

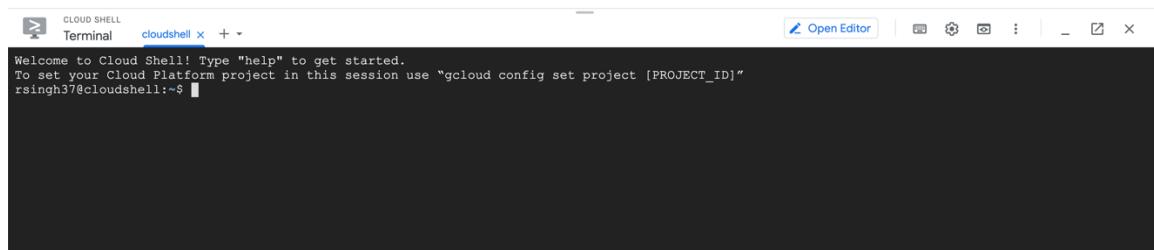
Lab 2: Google Cloud Platform

1. Cloud Shell

- Preview and deploy an App Engine Application

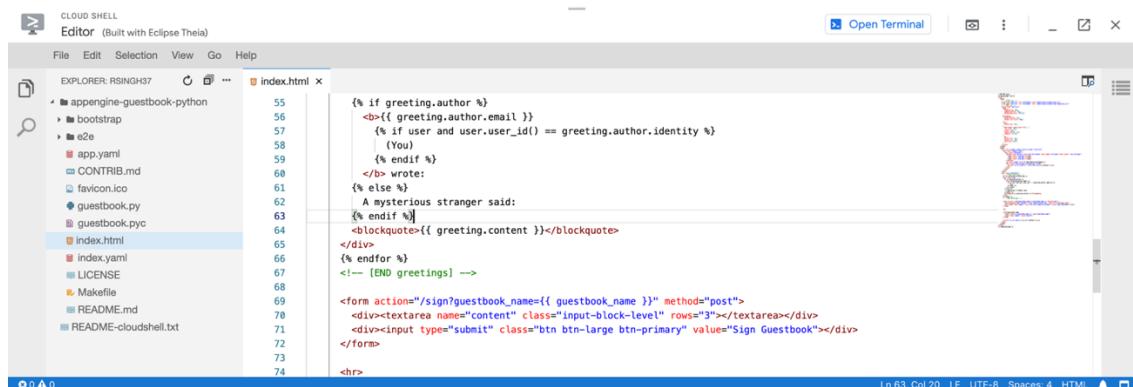
Google App Engine allows app developers to build web and backend in any programming language and deploy on a serverless program.

First, I created a free account on Google Cloud Platform, created a project and started the cloud shell from the Console.



```
CLOUD SHELL
Terminal  cloudshell x + ▾
Welcome to Cloud Shell! Type "help" to get started.
To set your Cloud Platform project in this session use "gcloud config set project [PROJECT_ID]"
rsingh37@cloudshell:~$
```

I wrote the code on the shell which cloned the repository from github, cd changed the location of the shell and then runs the app locally. The snippet shows the sample code in the repo and then I previewed the app before hosting it on the internet. The default port is 8080.



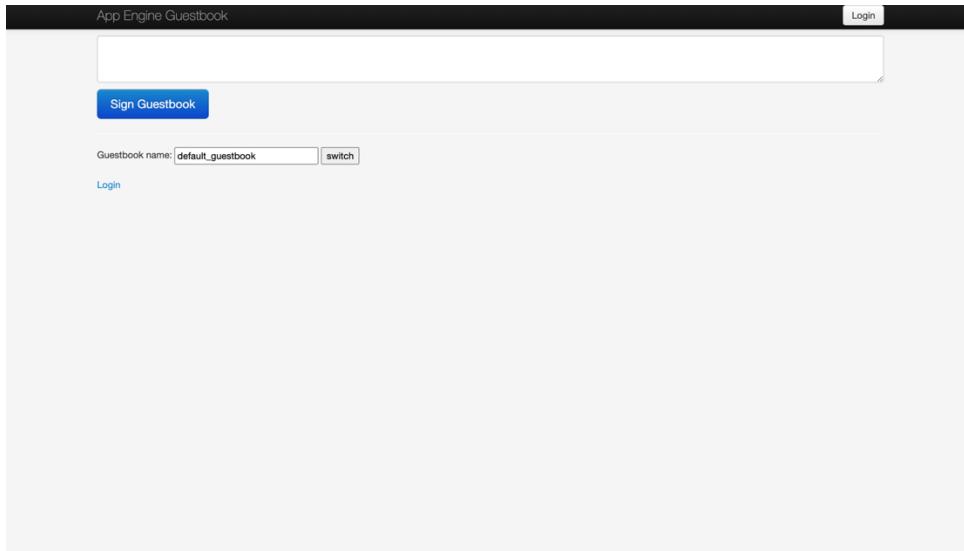
The screenshot shows the Google Cloud Shell Editor interface. The left sidebar displays a file tree for a project named 'appengine-guestbook-python'. The current file being edited is 'index.html'. The right pane shows the content of the 'index.html' file:

```
EXPLORER: RSINGH37
File Edit Selection View Go Help
index.html x
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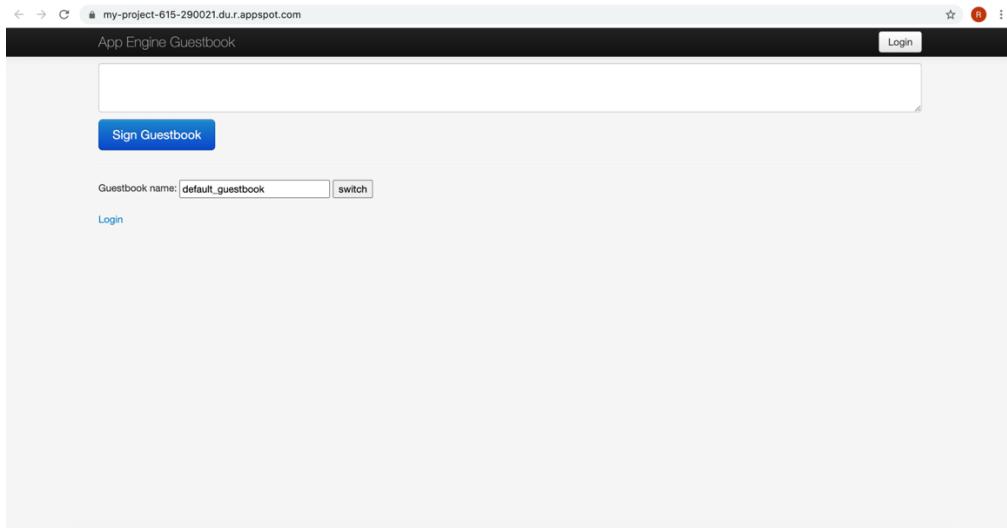
  {% if greeting.author %}
    <div>{{ greeting.author.email }}</div>
    {% if user and user.user_id() == greeting.author.identity %}
      | (You)
    {% endif %}
    <br> wrote:
    {% else %}
      A mysterious stranger said:
    {% endif %}
    <blockquote>{{ greeting.content }}</blockquote>
  </div>
  {% endfor %}
  <!-- [END greetings] -->

<form action="/sign?guestbook_name={{ guestbook_name }}" method="post">
  <div><textarea name="content" class="input-block-level" rows="3"></textarea></div>
  <div><input type="submit" class="btn btn-large btn-primary" value="Sign Guestbook"></div>
</form>
<hr>
```

At the bottom of the editor, there are status indicators: Line 63, Column 20, LF, UTF-8, Spaces 4, and HTML.



Then, I create an app engine using the command and deploy the app to the App Engine using gcloud app deploy. After deployment, I can see the target url which I can use in the search of chrome, the URL also has the project ID for my cloud. The below snippet shows the application created in the URL.



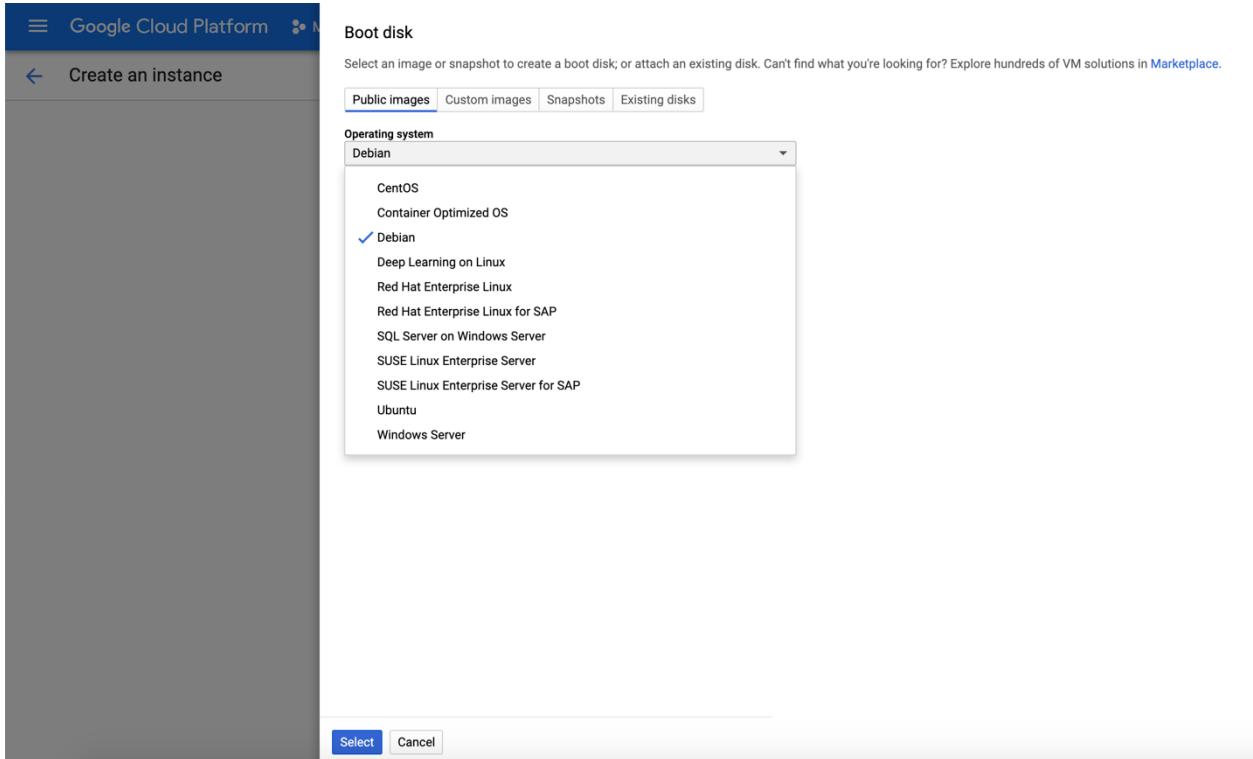
2. Creating VM Instances

A VM instance is a virtual machine hosted on Google's infrastructure. The instance can be created using gcloud, console or Compute Engine API.

- o Creating an instance from public image

Google Cloud provides and maintains many OS public images. All the projects can create VMs using public OS images. I started with creating a new instance and the boot disk allows you to choose from many public images. I selected the Debian GNU which is mounted on a disk size of 20GB.

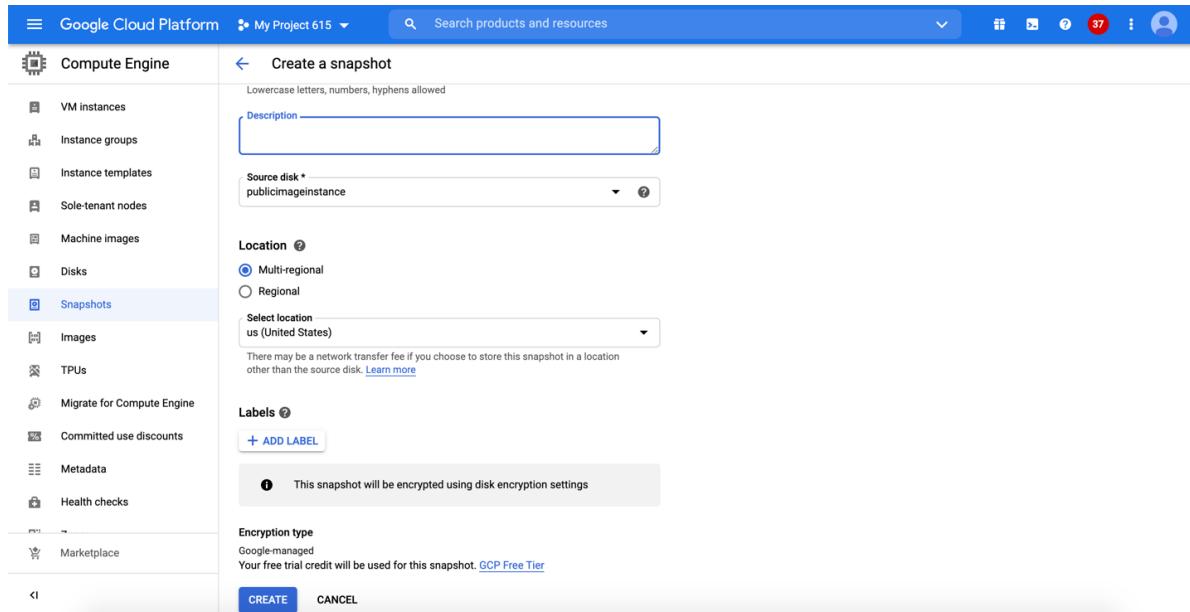
The screenshot shows the 'Create an instance' page in the Google Cloud Platform. The top navigation bar includes 'Google Cloud Platform', 'My Project 615', a search bar, and user account information. On the left, a sidebar lists options: 'New VM instance' (selected), 'New VM instance from template', 'New VM instance from machine image', and 'Marketplace'. The main form is titled 'Name' and contains fields for 'Name' (set to 'publicimageinstance'), 'Labels' (empty), 'Region' (set to 'us-central1 (Iowa)'), 'Zone' (set to 'us-central1-a'), 'Machine configuration' (Machine family: 'General-purpose', Series: 'E2', Machine type: 'e2-medium (2 vCPU, 4 GB memory)'), and 'CPU platform and GPU' (vCPU: 1 shared core, Memory: 4 GB). A note at the bottom indicates '\$24.86 monthly estimate' and '\$0.034 hourly'.



