

**LAPORAN AKHIR TUGAS BESAR CLOUD COMPUTING
PEMBUATAN VM INSTANCE, WEB SERVER, DATABASE, DAN
SERVER HARDENING DI GCP**



Disusun oleh :

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**PROGRAM STUDI S1 TEKNIK TELEKOMUNIKASI
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KATA PENGANTAR

Puji syukur ke hadirat Tuhan Yang Maha Esa atas rahmat dan karunia-Nya, sehingga penulis dapat menyelesaikan laporan akhir tugas besar mata kuliah Cloud Computing ini dengan baik dan tepat waktu. Laporan ini berjudul "*Pembuatan VM Instance, Web Server, Database, dan Server Hardening di GCP*" yang merupakan hasil dari implementasi praktis teknologi Cloud Computing di Google Cloud Platform (GCP).

Laporan ini disusun untuk memenuhi salah satu tugas besar dalam mata kuliah Cloud Computing. Dalam laporan ini, penulis menjelaskan langkah-langkah dan hasil dari proses pembuatan Virtual Machine (VM) Instance, konfigurasi web server, instalasi database, serta penerapan server hardening sebagai upaya meningkatkan keamanan infrastruktur cloud.

Penulis berharap laporan ini dapat memberikan manfaat bagi pembaca, khususnya dalam memahami dan menerapkan teknologi Cloud Computing secara praktis dan aman.

Bandung, 31 Desember 2024

Kelompok 9

BAB I

PENDAHULUAN

1.1 Deskripsi Tugas

Laporan ini merupakan dokumentasi dari tugas akhir mata kuliah Cloud Computing yang mencakup pembuatan dan pengamanan VM Instance di Google Cloud Platform (GCP). Tugas ini melibatkan pengaturan web server Apache, database MySQL, server hardening menggunakan Fail2ban, integrasi Google Cloud Storage, serta implementasi monitoring dan alerting.

1.2 Tujuan

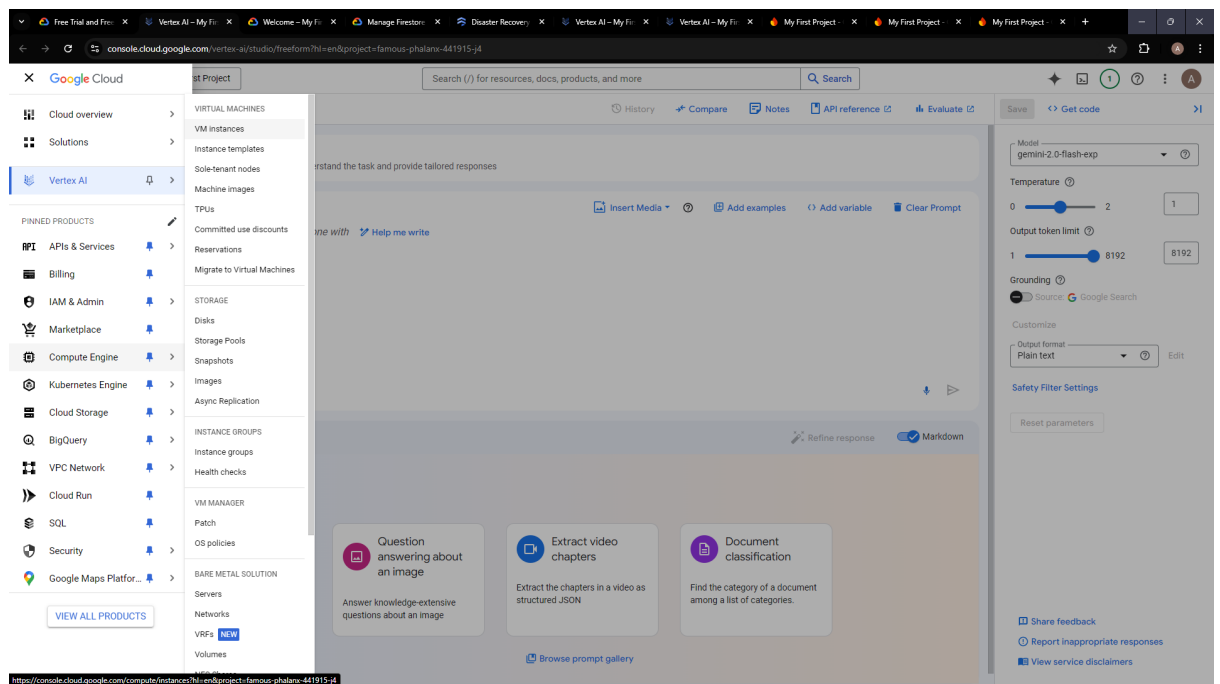
1. Memahami langkah-langkah pembuatan dan konfigurasi VM instance di GCP.
2. Mengamankan server dari potensi ancaman dengan menggunakan Fail2ban dan firewall.
3. Meningkatkan kemampuan pemantauan sistem menggunakan Google Cloud Monitoring.
4. Membangun kemampuan untuk mengintegrasikan layanan cloud dengan kebutuhan aplikasi.

BAB II

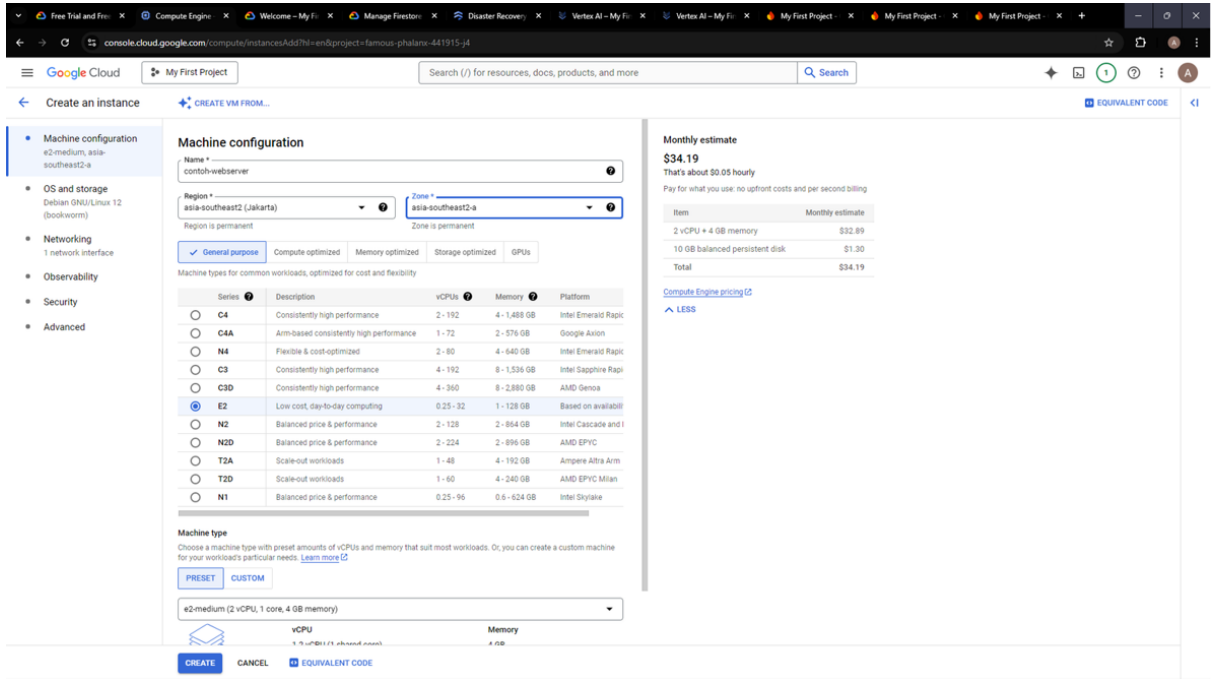
DOKUMENTASI TEKNIS

2.1 Pembuatan VM Instance

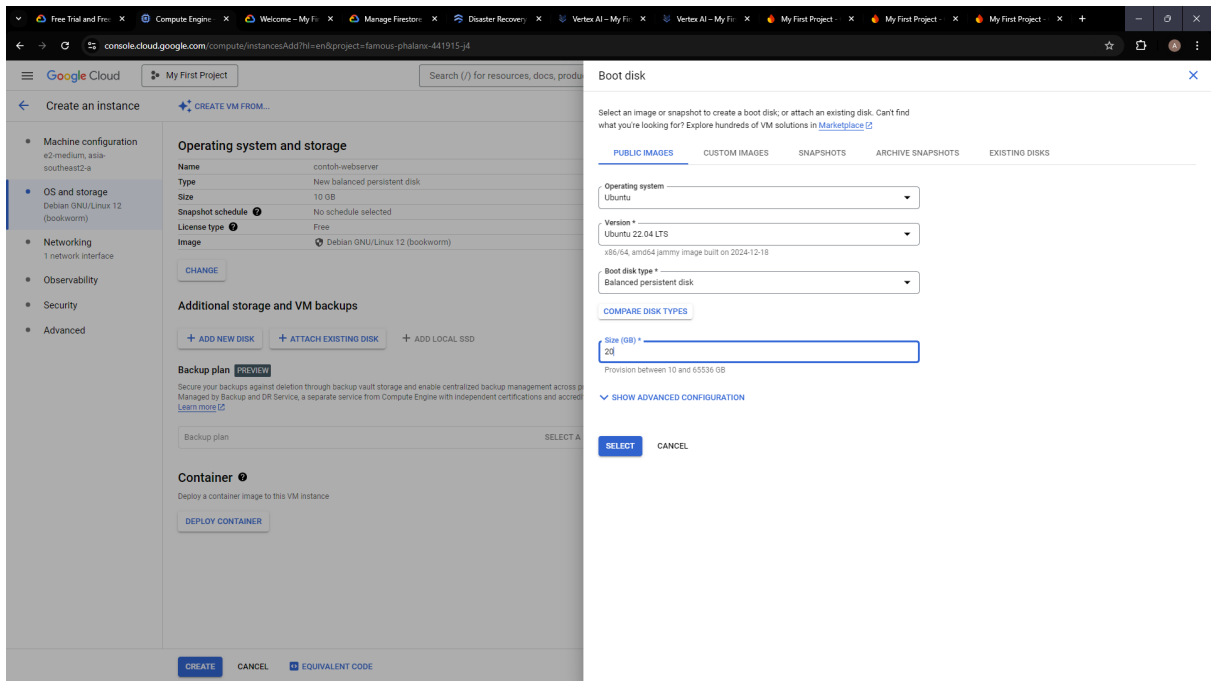
VM Instance adalah layanan komputasi virtual yang disediakan oleh Google Cloud Platform (GCP) untuk menjalankan aplikasi berbasis server. Dalam tugas ini, VM Instance digunakan untuk menjalankan web server Apache dan database MySQL. Proses pembuatan VM Instance meliputi langkah-langkah berikut:



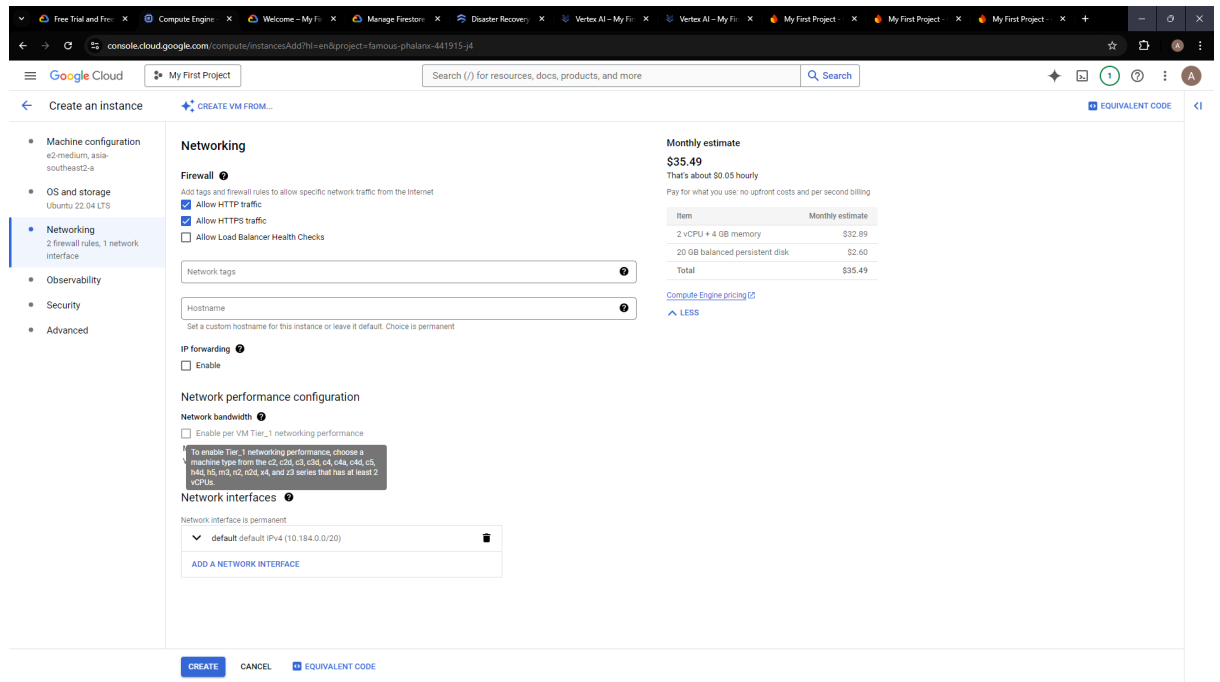
Gambar 2.1 Pembuatan VM Instance



Gambar 2.2 Settingan name & region VM



Gambar 2.3 Settingan machine-type VM



Gambar 2.4 Settingan network VM

- Masuk ke dashboard Google Cloud Platform.
- Navigasi ke menu "Compute Engine > VM Instances".
- Klik "Create Instance" dan masukkan detail berikut:
 - **Name:** [Nama VM]
 - **Region:** [Region yang dipilih]
 - **Machine Type:** [Jenis Mesin]
 - **Boot Disk:** Ubuntu 20.04
 - **Network:** Pilih default atau tambahkan aturan firewall.
- Klik "Create" dan tunggu proses selesai.

Langkah-langkah ini memastikan bahwa VM Instance siap digunakan untuk tugas-tugas selanjutnya.

