Dataflow: Qwik Start – Python

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1. Introduction

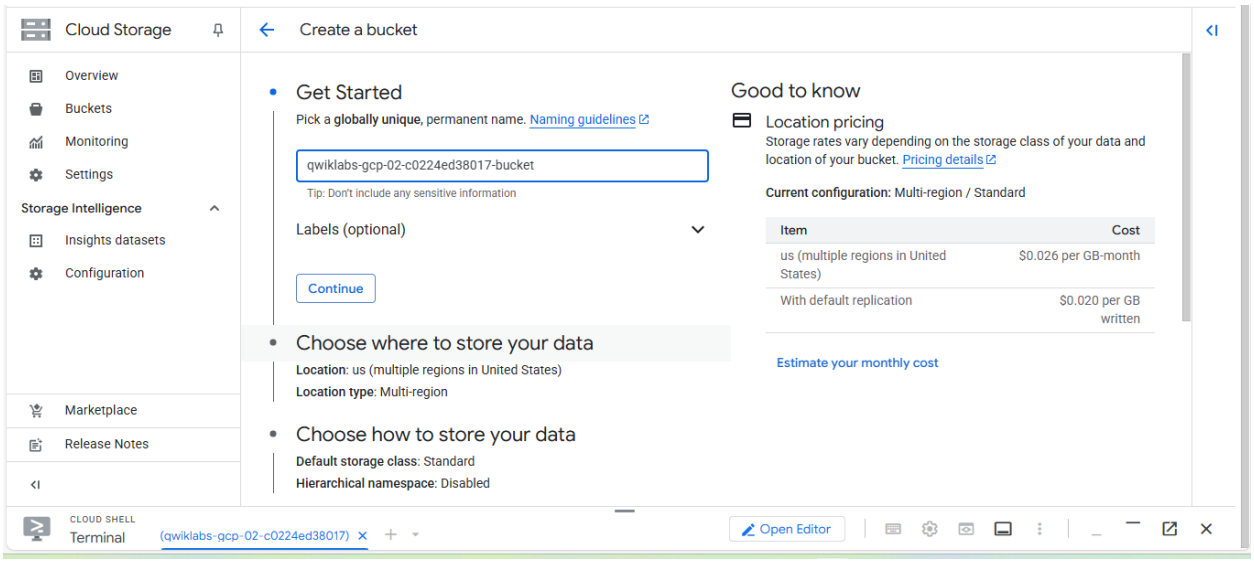
This project demonstrates how to:

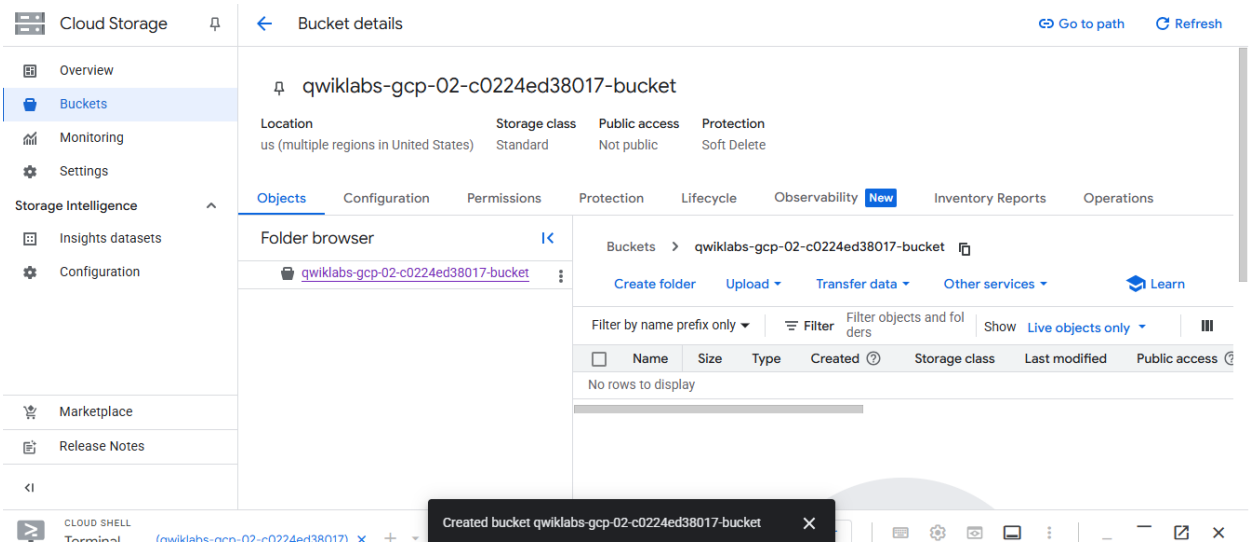
- Set up a **Google Cloud Storage (GCS) bucket** for Dataflow outputs.
- Install and test the **Apache Beam SDK** (Python) in a Docker container.
- Run a **WordCount pipeline** locally and remotely via Dataflow.
- Monitor pipeline execution and verify results.