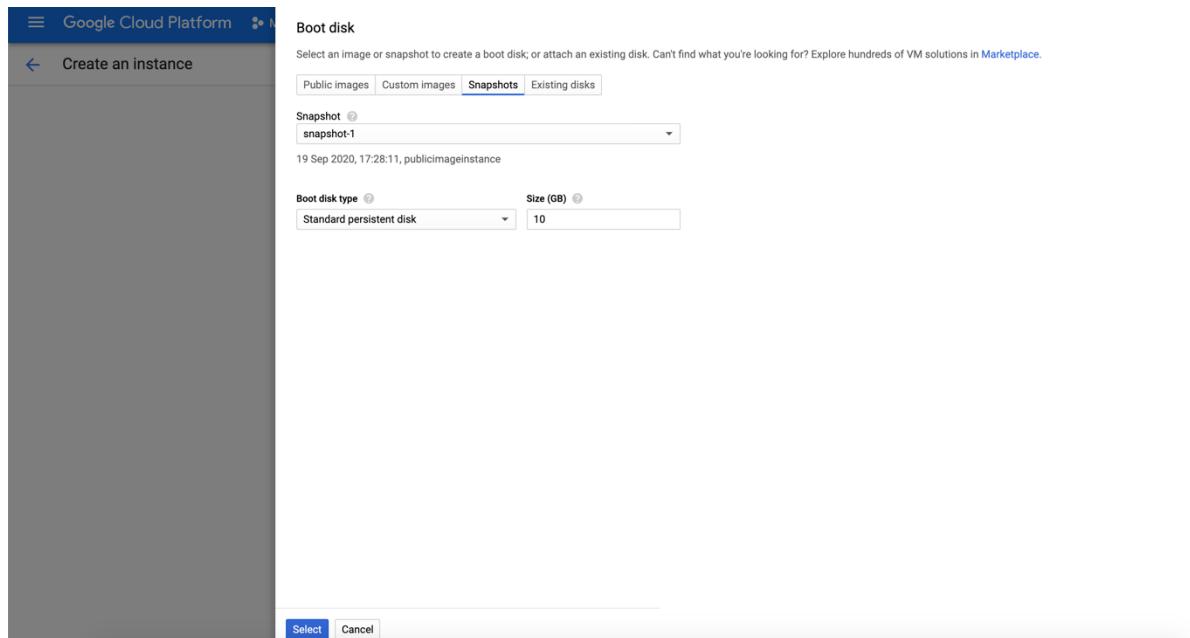
- o Creating an instance from a snapshot

If you have backed a disk with a snapshot, you can use that to create an instance. I have used the snapshot of the previous instance's disk. Snapshots also backup data and are incremental in nature so it contains the modified data from the previous one. It is faster

than an image as it has modified data. Snapshots are global resources and are accessible by any resource in the same project.

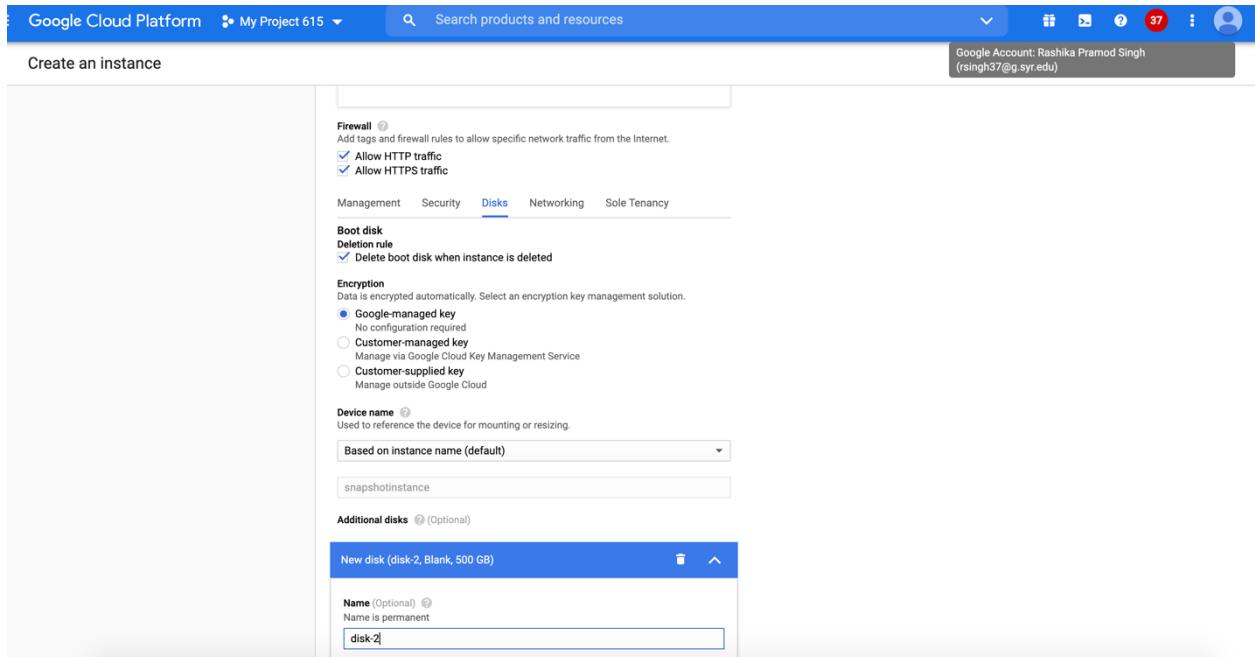


I used a snapshot from the previous instance and used it to create a new VM instance.



The rules state that whenever instance is deleted the boot disk is also deleted and the firewall rules allow the HTTP traffic and the HTTPS traffic. This adds a network tag to the instance and creates the corresponding ingress rule for the incoming traffic. Configuring instances with

firewall allows them to be accessed even through the internet. I have also added an additional disk to the instance.



The snippet shows that the instance is created.

Name	Zone	Recommendation	In use by	Internal IP	External IP
preemptibleinstance	us-central1-a			10.128.0.4 (nic0)	34.123.160.219
publicimageinstance	us-central1-a			10.128.0.2 (nic0)	35.224.129.83
snapshotinstance	us-central1-a			10.128.0.3 (nic0)	34.68.52.229

- Creating and starting a preemptible VM instance

A preemptible instance is an instance that you can create and run at lower price than normal ones and the compute engine can stop the instances if resources are required for another task. Preemptible instances will always stop after 24 hours.

- o Checking a preemptible instance

Here I create a preemptible instance where the instances have excess capacity so their availability can vary with usage. I created an instance as preemptible by selecting the preemptible option in the availability policy.

The screenshot shows the 'Create an instance' wizard in the Google Cloud Platform. The left sidebar lists options: 'New VM instance' (selected), 'New VM instance from template', 'New VM instance from machine image', and 'Marketplace'. The main form is for 'New VM instance'. It includes fields for 'Name' (preemptibleinstance), 'Labels' (optional), 'Region' (us-central1), 'Zone' (us-central1-a), 'Machine configuration' (Machine family: General-purpose, Series: E2, Machine type: e2-medium (2 vCPU, 4 GB memory)), 'CPU platform and GPU' (vCPU: 1 shared core, Memory: 4 GB), and 'Confidential VM service' (checkbox). A note says 'That's about \$0.034 hourly'.

The screenshot shows the continuation of the 'Create an instance' wizard. Under 'Availability policy', it is set to 'On'. It includes sections for 'Preemptibility' (described as costing less and lasting 24 hours), 'On host maintenance' (terminating VM instance), and 'Automatic restart' (off). A note at the bottom states 'Your free trial credit will be used for this VM instance. GCP Free Tier'.

The screenshot shows that the instance is preemptible.

The screenshot shows the Google Cloud Platform Compute Engine interface. On the left sidebar, under the 'Compute Engine' section, there are several options: VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, and Marketplace. The 'VM instances' option is selected. In the main content area, the title is 'VM instances'. There is a 'CREATE INSTANCE' button and a search bar. A table lists three VM instances:

Name	Zone	Recommendation	In use by	Internal IP	External IP
preemptibleinstance	us-central1-a			10.128.0.4 (nic0)	34.123.160.219
publicimageinstance	us-central1-a			10.128.0.2 (nic0)	35.224.129.83
snapshotinstance	us-central1-a			10.128.0.3 (nic0)	34.68.52.229

Below the table, there is a 'Select an instance' dropdown menu with tabs for PERMISSIONS, LABELS, and MONITORING. A message says 'Please select at least one resource.' At the bottom, there are related actions: View Billing Report, Monitor VMs, Monitor Stackdriver Logs, Set up Firewall Rules, and a 'Setup' button.

- Checking if an instance is preemptible

Here I am checking if an instance is preemptible or not. I can check this by clicking on the instance and checking the availability option. Here preemptible is on which shows that the instance is preemptible.

The screenshot shows the Google Cloud Platform Compute Engine interface. On the left sidebar, under the 'Compute Engine' section, there are several options: VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, and Marketplace. The 'VM instances' option is selected. In the main content area, the title is 'VM instance details'. There is a back arrow, an 'EDIT' button, a 'RESET' button, and buttons for 'CREATE MACHINE IMAGE' and 'CREATE SIMILAR'. A message at the top right says 'Google Account: Rashika Pramod Singh (rsingh37@g.syr.edu)'. The page displays detailed configuration for a VM instance, including:

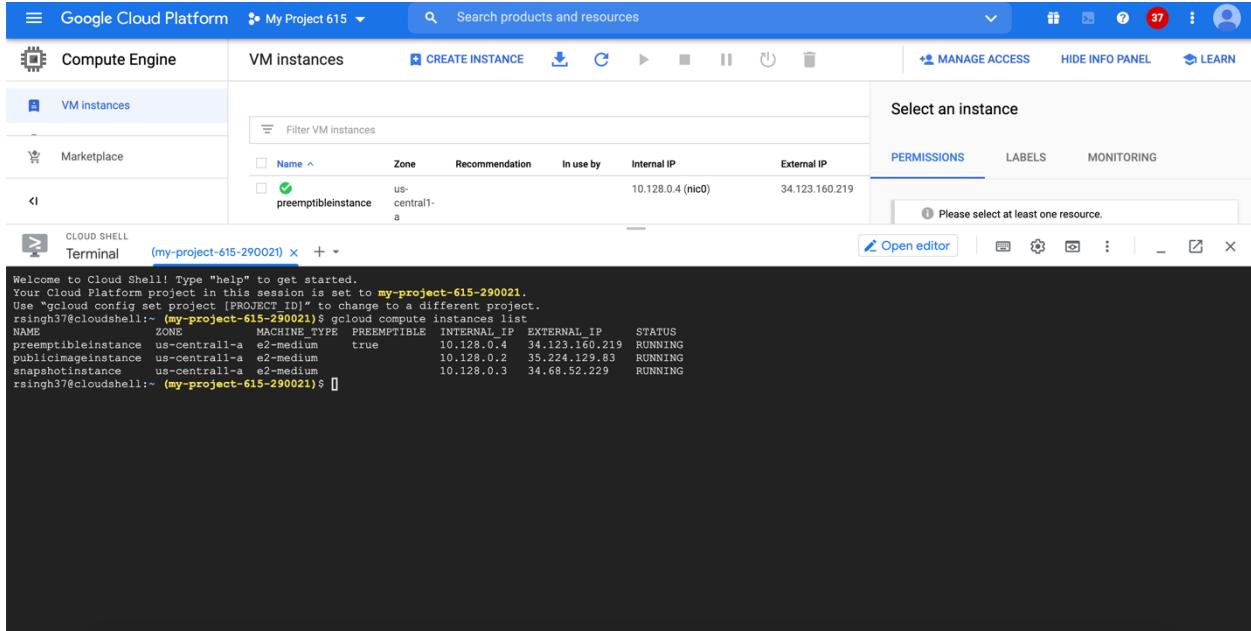
- Additional disks:** None
- Local disks:** None
- Shielded VM:** To edit Shielded VM features you need to stop the instance first. Options include Turn on Secure Boot, Turn on vTPM, and Turn on Integrity Monitoring.
- Availability policies:**
 - Preemptibility: On
 - On host maintenance: Terminate VM Instance
 - Automatic restart: Off
- Custom metadata:** None
- SSH Keys:** Block project-wide SSH keys
- Service account:** 296925922830-compute@developer.gserviceaccount.com
- Cloud API access scopes:** Allow default access
- Equivalent REST:** A link to the equivalent REST API endpoint.