2.1.1 Penginstalan Apache dan MySQL-Server

Setelah VM Instance berhasil dibuat, langkah berikutnya adalah menginstal Apache sebagai web server dan MySQL sebagai database server. Proses penginstalan dilakukan melalui terminal VM dengan langkah-langkah berikut:

1. Update dan Upgrade Paket:

sudo apt update && sudo apt upgrade -y

2. Instal Apache:

sudo apt install apache2 -y

```
ssh.cloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696647&useAdminProxy=true - Google Chrome
ssh.cloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696647&useAdminProxy=true
SSH-in-browser
alifantotoefilushara@web-server:~$ sudo apt install apache2 -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils bzzip2 libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.3-0 mailcap mime-support
  ssl-cert
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom www-browser bzzip2-doc
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils bzzip2 libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.3-0 mailcap mime-support
  ssl-cert
0 upgraded, 13 newly installed, 0 to remove and 0 not upgraded.
Need to get 2141 kB of archives.
After this operation, 8524 kB of additional disk space will be used.
Get:1 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libapr1 amd64 1.7.0-8ubuntu0.22.04.2 [108 kB]
Get:2 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libaprutil1 amd64 1.6.1-5ubuntu4.22.04.2 [92.8 kB]
Get:3 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libaprutil1-dbd-sqlite3 amd64 1.6.1-5ubuntu4.22.04.2 [11.3 kB]
Get:4 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libaprutil1-ldap amd64 1.6.1-5ubuntu4.22.04.2 [9170 B]
Get:5 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 liblua5.3-0 amd64 5.3.6-1build1 [140 kB]
Get:6 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 apache2-bin amd64 2.4.52-1ubuntu4.12 [1348 kB]
Get:7 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 apache2-data all 2.4.52-1ubuntu4.12 [165 kB]
Get:8 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 apache2-utils amd64 2.4.52-1ubuntu4.12 [59.1 kB]
Get:9 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mailcap all 3.70+nmu1ubuntu1 [23.8 kB]
Get:10 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mime-support all 3.66 [3696 B]
Get:11 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 apache2 amd64 2.4.52-1ubuntu4.12 [97.9 kB]
Get:12 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 bzzip2 amd64 1.0.8-5build1 [34.8 kB]
Get:13 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 ssl-cert all 1.1.2 [17.4 kB]
Fetched 2141 kB in 6s (5632 kB/s)
Preconfiguring packages ...
Selecting previously unselected package libapr1:amd64.
(Reading database ... 66627 files and directories currently installed.)
Preparing to unpack .../00-libapr1_1.7.0-8ubuntu0.22.04.2_amd64.deb ...
Unpacking libapr1:amd64 (1.7.0-8ubuntu0.22.04.2) ...
Selecting previously unselected package libaprutil1:amd64.
Preparing to unpack .../01-libaprutil1_1.6.1-5ubuntu4.22.04.2_amd64.deb ...
Unpacking libaprutil1:amd64 (1.6.1-5ubuntu4.22.04.2) ...
Selecting previously unselected package libaprutil1-dbd-sqlite3:amd64.
Preparing to unpack .../02-libaprutil1-dbd-sqlite3_1.6.1-5ubuntu4.22.04.2_amd64.deb ...
Unpacking libaprutil1-dbd-sqlite3:amd64 (1.6.1-5ubuntu4.22.04.2) ...
Selecting previously unselected package libaprutil1-ldap:amd64.
Preparing to unpack .../03-libaprutil1-ldap_1.6.1-5ubuntu4.22.04.2_amd64.deb ...
Unpacking libaprutil1-ldap:amd64 (1.6.1-5ubuntu4.22.04.2) ...
Selecting previously unselected package liblua5.3-0:amd64.
Preparing to unpack .../04-liblua5.3-0_5.3.6-1build1_amd64.deb ...
Unpacking liblua5.3-0:amd64 (5.3.6-1build1) ...
Selecting previously unselected package apache2-bin.
Preparing to unpack .../05-apache2-bin_2.4.52-1ubuntu4.12_amd64.deb ...
Unpacking apache2-bin (2.4.52-1ubuntu4.12) ...
Selecting previously unselected package apache2-data.
Preparing to unpack .../06-apache2-data_2.4.52-1ubuntu4.12_all.deb ...
Unpacking apache2-data (2.4.52-1ubuntu4.12) ...
Selecting previously unselected package apache2-utils.
```

Gambar 2.5 Penginstallan apache2

```
ssh.cloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696647&useAdminProxy=true - Google Chrome
ssh.cloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696647&useAdminProxy=true
SSH-in-browser
alifantotoefilushara@web-server:~$ sudo apt install apache2 -y
Enabling module mime.
Enabling module negotiation.
Enabling module setenvif.
Enabling module filter.
Enabling module deflate.
Enabling module status.
Enabling module reqtimeout.
Enabling conf charset.
Enabling conf localized-error-pages.
Enabling conf other-vhosts-access-log.
Enabling conf security.
Enabling conf serve-cgi-bin.
Enabling site 000-default.
Created symlink /etc/systemd/system/multi-user.target.wants/apache2.service -> /lib/systemd/system/apache2.service.
Created symlink /etc/systemd/system/multi-user.target.wants/apache-htcacheclean.service -> /lib/systemd/system/apache-htcacheclean.service.
Processing triggers for ufw (0.36.1-4ubuntu0.1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.8) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
alifantotoefilushara@web-server:~$ sudo enable apache2
-bash: enable: apache2: not a shell builtin
alifantotoefilushara@web-server:~$ sudo systemctl enable apache2
Synchronizing state of apache2.service with SysV service script with /lib/systemd/systemd-sysv-install.
Executing: /lib/systemd/systemd-sysv-install enable apache2
alifantotoefilushara@web-server:~$ sudo systemctl start apache2
alifantotoefilushara@web-server:~$ sudo systemctl status apache2
* apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2024-12-27 11:21:41 UTC; 1min 24s ago
     Docs: https://httpd.apache.org/docs/2.4/
    Main PID: 2897 (apache2)
      Tasks: 55 (limit: 4687)
     Memory: 5.0M
           CPU: 5ms
    CGroup: /system.slice/apache2.service
            └─2897 /usr/sbin/apache2 -k start
              └─2899 /usr/sbin/apache2 -k start
                └─2900 /usr/sbin/apache2 -k start

Dec 27 11:21:41 web-server systemd[1]: Starting The Apache HTTP Server...
Dec 27 11:21:41 web-server systemd[1]: Started The Apache HTTP Server.
alifantotoefilushara@web-server:~$
```

Gambar 2.6 Verifikasi penginstalan apache2

- Setelah instalasi selesai, verifikasi Apache dengan membuka browser dan mengakses IP publik VM. Halaman default Apache akan muncul jika instalasi berhasil.

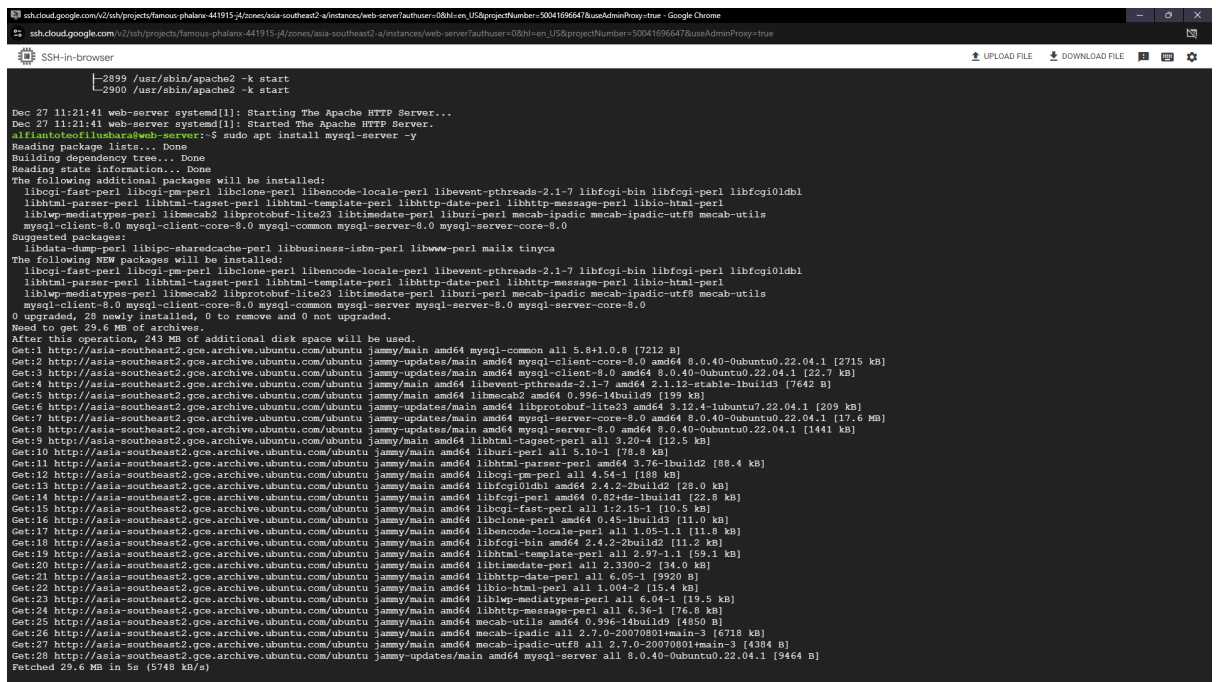
- Instal MySQL Server:**

`sudo apt install mysql-server -y`

Setelah instalasi selesai, amankan MySQL dengan menjalankan perintah berikut:

`sudo mysql_secure_installation`

Ikuti panduan yang muncul untuk mengatur kata sandi root dan opsi keamanan lainnya.



```
Dec 27 11:21:41 web-server systemd[1]: Starting The Apache HTTP Server...
Dec 27 11:21:41 web-server systemd[1]: Started The Apache HTTP Server.
af1a4a0e0c11@server:~$ sudo apt install mysql-server -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libcgi-fast-perl libcgi-pm-perl libclone-perl libencode-locale-perl libevent-pthreads-2.1-7 libfcgi-bin libfcgi-perl libfcgi0ldbl
  libhtml-parser-perl libhtml-tagset-perl libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libprotobuf-lite23 libtime-date-perl liburi-perl mecab-ipadic mecab-ipadic-utf8 mecab-utils
  mysql-client-8.0 mysql-client-core-8.0 mysql-common mysql-server-8.0 mysql-server-core-8.0
Suggested packages:
  libdata-dump-perl libipc-sharedcache-perl libbusiness-ismn-perl libwww-perl mailx tinyca
The following NEW packages will be installed:
  libcgi-fast-perl libcgi-pm-perl libclone-perl libencode-locale-perl libevent-pthreads-2.1-7 libfcgi-bin libfcgi-perl libfcgi0ldbl
  libhtml-parser-perl libhtml-tagset-perl libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libprotobuf-lite23 libtime-date-perl liburi-perl mecab-ipadic mecab-ipadic-utf8 mecab-utils
  mysql-client-8.0 mysql-client-core-8.0 mysql-common mysql-server mysql-server-8.0 mysql-server-core-8.0
0 upgraded, 28 newly installed, 0 to remove and 0 not upgraded.
Need to get 29.6 MB of archives.
After this operation, 243 MB of additional disk space will be used.
Get:1 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mysql-common all 5.8+1.0.8 [7212 B]
Get:2 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 mysql-client-core-8.0 amd64 8.0.40-0ubuntu0.22.04.1 [2715 kB]
Get:3 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 mysql-client-8.0 amd64 8.0.40-0ubuntu0.22.04.1 [22.7 kB]
Get:4 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libevent-pthreads-2.1-7 amd64 2.1.12-stable-1build3 [7642 B]
Get:5 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libmecab2 amd64 0.996-14build9 [199 kB]
Get:6 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libprotobuf-lite23 amd64 3.12.4-1ubuntu7.22.04.1 [209 kB]
Get:7 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 mysql-server-core-8.0 amd64 8.0.40-0ubuntu0.22.04.1 [17.6 MB]
Get:8 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 mysql-server-8.0 amd64 8.0.40-0ubuntu0.22.04.1 [1441 kB]
Get:9 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libhtml-tagset-perl all 3.20-4 [12.5 kB]
Get:10 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 liburi-perl all 5.10-1 [78.8 kB]
Get:11 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libhtml-parser-perl amd64 3.76-1build2 [88.4 kB]
Get:12 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libcgi-pm-perl all 4.54-1 [188 kB]
Get:13 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libfcgi0ldbl amd64 2.4-2-2build2 [28.0 kB]
Get:14 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libfcgi-perl amd64 0.82ds-1build1 [22.8 kB]
Get:15 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libcgi-fast-perl all 1:2.15-1 [10.5 kB]
Get:16 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libclone-perl amd64 0.45-1build3 [11.0 kB]
Get:17 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libencode-locale-perl all 1.05-1 [11.8 kB]
Get:18 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libfcgi-bin amd64 2.4-2-2build2 [11.2 kB]
Get:19 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libhtml-template-perl all 2.97-1 [59.1 kB]
Get:20 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libtime-date-perl all 2.3300-2 [34.0 kB]
Get:21 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libhttp-date-perl all 6.05-1 [9920 B]
Get:22 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libio-html-perl all 1.004-2 [15.4 kB]
Get:23 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 liblwp-mediatypes-perl all 6.04-1 [19.5 kB]
Get:24 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libhttp-message-perl all 6.36-1 [76.8 kB]
Get:25 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mecab-utils amd64 0.996-14build9 [4850 B]
Get:26 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mecab-ipadic all 2.7.0-20070801main-3 [6718 kB]
Get:27 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 mecab-ipadic-utf8 all 2.7.0-20070801main-3 [4384 B]
Get:28 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/main amd64 mysql-server all 8.0.40-0ubuntu0.22.04.1 [9464 B]
Fetched 29.6 MB in 5s (5748 kB/s)
```

Gambar 2.7 Penginstalan mysql-server

- Verifikasi Instalasi MySQL:** Login ke MySQL untuk memastikan bahwa server database berjalan dengan baik:

`sudo mysql -u root -p`

```
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server/authuser=08N=en_US&projectNumber=50041696647&useAdminProxy=true - Google Chrome
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server/authuser=08N=en_US&projectNumber=50041696647&useAdminProxy=true
SSH-in-browser
No services need to be restarted.
No containers need to be restarted.
No user sessions are running outdated binaries.
No VM guests are running outdated hypervisor (qemu) binaries on this host.
alifantotoefilushara@web-server:~$ sudo mysql_secure_installation
Securing the MySQL server deployment.
Connecting to MySQL using a blank password.
VALIDATE PASSWORD COMPONENT can be used to test passwords
and improve security. It checks the strength of password
and allows the users to set only those passwords which are
secure enough. Would you like to setup VALIDATE PASSWORD component?

Press y|Y for Yes, any other key for No: y

There are three levels of password validation policy:

LOW Length >= 8
MEDIUM Length >= 8, numeric, mixed case, and special characters
STRONG Length >= 8, numeric, mixed case, special characters and dictionary file

Please enter 0 = LOW, 1 = MEDIUM and 2 = STRONG: 1

Skipping password set for root as authentication with auth_socket is used by default.
If you would like to use password authentication instead, this can be done with the "ALTER USER" command.
See https://dev.mysql.com/doc/refman/8.0/en/alter-user.html#alter-user-password-management for more information.

By default, a MySQL installation has an anonymous user,
allowing anyone to log into MySQL without having to have
a user account created for them. This is intended only for
testing, and to make the installation go a bit smoother.
You should remove them before moving into a production
environment.

Remove anonymous users? (Press y|Y for Yes, any other key for No) : y
Success.

Normally, root should only be allowed to connect from
'localhost'. This ensures that someone cannot guess at
the root password from the network.

Disallow root login remotely? (Press y|Y for Yes, any other key for No) : y
Success.

By default, MySQL comes with a database named 'test' that
anyone can access. This is also intended only for testing,
and should be removed before moving into a production
environment.
```

Gambar 2.8 Verifikasi 1 Penginstalan mysql-server

```
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server/authuser=08N=en_US&projectNumber=50041696647&useAdminProxy=true - Google Chrome
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server/authuser=08N=en_US&projectNumber=50041696647&useAdminProxy=true
SSH-in-browser
No services need to be restarted.
No containers need to be restarted.
No user sessions are running outdated binaries.
No VM guests are running outdated hypervisor (qemu) binaries on this host.
alifantotoefilushara@web-server:~$ sudo mysql_secure_installation
Securing the MySQL server deployment.
Connecting to MySQL using a blank password.
VALIDATE PASSWORD COMPONENT can be used to test passwords
and improve security. It checks the strength of password
and allows the users to set only those passwords which are
secure enough. Would you like to setup VALIDATE PASSWORD component?

Press y|Y for Yes, any other key for No: y

There are three levels of password validation policy:

LOW Length >= 8
MEDIUM Length >= 8, numeric, mixed case, and special characters
STRONG Length >= 8, numeric, mixed case, special characters and dictionary file

Please enter 0 = LOW, 1 = MEDIUM and 2 = STRONG: 1

Skipping password set for root as authentication with auth_socket is used by default.
If you would like to use password authentication instead, this can be done with the "ALTER USER" command.
See https://dev.mysql.com/doc/refman/8.0/en/alter-user.html#alter-user-password-management for more information.

By default, a MySQL installation has an anonymous user,
allowing anyone to log into MySQL without having to have
a user account created for them. This is intended only for
testing, and to make the installation go a bit smoother.
You should remove them before moving into a production
environment.

Remove anonymous users? (Press y|Y for Yes, any other key for No) : y
Success.

Normally, root should only be allowed to connect from
'localhost'. This ensures that someone cannot guess at
the root password from the network.

Disallow root login remotely? (Press y|Y for Yes, any other key for No) : y
Success.

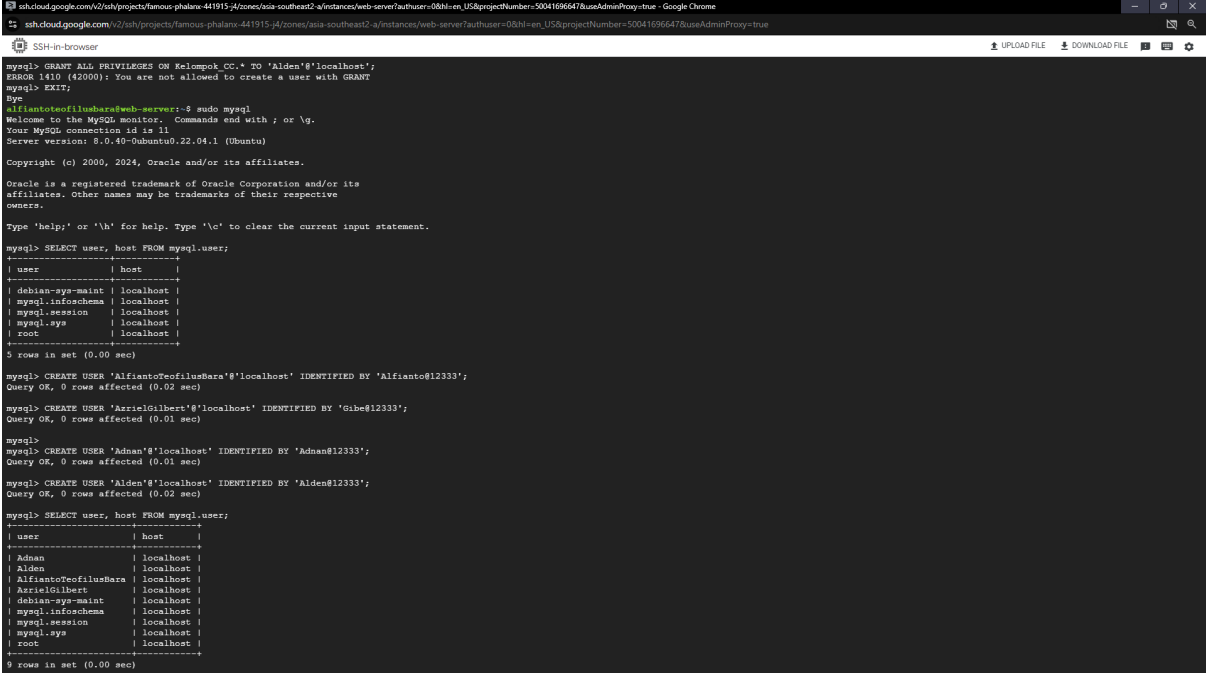
By default, MySQL comes with a database named 'test' that
anyone can access. This is also intended only for testing,
and should be removed before moving into a production
environment.
```

Gambar 2.9 Verifikasi 2 penginstalan mysql-server

Konfigurasi Database MySQL Setelah MySQL berhasil diinstal, langkah berikutnya adalah membuat database dan tabel untuk keperluan aplikasi. Langkah-langkahnya sebagai berikut:

1. Masuk ke MySQL:

sudo mysql -u root -p



```
mysql> GRANT ALL PRIVILEGES ON Kelompok_CC.* TO 'Alden'@'localhost';
ERROR 1410 (42000): You are not allowed to create a user with GRANT
mysql> EXIT;
Bye
alifianto@teofilusbara:~$ sudo mysql
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.40-0ubuntu0.22.04.1 (Ubuntu)

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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> SELECT user, host FROM mysql.user;
+-----+-----+
| user | host |
+-----+-----+
| debian-sys-maint | localhost |
| mysql.infoschema | localhost |
| mysql.session | localhost |
| mysql.sys | localhost |
| root | localhost |
+-----+-----+
5 rows in set (0.00 sec)

mysql> CREATE USER 'AlfiantoTeofilusBera'@'localhost' IDENTIFIED BY 'Alfianto@12333';
Query OK, 0 rows affected (0.02 sec)

mysql> CREATE USER 'AzrielGilbert'@'localhost' IDENTIFIED BY 'Gibe@12333';
Query OK, 0 rows affected (0.01 sec)

mysql>
mysql> CREATE USER 'Adnan'@'localhost' IDENTIFIED BY 'Adnan@12333';
Query OK, 0 rows affected (0.01 sec)

mysql> CREATE USER 'Alden'@'localhost' IDENTIFIED BY 'Alden@12333';
Query OK, 0 rows affected (0.02 sec)

mysql> SELECT user, host FROM mysql.user;
+-----+-----+
| user | host |
+-----+-----+
| Adnan | localhost |
| Alden | localhost |
| AlfiantoTeofilusBera | localhost |
| AzrielGilbert | localhost |
| debian-sys-maint | localhost |
| mysql.infoschema | localhost |
| mysql.session | localhost |
| mysql.sys | localhost |
| root | localhost |
+-----+-----+
9 rows in set (0.00 sec)
```

Gambar 2.10 Konfigurasi 1 mysql

2. Membuat Database:

CREATE DATABASE Kelompok_CC;

3. Menggunakan Database:

USE Kelompok_CC;

4. Membuat Tabel users:

```
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696547&useAdminProxy=true - Google Chrome
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696547&useAdminProxy=true

SSH-in-browser

| AzrielGilbert | localhost |
| debian-sys-maint | localhost |
| mysql.infoschema | localhost |
| mysql.session | localhost |
| mysql.sys | localhost |
| root | localhost |
+-----+
9 rows in set (0.00 sec)

mysql> EXIT
Bye
alfiantoteofilusbara@web-server:~$ mysql -u AlfiantoTeofilusBara -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 12
Server version: 8.0.40-Ubuntu0.22.04.1 (Ubuntu)

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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> USE Kelompok_CC;
Database changed
mysql> EXIT;
Bye
alfiantoteofilusbara@web-server:~$ USE Kelompok_CC;
USE: command not found
alfiantoteofilusbara@web-server:~$ mysql -u AlfiantoTeofilusBara -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 13
Server version: 8.0.40-Ubuntu0.22.04.1 (Ubuntu)

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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> USE Kelompok_CC;
Database changed
mysql> USE Kelompok_CC;
Database changed
mysql> SHOW TABLES;
Empty set (0.00 sec)

mysql> CREATE TABLE users (
  ->   id INT AUTO_INCREMENT PRIMARY KEY,
  ->   username VARCHAR(50) NOT NULL,
  ->   password VARCHAR(100) NOT NULL,
  ->   email VARCHAR(100),
  -> );
```

Gambar 2.11 Konfigurasi 2 mysql

5. Menambahkan Data ke Tabel users:
6. Verifikasi Data:

```
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696547&useAdminProxy=true - Google Chrome
sshcloud.google.com/v2/ssh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/web-server?authuser=0&hl=en_US&projectNumber=50041696547&useAdminProxy=true

SSH-in-browser

| id | username | password | email | created_at |
+----+-----+-----+-----+-----+
| 1 | Alfianto | Alfianto@12333 | alfianto@gmail.com | 2024-12-27 12:11:41 |
+----+-----+-----+-----+
1 row in set (0.00 sec)

mysql> INSERT INTO users (username, password, email)
  -> VALUES ('Azriel', 'Azriel@12333', 'azriel@gmail.com');
Query OK, 1 row affected (0.01 sec)

mysql> SELECT * FROM users;
+----+-----+-----+-----+-----+
| id | username | password | email | created_at |
+----+-----+-----+-----+-----+
| 1 | Alfianto | Alfianto@12333 | alfianto@gmail.com | 2024-12-27 12:11:41 |
| 2 | Azriel | Azriel@12333 | azriel@gmail.com | 2024-12-27 12:12:08 |
+----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql> UPDATE users;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near '' at line 1
mysql> UPDATE users
  -> SET username = 'AzrielGilbert'
  -> WHERE username = 'Azriel';
Query OK, 1 row affected (0.00 sec)
Rows matched: 1 Changed: 1 Warnings: 0

mysql> SELECT * FROM users;
+----+-----+-----+-----+-----+
| id | username | password | email | created_at |
+----+-----+-----+-----+-----+
| 1 | Alfianto | Alfianto@12333 | alfianto@gmail.com | 2024-12-27 12:11:41 |
| 2 | AzrielGilbert | Azriel@12333 | azriel@gmail.com | 2024-12-27 12:12:08 |
+----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql> INSERT INTO users (username, password, email)
  -> VALUES ('Adnan', 'Adnan@12333', 'adnan@gmail.com');
Query OK, 1 row affected (0.00 sec)

mysql> INSERT INTO users (username, password, email)
  -> VALUES ('Alden', 'Alden@12333', 'alden@gmail.com');
Query OK, 1 row affected (0.00 sec)

mysql> SELECT * FROM users;
+----+-----+-----+-----+-----+
| id | username | password | email | created_at |
+----+-----+-----+-----+-----+
| 1 | Alfianto | Alfianto@12333 | alfianto@gmail.com | 2024-12-27 12:11:41 |
| 2 | AzrielGilbert | Azriel@12333 | azriel@gmail.com | 2024-12-27 12:12:08 |
| 3 | Adnan | Adnan@12333 | adnan@gmail.com | 2024-12-27 12:15:20 |
| 4 | Alden | Alden@12333 | alden@gmail.com | 2024-12-27 12:15:25 |
+----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

mysql> EXIT;
Bye
```

Gambar 2.12 Verifikasi pembuatan database dan tabel

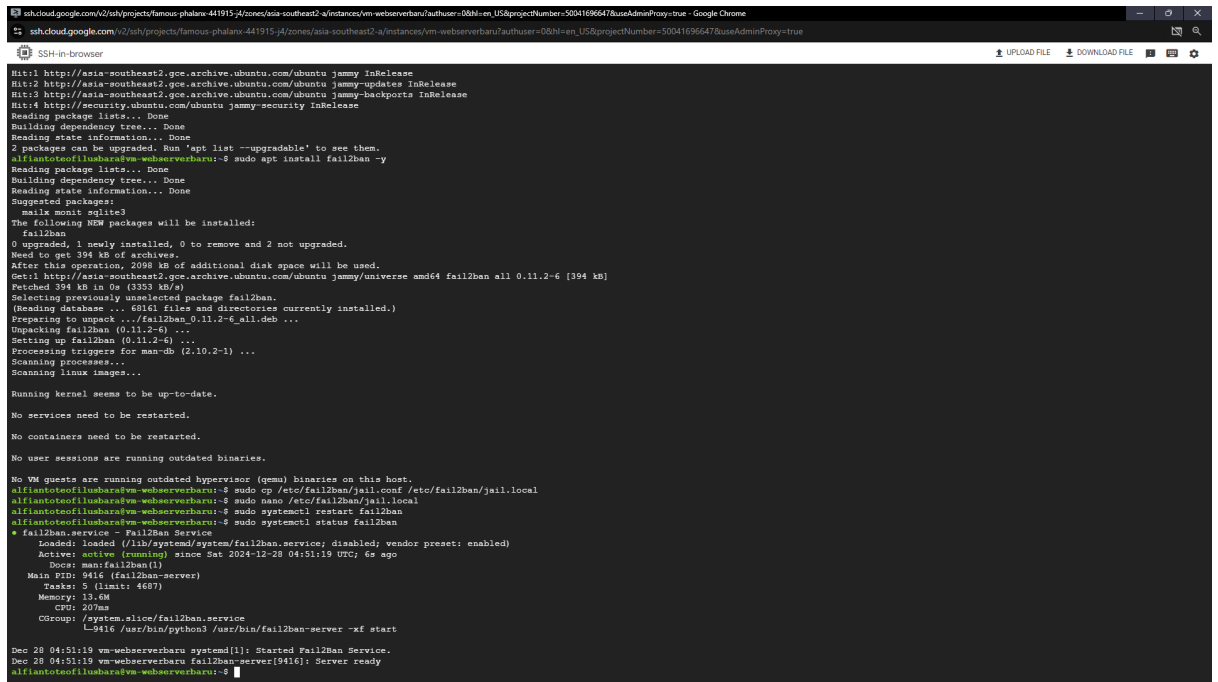
Dengan kedua layanan ini terinstal dan database terkonfigurasi, VM Instance siap untuk digunakan sebagai web server dan database server.

