

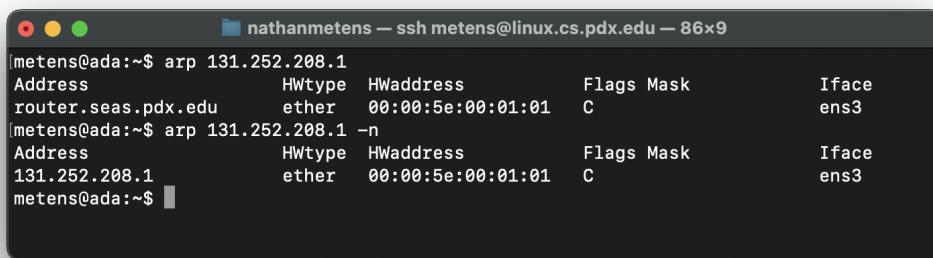
Lab #1

Lab 1.2: ARP, Wireshark, Netsim	1
1. ARP (linux.cs.pdx.edu)	1
2. -	3
3. ARP (Cloud)	5
4. Netsim	7
1.3: Cloud Networking	8
3. Scan Targets for Services	8
5. Navigating Default Networks	9
6) Creating Custom Networks	12

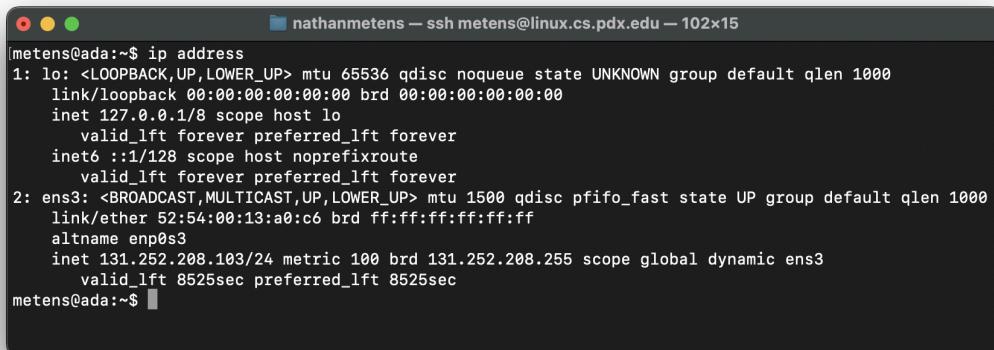
Lab 1.2: ARP, Wireshark, Netsim

1. ARP (linux.cs.pdx.edu)

Using the `ip address` command:

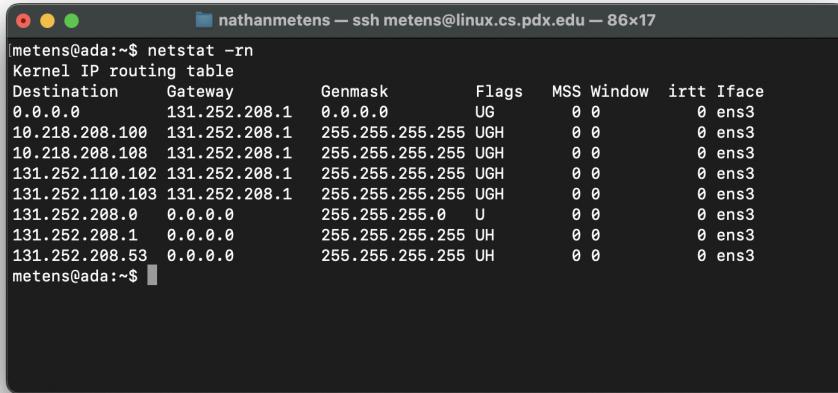


```
nathanmetens$ arp 131.252.208.1
Address           HWtype  HWaddress          Flags Mask     Iface
router.seas.pdx.edu  ether   00:00:5e:00:01:01  C      ens3
nathanmetens$ arp 131.252.208.1 -n
Address           HWtype  HWaddress          Flags Mask     Iface
131.252.208.1    ether   00:00:5e:00:01:01  C      ens3
nathanmetens$
```



```
nathanmetens$ ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:13:a0:c6 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    inet 131.252.208.103/24 metric 100 brd 131.252.208.255 scope global dynamic ens3
        valid_lft 8525sec preferred_lft 8525sec
nathanmetens$
```

Using `netstat -rn` we get:

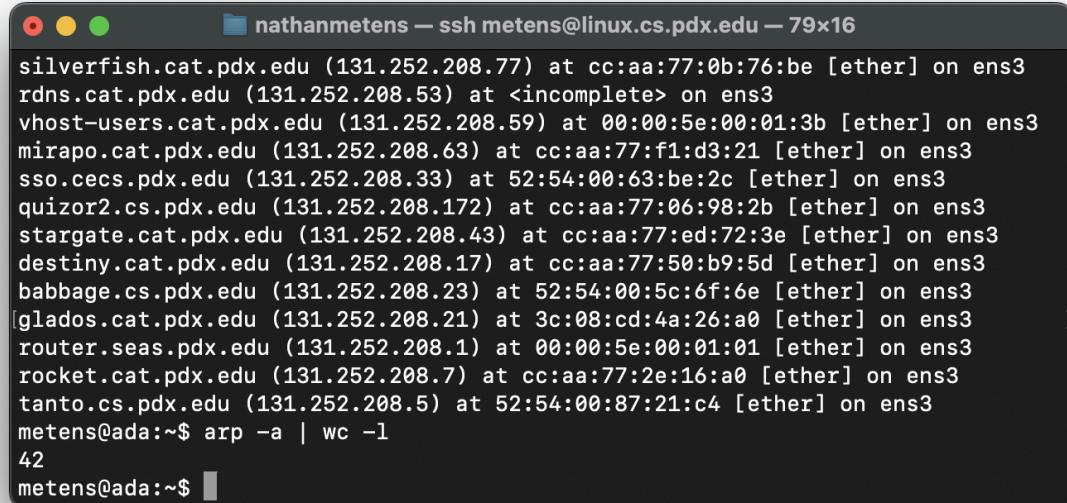


```
[metens@ada:~$ netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask        Flags   MSS Window irtt Iface
0.0.0.0         131.252.208.1  0.0.0.0       UG        0 0          0 ens3
10.218.208.100 131.252.208.1  255.255.255.255  UGH      0 0          0 ens3
10.218.208.108 131.252.208.1  255.255.255.255  UGH      0 0          0 ens3
131.252.110.102 131.252.208.1  255.255.255.255  UGH      0 0          0 ens3
131.252.110.103 131.252.208.1  255.255.255.255  UGH      0 0          0 ens3
131.252.208.0   0.0.0.0        255.255.255.0    U        0 0          0 ens3
131.252.208.1   0.0.0.0        255.255.255.255  UH       0 0          0 ens3
131.252.208.53  0.0.0.0        255.255.255.255  UH       0 0          0 ens3
metens@ada:~$ ]
```

The default router's IP address (i.e the gateway address of the default route 0.0.0.0) is 131.252.208.1.

The name of the default router is "router.seas.pdx.edu" and its hardware address is 00:00:5e:00:01:01.

