1. GCP Configurations

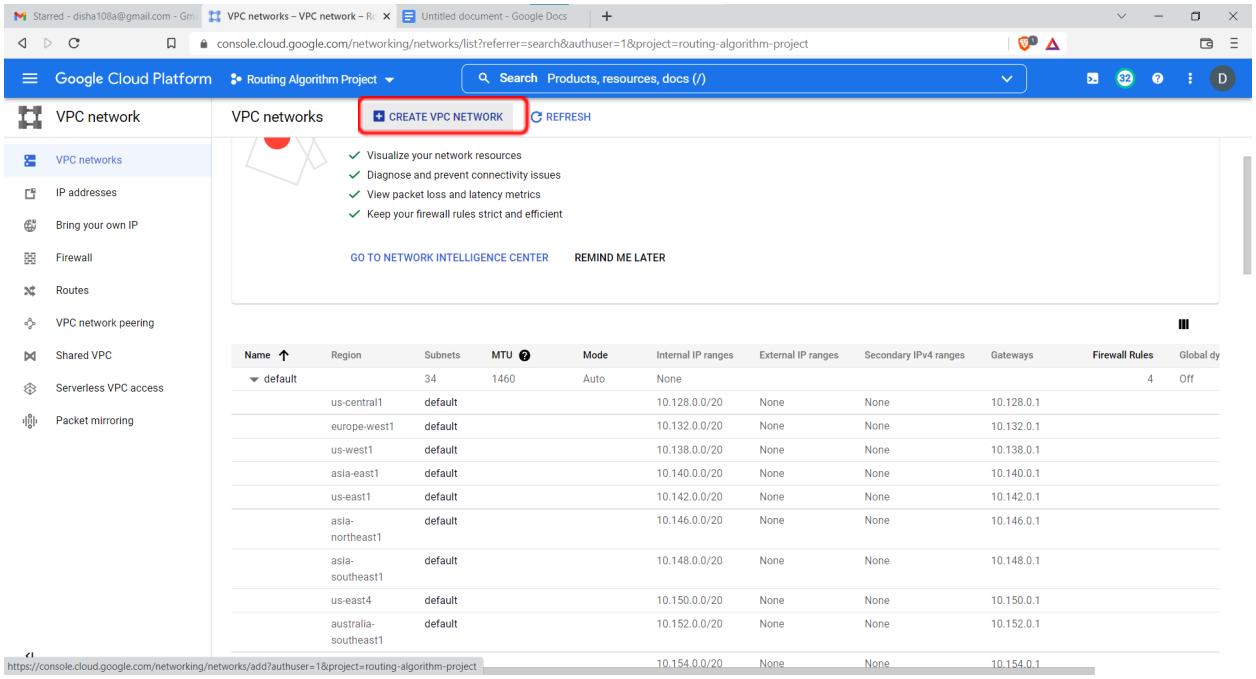
Our project is done in the Google Cloud Platform (GCP). We have mainly used two services provided by GCP:

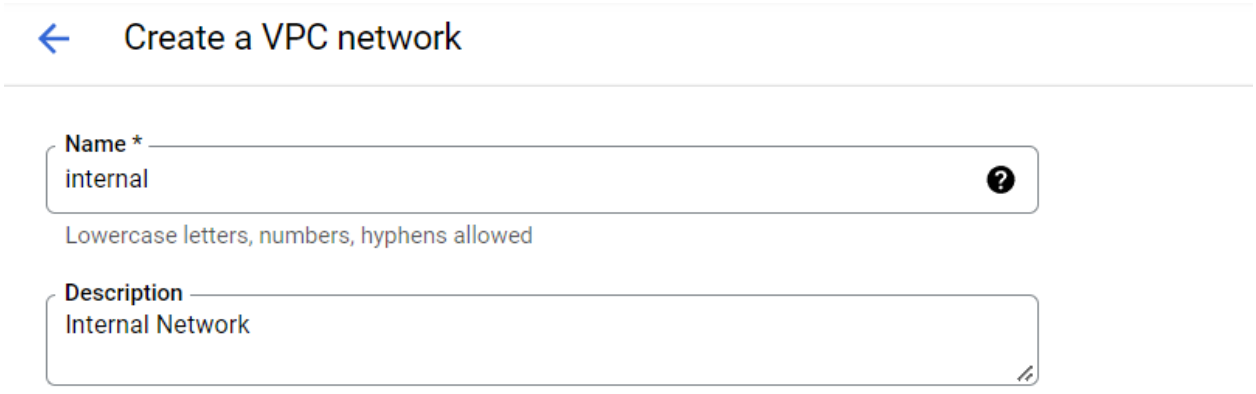
1.1. VPC Setup

Google Cloud Platform provides us with a default VPC network called “default” as shown below:

Name	Region	Subnets	MTU	Mode	Internal IP ranges	External IP ranges	Secondary IPv4 ranges	Gateways	Firewall Rules	Global dy
default		34	1460	Auto	None				4	Off
	us-central1	default			10.128.0.0/20	None	None	10.128.0.1		
	europe-west1	default			10.132.0.0/20	None	None	10.132.0.1		
	us-west1	default			10.138.0.0/20	None	None	10.138.0.1		

But we have used a different network of our own. To create a VPC network, we followed the below steps:

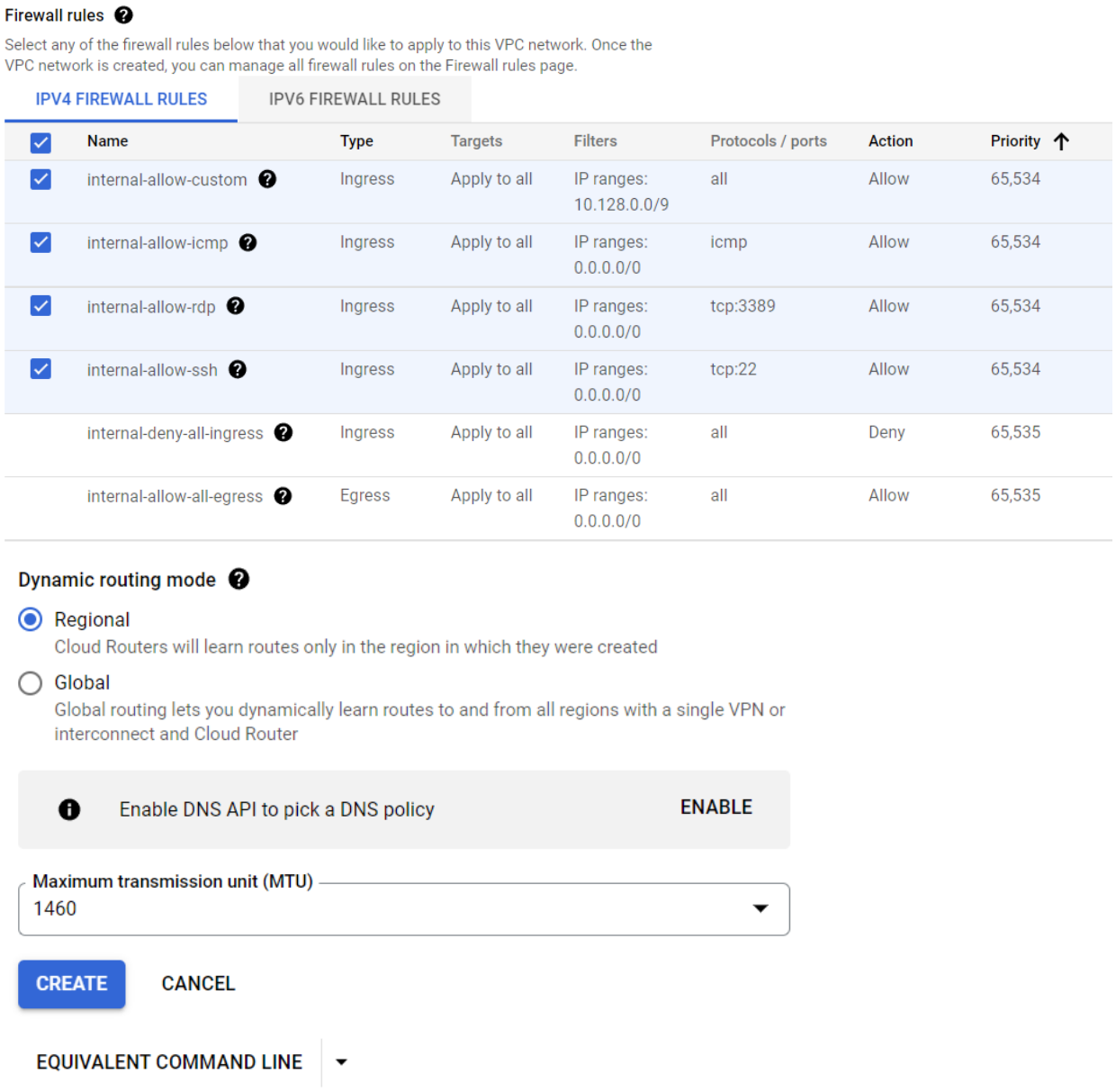




Name of the VPC network should be unique.

The firewall rules associated with this VPC network are:

- allowing ssh
- allowing icmp
- allowing rdp connections
- allowing internal connections between virtual machines in the network



After choosing these necessary configurations we can click on the “create” button, also we can generate the equivalent command line for this manual steps.

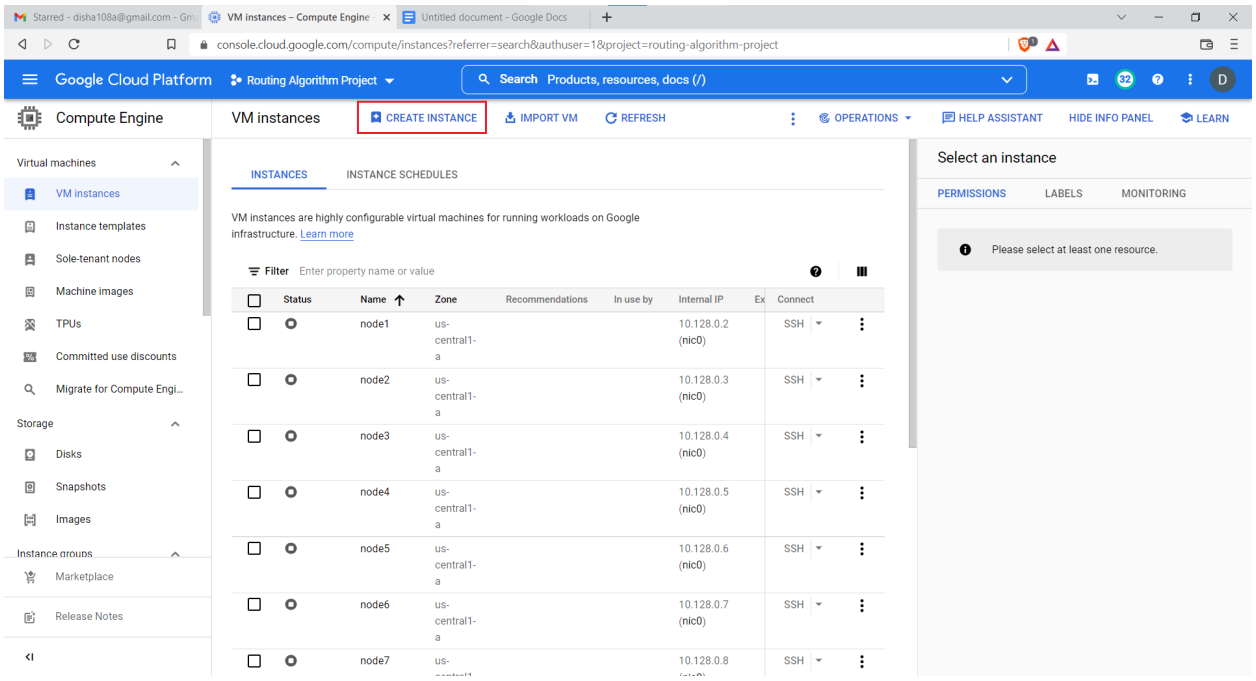
1.2. Compute Engine Setup

We have used GCP's Compute Engine to launch virtual machines (VMs) on demand. The specifications of each VM is as follows:

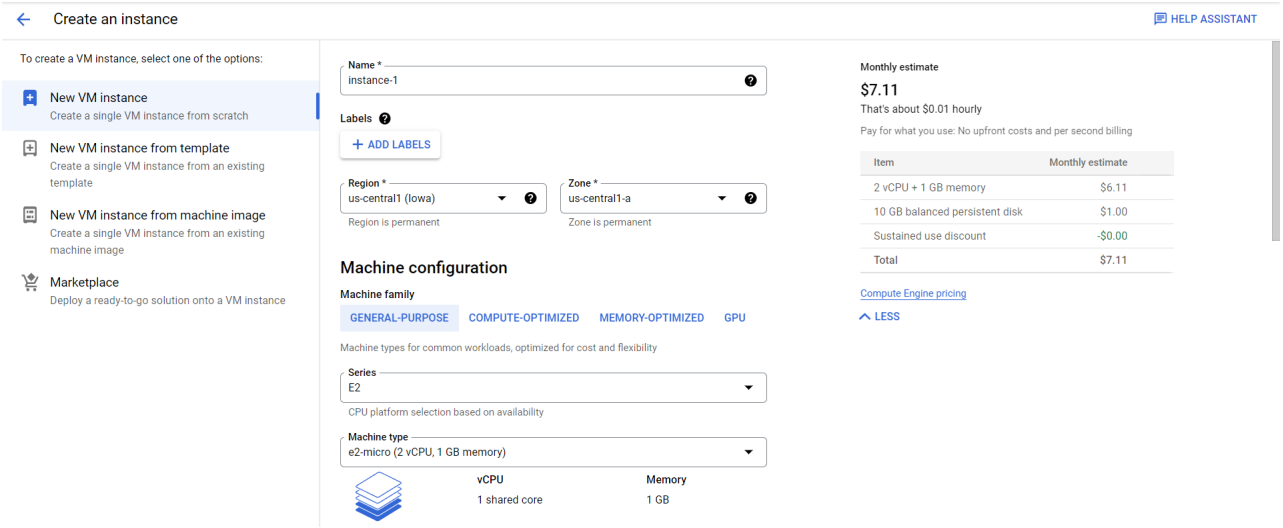
Name	Region	IP Address Range	Zone	Machine Type	Boot Disk Image	Boot Disk Size (GB)	Subnetwork	Primary Internal IP
node1	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.2
node2	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.3
node3	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.4
node4	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.5
node5	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.6
node6	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.7
node7	us-central1	10.128.0.0/20	us-central1-a	e2-micro	ubuntu-1804-lts	10	internal1	10.128.0.8

