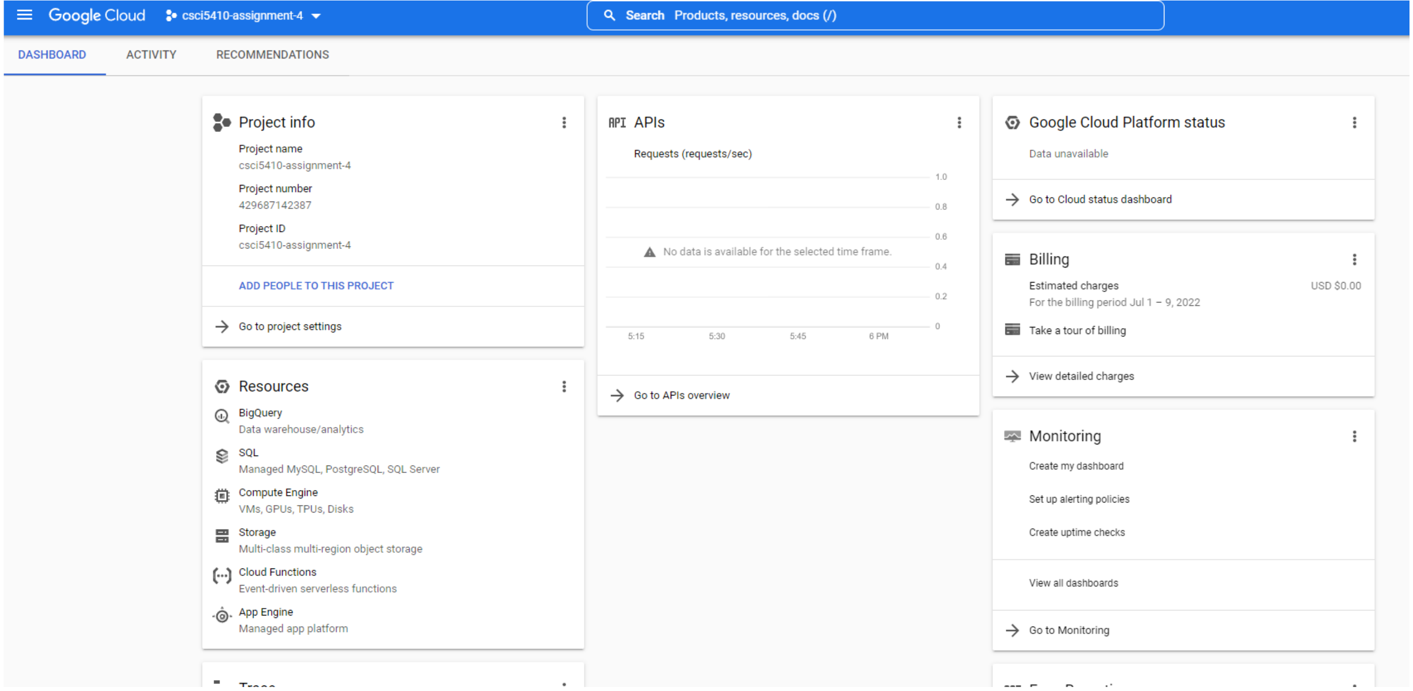
CSCI 5410

Assignment 4 – Part B

Name: Benny Daniel Tharigopala
Banner ID: B00899629
GitLab URL: https://git.cs.dal.ca/benny/csci5410_B00899629_Benny_Tharigopala

Event-driven serverless application using GCP ML

Creating a project on Google Cloud Platform (GCP)



Project info

Project name
csci5410-assignment-4

Project number
429687142387

Project ID
csci5410-assignment-4

Resources

- BigQuery – Data warehouse/analytics
- SQL – Managed MySQL, PostgreSQL, SQL Server
- Compute Engine – VMs, GPUs, TPUs, Disks
- Storage – Multi-class multi-region object storage
- Cloud Functions – Event-driven serverless functions
- App Engine – Managed app platform

APIs

No data is available for the selected time frame.

Google Cloud Platform status

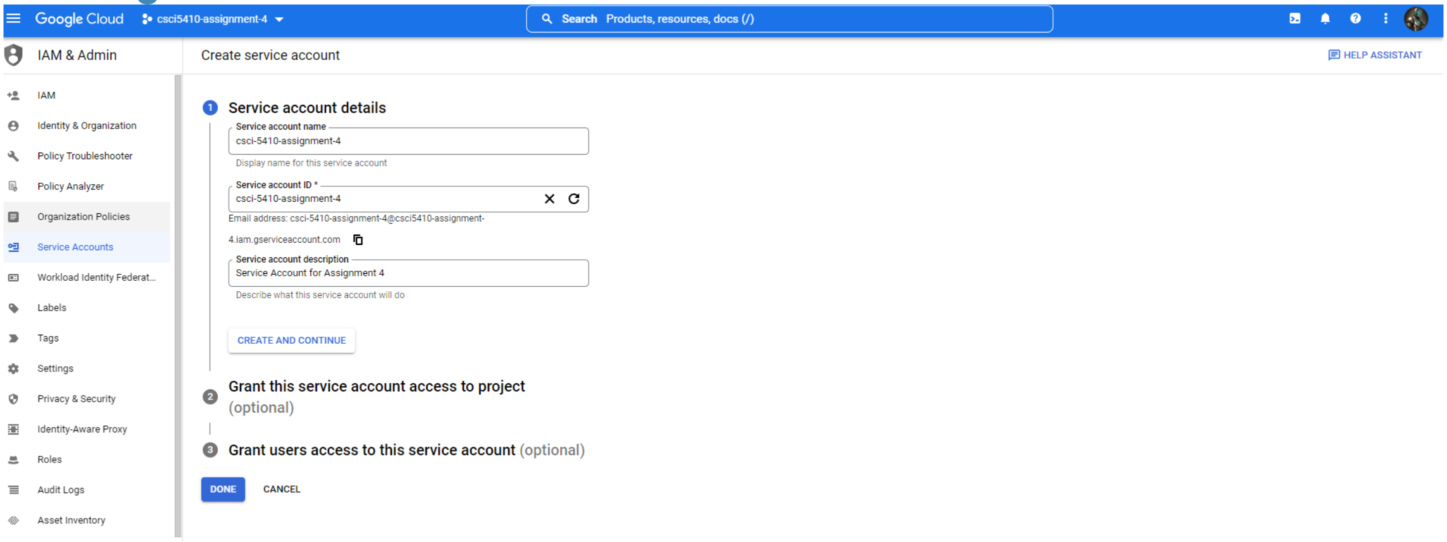
Data unavailable

Billing

Estimated charges USD $0.00
For the billing period Jul 1 – 9, 2022

Monitoring

Creating a service account on GCP



Create service account

1 Service account details

Service account name: csci-5410-assignment-4
Display name for this service account

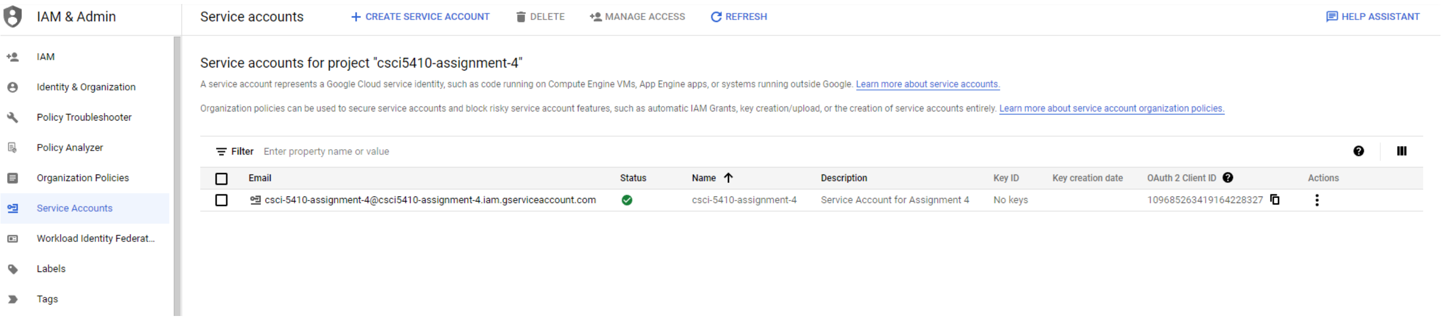
Service account ID *: csci-5410-assignment-4
Email address: csci-5410-assignment-4@csci5410-assignment-4.iam.gserviceaccount.com

Service account description: Service Account for Assignment 4
Describe what this service account will do

