# Homework 5

▼ **Github Link**

https://github.com/ArkashJ/DS561-HW/tree/main/hw5

▼ **Initial Setup**

**1) Enable the Cloud SQL API -** https://cloud.google.com/sql/docs/mysql/connect-connectors#python

## Before you begin

- Enable the Cloud SQL Admin API.

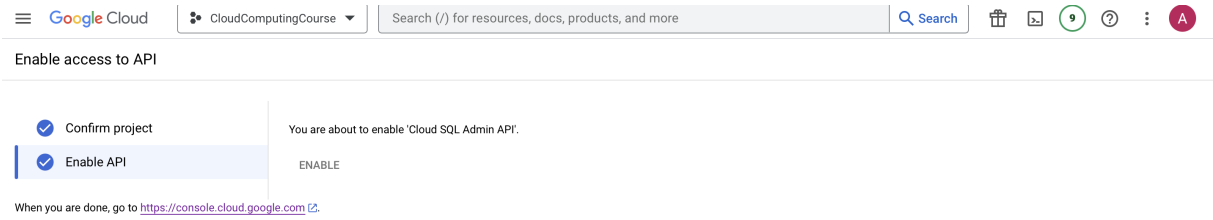
  Enable the API

- Create a Cloud SQL instance, including configuring the default user.

  For more information about creating instances, see Create instances.

  For more information about configuring the default user, see Set the password for the default user account.

- Configure the roles and permissions required to connect to a Cloud SQL instance.




**2) Install necessary dependencies**

```
pip3 install pymysql
pip3 install sqlalchemy
pip3 install "cloud-sql-python-connector[pymysql]"
```

Activate credentials locally

```
gcloud auth application-default login
```

Cloud SDK > Documentation > Guides

Was this helpful?

# You are now authenticated with the gcloud CLI!

Send feedback

The authentication flow has completed successfully. You may close this window, or check out the resources below.

## Information about command-line tools and client libraries

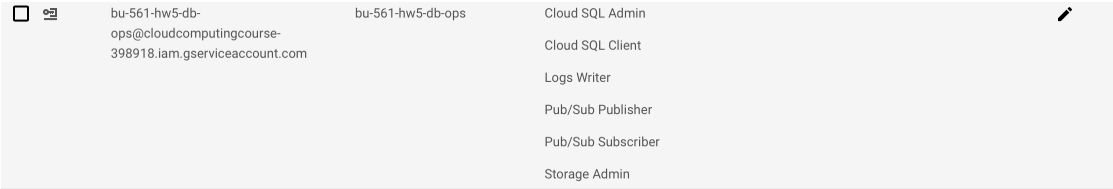
To learn more about Google Cloud CLI commands, see the gcloud CLI guide.

To learn more about the command-line tools for App Engine, Compute Engine, Cloud Storage, BigQuery, Cloud SQL, and Cloud DNS (which are all bundled with the gcloud CLI), see Accessing services with the gcloud CLI.

If you're a client application developer and want to find out more about accessing Google Cloud services with a programming language or framework, see Client Libraries Explained.