To launch a compute engine, we have to follow the below steps:

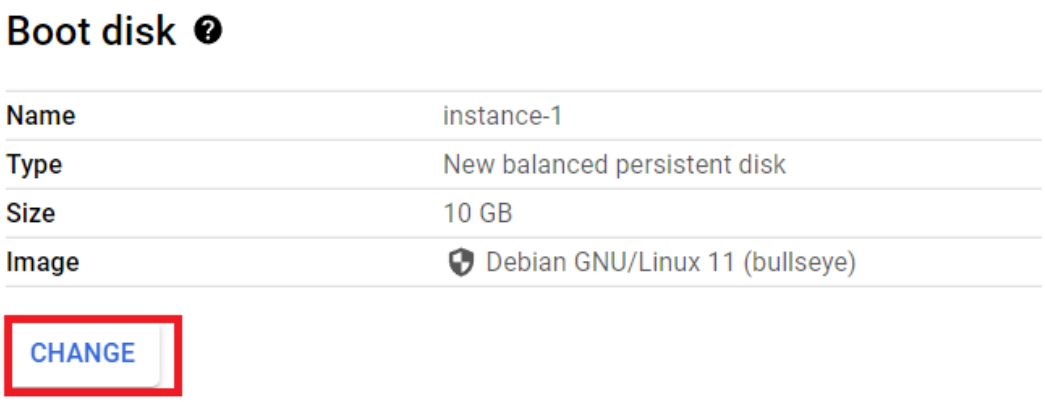
- Form the Compute Engine dashboard click on "CREATE INSTANCE"

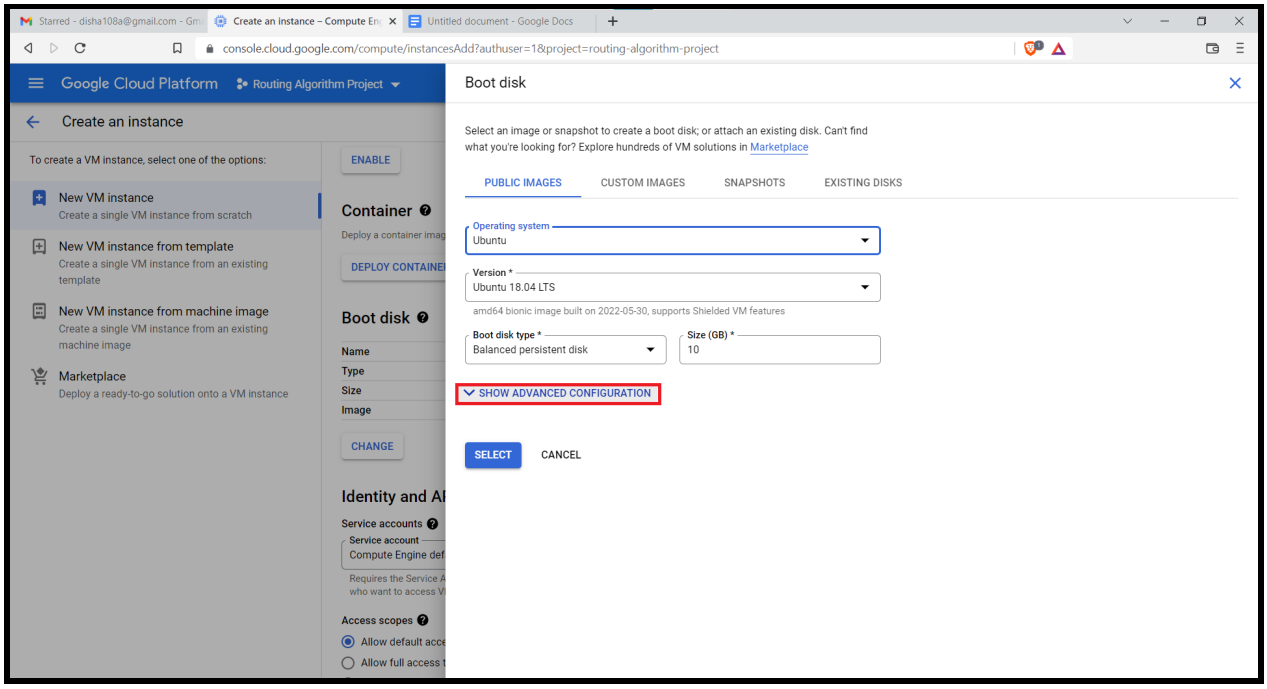


- Provide the instance name, region, zone and machine type according to the requirements.