2 Grant this service account access to project (optional)

3 Grant users access to this service account (optional)

A new service account is created



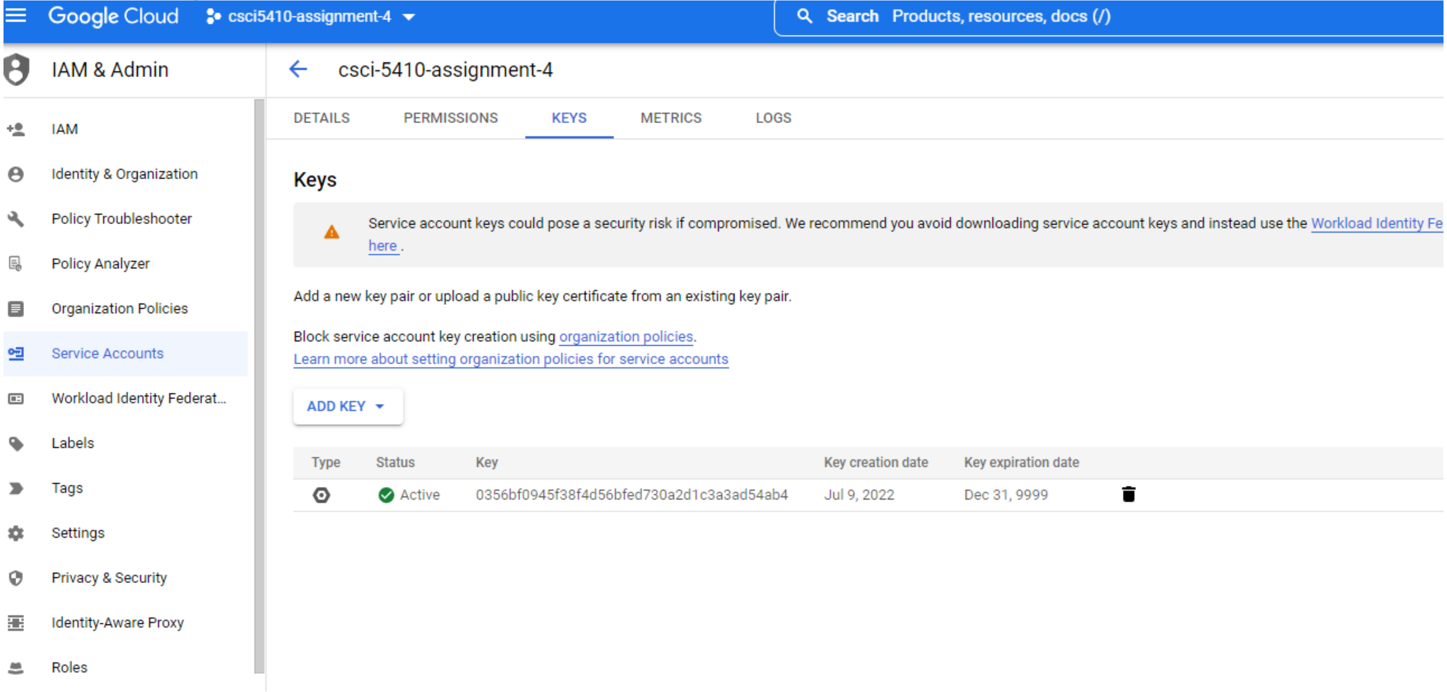
Service accounts for project "csci5410-assignment-4"

A service account represents a Google Cloud service identity, such as code running on Compute Engine VMs, App Engine apps, or systems running outside Google. Learn more about service accounts.

Organization policies can be used to secure service accounts and block risky service account features, such as automatic IAM Grants, key creation/upload, or the creation of service accounts entirely. Learn more about service account organization policies.

□	Email	Status	Name ↑	Description	Key ID	Key creation date	OAuth 2 Client ID	Actions
□	csci-5410-assignment-4@csci5410-assignment-4.iam.gserviceaccount.com	✓	csci-5410-assignment-4	Service Account for Assignment 4	No keys		109685263419164228327	⋮

Generating a key to establish a connection to GCP with JAVA SDK



csci-5410-assignment-4

Keys

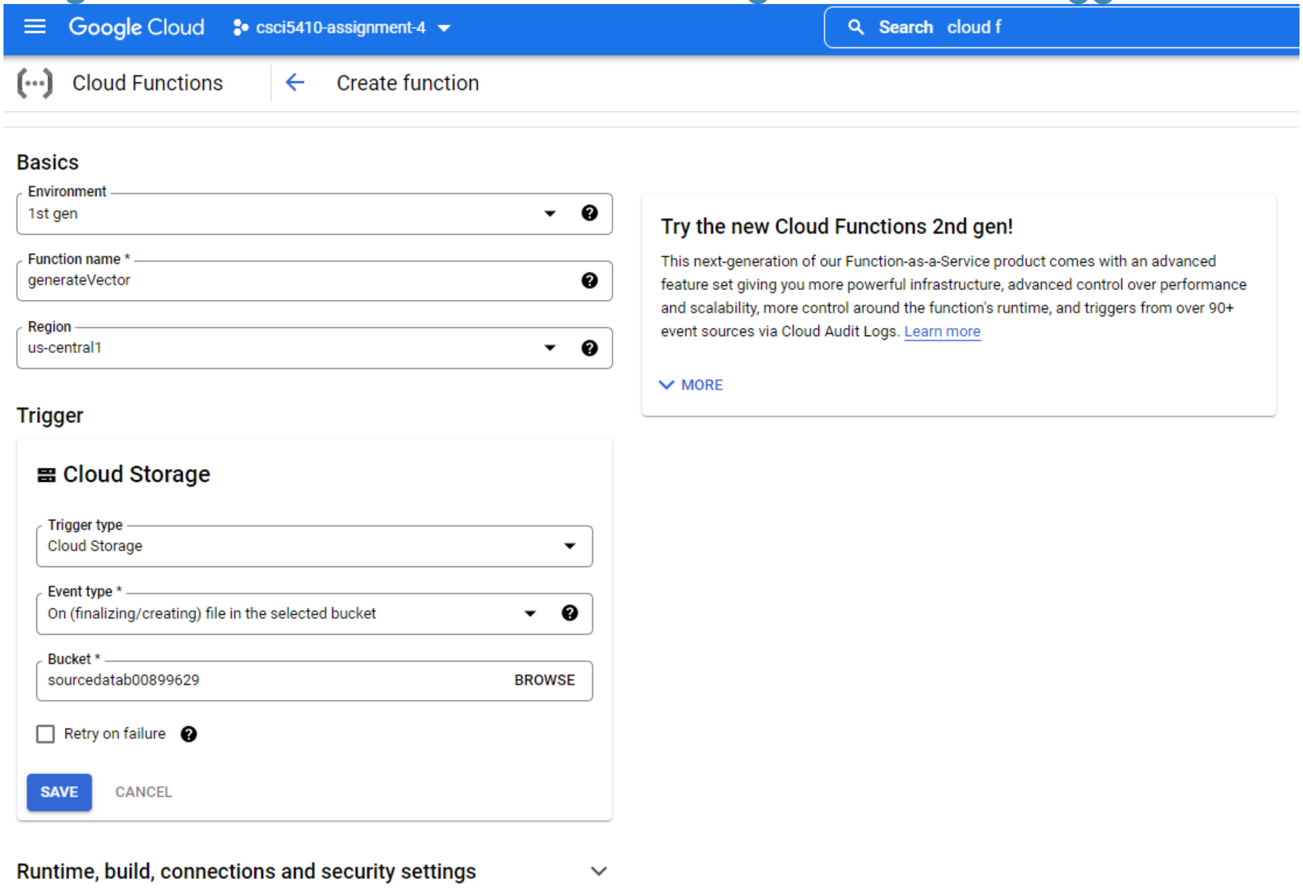
Service account keys could pose a security risk if compromised. We recommend you avoid downloading service account keys and instead use the Workload Identity Fe here .

Add a new key pair or upload a public key certificate from an existing key pair.

Block service account key creation using organization policies.
Learn more about setting organization policies for service accounts

Type	Status	Key	Key creation date	Key expiration date
	Active	0356bf0945f38f4d56bfed730a2d1c3a3ad54ab4	Jul 9, 2022	Dec 31, 9999

Creating a Cloud Function with a Cloud Storage bucket as a Trigger



Create function

Basics

Environment: 1st gen

Function name *: generateVector

Region: us-central1

Trigger

Cloud Storage

Trigger type: Cloud Storage

Event type *: On (finalizing/creating) file in the selected bucket

Bucket *: sourcedatab00899629

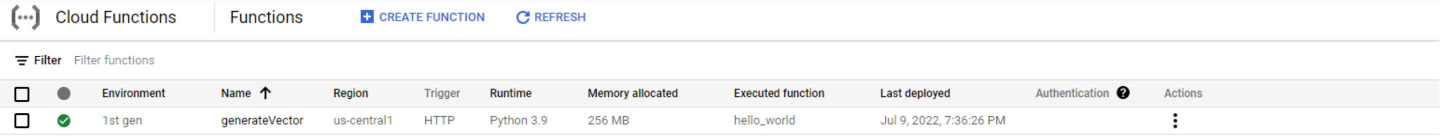
□ Retry on failure

Runtime, build, connections and security settings

Try the new Cloud Functions 2nd gen!

