Google Cloud

Leveraging GCP

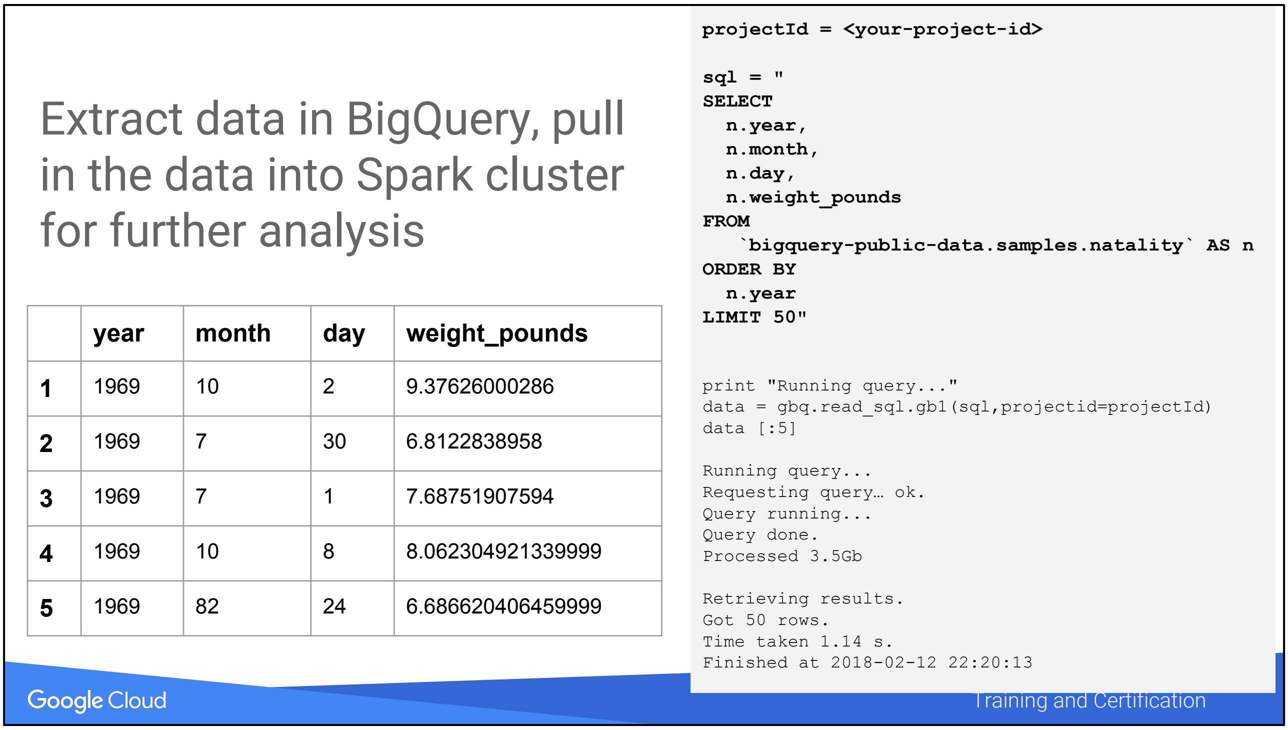
Data Engineering on Google Cloud Platform

Notes:

25 slides + 1 lab: 1 hour

Agenda

BigQuery support + Lab
Customizing clusters + Lab



Extract data in BigQuery, pull in the data into Spark cluster for further analysis

	year	month	day	weight_pounds
1	1969	10	2	9.37626000286
2	1969	7	30	6.8122838958
3	1969	7	1	7.68751907594
4	1969	10	8	8.062304921339999
5	1969	82	24	6.686620406459999

```
projectId = <your-project-id>

sql = "
SELECT
  n.year,
  n.month,
  n.day,
  n.weight_pounds
FROM
   `bigquery-public-data.samples.natality` AS n
ORDER BY
  n.year
LIMIT 50"


print "Running query..."
data = gbq.read_sql.gbl(sql,projectid=projectId)
data [:5]

Running query...
Requesting query… ok.
Query running...
Query done.
Processed 3.5Gb

Retrieving results.
Got 50 rows.
Time taken 1.14 s.
Finished at 2018-02-12 22:20:13
```

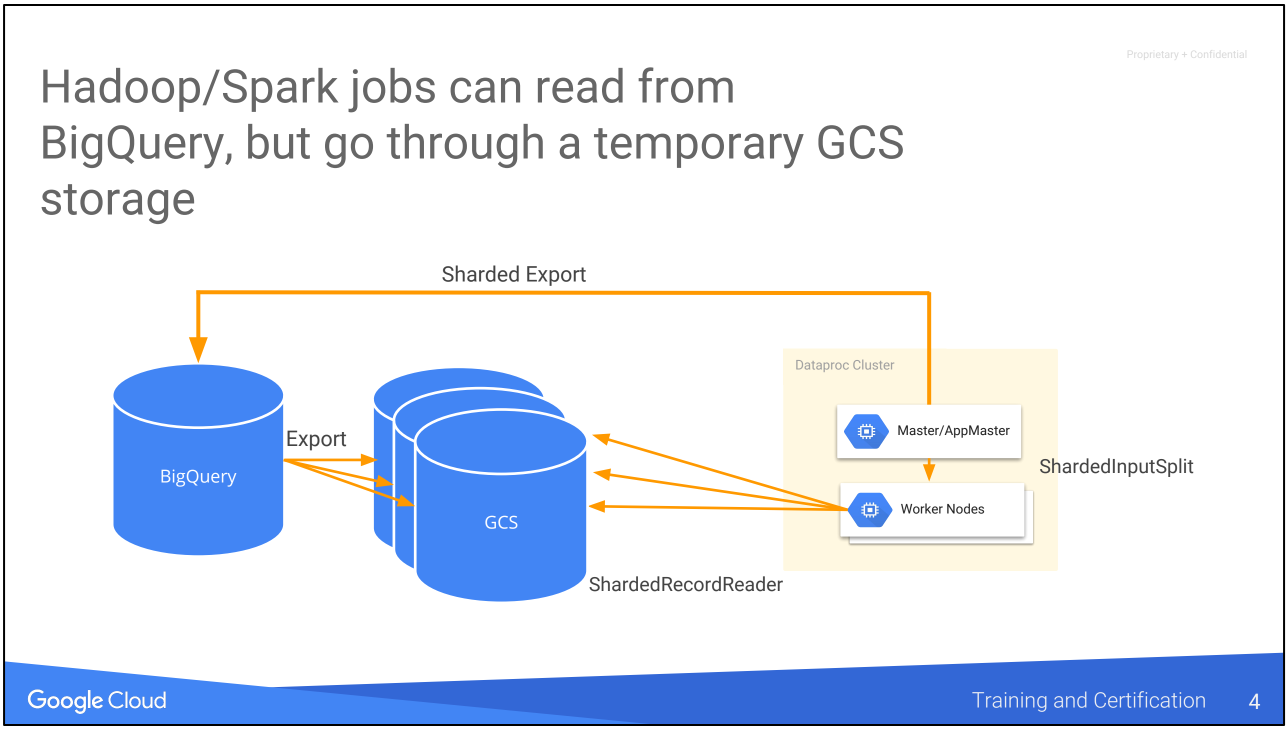
Notes:

In the lab, most of the work was done in BigQuery. Notice that what comes back is only 50 rows.

We then read the results from BQ directly into a *pandas* dataframe. But what if you want to process the dataset in your Dataproc cluster? You need to read into a RDD or Spark Dataframe in order to do that …. The Pandas dataframe is in-memory and won't support it.

You can do this, but it involves import/export to GCS.

Example: Imagine that you have data in BigQuery and you want to run a Spark job on it, perhaps a job that is better expressed in terms of functional code rather than SQL.

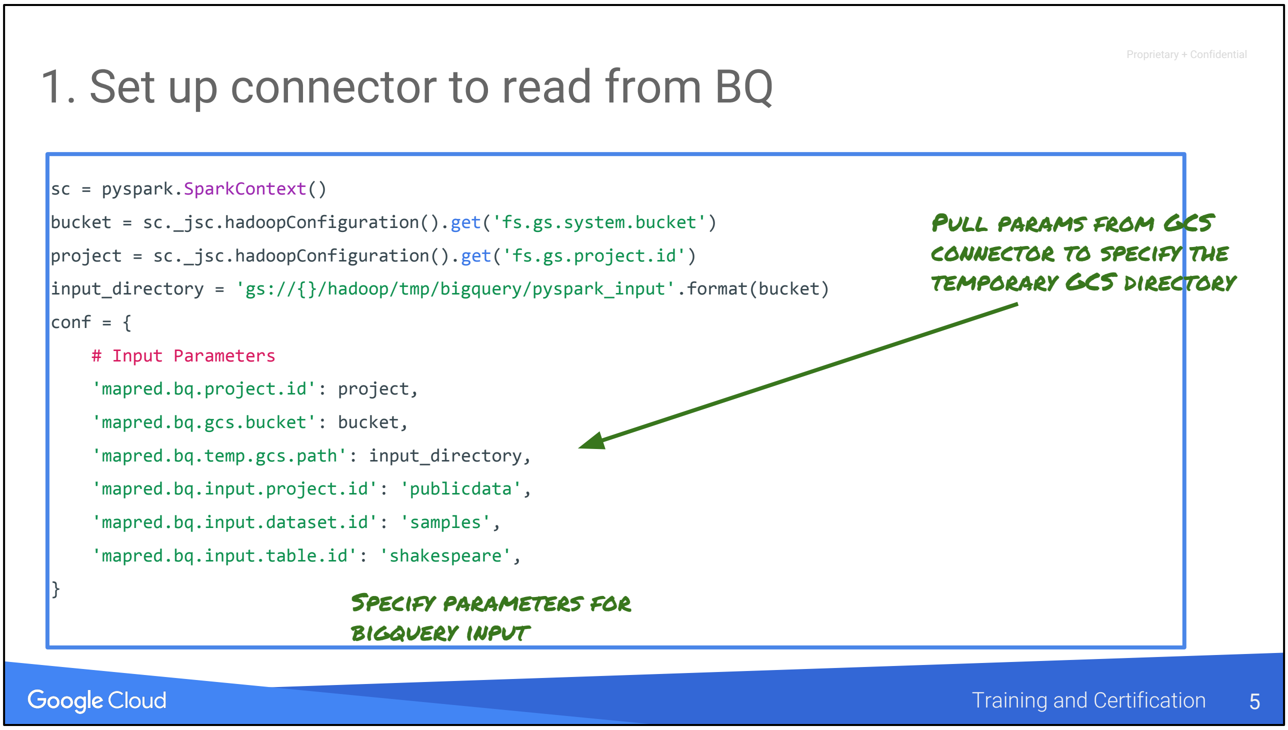


Hadoop/Spark jobs can read from BigQuery, but go through a temporary GCS storage

Notes:

See
https://cloud.google.com/hadoop/examples/bigquery-connector-spark-example
Hadoop/Spark job begins immediately, reading export results as they come

If the job fails, you may need to manually remove any remaining temporary Google Cloud Storage files, BigQuery datasets, and BigQuery tables. Typically, you'll find temporary BigQuery exports used by InputFormat in gs://bucket/hadoop/tmp/bigquery/ and temporary datasets named after your specified output dataset with a hadoop_temporary_job_[jobid] suffix.