2. Task 1: Creating a Cloud Storage Bucket

Steps Executed:

1. Navigated to **Cloud Storage > Buckets**.
2. Created a bucket with:
    a. **Name**: [UNIQUE_NAME]-bucket (e.g., myproject-bucket)
    b. **Location Type**: Multi-region (us)
3. Disabled public access (default).





3. Task 2: Installing Apache Beam SDK

Steps Executed:

1. Launched a **Python 3.9 Docker container**:

```
docker run -it -e DEVSHELL_PROJECT_ID=$DEVSHELL_PROJECT_ID python:3.9 /bin/bash
```

2. Installed Apache Beam with GCP dependencies:

```
pip install 'apache-beam[gcp]'==2.42.0
```

3. Tested the WordCount example **locally**:

```
python -m apache_beam.examples.wordcount --output counts.txt
cat counts.txt
```

```
student_01_9d65d778187b@cloudshell:~ (qwiklabs-gcp-02-c0224ed38017)$ docker run -it -e DEVSHELL_PROJECT_ID=$DEVSHELL_PROJECT_ID python:3.9 /bin/bash
Unable to find image 'python:3.9' locally
3.9: Pulling from library/python
3e6b9d1a9511: Downloading [========================>                          ]  23.64MB/48.49MB
37927ed901b1: Download complete
79b2f47ad444: Downloading [================>                                  ]  22.51MB/64.4MB
e23f099911d6: Waiting
3936689bd0c0: Waiting
d188aca32b40: Waiting
31a5ef1ce157: Waiting
```

```
student_01_9d65d778187b@cloudshell:~ (qwiklabs-gcp-02-c0224ed38017)$ docker run -it -e DEVSHELL_PROJECT_ID=$DEVSHELL_PROJECT_ID python:3.9 /bin/bash
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3e6b9d1a9511: Pull complete
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79b2f47ad444: Pull complete
e23f099911d6: Pull complete
3936689bd0c0: Pull complete
d188aca32b40: Pull complete
31a5ef1ce157: Pull complete
Digest: sha256:089307feed90d56945980075a2a857c28141354a0158c5a251ebf63291859aa6
Status: Downloaded newer image for python:3.9
root@1e0cbd8fec0f:/#
```

```
root@1e0cbd8fec0f:/# pip install 'apache-beam[gcp]'==2.42.0
Collecting apache-beam[gcp]==2.42.0
  Downloading apache_beam-2.42.0-cp39-cp39-manylinux2010_x86_64.whl (12.1 MB)
     ---------------------------------------- 12.1/12.1 MB 69.3 MB/s eta 0:00:00
Collecting orjson<4.0
  Downloading orjson-3.10.18-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (132 kB)
     ---------------------------------------- 132.6/132.6 kB 22.2 MB/s eta 0:00:00
Collecting dill<0.3.2,>=0.3.1.1
  Downloading dill-0.3.1.1.tar.gz (151 kB)
     ---------------------------------------- 152.0/152.0 kB 24.3 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
```

```
WARNING:google_auth_httplib2:httplib2 transport does not support per-request timeout. Set the timeout when constructing the httplib2.Http instance.
WARNING:google_auth_httplib2:httplib2 transport does not support per-request timeout. Set the timeout when constructing the httplib2.Http instance.
INFO:root:Default Python SDK image for environment is apache/beam_python3.9_sdk:2.42.0
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function annotate_downstream_side_inputs at 0x77fd9aff2790> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function fix_side_input_pcoll_coders at 0x77fd9aff28b0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function pack_combiners at 0x77fd9aff2dc0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function lift_combiners at 0x77fd9aff2e50> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function expand_sdf at 0x77fd9aff3040> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function expand_gbk at 0x77fd9aff30d0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function sink_flattens at 0x77fd9aff31f0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function greedily_fuse at 0x77fd9aff3280> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function read_to_impulse at 0x77fd9aff3310> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function impulse_to_input at 0x77fd9aff33a0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function sort_stages at 0x77fd9aff35e0> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function add_impulse_to_dangling_transforms at 0x77fd9aff3700> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function setup_timer_mapping at 0x77fd9aff3550> ====================
INFO:apache_beam.runners.portability.fn_api_runner.translations:==================== <function populate_data_channel_coders at 0x77fd9aff3670> ====================
INFO:apache_beam.runners.worker.statecache:Creating state cache with size 100
INFO:apache_beam.runners.portability.fn_api_runner.worker_handlers:Created Worker handler <apache_beam.runners.portability.fn_api_runner.worker_handlers.EmbeddedWorkerHa
ndler object at 0x77fd9af77eb0> for environment ref_Environment_default_environment_1 (beam:env:embedded_python_v1, b'')
```

```
root@1e0cbd8fec0f:/# ls
OUTPUT_FILE-00000-of-00001  bin  boot  dev  etc  home  lib  lib64  media  mnt  opt  proc  root  run  sbin  srv  sys  tmp  usr  var
root@1e0cbd8fec0f:/#
```

```
wages: 1
cup: 1
deservings: 1
hang'd: 1
Thou'lt: 1
button: 1
faints: 1
Break: 1
Vex: 1
ghost: 1
rack: 1
Stretch: 1
usurp'd: 1
Friends: 1
Rule: 1
gored: 1
journey: 1
weight: 1
ought: 1
oldest: 1
root@1e0cbd8fec0f:/#
```

