

Note: Section 1 in the document means Section 3 of the lab manual

Section 1: Google Cloud Shell

a. Welcome to GCP

The screenshot shows the Google Cloud Platform Home page. At the top, it says "Welcome, Akshay Pradeep". Below that is a section titled "Begin with the basics" with a "GO TO CHECKLIST" button. To the right is a "What's covered" section with a bulleted list: "Reviewing billing, credits, and projects", "Managing resources and accounts", "Adding resources to a project", and "Understanding and calculating pricing". Under "Top products", there is a "Compute products" section featuring "Compute Engine" (Made by Google) with a "GO TO COMPUTE ENGINE" button. Other popular compute options listed are "Kubernetes Engine", "App Engine", "Cloud Run", and "Functions". The sidebar on the left lists various Google Cloud services like Marketplace, Billing, APIs & Services, IAM & Admin, Getting started, Security, Anthos, Compute, Storage, and more.

b. Create Project

The screenshot shows the Google Cloud Platform Dashboard for the "ProjectAkshay" project. The dashboard has several sections: "Project info" (Project name: ProjectAkshay, Project ID: 619054701159), "Resources" (This project has no resources), "Trace" (No trace data from the past 7 days), "Getting Started" (Explore and enable APIs, Deploy a prebuilt solution, Add dynamic logging to a running application, Monitor errors with Error Reporting), "API APIs" (Requests (requests/sec) chart showing no data available), "Google Cloud Platform status" (All services normal), "Monitoring" (Set up alerting policies, Create uptime checks, View all dashboards), "Error Reporting" (No sign of any errors, Learn how to set up Error Reporting), and "News" (gVisor: Protecting GKE and serverless users in the real world, Set the stage for better conversations about aliship, Now, setting up continuous deployment for Cloud Run is a snap). The sidebar on the left is identical to the one in the previous screenshot.

c. Preview and Deploy an App Engine Application

- Clone: Cloning a repository pulls down a full copy of all the repository data that GitHub has at that point in time, including all versions of every file and folder for the project.
- App Engine: It is used to build highly scalable applications on a fully managed serverless platform.
- After cloning the application from GitHub repository and then reviewing the website via cloudshell Web Review button. This helps us to have a look of the website before hosting it on the internet.

The screenshot shows the "App Engine Guestbook" application. It displays a message from a "mysterious stranger" saying "Hi". Below that is a large empty text area for comments. At the bottom is a blue "Sign Guestbook" button. Below the button is a form with fields for "Guestbook name:" (containing "Akshay") and "switch". There are also "Login" links at the top right and bottom left.

- Deploying the Application in order to be reachable from the internet. On executing, it also gives the target URL that can be used to reach to the web application. It also shows various other features like viewing logs, running the application in browser command.

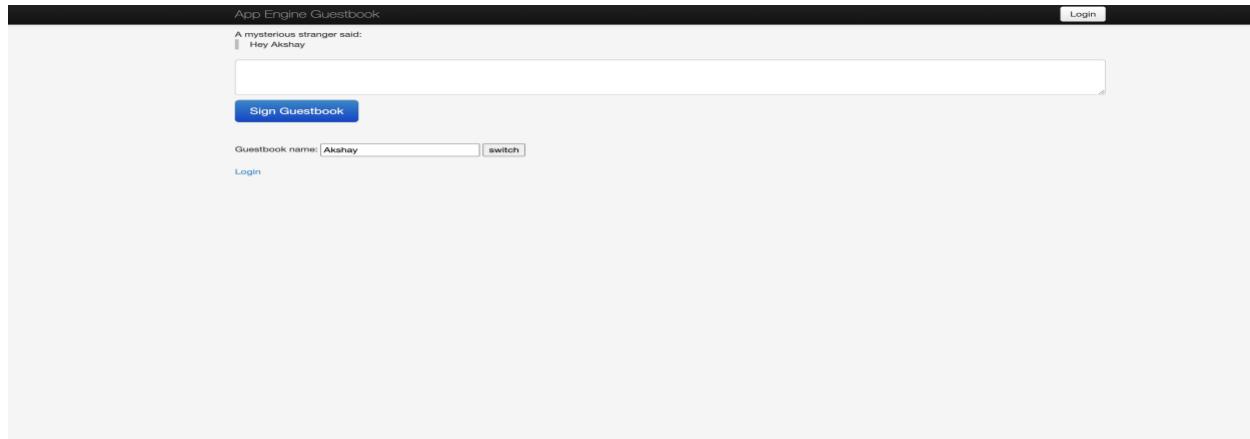
```
Beginning deployment of service [default]...
Uploading 21 files to Google Cloud Storage
File upload done.
Updating service [default]...done.
Setting traffic split for service [default]...done.
Deployed service [default] to [https://projectakshay.ue.r.appspot.com]
.... 100%...done.
Updating config [index]...done.

Indexes are being rebuilt. This may take a moment.

You can stream logs from the command line by running:
$ gcloud app logs tail -s default

To view your application in the web browser run:
$ gcloud app browse
abhala@cloudshell:~/appengine-guestbook-python (projectakshay)$ gcloud app browse
```

- Viewing the application via the created URL in the browser. I passed the target URL provided in the chrome URL address space. This also shows that the URL provided contains the project ID created by the cloud for unique reference.



Section 2: Creating VM Instances

a. Creating and starting an Instance

i. Creating an instance from a public image

- **Public images:** are provided and maintained by Google, open source communities, and third-party vendors. By default, all Google Cloud projects have access to these images and can use them to create instances.
- **Instance:** A cloud instance is a virtual server instance in a cloud computing environment. It is built, hosted and delivered using a cloud computing platform, and can be accessed remotely. Cloud instances are also known as cloud servers, virtual servers, virtual machines etc.
- **Machine Configuration:** You must choose a machine type when you create an instance. You can select from several predefined machine types in each machine type family. If the predefined machine types do not meet your needs, you can create your own custom machine types.
- **Boot Disk:** By default, each Compute Engine instance has a single boot persistent disk (PD) that contains the operating system. When your apps require additional storage space, you can add one or more additional storage options to your instance.

- I selected the Debian GNU/ Linux Operating System Image. It is mounted on a disk having a size of 20GB. Public images are available to all the users and consist of files required to start a system with an OS. As seen, the region selected for this image is us-east1 with zone b along with a default (already available) service account.
- Select Allow HTTP traffic or Allow HTTPS traffic to permit HTTP or HTTPS traffic to the VM. When you select one of these, Compute Engine adds a network tag to your VM, which associates the firewall rule with the VM. Then, Compute Engine creates the corresponding ingress firewall rule that allows all incoming traffic on tcp:80 (HTTP) or tcp:443 (HTTPS).

The screenshot shows the Google Cloud Platform interface for managing VM instances. On the left, there's a sidebar for 'Compute Engine' with various options like VM instances, Instance groups, and Snapshots. The main area is titled 'VM Instances' and shows a table with one row for 'instance-1'. The table columns include Name, Zone, Recommendation, Internal IP, External IP, and Connect. Below the table, there are several 'Related Actions' buttons: View Billing Report, Monitor VMs, Explore VM Logs, Setup Firewall Rules, and Patch Management. To the right of the main content, there's a sidebar with 'Start your project' steps, 'How-to guides and tutorials' (including links to setting up a static IP, creating Windows instances, and connecting via client libraries), and a 'Pricing' section.

b. Creating an instance from a snapshot

- First, we create a snapshot of a particular disk. Here, I have created a snapshot of previously created instance's disk -instance-1. Snapshots are incremental in nature i.e. the consecutive snapshots contain only the modified data since the previous snapshot. This makes them faster and feasible than an entire image of the disk which will contain repetitive data.