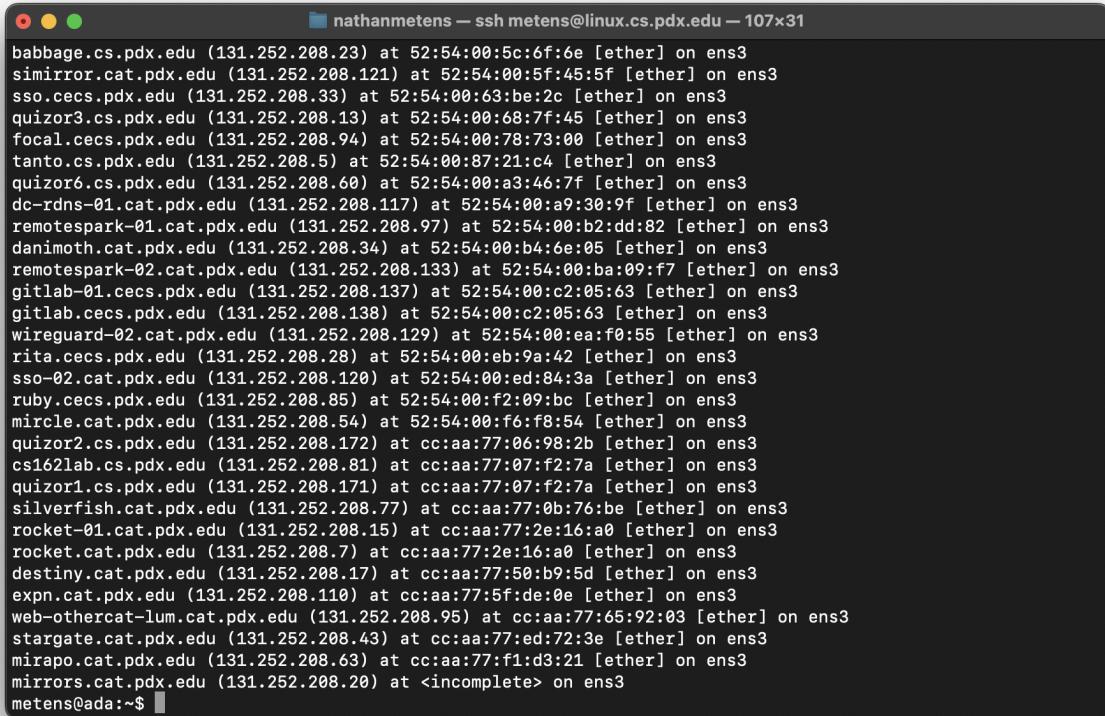
Using the `arp -a` and the `arp -a | wc -l` commands, we can examine the Address Resolution Protocol table and pipe that table into a counter. We see that there are 42 total entries in the ARP table:



```
[silverfish.cat.pdx.edu (131.252.208.77) at cc:aa:77:0b:76:be [ether] on ens3
rdns.cat.pdx.edu (131.252.208.53) at <incomplete> on ens3
vhost-users.cat.pdx.edu (131.252.208.59) at 00:00:5e:00:01:3b [ether] on ens3
mirapo.cat.pdx.edu (131.252.208.63) at cc:aa:77:f1:d3:21 [ether] on ens3
sso.cecs.pdx.edu (131.252.208.33) at 52:54:00:63:be:2c [ether] on ens3
quizor2.cs.pdx.edu (131.252.208.172) at cc:aa:77:06:98:2b [ether] on ens3
stargate.cat.pdx.edu (131.252.208.43) at cc:aa:77:ed:72:3e [ether] on ens3
destiny.cat.pdx.edu (131.252.208.17) at cc:aa:77:50:b9:5d [ether] on ens3
babbage.cs.pdx.edu (131.252.208.23) at 52:54:00:5c:6f:6e [ether] on ens3
glados.cat.pdx.edu (131.252.208.21) at 3c:08:cd:4a:26:a0 [ether] on ens3
router.seas.pdx.edu (131.252.208.1) at 00:00:5e:00:01:01 [ether] on ens3
rocket.cat.pdx.edu (131.252.208.7) at cc:aa:77:2e:16:a0 [ether] on ens3
tanto.cs.pdx.edu (131.252.208.5) at 52:54:00:87:21:c4 [ether] on ens3
metens@ada:~$ arp -a | wc -l
42
metens@ada:~$ ]
```

