Task 1. Set the default region and zone for all resources
gcloud config set compute/region us-east5
gcloud config set compute/zone us-east5-a

Task 2: Create multiple web server instances
Setting Up the first instances
gcloud compute instances create www1 --zone=us-east5-a --tags=network-lb-tag --machine-type=e2-small --image-family=debian-11 --image-project=debian-cloud
sudo apt-get remove --purge man-db
apt-get update
apt-get install apache2 -y
service apache2 restart
cd /
echo "<h3>WebServer: www1</h3>" | tee var/www/html/index.html
service apache2 restart
systemctl restart apache2

Setting Up the second instances
gcloud compute instances create www2 --zone=us-east5-a --tags=network-lb-tag --machine-type=e2-small --image-family=debian-11 --image-project=debian-cloud
sudo apt-get remove --purge man-db
apt-get update
apt-get install apache2 -y
service apache2 restart
cd /
echo "<h3>WebServer: www2</h3>" | tee var/www/html/index.html
service apache2 restart
systemctl restart apache2

Setting Up the third instances
gcloud compute instances create www3 --zone=us-east5-a --tags=network-lb-tag --machine-type=e2-small --image-family=debian-11 --image-project=debian-cloud
sudo apt-get remove --purge man-db
apt-get update
apt-get install apache2 -y
service apache2 restart
cd /
echo "<h3>WebServer: www3</h3>" | tee var/www/html/index.html
service apache2 restart
systemctl restart apache2

Create a firewall rule to allow external traffice to the VM instance:
gcloud compute firewall-rules create www-firewall-network-lb ^
  --target-tags network-lb-tag --allow tcp:80

```
NAME                     NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
www-firewall-network-lb  default  INGRESS    1000      tcp:80        False
```

Run the following to list your instances. You'll see their IP addresses in the EXTERNAL_IP column:
gcloud compute instances list

```
C:\Users\world>gcloud compute instances list
NAME  ZONE        MACHINE_TYPE  PREEMPTIBLE  INTERNAL_IP  EXTERNAL_IP    STATUS
rip   us-west4-b  e2-medium                  10.182.0.2                  SUSPENDED
crow  us-east5-a  e2-micro                   10.202.0.3                  SUSPENDED
www1  us-east5-a  e2-small                   10.202.0.21  34.162.11.127  RUNNING
www2  us-east5-a  e2-small                   10.202.0.22  34.162.249.96  RUNNING
www3  us-east5-a  e2-small                   10.202.0.23  34.162.52.195  RUNNING
```

Verify that each instance is running with curl, replacing [IP_ADDRESS] with the IP address for each of your VM

www1 curl http://34.162.11.127
www2 curl http://34.162.249.96
www3 curl http://34.162.52.195

```
C:\Users\world>curl http://34.162.11.127
<h3>WebServer: www1</h3>

C:\Users\world>curl http://34.162.249.96
<h3>WebServer: www2</h3>

C:\Users\world>curl http://34.162.52.195
<h3>WebServer: www3</h3>
```

Task 3: Configure the load balancing server

Create a static external IP address for your load balancer:

gcloud compute addresses create network-lb-ip-1 ^
--region us-east5

Add a legacy HTTP help check resource:

gcloud compute http-health-checks create basic-check

```
C:\Users\world>gcloud compute http-health-checks create basic-check
Created [https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/global/httpHealthChecks/basic-check].
NAME         HOST  PORT  REQUEST_PATH
basic-check        80    /
```

Add a target pool in the same region as your instances. Run the following to create the target pool and use the health check, which is required for the service to function:

gcloud compute target-pools create www-pool ^
--region us-east5 --http-health-check basic-check

```
C:\Users\world>gcloud compute target-pools create www-pool ^
More?   --region us-east5 --http-health-check basic-check
Created [https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5/targetPools/www-pool].
NAME      REGION    SESSION_AFFINITY  BACKUP  HEALTH_CHECKS
www-pool  us-east5  NONE                      basic-check
```

Add the instances to the pool:

gcloud compute target-pools add-instances www-pool ^
--instances www1,www2,www3

Add a forwarding rule:

gcloud compute forwarding-rules create www-rule ^
--region us-east5 ^
--ports 80 ^
--address network-lb-ip-1 ^
--target-pool www-pool

Task 4: Sending traffice to your instances

Enter the following command to view the external IP address of the www-rule forwarding rule used by the load balancer:
gcloud compute forwarding-rules describe www-rule --region us-east5

```
C:\Users\world>gcloud compute forwarding-rules describe www-rule --region us-east5
IPAddress: 34.162.211.3
IPProtocol: TCP
creationTimestamp: '2023-11-27T18:02:13.813-08:00'
description: ''
fingerprint: 1wa40ACCdj4=
id: '336635609915913418'
kind: compute#forwardingRule
labelFingerprint: 42WmSpB8rSM=
loadBalancingScheme: EXTERNAL
name: www-rule
networkTier: PREMIUM
portRange: 80-80
region: https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5
selfLink: https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5/forwardingRules/www-rule
target: https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5/targetPools/www-pool
```

