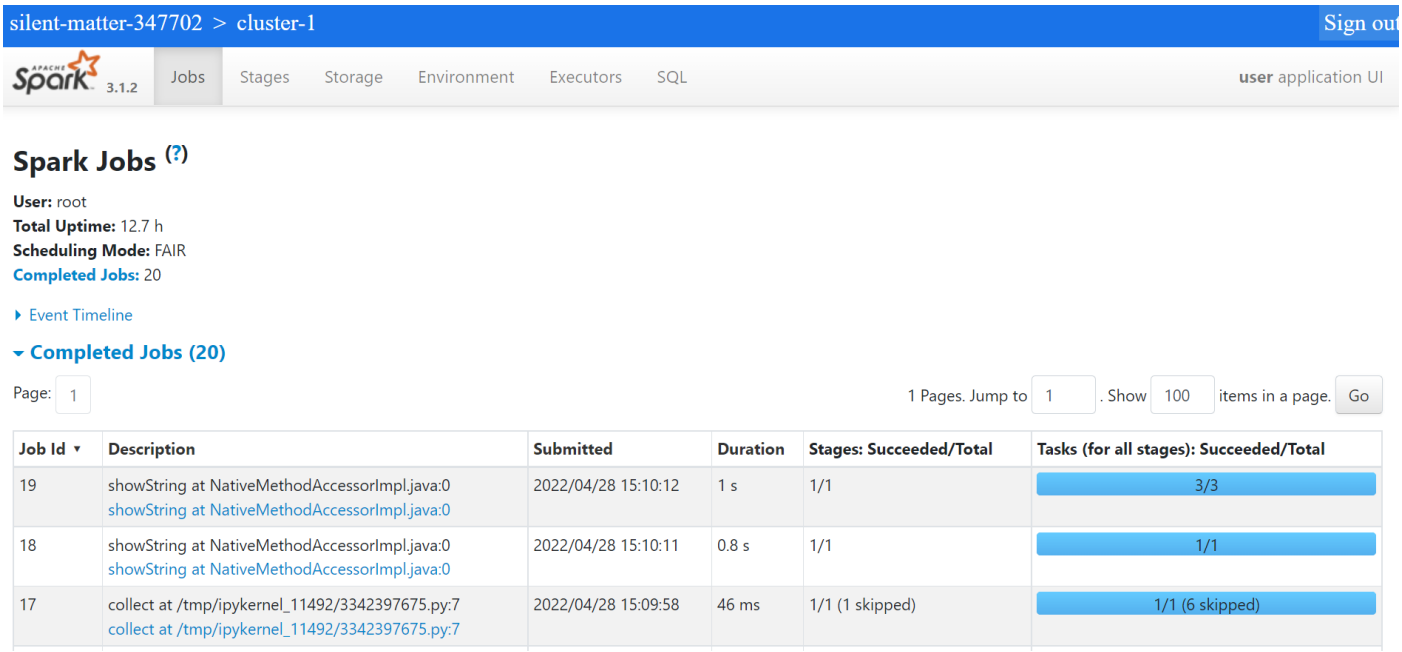
Client local time zone: Etc/GMT-8

Search:

Version	App ID	App Name	Driver Host	Started	Completed	Duration	Spark User	Last Updated	Event Log
3.1.2	application_1651134968653_0004	user	cluster-1-w-1.asia-east1-b.c.silent-matter-347702.internal	2022-04-28 23:06:57	2022-04-29 11:50:13	12.7 h	root	2022-04-29 11:50:14	Download
3.1.2	application_1651134968653_0001	user	cluster-1-w-0.asia-east1-b.c.silent-matter-347702.internal	2022-04-28 21:23:32	2022-04-28 22:08:58	45 min	root	2022-04-28 22:08:59	Download
3.1.2	local-1650970567472	HW	cluster-1-m.asia-east1-b.c.silent-matter-347702.internal	2022-04-26 18:56:05	2022-04-26 19:02:43	6.6 min	root	2022-04-26 19:02:44	Download