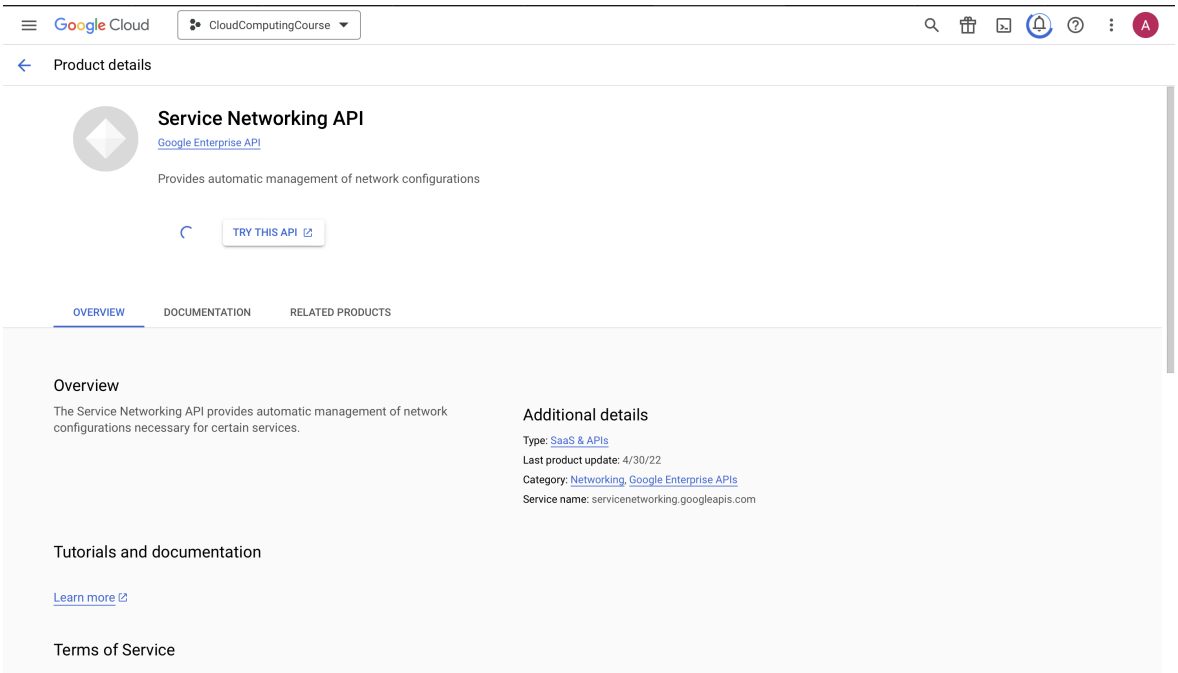
**3) Make a new service account**

- Give it `cloud sql admin` and `cloud sql client` permissions

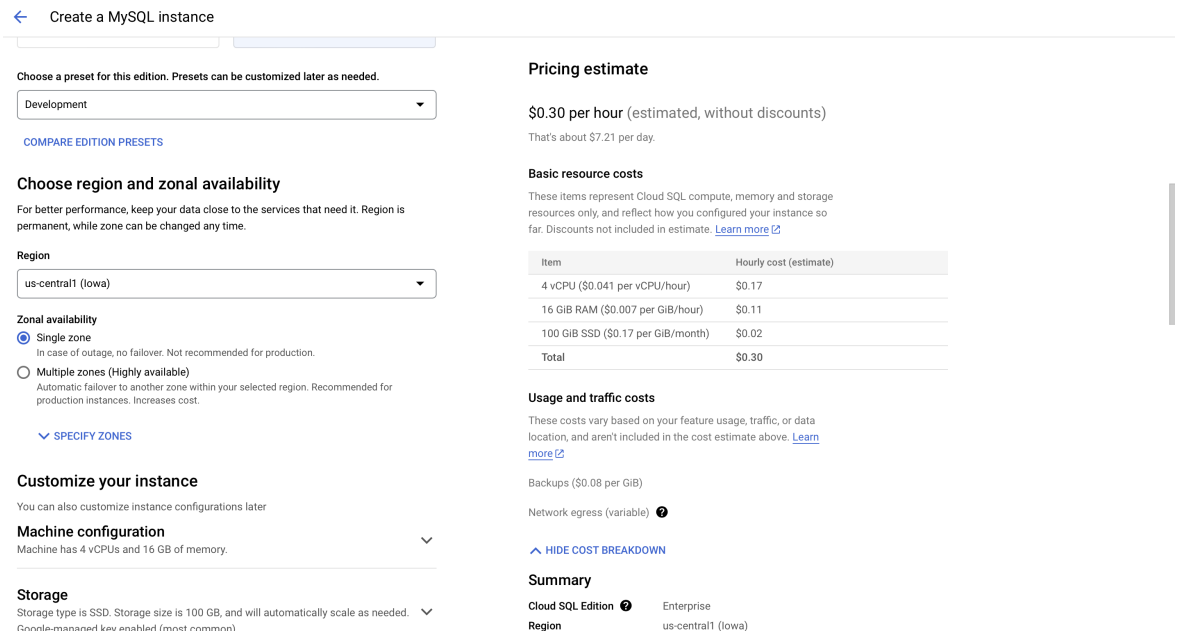



**4) Create DB Instance**

- Enable Service Networking API for Private IP




- Make a SQL instance




- The Private IP is added when the connector is made as seen from the Jupyter notebok