The screenshot shows the Google Cloud Platform interface for managing snapshots. The sidebar for 'Compute Engine' has 'Snapshots' selected. The main area is titled 'Snapshots' and shows a table with one row for 'snapshot-1'. The table columns include Name, Location, Snapshot size, Creation time, Creation type, and Source. A modal window is open on the right, titled 'Select a snapshot', with tabs for 'PERMISSIONS' and 'LABELS'. It displays the message 'Please select at least one resource.' and shows the snapshot 'snapshot-1' as the selected item. At the top of the modal, it says 'Google account: Akhay Pradeep Bhale (akhal@syry.edu)' and has 'DISMISS' and 'ACTIVATE' buttons.

- Using the created snapshot as the boot disk, an instance is created.
- The specifications are provided to the instance. The firewall rules allow the instance to receive all the HTTP and HTTPS traffic. It also states that the boot disk should be deleted when the instance is deleted. Configuring an instance with firewalls allows them to be referenced from the external network i.e. the internet. HTTPS is a secure version of HTTP.

To create a VM instance, select one of the options:

- New VM instance**: Create a single VM instance from scratch
- New VM instance from template**: Create a single VM instance from an existing template
- New VM instance from machine image**: Create a single VM instance from an existing machine image
- Marketplace**: Deploy a ready-to-go solution onto a VM instance

Name: Name is permanent
Name: instance-2

Labels: Labels are optional
Labels: + Add label

Region: Region is permanent
Region: us-east1 (South Carolina)

Zone: Zone is permanent
Zone: us-east1-b

Machine configuration

Machine family: General-purpose, Memory-optimized, Compute-optimized
Machine types for common workloads, optimized for cost and flexibility

Series: E2

Machine type: e2-medium (2 vCPU, 4 GB memory)

vCPU	Memory	GPUs
1 shared core	4 GB	-

Boot disk: New 10 GB standard persistent disk
Snapshot: snapshot-1

Identity and API access

Service account: Compute Engine default service account

● Instance created successfully

Compute Engine

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

Zones

Network endpoint groups

Operations

Security scans

OS patch management NEW

Settings

Marketplace

VM instances

CREATE INSTANCE **IMPORT VM** **REFRESH** **MANAGE ACCESS** **SHOW INFO PANEL**

Filter VM instances

Name	Zone	Recommendation	In use by	Internal IP	External IP	Connect
instance-1	us-east1-b			10.142.0.2 (nic0)	35.237.221.171	SSH
instance-2	us-east1-b			10.142.0.3 (nic0)	35.196.120.102	SSH

Related Actions

- View Billing Report**: View and manage your Compute Engine billing
- Monitor VMs**: View outlier VMs across metrics like CPU and Network
- Explore VM Logs**: View, search, analyze, and download VM instance logs
- Setup Firewall Rules**: Control traffic to and from a VM instance
- Patch Management**: Schedule patch updates and view patch compliance on VM instances

Snapshot instance

c. Creating a Preemptible instance

- A preemptible VM is a cheap option to the normal instances. The compute engine might terminate (preempt) these instances if it requires access to those resources for other tasks. Preemptible instances are excess Compute Engine capacity so their availability varies with usage. Switching on the preemptibility option in the availability policy while creating an instance makes it a preemptible instance. We create a preemptible instance as follows:

Reservations
Use an existing reservation when creating this VM instance
Automatically use created reservation

Automation
Startup script (Optional)
You can choose to specify a startup script that will run when your instance boots up or restarts. Startup scripts can be used to install software and updates, and to ensure that services are running within the virtual machine. [Learn more](#)

Metadata (Optional)
You can set custom metadata for an instance or project outside of the server-defined metadata. This is useful for passing in arbitrary values to your project or instance that can be queried by your code on the instance. [Learn more](#)

Key	Value
+ Add item	

Availability policy
Preemptibility
A preemptible VM costs much less, but lasts only 24 hours. It can be terminated sooner due to system demands. [Learn more](#)

On

On host maintenance
When Compute Engine performs periodic infrastructure maintenance it can migrate your VM instances to other hardware without downtime

Terminate VM instance

Automatic restart
Compute Engine can automatically restart VM instances if they are terminated for non-user-initiated reasons (maintenance event, hardware failure, software failure and so on)

Off

[Less](#)

Your free trial credit will be used for this VM instance. [GCP Free Tier](#)

[Create](#) [Cancel](#)

Equivalent REST or command line

VM instances

Network tags
http-server, https-server

Deletion protection
 Enable deletion protection
When deletion protection is enabled, instance cannot be deleted. [Learn more](#)

Confidential VM service
Disabled

Boot disk

Name	Image	Size (GB)	Device name	Type	Encryption	Mode	When
instance-3	debian-10-buster-v20200910	10	instance-3	Standard persistent disk	Google managed	Boot, read/write	Delete

Additional disks
None

Local disks
None

Shielded VM
To edit Shielded VM features you need to stop the instance first.
Turn on all settings for the most secure configuration.

- Turn on Secure Boot
- Turn on vTPM
- 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
None

Service account
619054701159-compute@developer.gserviceaccount.com

Cloud API access scopes
Allow default access
[Details](#)

Marketplace

Equivalent REST

- Successful creation of Preemptible instance

Name	Zone	Recommendation	In use by	Internal IP	External IP	Connect
instance-1	us-east1-b			10.142.0.2 (nic0)	35.237.221.171	SSH
instance-2	us-east1-b			10.142.0.3 (nic0)	35.196.120.102	SSH
instance-3	us-central1-a			10.128.0.2 (nic0)	35.225.150.163	SSH

d. Checking an instance's status

- We list all the running instances and check one of the running instances as follows:
 - \$ gcloud compute instances list ** lists all the compute engine's instances running on cloud
 - \$ gcloud compute instances describe instance-1 ** displays the instance's status
 - An instance can have the following states:
 - Provisioning:** Resources are being allocated for the instance. The instance is not running yet.
 - Staging:** Resources have been acquired and the instance is being prepared for first boot.
 - Running:** The instance is booting up or running. You should be able to SSH into the instance soon, but not immediately, after it enters this state.
 - Stopping:** the instance is being stopped. This can be because a user has made a request to stop the instance or there was a failure. This is a temporary status and the instance will move to Terminated.
 - Repairing:** The instance is being repaired. This can happen because the instance encountered an internal error, or the underlying machine is unavailable due to maintenance. During this time, the instance is unusable. If repair is successful, the instance returns to one of the above states.
 - Terminated:** A user shut down the instance, or the instance encountered a failure. You can choose to restart the instance or delete it.
 - Suspending:** A user has suspended the instance. The instance is suspended. You can choose to resume or delete it.