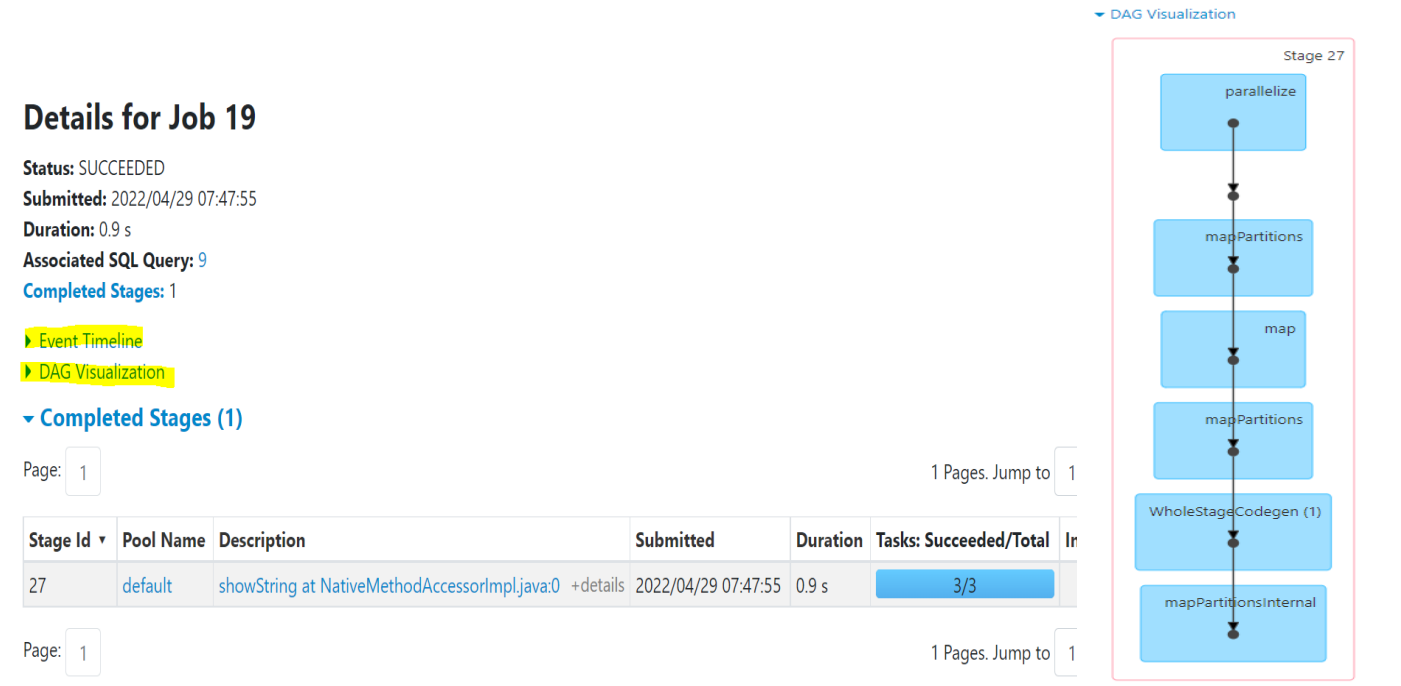
Step4: 你可以藉由 Event Timeline 中圖表了解到你哪個階段、什麼時間點、做了什麼事情。另外，你也可以從 Complete Jobs 中了解到每個步驟所時間。