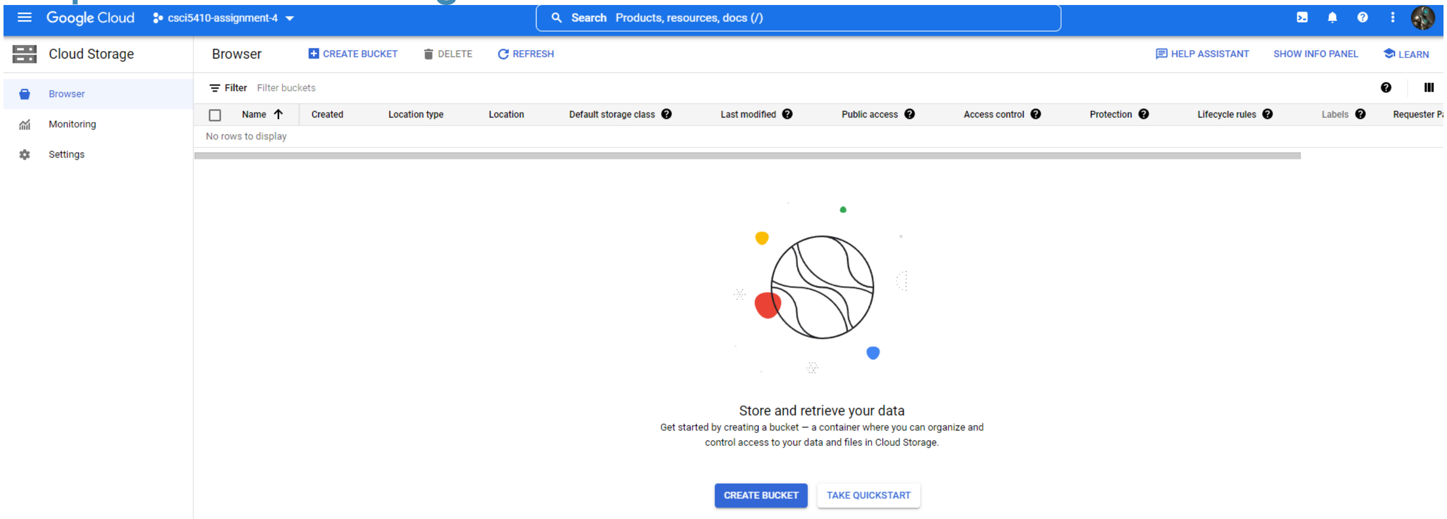
This next-generation of our Function-as-a-Service product comes with an advanced feature set giving you more powerful infrastructure, advanced control over performance and scalability, more control around the function's runtime, and triggers from over 90+ event sources via Cloud Audit Logs. Learn more

New Cloud Function on GCP



□	●	Environment	Name ↑	Region	Trigger	Runtime	Memory allocated	Executed function	Last deployed	Authentication	Actions
□	✓	1st gen	generateVector	us-central1	HTTP	Python 3.9	256 MB	hello_world	Jul 9, 2022, 7:36:26 PM		⋮

Snapshot of Cloud Storage dashboard with no Buckets

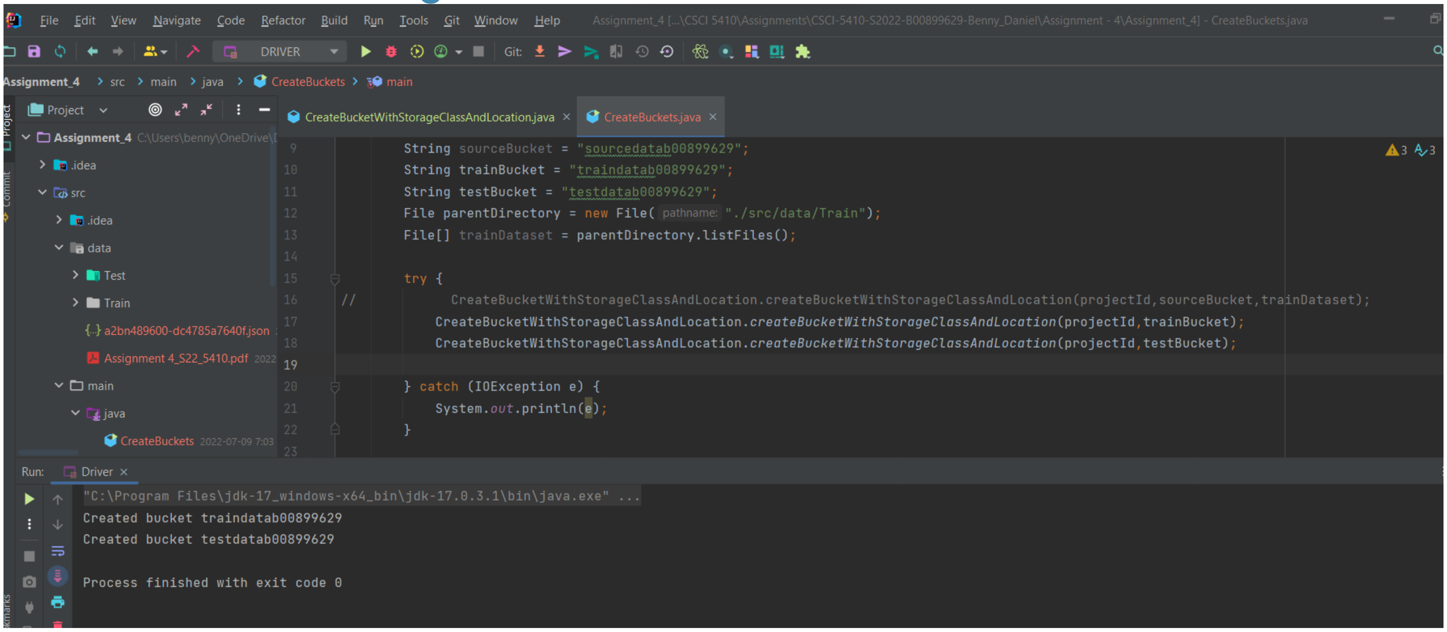


□	Name ↑	Created	Location type	Location	Default storage class	Last modified	Public access	Access control	Protection	Lifecycle rules	Labels	Requester Pa
No rows to display												

Store and retrieve your data

Get started by creating a bucket — a container where you can organize and control access to your data and files in Cloud Storage.

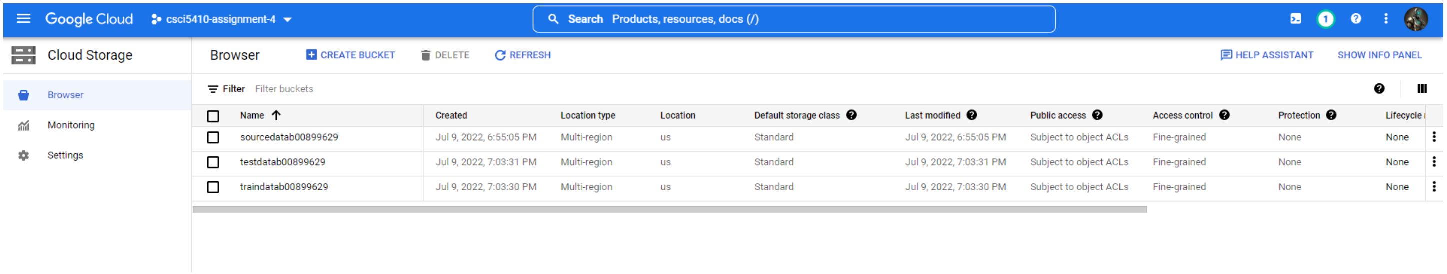
Driver Code for Creating Buckets


File
Edit
View
Navigate
Code
Refactor
Build
Run
Tools
Git
Window
Help
Assignment_4 [...\CSCI 5410\Assignments\CSCI-5410-S2022-B00899629-Benny_Daniel\Assignment - 4\Assignment_4] - CreateBuckets.java
DRIVER
Git:
Assignment_4 > src > main > java > CreateBuckets > main
Project
Assignment_4 C:\Users\benny\OneDrive\
.idea
src
.idea
data
Test
Train
a2bn489600-dc4785a7640f.json
Assignment 4_S22_5410.pdf 2022
main
java
CreateBuckets 2022-07-09 7:03
CreateBucketWithStorageClassAndLocation.java
CreateBuckets.java
Run:
Driver

```java
        String sourceBucket = "sourcedatab00899629";
        String trainBucket = "traindatab00899629";
        String testBucket = "testdatab00899629";
        File parentDirectory = new File( pathname: "./src/data/Train");
        File[] trainDataset = parentDirectory.listFiles();

        try {
//              CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId,sourceBucket,trainDataset);
            CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId,trainBucket);
            CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId,testBucket);

        } catch (IOException e) {
            System.out.println(e);
        }
```

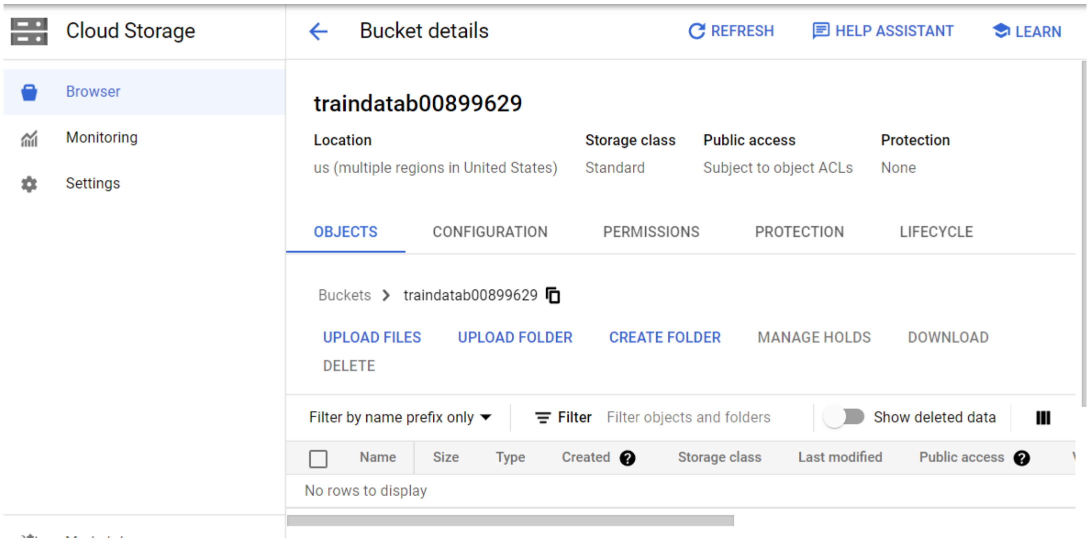
```
"C:\Program Files\jdk-17_windows-x64_bin\jdk-17.0.3.1\bin\java.exe" ...
Created bucket traindatab00899629
Created bucket testdatab00899629

Process finished with exit code 0
```