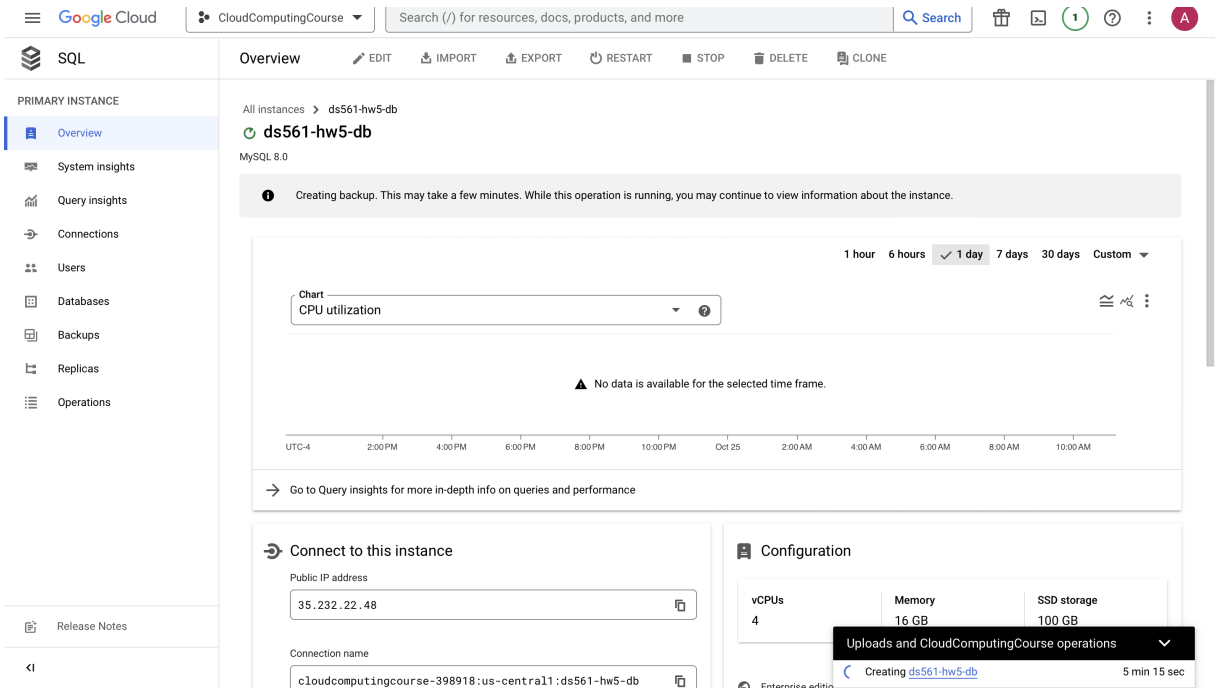
sample code

Let's update our `getconn` function to connect to our Cloud SQL instance with Private IP.

```
]:
from google.cloud.sql.connector import Connector, IPTypes
import sqlalchemy

# initialize connector
connector = Connector()

# getconn now set to private IP
def getconn():
    conn = connector.connect(
      INSTANCE_CONNECTION_NAME, # ::
      "pymysql",
      user=DB_USER,
      password=DB_PASS,
      db=DB_NAME,
      ip_type=IPTypes.PRIVATE
    )
    return conn

# create connection pool
pool = sqlalchemy.create_engine(
    "mysql+pymysql://",
    creator=getconn,
)

# connect to connection pool
with pool.connect() as db_conn:
    # query database and fetch results
    results = db_conn.execute(sqlalchemy.text("SELECT * FROM ratings")).fetchall()

    # show results
    for row in results:
        print(row)

# cleanup connector
connector.close()
```

```
connector = Connector(
    ip_type=IPTypes.PRIVATE,
)

def get_connection() -> pymysql.connections.Connection:
    conn: pymysql.connections.Connection = connector.connect(
        os.environ["INSTANCE_NAME"],
        "pymysql",
        os.environ["DB_USER"],
        os.environ["DB_PASSWORD"],
        os.environ["DB_NAME"],

        )
    return conn
```