1. Set up connector to read from BQ

```
sc = pyspark.SparkContext()
bucket = sc._jsc.hadoopConfiguration().get('fs.gs.system.bucket')
project = sc._jsc.hadoopConfiguration().get('fs.gs.project.id')
input_directory = 'gs://{}/hadoop/tmp/bigquery/pyspark_input'.format(bucket)
conf = {
    # Input Parameters
    'mapred.bq.project.id': project,
    'mapred.bq.gcs.bucket': bucket,
    'mapred.bq.temp.gcs.path': input_directory,
    'mapred.bq.input.project.id': 'publicdata',
    'mapred.bq.input.dataset.id': 'samples',
    'mapred.bq.input.table.id': 'shakespeare',
}
```

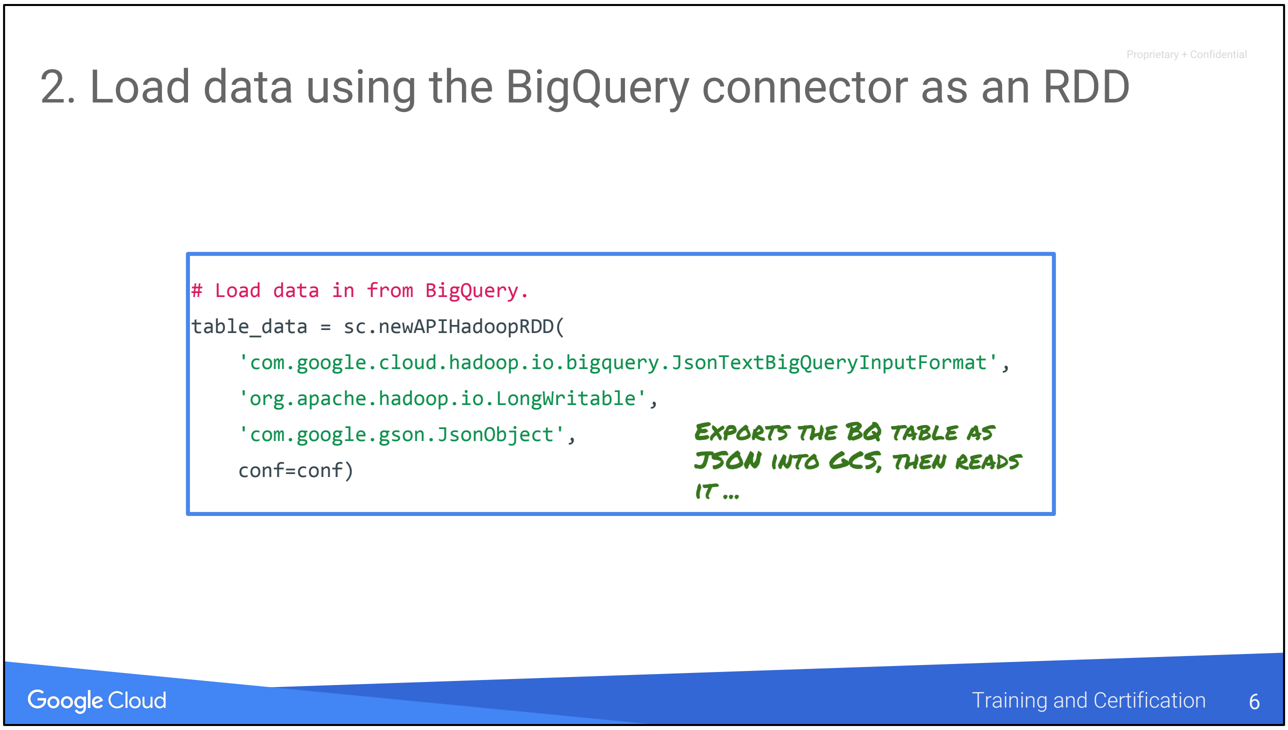
PULL PARAMS FROM GCS CONNECTOR TO SPECIFY THE TEMPORARY GCS DIRECTORY

SPECIFY PARAMETERS FOR BIGQUERY INPUT

Notes:

Essentially dump the BQ table to GCS, so that you can read it from Spark.

The GCS path is the input_directory for pyspark.



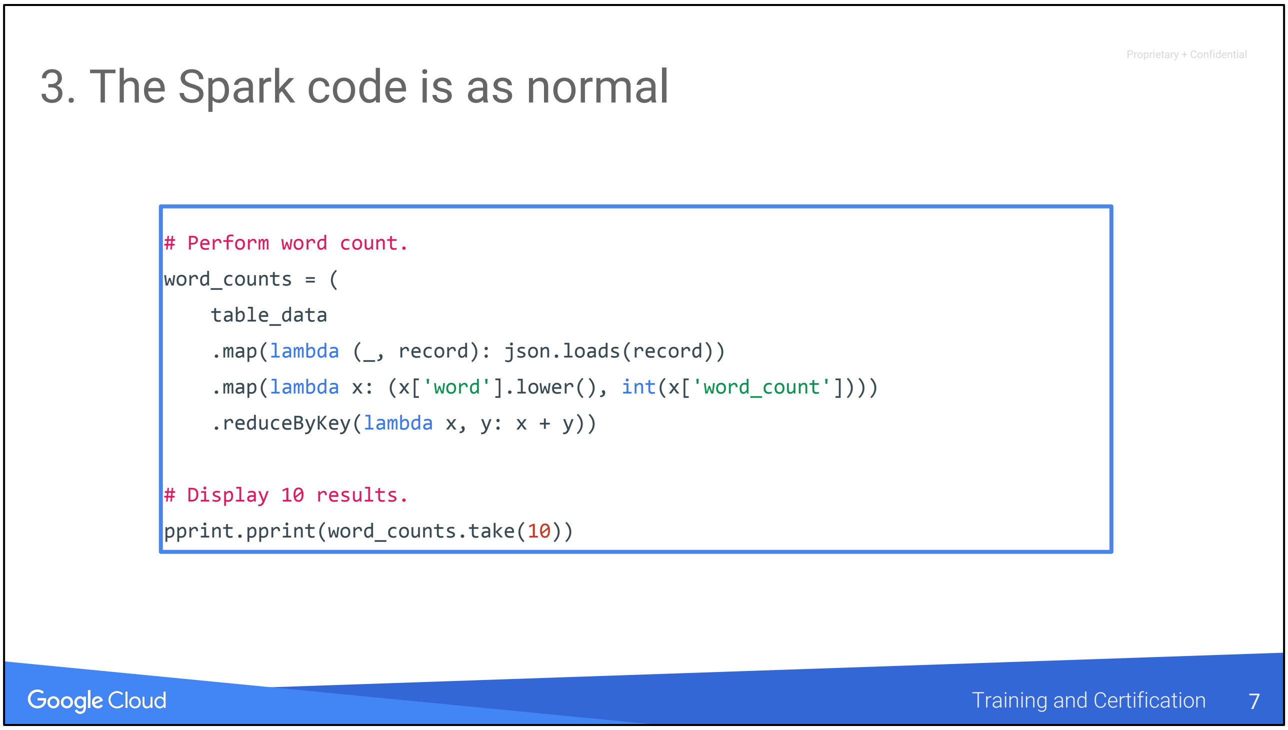
2. Load data using the BigQuery connector as an RDD

```
# Load data in from BigQuery.
table_data = sc.newAPIHadoopRDD(
    'com.google.cloud.hadoop.io.bigquery.JsonTextBigQueryInputFormat',
    'org.apache.hadoop.io.LongWritable',
    'com.google.gson.JsonObject',
    conf=conf)
```

EXPORTS THE BQ TABLE AS JSON INTO GCS, THEN READS IT ...

Notes:

Also, you can only read a table, not a query. To read the results of a query, first run query in BQ, and export it as a table.