2.2 Server Hardening

Server hardening adalah proses pengamanan server untuk melindunginya dari ancaman atau serangan yang mungkin terjadi. Salah satu langkah yang dilakukan adalah instalasi dan konfigurasi Fail2ban, sebuah alat yang dapat mencegah serangan brute-force dengan memblokir IP yang mencurigakan. Prosesnya meliputi:

- **Instalasi Fail2ban:**

sudo apt install fail2ban -y



```
Hit:1 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
2 packages can be upgraded. Run 'apt list --upgradable' to see them.
aliantotoefilushara@vm-webserverbaru:~$ sudo apt install fail2ban -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Suggested packages:
  mailx msmtp edit3
The following NEW packages will be installed:
  fail2ban
0 upgraded, 1 newly installed, 0 to remove and 2 not upgraded.
Need to get 394 kB of archives.
After this operation, 2098 kB of additional disk space will be used.
Get:1 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/universe amd64 fail2ban all 0.11.2-6 [394 kB]
debconf: delaying package configuration, since apt-utils is not installed
Fetched 394 kB in 0s (9393 kB/s)
Selecting previously unselected package fail2ban.
(Reading database ... 69161 files and directories currently installed.)
Preparing to unpack .../fail2ban_0.11.2-6_all.deb ...
Unpacking fail2ban (0.11.2-6) ...
Setting up fail2ban (0.11.2-6) ...
Processing triggers for man-db (2.10.2-1) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
aliantotoefilushara@vm-webserverbaru:~$ sudo cp /etc/fail2ban/jail.conf /etc/fail2ban/jail.local
aliantotoefilushara@vm-webserverbaru:~$ sudo nano /etc/fail2ban/jail.local
aliantotoefilushara@vm-webserverbaru:~$ sudo systemctl restart fail2ban
aliantotoefilushara@vm-webserverbaru:~$ sudo systemctl status fail2ban
* fail2ban.service - fail2ban Service
   Loaded: loaded (/lib/systemd/system/fail2ban.service; disabled; vendor preset: enabled)
   Active: active (running) since Sat 2024-12-28 04:51:19 UTC; 6s ago
     Docs: man:fail2ban(1)
   Main PID: 9416 (fail2ban-server)
      Tasks: 5 (limit: 4687)
    Memory: 13.4M
       CPU: 207ms
    CGroup: /system.slice/fail2ban.service
            └─9416 /usr/bin/python3 /usr/bin/fail2ban-server -xf start

Dec 28 04:51:19 vm-webserverbaru systemd[1]: Started fail2ban Service.
Dec 28 04:51:19 vm-webserverbaru fail2ban-server[9416]: Server ready
aliantotoefilushara@vm-webserverbaru:~$
```

Gambar 2.13 Penginstalan & verifikasi fail2ban

Konfigurasi Fail2ban:

`sudo nano /etc/fail2ban/jail.local`

Tambahkan aturan untuk melindungi SSH:

`[sshd]`

`enabled = true`

`port = ssh`

`filter = sshd`

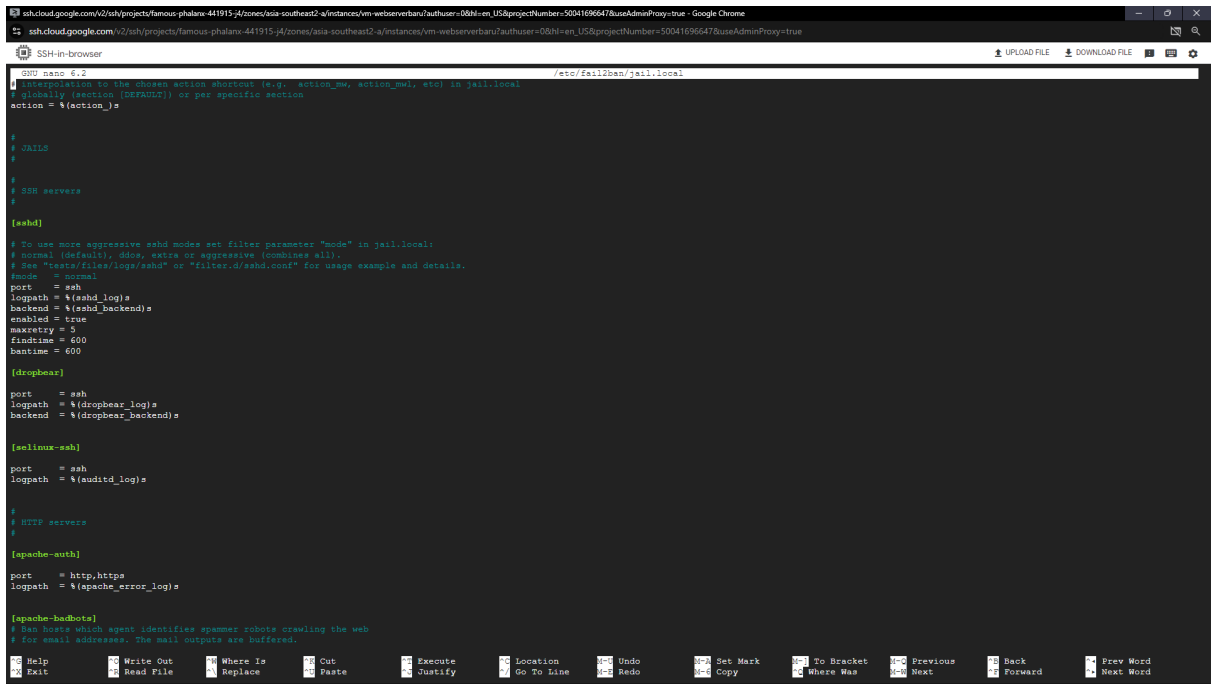
`logpath = %(sshd_log) s`

`backend = % (sshd_backend) s`

`maxretry = 5`

`bantime = 600`

`findtime - 600`



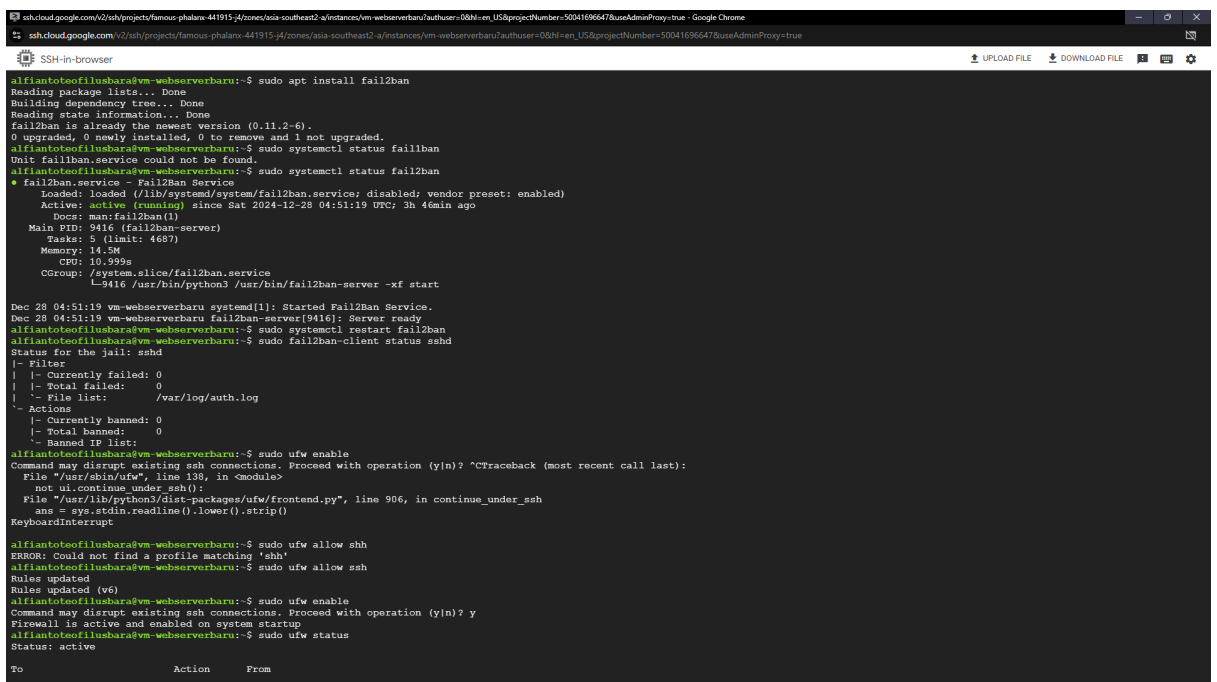
Gambar 2.14 Konfigurasi fail2ban

Pengaturan firewall untuk akses SSH:

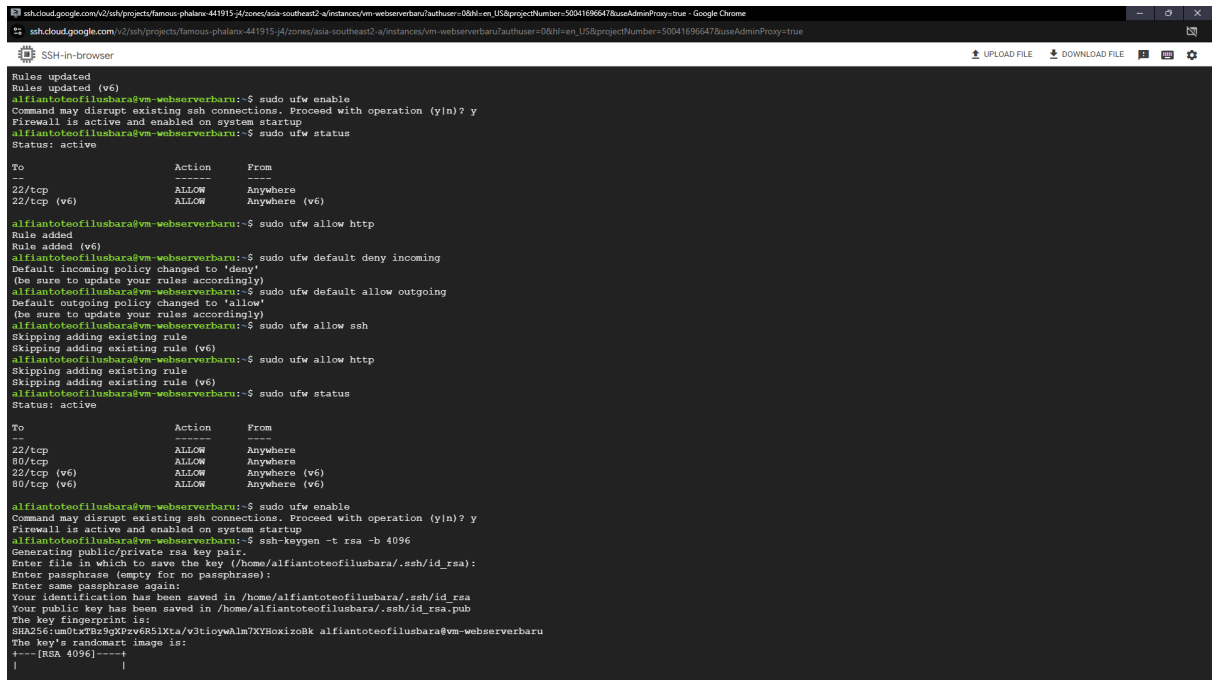
sudo ufw allow from [IP Address] to any port 22

- sudo ufw enable
- **Restart Fail2ban:**

sudo systemctl restart fail2ban



Gambar 2.15 Settingan firewall untuk SSH



```
Rules updated
Rules updated (v6)
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw enable
Command may disrupt existing ssh connections. Proceed with operation (y/n)? y
Firewall is active and enabled on system startup
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw status
Status: active

To:                                     Action      From
--                                     -
22/tcp                                ALLOW       Anywhere
22/tcp (v6)                           ALLOW       Anywhere (v6)

alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw allow http
Rule added
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw default deny incoming
Default incoming policy changed to 'deny'
(be sure to update your rules accordingly)
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw default allow outgoing
Default outgoing policy changed to 'allow'
(be sure to update your rules accordingly)
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw allow http
Skipping adding existing rule
Skipping adding existing rule (v6)
alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw status
Status: active

To:                                     Action      From
--                                     -
22/tcp                                ALLOW       Anywhere
80/tcp                                ALLOW       Anywhere
22/tcp (v6)                           ALLOW       Anywhere (v6)
80/tcp (v6)                           ALLOW       Anywhere (v6)

alfiantoteofilusbara@vm-webserverbaru:~$ sudo ufw enable
Command may disrupt existing ssh connections. Proceed with operation (y/n)? y
Firewall is active and enabled on system startup
alfiantoteofilusbara@vm-webserverbaru:~$ ssh-keygen -t rsa -b 4096
Generating public/private rsa key pair.
Enter file in which to save the key (/home/alfiantoteofilusbara/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/alfiantoteofilusbara/.ssh/id_rsa
Your public key has been saved in /home/alfiantoteofilusbara/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:um0tKTBz9gKpZv6R51Xta/v3tIoyw4m7XYHoxiz0Bk alfiantoteofilusbara@vm-webserverbaru
The key's randomart image is:
+----[RSA 4096]-----+
```

Gambar 2.16 Status firewall

Dengan langkah-langkah ini, server menjadi lebih terlindungi dari potensi serangan brute-force dan akses yang tidak diizinkan.