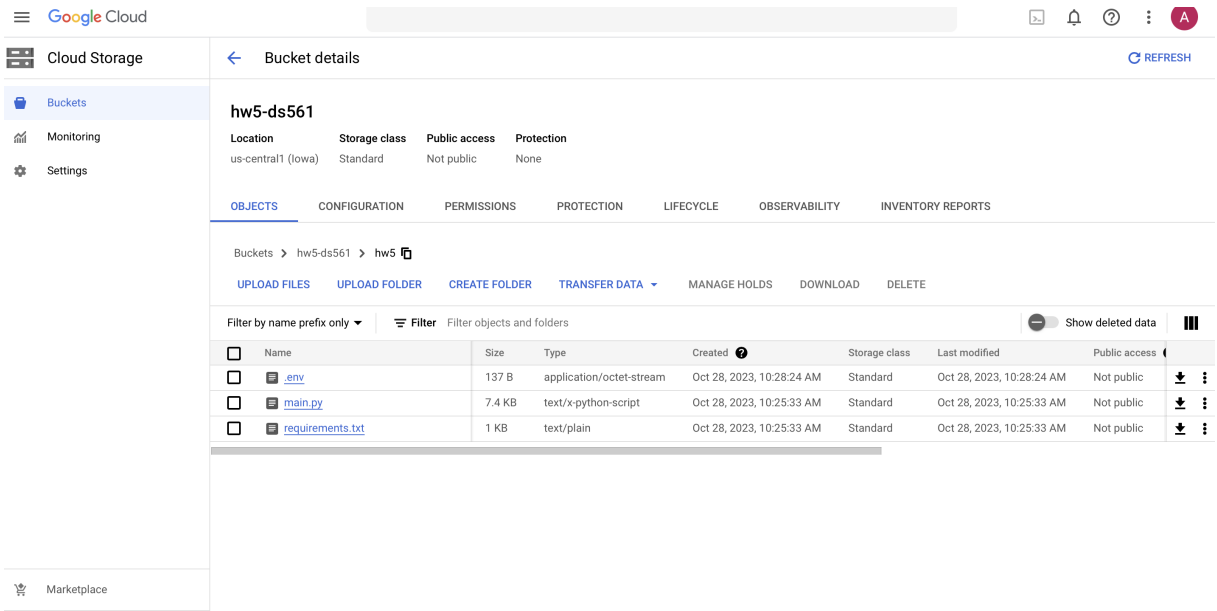
**5) Once the instance is made, make a user and db**