Using the describe command for an instance provides with all the information about an instance:

```
$ gcloud config set project PROJECT_ID
or to unset it, run:
$ gcloud config unset project
abhala@cloudshell:~ (projectakshay)$ gcloud compute instances list
Updated property [core/project].
abhala@cloudshell:~ (projectakshay)$ gcloud compute instances list
NAME        ZONE        MACHINE_TYPE PREEMPTIBLE INTERNAL_IP  EXTERNAL_IP    STATUS
instance-3  us-central1-a  e2-medium    true        10.128.0.2   35.225.150.163  RUNNING
instance-1  us-east1-b    e2-medium    false       10.142.0.2   35.237.221.171  RUNNING
instance-2  us-east1-b    e2-medium    false       10.142.0.3   35.196.120.102  RUNNING
abhala@cloudshell:~ (projectakshay)$
```

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute instances describe instance-1
Did you mean zone [us-east1-c] for instance: [instance-1] (Y/n)? n
No zone specified. Using zone [us-east1-b] for instance: [instance-1].
canIpForward: false
cpuPlatform: Intel Haswell
creationTimestamp: '2020-09-19T13:42:26.951-07:00'
deletionProtection: false
description: ''
disks:
- autoDelete: true
  boot: true
  deviceName: instance-1
  diskSizeGb: 10
  diskType: pd-ssd
  guestOsFeatures:
  - type: UEFI_COMPATIBLE
  - type: VIRTIO_SCSI_MULTIQUEUE
  interface: 0
  interfaceType: 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/projectakshay/zones/us-east1-b/disks/instance-1
    type: PERSISTENT
  displayType: false
  fingerprint: uQRhd367xM-
  id: '8585779986412852189'
  kind: paravirtual
  labelFingerprint: 42WmSpB8rSM=
  machineType: https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-east1-b/machineTypes/e2-medium
  metadata:
    fingerprint: e2TRYNNI-88-
    kind: compute#metadata
  name: instance-1
  networkInterfaces:
  - accessConfigures:
    - kind: compute#accessConfig
      name: External NAT
      natIP: 35.237.221.171
      networkTier: PREMIUM
```

e. Connecting to instances

i. Connecting to Linux instance from Browser

- On clicking the SSH button in an instance, an SSH connection is created to the instance on the default port. This way of connecting to an instance creates a key on its own. SSH connection helps an established connection to an instance to be secure due to encryption. Therefore, a public and a private key always needs to be created every time an SSH connection is to be established.

```
Connected, host fingerprint: ssh-rsa 0 81:CF:D9:FB:CA:48:5C:C1:53:8F:2B:CB:96:D5
:81:B3:92:7A:29:E6:C7:92:8B:2E:C4:12:8E:13:CC:A7:3C:C5
Linux instance-1 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 22:23:41 2020 from 35.237.221.171
abhala@instance-1:~$
```

ii. Connecting to Windows instances

- For connecting to Windows instance, we use Chrome RDP plugin which is a chrome application that lets you manage multiple Remote Desktop connections to Windows VM instances. Here, I installed the Chrome RDP plugin on my local computer. We first start by creating an instance , here, windows-instance and connect this instance through the Chrome RDP plugin.

Network interfaces	Name	IP range	Subnetwork	Primary internal IP	Alias IP ranges	External IP	Network Tier	IP forwarding	Network details
nic0	default			10.128.0.9	—	35.192.128.92 (ephemeral)	Premium	Off	View details

The screenshot shows the Google Cloud Platform Compute Engine interface. On the left, a sidebar lists various Compute Engine management options like VM instances, Instance groups, and Machine images. The main area displays a table of VM instances with columns for Name, Zone, Recommendation, In use by, Internal IP, External IP, and Connect. One instance, 'Windows instance', is highlighted with a blue border and an arrow pointing to it from the left.

Name	Zone	Recommendation	In use by	Internal IP	External IP	Connect
crdhost	us-central1-a			10.128.0.9 (nic0)	None	RDP
instance-1	us-east1-b			10.142.0.2 (nic0)	None	SSH
instance-2	us-east1-b			10.142.0.3 (nic0)	None	SSH
instance-3	us-central1-a			10.128.0.7 (nic0)	None	SSH

The screenshot shows the Windows Server Manager Dashboard. It features a 'QUICK START' section with steps: 1. Configure this local server, 2. Add roles and features, 3. Add other servers to manage, 4. Create a server group, and 5. Connect this server to cloud services. Below this is a 'WHAT'S NEW' section with a 'LEARN MORE' button. The main pane shows the Windows Server Start menu with icons for Server Manager, Windows PowerShell, Windows PowerShell ISE, Task Manager, Control Panel, Event Viewer, and File Explorer. A 'All Servers' summary card indicates 1 server managed, with details for Manageability, Events, Services, Performance, and BPA results. The taskbar at the bottom shows the date and time as 9/25/2020 2:31 AM.

iii. Special Administrative Console - Connecting to an instance through the command line

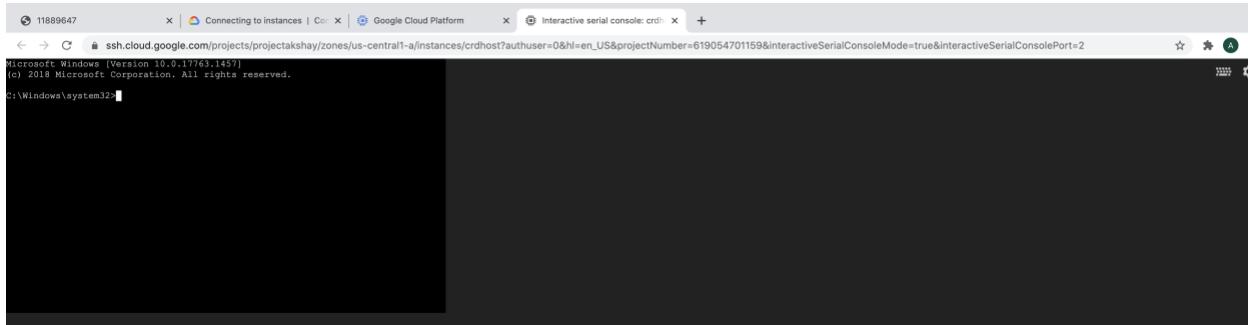
Code: SAC>cmd

The Command Prompt session was successfully launched.

SAC>

EVENT: A new channel has been created. Use "ch -?" for channel help.

```
Channel: Cmd0001
SAC> ch -sn cmd0001
Press any key to confirm connection to the channel.
```



f. Connecting to instances using advanced methods

i. Providing Public SSH keys to instances

- An SSH key is an access credential in the SSH protocol. Its function is similar to that of user names and passwords, but the keys are primarily used for automated processes. On clicking the SSH button in an instance, an SSH connection is created to the instance on the default port. This way of connecting to an instance creates a key on its own. SSH connection helps an established connection to an instance to be secure due to encryption. Therefore, a public and a private key always needs to be created every time an SSH connection is to be established.
- The Calculation Engine normally produces SSH keys. If we need to use our own SSH keys, we need to build our own SSH key pair and supply the instance with your public SSH key file before you can connect. Now, we have set up an os-login to supply the instance with SSH keys.

```
abhala@cloudshell: ~ [projectakshay]$ gcloud compute ssh --project projectakshay --zone us-east1-b instance-1
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.
This tool needs to create the directory [/home/abhala/.ssh] before
being able to generate SSH keys.