2.3 Integrasi Google Cloud Storage (GCS)

Google Cloud Storage (GCS) adalah layanan penyimpanan berbasis cloud yang dapat digunakan untuk menyimpan data aplikasi atau database. Integrasi GCS dengan VM Instance dilakukan melalui langkah-langkah berikut:

1. Aktifkan Google Cloud Storage API di GCP

Sebelum menggunakan Google Cloud Storage, pastikan bahwa API Google Cloud Storage telah diaktifkan di proyek GCP Anda.

2. Buat Bucket GCS

Untuk membuat bucket GCS, kami menggunakan perintah `gcloud storage buckets create` dengan nama bucket `bucketkubarulagi` dan lokasi `asia-southeast2` (Jakarta). Berikut adalah perintah yang digunakan:

```
gcloud storage buckets create gs://bucketkubarulagi --location=asia-southeast2
```

Setelah perintah ini dijalankan, bucket GCS berhasil dibuat.

3. Menyambungkan Google Cloud Storage ke VM

Untuk mengintegrasikan bucket GCS dengan VM, kami menggunakan perintah `gsutil` untuk melakukan pengunggahan dan pengunduhan file antara VM dan GCS.

4. Mengunggah File ke GCS

File `data.txt` yang terletak di direktori `/home/alfiantoteofilusbara/` pada VM diunggah ke bucket GCS dengan perintah:

```
gsutil cp /home/alfiantoteofilusbara/data.txt gs://bucketkubarulagi/
```

5. Mengunduh File dari GCS ke VM

Untuk memastikan bahwa proses pengambilan data dari GCS berfungsi dengan baik, file `data.txt` diunduh kembali dari bucket GCS ke direktori `home` VM dengan perintah:

```
gsutil cp gs://bucketkubarulagi/data.txt /home/alfiantoteofilusbara
```

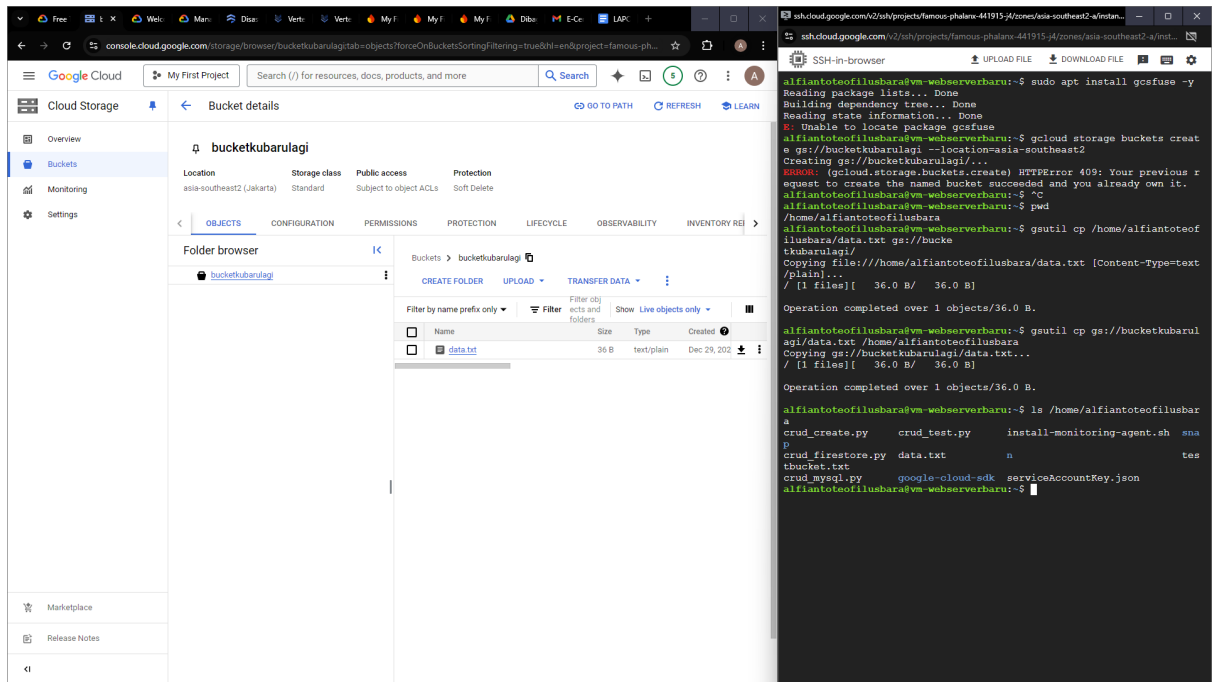
File berhasil diunduh dan ditempatkan di direktori `/home/alfiantoteofilusbara/` pada VM.

6. Uji Penyimpanan dan Pengambilan Data

Proses penyimpanan dan pengambilan data diuji dengan langkah-langkah berikut:

- Mengunggah file dari VM ke bucket GCS menggunakan perintah `gsutil cp`.
- Mengunduh file dari bucket GCS kembali ke VM dengan perintah `gsutil cp`.

7. Pengujian ini berhasil, membuktikan bahwa integrasi antara VM dan GCS berjalan dengan baik, serta file dapat disalin bolak-balik antara GCS dan VM.



Gambar 2.17 Hasil dari GCS

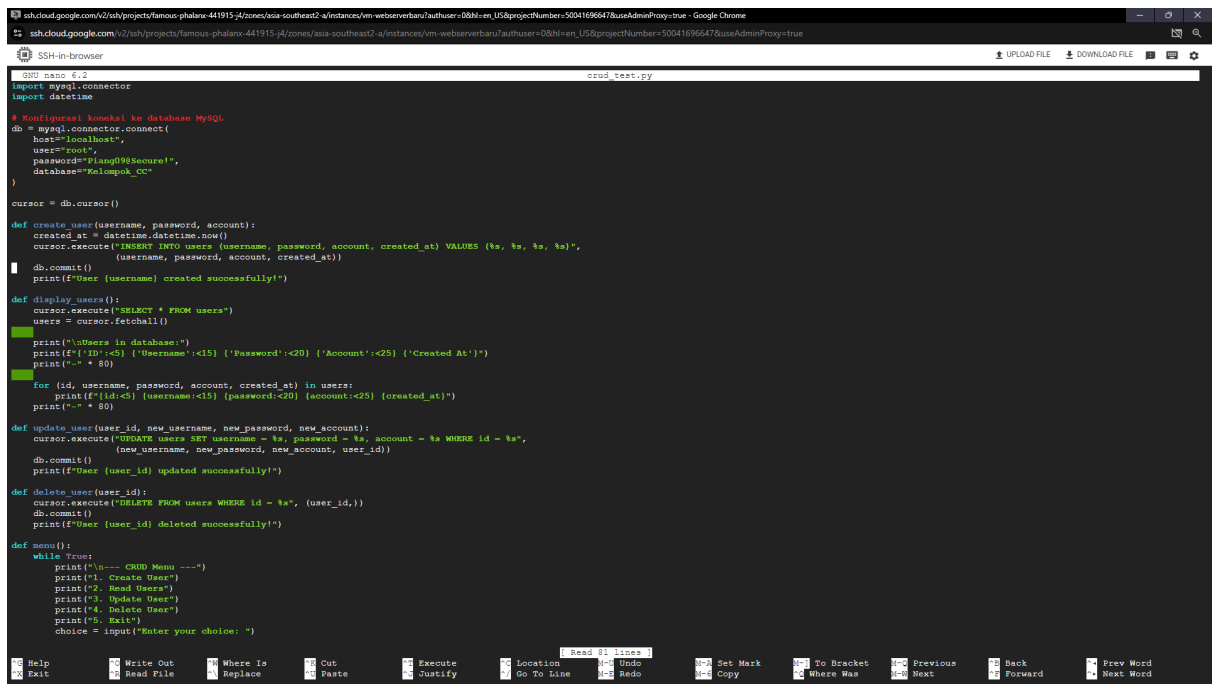
2.4 CRUD Test

CRUD (Create, Read, Update, Delete) adalah operasi dasar yang digunakan untuk mengelola data dalam sistem database. Dalam laporan ini, dua jenis database, yaitu MySQL dan Firestore, diuji dengan melakukan operasi CRUD melalui dua script Python yang masing-masing mewakili setiap database.

2.4.1 CRUD pada MySQL

Script **crud_test.py** menggunakan MySQL untuk menjalankan operasi CRUD:

- **Create:** Menambahkan pengguna baru dengan menyimpan data ke tabel users menggunakan query INSERT.
- **Read:** Menampilkan semua pengguna dari tabel users dengan melakukan query SELECT.
- **Update:** Memperbarui informasi pengguna yang sudah ada dengan query UPDATE.
- **Delete:** Menghapus pengguna berdasarkan ID dengan query DELETE.



```
#!/usr/bin/env python3
import mysql.connector
import datetime

# Konfigurasi koneksi ke Database MySQL
db = mysql.connector.connect(
    host="localhost",
    user="root",
    password="Piang098Secure!",
    database="kelompok_cc"
)

cursor = db.cursor()

def create_user(username, password, account):
    created_at = datetime.datetime.now()
    cursor.execute("INSERT INTO users (username, password, account, created_at) VALUES (%s, %s, %s, %s)",
        (username, password, account, created_at))
    db.commit()
    print(f"User {username} created successfully!")

def display_users():
    cursor.execute("SELECT * FROM users")
    users = cursor.fetchall()

    print("\nUsers in database:")
    print(f"{'ID':<5} {'Username':<15} {'Password':<20} {'Account':<25} {'Created At':<15}")
    print("-" * 80)

    for (id, username, password, account, created_at) in users:
        print(f"{id:<5} {username:<15} {password:<20} {account:<25} {created_at:<15}")
        print("-" * 80)

def update_user(user_id, new_username, new_password, new_account):
    cursor.execute("UPDATE users SET username = %s, password = %s, account = %s WHERE id = %s",
        (new_username, new_password, new_account, user_id))
    db.commit()
    print(f"User {user_id} updated successfully!")

def delete_user(user_id):
    cursor.execute("DELETE FROM users WHERE id = %s", (user_id,))
    db.commit()
    print(f"User {user_id} deleted successfully!")

def menu():
    while True:
        print("\n--- CRUD Menu ---")
        print("1. Create User")
        print("2. Read Users")
        print("3. Update User")
        print("4. Delete User")
        print("5. Exit")
        choice = input("Enter your choice: ")

        if choice == "1":
            username = input("Enter username: ")
            password = input("Enter password: ")
            account = input("Enter account: ")
            create_user(username, password, account)

        elif choice == "2":
            display_users()

        elif choice == "3":
            user_id = input("Enter user ID to update: ")
            new_username = input("Enter new username: ")
            new_password = input("Enter new password: ")
            new_account = input("Enter new account: ")
            update_user(user_id, new_username, new_password, new_account)

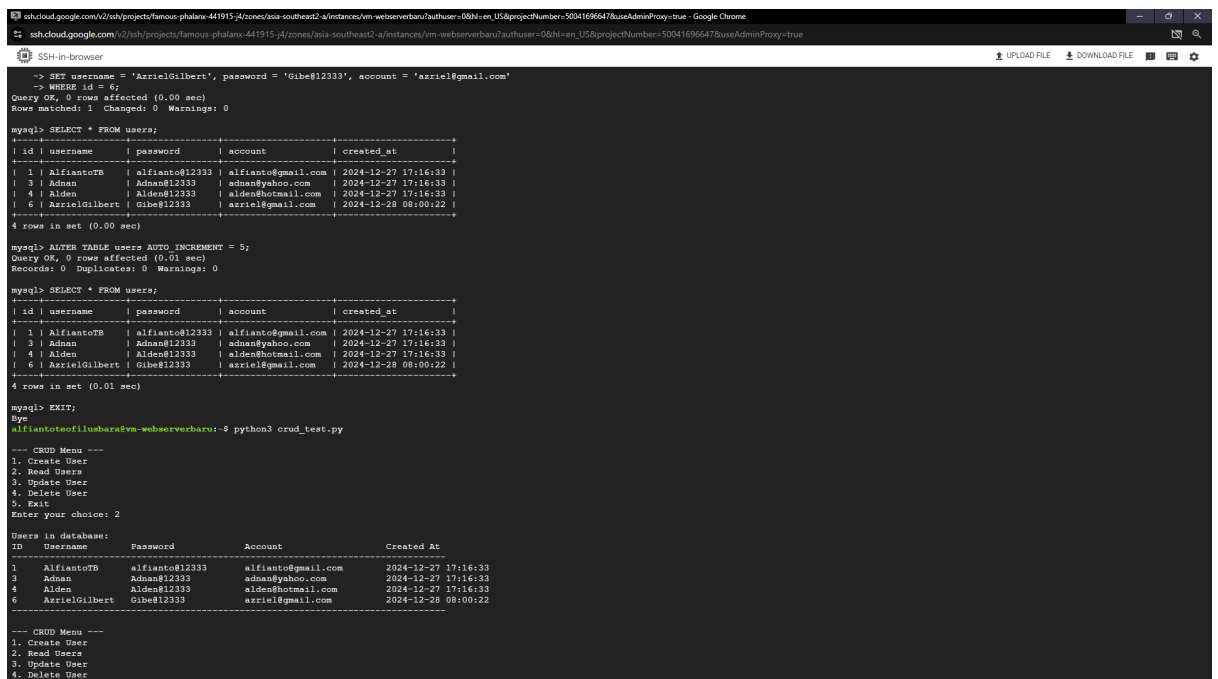
        elif choice == "4":
            user_id = input("Enter user ID to delete: ")
            delete_user(user_id)

        elif choice == "5":
            break

        else:
            print("Invalid choice. Please try again.")
```