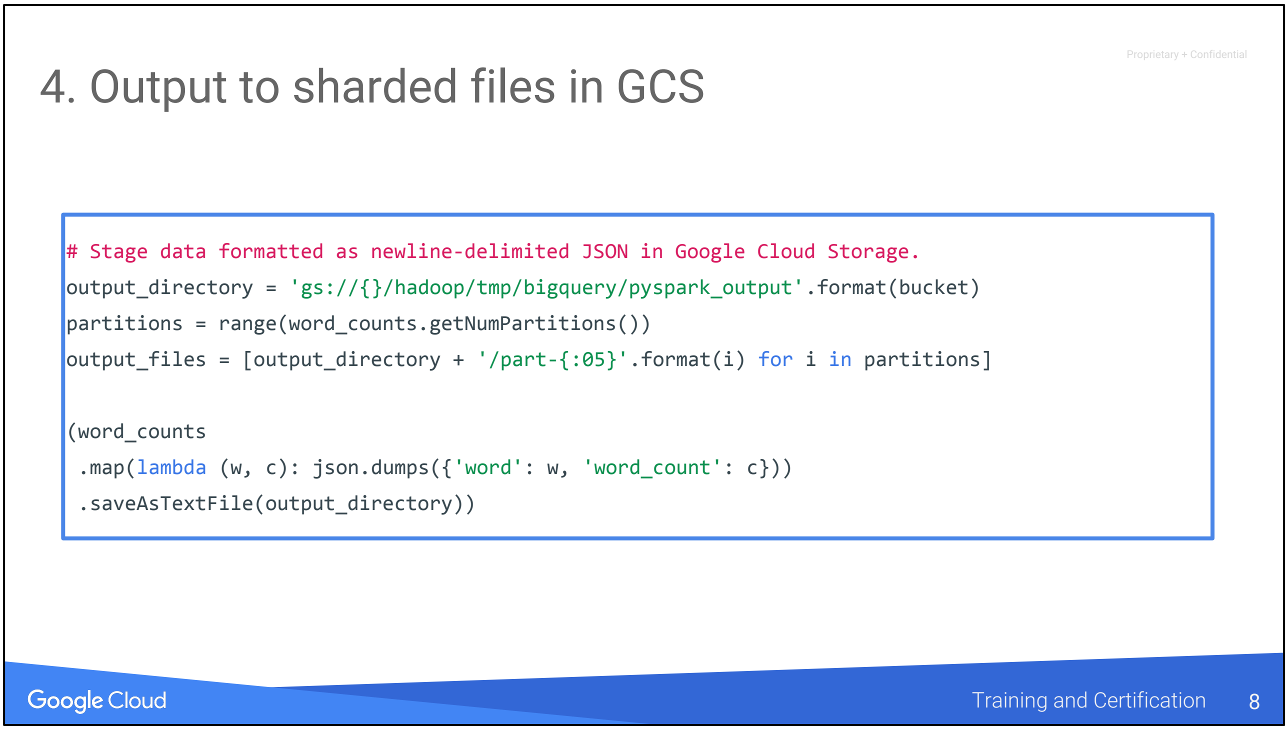
3. The Spark code is as normal

```
# Perform word count.
word_counts = (
    table_data
    .map(lambda (_, record): json.loads(record))
    .map(lambda x: (x['word'].lower(), int(x['word_count'])))
    .reduceByKey(lambda x, y: x + y))

# Display 10 results.
pprint.pprint(word_counts.take(10))
```

Notes:

Datalab, BigQuery & Spark.



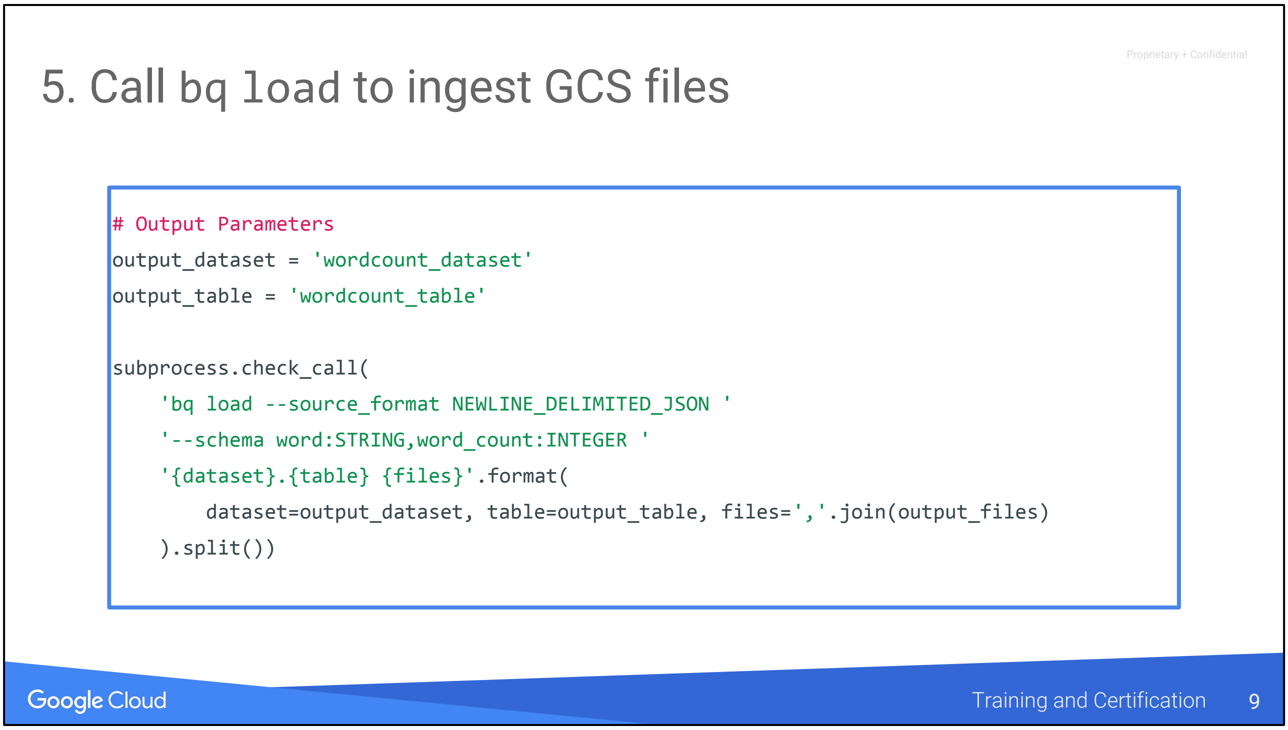
4. Output to sharded files in GCS

```
# Stage data formatted as newline-delimited JSON in Google Cloud Storage.
output_directory = 'gs://{}/hadoop/tmp/bigquery/pyspark_output'.format(bucket)
partitions = range(word_counts.getNumPartitions())
output_files = [output_directory + '/part-{:05}'.format(i) for i in partitions]

(word_counts
 .map(lambda (w, c): json.dumps({'word': w, 'word_count': c}))
 .saveAsTextFile(output_directory))
```

Notes:

Output to GCS. You can then call “bq load” if you want the output in BQ.



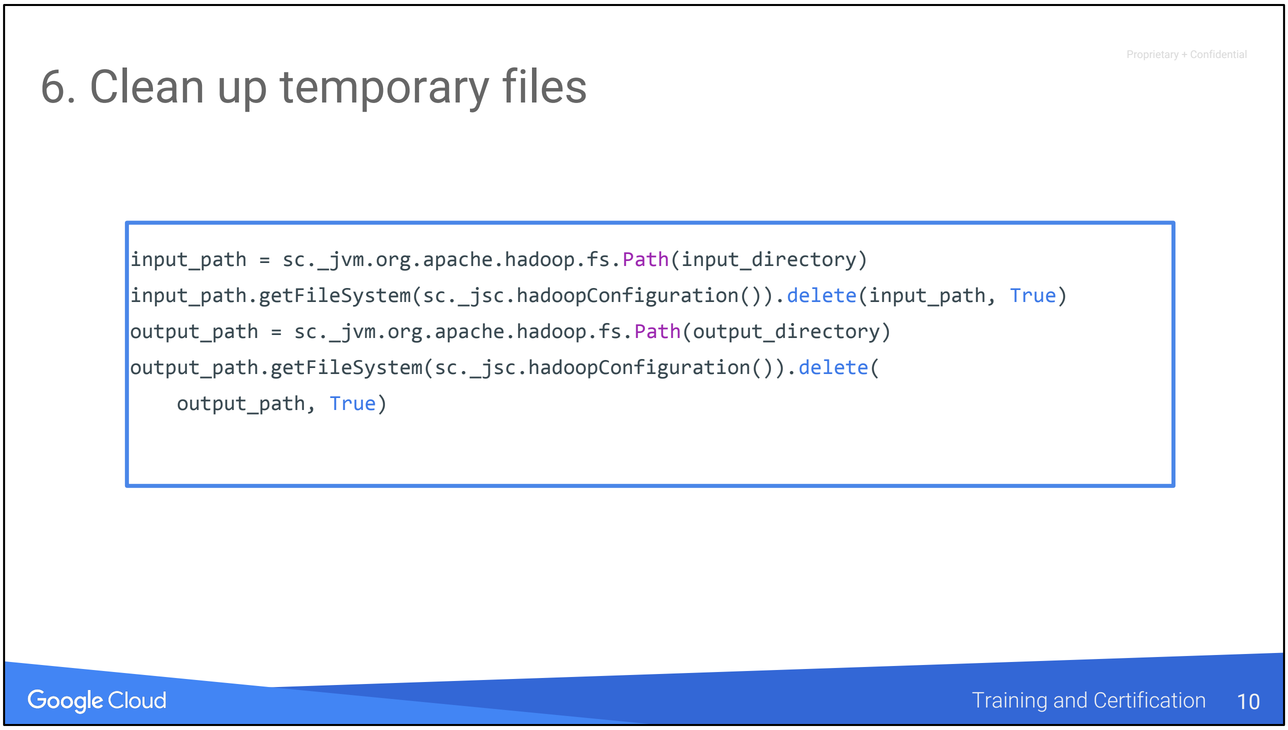
5. Call bq load to ingest GCS files

```
# Output Parameters
output_dataset = 'wordcount_dataset'
output_table = 'wordcount_table'

subprocess.check_call(
    'bq load --source_format NEWLINE_DELIMITED_JSON '
    '--schema word:STRING,word_count:INTEGER '
    '{dataset}.{table} {files}'.format(
        dataset=output_dataset, table=output_table, files=','.join(output_files)
    ).split())
```

Notes:

Calling bq load to go from gCS -> BQ.