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

Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/abhala/.ssh/google_compute_engine.
Your public key has been saved in /home/abhala/.ssh/google_compute_engine.pub.
The key fingerprint is:
SHA256:JYqZBnGBzvc1RSy8cQliQq5FjoKmAoRVtluVwohLBE abhala@cs-327594034274-default-default-7fjtk
The key's randomart image is:
+---[RSA 2048]---+
|..+*=E=+..|
|*=-+ B=o+ |
|B=o + =*+ .|
|B.o ..o=+. |
|+ ...oS .|
|. .... o |
|. .... o |
|. .... o |
|. .... o |
+---[SHA256]---+
Updating project ssh metadata...:Updated [https://www.googleapis.com/compute/v1/projects/projectakshay].
Updating project ssh metadata...done.
Waiting for SSH key to propagate.
Warning: Permanently added 'compute.8585779986412852189' (ECDSA) to the list of known hosts.
Linux instance-1 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 21:14:13 2020 from 35.235.240.50
abhala@instance-1:~$
```

ii. Connecting using third-party tools (SSH)

- For this stage, we generate keys on mac using the local terminal and provide the instance with the public SSH key. SSH access control becomes simpler by making OS login, and we do not need to handle keys across multiple VM instance.

```
(base) abhala-MBP:~ abhala$ ssh-keygen -t rsa -f ~/Desktop/key -C techamatic
Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /Users/abhala/Desktop/key.
Your public key has been saved in /Users/abhala/Desktop/key.pub.
The key fingerprint is:
SHA256:x88kqjtbHhiJTauFVMTz1Y+Nqv/N0e2dZ8EVQm5PWFU techamatic
The key's randomart image is:
----[RSA 3072]----+
  oo    ... .E|
  .o   . o.o. |
  . .o . 0... |
  . = o.. + = .|
  o * S +... ...|
  o o o.= +.|
  . . +. o . +|
  .+... o o=|
  ++..... oo+|
----[SHA256]----+
```

g. Creating Customized Boot Disks

i. Creating a standalone root persistent disk from an image

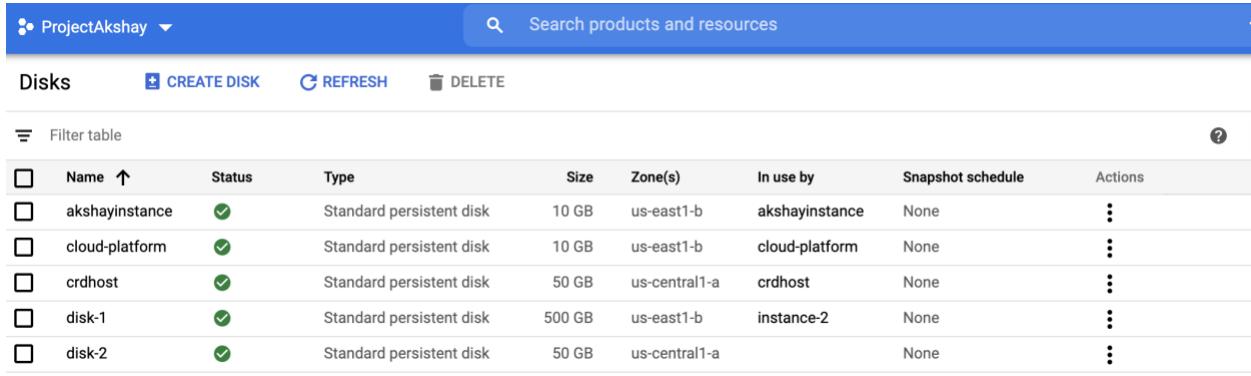
- **Boot persistent disks:** Persistent disks are durable network storage devices that your instances can access like physical disks in a desktop or a server. The data on each persistent disk is distributed across several physical disks.
- You can create a standalone boot persistent disk outside of instance creation and attach it to an instance afterwards.

The screenshot shows the 'Create a disk' page in the Google Cloud Platform Compute Engine section. The left sidebar lists various Compute Engine components: VM instances, Instance groups, Instance templates, Sole-tenant nodes, Machine images, Disks (selected), Snapshots, Images, TPUs, Migrate for Compute Engine, Committed use discounts, Metadata, Health checks, Zones, Network endpoint groups, Operations, Security scans, OS patch management (NEW), Settings, and Marketplace. The main form is titled 'Create a disk' and contains the following fields:

- Name:** disk-2
- Description (Optional):** (empty)
- Type:** Standard persistent disk
- Region:** us-central1 (Iowa)
- Zone:** us-central1-a
- Snapshot schedule:** No schedule
- Source type:** Image (selected)
- Source image:** c0-common-gce-gpu-image-20200128
- Size (GB):** 50
- Estimated performance:**

Operation type	Read	Write
Sustained random IOPS limit	37.50	75.00
Sustained throughput limit (MB/s)	6.00	6.00
- Encryption:** Data is encrypted automatically. Select an encryption key management solution.
 - Google-managed key (No configuration required)
 - Customer-managed key (Manage via Google Cloud Key Management Service)
 - Customer-supplied key (Manage outside of Google Cloud)

- Successful Creation of disk:



The screenshot shows the Google Cloud Platform interface for managing disks. The top navigation bar includes 'ProjectAkshay' and a search bar. Below it, a toolbar has 'Disks', 'CREATE DISK', 'REFRESH', and 'DELETE' buttons. A 'Filter table' button is also present. The main area displays a table of five persistent disks:

<input type="checkbox"/>	Name	Status	Type	Size	Zone(s)	In use by	Snapshot schedule	Actions
<input type="checkbox"/>	akshayinstance	✓	Standard persistent disk	10 GB	us-east1-b	akshayinstance	None	⋮
<input type="checkbox"/>	cloud-platform	✓	Standard persistent disk	10 GB	us-east1-b	cloud-platform	None	⋮
<input type="checkbox"/>	crdhost	✓	Standard persistent disk	50 GB	us-central1-a	crdhost	None	⋮
<input type="checkbox"/>	disk-1	✓	Standard persistent disk	500 GB	us-east1-b	instance-2	None	⋮
<input type="checkbox"/>	disk-2	✓	Standard persistent disk	50 GB	us-central1-a		None	⋮

h. Creating SQL Server instances

- An SQL Server instance is a complete SQL server and you can install many instances on a machine but you can have only 1 default instance.
- We create an instance using the root disk as an SQL server. Attributes are set according to the configuration an SQL Server requires for efficient performance such as 2CPUs, etc. SQL Server provides a database structure that can be manipulated by a database management system.

The screenshot shows the configuration interface for creating a new VM instance. Key settings include:

- VM Type:** e2-medium (2 vCPU, 4 GB memory)
- Processor:** vCPU (1 shared core)
- Memory:** 4 GB
- GPU:** -
- CPU platform and GPU:** A warning message states: "⚠️ The current configuration may slow performance. 4 vCPUs are the minimum required for SQL Server Enterprise."
- Confidential VM service:** Enable the Confidential Computing service on this VM instance.
- Container:** Deploy a container image to this VM instance. [Learn more](#)
- Boot disk:** New 50 GB standard persistent disk (Image: SQL Server 2012 Enterprise on Win...). [Change](#)
- Identity and API access:**
 - Service account:** Compute Engine default service account
 - Access scopes:** Allow default access, Allow full access to all Cloud APIs, Set access for each API
- Firewall:** Add tags and firewall rules to allow specific network traffic from the Internet.
 - Allow HTTP traffic
 - Allow HTTPS traffic
- Management, security, disks, networking, sole tenancy:**

You will be billed for this instance. [Compute Engine pricing](#)

Create **Cancel**

- We also create a firewall for the SQL instance to allow all the incoming traffic on the port 1433 / all. This allows the external SQL Management studio to connect to the instance in order to manage the database in the SQL Server.
- The following shows the successful creation of the firewall and it is linked to the SQL instance.

The screenshot shows the Google Cloud Firewall rules table for the project "ProjectAkshay". The table includes columns for Name, Type, Targets, Filters, Protocols / ports, Action, Priority, Network, Logs, Hit count, Last hit, and Insights. A search bar at the top allows filtering by product and resource name.

	Name	Type	Targets	Filters	Protocols / ports	Action	Priority	Network	Logs	Hit count	Last hit	Insights
<input type="checkbox"/>	vm1-allow-egress-tcp-port80-to-vm1	Egress	Apply to all	IP ranges: 192.168.1	tcp:80	Allow	60	auto-mode	Off	—	—	▼
<input type="checkbox"/>	vm1-allow-egress-tcp-port443-to-192.0.2.5	Egress	webserver	IP ranges: 192.0.2.5/	tcp:443	Allow	70	auto-mode	Off	—	—	▼
<input type="checkbox"/>	deny-all-access	Egress	Apply to all	IP ranges: 0.0.0.0/0	tcp	Deny	1000	auto-mode	Off	—	—	▼
<input type="checkbox"/>	vm1-allow-ingress-tcp-port80-from-subnet1	Ingress	webserver	IP ranges: 10.240.10	tcp:80	Allow	50	auto-mode	Off	—	—	▼
<input type="checkbox"/>	vm1-allow-ingress-tcp-ssh-from-vm2	Ingress	webserver	Tags: database	tcp:22	Allow	80	auto-mode	Off	—	—	▼
<input type="checkbox"/>	deny-subnet1-webserver-access	Ingress	webserver	IP ranges: 0.0.0.0/0	tcp	Deny	1000	auto-mode	Off	—	—	▼
<input checked="" type="checkbox"/>	fire-akshay	Ingress	Apply to all	IP ranges: 0.0.0.0/0	all	Allow	1000	auto-mode	On ⓘ	0	No hits	▼
<input type="checkbox"/>	auto-mode-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	icmp	Allow	65534	auto-mode	Off	—	—	▼
<input type="checkbox"/>	auto-mode-allow-internal	Ingress	Apply to all	IP ranges: 10.128.0.0/16	all	Allow	65534	auto-mode	Off	—	—	▼
<input type="checkbox"/>	akshay	Ingress	Apply to all	IP ranges: 34.67.92.0/24	all	Allow	1000	default	Off	—	—	▼

Section 3: Manage Your Instances

A. Stopping an Instance (GCloud)