Gambar 2.18 Script crud_test.py untuk MySQL

Script ini memastikan bahwa operasi CRUD dapat dilakukan dengan baik pada database MySQL.



```
--> SET username = 'ArielGilbert', password = 'Gibe12333', account = 'azriel@gmail.com'
--> WHERE id = 6;
Query OK, 0 rows affected (0.00 sec)
Rows matched: 1 Changed: 0 Warnings: 0

mysql> SELECT * FROM users;
+----+-----+-----+-----+-----+
| id | username | password | account | created_at |
+----+-----+-----+-----+-----+
| 1 | AlfiantoTB | alfianto12333 | alfianto@gmail.com | 2024-12-27 17:16:33 |
| 3 | Adnan | Adnan12333 | adnan@yahoo.com | 2024-12-27 17:16:33 |
| 4 | Alden | Alden12333 | alden@hotmail.com | 2024-12-27 17:16:33 |
| 6 | ArielGilbert | Gibe12333 | azriel@gmail.com | 2024-12-28 08:00:22 |
+----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

mysql> ALTER TABLE users AUTO_INCREMENT = 5;
Query OK, 0 rows affected (0.01 sec)
Records: 0 Duplicates: 0 Warnings: 0

mysql> SELECT * FROM users;
+----+-----+-----+-----+-----+
| id | username | password | account | created_at |
+----+-----+-----+-----+-----+
| 1 | AlfiantoTB | alfianto12333 | alfianto@gmail.com | 2024-12-27 17:16:33 |
| 3 | Adnan | Adnan12333 | adnan@yahoo.com | 2024-12-27 17:16:33 |
| 4 | Alden | Alden12333 | alden@hotmail.com | 2024-12-27 17:16:33 |
| 6 | ArielGilbert | Gibe12333 | azriel@gmail.com | 2024-12-28 08:00:22 |
+----+-----+-----+-----+-----+
4 rows in set (0.01 sec)

mysql> EXIT;
Bye
alfiantoteofilus@va-webservers:~$ python3 crud_test.py

--- CRUD Menu ---
1. Create User
2. Read Users
3. Update User
4. Delete User
5. Exit
Enter your choice: 2

Users in database:
ID Username Password Account Created At
1 AlfiantoTB alfianto12333 alfianto@gmail.com 2024-12-27 17:16:33
3 Adnan Adnan12333 adnan@yahoo.com 2024-12-27 17:16:33
4 Alden Alden12333 alden@hotmail.com 2024-12-27 17:16:33
6 ArielGilbert Gibe12333 azriel@gmail.com 2024-12-28 08:00:22

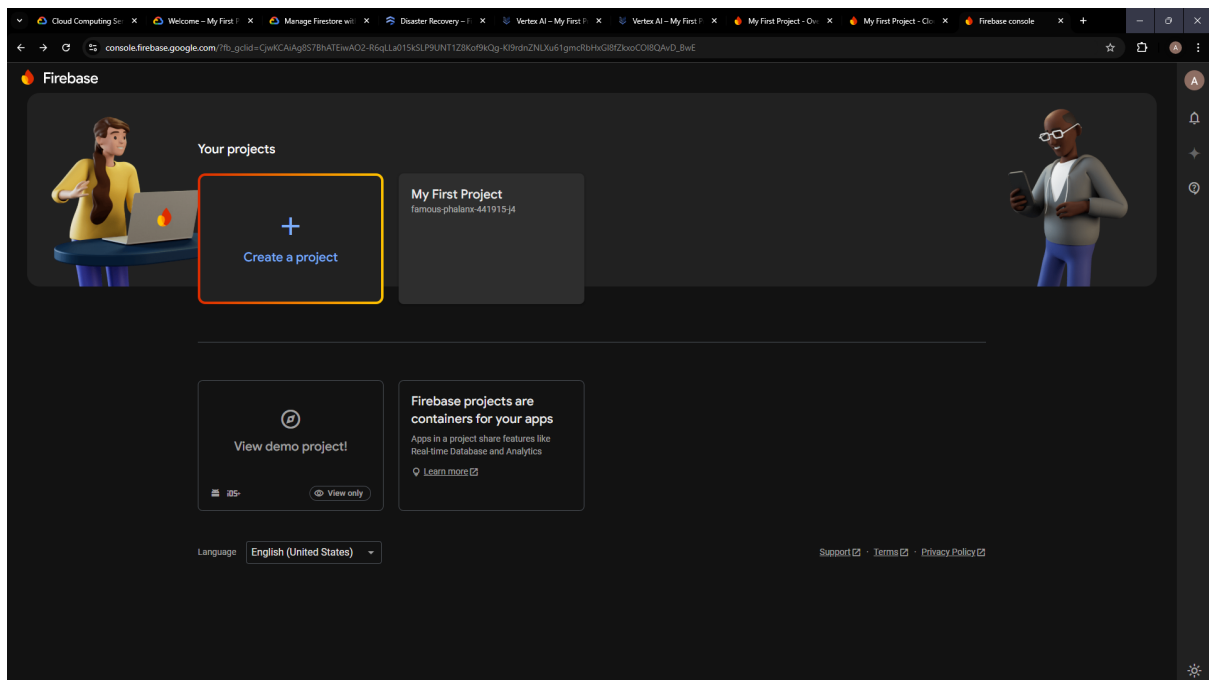
--- CRUD Menu ---
1. Create User
2. Read Users
3. Update User
4. Delete User
```

Gambar 2.19 Hasil script python crud_test untuk MySQL

2.4.2 CRUD pada Firestore

Langkah Persiapan Sebelum Membuat crud_firestore.py

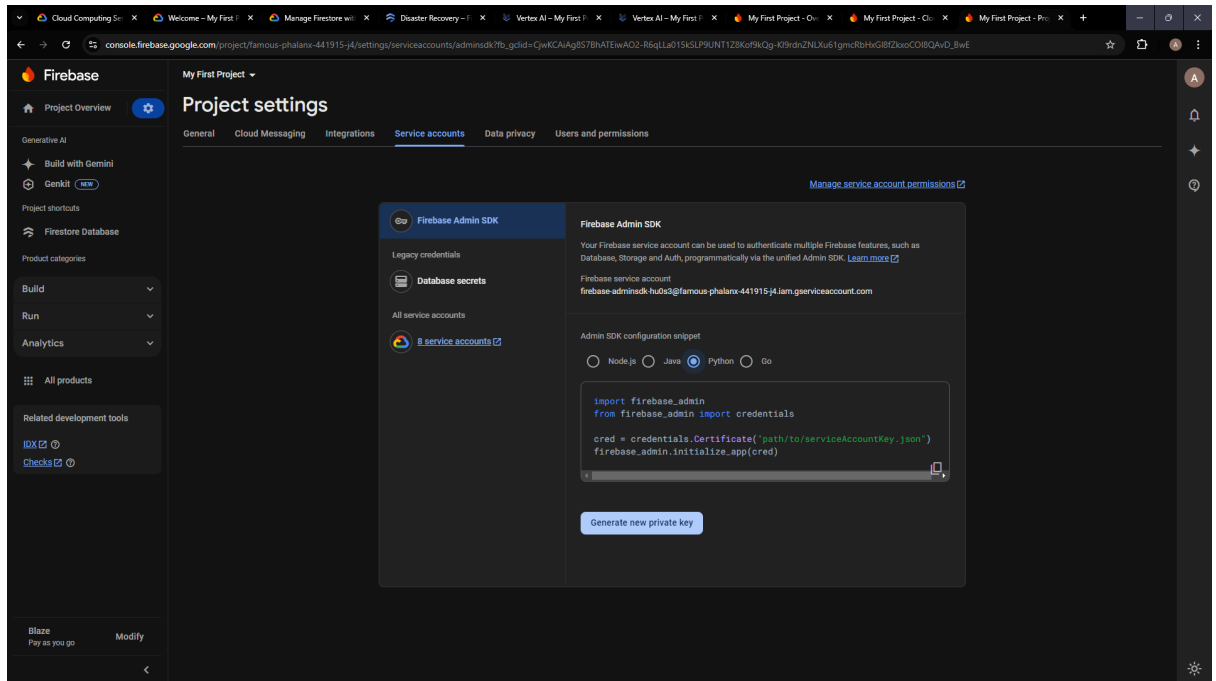
- **Masuk ke Firebase Console**
 - Buka Firebase Console.
 - Login menggunakan akun GCP
- **Pilih Proyek Firebase**
 - Klik tombol **Add Project** atau pilih proyek yang sudah ada jika Anda ingin mengintegrasikan dengan proyek sebelumnya..
 - ikuti panduan pembuatan proyek, seperti memasukkan nama proyek dan mengaktifkan Google Analytics (opsional).
 - Setelah selesai, klik **Create Project**.



Gambar 2.20 Tampilan firebase

- **Mengunduh File Kunci JSON untuk Akun Layanan**
 - Klik tombol **Generate New Private Key**.
 - Firebase akan menghasilkan file kunci JSON untuk akun layanan.

- Simpan file ini (biasanya bernama karakter acak) di komputer lokal. Rename file tersebut agar mudah diingat seperti *serviceAccountKey.json*



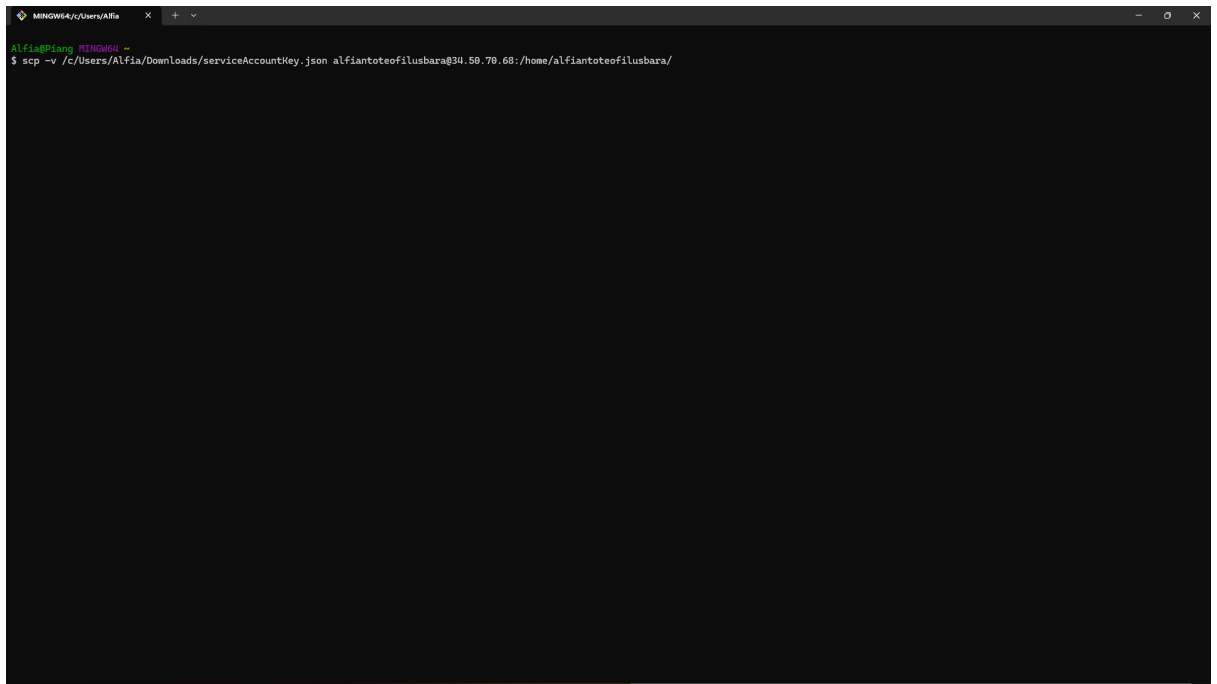
Gambar 2.21 Mengunduh PrivKey

Setelah mengunduh file dari Firebase Console, simpan file *serviceAccountKey.json* di lokasi yang mudah diakses.

- Buka Git Bash
- Buka aplikasi **Git Bash** di komputer lokal.

Gunakan Perintah *scp* untuk Mengunggah File. Jalankan perintah berikut di Git Bash untuk mengunggah file ke VM:

```
scp /c/Users/<username>/Downloads/serviceAccountKey.json
<user>@<vm_ip>:/path/to/destination
```



Gambar 2.22 Mengunggah file PrivKey

Masukkan Password VM (Jika Diminta). Ketika perintah scp dijalankan, Anda mungkin akan diminta memasukkan password pengguna VM. Ketik password dan tekan **Enter**.

- **Verifikasi File di VM**

ssh <user>@<vm_ip>

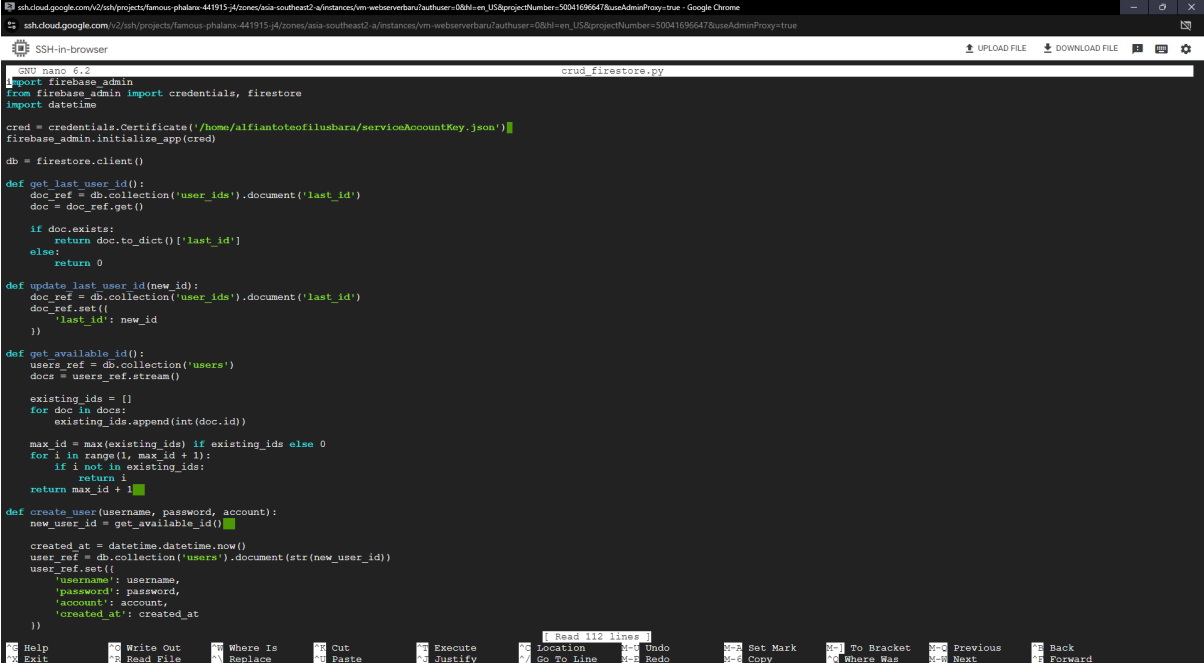
Gambar 2.24 Penginstalan google-cloud-firestore

- **Menginisialisasi Firebase di Aplikasi Python**

Tambahkan kode berikut di awal skrip Python yang telah di download dan di unggah ke VM untuk menginisialisasi Firebase.