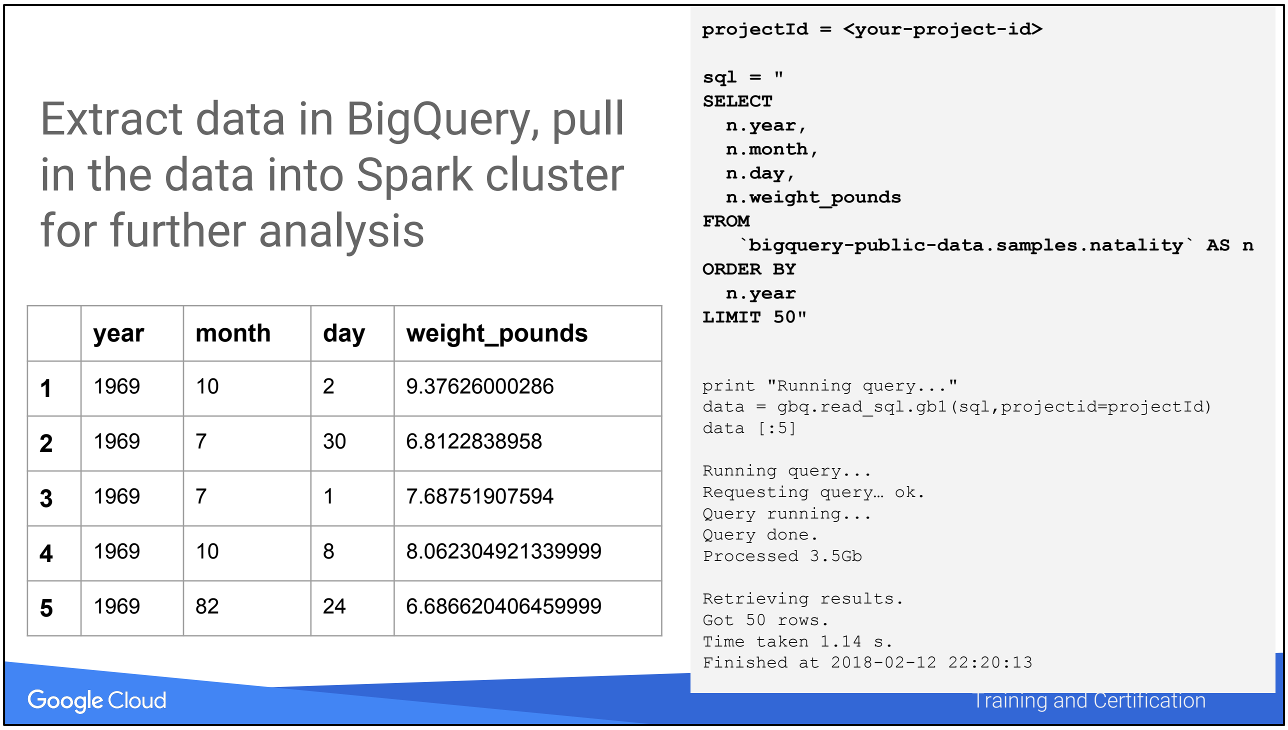


6. Clean up temporary files

```
input_path = sc._jvm.org.apache.hadoop.fs.Path(input_directory)
input_path.getFileSystem(sc._jsc.hadoopConfiguration()).delete(input_path, True)
output_path = sc._jvm.org.apache.hadoop.fs.Path(output_directory)
output_path.getFileSystem(sc._jsc.hadoopConfiguration()).delete(
    output_path, True)
```

Notes:

Clean up the temporary input/output files.