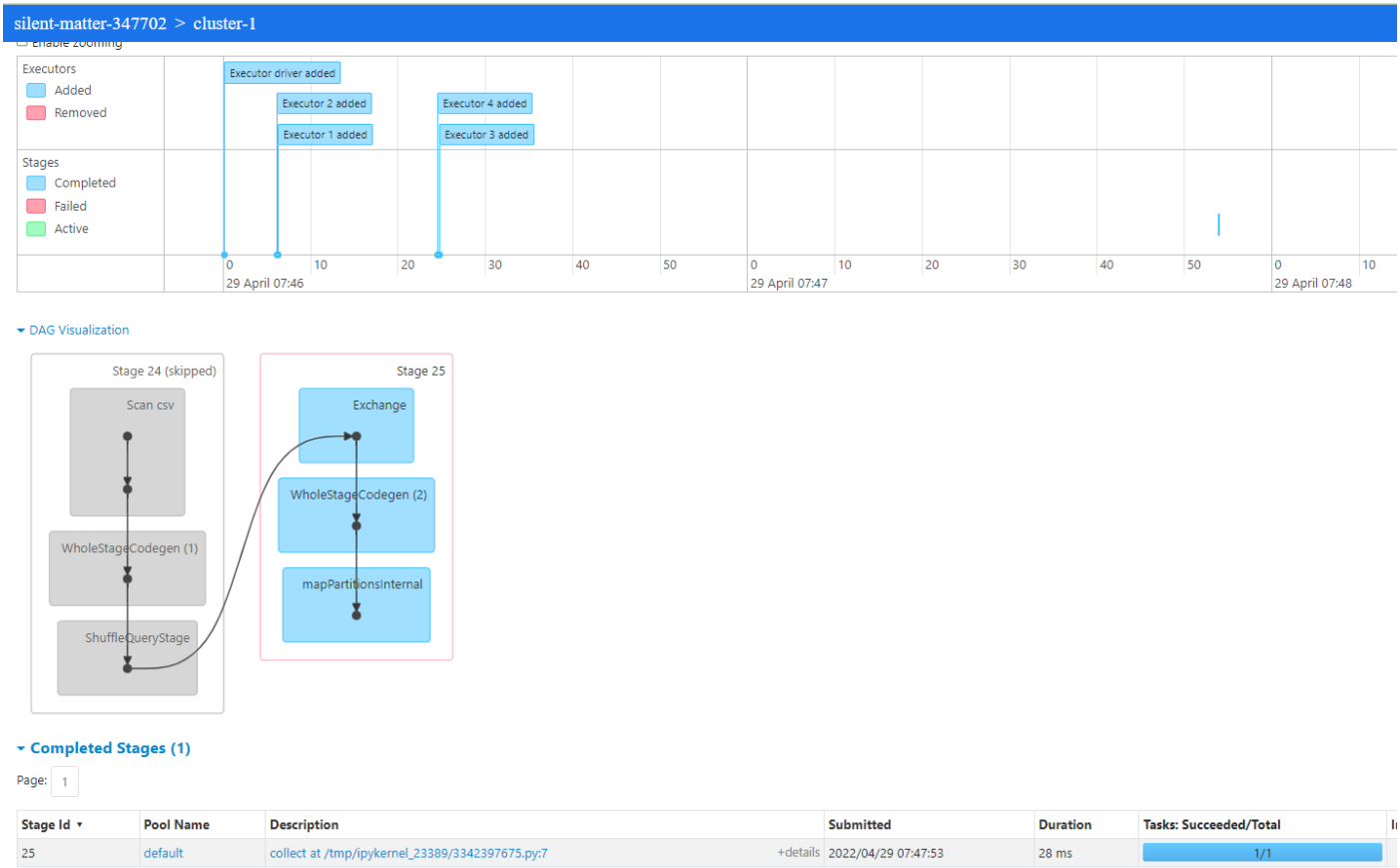




Other valuable observations, or difficulties encountered in this work and how you resolve them

(1) 你可以點 Description 來查看更細部的訊息，這個裡面除了剛剛上面說的 Event Timeline 與 Complete Jobs 外，還有 “DAG Visualization” ，google 用圖形化的方式呈現執行步驟讓你更加清楚與了解 Spark 下的運作。





(2) 藉由時間消耗可以知道 showString 所使用的時間較 collect 多出許多。

(3) 有時候使用 YARN cluster mode 時，在重複執行程式的後如果發現結果有誤(如下圖一)，可以在 Jypyter notebook 中江 Kernel 重新 restart 再去 Run 結果就會正常了(如下圖二)，這有可能是 Kernel 中資源重複抓取的原因。

```
dataframe.show()
```