- Change the boot disc configurations

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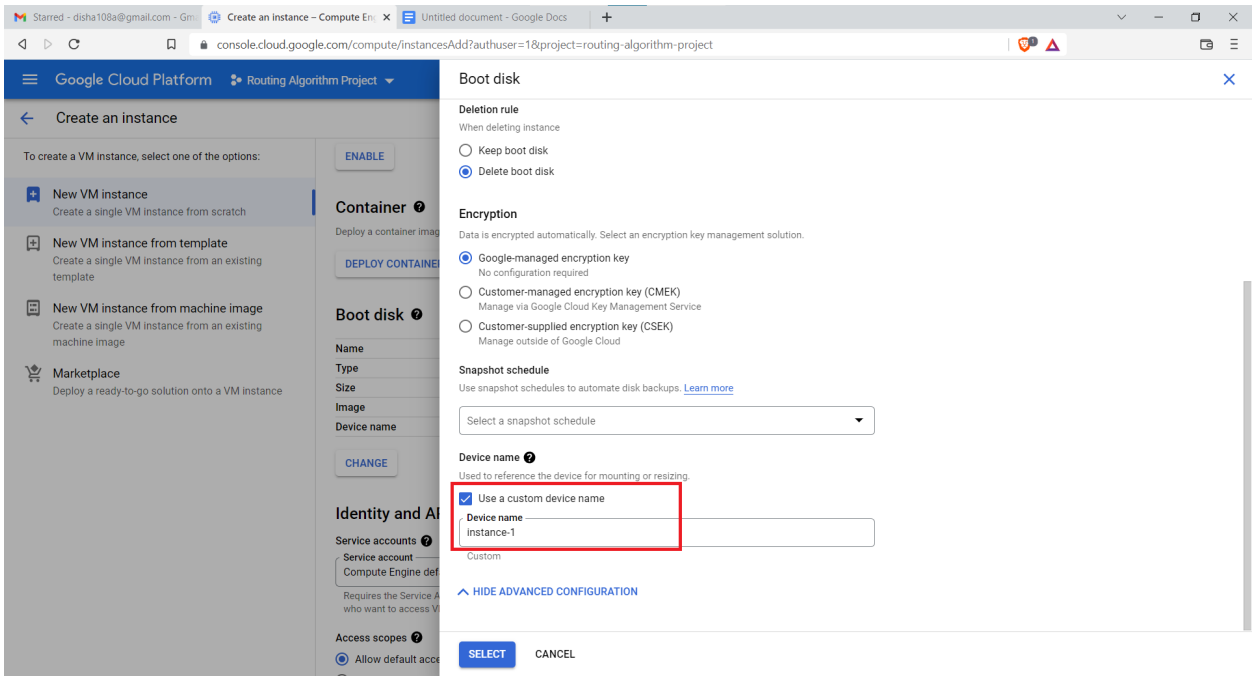
Google Cloud Platform
Routing Algorithm Project
Create an instance
To create a VM instance, select one of the options:
New VM instance
Create a single VM instance from scratch
New VM instance from template
Create a single VM instance from an existing template
New VM instance from machine image
Create a single VM instance from an existing machine image
Marketplace
Deploy a ready-to-go solution onto a VM instance
ENABLE
Container
DEPLOY CONTAINER
Boot disk
Name
Type
Size
Image
CHANGE
Identity and A
Service accounts
Service account
Compute Engine def
Access scopes
Allow default acce
Allow full access t
Boot disk
Select an image or snapshot to create a boot disk; or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in Marketplace
PUBLIC IMAGES
CUSTOM IMAGES
SNAPSHOTS
EXISTING DISKS
Operating system
Ubuntu
Version *
Ubuntu 18.04 LTS
amd64 bionic image built on 2022-05-30, supports Shielded VM features
Boot disk type *
Balanced persistent disk
Size (GB) *
10
SHOW ADVANCED CONFIGURATION
SELECT
CANCEL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Google Cloud Platform
Routing Algorithm Project
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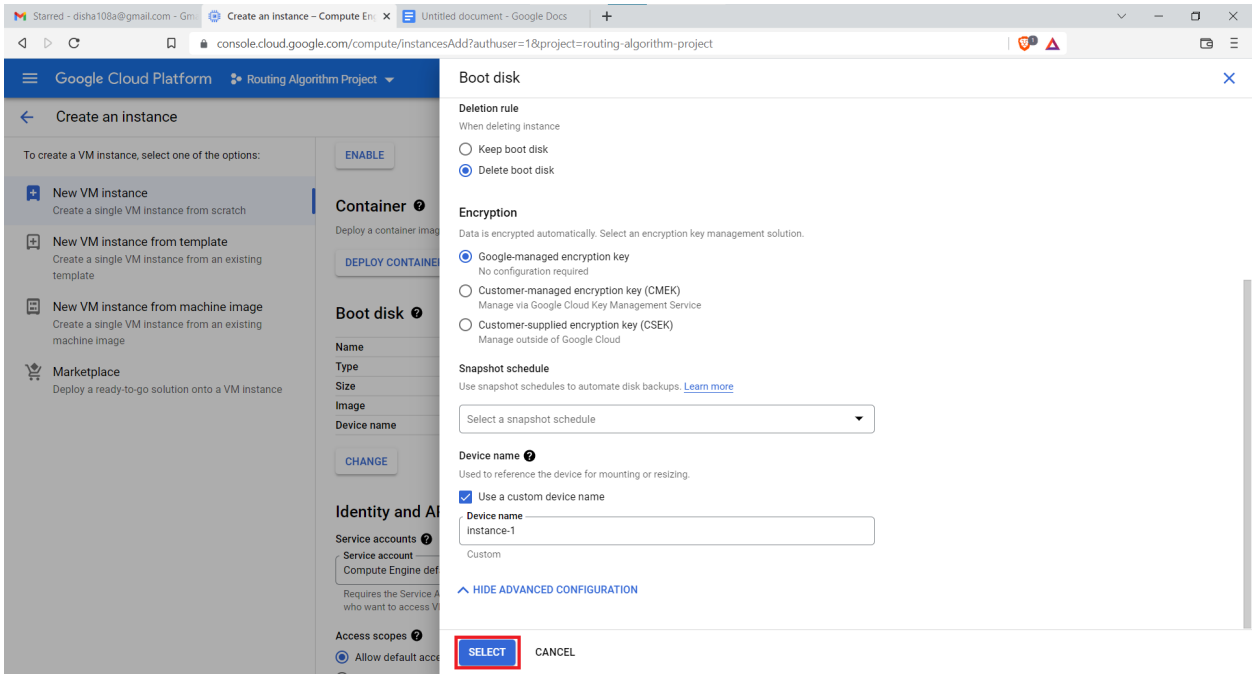
Deploy a ready-to-go solution onto a VM instance
ENABLE
Container
DEPLOY CONTAINER
Boot disk
Name
Type
Size
Image
Device name
CHANGE
Identity and A
Service accounts
Service account
Compute Engine def
Access scopes
Allow default acce
Boot disk
Deletion rule
When deleting instance
Keep boot disk