- Checking an instance's status

I can check a created instance's status by using gcloud command:

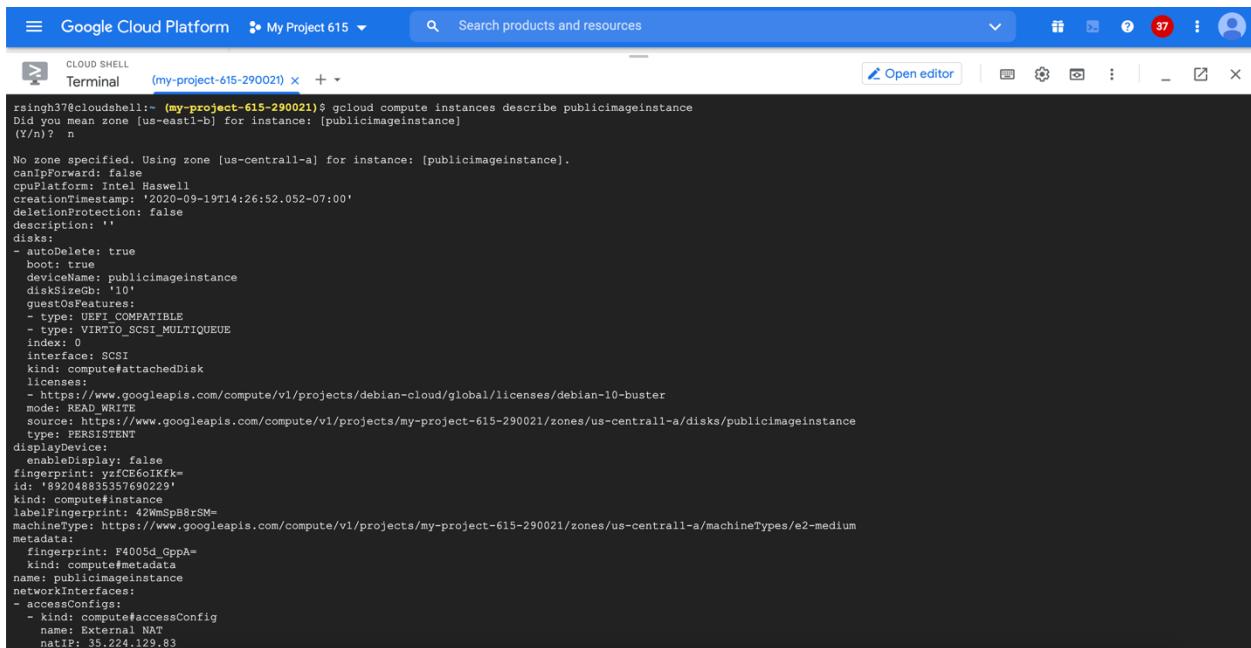
\$gcloud compute instances list #This command lists all the instances running on the cloud. I can view more information about a particular instance by using the command:

\$gcloud compute instances describe publicimageinstance #This command shows the details of a single instance publicimageinstance.



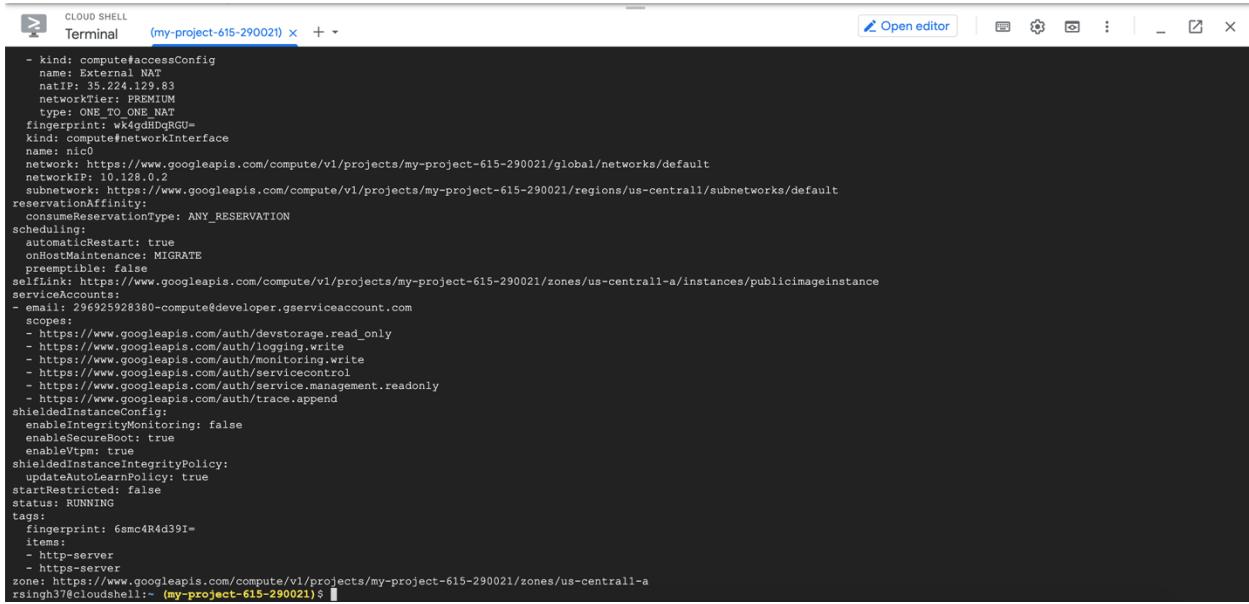
The screenshot shows the Google Cloud Platform Compute Engine interface. In the left sidebar, 'VM instances' is selected. A table lists one instance: 'preemptibleinstance' in 'us-central1-a'. The instance has an internal IP of 10.128.0.4 (nic0) and an external IP of 34.123.160.219. On the right, there's a 'Select an instance' panel with tabs for 'PERMISSIONS', 'LABELS', and 'MONITORING'. Below it is a message: 'Please select at least one resource.' At the bottom, a terminal window titled '(my-project-615-290021)' shows the command 'gcloud compute instances list' output:

```
Welcome to Cloud Shell! Type "help" to get started.  
Your Cloud Platform project in this session is set to my-project-615-290021.  
Use "gcloud config set project [PROJECT ID]" to change to a different project.  
rsingh37@cloudshell:~ [my-project-615-290021]$ gcloud compute instances list  
NAME          ZONE      MACHINE_TYPE PREEMPTIBLE INTERNAL_IP  EXTERNAL_IP STATUS  
preemptibleinstance us-central1-a e2-medium    true        10.128.0.4   34.123.160.219 RUNNING  
publicimageinstance us-central1-a e2-medium    false       10.128.0.2   35.224.129.83  RUNNING  
snapshotinstance  us-central1-a e2-medium    false       10.128.0.3   34.68.52.229  RUNNING  
rsingh37@cloudshell:~ [my-project-615-290021]$
```



The screenshot shows a terminal window in the Google Cloud Platform interface. The command 'gcloud compute instances describe publicimageinstance' is run. The output shows the configuration for the 'publicimageinstance' in 'us-central1-a' zone:

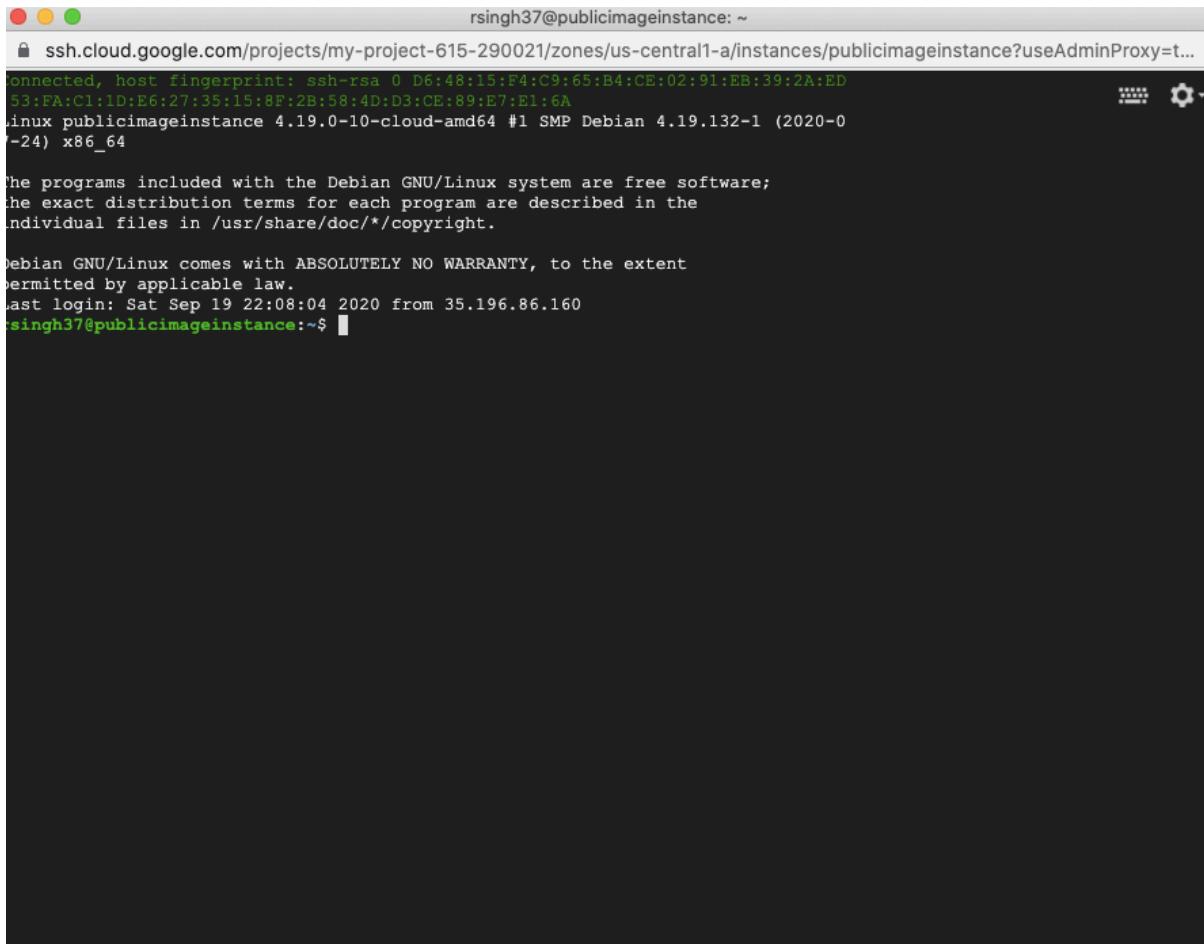
```
rsingh37@cloudshell:~ [my-project-615-290021]$ gcloud compute instances describe publicimageinstance  
Did you mean zone [us-east1-b] for instance: [publicimageinstance]  
(Y/n)? n  
  
No zone specified. Using zone [us-central1-a] for instance: [publicimageinstance].  
canIpForward: false  
cpuPlatform: Intel Haswell  
creationTimestamp: '2020-09-19T14:26:52.052-07:00'  
deletionProtection: false  
description: ''  
disks:  
- autoDelete: true  
boot: true  
deviceName: publicimageinstance  
diskSizeGb: '10'  
guestOsFeatures:  
- type: UEFI_COMPATIBLE  
- type: VIRTIO_SCSI_MULTIQUEUE  
index: 0  
interface: SCSI  
kind: compute#attachedDisk  
licenses:  
- url: https://www.googleapis.com/compute/v1/projects/debian-cloud/global/licenses/debian-10-buster  
mode: READ_WRITE  
source: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-central1-a/disks/publicimageinstance  
type: PERSISTENT  
displayDevice:  
enableDisplay: false  
fingerprint: yfCE6oIKfk=  
id: '9204883535769029'  
kind: compute#AttachedDisk  
labelFingerprint: 42NmSpB8rSM=  
machineType: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-central1-a/machineTypes/e2-medium  
metadata:  
- fingerprint: F4005dGppA=  
  kind: compute#metadata  
  name: publicimageinstance  
networkInterfaces:  
- accessConfigs:  
  - kind: compute#accessConfig  
    name: External NAT  
    natIP: 35.224.129.83
```



```
CLOUD SHELL Terminal (my-project-615-290021) + Open editor
- kind: compute#accessConfig
  name: External NAT
  natIP: 35.224.129.83
  networkTier: PREMIUM
  type: ONE_TO_ONE_NAT
  fingerprint: wk4qdIdRGu=
  kind: compute#networkInterface
  name: nic0
  network: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/networks/default
  networkIP: 10.128.0.2
  subnetwork: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-central1/subnetworks/default
  reservationAffinity:
    consumeReservationType: ANY_RESERVATION
  scheduling:
    automaticRestart: true
    onHostMaintenance: MIGRATE
    preemptible: false
  selfLink: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-central1-a/instances/publicimageinstance
  serviceAccounts:
    - email: 296925928380-compute@developer.gserviceaccount.com
      scopes:
        - https://www.googleapis.com/auth/devstorage.read_only
        - https://www.googleapis.com/auth/logging.write
        - https://www.googleapis.com/auth/mirror.write
        - https://www.googleapis.com/auth/servicecontrol
        - https://www.googleapis.com/auth/service.management.readonly
        - https://www.googleapis.com/auth/trace.append
  shieldedInstanceConfig:
    enableIntegrityMonitoring: false
    enableSecureBoot: true
    enableVtpm: true
  shieldedInstanceStatePolicy:
    updateAutoLearnPolicy: true
  startRestricted: false
  status: RUNNING
  tags:
    fingerprint: 6smc4R4d39I=
    items:
      - http-server
      - https-server
  zone: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-central1-a
rsingh37@cloudshell:~ (my-project-615-290021)$
```

- Connecting to instances
 - Connecting to Linux instances

I can connect to a Linux instance by clicking on the SSH button next in an instance, this will create an SSH connection on the default port. SSH connection are secured due to encryption. Every time a public and private key is created on its own.