Script **crud_firestore.py** mengimplementasikan operasi CRUD menggunakan Firestore:

- **Create:** Menambahkan pengguna baru ke koleksi users dengan menyusun data ke dalam dokumen, serta menggunakan ID otomatis yang disesuaikan dengan maksimal ID sebelumnya.
- **Read:** Membaca semua dokumen pengguna dari koleksi users menggunakan stream.
- **Update:** Memperbarui data pengguna berdasarkan ID dengan mengupdate dokumen yang sesuai di Firestore.
- **Delete:** Menghapus pengguna berdasarkan ID dengan menghapus dokumen di Firestore.



```
sshcloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/vm-webserverbaru/authuser=08h-en_US&projectNumber=50041696647&useAdminProxy=true - Google Chrome
sshcloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/vm-webserverbaru/authuser=08h-en_US&projectNumber=50041696647&useAdminProxy=true
SSH-in-browser
crud_firestore.py
GNU nano 6.2
import firebase_admin
from firebase_admin import credentials, firestore
import datetime

cred = credentials.Certificate('/home/alfiantotoefilushara/serviceAccountKey.json')
firebase_admin.initialize_app(cred)

db = firestore.client()

def get_last_user_id():
    doc_ref = db.collection('user_ids').document('last_id')
    doc = doc_ref.get()

    if doc.exists:
        return doc.to_dict()['last_id']
    else:
        return 0

def update_last_user_id(new_id):
    doc_ref = db.collection('user_ids').document('last_id')
    doc_ref.set({
        'last_id': new_id
    })

def get_available_id():
    users_ref = db.collection('users')
    docs = users_ref.stream()

    existing_ids = []
    for doc in docs:
        existing_ids.append(int(doc.id))

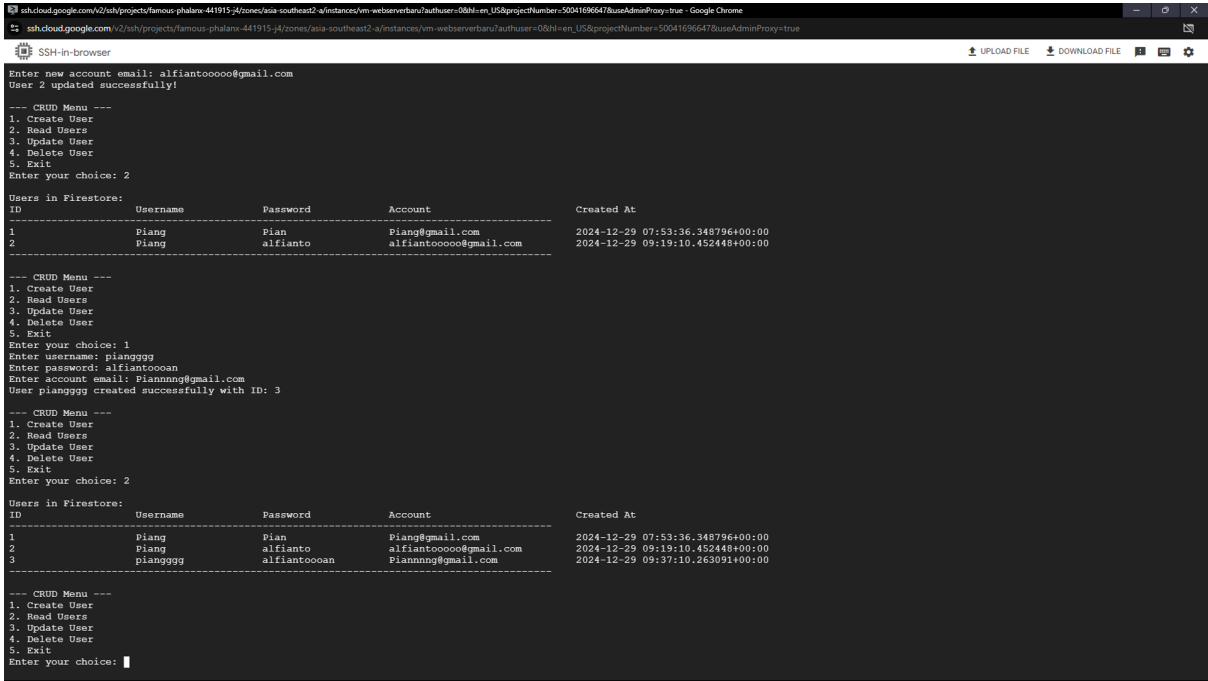
    max_id = max(existing_ids) if existing_ids else 0
    for i in range(1, max_id + 1):
        if i not in existing_ids:
            return i
    return max_id + 1

def create_user(username, password, account):
    new_user_id = get_available_id()

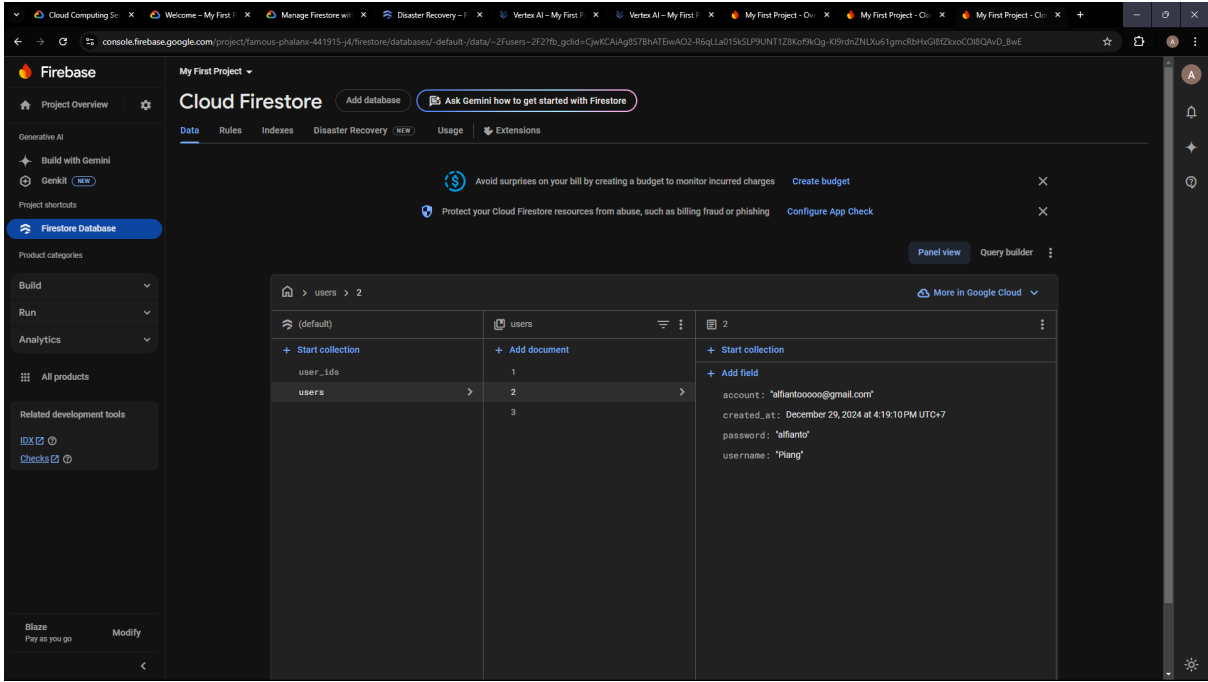
    created_at = datetime.datetime.now()
    user_ref = db.collection('users').document(str(new_user_id))
    user_ref.set({
        'username': username,
        'password': password,
        'account': account,
        'created_at': created_at
    })

[ Read 112 lines
Help      Write Out  Where Is  Cut       Execute   Location  Undo     Set Mark  To Bracket Previous  Back
Exit      Read File  Replace  Paste     Justify   Go To Line Redo     Copy      Where Was Next      Forward
```

Gambar 2.25 Script crud_firestore.py



Gambar 2.26 Output 1 script crud_firestore



Gambar 2.27 Output 2 di firebase

Untuk file script crud_test.py untuk MySQL dan script crud_firestore.py ada di link berikut :

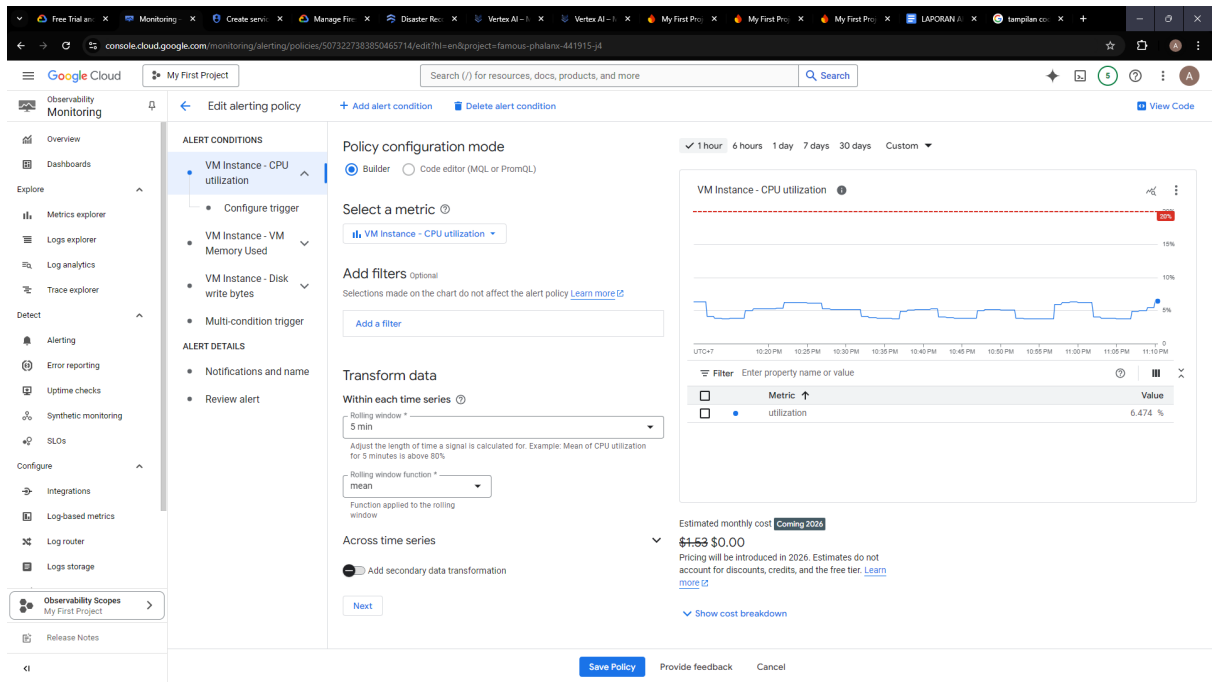
- crud_test.py :
https://github.com/AlfiantoBara/Script-CRUD-GCP/blob/main/crud_test.py
- crud_firestore.py :
https://github.com/AlfiantoBara/Script-CRUD-GCP/blob/main/crud_firestore.py

Kedua script tersebut menunjukkan bagaimana operasi CRUD dilakukan dengan efektif di MySQL dan Firestore, masing-masing menggunakan pendekatan yang sesuai dengan struktur masing-masing database.

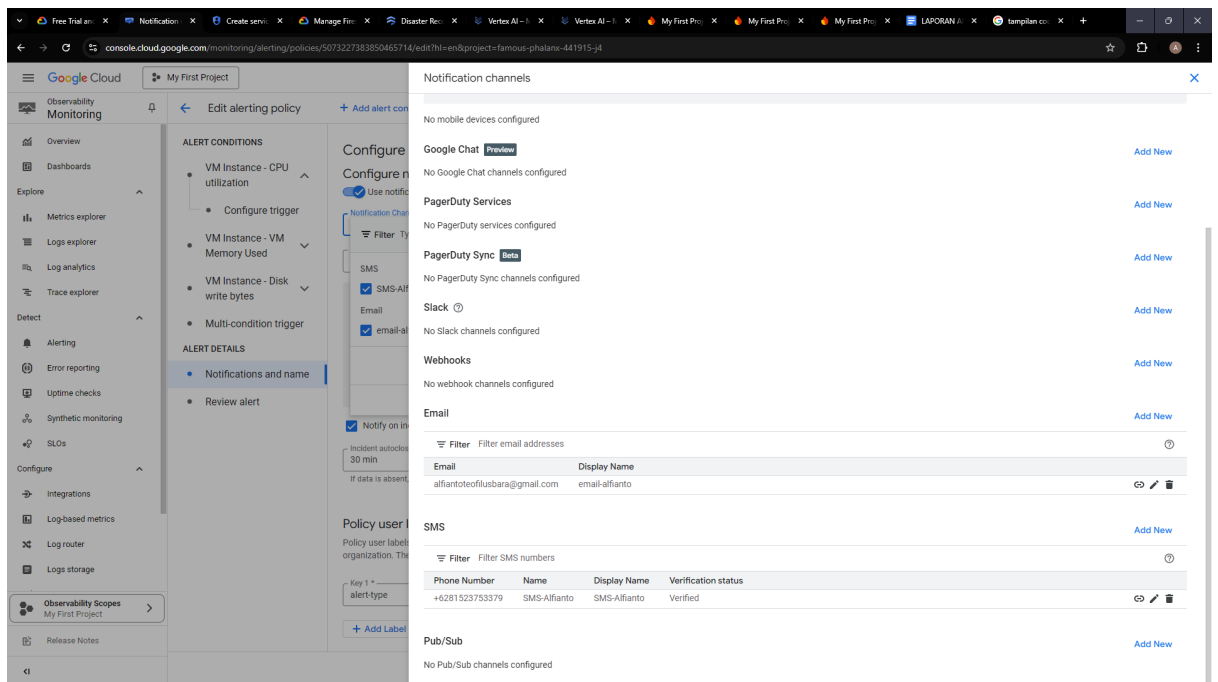
2.5 Monitoring dan Alerting

Monitoring dan alerting adalah fitur penting untuk memastikan performa dan ketersediaan sistem tetap terjaga. Proses ini dilakukan melalui langkah-langkah berikut:

- Aktifkan Google Cloud Monitoring di GCP.
- Tambahkan VM instance ke dalam monitoring.
- Buat dashboard kustom untuk memantau parameter seperti CPU Utilization, VM memory usage, dan Disk Write bytes.
- Buat alert policy untuk memantau CPU usage dengan threshold 80%.
- Tambahkan notifikasi email ke [email anggota kelompok].