Delete boot disk
Encryption
Data is encrypted automatically. Select an encryption key management solution.
Google-managed encryption key
No configuration required
Customer-managed encryption key (CMEK)
Manage via Google Cloud Key Management Service
Customer-supplied encryption key (CSEK)
Manage outside of Google Cloud
Snapshot schedule
Use snapshot schedules to automate disk backups. Learn more
Select a snapshot schedule
Device name
Used to reference the device for mounting or resizing.
Use a custom device name
Device name
instance-1
Custom
HIDE ADVANCED CONFIGURATION
SELECT
CANCEL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console.cloud.google.com/compute/instancesAdd?authuser=1&project=routing-algorithm-project
Google Cloud Platform
Routing Algorithm Project
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Container
DEPLOY CONTAINE
Boot disk
Name
Type
Size
Image
Device name
CHANGE
Identity and A
Service accounts
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Data is encrypted automatically. Select an encryption key management solution.
Google-managed encryption key
No configuration required
Customer-managed encryption key (CMEK)
Manage via Google Cloud Key Management Service
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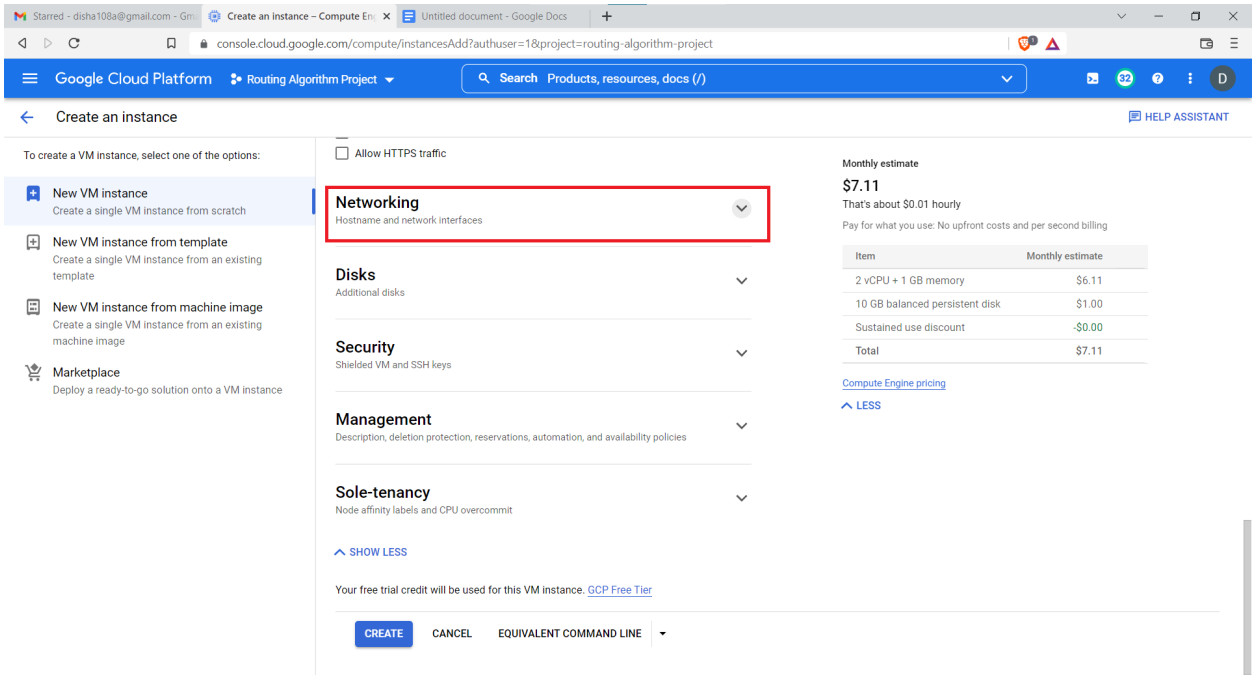
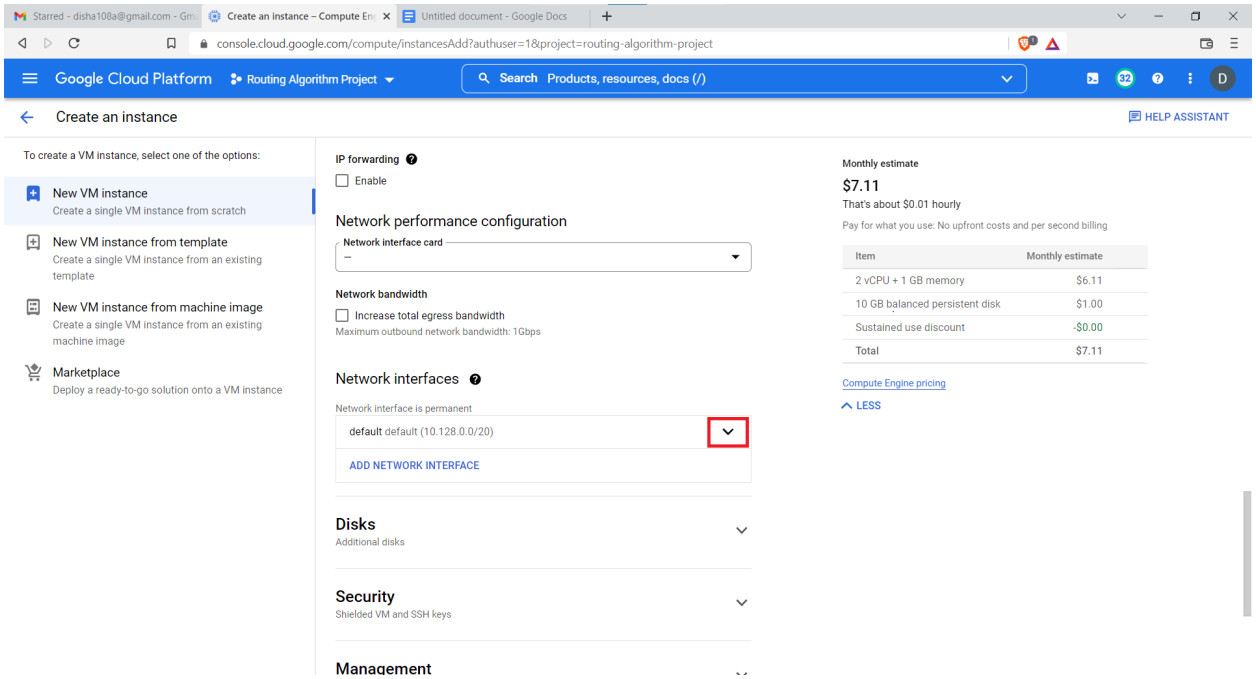
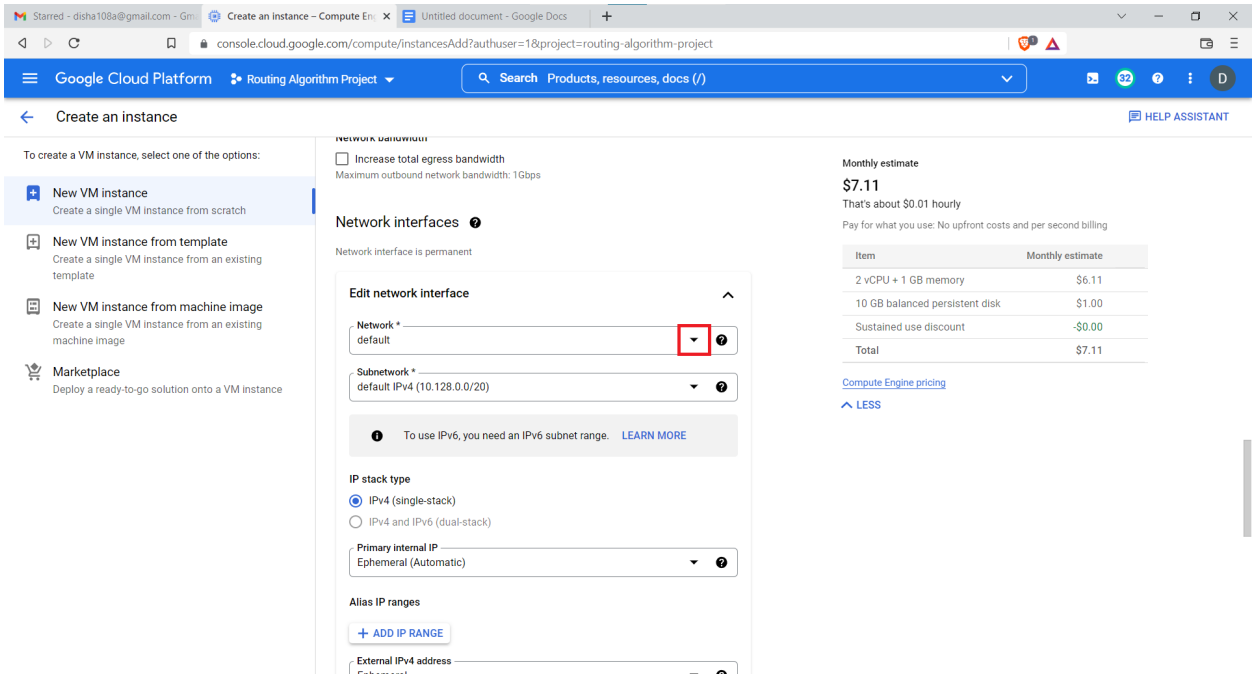
Use snapshot schedules to automate disk backups. Learn more
Select a snapshot schedule
Device name
Used to reference the device for mounting or resizing.
Use a custom device name
Device name
instance-1
Custom
HIDE ADVANCED CONFIGURATION
SELECT
CANCEL