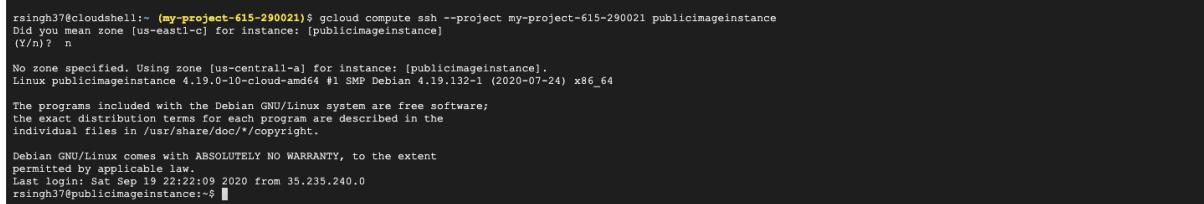
```
rsingh37@publicimageinstance: ~
ssh.cloud.google.com/projects/my-project-615-290021/zones/us-central1-a/instances/publicimageinstance?useAdminProxy=t...
Connected, host fingerprint: ssh-rsa 0 D6:48:15:F4:C9:65:B4:CE:02:91:EB:39:2A:ED
53:FA:C1:D6:27:35:15:8F:2B:58:4D:D3:CE:89:E7:E1:6A
Linux publicimageinstance 4.19.0-10-cloud-amd64 #1 SMP Debian 4.19.132-1 (2020-07-24) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Sep 19 22:08:04 2020 from 35.196.86.160
rsingh37@publicimageinstance:~$
```

I have also connected to Linux instances using gcloud command:

\$gcloud compute ssh --project my-project-615-290021 publicimageinstance #This command connects to instances that I have the permission to connect. Here my-project-615-290021 is the project_id and publicimageinstance is the name of the instance that I want to connect to. This generates a public and private key for the instance



```
rsingh37@cloudshell:~ (my-project-615-290021)$ gcloud compute ssh --project my-project-615-290021 publicimageinstance
Did you mean zone [us-east1-c] for instance: [publicimageinstance]
(Y/n)? n

No zone specified. Using zone [us-central1-a] for instance: [publicimageinstance].
Linux publicimageinstance 4.19.0-10-cloud-amd64 #1 SMP Debian 4.19.132-1 (2020-07-24) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Sep 19 22:22:09 2020 from 35.235.240.0
rsingh37@publicimageinstance:~$
```

- Connecting to Windows instances

This helps me to connect to a Windows instance. I start by creating a windows instance and creating a password for it. For creating a Windows instance, I change the boot disk as Windows server and note the external IP of the Windows instance that I want to connect to. Then, I use Microsoft Remote Desktop to connect to the instances using the external IP and credentials that I

created. The snippet shows creation of a Windows instance and then connecting to it using Remote Desktop.

The image consists of two screenshots. The top screenshot is from the Google Cloud Platform Compute Engine interface, showing the 'VM instances' details for a machine named 'windowsinstance'. It displays configuration options like 'Machine type' (e2-medium), 'CPU platform' (Intel Haswell), and 'Zone' (us-central1-a). The bottom screenshot is a Windows command prompt window titled 'Administrator: C:\Windows\system32\cmd.exe', showing a blank black screen with the IP address '104.155.150.251' at the top.

- o Special Administrative Console

This is used to connect to an instance using interactive serial console. First you go to the instance you want to establish connection to and edit the instance. Under Remote access, once you enable connecting to serial port, it enables the interactive serial console for the instance. Under remote access, select the connect to serial console and select port 2. You can enable metadata by selecting enable connecting serial ports in the console, this allows the instance to connect to a port.

The screenshot shows the Google Cloud Platform Compute Engine interface. On the left, a sidebar lists options like VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, Marketplace, and Help. The main panel is titled 'VM instance details' for 'moveinstance'. It shows the instance ID (631227630523914367), machine type (e2-medium), reservation (Automatically choose), CPU platform (Intel Haswell), and display device settings. The 'Zone' is set to us-central1-f. The 'Creation time' is Sep 20, 2020, 2:59:28 PM. The 'Network interfaces' section shows 'nic0: default default'. At the top right, there are 'EDIT', 'RESET', 'CREATE MACHINE IMAGE', and a user account dropdown for Rashika Pramod Singh (rsingh37@g.syr.edu). A red status bar at the bottom of the main panel displays the command: 'serialport: Connected to my-project-615-z90021.us-central1-f.moveinstance port 2 (session ID: df0090cd7aab667ad298866e52bd67ece8ec63a3, active connections: 1)'.

Using gcloud, I entered the command:

\$gcloud compute connect-to-serial-port moveinstance—port=2 #The command connects to the instance moveinstance at port number 2.

```
Rashikas-Air:~ rashikasingh$ gcloud compute connect-to-serial-port moveinstance ]  
--port=2  
No zone specified. Using zone [us-central1-f] for instance: [moveinstance].  
serialport: Connected to my-project-615-290021.us-central1-f.moveinstance port 2  
(session ID: 644ffe71fd47a5c83cac5fb7ad29c0ef11583a274c90005122bc68ca3d90c629,  
active connections: 1).
```

- Connecting to instances using advanced methods
 - Providing public SSH keys to instances

For connecting to instances using advanced methods, you will have to create an SSH key. We create a key-value pair in order to identify the instance from outside. A key-value pair (KVP) is a set of two linked data items: a key which is a unique identifier and value with is the data that is identified to the location of the data. It is used for authentication key pairs for SSH. This is used for automating logins, single sign-on and for authenticating hosts. I create a key-value pair using the command ssh-key-gen where the type is rsa and the key is stored at the location given as gcpkey. The -C is the comment at the text that the username is rsingh37. This generates a public and private key. I enter the passphrase and then the key is stored to the given location in my local machine.

```
ssh — bash — 80x24
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
[Rashikas-MacBook-Air:~ rashikasingh$ ssh-keygen -t rsa -f ~/.ssh/gcpkey -C rsingh37
Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /Users/rashikasingh/.ssh/gcpkey.
Your public key has been saved in /Users/rashikasingh/.ssh/gcpkey.pub.
The key fingerprint is:
SHA256:i0NZksqNERptXgqGwjmaxeNt6hB2XqU/CJ1UtzM+noY rsingh37
The key's randomart image is:
+---[RSA 3072]---+
| .00... . . .
| o+*ooo.o. .
| o=o*+o* .+
| +..+=X +. o
| ..oo* * So
| . . . o +o.o
| o oEo+
| . . .
+---[SHA256]---+
```

The screenshot shows that I have to Enable OS-login as it allows linking the account to the instance. In the custom metadata, I enable-oslogin as TRUE.

The screenshot shows the Google Cloud Platform Compute Engine Metadata page. The left sidebar lists various Compute Engine services: VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata (which is selected), Health checks, and Marketplace. The main content area is titled "Metadata" and shows the "Metadata" tab selected. It displays a table with one row: "enable-oslogin" with the value "TRUE". Below the table, there is a link to "Equivalent REST". At the top right, there is a message bar for "Google Account: Rashika Pramod Singh (rsingh37@g.syr.edu)".

The screenshot shows the Google Cloud Platform interface for the 'Compute Engine' section. On the left, there's a sidebar with various options like VM instances, Instance groups, Instance templates, etc. The main panel is titled 'VM instance details' for a specific instance named 'publicimageinstance'. It shows the configuration for this instance, including a single boot disk of 10 GB from the 'debian-10-buster-v20200910' image. There are sections for 'Shielded VM', 'Availability policies', 'Custom metadata', and 'SSH Keys'. The 'Service account' listed is '296925928380-compute@developer.gserviceaccount.com'. At the top right, there are buttons for 'EDIT', 'RESET', 'CREATE MACHINE IMAGE', 'CREATE SIMILAR', and a link to 'Google account: Rashika Pramod Singh (rsingh37@g.syr.edu)'.

Then in my terminal, I added the public key to the user account using the gcloud command:
\$gcloud compute os-login ssh-keys add –key-file ~/.ssh/gcpkey.pub –ttl 0 #this command adds the user to the key and sets expiration time to 0. Following that, I check the user profile using gcloud compute os-login describe-profile. I can see that my user key is added with the username. O use the command:

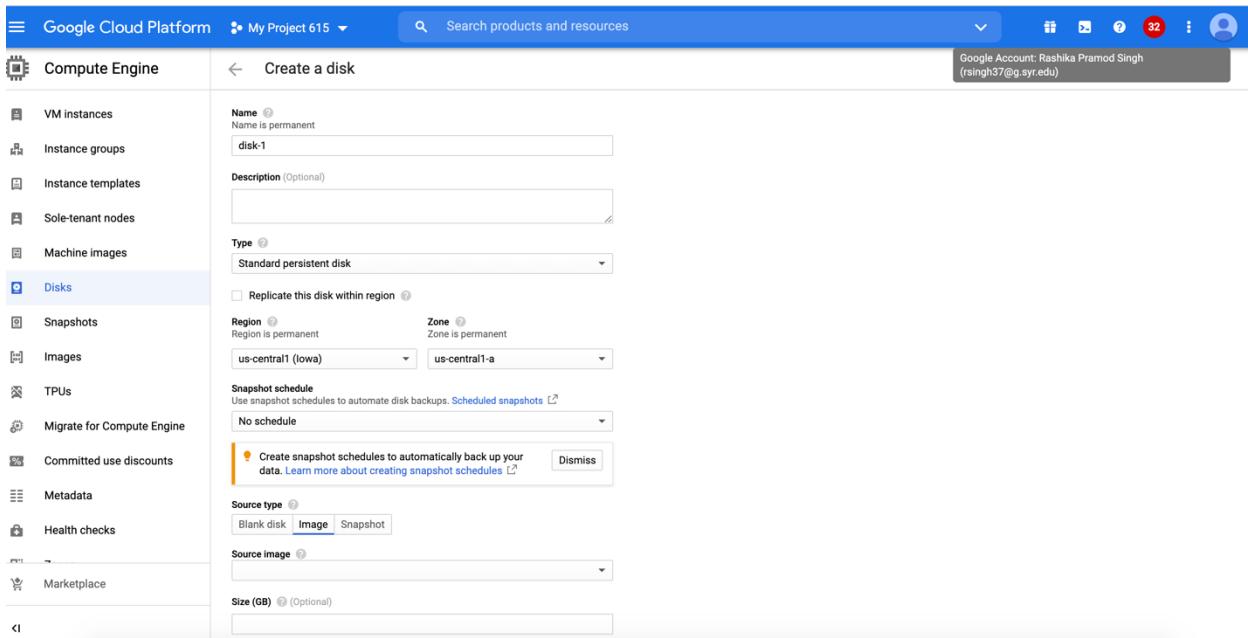
```
$ ssh -i ~/.ssh/gcpkey rsingh37_g_syr_edu@34.122.40.72 # The command specifies the path, rsingh37_g_syr_edu is the username and after @ is the external IP of the instance that I want to connect to. A successful connection is established, and I can close the connection using exit command.
```

```
Last login: Sun Sep 20 11:18:10 on ttys000
The default interactive shell is now zsh.
To update your account to use zsh, please run 'chsh -s /bin/zsh'.
For more details, please visit https://support.apple.com/kb/HT200050.
Rashikas-Air:~ rashikasinh$ gcloud compute os-login describe-profile
name: '104266922227936108598'
posixAccounts:
- gid: '1000127429'
homeDirectory: '/home/rsingh37_g_syr_edu'
operatingSystemType: LINUX
primary: true
uid: '1000127429'
users: 'rsingh37_g_syr_edu'
sshPublicKeys:
 4403965df357448aa38f7e8e9466e4fbdeb7c7a80fd76131037e9347ff80c170:
  key:
    ssh-rsa AAAAB3NzaC1eB58AAQAAABgQC44tHzcMNnscu8WmKdKh81uMPCBnnP11sdw+cygjBDw8m1s4fcsv1wh9001uRHzfbc5k3M87VAscRRbeLyxB31mYf8z9ATkjn7E42j+OaOUh8mnnPdd4ad3+Lg+hYPI/q3j9Hy7Aipu76+1NN6faXq312gUhn
CBv5gaedffvchPEsywD844drdbexcR0SQJuAuB2LRjOpAX1hpooujy54PHQeojo4j9+uce4U2mbAOee/Gs02xgtuXsTytT3byiwLpplmxNj378v0k1Zdt6eBRHSNj1wvQzBewvpKqHslJwaP2KMjR1y4506XeqMFH=mEhzycVDc3pUi aqu3+0xRjy3nzA4PxZesS
cwBLCzySyTytQuxtwwcxquInxsX27+chSdj8mmtuvbvptl3tmn+6dgRsy84o+0/ahTVsX2up+TjU1Eav/7diGPRT6du7xFzUn/nfjqpF8hfP22FkP5oyV18ThuMGNX5iluBawvvpeEAUfVh2VLE= rsingh37
name: users/rsingh37_g_syr_edu@sshPublicKeys/4403965df357448aa38f7e8e9466e4fbdeb7c7a80fd76131037e9347ff80c170
Rashikas-Air:~ rashikasinh$ ssh -i ~/.ssh/gcpkey rsingh37_g_syr_edu@34.122.40.72
Connection to 34.122.40.72 closed.
Rashikas-Air:~ rashikasinh$ 
```

- Creating customized Boot Disks

- Creating a standalone boot persistent disk from an image.

A boot disk is a digital storage medium from which a computer can load and run an operating system or program. A computer must have a built-in program which will load and execute a program from a boot disk meeting certain standard. When we create a VM we also require a boot disk for the VM. We can create a disk using the following steps in the create instances.



I add a source image as the selected below with size 50GB.