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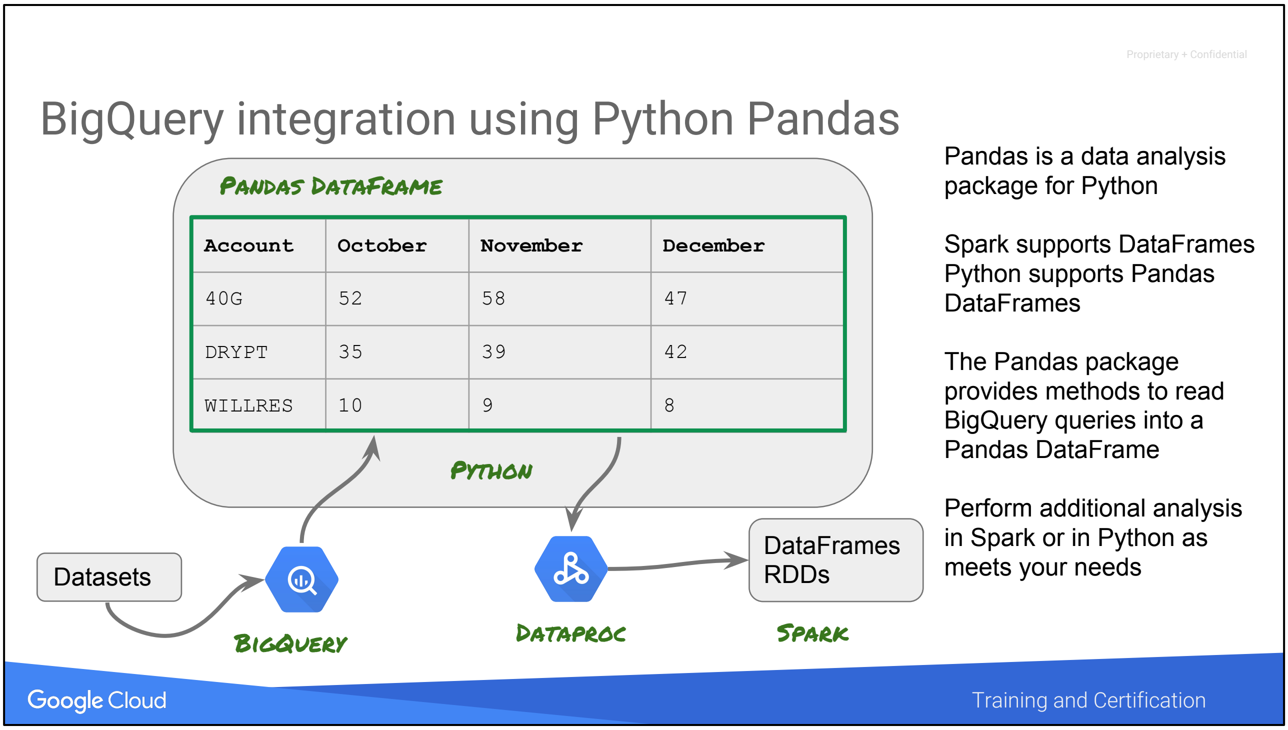
```

Google Cloud

Training and Certification

Notes:

This is one option. However, another option is to work with the data in Python.



Proprietary + Confidential

BigQuery integration using Python Pandas

Account	October	November	December
40G	52	58	47
DRYPT	35	39	42
WILLRES	10	9	8

Pandas is a data analysis package for Python

Spark supports DataFrames
Python supports Pandas DataFrames

The Pandas package provides methods to read BigQuery queries into a Pandas DataFrame

Perform additional analysis in Spark or in Python as meets your needs

Google Cloud

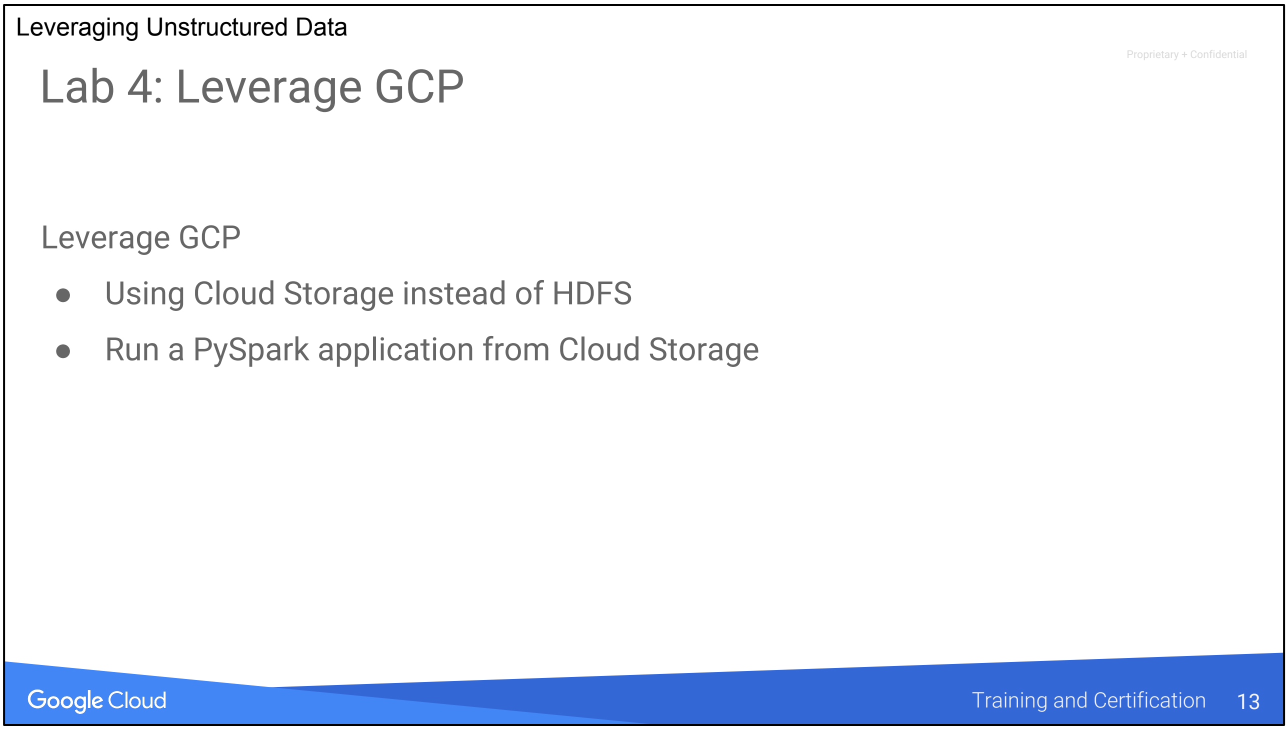
Training and Certification

Python Pandas
A Python package that provides data structures designed to make it easier to work with "relational" or "labeled" data. Pandas is a library of functions for practical data analysis in Python. One of the data structures is a Pandas DataFrame.
http://pandas.pydata.org/

Spark DataFrame
A distributed collection of data organized into named columns, conceptually similar to a table in a relational database or a DataFrame in Python.

You can load BigQuery data into a Python DataFrame using Pandas.
http://pandas.pydata.org/pandas-docs/stable/generated/pandas.read_gbq.html

Here is a tutorial that illustrates how to do this.
https://cloud.google.com/blog/big-data/2017/02/google-cloud-platform-for-data-scientists-using-jupyter-notebooks-with-apache-spark-on-google-cloud



Leveraging Unstructured Data

Lab 4: Leverage GCP

Leverage GCP

- Using Cloud Storage instead of HDFS
- Run a PySpark application from Cloud Storage

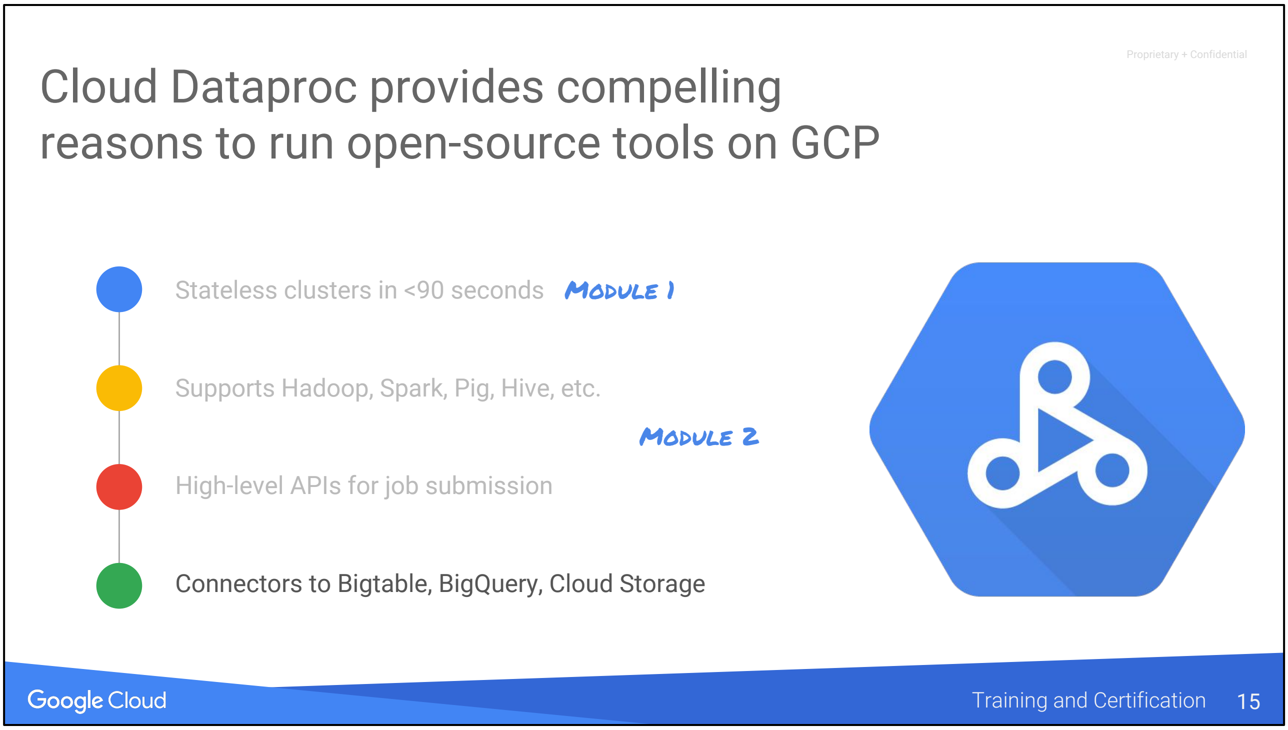
Notes:

Datalab, BigQuery & Spark.

Lab 4: Leverage GCP
Explore Spark using a Datalab Notebook
Using Cloud Storage instead of HDFS
Run a PySpark application from Cloud Storage
Using Python Pandas to add BigQuery to a Spark application

Agenda

Customizing clusters + Lab

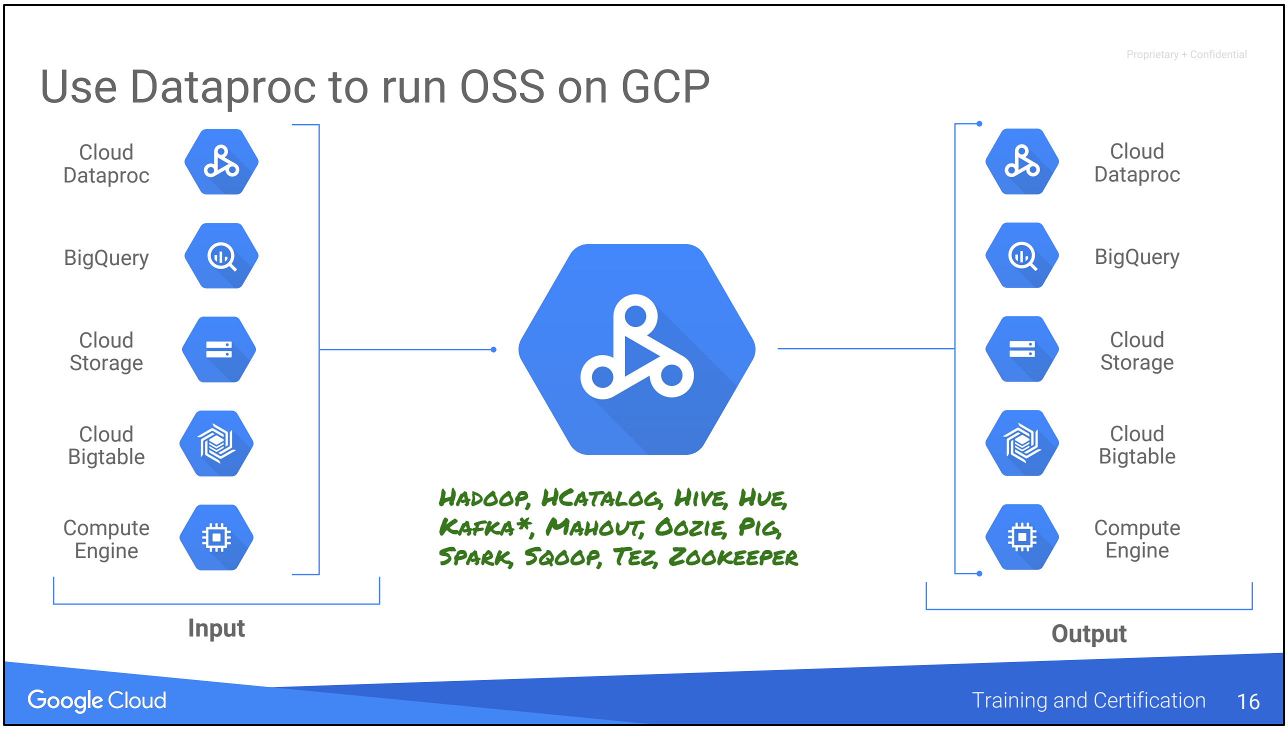


Cloud Dataproc provides compelling reasons to run open-source tools on GCP