- Now launch the instance in the VPC network we created in the prior step



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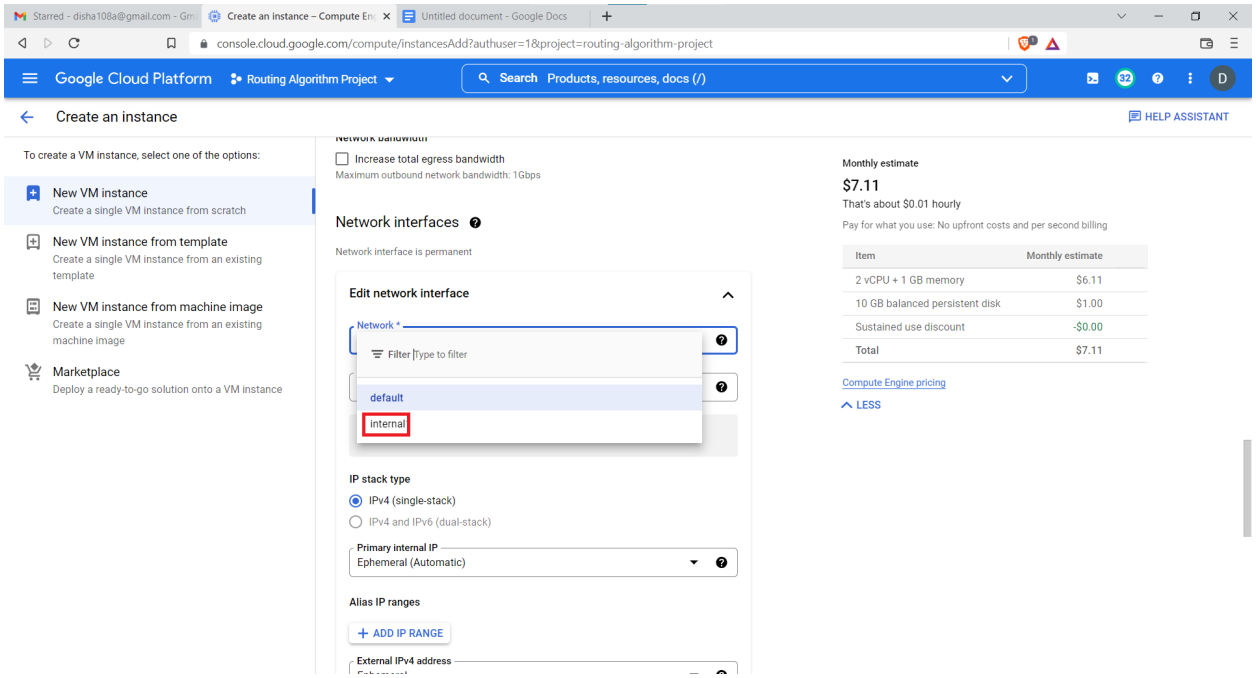
console.cloud.google.com/compute/instancesAdd?authuser=1&project=routing-algorithm-project
Google Cloud Platform
Routing Algorithm Project
Search Products, resources, docs (/)
Create an instance
HELP ASSISTANT
To create a VM instance, select one of the options:
New VM instance
Create a single VM instance 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
Increase total egress bandwidth
Maximum outbound network bandwidth: 1Gbps
Network interfaces
Network interface is permanent
Edit network interface
Network *
default
Subnetwork *
default IPv4 (10.128.0.0/20)
To use IPv6, you need an IPv6 subnet range.
LEARN MORE
IP stack type
IPv4 (single-stack)
IPv4 and IPv6 (dual-stack)
Primary internal IP
Ephemeral (Automatic)
Alias IP ranges
ADD IP RANGE
External IPv4 address
Monthly estimate
$7.11
That's about $0.01 hourly
Pay for what you use: No upfront costs and per second billing
Item
Monthly estimate
2 vCPU + 1 GB memory
$6.11
10 GB balanced persistent disk
$1.00
Sustained use discount
-$0.00
Total
$7.11
Compute Engine pricing
LESS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console.cloud.google.com/compute/instancesAdd?authuser=1&project=routing-algorithm-project
Google Cloud Platform
Routing Algorithm Project
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Create a single VM instance from an existing machine image
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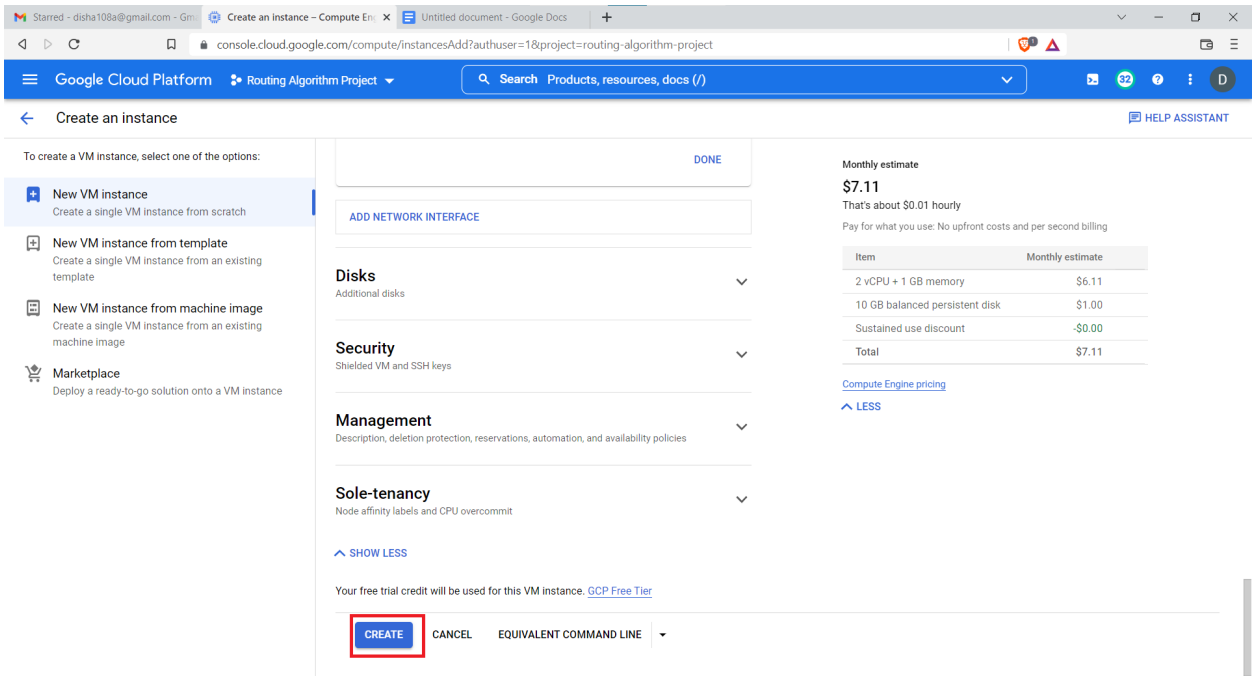
Increase total egress bandwidth
Maximum outbound network bandwidth: 1Gbps
Network interfaces
Network interface is permanent
Edit network interface
Network *
Filter Type to filter
default
internal
IP stack type
IPv4 (single-stack)
IPv4 and IPv6 (dual-stack)
Primary internal IP
Ephemeral (Automatic)
Alias IP ranges
ADD IP RANGE
External IPv4 address
Monthly estimate
$7.11
That's about $0.01 hourly
Pay for what you use: No upfront costs and per second billing
Item
Monthly estimate
2 vCPU + 1 GB memory
$6.11
10 GB balanced persistent disk
$1.00
Sustained use discount
-$0.00
Total
$7.11
Compute Engine pricing
LESS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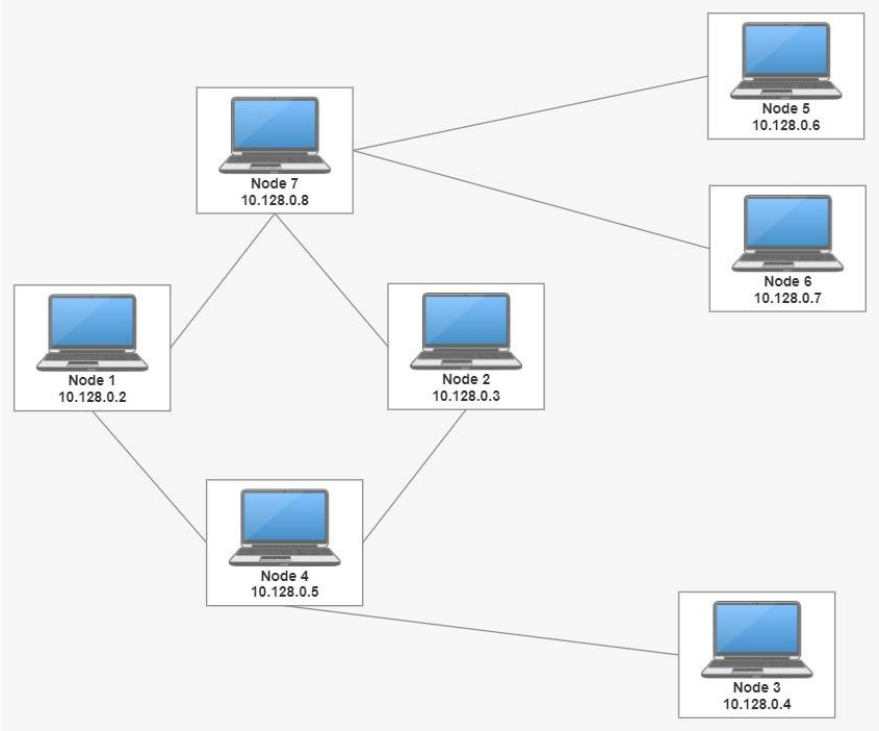
console.cloud.google.com/compute/instancesAdd?authuser=1&project=routing-algorithm-project
Google Cloud Platform
Routing Algorithm Project
Search Products, resources, docs (/)
Create an instance
HELP ASSISTANT
To create a VM instance, select one of the options:
New VM instance
Create a single VM instance 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
DONE
ADD NETWORK INTERFACE
Disks
Additional disks
Security
Shielded VM and SSH keys
Management
Description, deletion protection, reservations, automation, and availability policies
Sole-tenancy
Node affinity labels and CPU overcommit
SHOW LESS
Your free trial credit will be used for this VM instance. GCP Free Tier
CREATE
CANCEL
EQUIVALENT COMMAND LINE
Monthly estimate
$7.11
That's about $0.01 hourly
Pay for what you use: No upfront costs and per second billing
Item
Monthly estimate
2 vCPU + 1 GB memory
$6.11
10 GB balanced persistent disk
$1.00
Sustained use discount
-$0.00
Total
$7.11
Compute Engine pricing
LESS