The screenshot shows the 'Create a disk' dialog in the Google Cloud Platform Compute Engine section. The 'Name' field is set to 'disk-1'. The 'Type' is 'Standard persistent disk'. Under 'Region', 'us-central1 (Iowa)' is selected. Under 'Zone', 'us-central1-a' is selected. The 'Snapshot schedule' dropdown is set to 'No schedule'. The 'Source type' is 'Image', and the 'Source image' is 'c0-common-gce-gpu-image-20200128'. The 'Size (GB)' is set to '50'.

The following snippet shows the successful creation of the boot disk.

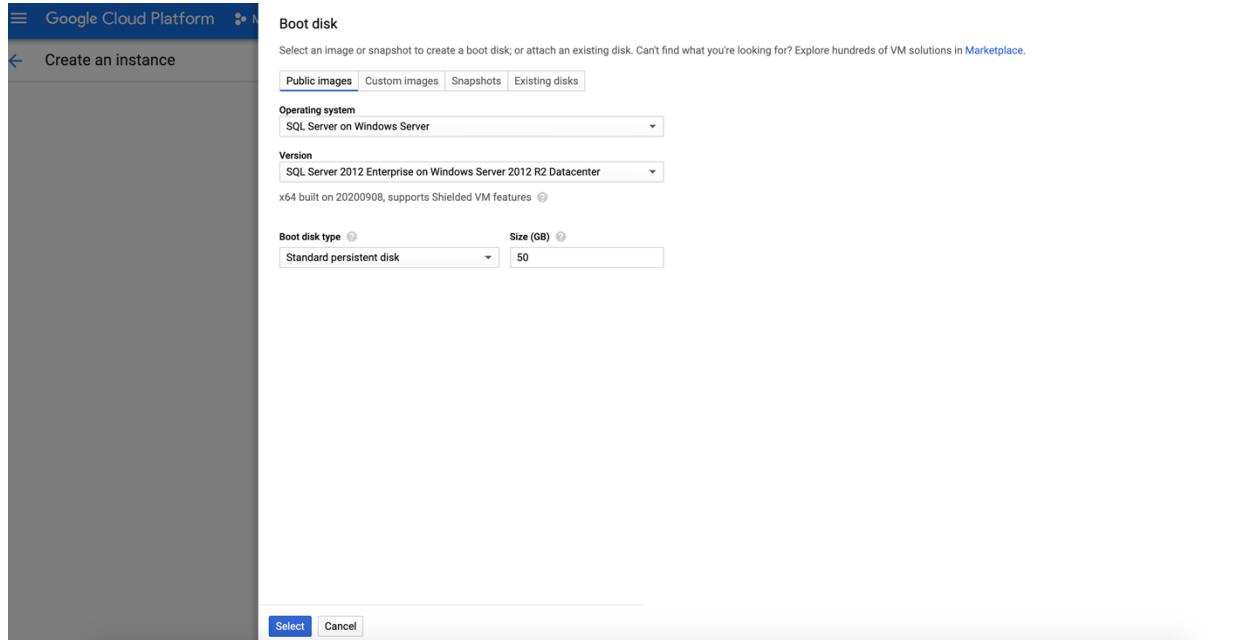
The screenshot shows the 'Disks' list page in the Google Cloud Platform Compute Engine section. The table lists five disks:

Name	Status	Type	Size	Zone(s)	In use by	Actions
disk-1	✓	Standard persistent disk	50 GB	us-central1-a		⋮
preemptibleinstance	✓	Standard persistent disk	10 GB	us-central1-a	preemptibleinstance	⋮
publicimageinstance	✓	Standard persistent disk	10 GB	us-central1-a	publicimageinstance	⋮
snapshotinstance	✓	Standard persistent disk	20 GB	us-central1-a	snapshotinstance	⋮
trialdisk	✓	Standard persistent disk	10 GB	us-central1-a	snapshotinstance	⋮

A modal window titled 'Select a disk' is open on the right, showing the 'PERMISSIONS' tab and a message: 'Please select at least one resource.'

- Creating SQL Server instances

You can also create a VM with a preconfigured SQL Server public image. I make the changes in the create VM, you must enable billing as this is not included in the free version.



The screenshot shows successful creation of the instance-1 which I later stopped.

The screenshot shows the 'VM instances' page in the Google Cloud Platform. The left sidebar lists various Compute Engine services. The main table lists several VM instances:

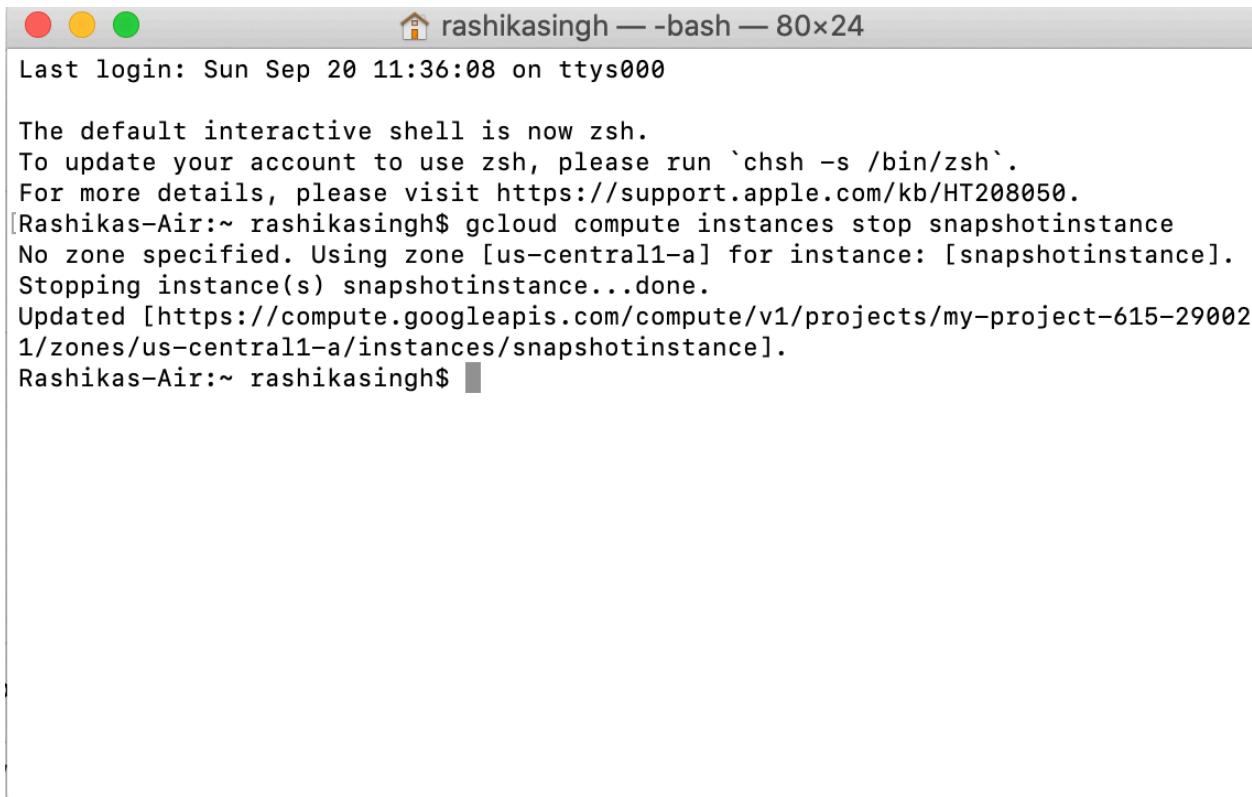
Name	Location	IP Address	State
instance-1	us-central1-a	10.128.0.5 (nic0)	None
instance-group-1-4bcs	us-central1-a	10.128.0.15 (nic0)	35.202.39.1
moveinstance	us-central1-f	10.128.0.13 (nic0)	None
preemptibleinstance	us-central1-a	10.128.0.4 (nic0)	None
publicimageinstance	us-central1-a	10.128.0.2 (nic0)	None
serviceaccountdemo	asia-east1-b	10.140.0.2 (nic0)	35.229.15.1
serviceaccountinstance	us-central1-a	10.128.0.6 (nic0)	None
windowsinstance	us-central1-a	10.128.0.16 (nic0)	104.155.1

A modal window titled 'Select an instance' is open, prompting the user to 'Please select at least one resource.' It includes tabs for 'PERMISSIONS', 'LABELS', and 'MONITORING'.

3. Managing your instances

- Stopping an instance (gcloud)

You can stop an instance using gcloud command, the command has to have the instance name like the snapshotinstance in the screenshot.



```
Last login: Sun Sep 20 11:36:08 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
[Rashikas-Air:~ rashikasingh$ gcloud compute instances stop snapshotinstance
No zone specified. Using zone [us-central1-a] for instance: [snapshotinstance].
Stopping instance(s) snapshotinstance...done.
Updated [https://compute.googleapis.com/compute/v1/projects/my-project-615-29002
1/zones/us-central1-a/instances/snapshotinstance].
Rashikas-Air:~ rashikasingh$ ]
```

The snapshotinstance is stopped.

Name	Zone	Recommendation	In use by	Internal IP	External IP
preemptibleinstance	us-central1-a			10.128.0.4 (nic0)	104.155.150.251
publicimageinstance	us-central1-a			10.128.0.2 (nic0)	34.122.40.72
snapshotinstance	us-central1-a			10.128.0.3 (nic0)	None

- Deleting an instance

You can delete an instance by specifying the instance name in the gcloud command gcloud delete, I used snapshotinstance.

```
rashikasingh — bash — 91x26
Last login: Sun Sep 20 11:36:08 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
[Rashikas-Air:~ rashikasingh$ gcloud compute instances stop snapshotinstance
No zone specified. Using zone [us-central1-a] for instance: [snapshotinstance].
Stopping instance(s) snapshotinstance...done.
Updated [https://compute.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-central1-a/instances/snapshotinstance].
[Rashikas-Air:~ rashikasingh$ gcloud compute instances delete snapshotinstance
No zone specified. Using zone [us-central1-a] for instance: [snapshotinstance].
The following instances will be deleted. Any attached disks configured
to be auto-deleted will be deleted unless they are attached to any
other instances or the `--keep-disks` flag is given and specifies them
for keeping. Deleting a disk is irreversible and any data on the disk
will be lost.
- [snapshotinstance] in [us-central1-a]

Do you want to continue (Y/n)? Y

Deleted [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-central1-a/instances/snapshotinstance].
Rashikas-Air:~ rashikasingh$
```

This screenshot shows that the instance is deleted.

Name	Zone	Recommendation	In use by	Internal IP	External IP
preemptibleinstance	us-central1-a			10.128.0.4 (nic0)	104.155.150.251
publicimageinstance	us-central1-a			10.128.0.2 (nic0)	34.122.40.72

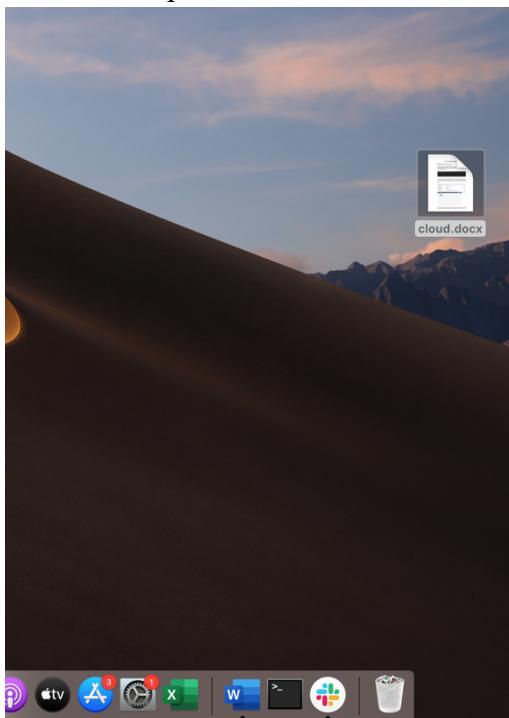
- Moving an instance

You can move an instance from one zone to another using gcloud. You mention the instance name and the current location and the location to be moved. Here the source is us-central1-a and destination zone is us-central1-f.

```
Rashikas-Air:~ rashikasingh$ gcloud compute instances move moveinstance --zone us-central1-a --destination-zone us-central1-f
Moving gce instance moveinstance...done.
Rashikas-Air:~ rashikasingh$
```

- Copy files between instance and local computer

Here, I copied a file called cloud.docx from my machine's desktop to the cloud.



I used the command gcloud compute scp to copy contents from my local computer to the instance publicimageinstance. The screenshot shows that the document is added to the instance.

```
rashikasingh — bash — 129x27
WARNING: The private SSH key file for gcloud does not exist.
WARNING: The public SSH key file for gcloud does not exist.
WARNING: You do not have an SSH key for gcloud.
WARNING: SSH keygen will be executed to generate a key.
Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase):
[Enter same passphrase again:
[Your identification has been saved in /Users/rashikasingh/.ssh/google_compute_engine.
Your public key has been saved in /Users/rashikasingh/.ssh/google_compute_engine.pub.
The key fingerprint is:
SHA256:S7un2yRd8RvVdwU9mg/K8qnZsbNGL/a00YHypn3kuS rashikasingh@Rashikas-Air.fios-router.home
The key's randomart image is:
+---[RSA 3072]---+
|          .o.|
|          ..o|
|          . . +|
|          o ..+ ..|
|          S.+...o |
|          o +*....|
|          = *==..|
|          *BE==|
|          +B=*O=o |
+---[SHA256]---+
No zone specified. Using zone [us-central1-a] for instance: [publicimageinstance].
Warning: Permanently added 'compute.892048835357698229' (ECDSA) to the list of known hosts.
cloud.docx          100% 4462KB   1.0MB/s  00:04
Rashikas-Air:~ rashikasingh$
```

- Setting Access Control
 - Creating a new service account

Service Account is an account linked with an application or VM instead of a user account. I created a service account name rashikasingh and add editor access to the account.