- Stateless clusters in <90 seconds MODULE 1
- Supports Hadoop, Spark, Pig, Hive, etc.
- High-level APIs for job submission MODULE 2
- Connectors to Bigtable, BigQuery, Cloud Storage

Notes:

We have already looked at #1 to #3. Let’s look at #3 here.



Use Dataproc to run OSS on GCP

Cloud Dataproc
BigQuery
Cloud Storage
Cloud Bigtable
Compute Engine

Input

HADOOP, HCATALOG, HIVE, HUE, KAFKA*, MAHOUT, OOZIE, PIG, SPARK, SQOOP, TEZ, ZOOKEEPER

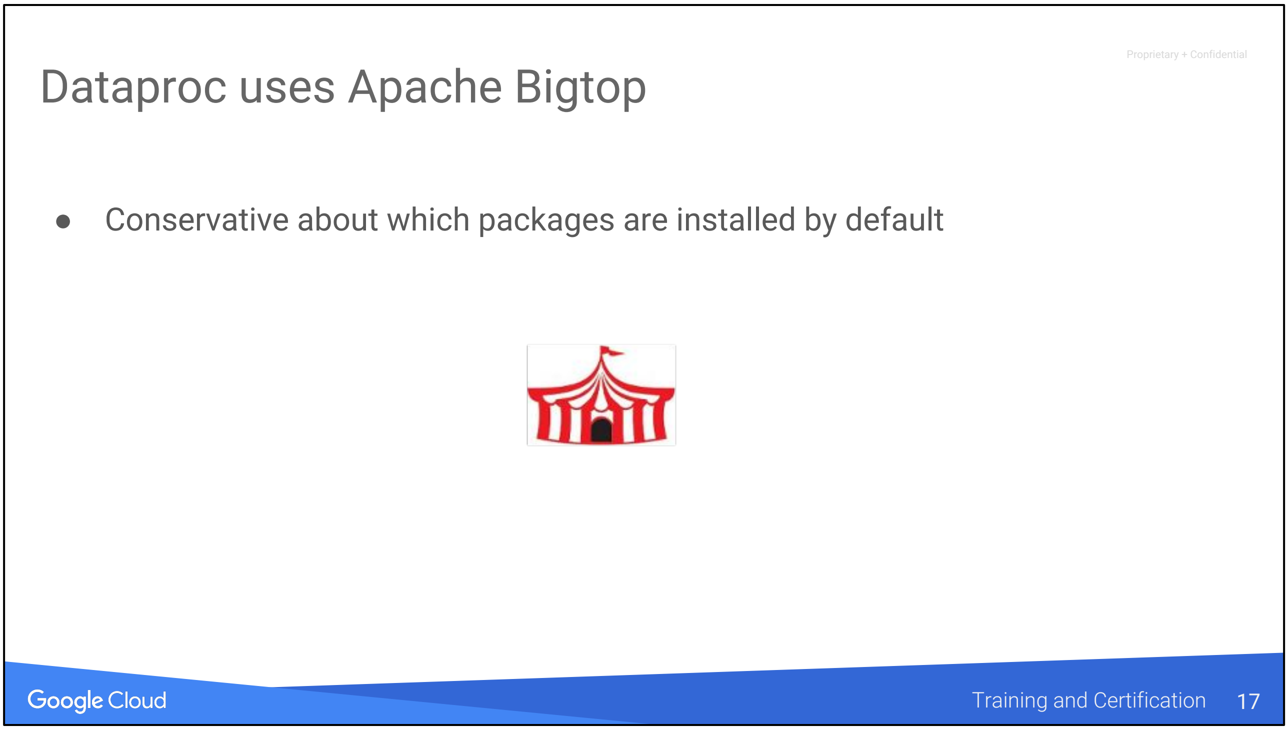
Cloud Dataproc
BigQuery
Cloud Storage
Cloud Bigtable
Compute Engine

Output

Notes:

You can read from GCP sources and write to GCP sources, and use Dataproc as the intermingling glue.

Kafka support is experimental at present.

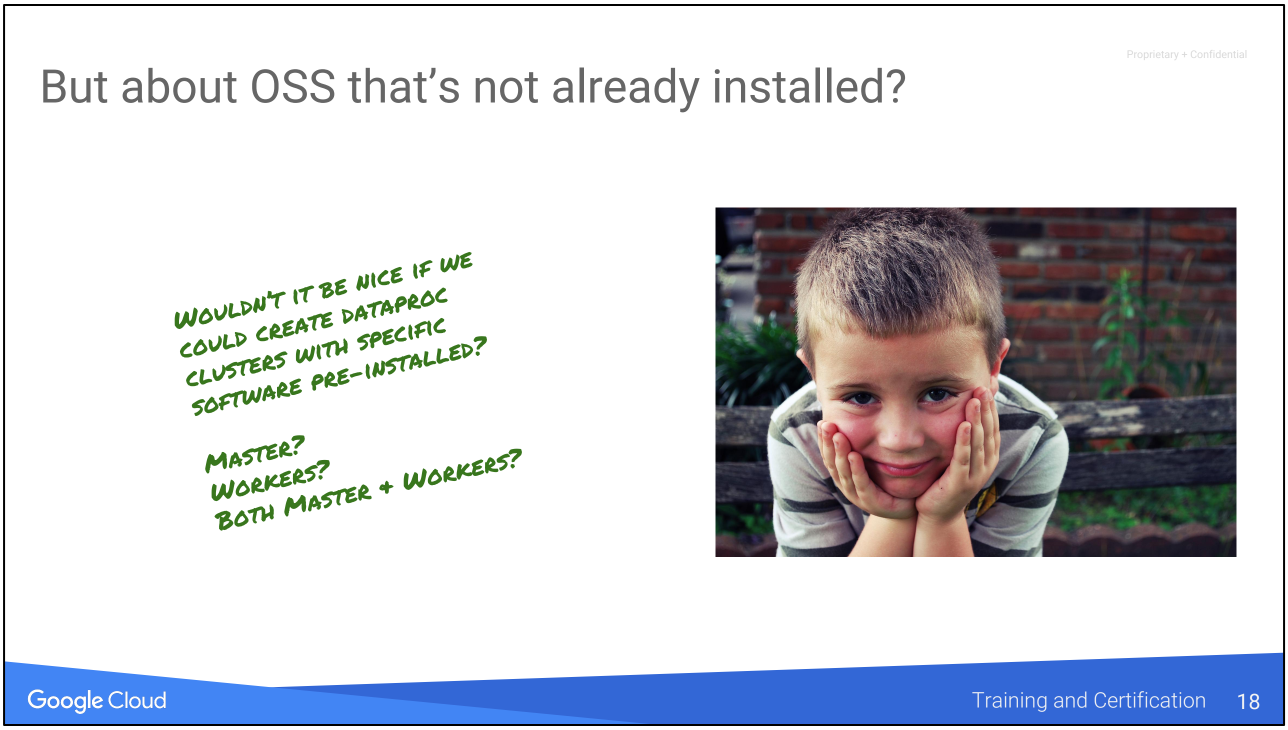


Dataproc uses Apache Bigtop

- Conservative about which packages are installed by default

Notes:

To ensure that clusters are performant and resources are not squandered on un-needed stuff.
https://dataproc-bigtop-repo.storage.googleapis.com



But about OSS that's not already installed?

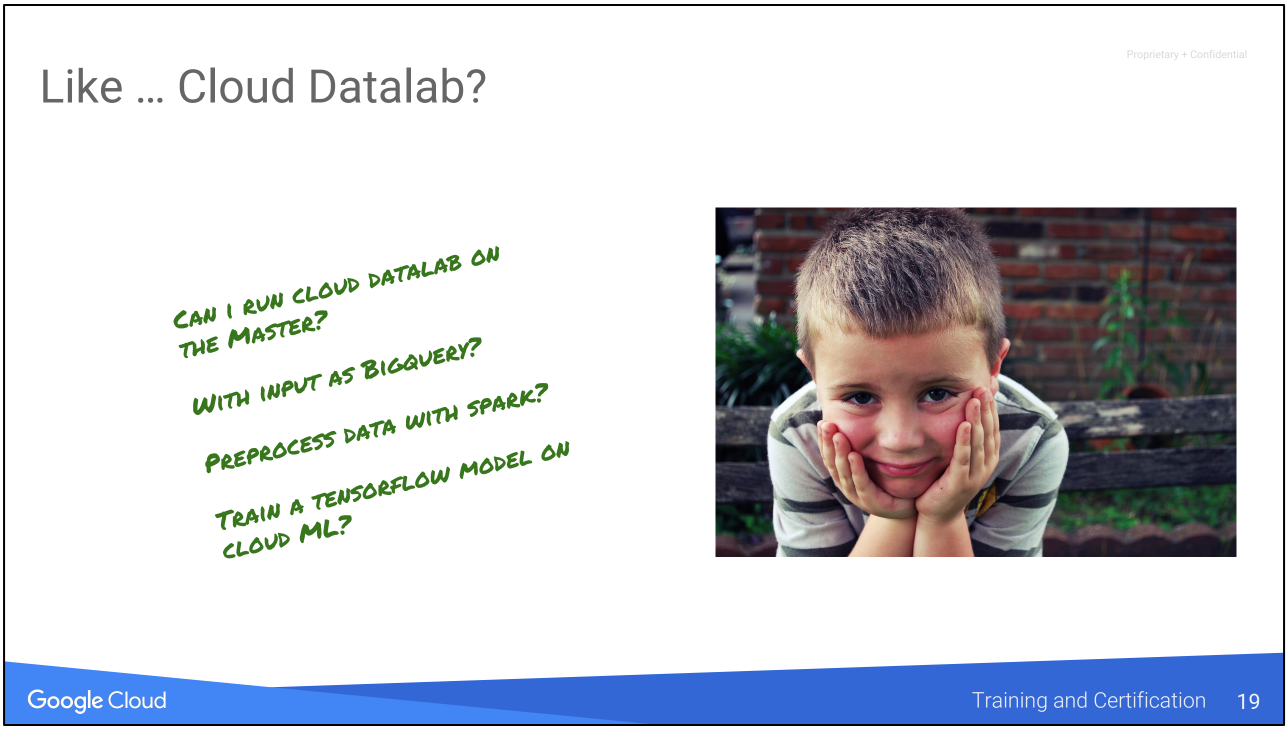
WOULDN'T IT BE NICE IF WE COULD CREATE DATAPROC CLUSTERS WITH SPECIFIC SOFTWARE PRE-INSTALLED?

MASTER?
WORKERS?
BOTH MASTER + WORKERS?

Notes:

https://pixabay.com/en/boy-idea-sad-eyes-school-thinking-1867332/ (cc0)

Not as simple as a deployment manager because we need to know whether to install it on the master-only or workers-only.



Like … Cloud Datalab?

Can I run cloud datalab on the Master?

With input as BigQuery?

Preprocess data with spark?

Train a tensorflow model on cloud ML?

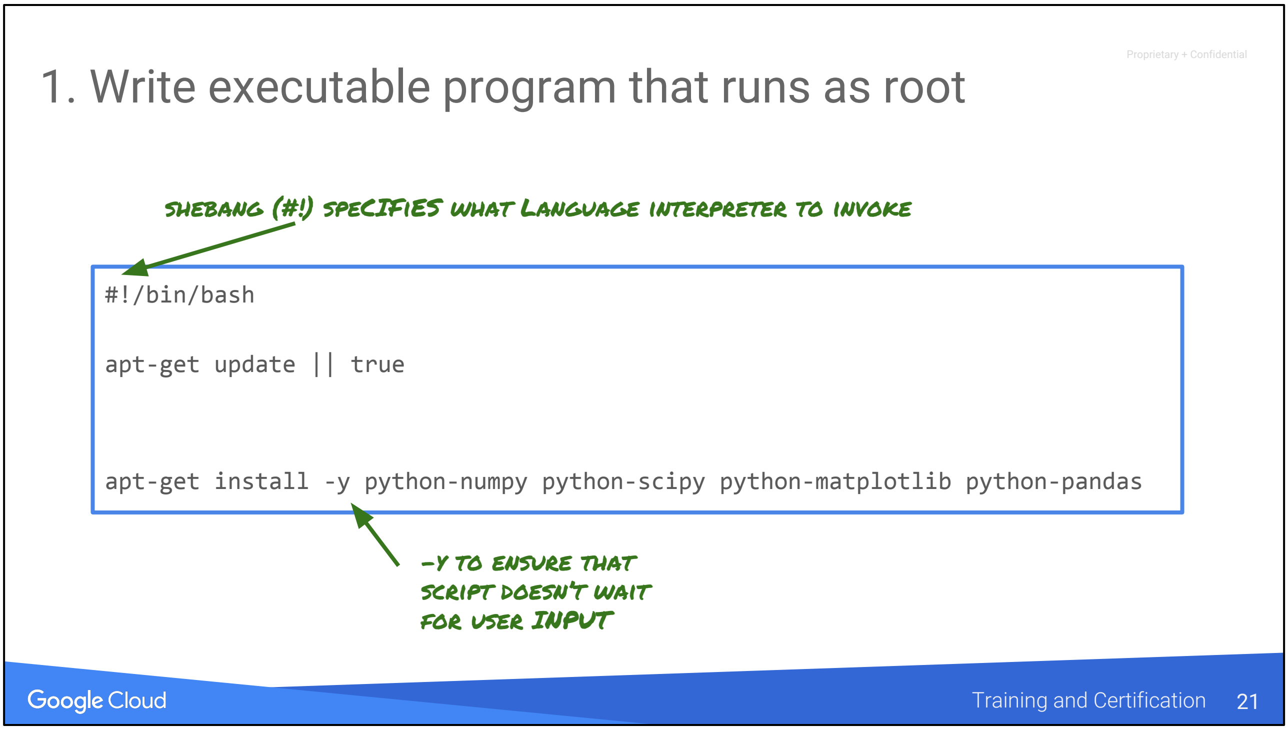
Notes:

https://pixabay.com/en/boy-idea-sad-eyes-school-thinking-1867332/ (cc0)

BigQuery & Cloud ML are serverless, so that’s easy. You can do it from anywhere. But datalab & spark do need a machine to run on.

To install software on Dataproc cluster...

1. Write an executable program (bash, python, etc.)
2. Upload it to Cloud Storage
3. Specify GCS location in Dataproc creation command



1. Write executable program that runs as root

SHEBANG (#!) SPECIFIES WHAT LANGUAGE INTERPRETER TO INVOKE