Buckets for Source, Train and Test Files



☐	Name ↑	Created	Location type	Location	Default storage class	Last modified	Public access	Access control	Protection	Lifecycle
☐	sourcedatab00899629	Jul 9, 2022, 6:55:05 PM	Multi-region	us	Standard	Jul 9, 2022, 6:55:05 PM	Subject to object ACLs	Fine-grained	None	None
☐	testdatab00899629	Jul 9, 2022, 7:03:31 PM	Multi-region	us	Standard	Jul 9, 2022, 7:03:31 PM	Subject to object ACLs	Fine-grained	None	None
☐	traindatab00899629	Jul 9, 2022, 7:03:30 PM	Multi-region	us	Standard	Jul 9, 2022, 7:03:30 PM	Subject to object ACLs	Fine-grained	None	None

Empty Bucket for Train data



traindatab00899629

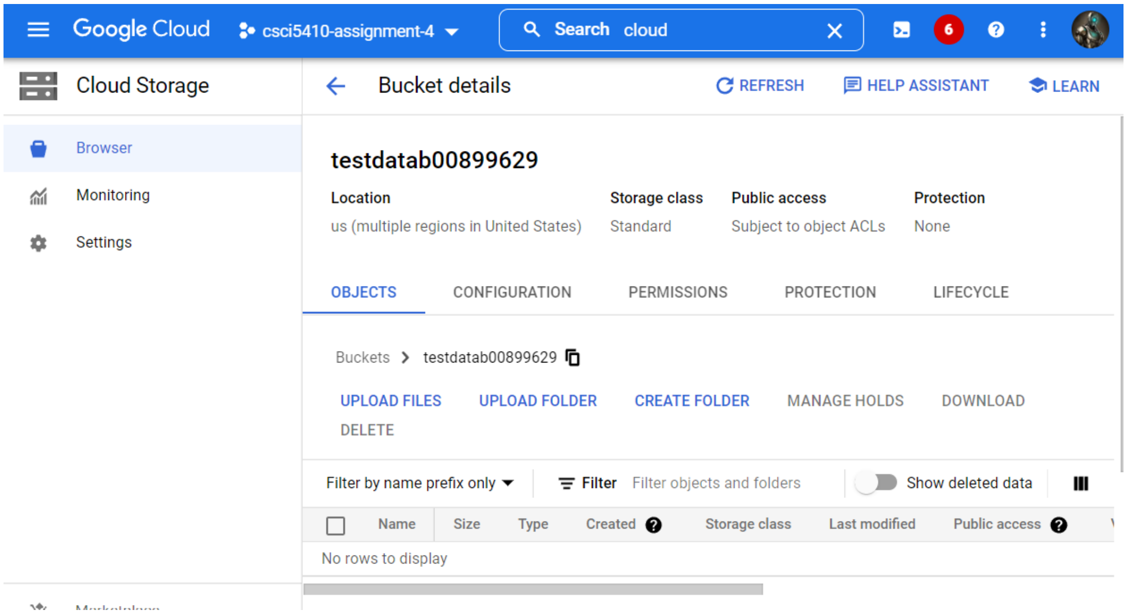
Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Subject to object ACLs	None

Buckets > traindatab00899629

☐	Name	Size	Type	Created	Storage class	Last modified	Public access

No rows to display

Empty Bucket for Test data



testdatab00899629

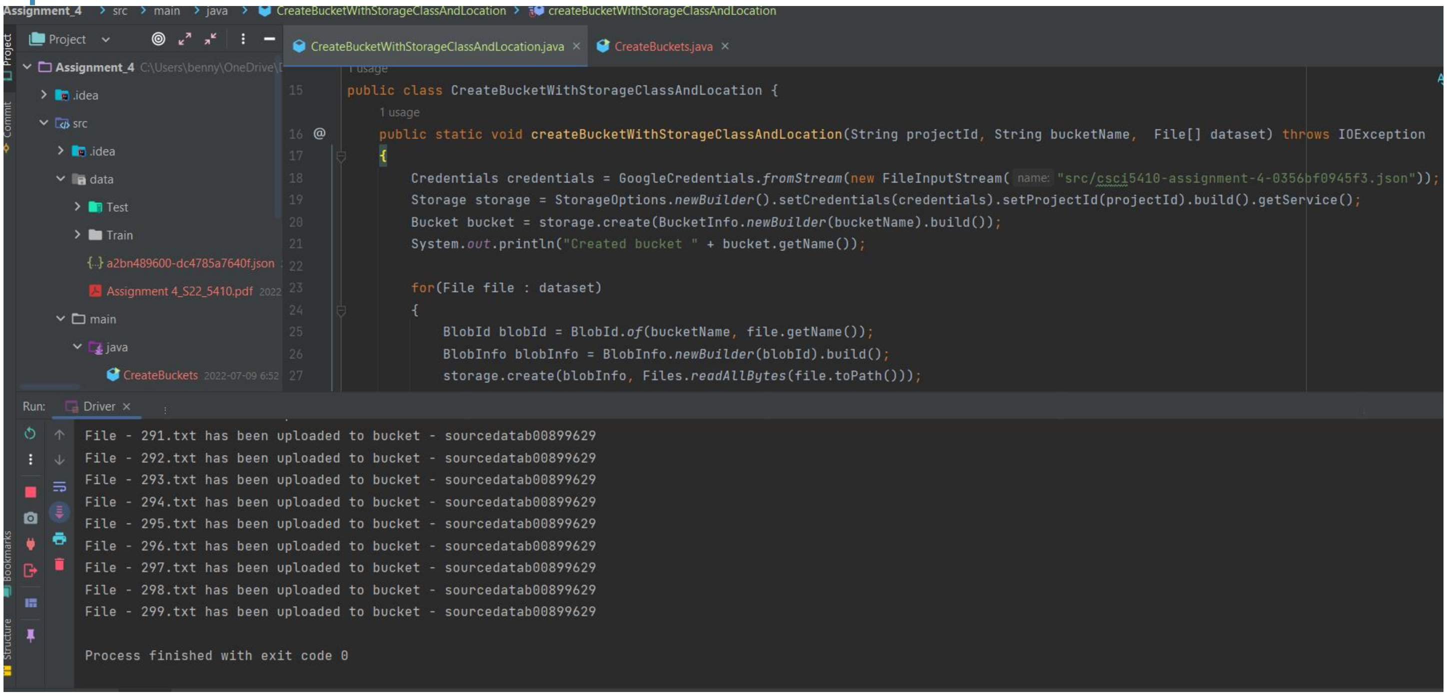
Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Subject to object ACLs	None

Buckets > testdatab00899629

☐	Name	Size	Type	Created	Storage class	Last modified	Public access

No rows to display

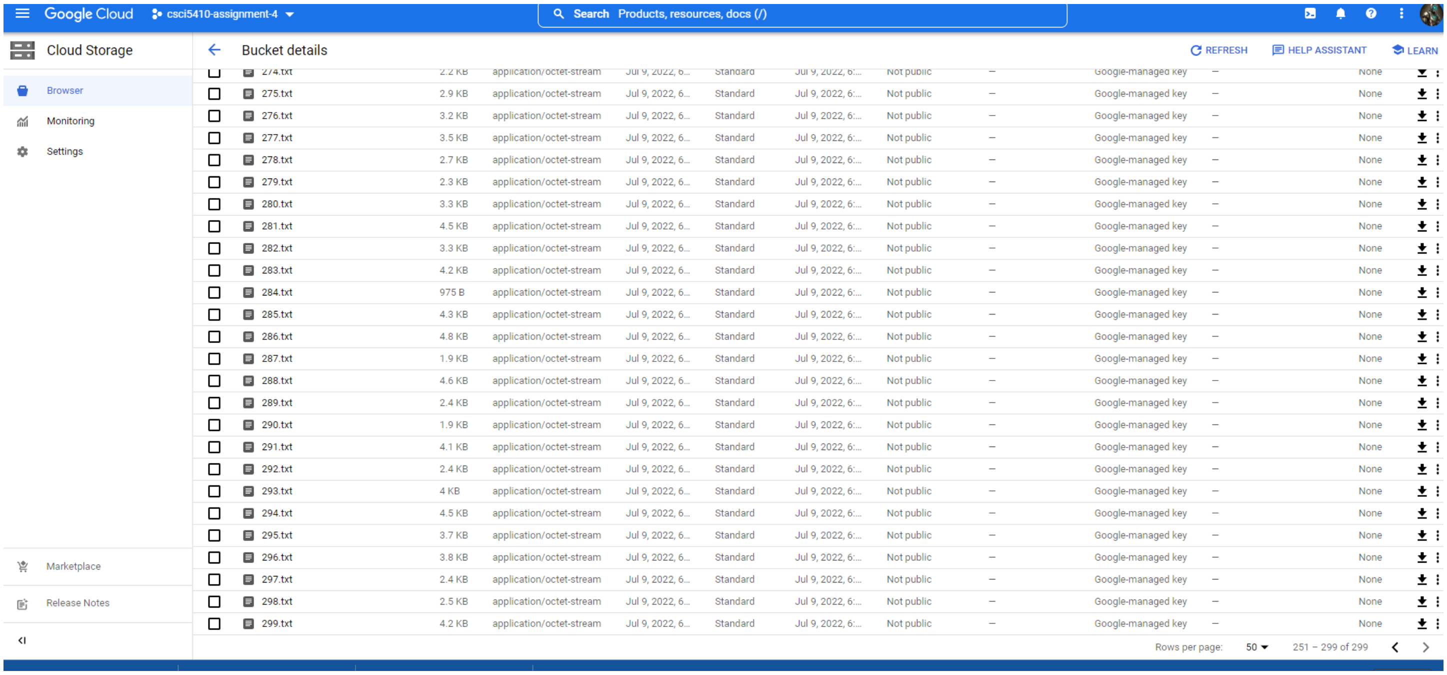
Upload “Train” Files to the Source Bucket