The screenshot shows the 'Create service account' form. On the left, a sidebar lists 'Service Accounts' under 'IAM & Admin'. The main form has three steps: 1. Service account details (with 'Service account name' set to 'rashikasingh'), 2. Grant this service account access to project (optional) (with 'Service account ID' set to 'rashikasingh @my-project-615-290021.iam.gserviceaccount.com'), and 3. Grant users access to this service account (optional). A note at the top right says 'Google account: Rashika Pramod Singh (rsingh37@g.syr.edu)'. Buttons for 'CREATE' and 'CANCEL' are at the bottom.

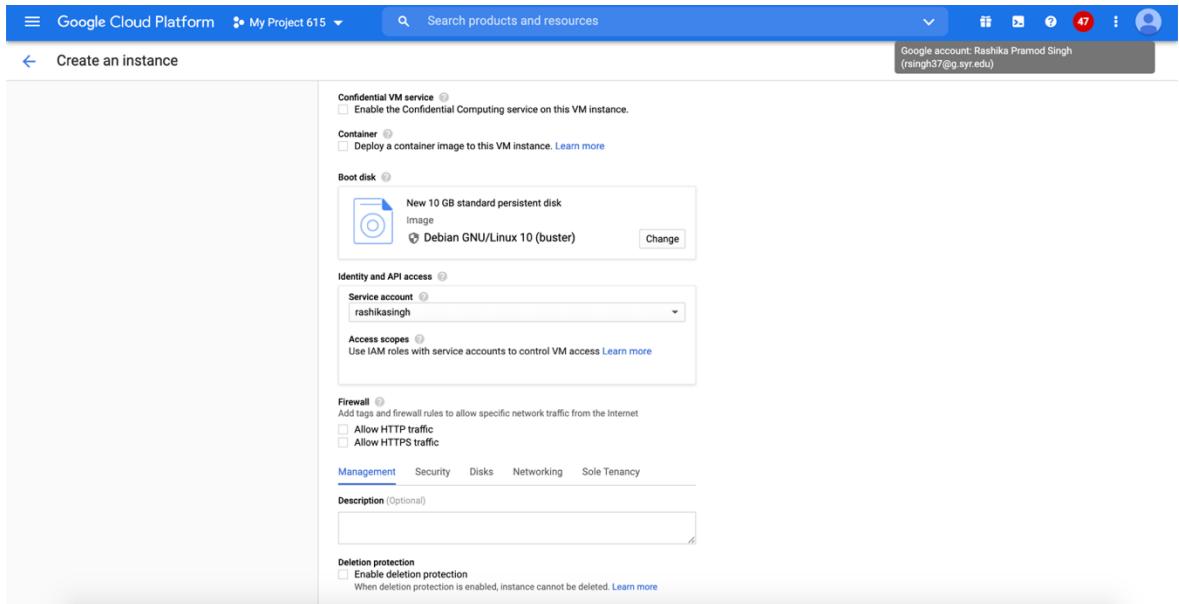
I created a service account rashikasingh for my project 615 which shows in the screenshot.

The screenshot shows the 'Service accounts' list for project 'My Project 615'. The sidebar shows 'Service Accounts' selected. The table lists two service accounts:

Email	Status	Name	Description	Key ID	Key creation date	Actions
296925928380-compute@developer.gserviceaccount.com	✓	Compute Engine default service account	No keys			⋮
rashikasingh@my-project-615-290021.iam.gserviceaccount.com	✓	rashikasingh	No keys			⋮

- Setting up a new instance to run as a service account

I created a new instance and, in the identity, and API access added a service account rashikasingh which I created.



The screenshot shows the creation of service account instance using console and gcloud.

The screenshot shows the 'VM instances' page in the Google Cloud Platform Compute Engine section. The left sidebar lists options like VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, Marketplace, and Help. The main area displays a table of VM instances with columns for Name, Zone, Recommendation, In use by, Internal IP, and External IP. Instances listed include 'instance-1', 'preemptibleinstance', 'publicimageinstance', and 'serviceaccountinstance'. A 'PERMISSIONS' tab is selected, showing a message: 'Please select at least one resource.' Below the table are 'Related Actions' buttons for View Billing Report, Monitor VMs, Explore VM Logs, Setup Firewall Rules, and Patch Manager.

This allows users with the service account to have access to the VM as an editor, the service account email is added in the commandline. One VM can have only one service account.

```

gcloud compute instances create --help
Rashikas-Air:~ rashikasingh$ gcloud compute instances create serviceaccountdemo --service-account rashikasingh@my-project-615-290021.iam.gserviceaccount.com
For the following instance:
- [serviceaccountdemo]
choose a zone:
[1] asia-east1-a
[2] asia-east1-b
[3] asia-east1-c
[4] asia-east2-a
[5] asia-east2-b
[6] asia-east2-c
[7] asia-northeast1-a
[8] asia-northeast1-b
[9] asia-northeast1-c
[10] asia-northeast2-a
[11] asia-northeast2-b
[12] asia-northeast2-c
[13] asia-northeast3-a
[14] asia-northeast3-b
[15] asia-northeast3-c
[16] asia-south1-a
[17] asia-south1-b
[18] asia-south1-c
[19] asia-southeast1-a
[20] asia-southeast1-b
[21] asia-southeast1-c
[22] asia-southeast2-a
[23] asia-southeast2-b
[24] asia-southeast2-c
[25] australia-southeast1-a
[26] australia-southeast1-b
[27] australia-southeast1-c
[28] europe-north1-a
[29] europe-north1-b
[30] europe-north1-c
[31] europe-west1-b
[32] europe-west1-c
[33] europe-west1-d
[34] europe-west2-a
[35] europe-west2-b
[36] europe-west2-c
[37] europe-west3-a
[38] europe-west3-b
[39] europe-west3-c
[40] europe-west4-a
[41] europe-west4-b
[42] europe-west4-c
[43] europe-west5-a
[44] europe-west5-b
[45] europe-west5-c
[46] northamerica-northeast1-a
[47] northamerica-northeast1-b
[48] northamerica-northeast1-c
[49] northamerica-east1-a
[50] southamerica-east1-b
Did not print [23] options.
Too many options [73]. Enter "list" at prompt to print choices fully.
Please enter your numeric choice: 2

Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/asia-east1-b/instances/serviceaccountdemo].
NAME          ZONE        MACHINE_TYPE  INTERNAL_IP  EXTERNAL_IP  STATUS
serviceaccountdemo  asia-east1-b  n1-standard-1    10.140.8.2   35.229.153.91  RUNNING
Rashikas-Air:~ rashikasingh$ 

```

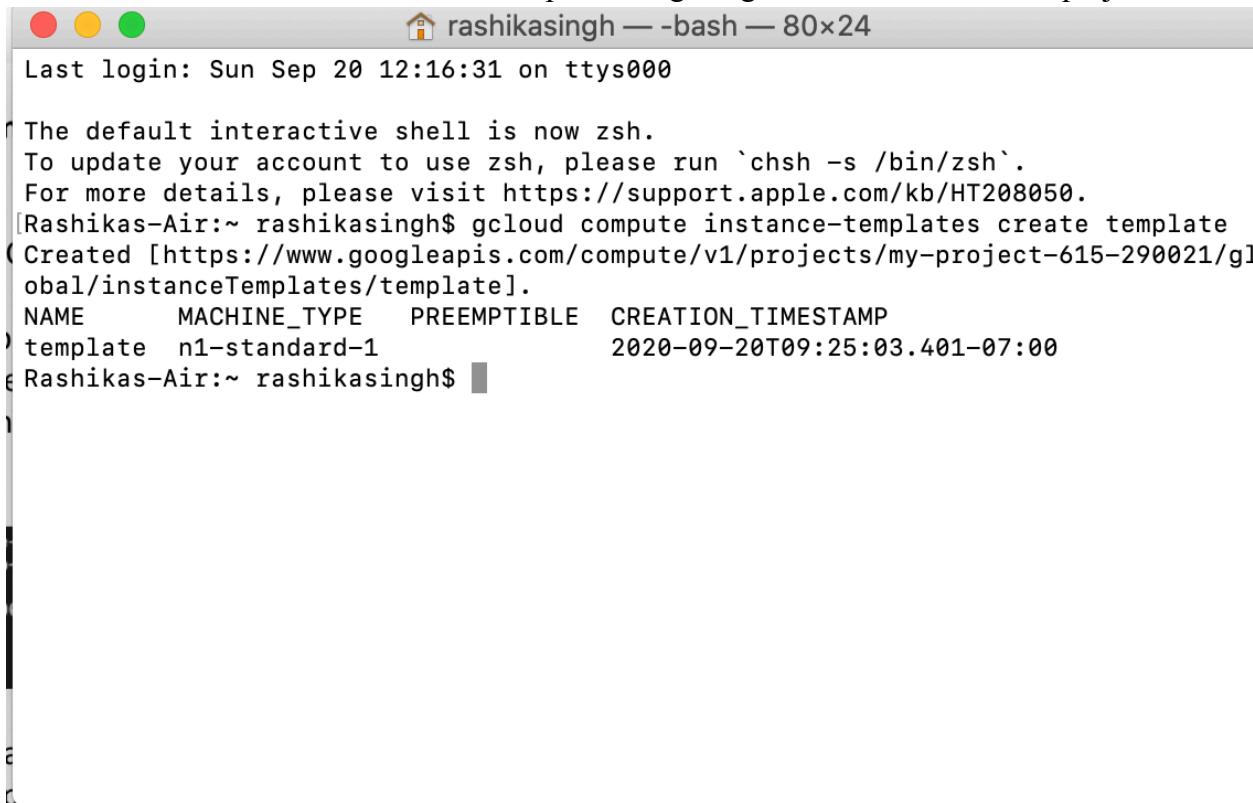
- Changing the service account and access scopes for an instance

You can change the service account and access scopes for an instance. Here I changed the service account as Compute Engine default account and changed the scope to Allow full access in the console. This allows flexibility if any changes need to be added to the account.

4. Creating and Managing Instance Templates

- Creating a new instance template (gcloud)

An instance template is a resource which can be used to create VM instances and managed instance groups. It defines the machine type, boot disk or container image and other properties. This can be used to create a MIG or individual VMs. They are convenient to save a configuration and use later on. I created an instance template using the gcloud command for the project.



```
Last login: Sun Sep 20 12:16:31 on ttys000
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
[Rashikas-Air:~ rashikasingh$ gcloud compute instance-templates create template
(Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/instanceTemplates/template].
NAME      MACHINE_TYPE    PREEMPTIBLE   CREATION_TIMESTAMP
template  n1-standard-1          2020-09-20T09:25:03.401-07:00
e Rashikas-Air:~ rashikasingh$ ]
```

- Creating an instance template that specifies a subnet

First, I create a subnet which are regional resources. Each subnet defines range of IP addresses. Traffic to and from instances are controlled by firewall rules. I create a subnet instance which allows IP ranges mentioned in the creation.

The screenshot shows the Google Cloud Platform interface for managing VPC networks. The left sidebar lists various VPC-related services: VPC networks, External IP addresses, Firewall, Routes, VPC network peering, Shared VPC, Serverless VPC access, and Packet mirroring. The main content area displays 'VPC network details' for the 'default' subnet in the 'northeast1' region. The table lists subnets with their ranges, gateway, and role. A 'Select a subnet' dropdown is open, and a 'PERMISSIONS' section indicates that at least one resource must be selected. The bottom of the page includes a REST API link.

Name	Region	IP address ranges	Gateway	Role
default	europe-west4	10.164.0.0/20	10.164.0.1	Off
default	europe-north1	10.166.0.0/20	10.166.0.1	Off
default	us-west2	10.168.0.0/20	10.168.0.1	Off
default	asia-east2	10.170.0.0/20	10.170.0.1	Off
default	europe-west6	10.172.0.0/20	10.172.0.1	Off
default	asia-northeast2	10.174.0.0/20	10.174.0.1	Off
default	asia-northeast3	10.178.0.0/20	10.178.0.1	Off
default	us-west3	10.180.0.0/20	10.180.0.1	Off
default	us-west4	10.182.0.0/20	10.182.0.1	Off
default	asia-southeast2	10.184.0.0/20	10.184.0.1	Off
newsubnet	us-west4	100.64.0.0/10	100.64.0.1	Off
subnetinstance	us-east1	10.0.0.0/9	10.0.0.1	Off

Then, gcloud command creates an instance template in the region with the subnetinstance.

```
Rashikas-Air:~ rashikasingh$ gcloud compute instance-templates create templatesample --region us-east1 --subnet subnetinstance
Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/instanceTemplates/templatesample].
NAME          MACHINE_TYPE  PREEMPTIBLE  CREATION_TIMESTAMP
templatesample  n1-standard-1  2020-09-20T11:40:14.010-07:00
Rashikas-Air:~ rashikasingh$
```

5. Creating and Managing Groups of Instances

A managed instance group allows you to manage multiple instances together and any change to the configuration affects the group as a whole.

- Creating managed instance groups.
 - Creating a managed instance group

Here I created a MIG from the console.

The screenshot shows the Google Cloud Platform Compute Engine interface. On the left, there's a sidebar with various options like VM instances, Instance groups (which is selected and highlighted in blue), Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, and Marketplace. The main content area is titled 'Instance groups' and shows a table with one row. The table has columns for Name, Zone, Instances, Template, Group type, Creation time, Recommendation, Autoscaling, and In use by. The single row shows 'instance-group-1' in the 'Name' column, 'us-central1-a' in 'Zone', '1' in 'Instances', 'template' in 'Template', 'Managed' in 'Group type', 'Sep 20, 2020, 12:29:53 PM' in 'Creation time', and 'On: Target CPU utilization 60%' in 'Autoscaling'. A note above the table says: 'Instance groups are collections of VM instances that use load balancing and automated services, like autoscaling and autohealing. [Learn more](#)'.