```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to projectakshay.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
abhala@cloudshell:~ (projectakshay)$ gcloud compute instances stop instance-1
Did you mean zone [us-east1-b] for instance: [instance-1] (Y/n)? n

No zone specified. Using zone [us-east1-b] for instance: [instance-1].
Stopping instance(s) instance-1...done.
Updated [https://compute.googleapis.com/compute/v1/projects/projectakshay/zones/us-east1-b/instances/instance-1].
```

B. Deleting an Instance (GCloud)

```
Did you mean zone [us-east1-b] for instance: [instance-3] (Y/n)? n

No zone specified. Using zone [us-central1-a] for instance: [instance-3].
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.
- [instance-3] in [us-central1-a]

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

Deleted [https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-central1-a/instances/instance-3].
abhala@cloudshell:~ (projectakshay)$
```

C. Moving an instance between zones (GCloud)

As seen, the zone of instance-5 changes from us-central1-a to us-central1-f as desired.

Name	Zone	Recommendation	In use by	Internal IP	External IP	Connect
crdhost	us-central1-a			10.128.0.9 (nic0)	None	RDP ▾
instance-1	us-east1-b			10.142.0.2 (nic0)	None	SSH ▾
instance-2	us-east1-b			10.142.0.3 (nic0)	None	SSH ▾
instance-3	us-central1-a			10.128.0.7 (nic0)	None	SSH ▾
instance-5	us-central1-a			10.128.0.11 (nic0)	34.67.92.11	SSH ▾

D. Performing Other Tasks With Your Instances:

I. Copy files between an instance and local computer

- I created a file named file-1.txt on my Local machine's desktop and I have successfully copied it to the instance instance-1 (public image) folder named abhala_g_syr_edu using the gcloud compute scp command to copy files between local machine and an instance:

```
Last login: Mon Sep 21 22:26:54 on ttys000
[akshaybhala@MacBook-Pro ~ % gcloud compute scp /Users/akshaybhala/file-1.txt instance-1:/home/abhala_g_syr_edu
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/akshaybhala/.ssh/google_compute_engine.
Your public key has been saved in /Users/akshaybhala/.ssh/google_compute_engine.pub.
The key fingerprint is:
SHA256:7dWpvCTPiFDg4uYaZEAKS+suP+pmkJpJHHWGhcZolu0 akshaybhala@MacBook-Pro
The key's randomart image is:
+---[RSA 3072]---+
|...+= . |
|.+.0 o |
|o.= + . |
|.= . . o . . |
|ooo o S o o o |
|+o E o . o o + |
|=+ . o o . + |
|=+. + . o = |
|=o.. . . . o o|
+---[SHA256]---+
No zone specified. Using zone [us-east1-b] for instance: [instance-1].
Warning: Permanently added 'compute.8585779986412852189' (ECDSA) to the list of known hosts.
file-1.txt          100%   373      6.0KB/s  00:00
akshaybhala@MacBook-Pro ~ %
```

The following is the SSH from the browser listing the folder's content after successful operation:

```
ssh.cloud.google.com/projects/projectakshay/zones/us-east1-b/instances/instance-1?useAdminProxy=true&authuser=0&hl=en_US&projectNumber=619054701159
connected, host fingerprint: ssh-rsa 0 81:CF:D9:FB:CA:48:5C:15:3:8F:2B:C8:96:D5
B1:A3:92:7A:29:E6:C7:92:8B:2E:04:12:8E:13:C1:7A:3:C1:CD
Linux instance-1 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: Tue Sep 22 02:23:59 2020 from 74.125.45.81
abhala@ProjectAkshay:~$ ls
file-1.txt
abhala@ProjectAkshay:~$
```

E. Setting Access Control

a. Creating a Service account

- A service account is an account linked with an application or a VM instead of a user account. The role given to a service account can be used by anyone having access to that service account. Created a service account with the following roles:

	Status	Name	Description	Key ID	Key creation date	Actions
<input type="checkbox"/>	Green checkmark	akshay		No keys		⋮

b. Setting up a new instance to run as a service account (Console and GCloud)

- The instances created with this service account will allow users with that service account to have access to the VM the way it is provided by the roles of the service account i.e. this service account allows the VM to be edited due to the editor role. A VM can have a single service account.

Boot disk ?

New 10 GB standard persistent disk
Image: Debian GNU/Linux 10 (buster) Change

Identity and API access ?

Service account ?
akshay

Access scopes ?
Use IAM roles with service accounts to control VM access [Learn more](#)

Firewall ?
Add tags and firewall rules to allow specific network traffic from the Internet

Allow HTTP traffic
 Allow HTTPS traffic

▼ Management, security, disks, networking, sole tenancy

CLOUD SHELL Terminal (projectakshay) + + Open Editor