Assignment_4 > src > main > java > CreateBucketWithStorageClassAndLocation > createBucketWithStorageClassAndLocation
Project
Assignment_4 C:\Users\benny\OneDrive\
.idea
src
.idea
data
Test
Train
a2bn489600-dc4785a7640f.json
Assignment 4_S22_5410.pdf 2022
main
java
CreateBuckets 2022-07-09 6:52
CreateBucketWithStorageClassAndLocation.java
CreateBuckets.java
Run:
Driver

```java
public class CreateBucketWithStorageClassAndLocation {
    public static void createBucketWithStorageClassAndLocation(String projectId, String bucketName,  File[] dataset) throws IOException
    {
        Credentials credentials = GoogleCredentials.fromStream(new FileInputStream( name: "src/csci5410-assignment-4-0356bf0945f3.json"));
        Storage storage = StorageOptions.newBuilder().setCredentials(credentials).setProjectId(projectId).build().getService();
        Bucket bucket = storage.create(BucketInfo.newBuilder(bucketName).build());
        System.out.println("Created bucket " + bucket.getName());

        for(File file : dataset)
        {
            BlobId blobId = BlobId.of(bucketName, file.getName());
            BlobInfo blobInfo = BlobInfo.newBuilder(blobId).build();
            storage.create(blobInfo, Files.readAllBytes(file.toPath()));
```

```
File - 291.txt has been uploaded to bucket - sourcedatab00899629
File - 292.txt has been uploaded to bucket - sourcedatab00899629
File - 293.txt has been uploaded to bucket - sourcedatab00899629
File - 294.txt has been uploaded to bucket - sourcedatab00899629
File - 295.txt has been uploaded to bucket - sourcedatab00899629
File - 296.txt has been uploaded to bucket - sourcedatab00899629
File - 297.txt has been uploaded to bucket - sourcedatab00899629
File - 298.txt has been uploaded to bucket - sourcedatab00899629
File - 299.txt has been uploaded to bucket - sourcedatab00899629

Process finished with exit code 0
```

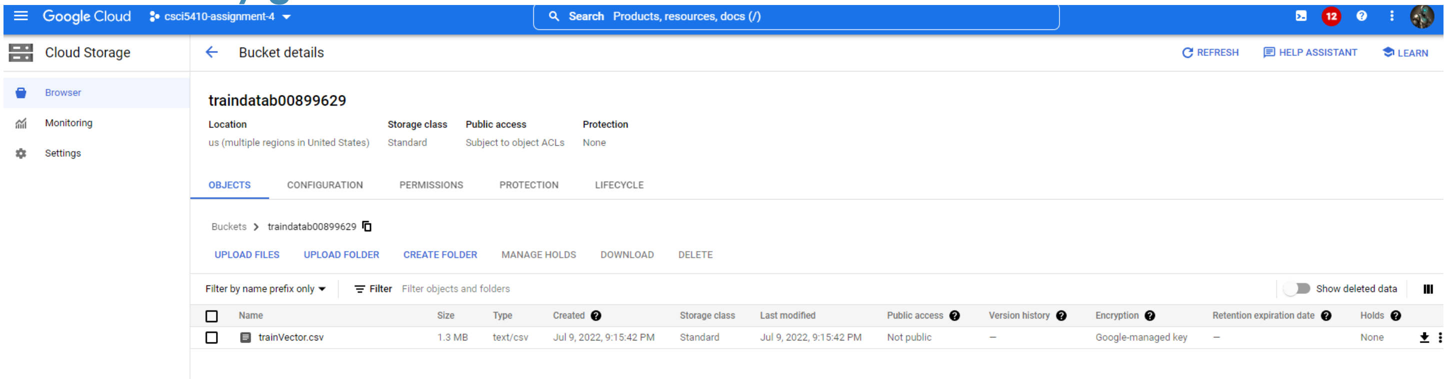
Source Bucket with Files



□	274.txt	2.2 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	275.txt	2.9 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	276.txt	3.2 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	277.txt	3.5 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	278.txt	2.7 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	279.txt	2.3 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	280.txt	3.3 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	281.txt	4.5 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	282.txt	3.3 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	283.txt	4.2 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	284.txt	975 B	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	285.txt	4.3 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	286.txt	4.8 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	287.txt	1.9 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	288.txt	4.6 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	289.txt	2.4 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	290.txt	1.9 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	291.txt	4.1 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	292.txt	2.4 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	293.txt	4 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	294.txt	4.5 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	295.txt	3.7 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	296.txt	3.8 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	297.txt	2.4 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	298.txt	2.5 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None
□	299.txt	4.2 KB	application/octet-stream	Jul 9, 2022, 6...	Standard	Jul 9, 2022, 6:...	Not public	–	Google-managed key	–	None

Rows per page: 50 251 – 299 of 299

Automatically generated CSV file



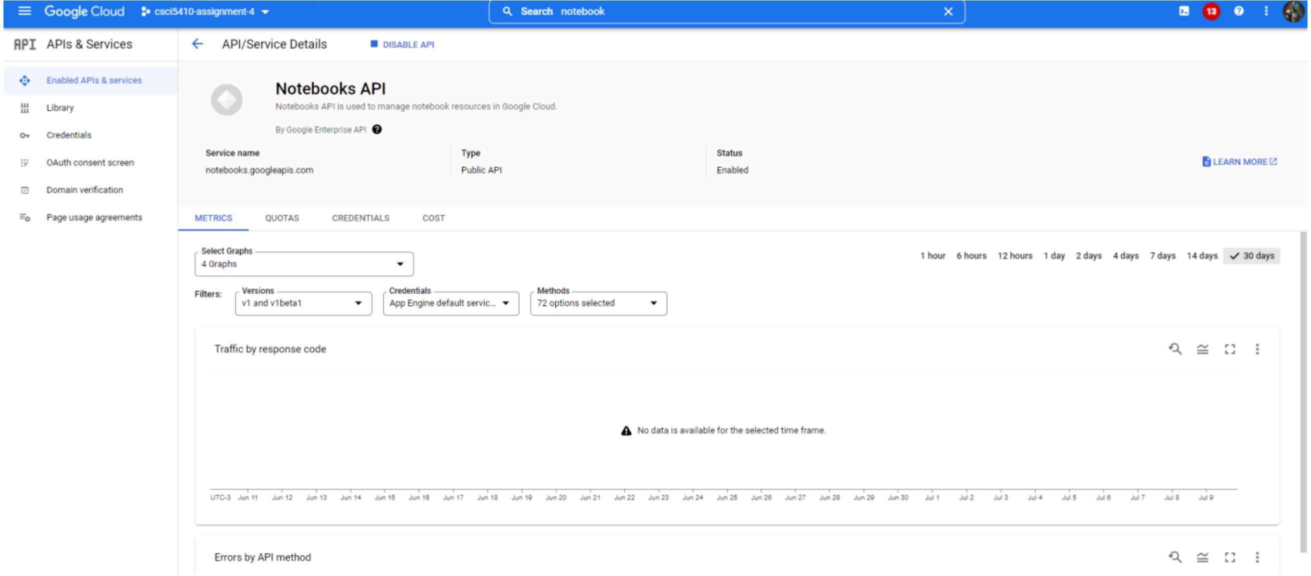
traindatab00899629

Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Subject to object ACLs	None

Buckets > traindatab00899629

Name	Size	Type	Created	Storage class	Last modified	Public access	Version history	Encryption	Retention expiration date	Holds
trainVector.csv	1.3 MB	text/csv	Jul 9, 2022, 9:15:42 PM	Standard	Jul 9, 2022, 9:15:42 PM	Not public	–	Google-managed key	–	None

Enabling API for Using Managed Notebooks



Notebooks API

Notebooks API is used to manage notebook resources in Google Cloud.

By Google Enterprise API

Service name	Type	Status
notebooks.googleapis.com	Public API	Enabled

Select Graphs: 4 Graphs

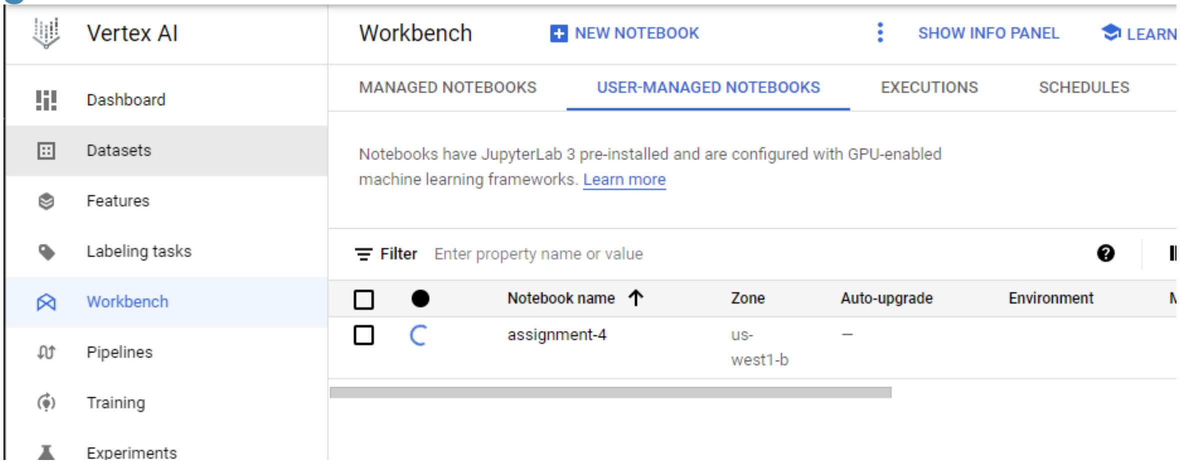
Filters: Versions: v1 and v1beta1; Credentials: App Engine default servic...; Methods: 72 options selected

Traffic by response code

No data is available for the selected time frame.