Gambar 2.28 Pembuatan alert policy



Gambar 2.29 Tujuan notifikasi

Langkah-langkah ini membantu menjaga kinerja sistem dan mengidentifikasi potensi masalah sejak dini.

```
sshcloud.google.com/v2/sh/projects/famous-phalanx-441915-j4/zones/asia-southeast2-a/instances/vm-webserverbaru/author=00h-en_US$projectNumber=5004169647$useAdminProxy=true
SSH-in-browser
alifantoteofilusbar@vm-webserverbaru:~$ sudo apt-get install stress-ng
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libipeec-mbl libjudydebian1 libtcl1
Suggested packages:
  libtcl-tools
The following NEW packages will be installed:
  libipeec-mbl libjudydebian1 libtcl1 stress-ng
0 upgraded, 4 newly installed, 0 to remove and 1 not upgraded.
Need to get 3037 kB of archives.
After this operation, 16.5 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/universe amd64 libipeec-mbl amd64 1.2-1 [926 kB]
Get:2 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/universe amd64 libjudydebian1 amd64 1.0.5-5 [94.6 kB]
Get:3 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy/main amd64 libtcl1 amd64 1.0.19+dfsg-1build1 [2970 B]
Get:4 http://asia-southeast2.gce.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 stress-ng amd64 0.13.12-2ubuntu1 [2107 kB]
Fetched 3037 kB in 6s (506 kB/s)
Selecting previously unselected package libipeec-mbl.
(Reading database ... 75585 files and directories currently installed.)
Preparing to unpack .../libipeec-mbl_1.2-1_amd64.deb ...
Unpacking libipeec-mbl (1.2-1) ...
Selecting previously unselected package libjudydebian1.
Preparing to unpack .../libjudydebian1_1.0.5-5_amd64.deb ...
Unpacking libjudydebian1 (1.0.5-5) ...
Selecting previously unselected package libtcl1amd64.
Preparing to unpack .../libtcl1_1.0.19+dfsg-1build1_amd64.deb ...
Unpacking libtcl1amd64 (1.0.19+dfsg-1build1) ...
Selecting previously unselected package stress-ng.
Preparing to unpack .../stress-ng_0.13.12-2ubuntu1_amd64.deb ...
Unpacking stress-ng (0.13.12-2ubuntu1) ...
Setting up libjudydebian1 (1.0.5-5) ...
Setting up libipeec-mbl (1.2-1) ...
Setting up libtcl1amd64 (1.0.19+dfsg-1build1) ...
Setting up stress-ng (0.13.12-2ubuntu1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.8) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

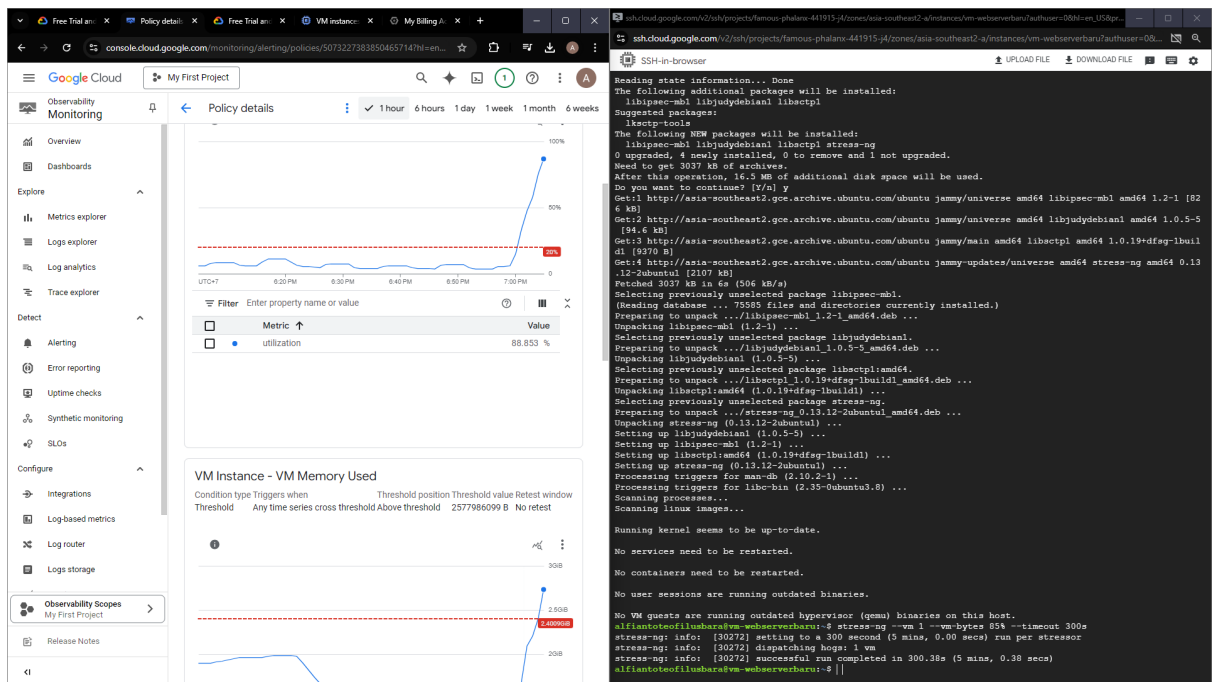
No services need to be restarted.

No containers need to be restarted.

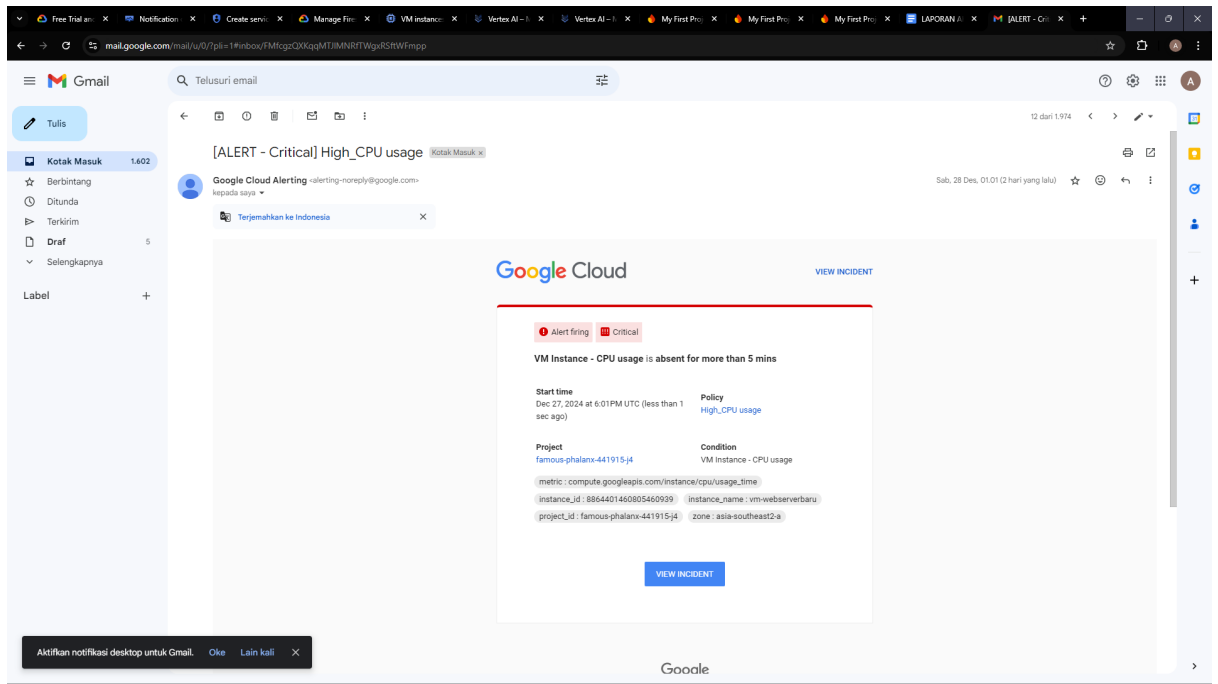
No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
alifantoteofilusbar@vm-webserverbaru:~$ stress-ng --vm 1 --vm-bytes 85% --timeout 300s
stress-ng: info: [30272] setting to a 300 second (5 mins, 0.00 secs) run per stressor
stress-ng: info: [30272] dispatching hogs: 1 vm
stress-ng: info: [30272] successful run completed in 300.38s (5 mins, 0.38 secs)
alifantoteofilusbar@vm-webserverbaru:~$
```

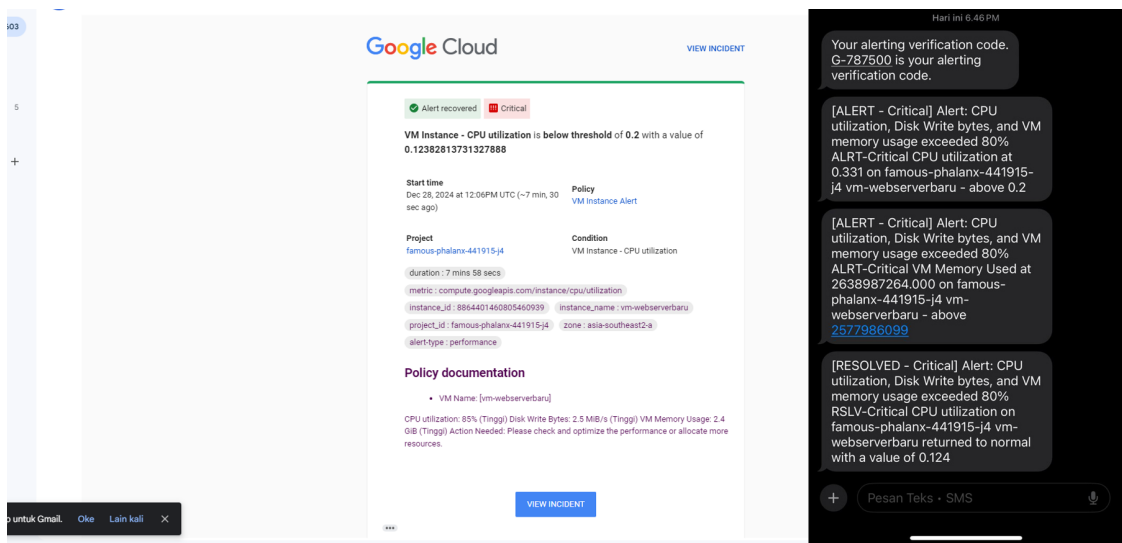
Gambar 2.30 Melakukan pengetesan pada VM menggunakan stress



Gambar 2.31 Hasil pengetesan



Gambar 2.32 Notifikasi 1 alert gmail



Gambar 2.33 Notifikasi 2 gmail dan sms

BAB III

KESIMPULAN

3. 1 Kesimpulan

Tugas Akhir Mata Kuliah Cloud Computing bertujuan untuk melatih mahasiswa dalam mengelola infrastruktur berbasis cloud menggunakan Google Cloud Platform (GCP). Dalam tugas ini, mahasiswa diharuskan membuat dan mengonfigurasi Virtual Machine (VM) untuk menjalankan web server Apache dan database MySQL. Selain itu, mahasiswa juga belajar meningkatkan keamanan server melalui langkah-langkah hardening, seperti implementasi Fail2ban untuk melindungi dari serangan brute-force, pengaturan firewall, dan pengamanan akses SSH. Google Cloud Storage (GCS) juga diintegrasikan ke dalam VM untuk menyimpan data aplikasi, dengan proses penyimpanan dan pengambilan data yang diuji menggunakan script yang dibuat.

Tugas ini juga mencakup pengembangan dan pengujian script untuk menjalankan operasi CRUD pada MySQL (localhost) dan Firestore di GCP, memberikan pemahaman mendalam tentang pengelolaan data di berbagai platform. Selain itu, mahasiswa menerapkan monitoring dan alerting menggunakan Google Cloud Monitoring untuk memantau performa VM dan mengonfigurasi notifikasi jika terjadi lonjakan penggunaan atau masalah lainnya. Melalui tugas ini, mahasiswa diharapkan mampu memahami, mengimplementasikan, dan mengelola infrastruktur cloud dengan efektif, serta siap menghadapi tantangan serupa di dunia kerja.

BAB IV

KONTRIBUSI KELOMPOK

4.1 Kontribusi

Pada bagian ini, dijelaskan kontribusi masing-masing anggota kelompok selama pelaksanaan tugas hingga penyusunan laporan akhir. Kelompok terdiri dari empat orang, dengan rincian kontribusi sebagai berikut:

1. Alfianto Teofilus Bara - 1101213377

- **Billing :** Membuat kartu untuk membangkitkan akun GCP
- **Pembuatan VM Instance:** Membuat dan mengonfigurasi VM instance di GCP, termasuk instalasi Apache dan MySQL.
- **Server Hardening:** Mengimplementasikan langkah-langkah keamanan seperti Fail2ban, pengaturan firewall, dan pengamanan akses SSH.
- **Integrasi Google Cloud Storage:** Menghubungkan Google Cloud Storage dengan VM dan melakukan pengujian proses penyimpanan serta pengambilan data.
- **Pengujian CRUD:** Membuat script CRUD untuk MySQL (localhost) dan Firestore di GCP, serta mendokumentasikan hasil pengujian.
- **Monitoring dan Alerting:** Menyiapkan monitoring menggunakan Google Cloud Monitoring dan membuat konfigurasi alert untuk CPU usage dan disk usage.
- **Dokumentasi:** Menulis laporan akhir secara rinci, meliputi seluruh tahapan dari pembuatan VM hingga implementasi monitoring.

2. Azriel Gilbert Rogito - 1101213206

- **Membuat ide**

3. Muhammad Adnan - 110121

4. Daniel Alden Susetyo - 110121