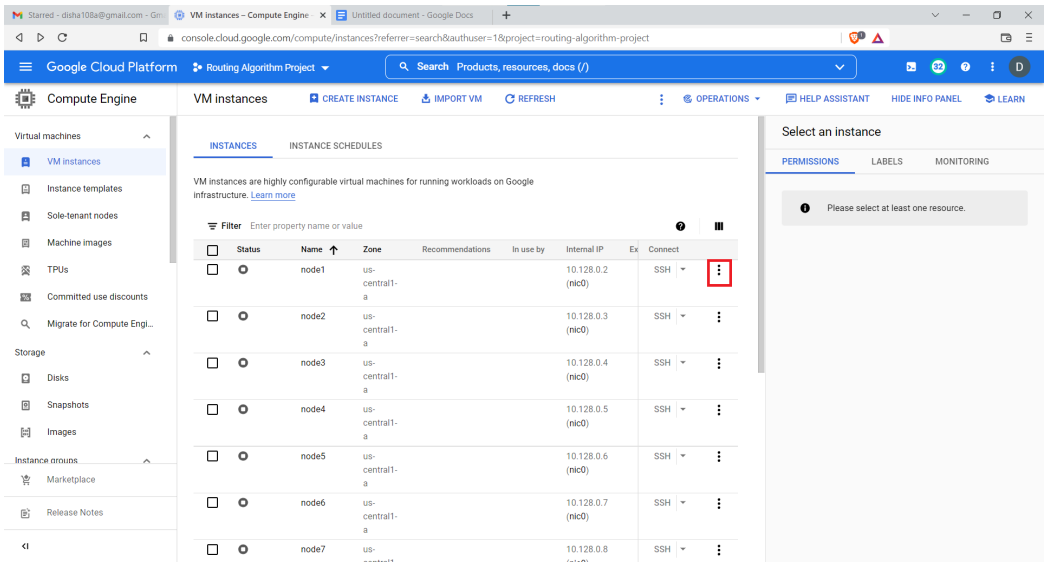
- Following the above steps create instance for each of the nodes in the below network:

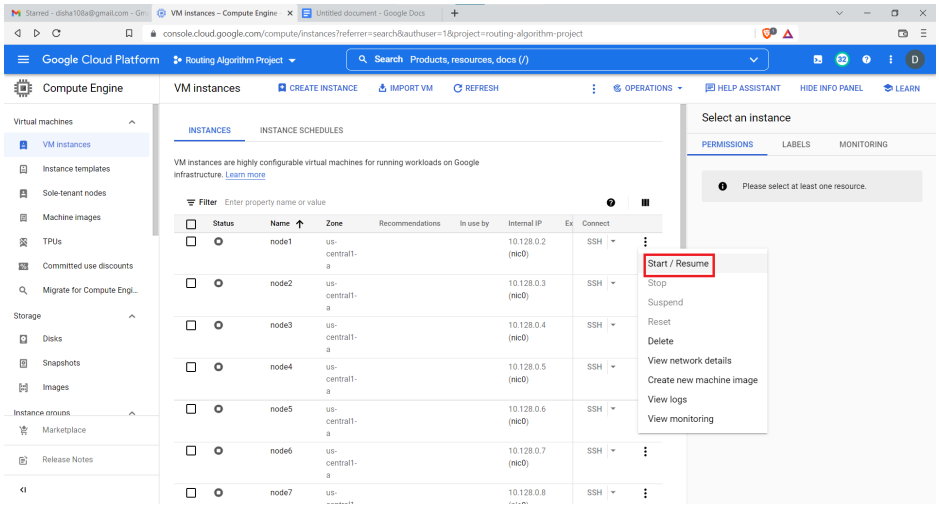


2. Coding & Implementation

2.1. Accessing the VMs

To access the vms, we need to first **start** the vm and then **ssh** to the vms.