Errors by API method

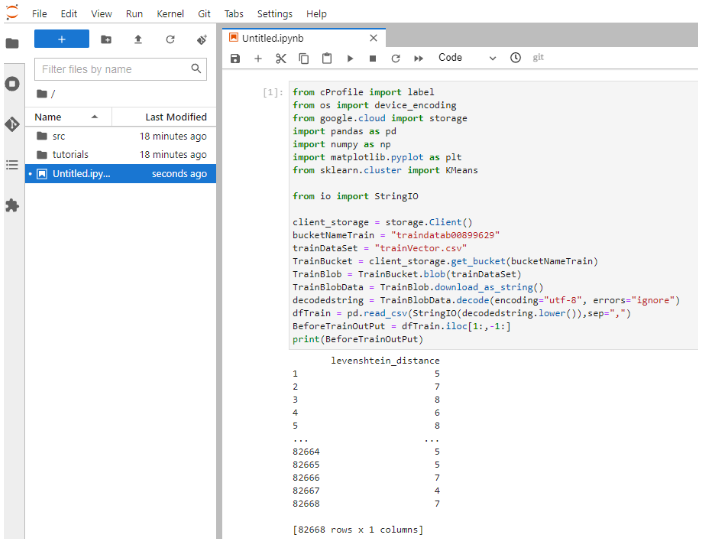
Creating a new Notebook on Vertex AI



Notebooks have JupyterLab 3 pre-installed and are configured with GPU-enabled machine learning frameworks. Learn more

□	●	Notebook name ↑	Zone	Auto-upgrade	Environment
□	C	assignment-4	us-west1-b	–	

Peek at the Dataframe



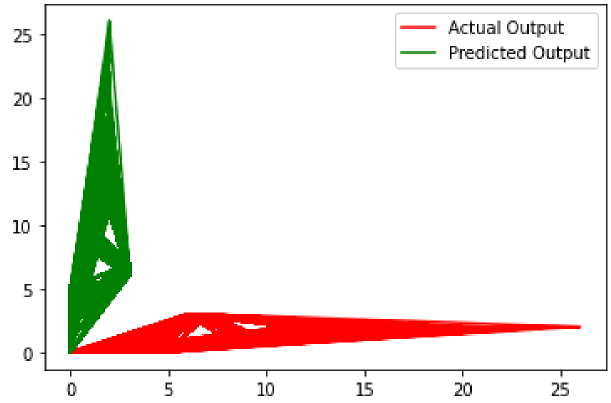
Name	Last Modified
src	18 minutes ago
tutorials	18 minutes ago
Untitled.ipy...	seconds ago

```
[1]: from cProfile import label
     from os import device_encoding
     from google.cloud import storage
     import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     from sklearn.cluster import KMeans

     from io import StringIO

     client_storage = storage.Client()
     bucketNameTrain = "traindatab00899629"
     trainDataSet = "trainVector.csv"
     TrainBucket = client_storage.get_bucket(bucketNameTrain)
     TrainBlob = TrainBucket.blob(trainDataSet)
     TrainBlobData = TrainBlob.download_as_string()
     decodedstring = TrainBlobData.decode(encoding="utf-8", errors="ignore")
     dfTrain = pd.read_csv(StringIO(decodedstring.lower()),sep=",")
     BeforeTrainOutPut = dfTrain.iloc[1:,-1:]
     print(BeforeTrainOutPut)
```

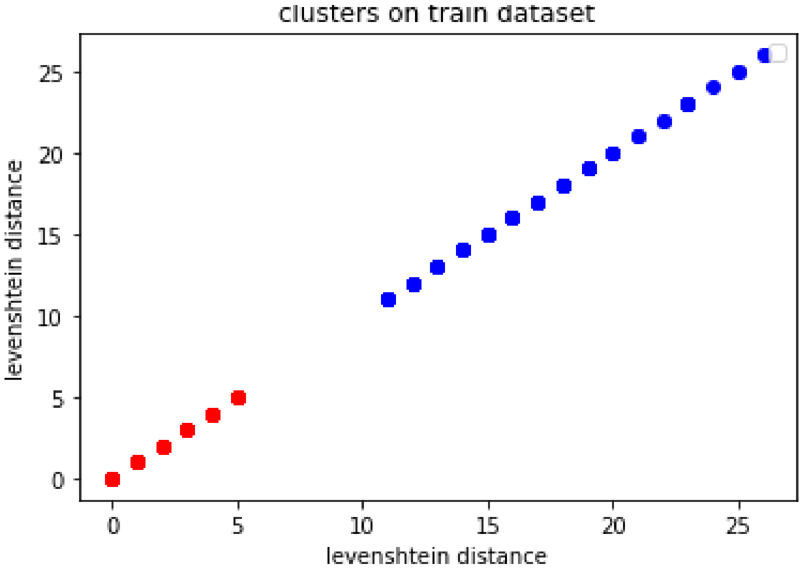
```
       levenshtein_distance
1                         5
2                         7
3                         8
4                         6
5                         8
...                     ...
82664                     5
82665                     5
82666                     7
82667                     4
82668                     7

[82668 rows x 1 columns]
```

Visualize the Plot for the Training Dataset

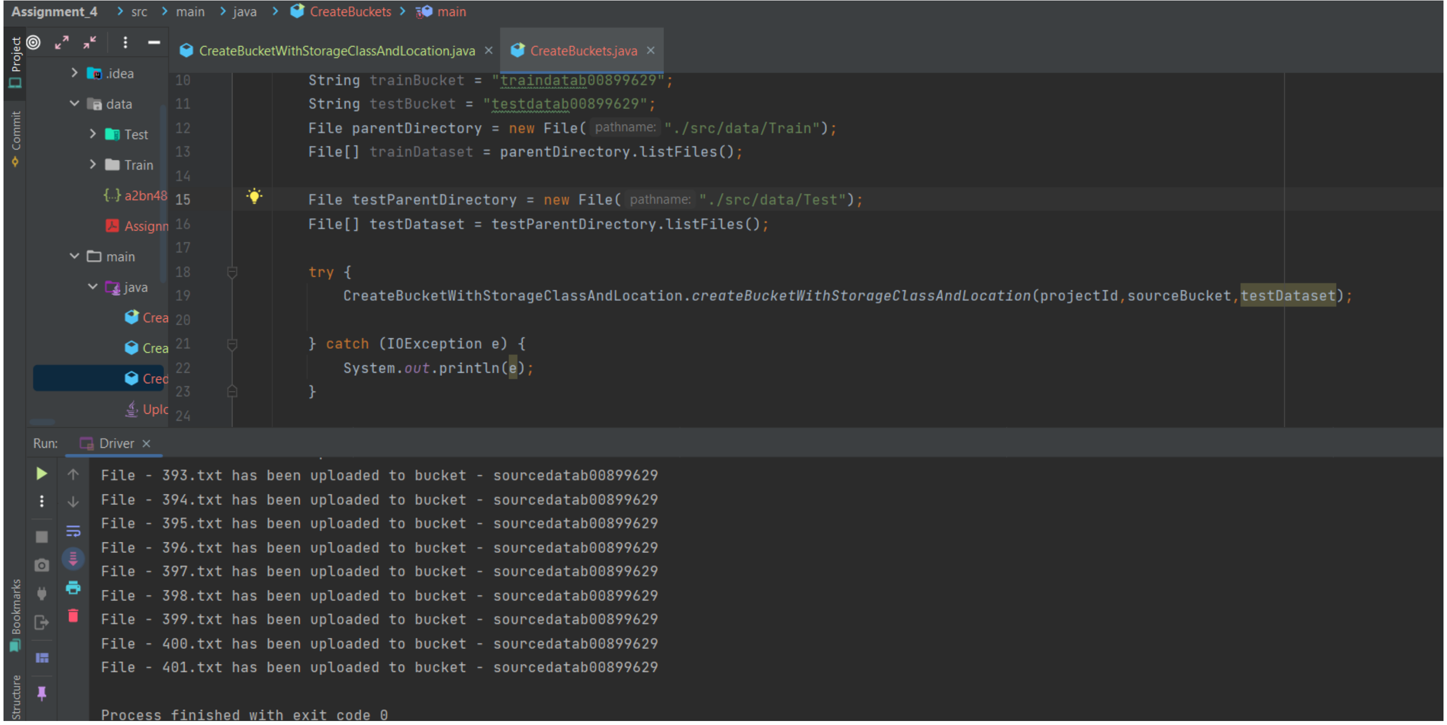
```
[9]: plt.plot(BeforeTrainOutPut, TrainOutput , label = "Actual Output",color="red")
     plt.plot( TrainOutput,BeforeTrainOutPut , label = "Predicted Output",color="green")
     plt.legend()
     plt.show()
```