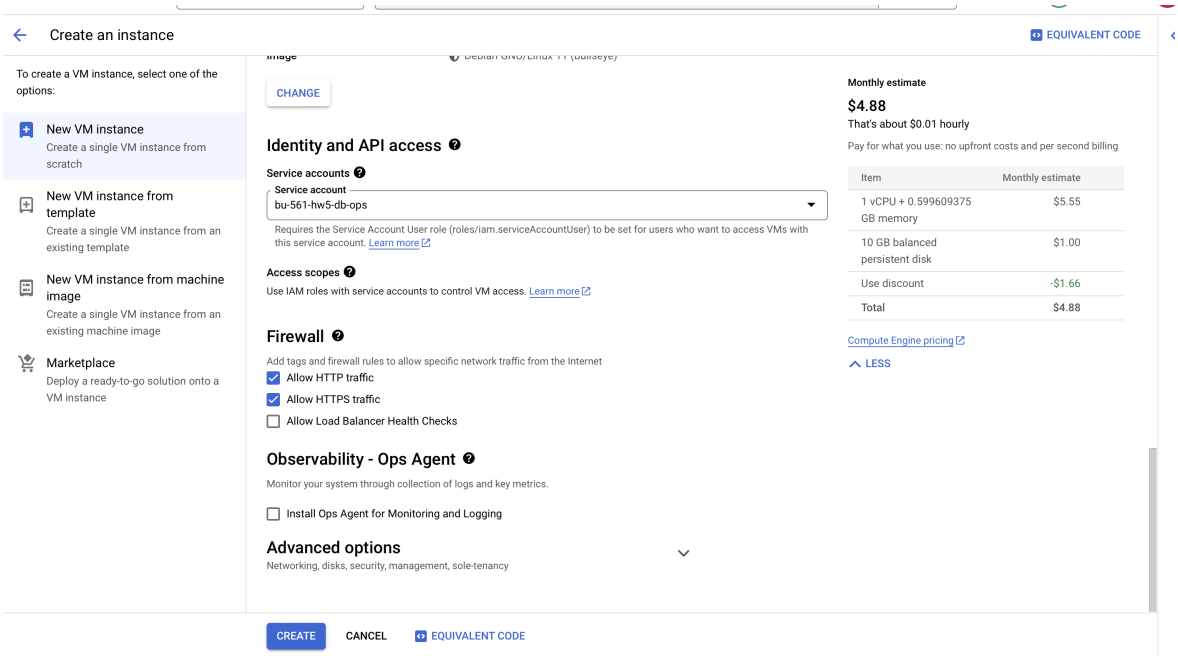

## ▼ Implementation

- Make a new bucket

```
gsutil -m cp -r .env  gs://hw5-ds561/hw5
```



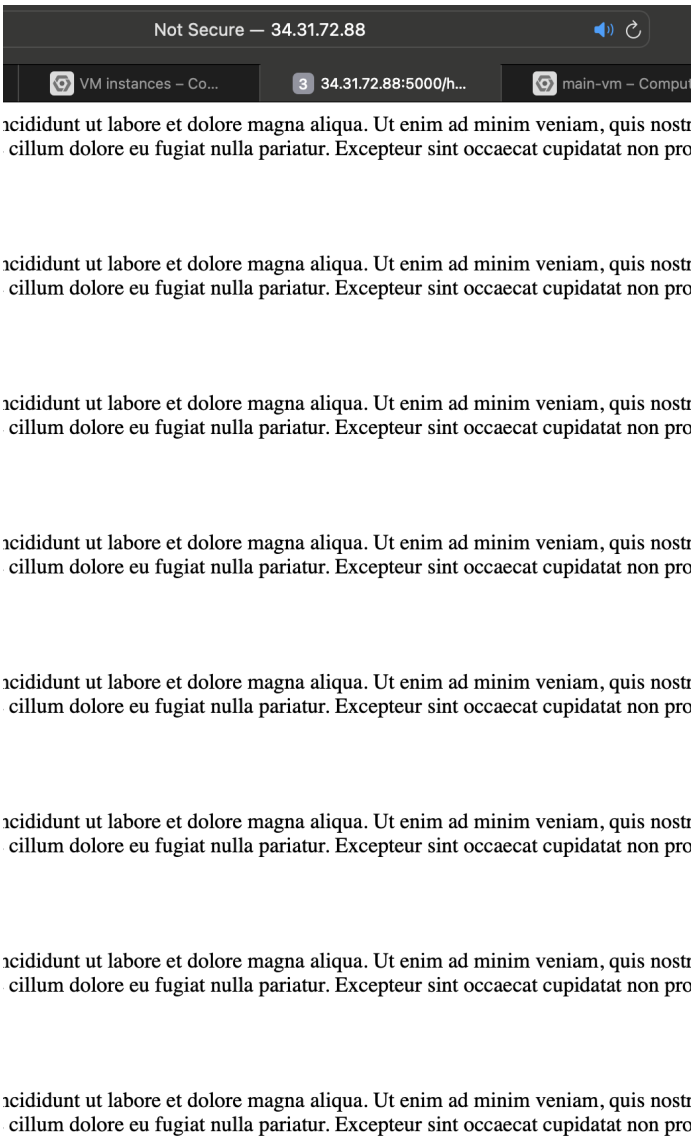

- Make the cheapest VM as we did in HW4




- Add the same startup script as last time

| Key | Value |
|---|---|
| startup-script | #!/bin/bash<br><br>echo "installing python3"<br>sudo apt-get install python3-pip -y<br><br>echo "copying files from bucket"<br>sudo gsutil -m cp -r gs://hw5-ds561/hw5 /home/arkjain<br>curr_path="/home/arkjain/hw5-files"<br>echo "installing requirements"<br>cd $curr_path<br><br>sudo pip3 install -r requirements.txt<br>echo "running flask app"<br>waitress-serve --host 0.0.0.0 --port=5000 main:app & |

- Go on the link to see the files:




```
http://34.31.72.88:5000/hw2-arkjain-mini-internet/mini_internet_test/110.html
```

**Connect to your database and make 2 tables**

```
DS561-HW/hw5 on ⎇ main [!⇡] via 🐍 v3.11.4 on ☁️ arkjain@bu.edu(us-east4)
❯ gcloud sql connect ds561-hw5-db --user=root --quiet
Allowlisting your IP for incoming connection for 5 minutes...done.
Connecting to database with SQL user [root].Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 23
Server version: 8.0.31-google (Google)

Copyright (c) 2000, 2023, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

```
mysql> CREATE TABLE request(
    ->                          country VARCHAR(255),
    ->                          gender ENUM('Male', 'Female'),
    ->                          age ENUM('0-16', '17-25', '26-35', '36-45', '46-55', '56-65', '66-75', '76+'),
    ->                          income ENUM('0-10k', '10k-20k', '20k-40k', '40k-60k', '60k-100k', '100k-150k', '150k-250k', '250k+'),
    ->                          is_banned BOOLEAN,
    ->                          client_ip VARCHAR(15),
    ->                          time_of_request TIMESTAMP
    ->                          );
Query OK, 0 rows affected (0.32 sec)

mysql> CREATE TABLE request_time(
    ->                          request_time TIMESTAMP,
    ->                          requested_file VARCHAR(255),
    ->                          error_code INT
    ->                          );
Query OK, 0 rows affected (0.11 sec)

mysql>
```

**Initially empty**

```
mysql> SELECT * FROM request;
Empty set (0.06 sec)

mysql> SELECT * FROM request_time;
Empty set (0.05 sec)

mysql>
```

- 200 - **Make a curl request**

```
DS561-HW/hw5 on main [!↑] via v3.11.4 (env) on arkjain@bu.edu(us-east4) took 5s
❯ curl -X GET -G "http://34.31.72.88:5000/hw2-arkjain-mini-internet/mini_internet_test/110.html"
```