Access the external IP address
gcloud compute forwarding-rules describe www-rule --region us-east5 --format="json"

```
C:\Users\world>gcloud compute forwarding-rules describe www-rule --region us-east5 --format="json"
{
  "IPAddress": "34.162.211.3",
  "IPProtocol": "TCP",
  "creationTimestamp": "2023-11-27T18:02:13.813-08:00",
  "description": "",
  "fingerprint": "1wa40ACCdj4=",
  "id": "336635609915913418",
  "kind": "compute#forwardingRule",
  "labelFingerprint": "42WmSpB8rSM=",
  "loadBalancingScheme": "EXTERNAL",
  "name": "www-rule",
  "networkTier": "PREMIUM",
  "portRange": "80-80",
  "region": "https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5",
  "selfLink": "https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5/forwardingRules/www-r
ule",
  "target": "https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/regions/us-east5/targetPools/www-pool"
}
```

Use curl command to access the external IP address, replacing IP_ADDRESS with an external IP address from the previous command:
Curl 34.162.211.3

```
C:\Users\world>curl 34.162.211.3
<h3>WebServer: www3</h3>
```

Task 5: Create an HTTP load balancer

First, create the load balancer template:
gcloud compute instance-templates create lb-backend-template ^
  --region=us-east5 ^
  --network=default ^
  --subnet=default ^
  --tags=allow-health-check ^
  --machine-type=e2-medium ^
  --image-family=debian-11 ^
  --image-project=debian-cloud

Create a managed instance group based on the templates:

```
gcloud compute instance-groups managed create lb-backend-group ^
  --template=lb-backend-template --size=2 --zone=us-east5-a
```

Then route into the two lb-backend instances and conduct the following

```
 sudo su
 sudo apt-get remove --purge man-db
 apt-get update
 apt-get install apache2 -y
 systemctl reload apache2
 a2ensite default-ssl
 systemctl restart apache2
 a2enmod ssl
 vm_hostname="$(curl -H "Metadata-Flavor:Google" http://169.254.169.254/computeMetadata/v1/instance/name)"
 echo "Page served from: $vm_hostname" | tee /var/www/html/index.html
 systemctl restart apache2
```

Create the fw-allow-health-check firewall rule.

```
gcloud compute firewall-rules create fw-allow-health-check ^
 --network=default ^
 --action=allow ^
 --direction=ingress ^
 --source-ranges=130.211.0.0/22,35.191.0.0/16 ^
 --target-tags=allow-health-check ^
 --rules=tcp:80
```

```
C:\Users\world>gcloud compute firewall-rules create fw-allow-health-check ^
More?   --network=default ^
More?   --action=allow ^
More?   --direction=ingress ^
More?   --source-ranges=130.211.0.0/22,35.191.0.0/16 ^
More?   --target-tags=allow-health-check ^
More?   --rules=tcp:80
Creating firewall...-Created [https://www.googleapis.com/compute/v1/projects/ict418joshuacrow/global/firewalls/fw-all
ow-health-check].
Creating firewall...done.
NAME                    NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
fw-allow-health-check   default  INGRESS    1000      tcp:80        False
```

Now that the instances are up and running, set up a global static external IP address that your customers use to reach your load balancer:

```
gcloud compute addresses create lb-ipv4-1 ^
 --ip-version=IPV4 ^
 --global
```

Note the IPv4 address that was reserved:

```
gcloud compute addresses describe lb-ipv4-1 ^
 --format="get(address)" ^
 --global
DEVICE RESPONDS:  34.117.255.62
```

Create a health check for the load balancer:

```
gcloud compute health-checks create http http-basic-check ^
 --port 80
```

Create a backend service:

```
gcloud compute backend-services create web-backend-service ^
 --protocol=HTTP ^
 --port-name=http ^
 --health-checks=http-basic-check ^
 --global
```

Add your instance group as the backend to the backend service:

```
gcloud compute backend-services add-backend web-backend-service ^
  --instance-group=lb-backend-group ^
  --instance-group-zone=us-east5-a ^
  --global
```

Create a URL mapLinks to an external site. to route the incoming requests to the default backend service:

```
gcloud compute url-maps create web-map-http ^
    --default-service web-backend-service
```

Create a target HTTP proxy to route requests to your URL map:

```
gcloud compute target-http-proxies create http-lb-proxy ^
    --url-map web-map-http
```

Create a global forwarding rule to route incoming requests to the proxy:

```
gcloud compute forwarding-rules create http-content-rule ^
   --address=lb-ipv4-1 ^
   --global ^
   --target-http-proxy=http-lb-proxy ^
   --ports=80
```