```
Did not print [23] options.
Too many options [73]. Enter "list" at prompt to print choices fully.
Please enter your numeric choice: 46

ERROR: (gcloud.compute.instances.create) Could not fetch resource:
- The resource 'projects/projectakshay/zones/us-east1-b/instances/serviceinstance' already exists

abhala@cloudshell:~ (projectakshay)$ gcloud compute instances create akshayinstance --service-account akshay@projectakshay.iam.gserviceaccount.com --scopes cloud-platform
Did you mean zone [us-east1-b] for instance: [akshayinstance] (Y/n)? Y

Created [https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-east1-b/instances/akshayinstance].
NAME          ZONE        MACHINE_TYPE  PREEMPTIBLE INTERNAL_IP  EXTERNAL_IP    STATUS
akshayinstance us-east1-b  n1-standard-1      10.142.0.7   34.74.126.187  RUNNING
abhala@cloudshell:~ (projectakshay)$
```

c. Changing the service account and access scopes for an instance

- Apps running on your instances can authorize and interact with Google Cloud APIs through a service account.
- To change an instance's service account and access scopes, the instance must be temporarily stopped
- Use the command `instances set-service-account` and provide the instance name, the service account email, and the desired scopes.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute instances set-service-account akshayinstance --service-account akshay@projectakshay.iam.gserviceaccount.com --scopes compute-rw,storage-ro
Did you mean zone [us-east1-b] for instance: [akshayinstance] (Y/n)? Y

Updated [https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-east1-b/instances/akshayinstance].
abhala@cloudshell:~ (projectakshay)$
```

Section 4: Creating and Managing Instance Templates

a. Creating instance templates

i. Creating an instance template (GCloud)

- Instance templates define the machine type, boot disk image or container image, labels, and other instance properties. It can be used to create VMs later on, either a single instance or a group of instances. An instance template cannot be updated and requires creation of whole another template if any changes occur.

The screenshot shows the Google Cloud Platform interface for managing instance groups. On the left, there's a sidebar with icons for Instance groups, Instance templates (which is the active tab), Sole-tenant nodes, Machine images, Disks, Snapshots, Images, and Marketplace. The main area has a title 'Instance groups' and a sub-section 'Instance templates'. Below this, there's a table with one row:

Name	Machine type	Image	Disk type	Placement policy	In use by	Creation t
instance-new	1 vCPU, 3.75 GB	debian-10	Standard persistent disk	No policy		Sep 20, 2020 5:07:06 P

CLOUD SHELL Terminal (projectakshay) + +

```
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.
- [instance-3] in [us-central1-a]

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

Deleted [https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-central1-a/instances/instance-3].
abhala@cloudshell:~ (projectakshay)$ gcloud compute instance-templates create instance-new
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/instanceTemplates/instance-new].
NAME          MACHINE_TYPE  PREEMPTIBLE  CREATION_TIMESTAMP
instance-new  n1-standard-1      2020-09-20T14:07:06.151-07:00
```

b. Creating an instance template that specifies a subnet

Using this template to create instances for a managed instance group (with or without autoscaling) automatically creates the instance in the specified region and subnet. This lets you control the subnet of new instances created for load balancing. It allows an instance to be in a selected network rather than globally.

Name	Machine type	Image	Disk type	Placement policy	In use by	Creation time
instance-new	1 vCPU, 3.75 GB	debian-10	Standard persistent disk	No policy		Sep 20, 2020, 5:07:06 PM
instance-new-1	1 vCPU, 3.75 GB	debian-10	Standard persistent disk	No policy		Sep 20, 2020, 5:10:39 PM

```

- Invalid value for field 'region': 'us-central1-f'. Unknown region.
abhala@cloudshell:~ (projectakshay)$ gcloud compute instance-templates create instance-new-1 --region us-central1 --subnet default
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/instanceTemplates/instance-new-1].
NAME          MACHINE_TYPE  PREEMPTIBLE  CREATION_TIMESTAMP
instance-new-1  n1-standard-1    2020-09-20T14:10:39.639-07:00
abhala@cloudshell:~ (projectakshay)$ 

```

Section 5: Creating and Managing Groups of Instances

A. Creating a managed instance group

a. Creating a managed instance group (Console and GCloud)

- A managed group of instances allows us to manage multiple instances at a time and not individually. So, any change to the group's configuration changes the configuration of all the instances in that group. Managed instance group provides identical instances.

Console:

Name	Zone	Instances	Template	Group type	Creation time	Recommendation	Autoscaling	In use by
instance-group-1	us-central1-a	1	instance-new	Managed	Sep 20, 2020, 5:13:54 PM			On Target CPU utilization 60%

Gcloud:

Creating managed instance group from GCloud. As shows, managed keyword is used for managed group and template used is insttemp. The name given to the instances in the group is instance-group-new.

Name	Zone	Instances	Template	Group type	Creation time	Recommendation	Autoscaling	In use by
instance-group-1	us-central1-a	1	instance-new	Managed	Sep 20, 2020, 5:13:54 PM		On: Target CPU utilization 60%	
instance-group-new	us-central1-a	3	instance-new-	Managed	Sep 20, 2020, 5:21:19 PM		No configuration	

CLOUD SHELL Terminal (projectakshay) + ~ abhala@cloudshell:~ (projectakshay)\$ gcloud compute instance-groups managed create instance-group-new \
> --base-instance-name test \
> --size 3 \
> --instance-template instance-new-1 \
> --zone us-central1-a
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/zones/us-central1-a/instanceGroupManagers/instance-group-new].
NAME MACHINE_TYPE PREEMPTIBLE CREATION_TIMESTAMP
instance-group-new us-central1-a zone test 0 3 instance-new-1 no
abhala@cloudshell:~ (projectakshay)\$

b. Creating groups of preemptible instances

- A preemptible VM is an instance that you can create and run at a much lower price than normal instances.
- You can use managed instance groups to quickly create multiple preemptible instances, which can reduce the costs of the VMs in your managed instance groups. To create a group of A preemptible VM is an instance that you can create and run at a much lower price than normal instances.
- You can use managed instance groups to quickly create multiple preemptible instances, which can reduce the costs of the VMs in your managed instance groups. To create a group of preemptible instances, set the preemptible option in an instance template, and then use the template to create the managed instance group.
- In gcloud compute, create an instance template using the instance-templates create command. Include the --preemptible flag.

```
To search the help text of gcloud commands, run:
gcloud help -- SEARCH_TERMS
abhala@cloudshell:~ (projectakshay)$ gcloud compute instance-templates create new \
> --preemptible
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/instanceTemplates/new].
NAME           MACHINE_TYPE   PREEMPTIBLE  CREATION_TIMESTAMP
new            n1-standard-1  true         2020-09-20T14:28:45.926-07:00
abhala@cloudshell:~ (projectakshay)$
```

B. Setting up a health check and an autohealing policy (Console and GCloud)

- Managed instance groups (MIGs) maintain high availability of your applications by proactively keeping your virtual machine (VM) instances available, which means in Running state. If a managed instance stops running, but the change of state was not initiated by the MIG, then the MIG automatically recreates that instance.
- For example, create a health check that looks for a response on port 80 and that can tolerate some failure before it marks VMs as UNHEALTHY and causes them to be recreated. In this example, a VM is marked as healthy if it returns successfully once. It is marked as unhealthy if it returns unsuccessfully 3 consecutive times.
- Make sure your network firewall rules allow the health check to connect. For this example, our MIG uses the default network and its VMs are listening on port 80. If port 80 is not already open on the default network, create a firewall rule.
- Apply the health check by configuring an autohealing policy for your regional or zonal MIG. Under Autohealing, select the health check that you created previously.
- After the group creation or health check configuration update completes, it can take 30 minutes before autohealing begins monitoring instances in the group.