```
Press CTRL+C to quit
hw2-arkjain-mini-internet mini_internet_test 7229.html
headers:  {'Host': '127.0.0.1:8000', 'Accept-Encoding': 'identity', 'X-Country': 'South Africa', 'X-Client-Ip': '240.177.216.132', 'X-Gender': 'Female', 'X-Age': '46-55', 'X-Inco
me': '40k-60k', 'X-Time': '2023-10-28 09:00:00'}
here in if
Here trying to make a connection
here------
Prefix mini_internet_test/7229.html blobs <google.api_core.page_iterator.HTTPIterator object at 0x106a28990>
blob name: mini_internet_test/7229.html
127.0.0.1 - - [28/Oct/2023 16:32:04] "GET hw2-arkjain-mini-internet/mini_internet_test/7229.html HTTP/1.1" 200 -
```

```
mysql> SELECT * FROM request;
+--------------+--------+-------+---------+-----------+-----------------+---------------------+
| country      | gender | age   | income  | is_banned | client_ip       | time_of_request     |
+--------------+--------+-------+---------+-----------+-----------------+---------------------+
| South Africa | Female | 46-55 | 40k-60k |      NULL | 240.177.216.132 | 2023-10-28 09:00:00 |
+--------------+--------+-------+---------+-----------+-----------------+---------------------+
1 row in set (0.05 sec)
```

- 501 make a bad request

```
here------
Prefix mini_internet_test/110.html blobs <google.api_core.page_iterator.HTTPIterator object at 0x106a0fad0>
blob name: mini_internet_test/110.html
127.0.0.1 - - [28/Oct/2023 16:35:25] "GET /hw2-arkjain-mini-internet/mini_internet_test/110.html HTTP/1.1" 200 -
hw2-arkjain-mini-internet mini_internet_test 110.html
Error, wrong HTTP Request Type
127.0.0.1 - - [28/Oct/2023 16:35:35] "POST /hw2-arkjain-mini-internet/mini_internet_test/110.html HTTP/1.1" 501 -
```

```
mysql> SELECT * FROM request_time
    -> ;
+---------------------+-----------------+-------------+
| request_time        | requested_file  | error_code  |
+---------------------+-----------------+-------------+
| 2023-10-28 09:00:00 | 7229.html       |         200 |
| NULL                | 110.html        |         501 |
+---------------------+-----------------+-------------+
2 rows in set (0.05 sec)

mysql>
```

- SIDE NOTE:
- Make a firewall rule and reserve a static IP

```
DS561-HW/hw5 on main [!?↑] via v3.11.4 on arkjain@bu.edu(us-east4)
❯ gcloud compute firewall-rules create hw5-server --allow tcp:5000 --source-tags=hw5-server --source-ranges=0.0.0.0/0
Creating firewall...⠶Created [https://www.googleapis.com/compute/v1/projects/cloudcomputingcourse-398918/global/firewalls/hw5-server].
Creating firewall...done.
NAME        NETWORK  DIRECTION  PRIORITY  ALLOW     DENY  DISABLED
hw5-server  default  INGRESS    1000      tcp:5000        False

DS561-HW/hw5 on main [!?↑] via v3.11.4 on arkjain@bu.edu(us-east4) took 5s
❯
```

---

### ▼ Stress Test

- Make a new `N1 4GB` micro shared VM and upload the bash script to it
  - Its starts 2 concurrent clients and makes 50k requests to the server

```
#!/bin/bash

# Set the number of clients to run
NUM_CLIENTS=2

# Start the clients
for i in $(seq 1 $NUM_CLIENTS); do
    python3 http-client.py -d 35.208.125.55  -p 5000 -n 50000 \
-i 9999 -b /hw2-arkjain-mini-internet -w mini_internet_test -r 137 &
done

# Wait for all the clients to finish
wait

# Print the results
echo "All clients finished running."
```

- In the VM upload the http-client as well
  - Give the bash script permissions and run it
  - `chmod u+x blow_up_client.sh`

```
mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|    68196 |
+----------+
1 row in set (0.05 sec)

mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|    72525 |
+----------+
1 row in set (0.10 sec)

mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|    72538 |
+----------+
1 row in set (0.06 sec)
```