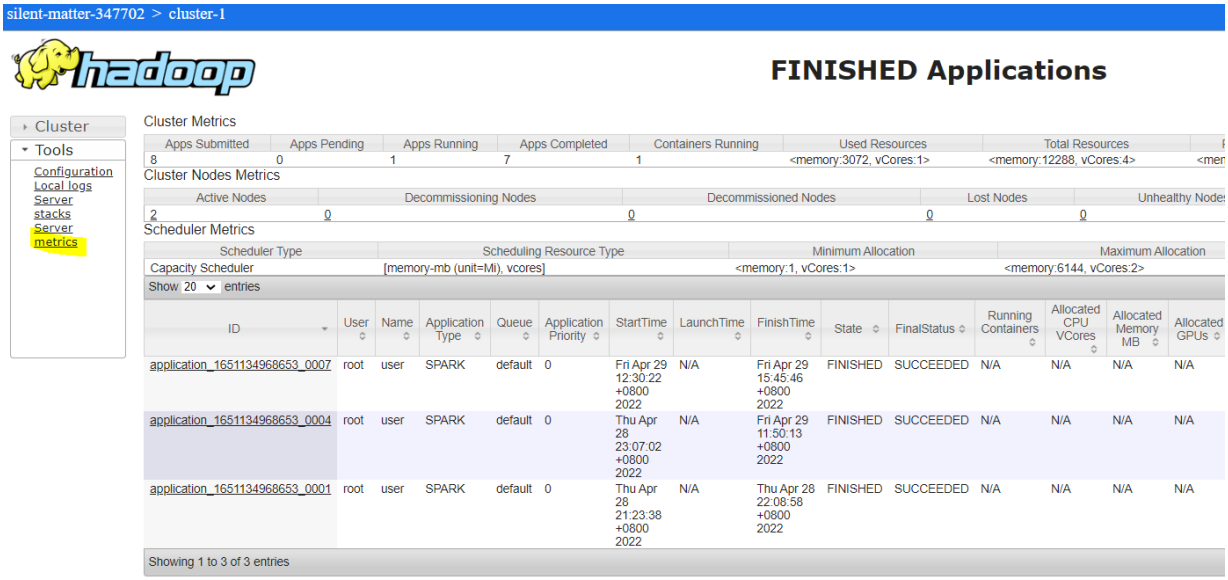
```
+---------------+-----------------+-----------------+
|passenger_count|  Credit card_agv|         Cash_agv|
+---------------+-----------------+-----------------+
|              1| 16.8150032579668| 16.8150032579668|
|              2|17.55266010762928|17.55266010762928|
|              3|17.23603242470929|17.23603242470929|
|              4|17.52751244328926|17.52751244328926|
+---------------+-----------------+-----------------+
```

Restart 之後結果就正常了

```
dataframe.show()
```

```
+---------------+------------------+------------------+
|passenger_count|   Credit_card_agv|          Cash_agv|
+---------------+------------------+------------------+
|              1| 18.09561629483899|13.682682121839113|
|              2| 18.82315922602104| 14.72907295625041|
|              3|18.397956039882864|14.810038897804311|
|              4|18.679751424181198|15.506981138430348|
+---------------+------------------+------------------+
```

(4) Interfaces 中的 YARN Resource Manager 可以讓你進一步看到 YARN metric (如下方截圖)