This shows specification of the instance group.

The screenshot shows the Google Cloud Platform Compute Engine interface, similar to the previous one but with more detailed information. The sidebar and main navigation are identical. The main content area is titled 'Instance groups' and shows a table for the 'instance-group-1' group. The table has tabs for Members, Details, Monitoring, and Errors. The 'Members' tab is active. It shows a summary section with 'Instance template' (template), 'Instances by status' (1 in total), 'Location' (us-central1-a), and 'Instances by health' (Autohealing needs to be configured to get instances health). It also shows 'Autohealing' (Autohealing is not configured) and 'Autoscaling' (On, CPU utilization 60%). Below this is a table of group members. The table has columns for Name, Creation time, Template, Per instance config, Health check status, Internal IP, External IP, and Connect. There is one row for 'instance-group-1-4bcs' with values: Sep 20, 2020, 12:29:59 PM, template, and 10.128.0.7 (nic0), 35.202.39.160, and SSH.

A managed instance group can also be created from the gcloud. Managed is used for creating MIG and the name is given instancegroup2 with a size 5.

```
Rashikas-Air:~ rashikasingh$ gcloud compute instance-groups managed create instancegroup2 --base-instance-name ins --size 5 --template template --zone us-east1-b
Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-east1-b/instanceGroupManagers/instancegroup2].
NAME          LOCATION    SCOPE   BASE_INSTANCE_NAME  SIZE  TARGET_SIZE  INSTANCE_TEMPLATE  AUTOSCALED
instancegroup2  us-east1-b  zone     ins                0      5           template        no
Rashikas-Air:~ rashikasingh$
```

- Creating groups of preemptible instances

For this, first I created an instance template for preemptible instances and then make a group for it.

The screenshot shows the Google Cloud Platform Compute Engine interface. The left sidebar is titled 'Compute Engine' and includes options like VM instances, Instance groups, Instance templates (which is selected), Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, Marketplace, and Help. The main content area is titled 'Create an instance template'. It features a 'Metadata' section with a 'Key' and 'Value' input field, a 'Preemptibility' section (set to 'On'), a 'On host maintenance' section (set to 'Terminate VM instance'), and an 'Automatic restart' section (set to 'Off'). A note at the bottom states, 'You can always create instance templates free of charge. Your free trial credit won't be used.' At the bottom right are 'Create' and 'Cancel' buttons. The top navigation bar shows 'My Project 615' and a search bar, along with a user account icon.

The screenshot shows the Google Cloud Platform Compute Engine Instance templates page. The left sidebar lists various Compute Engine resources: VM instances, Instance groups, Instance templates (selected), Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, and Marketplace. The main content area displays a table of instance templates:

Name	Machine type	Image	Disk type	Placement policy	In use by	Creation time
instance-template-2	2 vCPUs, 4 GB	debian-10-buster-v20200910	Standard persistent disk	No policy		Sep 20, 2020, 12:34:01 PM
template	1 vCPU, 3.75 GB	debian-10	Standard persistent disk	No policy	instance-group-1, instancegroup2	Sep 20, 2020, 12:25:03 PM

To the right, there is a sidebar titled "Select an instance template" with tabs for "PERMISSIONS" and "LABELS". A message at the bottom of the sidebar says "Please select at least one resource."

This shows the creation of instance groups.

The screenshot shows the Google Cloud Platform Compute Engine Instance groups page. The left sidebar is identical to the previous screenshot. The main content area displays a table of instance groups:

Name	Zone	Instances	Template	Group type	Creation time	Recommendation	Autoscaling	In use by
instance-group-1	us-central1-a	1	template	Managed	Sep 20, 2020, 12:29:53 PM	On: Target CPU utilization 60%		
instancegroup2	us-east1-b	5	template	Managed	Sep 20, 2020, 12:32:14 PM	No configuration		

- Setting up health checking and auto healing

Here, I create a health check that looks for protocol HTTP on port 80 and tolerates failure before marking instances as UNHEALTHY.

The screenshot shows the Google Cloud Platform interface for creating a new health check. The left sidebar under 'Compute Engine' has 'Health checks' selected. The main area is titled 'Create a health check' with a back arrow. It includes fields for 'Name' (set to 'healthcheck'), 'Description' (empty), 'Scope' (set to 'Global'), 'Protocol' (set to 'HTTP' with port 80), 'Proxy protocol' (set to 'NONE'), and 'Request path' (set to '/'). A 'MORE' button is visible below the request path field. At the bottom are 'CREATE' and 'CANCEL' buttons, along with a note about equivalent REST or command line options.

GCP has a UI which provides all information per instance such as protocol, port and health criteria. GCP computes a health state for each instance whose criteria defines how often to check whether an instance is healthy. It includes checks and criteria such as how long to wait for a response, how many successful attempts or unsuccessful attempts are decisive? It defines how many times an instance has to fail before total time period to be considered unhealthy. The health check can even define how many times it has to fail over what total time period before an instance is considered unhealthy.

You can set a healthy instance threshold as 1 and unhealthy as 3. If it returns once successfully it is termed healthy and if returns thrice it is UNHEALTHY. This helps to check the health of instances.

The screenshot shows the 'Create a health check' page in the Google Cloud Platform Compute Engine section. On the left, a sidebar lists various Compute Engine components: VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks, Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, and Health checks (which is selected). Below this are links for Firewall, Marketplace, and Help.

The main form has a 'Logs' section with a toggle switch set to 'Off'. It also includes 'Health criteria' settings: 'Check interval' (5 seconds), 'Timeout' (5 seconds), 'Healthy threshold' (1 consecutive successes), and 'Unhealthy threshold' (3 consecutive failures).

At the bottom, there's a note: 'You can create this health check free of charge' and a 'CREATE' button.

I created a firewall rule which will allow the IP ranges with the health checker. This allows incoming traffic only from the mentioned IP.

The screenshot shows the 'Create a firewall rule' page in the Google Cloud Platform VPC network section. On the left, a sidebar lists: VPC networks, External IP addresses, Firewall (selected), Routes, VPC network peering, Shared VPC, Serverless VPC access, and Packet mirroring.

The main form has a 'Source filter' dropdown set to 'IP ranges' with a value of '130.211.0.0/22, 35.191.0.0/16'. It also includes a 'Second source filter' dropdown set to 'None'.

The 'Protocols and ports' section shows 'tcp : 80' checked and 'udp : all' unchecked. There's also an 'Other protocols' field with 'protocols, comma separated, e.g. ah, sctp'.

At the bottom, there's a 'CREATE' button.

I enabled the health check in the instance group which was previously created.

The health checker can be created using gcloud it checks on port 80 with an interval of 30s and healthy threshold as 1 and unhealthy as 3.

```
gcloud compute health-checks create http check2 --port 80 --check-interval 30s --healthy-threshold 1 --timeout 10s --unhealthy-threshold 3
Rashikas-Air:~ rashikasingh$ gcloud compute health-checks create http check2 --port 80 --check-interval 30s --healthy-threshold 1 --timeout 10s --unhealthy-threshold 3
Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/healthChecks/check2].
NAME    PROTOCOL
check2  HTTP
Rashikas-Air:~ rashikasingh$
```

This creates firewall rule to allow incoming traffic on tcp:80 with the IP ranges.

```
check2  HTTP
(Rashikas-Air:~ rashikasingh$ gcloud compute firewall-rules create allow-health-check2 --allow tcp:80 --source-ranges 130.211.0.0/22,35.191.0.0/16 --network default
Creating firewall...Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/firewalls/allow-health-check2].
Creating firewall...done.
NAME    NETWORK  DIRECTION  PRIORITY  ALLOW  DENY  DISABLED
allow-health-check2  default  INGRESS  1000    tcp:80    False
Rashikas-Air:~ rashikasingh$
```

This updates the instance group to enable health checker.

```
Rashikas-Air:~ rashikasingh$ gcloud compute instance-groups managed update instance-group-1 --health-check check2 --initial-delay 300 --zone us-central1-a
Updated [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/zones/us-central1-a/instanceGroupManagers/instance-group-1].
Rashikas-Air:~ rashikasingh$
```

6. Virtual Private Cloud (VPC)

Part 1: A Virtual Private Cloud (VPC) is a global private isolated virtual network partition that provides managed networking functionality for GCP.

- o Creating networks

- o Creating an auto mode network

An auto mode network selects all the regions hence it is automode.

The screenshot shows the 'Create a VPC network' page in the Google Cloud Platform. On the left, a sidebar lists options like 'VPC networks', 'External IP addresses', 'Firewall', 'Routes', 'VPC network peering', 'Shared VPC', 'Serverless VPC access', and 'Packet mirroring'. The main area has a title 'Create a VPC network' with a back arrow. It includes fields for 'Name *' (set to 'network1') and 'Description'. Below these are sections for 'Subnets' and 'Subnet creation mode' (set to 'Automatic'). A note states: 'These IP address ranges will be assigned to each region in your VPC network. When an instance is created for your VPC network, it will be assigned an IP from the appropriate region's address range.' A table shows IP address ranges by region:

Region ↑	IP address range
asia-east1	10.140.0.0/20
asia-northeast1	10.146.0.0/20
asia-south1	10.160.0.0/20
asia-southeast1	10.148.0.0/20
australia-southeast1	10.152.0.0/20

You can also select the firewall rules for the network which allow only certain traffic to pass through.

Name	Type	Targets	Filters	Protocols / ports	Action	Priority
network1-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	icmp	Allow	65,534
network1-allow-internal	Ingress	Apply to all	IP ranges: 10.128.0.0/9		Allow	65,534
network1-allow-rdp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	tcp:3389	Allow	65,534
network1-allow-ssh	Ingress	Apply to all	IP ranges: 0.0.0.0/0	tcp:22	Allow	65,534
network1-deny-all-ingress	Ingress	Apply to all	IP ranges: 0.0.0.0/0		Deny	65,535
network1-allow-all-egress	Egress	Apply to all	IP ranges: 0.0.0.0/0	all	Allow	65,535

- o Creating a custom mode network.

Here you can select a subnet mode as custom where you can select the mode here I selected regional mode and also selected firewall rules where you can specify which allows tcp, udp and icmp with the source ranges

```
Rashikas-Air:~ rashikasingh$ gcloud compute networks create network2 --subnet-mode=custom --bgp-routing-mode=regional
Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/networks/network2].
NAME      SUBNET_MODE  BGP_ROUTING_MODE  IPV4_RANGE  GATEWAY_IPV4
network2  CUSTOM       REGIONAL          
```

Instances on this network will not be reachable until firewall rules are created. As an example, you can allow all internal traffic between instances as well as SSH, RDP, and ICMP by running:

```
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp,udp,icmp --source-ranges <IP_RANGE>
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp:22,tcp:3389,icmp
```

```
Rashikas-Air:~ rashikasingh$ 
```

```
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp,udp,icmp --source-ranges <IP_RANGE>
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp:22,tcp:3389,icmp

Rashikas-Air:- rashikasingh$ gcloud compute networks subnets list
NAME           REGION          NETWORK RANGE
default        us-central1   default  10.128.0.0/28
network1      us-central1   network1 10.128.0.0/28
default        europe-west1  default  10.132.0.0/28
network1      europe-west1  network1 10.132.0.0/28
default        us-west1     default  10.138.0.0/28
network1      us-west1     network1 10.138.0.0/28
default        asia-east1    default  10.140.0.0/28
network1      asia-east1    network1 10.140.0.0/28
default        us-east1     default  10.142.0.0/28
network1      us-east1     network1 10.142.0.0/28
default        asia-northeast1 default  10.146.0.0/28
network1      asia-northeast1 network1 10.146.0.0/28
default        asia-southeast1 default  10.148.0.0/28
network1      asia-southeast1 network1 10.148.0.0/28
default        us-east4     default  10.150.0.0/28
network1      us-east4     network1 10.150.0.0/28
default        australia-southeast1 default  10.152.0.0/28
network1      australia-southeast1 network1 10.152.0.0/28
default        europe-west2   default  10.154.0.0/28
network1      europe-west2   network1 10.154.0.0/28
default        europe-west3   default  10.156.0.0/28
network1      europe-west3   network1 10.156.0.0/28
default        europe-west4   default  10.158.0.0/28
network1      europe-west4   network1 10.158.0.0/28
default        southamerica-east1 default  10.160.0.0/28
network1      southamerica-east1 network1 10.160.0.0/28
default        asia-south1   default  10.160.0.0/28
network1      asia-south1   network1 10.160.0.0/28
default        northamerica-northeast1 default  10.162.0.0/28
network1      northamerica-northeast1 network1 10.162.0.0/28
default        europe-west4   default  10.164.0.0/28
network1      europe-west4   network1 10.164.0.0/28
default        europe-north1  default  10.166.0.0/28
network1      europe-north1  network1 10.166.0.0/28
default        europe-north1  default  10.168.0.0/28
network1      europe-north1  network1 10.168.0.0/28
network1      us-west2     default  10.170.0.0/28
default        asia-east2    default  10.170.0.0/28
network1      asia-east2    network1 10.170.0.0/28
default        europe-west6   default  10.172.0.0/28
network1      europe-west6   network1 10.172.0.0/28
default        asia-northeast2 default  10.174.0.0/28
network1      asia-northeast2 network1 10.174.0.0/28
default        asia-northeast3 default  10.178.0.0/28
network1      asia-northeast3 network1 10.178.0.0/28
default        asia-northeast3 default  10.178.0.0/28
network1      asia-northeast3 network1 10.178.0.0/28
default        us-west3     default  10.180.0.0/28
default        us-west4     default  10.182.0.0/28
network1      us-west4     network1 10.182.0.0/28
default        asia-southeast2 default  10.184.0.0/28
network1      asia-southeast2 network1 10.184.0.0/28
Rashikas-Air:- rashikasingh$
```

- Viewing networks
- You can view the networks using the console..