```
mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|   102288 |
+----------+
1 row in set (0.05 sec)

mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|   102292 |
+----------+
1 row in set (0.06 sec)

mysql> select count(*) from request;
+----------+
| count(*) |
+----------+
|   102304 |
+----------+
1 row in set (0.18 sec)

mysql>
```

- I ran the stress test a few times because of errors. It took 4 hours to run

Streaming logs...

| | | |
|---|---|---|
| 2023-10-29 21:59:07.671 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:08.107 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:12.121 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:25.624 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:39.663 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:48.011 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:54.811 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 21:59:55.362 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:03.171 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:08.899 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:19.231 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:21.379 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:21.379 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 2 |
| 2023-10-29 22:00:25.786 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:27.083 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:35.937 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:00:53.679 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:01:04.628 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |
| 2023-10-29 22:01:04.629 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 2 |
| 2023-10-29 22:01:05.518 | hw5-server | startup-script: WARNING:waitress.queue:Task queue depth is 1 |


- How many requests were you able to process successfully vs unsuccessfully?
- How many requests came from banned countries?
- How many requests were made by Male vs Female users?
- What were the top 5 countries sending requests to your server?
- What age group issued the most requests to your server?
- What income group issued the most requests to your server?

Connect to your db and test as follows

## Kindly note that I had some additional elements in my database, probably by 1000 or so from old tests which I realized a bit late and it skewed my results by a tiny bit not much

`gcloud sql connect ds561-hw5-db --user=root --quiet`

**1) Successful vs unsuccessful:**

```
mysql> SELECT COUNT(*) AS error_count
    -> FROM request_time
    -> WHERE error_code <> 200;
+-------------+
| error_count |
+-------------+
|        4790 |
+-------------+
1 row in set (0.08 sec)

mysql>
```

```
mysql> SELECT
    ->     (SELECT COUNT(*) FROM request_time WHERE error_code = 200) AS successful_count,
    ->     (SELECT COUNT(*) FROM request_time WHERE error_code <> 200) AS unsuccessful_count,
    ->     (SELECT COUNT(*) FROM request_time WHERE error_code = 200) - (SELECT COUNT(*) FROM request_time WHERE error_code <> 200) AS difference;
+-----------------+-------------------+------------+
| successful_count | unsuccessful_count | difference |
+-----------------+-------------------+------------+
|           99985 |              4790 |      95195 |
+-----------------+-------------------+------------+
1 row in set (0.31 sec)

mysql>
```

**2) Banned Countries**

`SELECT COUNT(*) FROM request WHERE is_banned=TRUE;`

```
+-------------+
| error_count |
+-------------+
|        4790 |
+-------------+
```

**3) Count Male versus Female requesters**

```
mysql> SELECT
    ->     SUM(CASE WHEN gender = 'Male' THEN 1 ELSE 0 END) AS male_request_count,
    ->     SUM(CASE WHEN gender = 'Female' THEN 1 ELSE 0 END) AS female_request_count
    -> FROM request;
+-------------------+---------------------+
| male_request_count | female_request_count |
+-------------------+---------------------+
|             52424 |               52403 |
+-------------------+---------------------+
1 row in set (0.17 sec)
```

**4) Top 5 requesters**

```
mysql>
mysql> SELECT country, COUNT(*) AS request_count
    -> FROM request
    -> GROUP BY country
    -> ORDER BY request_count DESC
    -> LIMIT 5;
+--------------------------+---------------+
| country                  | request_count |
+--------------------------+---------------+
| Central African Republic |           664 |
| Kiribati                 |           640 |
| Georgia                  |           634 |
| Iceland                  |           634 |
| Italy                    |           620 |
+--------------------------+---------------+
5 rows in set (0.21 sec)

mysql>
```

**5) Max requests age group**

```
mysql> SELECT age, COUNT(*) AS request_count
    -> FROM request
    -> GROUP BY age
    -> ORDER BY request_count DESC
    -> LIMIT 1;
+-------+---------------+
| age   | request_count |
+-------+---------------+
| 36-45 |         13375 |
+-------+---------------+
1 row in set (0.14 sec)

mysql>
```

**6) Max income requesters group**

```
mysql> SELECT income, COUNT(*) AS request_count
    -> FROM request
    -> GROUP BY income
    -> ORDER BY request_count DESC
    -> LIMIT 1;
+---------+---------------+
| income  | request_count |
+---------+---------------+
| 20k-40k |         13648 |
+---------+---------------+
1 row in set (0.15 sec)
```

▼ **Code Explanation**

*Detailed Comments can be found in the README with useful links*

**Setting up the Connection Pool**

The following code has been added to my original `main.py` file such that it makes a connector with a **private IP,** as gets the connection from my google cloud account, including the DB information.

The `make_connection_pool()` function makes a sqlalchemy engine and calls the `get_connection()` function to establish a database connection.