4. Task 3: Running a Dataflow Pipeline Remotely

Steps Executed:

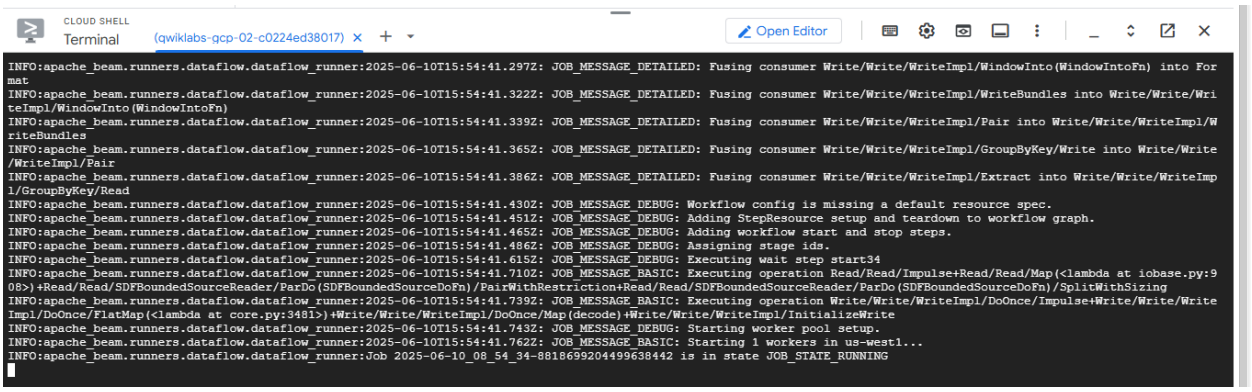
1. Set the bucket environment variable:

BUCKET=gs://[BUCKET_NAME]

2. Ran the WordCount pipeline on **Dataflow**:

```
python -m apache_beam.examples.wordcount \
  --project $DEVSHELL_PROJECT_ID \
  --runner DataflowRunner \
  --staging_location $BUCKET/staging \
  --temp_location $BUCKET/temp \
  --output $BUCKET/results/output \
  --region us-central1
```