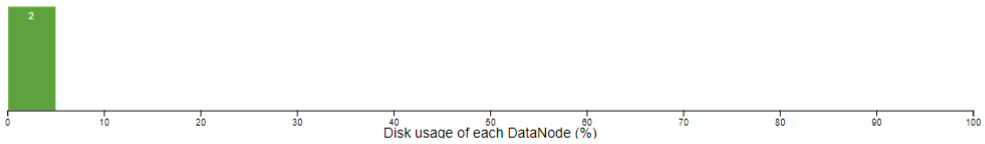


silent-matter-347702 > cluster-1


```
{
  "beans" : [ {
    "name" : "Hadoop:service=ResourceManager,name=RMNMInfo",
    "modelerType" : "org.apache.hadoop.yarn.server.resourcemanager.RMNMInfo",
    "LiveNodeManagers" : "[{\"HostName\":\"cluster-1-w-0.asia-east1-b.c.silent-matter-347702.internal\",\"Rack\":\"/
b.c.silent-matter-347702.internal:8042\",\"LastHealthUpdate\":1651223347567,\"HealthReport\":\"\",\"NodeManagerVersi
347702.internal\",\"Rack\":\"/default-rack\",\"State\":\"RUNNING\",\"NodeId\":\"cluster-1-w-1.asia-east1-b.c.silent-
347702.internal:8042\",\"LastHealthUpdate\":1651223346852,\"HealthReport\":\"\",\"NodeManagerVersion\":\"3.2.2\",\"N
  }, {
    "name" : "Hadoop:service=ResourceManager,name=RpcActivityForPort8033",
    "modelerType" : "RpcActivityForPort8033",
    "tag.port" : "8033",
    "tag.serverName" : "ResourceManagerAdministrationProtocolService",
    "tag.Context" : "rpc",
    "tag.NumOpenConnectionsPerUser" : "{}",
    "tag.Hostname" : "cluster-1-m",
    "ReceivedBytes" : 0,
    "SentBytes" : 0,
    "RpcQueueTimeNumOps" : 0,
    "RpcQueueTimeAvgTime" : 0.0,
    "RpcLockWaitTimeNumOps" : 0,
    "RpcLockWaitTimeAvgTime" : 0.0,
    "RpcProcessingTimeNumOps" : 0,
    "RpcProcessingTimeAvgTime" : 0.0,
```


(5) Interfaces 中的 HDFS NameNode 可以查看 Node 與 HDFS metric 的資訊。

Datanode usage histogram



In operation

Show 25 entries

Search:

Node	Http Address	Last contact	Last Block Report	Capacity	Blocks	Block pool used	Version
cluster-1-w-0.asia-east1-b.c.silent-matter-347702.internal:9866 (10.140.0.3:9866)	http://cluster-1-w-0.asia-east1-b.c.silent-matter-347702.internal:9864	1s	152m	245.89 GB	15	5.86 MB (0%)	3.2.2
cluster-1-w-1.asia-east1-b.c.silent-matter-347702.internal:9866 (10.140.0.2:9866)	http://cluster-1-w-1.asia-east1-b.c.silent-matter-347702.internal:9864	1s	40m	245.89 GB	15	5.86 MB (0%)	3.2.2

Showing 1 to 2 of 2 entries

Previous 1 Next

silent-matter-347702 > cluster-1


```
{
  "beans" : [ {
    "name" : "Hadoop:service=NameNode,name=JvmMetrics",
    "modelerType" : "JvmMetrics",
    "tag.Context" : "jvm",
    "tag.ProcessName" : "NameNode",
    "tag.SessionId" : null,
    "tag.Hostname" : "cluster-1-m",
    "MemNonHeapUsedM" : 70.65913,
    "MemNonHeapCommittedM" : 72.25,
    "MemNonHeapMaxM" : -1.0,
    "MemHeapUsedM" : 45.64061,
    "MemHeapCommittedM" : 114.125,
    "MemHeapMaxM" : 1473.375,
    "MemMaxM" : 1473.375,
    "GcCountParNew" : 47,
    "GcTimeMillisParNew" : 1181,
    "GcCountConcurrentMarkSweep" : 2,
    "GcTimeMillisConcurrentMarkSweep" : 142,
    "GcCount" : 49,
    "GcTimeMillis" : 1323,
    "GcNumWarnThresholdExceeded" : 0,
    "GcNumInfoThresholdExceeded" : 4,
    "GcTotalExtraSleepTime" : 11399,
    "ThreadsNew" : 0,
    "ThreadsRunnable" : 13,
    "ThreadsBlocked" : 0,
    "ThreadsWaiting" : 7,
    "ThreadsTimedWaiting" : 55,
    "ThreadsTerminated" : 0,
    "LogFatal" : 0,
    "LogError" : 0,
    "LogWarn" : 2,
    "LogInfo" : 519
  }, {
    "name" : "Hadoop:service=NameNode,name=RpcActivityForPort8051
```

(6) 此外你也可以在 Interfaces 中查看 YARN Application Timeline，了解 Applications 的完成狀況。