```
import pymysql
import sqlalchemy

connector = Connector(
    "cloudcomputingcourse-398918:us-central1:cloudcomputingcourse",
    "pymysql",
    ip_type=IPTypes.PRIVATE,
)
app = Flask(__name__)


def get_connection() -> pymysql.connections.Connection:
    conn: pymysql.connections.Connection = connector.connect(
        os.environ["INSTANCE_NAME"],
        "pymysql",
        os.environ["DB_USER"],
        os.environ["DB_PASSWORD"],
        os.environ["DB_NAME"],
    )
    return conn


def make_connection_pool():
    pool = sqlalchemy.create_engine(
        "mysql+pymysql://",
        creator=lambda: get_connection(),
        pool_size=5,
        max_overflow=2,
        pool_timeout=30,
        pool_recycle=1800,
    )
    return pool
```

### Modifying Flask App

I modified the initial flask route I had to store the country name, gender, income, age, time and client ip in a dictionary which I send as an argument to the `make_countries_mysql_table` function - a function to make 2 2-NF supported tables.

The first part simply checks if the tables exists or not and makes them and the second part indexes the data_from_headers dictionary element to store the value.

```
def make_countries_mysql_table(data_from_headers: dict,
data_from_request: dict):

    pool = make_connection_pool()

    with pool.connect() as conn:
        query = """
            CREATE TABLE IF NOT EXISTS Users (
                    id INT AUTO_INCREMENT PRIMARY KEY,
                    country VARCHAR(255) NOT NULL,
                    client_id INT NOT NULL,
                    gender_req ENUM('Male', 'Female'),
                    age ENUM('0-16', '17-25', '26-35', '36-45', '46-55', '56-65', '66-75', '76+'),
                    income_req ENUM('0-10k', '10k-20k', '20k-40k', '40k-60k', '60k-100k', '100k-150k', '150k-250k', '250k+'),
                    is_banned BOOLEAN NOT NULL,
                    )
            """
        conn.execute(query)

    with pool.connect() as conn:
        query = """
            CREATE TABLE IF NOT EXISTS Requests (
                    id INT AUTO_INCREMENT PRIMARY KEY,
```

```
                    time TIMESTAMP NOT NULL,
                    file_requested VARCHAR(255) NOT NULL,
                    )
            """
        conn.execute(query)
    with pool.connect() as connection:
        query = f"""
           INSERT INTO Users(country, client_id,
gender, income, age, is_banned)
           VALUES (
               '{data_from_headers["country"]}',
               '{data_from_headers["client_id"]}',
               '{data_from_headers["gender"]}',
               '{data_from_headers["income"]}',
               '{data_from_headers["age"]}',
               '{data_from_headers["population"]}',
               '{int(data_from_headers["is_banned"][1])}'
           )
           """
        connection.execute(query)
    with pool.connect() as connection:
        query = f"""
           INSERT INTO Requests(time, file_requested)
           VALUES (
               '{data_from_request["time"]}',
               '{data_from_request["file_requested"]}'
           )
           """
        connection.execute(query)
```

---

▼ **Resources**

## Useful links

- https://github.com/GoogleCloudPlatform/cloud-sql-python-connector/blob/main/samples/notebooks/mysql_python_connector.ipynb
- https://dev.mysql.com/downloads/mysql/
- https://dev.mysql.com/doc/dev/mysql-server/latest/PAGE_PROTOCOL.html#protocol_overview
- https://cloud.google.com/sql/docs/mysql/language-connectors
- https://docs.google.com/presentation/d/1u2EA9-9X_dNn8RBdBivoCuuxwGpdQV7YCcH6SClZCgY/edit#slide=id.g258da33442f_0_141
- https://docs.google.com/presentation/d/120uEEuhQNR984r-iGnGD5GELDZVFRm3RGC1N0gXTNrA/edit#slide=id.g27446ef6af8_0_70
- Information on cloud connectors - https://cloud.google.com/sql/docs/mysql/connect-connectors#python
- Github showing how to make a pool connection - https://github.com/GoogleCloudPlatform/cloud-sql-python-connector#how-to-use-this-connector
- Private IP info - https://cloud.google.com/sql/docs/mysql/configure-private-ip?_ga=2.112557828.-1858195586.1698198634#gcloud_1
- Making a DB on a cloud instance - https://support.google.com/appsheet/answer/10107301?hl=en

## Useful commands

Get the status of your VM

```
sudo journalctl -u google-startup-scripts.service -f
```

Find and Kill a busy server

```
lsof -i :8080
kill -9 $PID
```

---