The screenshot shows the Google Cloud Compute Engine interface under the 'Health checks' section. On the left sidebar, there are links for VM instances, Instance groups, Instance templates, Sole-tenant nodes, and Machine images. The main area displays a table of health checks. The table has columns for Name, Scope, Region, Host, Path, Protocol, Port, and In use by. There are three entries: 'check' (Global scope, Host /, Path /, Protocol HTTP, Port 80, In use by), 'example-check' (Global scope, Host /, Path /, Protocol HTTP, Port 80, In use by), and a header row for 'Name ↑'. A 'CREATE HEALTH CHECK' button is at the top of the table.

Health checks								
+ CREATE HEALTH CHECK REFRESH DELETE								
Google account: Akshay Pradeep Bhala (abhala@g.syr.edu)								
<input type="checkbox"/>	Name ↑	Scope	Region	Host	Path	Protocol	Port	In use by
<input type="checkbox"/>	check	Global		/		HTTP	80	
<input type="checkbox"/>	example-check	Global		/		HTTP	80	

GCLOUD:

- Create a health check for autohealing that is more conservative than a load balancing health check.
- Create a firewall rule to allow health check probes to connect to your app.
- Apply the health check by configuring an auto healing policy for your regional or zonal MIG. Use the update command to apply the health check to the MIG. The initial delay setting delays auto healing from potentially prematurely recreating the VM if the VM is in the process of starting up. The initial delay timer starts when the currentAction of the VM is VERIFYING.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute health-checks create http example-check --port 80 \
>      --check-interval 30s \
>      --healthy-threshold 1 \
>      --timeout 10s \
>      --unhealthy-threshold 3
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/healthChecks/example-check].
NAME        PROTOCOL
example-check  HTTP
abhala@cloudshell:~ (projectakshay) $
```

Section 6: Virtual Private Cloud (VPC)

i. Using VPC networks

a. Creating networks

1. Creating an auto mode network (Console)

- The following shows that auto mode is selected, hence all the regions are selected on its own:

The screenshot shows the Google Cloud VPC network interface. On the left sidebar, there are links for VPC networks, External IP addresses, Firewall, Routes, VPC network peering, Shared VPC, Serverless VPC access, and Packet mirroring. The main area displays a table of VPC networks. The table has columns for Name, Region, Subnets, Mode, IP address ranges, Gateways, Firewall Rules, Global dynamic routing, and Flow logs. There are six entries, each with 'auto-mode' selected in the Mode column. The regions listed are us-central1, europe-west1, us-west1, asia-east1, and us-east1. The table also shows IP ranges like 10.128.0.0/20, 10.132.0.0/20, etc., and gateways like 10.128.0.1, 10.132.0.1, etc.

VPC networks								
+ CREATE VPC NETWORK REFRESH								
Google account: Akshay Pradeep Bhala (abhala@g.syr.edu)								
<input type="checkbox"/>	Name ↑	Region	Subnets	Mode	IP address ranges	Gateways	Firewall Rules	Global dynamic routing
<input type="checkbox"/>	auto-mode	24		Auto			2	Off
<input type="checkbox"/>	us-central1				10.128.0.0/20	10.128.0.1		Off
<input type="checkbox"/>	europe-west1				10.132.0.0/20	10.132.0.1		Off
<input type="checkbox"/>	us-west1				10.138.0.0/20	10.138.0.1		Off
<input type="checkbox"/>	asia-east1				10.140.0.0/20	10.140.0.1		Off
<input type="checkbox"/>	us-east1				10.142.0.0/20	10.142.0.1		Off

2. Creating a custom mode network (GCloud)

- when a custom mode VPC network is created, no subnets are automatically created. This type of network provides you with complete control over its subnets and IP ranges. You decide which subnets to create in regions that you choose by using IP ranges that you specify.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks create customn \
> --subnet-mode=custom \
> --bgp-routing-mode=Regional
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/networks/customn].
Instances on this network will not be reachable until firewall rules
```

b. Working with subnets

1. Listing subnets (GCloud)

- You can list all subnets in all networks in your project, or you can show only the subnets for a particular network or region.

```
customn      asia-southeast2      customn      10.184.0.0/20
default      asia-southeast2     default      10.184.0.0/20
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks subnets list \
> --network=NETWORK
Listed 0 items.
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks subnets list \
> --filter="region:( us-central1-a)"
Listed 0 items.
abhala@cloudshell:~ (projectakshay)$
```

2. Describing a subnet (GCloud)

- You can view details of an existing subnet, such as its primary IP range, any secondary IP ranges, and its region.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks subnets describe default \
> --region=us-central
creationTimestamp: '2020-09-19T13:33:12.402-07:00'
fingerprint: Id-ctYaoHUQ=
gatewayAddress: 10.128.0.1
id: '6261249956746352103'
ipCidrRange: 10.128.0.0/20
kind: compute#subnetwork
name: default
network: https://www.googleapis.com/compute/v1/projects/projectakshay/global/networks/default
privateIpGoogleAccess: false
purpose: PRIVATE
region: https://www.googleapis.com/compute/v1/projects/projectakshay/regions/us-central1
selfLink: https://www.googleapis.com/compute/v1/projects/projectakshay/regions/us-central1/subnetworks/default
abhala@cloudshell:~ (projectakshay)$
```

3. Adding subnets (GCloud)

- When you create a subnet, you set a name, a region, and at least a primary IP address range according to the subnet rules.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks subnets create newsub \
>   --network=default \
>   --range=10.64.0.0/10 \
>   --region=europe-west1
Created [https://www.googleapis.com/compute/v1/projects/projectakshay/regions/europe-west1/subnetworks/newsub].
NAME      REGION      NETWORK      RANGE
newsub    europe-west1  default    10.64.0.0/10
```

4. Deleting subnets (GCloud)

- Before you can delete a subnet, you must delete all resources that use it.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks subnets delete newsub \
>   --region=europe-west1
The following subnetworks will be deleted:
- [newsub] in [europe-west1]

Do you want to continue (Y/n)? Y
Deleted [https://www.googleapis.com/compute/v1/projects/projectakshay/regions/europe-west1/subnetworks/newsub].
```

c. Modifying networks

1. Deleting a network (GCloud)

- In order to delete a network, I first delete the firewall linked to the network, so that I'm allowed to delete the network. This is because of different dependencies.

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute networks delete customn
The following networks will be deleted:
- [customn]

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

Deleted [https://www.googleapis.com/compute/v1/projects/projectakshay/global/networks/customn].
```

iii. Using firewall rules:

a. Creating Firewall Rules (Console)