Visualize the cluster for levenshtein distance



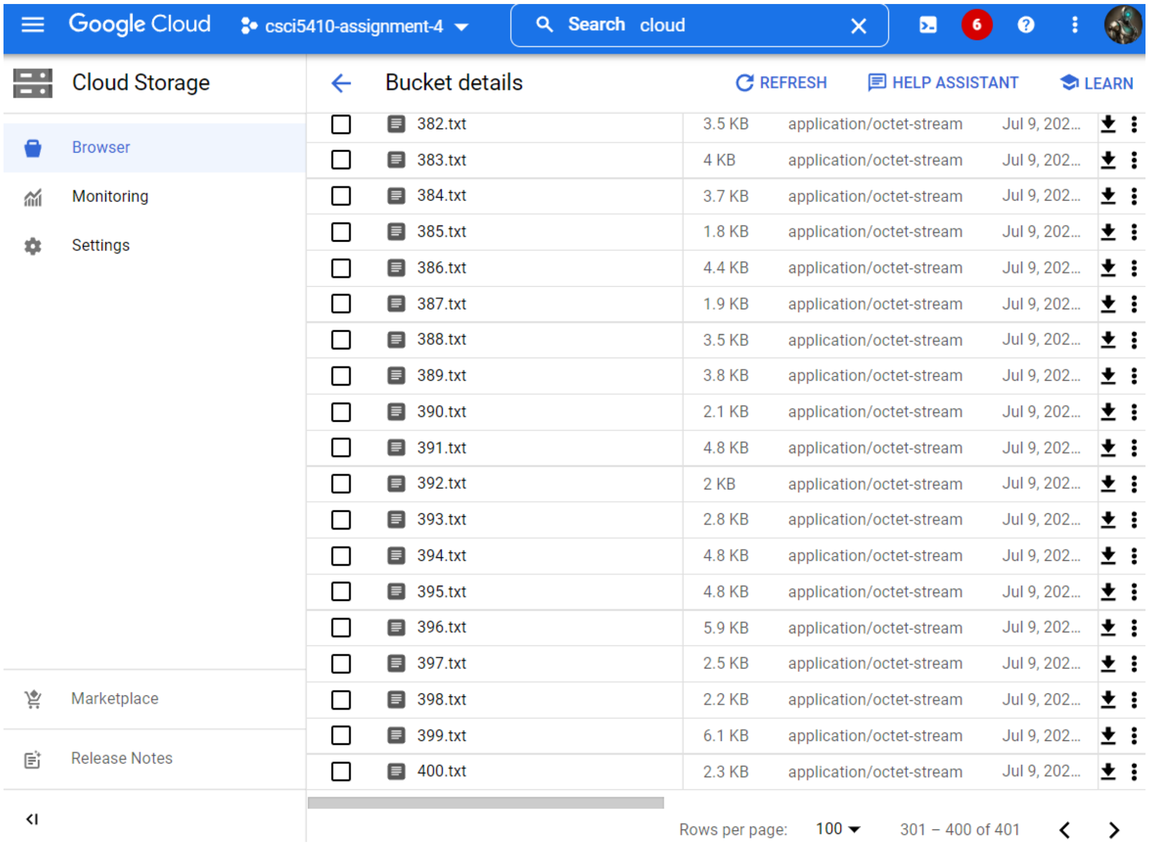
Upload Files to the “Test” Bucket



```
        String trainBucket = "traindatab00899629";
        String testBucket = "testdatab00899629";
        File parentDirectory = new File( pathname: "./src/data/Train");
        File[] trainDataset = parentDirectory.listFiles();

        File testParentDirectory = new File( pathname: "./src/data/Test");
        File[] testDataset = testParentDirectory.listFiles();

        try {
            CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId,sourceBucket,testDataset);

        } catch (IOException e) {
            System.out.println(e);
        }
```

```
File - 393.txt has been uploaded to bucket - sourcedatab00899629
File - 394.txt has been uploaded to bucket - sourcedatab00899629
File - 395.txt has been uploaded to bucket - sourcedatab00899629
File - 396.txt has been uploaded to bucket - sourcedatab00899629
File - 397.txt has been uploaded to bucket - sourcedatab00899629
File - 398.txt has been uploaded to bucket - sourcedatab00899629
File - 399.txt has been uploaded to bucket - sourcedatab00899629
File - 400.txt has been uploaded to bucket - sourcedatab00899629
File - 401.txt has been uploaded to bucket - sourcedatab00899629

Process finished with exit code 0
```

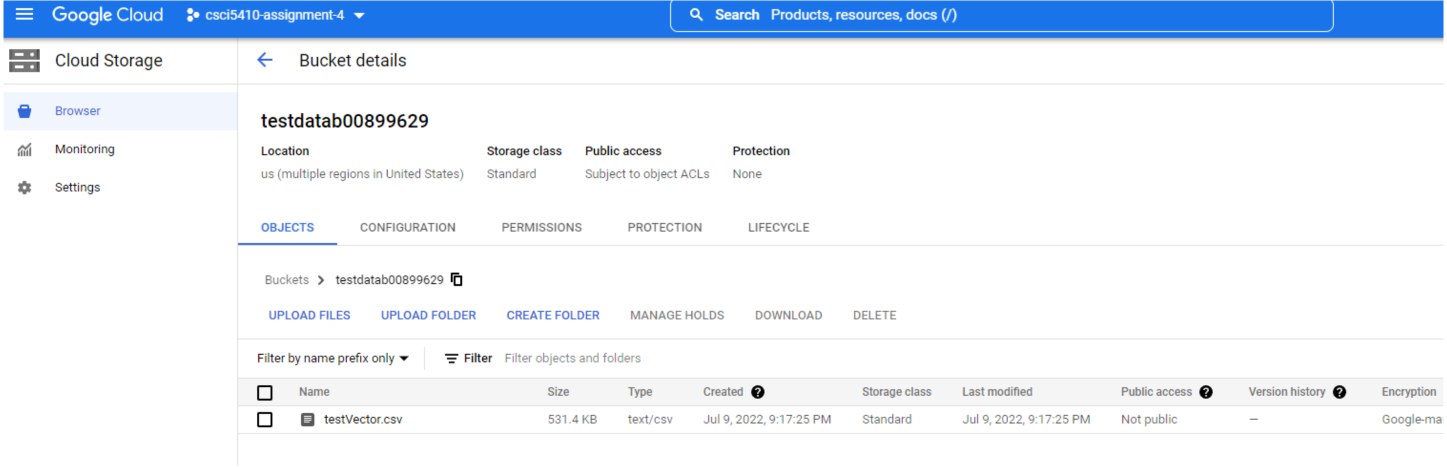
Empty Bucket for Test data



	Name	Size	Type	Created
□	382.txt	3.5 KB	application/octet-stream	Jul 9, 202...
□	383.txt	4 KB	application/octet-stream	Jul 9, 202...
□	384.txt	3.7 KB	application/octet-stream	Jul 9, 202...
□	385.txt	1.8 KB	application/octet-stream	Jul 9, 202...
□	386.txt	4.4 KB	application/octet-stream	Jul 9, 202...
□	387.txt	1.9 KB	application/octet-stream	Jul 9, 202...
□	388.txt	3.5 KB	application/octet-stream	Jul 9, 202...
□	389.txt	3.8 KB	application/octet-stream	Jul 9, 202...
□	390.txt	2.1 KB	application/octet-stream	Jul 9, 202...
□	391.txt	4.8 KB	application/octet-stream	Jul 9, 202...
□	392.txt	2 KB	application/octet-stream	Jul 9, 202...
□	393.txt	2.8 KB	application/octet-stream	Jul 9, 202...
□	394.txt	4.8 KB	application/octet-stream	Jul 9, 202...
□	395.txt	4.8 KB	application/octet-stream	Jul 9, 202...
□	396.txt	5.9 KB	application/octet-stream	Jul 9, 202...
□	397.txt	2.5 KB	application/octet-stream	Jul 9, 202...
□	398.txt	2.2 KB	application/octet-stream	Jul 9, 202...
□	399.txt	6.1 KB	application/octet-stream	Jul 9, 202...
□	400.txt	2.3 KB	application/octet-stream	Jul 9, 202...

Rows per page: 100 ▾ 301 – 400 of 401

Automatically Generated CSV file for Test Data



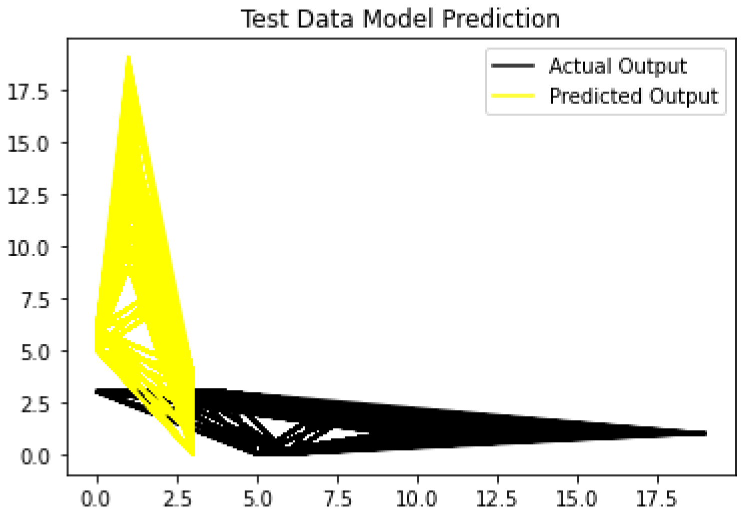
testdatab00899629

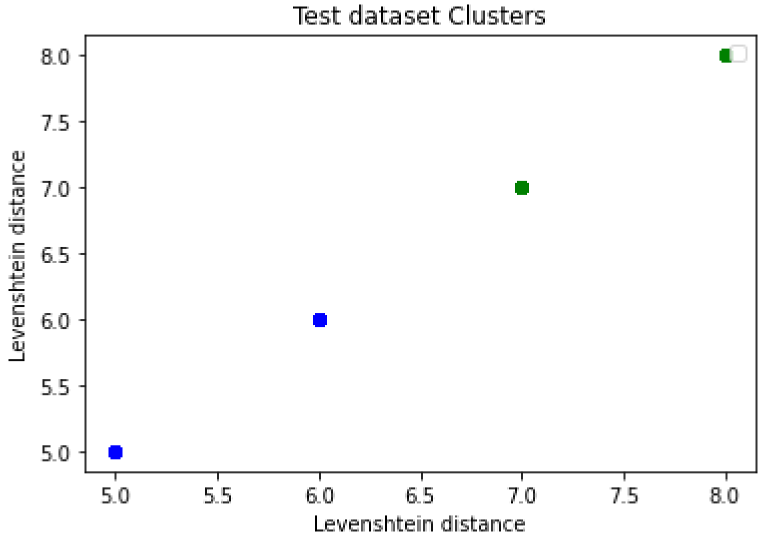
Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Subject to object ACLs	None