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Routing Algorithm Project
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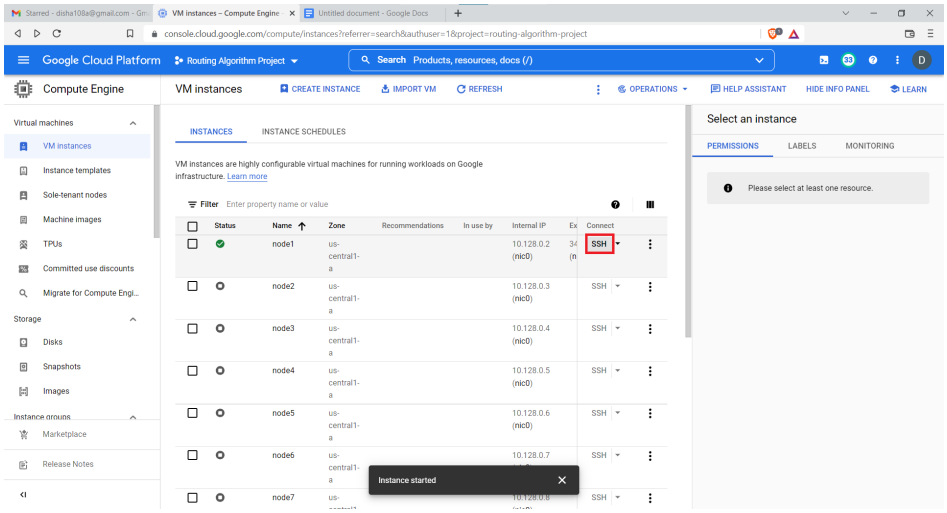
Compute Engine
VM instances
CREATE INSTANCE
IMPORT VM
REFRESH
OPERATIONS
HELP ASSISTANT
HIDE INFO PANEL
LEARN
INSTANCES
INSTANCE SCHEDULES
Select an instance
PERMISSIONS
LABELS
MONITORING
Please select at least one resource.
Start / Resume
Stop
Suspend
Reset
Delete
View network details
Create new machine image
View logs
View monitoring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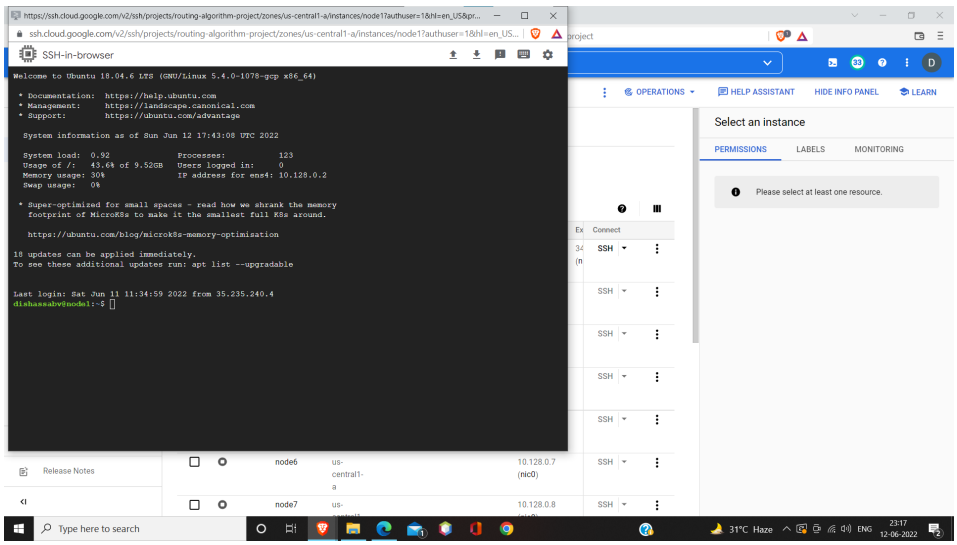
Routing Algorithm Project
Search Products, resources, docs (/)
Compute Engine
VM instances
CREATE INSTANCE
IMPORT VM
REFRESH
OPERATIONS
HELP ASSISTANT
HIDE INFO PANEL
LEARN
INSTANCES
INSTANCE SCHEDULES
Select an instance
PERMISSIONS
LABELS
MONITORING
Please select at least one resource.
SSH
Instance started


SSH-in-browser
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1078-gcp x86_64)
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
System information as of Sun Jun 12 17:43:08 UTC 2022
System load: 0.92 Processes: 123
Usage of /: 43.6% of 9.52GB Users logged in: 0
Memory usage: 30% IP address for ens4: 10.128.0.2
Swap usage: 0%
* Super-optimized for small spaces - read how we shrank the memory footprint of MicroK8s to make it the smallest full K8s around.
https://ubuntu.com/blog/microk8s-memory-optimisation
18 updates can be applied immediately.
To see these additional updates run: apt list --upgradable
Last login: Sat Jun 11 11:34:59 2022 from 35.235.240.4
Select an instance
PERMISSIONS
LABELS
MONITORING
Please select at least one resource.
Type here to search

2.2. Prerequisites

We have implemented the above discussed routing algorithm using python socket programming. For the successful running of the program we need to install some libraries as prerequisites. Those are as follows:

● Install pip3

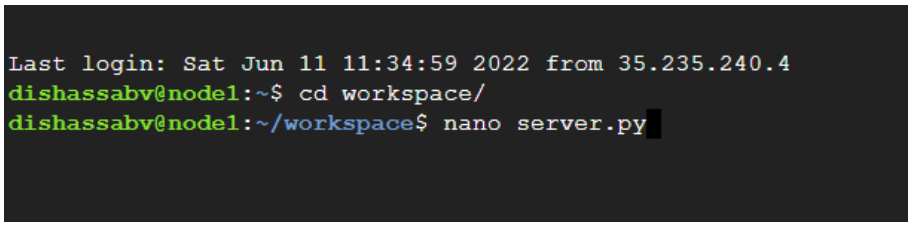
- **Step-1 Update System:** sudo apt-get update
- **Step-2 Install pip3:** sudo apt-get -y install python3-pip
- **Step-3 Verification:** pip3 --version

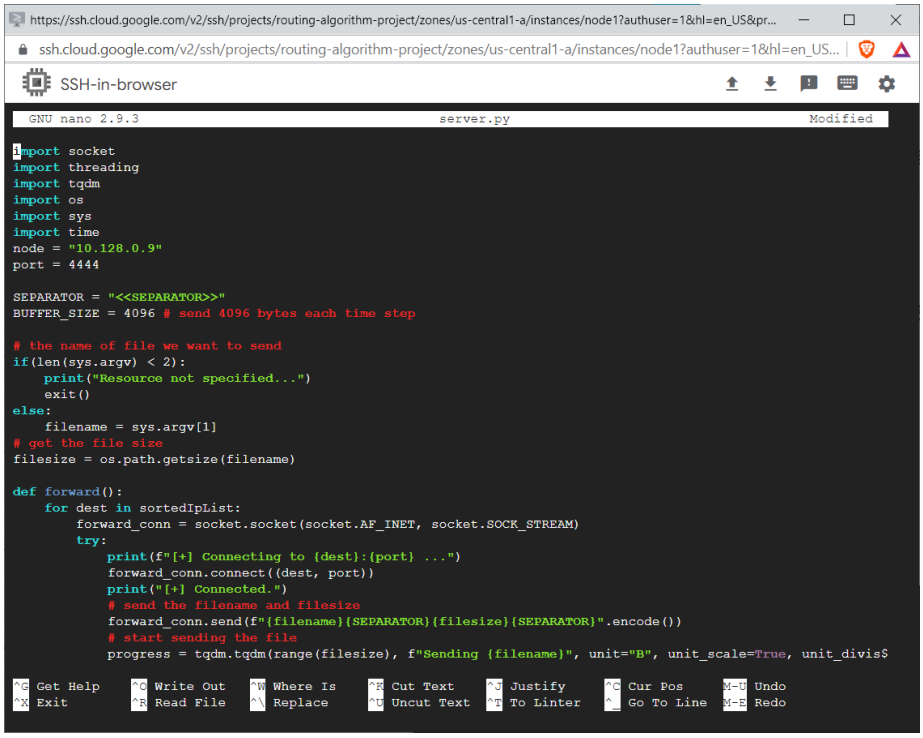
● Install the tqdm library

The command to install tqdm library: pip3 install tqdm

2.3. Writing the Code

- For writing the code, we will use the **nano editor.**





- **For saving** the code : **ctrl+o followed by enter**
- **To exit** nano editor: **ctrl+x**