VPC network	Firewall	+ CREATE FIREWALL RULE	REFRESH	CONFIGURE LOGS	DELETE																														
■ VPC networks																																			
■ External IP addresses																																			
■ Firewall	Firewall rules control incoming or outgoing traffic to an instance. By default, incoming traffic from outside your network is blocked. Learn more																																		
■ Routes																																			
■ VPC network peering																																			
■ Shared VPC																																			
■ Serverless VPC access																																			
■ Packet mirroring																																			
	Filter table																																		
	<table border="1"> <thead> <tr> <th>Name</th> <th>Type</th> <th>Targets</th> <th>Filters</th> <th>Protocols / ports</th> <th>Action</th> <th>Priority</th> <th>Network ↑</th> <th>Logs</th> <th>Hit count</th> </tr> </thead> <tbody> <tr> <td>fire-akshay</td> <td>Ingress</td> <td>Apply to all</td> <td>IP ranges: 0.0.0.0/0</td> <td>all</td> <td>Allow</td> <td>1000</td> <td>auto-mode</td> <td>On</td> <td>1</td> </tr> <tr> <td>auto-mode-allow-icmp</td> <td>Ingress</td> <td>Apply to all</td> <td>IP ranges: 0.0.0.0/0</td> <td>icmp</td> <td>Allow</td> <td>65534</td> <td>auto-mode</td> <td>Off</td> <td>1</td> </tr> </tbody> </table>	Name	Type	Targets	Filters	Protocols / ports	Action	Priority	Network ↑	Logs	Hit count	fire-akshay	Ingress	Apply to all	IP ranges: 0.0.0.0/0	all	Allow	1000	auto-mode	On	1	auto-mode-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	icmp	Allow	65534	auto-mode	Off	1				
Name	Type	Targets	Filters	Protocols / ports	Action	Priority	Network ↑	Logs	Hit count																										
fire-akshay	Ingress	Apply to all	IP ranges: 0.0.0.0/0	all	Allow	1000	auto-mode	On	1																										
auto-mode-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	icmp	Allow	65534	auto-mode	Off	1																										

b. Configuration examples - Recreate sample network configurations in the scenarios listed below

1. Example 1: Deny all ingress TCP connections except those to port 80 from subnet1

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute firewall-rules create vml-allow-ingress-tcp-port80-from-subnet1 \
> --network auto-mode \
> --action allow \
> --direction ingress \
> --rules tcp:80 \
> --source-ranges 10.240.10.0/24 \
> --priority 50 \
> --target-tags webserver
Creating firewall...Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/firewalls/vml-allow-ingress-tcp-port80-from-subnet1].
Creating firewall...done.
NAME          NETWORK   DIRECTION  PRIORITY ALLOW  DENY  DISABLED
vml-allow-ingress-tcp-port80-from-subnet1  auto-mode  INGRESS    50      tcp:80  False
```

2. Example 2: Deny all egress TCP connections except those to port 80 of vm1

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute firewall-rules create deny-all-access \
> --network auto-mode \
> --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/projectakshay/global/firewalls/deny-all-access].
Creating firewall...done.
NAME          NETWORK   DIRECTION  PRIORITY ALLOW  DENY  DISABLED
deny-all-access  auto-mode  EGRESS    1000      tcp   False
abhala@cloudshell:~ (projectakshay)$ gcloud compute firewall-rules create vml-allow-egress-tcp-port80-to-vml \
> --network auto-mode \
> --action allow \
> --direction egress \
> --rules tcp:80 \
> --destination-ranges 192.168.1.2/32 \
> --priority 60
Creating firewall...Created [https://www.googleapis.com/compute/v1/projects/projectakshay/global/firewalls/vml-allow-egress-tcp-port80-to-vml].
Creating firewall...done.
NAME          NETWORK   DIRECTION  PRIORITY ALLOW  DENY  DISABLED
vml-allow-egress-tcp-port80-to-vml  auto-mode  EGRESS    60      tcp:80  False
abhala@cloudshell:~ (projectakshay)$
```

3. Example 3: Allow egress TCP connections to port 443 of an external host

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute firewall-rules create vm1-allow-egress-tcp-port443-to-192-0-2-5 \
>   --network auto-mode \
>   --action allow \
>   --direction egress \
>   --rules tcp:443 \
>   --destination-ranges 192.0.2.5/32 \
>   --priority 70 \
>   --target-tags webserver
Creating firewall...done.
NAME          NETWORK  DIRECTION  PRIORITY  ALLOW  DENY  DISABLED
vm1-allow-egress-tcp-port443-to-192-0-2-5  auto-mode  EGRESS    70      tcp:443  False
```

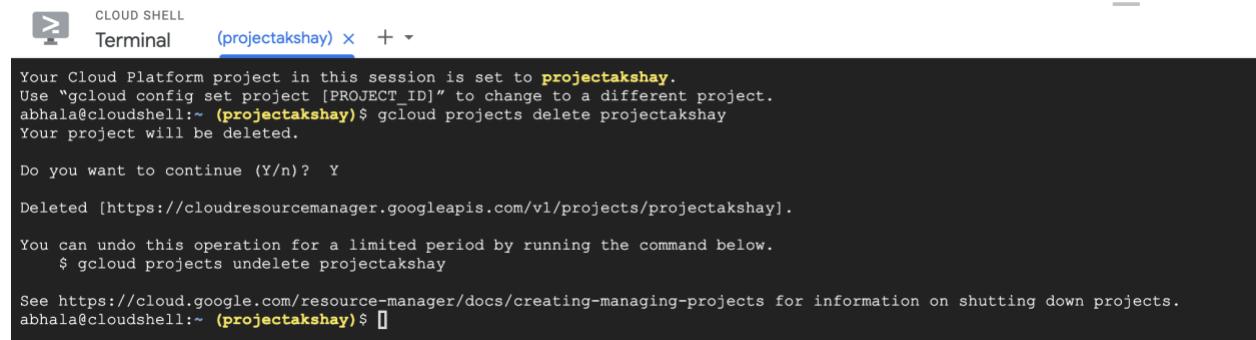
4. Example 4: Allow SSH connections from vm2 to vm1

```
abhala@cloudshell:~ (projectakshay)$ gcloud compute firewall-rules create vm1-allow-ingress-tcp-ssh-from-vm2 \
>   --network auto-mode \
>   --action allow \
>   --direction ingress \
>   --rules tcp:22 \
>   --source-tags database \
>   --priority 80 \
>   --target-tags webserver
Creating firewall...done.
NAME          NETWORK  DIRECTION  PRIORITY  ALLOW  DENY  DISABLED
vm1-allow-ingress-tcp-ssh-from-vm2  auto-mode  INGRESS   80      tcp:22  False
abhala@cloudshell:~ (projectakshay)$
```

Section 7: Clean UP

You can shut down projects using the Cloud Console or the `projects.delete()` method.

A project must have a life-cycle state of ACTIVE to be shut down in this way. `gcloud projects delete PROJECT_ID_OR_NUMBER`: Deletes the project with the given project ID.



```
CLOUD SHELL
Terminal (projectakshay) + ▾

Your Cloud Platform project in this session is set to projectakshay.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
abhala@cloudshell:~ (projectakshay)$ gcloud projects delete projectakshay
Your project will be deleted.

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

Deleted [https://cloudresourcemanager.googleapis.com/v1/projects/projectakshay].
You can undo this operation for a limited period by running the command below.
$ gcloud projects undelete projectakshay

See https://cloud.google.com/resource-manager/docs/creating-managing-projects for information on shutting down projects.
abhala@cloudshell:~ (projectakshay)$ []
```