```
#!/bin/bash

apt-get update || true


apt-get install -y python-numpy python-scipy python-matplotlib python-pandas
```

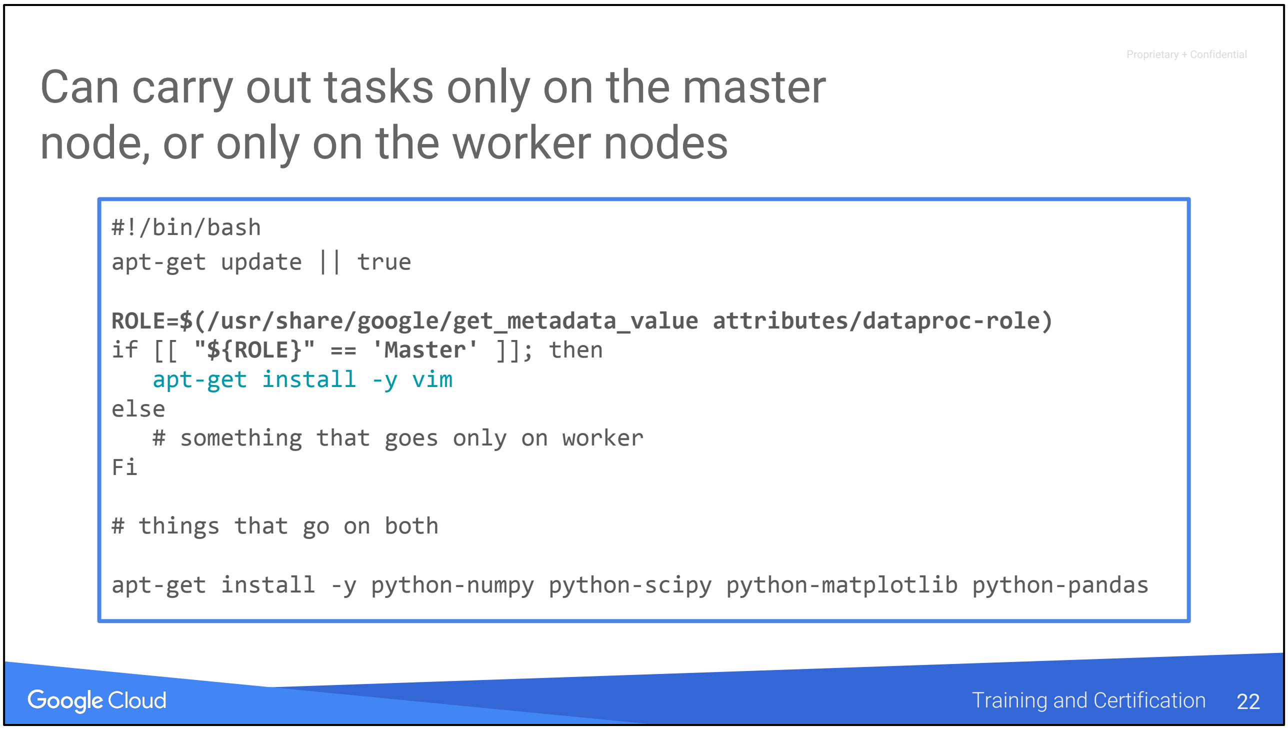
-Y TO ENSURE THAT SCRIPT DOESN'T WAIT FOR USER INPUT

Notes:

Because the script is run as root, there is no need to use “sudo”.

This installs a set of python packages on all nodes.

If you don’t have the -y, the installer will wait (default timeout = 10 minutes) before failing.



Can carry out tasks only on the master node, or only on the worker nodes

```
#!/bin/bash
apt-get update || true

ROLE=$(/usr/share/google/get_metadata_value attributes/dataproc-role)
if [[ "${ROLE}" == 'Master' ]]; then
   apt-get install -y vim
else
   # something that goes only on worker
Fi

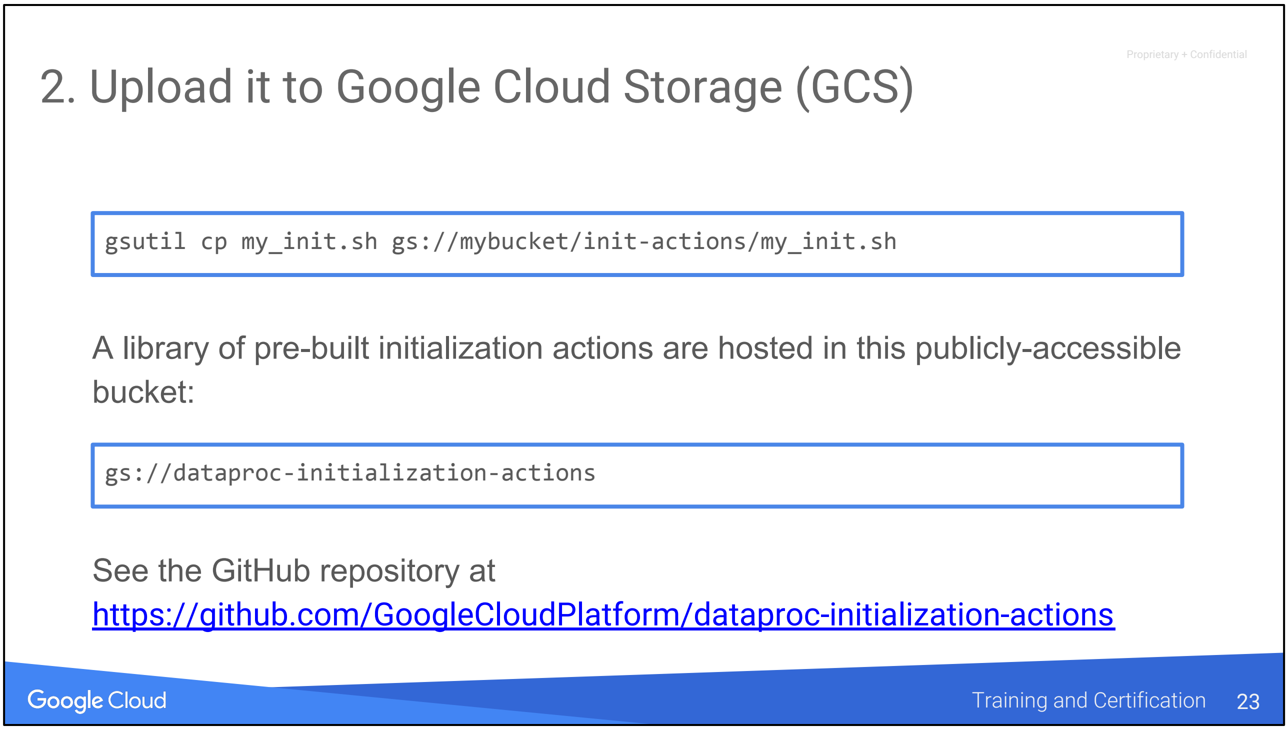
# things that go on both

apt-get install -y python-numpy python-scipy python-matplotlib python-pandas
```

Notes:

/usr/share/google is present on all Dataproc nodes

In this case, we are installing the editor “vim” only on the master node.



2. Upload it to Google Cloud Storage (GCS)