Buckets > testdatab00899629

□	Name	Size	Type	Created	Storage class	Last modified	Public access	Version history	Encryption
□	testVector.csv	531.4 KB	text/csv	Jul 9, 2022, 9:17:25 PM	Standard	Jul 9, 2022, 9:17:25 PM	Not public	–	Google-ma

Empty Bucket for Test data





Code Blocks

Create Buckets (Driver Class) [1-2]

```
import java.io.File;
import java.io.IOException;

public class CreateBuckets
{
    public static void main(String[] args)
    {
        String projectId = Credentials.PROJECT_ID;
        String sourceBucket = "sourcedatab00899629";
        String trainBucket = "traindatab00899629";
        String testBucket = "testdatab00899629";
        File parentDirectory = new File("./src/data/Train");
        File[] trainDataset = parentDirectory.listFiles();

        File testParentDirectory = new File("./src/data/Test");
        File[] testDataset = testParentDirectory.listFiles();

        try {

CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId
,sourceBucket,trainDataset);
CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId
,trainBucket);
CreateBucketWithStorageClassAndLocation.createBucketWithStorageClassAndLocation(projectId
,sourceBucket);
        } catch (IOException e) {
            System.out.println(e);
        }
    }
}
```

Create Buckets and Upload Files (Driver Class) [1-2]

```
import com.google.auth.Credentials;
import com.google.auth.oauth2.GoogleCredentials;
import com.google.cloud.storage.BlobId;
import com.google.cloud.storage.BlobInfo;
import com.google.cloud.storage.Storage;
import com.google.cloud.storage.StorageOptions;
import java.io.File;
import java.io.FileInputStream;
import java.io.IOException;
import java.nio.file.Files;
import com.google.cloud.storage.BucketInfo;
import com.google.cloud.storage.Bucket;


public class CreateBucketWithStorageClassAndLocation {
    public static void createBucketWithStorageClassAndLocation(String projectId, String
bucketName,  File[] dataset) throws IOException
    {
        Credentials credentials = GoogleCredentials.fromStream(new
FileInputStream("src/csci5410-assignment-4-0356bf0945f3.json"));
        Storage storage =
StorageOptions.newBuilder().setCredentials(credentials).setProjectId(projectId).build().g
etService();
        Bucket bucket = storage.create(BucketInfo.newBuilder(bucketName).build());
        System.out.println("Created bucket " + bucket.getName());
int count=0;
        for(File file : dataset)
        {
            if(count<10) {
                BlobId blobId = BlobId.of(bucketName, file.getName());
                BlobInfo blobInfo = BlobInfo.newBuilder(blobId).build();
                storage.create(blobInfo, Files.readAllBytes(file.toPath()));
                System.out.println("File - " + file.getName() + " has been uploaded to
bucket - " + bucketName);
                count++;
            }
            else {
                break;
            }
        }
    }

    public static void createBucketWithStorageClassAndLocation(String projectId, String
bucketName) throws IOException
    {
        Credentials credentials = GoogleCredentials.fromStream(new
FileInputStream("src/csci5410-assignment-4-0356bf0945f3.json"));
        Storage storage =
StorageOptions.newBuilder().setCredentials(credentials).setProjectId(projectId).build().g
etService();
        Bucket bucket = storage.create(BucketInfo.newBuilder(bucketName).build());
        System.out.println("Created bucket " + bucket.getName());
    }
}
```

Cloud Function to extract words and Levenshtein distance [3-5]

```
    file = event
    bucket = storage_client.get_bucket(file['bucket'])
    uploadbucket = storage_client.get_bucket('traindatab00899629');
    print('traindatab00899629')
    blob = bucket.blob(file['name'])
    contents = blob.download_as_string()

    decodedstring = contents.decode(encoding="utf-8", errors="ignore")
    decodedstring = decodedstring.replace("\n", " ")
    words = decodedstring.split(" ")
    length = len(words)
    uploadCsv = 'trainVector.csv'
    StoreInCsv = ""
    blob = uploadbucket.blob(uploadCsv)
```

```
def distance(s1,s2):
    if len(s1) > len(s2):
        s1,s2 = s2,s1
    l1 = len(s1) + 1
    l2 = len(s2) + 1
    dp = {}
    for i in range(l1):
        dp[i,0] = i
    for j in range(l2):
        dp[0,j] = j
    for i in range(1,l1):
        for j in range(1,l2):
            cost = 0 if s1[i - 1] == s2[j - 1] else 1
            dp[i,j] = min(dp[i,j - 1] + 1, dp[i - 1,j] + 1,dp[i - 1,j - 1] + cost)
    return dp[l1 - 1,l2 - 1]
```

```
for i in range(length - 1):
        s1 = re.sub('[^A-Za-z]+', '', words[i])
        s2 = re.sub('[^A-Za-z]+', '', words[i  + 1])
        if (s1.lower() not in stopWords) and (s2.lower() not in stopWords):
            distance = distance(s1.lower(), s2.lower())
            StoreInCsv += s1 + "," + s2 + "," + str(distance) + '\n'
        print(StoreInCsv)
```

K-Means Cluster and Plots [6-7]

```
client_storage = storage.Client()
bucketNameTrain = "traindatab00899629"
trainDataSet = "trainVector.csv"
TrainBucket = client_storage.get_bucket(bucketNameTrain)
TrainBlob = TrainBucket.blob(trainDataSet)
TrainBlobData = TrainBlob.download_as_string()
decodedstring = TrainBlobData.decode(encoding="utf-8", errors="ignore")
dfTrain = pd.read_csv(StringIO(decodedstring.lower()),sep=",")
BeforeTrainOutPut = dfTrain.iloc[1:,-1:]
print(BeforeTrainOutPut)
```

```
kmeans = KMeans(n_clusters=4, init='k-means++', max_iter=300)
TrainOutput = kmeans.fit_predict(BeforeTrainOutPut)
print(TrainOutput)

plt.plot(BeforeTrainOutPut, TrainOutput , label = "Actual Output")
plt.plot( TrainOutput,BeforeTrainOutPut , label = "Predicted Output")
plt.legend()
plt.show()
```

```
plt.scatter(BeforeTrainOutPut[TrainOutput == 0],BeforeTrainOutPut[TrainOutput == 0],color = 'red')
plt.scatter(BeforeTrainOutPut[TrainOutput == 2],BeforeTrainOutPut[TrainOutput == 2],color = 'blue')
plt.scatter(BeforeTrainOutPut[TrainOutput == 4],BeforeTrainOutPut[TrainOutput == 4],color = 'green')
plt.scatter(BeforeTrainOutPut[TrainOutput == 6],BeforeTrainOutPut[TrainOutput == 6],color = 'yellow')
plt.show();
```

```
bucketNameTest = "testdatab00899629"
testDataSet = "testVector.csv"
TestBucket = client_storage.get_bucket(bucketNameTest)
TestBlob = TestBucket.blob(testDataSet)
TestBlobData = TestBlob.download_as_string()
decodedstring = TestBlobData.decode(encoding="utf-8", errors="ignore")
dfTest = pd.read_csv(StringIO(decodedstring.lower()),sep=",")
BeforeTestOutPut = dfTest.iloc[1:,-1:]

TestOutput = kmeans.fit_predict(BeforeTestOutPut)
```

```
plt.plot(BeforeTestOutPut, TestOutput , label = "Actual Output")
plt.plot( TestOutput,BeforeTestOutPut , label = "Predicted Output")
plt.show()
```

```
cluster_centres = kmeans.cluster_centers_

plt.scatter(BeforeTestOutPut[TestOutput == 0],BeforeTestOutPut[TestOutput == 0],color =
'red')
plt.scatter(BeforeTestOutPut[TestOutput == 2],BeforeTestOutPut[TestOutput == 2],color =
'blue')
plt.scatter(BeforeTestOutPut[TestOutput == 4],BeforeTestOutPut[TestOutput == 4],color =
'green')
plt.scatter(BeforeTestOutPut[TestOutput == 6],BeforeTestOutPut[TestOutput == 6],color =
'yellow')

plt.title("Test dataset Clusters")
plt.xlabel("Levenshtein distance")
plt.ylabel("Levenshtein distance")
plt.legend()
plt.show();
```

Citations

[1] “Cloud Storage client libraries,” *Google Cloud*, May 12, 2017. https://cloud.google.com/storage/docs/reference/libraries (accessed Jul. 06, 2022).

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