Name	Region	IP address ranges	Gateway	Private Google access	Flow logs
network1	us-central1	10.128.0.0/28	10.128.0.1	Off	Off
network1	europe-west1	10.132.0.0/28	10.132.0.1	Off	Off
network1	us-west1	10.138.0.0/28	10.138.0.1	Off	Off
network1	asia-east1	10.140.0.0/28	10.140.0.1	Off	Off
network1	us-east1	10.142.0.0/28	10.142.0.1	Off	Off
network1	asia-	10.146.0.0/28	10.146.0.1	Off	Off

- Working with networks
 - Listing subnets
- Subnets are regional resources where each subnet defines a range of IP addresses. Traffic to and from instances can be controlled with network firewall rules. A subnet or subnetwork is a segmented piece of larger network. It is a logical partition of an IP

network into multiple, smaller networks which allows to split a large network into grouping of smaller, interconnected networks to avoid traffic and increase networking speed.

This snippet shows all the subnet networks.

```
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp,udp,icmp --source-ranges <IP_RANGE>
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network network2 --allow tcp:22,tcp:3389,icmp

Rashikas-Air:~ rashikasingh$ gcloud compute networks subnets list
NAME          REGION      NETWORK   RANGE
default       us-central1 default    10.128.0.0/28
network1     us-central1 network1  10.128.0.0/28
default       europe-west1 default    10.132.0.0/28
network1     europe-west1 network1  10.132.0.0/28
default       us-west1    default    10.138.0.0/28
network1     us-west1    network1  10.138.0.0/28
network1     asia-east1  default    10.140.0.0/28
network1     asia-east1  network1  10.140.0.0/28
default       us-east1    default    10.142.0.0/28
network1     us-east1    network1  10.142.0.0/28
default       asia-northeast1 default   10.146.0.0/28
network1     asia-northeast1 network1 10.146.0.0/28
default       asia-northeast1 default   10.146.0.0/28
network1     asia-southeast1 network1 10.146.0.0/28
default       us-east4    default   10.150.0.0/28
network1     us-east4    network1  10.150.0.0/28
network1     australia-southeast1 default  10.152.0.0/28
network1     australia-southeast1 network1 10.152.0.0/28
default       europe-west2  default  10.154.0.0/28
network1     europe-west2  network1 10.154.0.0/28
default       europe-west3  default  10.156.0.0/28
network1     europe-west3  network1 10.156.0.0/28
default       southamerica-east1 default 10.158.0.0/28
network1     southamerica-east1 network1 10.158.0.0/28
default       asia-south1  default  10.160.0.0/28
network1     asia-south1  network1 10.160.0.0/28
network1     northamerica-northeast1 default 10.162.0.0/28
network1     northamerica-northeast1 network1 10.162.0.0/28
default       europe-west4  default  10.164.0.0/28
network1     europe-west4  network1 10.164.0.0/28
default       europe-north1 default  10.166.0.0/28
network1     europe-north1 network1 10.166.0.0/28
default       us-west2    default  10.168.0.0/28
network1     us-west2    network1 10.168.0.0/28
network1     asia-west2   default  10.170.0.0/28
network1     asia-east2   network1 10.170.0.0/28
default       europe-west6  default 10.172.0.0/28
network1     europe-west6  network1 10.172.0.0/28
default       asia-northeast2 default 10.174.0.0/28
network1     asia-northeast2 network1 10.174.0.0/28
network1     asia-northeast3 default 10.178.0.0/28
network1     asia-northeast3 network1 10.178.0.0/28
default       asia-west3   default  10.180.0.0/28
network1     asia-west3   network1 10.180.0.0/28
default       us-west4    default  10.182.0.0/28
network1     us-west4    network1 10.182.0.0/28
default       asia-southeast2 default 10.184.0.0/28
network1     asia-southeast2 network1 10.184.0.0/28
Rashikas-Air:~ rashikasingh$
```

o Describing a subnet

The gcloud command can be used to describe a subnet if we mention the network name and region with details such as creating time, network, region among other details.

```
Rashikas-Air:~ rashikasingh$ gcloud compute networks subnets describe SUBNET_NAME \
[>
[Rashikas-Air:~ rashikasingh$ gcloud compute networks subnets describe network1 --region us-west3
creationTimestamp: '2020-09-20T09:47:24.945-07:00'
fingerprint: z7WSWdAiba4=
gatewayAddress: 10.180.0.1
id: '8263949363844888947'
ipCidrRange: 10.180.0.0/20
kind: compute#subnetwork
name: network1
network: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/networks/network1
privateIpGoogleAccess: false
purpose: PRIVATE
region: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-west3
selfLink: https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-west3/subnetworks/network1
Rashikas-Air:~ rashikasingh$
```

o Adding subnets

This adds subnets using gcloud with the name, network as default and IP range and the region you want the subnet.

```
gcloud compute networks subnets create --help
[Rashikas-Air:~ rashikasingh$ gcloud compute networks subnets create newsubnet --network=default --range=100.64.0.0/10 --region us-west4
Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-west4/subnetworks/newsubnet].
NAME      REGION    NETWORK   RANGE
newsubnet us-west4 default  100.64.0.0/10
Rashikas-Air:~ rashikasingh$ ]
```

- Deleting subnets

This is used to delete an existing subnet with the region mentioned.

```
[Rashikas-Air:~ rashikasingh$ gcloud compute networks subnets delete network1 --region=us-central1
The following subnetworks will be deleted:
- [network1] in [us-central1]

Do you want to continue (Y/n)? Y

Deleted [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/regions/us-central1/subnetworks/network1].
Rashikas-Air:~ rashikasingh$ ]
```

- Modifying networks

- Deleting a network

This deletes an existing network by specifying the existing network name. I also deleted the firewall associated with it to avoid errors.

```
[Rashikas-Air:~ rashikasingh$ gcloud compute networks delete network2
The following networks will be deleted:
- [network2]
```

```
Do you want to continue (Y/n)? Y
```

```
Deleted [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/networks/network2].
Rashikas-Air:~ rashikasingh$ ]
```

Part 2: Using firewall rules

- Creating firewall rules

Here I create a firewall rule with direction of traffic ingress (ingress is right to enter the property) while egress is the right to exit the property and with the IP ranges.

The screenshot shows the Google Cloud Platform interface for creating a new firewall rule under the 'VPC network' section. The left sidebar lists various VPC-related options like 'VPC networks', 'External IP addresses', 'Firewall' (which is selected), 'Routes', 'VPC network peering', 'Shared VPC', 'Serverless VPC access', and 'Packet mirroring'. The main panel is titled 'Create a firewall rule' and contains the following fields:

- Name ***: firewallrulesample (highlighted in blue)
- Description**: (empty text area)
- Logs**: A note about log generation and two radio buttons: 'On' (unselected) and 'Off' (selected).
- Network ***: default
- Priority ***: 1000
- Direction of traffic**: Ingress (radio button selected)
- Action on match**: Allow (radio button selected)
- Targets**: Specified target tags (dropdown menu)

A status bar at the top right indicates 'Google account: Rashika Pramod Singh (rsingh37@g.syr.edu)'.

The screenshot shows the 'Create a firewall rule' page in the Google Cloud Platform VPC network section. The left sidebar lists options like VPC networks, External IP addresses, Firewall (selected), Routes, VPC network peering, Shared VPC, Serverless VPC access, and Packet mirroring. The main form has the following fields:

- Action on match:** Radio button selected for "Allow".
- Targets:** "Specified target tags" dropdown set to "webserver".
- Source filter:** "IP ranges" dropdown set to "0.0.0.0/0".
- Source IP ranges:** Input field containing "0.0.0.0" with a note "for example, 0.0.0.0/0, 192.168.2.0/24".
- Second source filter:** "None".
- Protocols and ports:** Radio button selected for "Specified protocols and ports".
 - tcp:** Port 80 is checked.
 - udp:** Port "all" is checked.
 - Other protocols:** Unchecked.

This shows that the `firewallrulessample` is created.

The screenshot shows the list of Firewall rules. The left sidebar is identical to the previous screenshot. The main area displays a table of rules:

	Name	Type	Targets	Filters	Protocols / ports	Action	Priority	Network	Logs	Hit count
<input type="checkbox"/>	allow-health-check	Ingress	Apply to all	IP ranges: 130.2	tcp:80	Allow	1000	default	Off	
<input type="checkbox"/>	allow-health-check2	Ingress	Apply to all	IP ranges: 130.2	tcp:80	Allow	1000	default	Off	
<input type="checkbox"/>	default-allow-http	Ingress	http-server	IP ranges: 0.0.0.	tcp:80	Allow	1000	default	Off	
<input type="checkbox"/>	default-allow-https	Ingress	https-server	IP ranges: 0.0.0.	tcp:443	Allow	1000	default	Off	
<input type="checkbox"/>	firewallrulessample	Ingress	Apply to all	IP ranges: 0.0.0.	all	Allow	1000	default	Off	
<input type="checkbox"/>	default-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.	icmp	Allow	65534	default	Off	
<input type="checkbox"/>	default-allow-internal	Ingress	Apply to all	IP ranges: 10.12	tcp:0-65535 udp:0-65535 icmp	Allow	65534	default	Off	
<input type="checkbox"/>	default-allow-rdp	Ingress	Apply to all	IP ranges: 0.0.0.	tcp:3389	Allow	65534	default	Off	
<input type="checkbox"/>	default-allow-ssh	Ingress	Apply to all	IP ranges: 0.0.0.	tcp:22	Allow	65534	default	Off	
<input type="checkbox"/>	network1-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.	icmp	Allow	65534	network1	Off	

This shows the details of the firewall.

Google Cloud Platform - My Project 615 - Search products and resources

VPC network Firewall rule details

firewallrulelessample

Logs Off view

Network default

Priority 1000

Direction Ingress

Action on match Allow

Source filters

IP ranges 0.0.0.0/0

Protocols and ports all

Enforcement Enabled

Insights None

- Configuration examples:
 - Deny all ingress TCP connections except those to port 80 from subnet1
This denies all the incoming TCP connections except those from port 80 from subnet with priority of 1000 on the default network.

```
rashikasingh — bash — 80x24
Last login: Sun Sep 20 12:58:27 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.

[Rashikas-Air:~ rashikasingh$ gcloud compute networks delete network2
The following networks will be deleted:
- [network2]

Do you want to continue (Y/n)? Y

Deleted [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/networks/network2].
[Rashikas-Air:~ rashikasingh$ gcloud compute firewall-rules create deny-subnet1-webserver-access --network default --action deny --direction ingress --rules tcp --source-ranges 0.0.0.0/0 --priority 1000 --target-tags webserver
Creating firewall...:Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/firewalls/deny-subnet1-webserver-access].
Creating firewall...done.

NAME          NETWORK  DIRECTION  PRIORITY  ALLOW  DENY  DISABL
ED
deny-subnet1-webserver-access  default  INGRESS    1000      tcp  False
```

- Deny all egress TCP connections except those to port 80 of vm1
This denies all the outgoing traffic with TCP with priority 1000 except that of port 80 of vm1.

```
[Rashikas-Air:~ rashikasingh$ gcloud compute firewall-rules create deny-all-access --network default --action deny --direction egress --rules tcp --destination-ranges 0.0.0.0/0 --priority 1000
Creating firewall...:Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/firewalls/deny-all-access].
Creating firewall...done.
NAME          NETWORK DIRECTION PRIORITY ALLOW DENY DISABLED
deny-all-access default EGRESS    1000      tcp   False
Rashikas-Air:~ rashikasingh$ ]
```

- Allow egress TCP connections to port 443 of an external host
This allows all the exit traffic from TCP connections to port 443 of external host.

```
Rashikas-Air:~ rashikasingh$ gcloud compute firewall-rules create vm1-allow-egress-tcp-port443-to-192-0-2-5 --network default --action allow --direction egress --rules tcp:443 --destination-ranges 192.0.2.5/32 --priority 70 --target-tags webserver
Creating firewall...:Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/firewalls/vm1-allow-egress-tcp-port443-to-192-0-2-5].
Creating firewall...done.
NAME          NETWORK DIRECTION PRIORITY ALLOW DENY DISABLED
vm1-allow-egress-tcp-port443-to-192-0-2-5 default EGRESS    70      tcp:443  False
Rashikas-Air:~ rashikasingh$ ]
```

- Allow SSH connections from vm2 to vm1
This allows all SSH connections from vm2 to vm1 in the network.

```
Rashikas-Air:~ rashikasingh$ gcloud compute firewall-rules create vm1-allow-ingress-tcp-ssh-from-vm2 --network default --action allow --direction ingress --rules tcp:22 --source-tags database --priority 8
--target-tags webserver
Creating firewall...:Created [https://www.googleapis.com/compute/v1/projects/my-project-615-290021/global/firewalls/vm1-allow-ingress-tcp-ssh-from-vm2].
Creating firewall...done.
NAME          NETWORK DIRECTION PRIORITY ALLOW DENY DISABLED
vm1-allow-ingress-tcp-ssh-from-vm2 default INGRESS  80      tcp:22  False
Rashikas-Air:~ rashikasingh$ ]
```

Then, I shut down the instances, project and stop the billing.