```
gsutil cp my_init.sh gs://mybucket/init-actions/my_init.sh
```

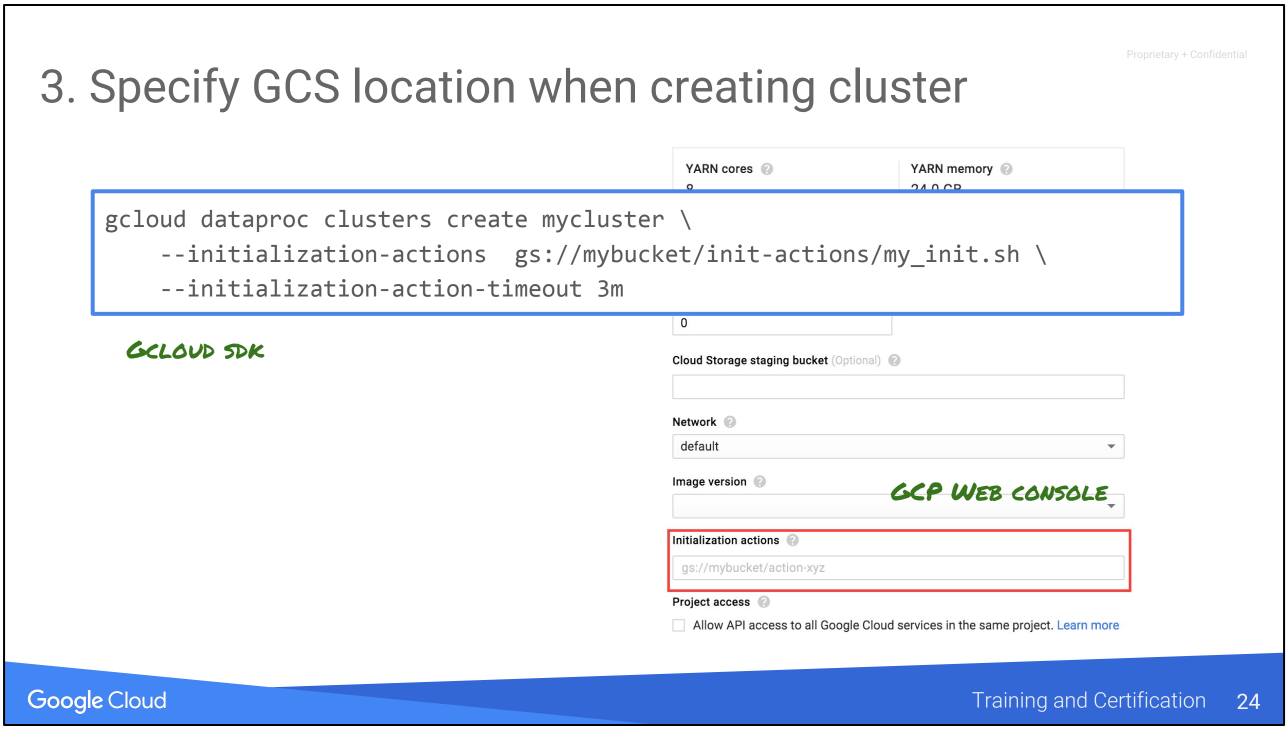
A library of pre-built initialization actions are hosted in this publicly-accessible bucket:

```
gs://dataproc-initialization-actions
```

See the GitHub repository at https://github.com/GoogleCloudPlatform/dataproc-initialization-actions

Notes:

Click on the link to browse the publicly hosted ones.



Proprietary + Confidential

3. Specify GCS location when creating cluster

```
gcloud dataproc clusters create mycluster \
    --initialization-actions  gs://mybucket/init-actions/my_init.sh \
    --initialization-action-timeout 3m
```

GCLOUD SDK

YARN cores: 8

YARN memory: 24.0 GB

0

Cloud Storage staging bucket (Optional)

Network: default

Image version

GCP WEB CONSOLE

Initialization actions: gs://mybucket/action-xyz

Project access

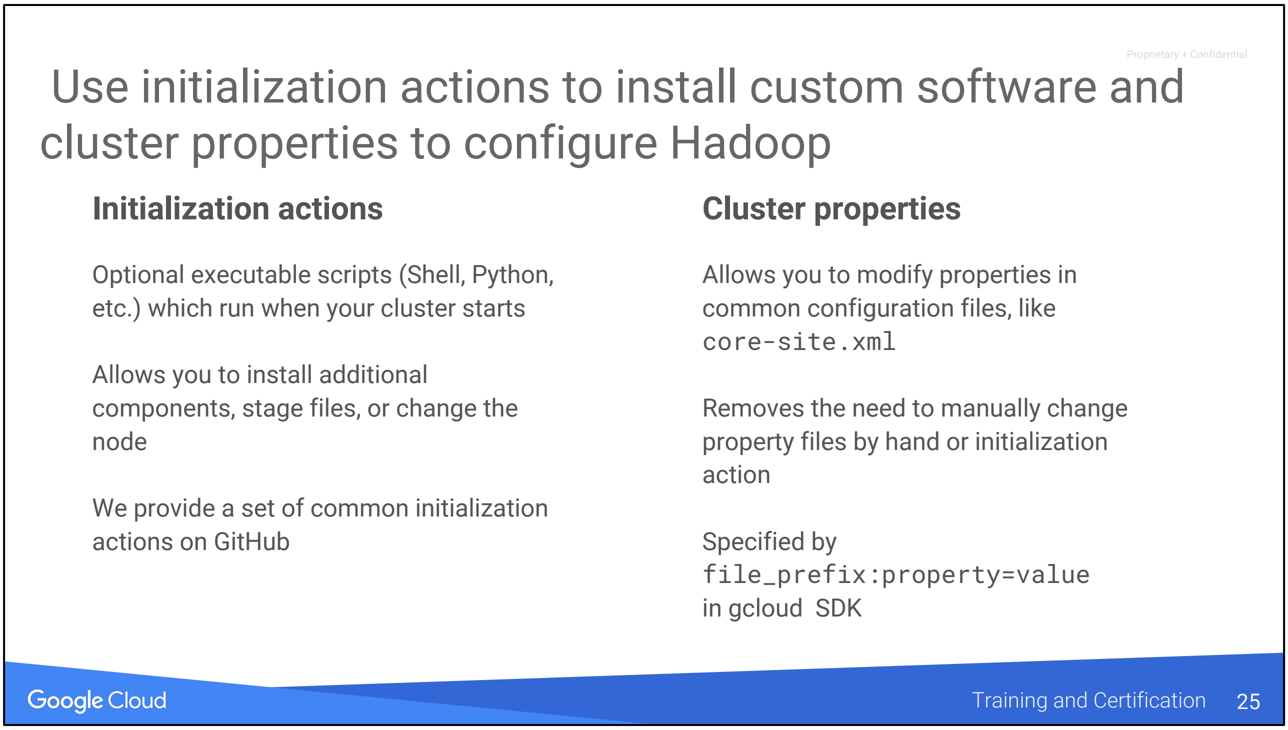
□ Allow API access to all Google Cloud services in the same project. Learn more

Notes:

Here, we are changing the timeout to be 3 minutes. Changing the timeout could be necessary for things like establishing database replicas etc. which might take time.

Separate multiple initialization actions by commas.

You can do it on the web console also.



Use initialization actions to install custom software and cluster properties to configure Hadoop

Initialization actions

Optional executable scripts (Shell, Python, etc.) which run when your cluster starts

Allows you to install additional components, stage files, or change the node

We provide a set of common initialization actions on GitHub

Cluster properties

Allows you to modify properties in common configuration files, like `core-site.xml`

Removes the need to manually change property files by hand or initialization action

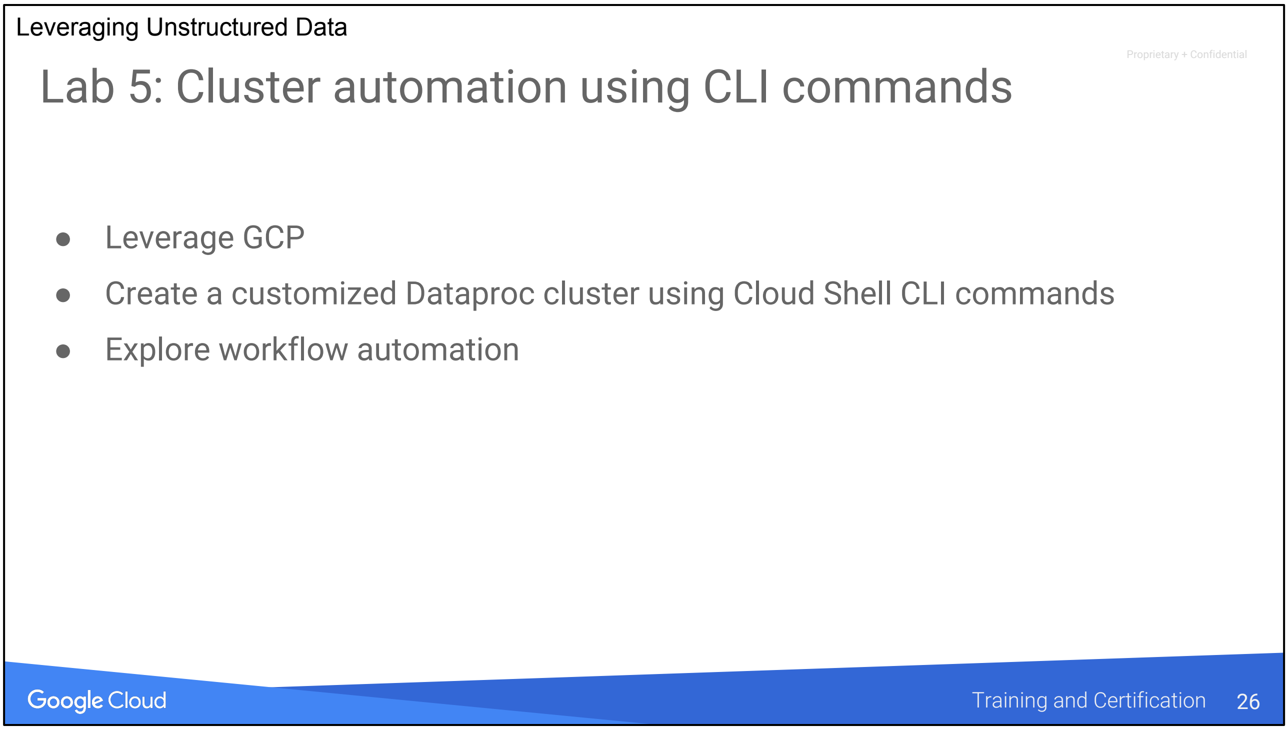
Specified by
`file_prefix:property=value`
in gcloud SDK

Notes:

Cluster properties not currently available on web-UI.

If you are migrating to Dataproc from on prem Hadoop or Hadoop hosted on VMs, you may already have customized Hadoop settings that you would like to apply to the cluster within Dataproc. This is supported in a limited way via Cluster properties. Although Dataproc automatically manages the installation of software packages and cluster settings, you may want to customize these configurations in specific cases to make sure that the Dataproc cluster works similarly to your customized environment.

You can see which properties are configurable here: https://cloud.google.com/dataproc/docs/concepts/configuring-clusters/cluster-properties



Leveraging Unstructured Data

Lab 5: Cluster automation using CLI commands

- Leverage GCP
- Create a customized Dataproc cluster using Cloud Shell CLI commands
- Explore workflow automation

Notes:

Datalab, BigQuery & Spark.

Lab 4: Leverage GCP
Explore Spark using a Datalab Notebook
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cloud.google.com

Images by Connie Zhou