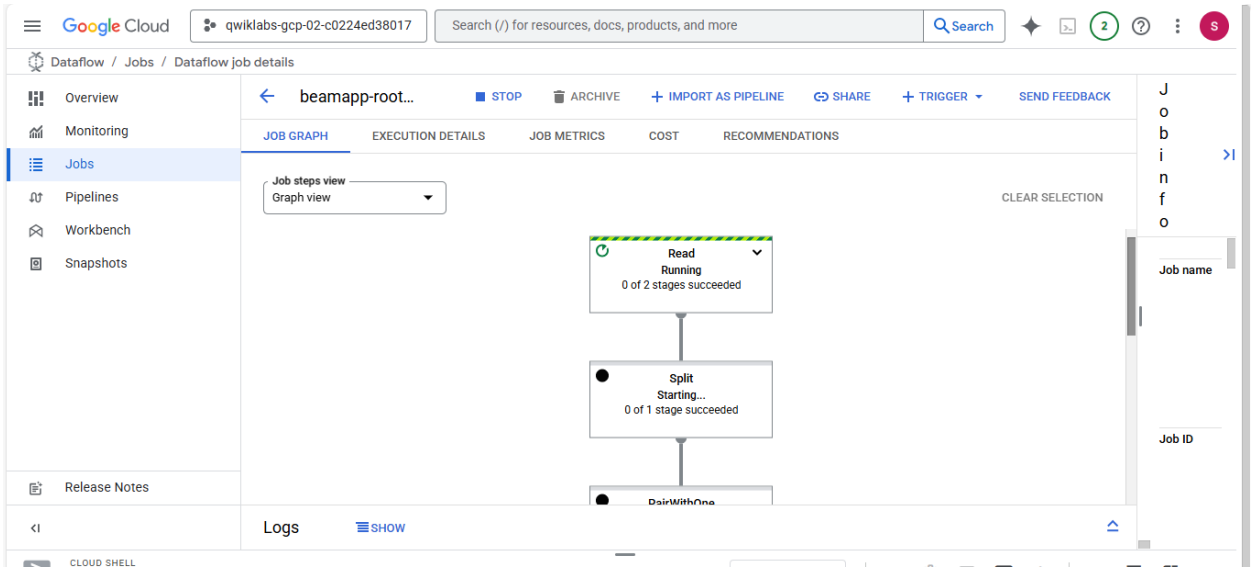
```
student_01_9d65d778187b@cloudshell:~ (qwiklabs-gcp-02-c0224ed38017)$ BUCKET=gs://qwiklabs-gcp-02-c0224ed38017-bucket
student_01_9d65d778187b@cloudshell:~ (qwiklabs-gcp-02-c0224ed38017)$ python -m apache_beam.examples.wordcount --project $DEVSHELL_PROJECT_ID \
  --runner DataflowRunner \
  --staging_location $BUCKET/staging \
  --temp_location $BUCKET/temp \
  --output $BUCKET/results/output \
  --region us-west1
/usr/bin/python: Error while finding module specification for 'apache_beam.examples.wordcount' (ModuleNotFoundError: No module named 'apache_beam')
student_01_9d65d778187b@cloudshell:~ (qwiklabs-gcp-02-c0224ed38017)$
```



5. Task 4: Verifying Pipeline Success

Steps Executed:

1. Navigated to **Dataflow** in the Cloud Console.
2. Confirmed job status changed to **"Succeeded"**.
3. Checked the output in GCS:
    a. Path: gs://[BUCKET_NAME]/results/output-*
    b. Contents: Word counts (similar to local test).



6. Key Learnings

✅ **Cloud Storage**: Buckets store pipeline outputs with multi-region redundancy.
✅ **Apache Beam**: Unified model for batch/streaming pipelines.

✅ **Dataflow**: Serverless execution with auto-scaling workers.
✅ **Monitoring**: Track jobs via Cloud Console logs.

7. Conclusion

This project successfully:

- Deployed a **WordCount pipeline** on Dataflow.
- Validated end-to-end data processing from local testing to cloud execution.
- Demonstrated GCP's serverless capabilities for large-scale data jobs.

Future Work:

- Process custom datasets (e.g., logs, user-generated content).
- Integrate with **BigQuery** for analytics.