2. -

Using `arp -a | sort -k 4` to sort the 4th column of the data corresponding to the hardware addresses, we get this:



```
babbage.cs.pdx.edu (131.252.208.23) at 52:54:00:5c:6f:6e [ether] on ens3
simirror.cat.pdx.edu (131.252.208.121) at 52:54:00:5f:45:5f [ether] on ens3
sso.cecs.pdx.edu (131.252.208.33) at 52:54:00:63:be:2c [ether] on ens3
quizor3.cs.pdx.edu (131.252.208.13) at 52:54:00:68:7f:45 [ether] on ens3
focal.cecs.pdx.edu (131.252.208.94) at 52:54:00:78:73:00 [ether] on ens3
tanto.cs.pdx.edu (131.252.208.5) at 52:54:00:87:21:c4 [ether] on ens3
quizor6.cs.pdx.edu (131.252.208.60) at 52:54:00:a3:46:7f [ether] on ens3
dc-rdns-01.cat.pdx.edu (131.252.208.117) at 52:54:00:a9:30:9f [ether] on ens3
remotespark-01.cat.pdx.edu (131.252.208.97) at 52:54:00:b2:dd:82 [ether] on ens3
danimoth.cat.pdx.edu (131.252.208.34) at 52:54:00:b4:6e:05 [ether] on ens3
remotespark-02.cat.pdx.edu (131.252.208.133) at 52:54:00:ba:09:f7 [ether] on ens3
gitlab-01.cecs.pdx.edu (131.252.208.137) at 52:54:00:c2:05:63 [ether] on ens3
gitlab.cecs.pdx.edu (131.252.208.138) at 52:54:00:c2:05:63 [ether] on ens3
wireguard-02.cat.pdx.edu (131.252.208.129) at 52:54:00:ea:f0:55 [ether] on ens3
rita.cecs.pdx.edu (131.252.208.28) at 52:54:00:eb:9a:42 [ether] on ens3
sso-02.cat.pdx.edu (131.252.208.120) at 52:54:00:ed:84:3a [ether] on ens3
ruby.cecs.pdx.edu (131.252.208.85) at 52:54:00:f2:09:bc [ether] on ens3
mircle.cat.pdx.edu (131.252.208.54) at 52:54:00:f6:f8:54 [ether] on ens3
quizor2.cs.pdx.edu (131.252.208.172) at cc:aa:77:06:98:2b [ether] on ens3
cs162lab.cs.pdx.edu (131.252.208.81) at cc:aa:77:07:f2:7a [ether] on ens3
quizor1.cs.pdx.edu (131.252.208.171) at cc:aa:77:07:f2:7a [ether] on ens3
silverfish.cat.pdx.edu (131.252.208.77) at cc:aa:77:0b:76:be [ether] on ens3
rocket-01.cat.pdx.edu (131.252.208.15) at cc:aa:77:2e:16:a0 [ether] on ens3
rocket.cat.pdx.edu (131.252.208.7) at cc:aa:77:2e:16:a0 [ether] on ens3
destiny.cat.pdx.edu (131.252.208.17) at cc:aa:77:50:b9:5d [ether] on ens3
expn.cat.pdx.edu (131.252.208.110) at cc:aa:77:f5:de:0e [ether] on ens3
web-othercat-lum.cat.pdx.edu (131.252.208.95) at cc:aa:77:65:92:03 [ether] on ens3
stargate.cat.pdx.edu (131.252.208.43) at cc:aa:77:ed:72:3e [ether] on ens3
mirapo.cat.pdx.edu (131.252.208.63) at cc:aa:77:f1:d3:21 [ether] on ens3
mirrors.cat.pdx.edu (131.252.208.20) at <incomplete> on ens3
metens@ada:~$
```

We can see that some IP addresses share the same hardware addresses:

cc:aa:77:07:f2:7a is shared by cs162lab.cs.pdx.edu and quizor1.cs.pdx.edu
cc:aa:77:2e:16:a0 is shared by rocket-01.cat.pdx.edu and rocket.cat.pdx.edu

Using the following `arp -a | sort -k 4 | awk '{print $4}' | uniq | wc -l` command to display the count of all the unique occurrences of the hardware addresses, we see that there are 40 total MAC addresses, which is 2 less than the 42 total IP addresses, meaning that there were two duplicates, as stated above.

```
nathanmetens — ssh metens@linux.cs.pdx.edu — 70x15
52:54:00:f6:f8:54
cc:aa:77:06:98:2b
cc:aa:77:07:f2:7a
cc:aa:77:07:f2:7a
cc:aa:77:0b:76:be
cc:aa:77:2e:16:a0
cc:aa:77:2e:16:a0
cc:aa:77:50:b9:5d
cc:aa:77:5f:de:0e
cc:aa:77:65:92:03
cc:aa:77:ed:72:3e
cc:aa:77:f1:d3:21
metens@ada:~$ arp -a | sort -k 4 | awk '{print $4}' | uniq | wc -l
40
metens@ada:~$
```

Here, I used a command that placed all of the IP addresses in column 2 of the arp output into a file called arp_entries:

```
nathanmetens — ssh metens@linux.cs.pdx.edu — 80x15
[metens@ada:~/CS430$ arp -an | awk -F '[(])' '{print $2}' > arp_entries
metens@ada:~/CS430$ ls
arp_entries
[metens@ada:~/CS430$ cat arp_entries
131.252.208.11
131.252.208.138
131.252.208.13
131.252.208.15
131.252.208.120
131.252.208.118
131.252.208.108
131.252.208.110
131.252.208.84
131.252.208.86
131.252.208.94
```

All of these IP addresses share the network prefix “131.252.208”.

3. ARP (Cloud)

I brought up the cloud VM, ssh into it, and installed the arp and netstat packages, then displayed the ip addresses:

```
metens@cloudshell:~ (cloud-metens)$ gcloud compute instances list
NAME: course-vm1
ZONE: us-west1-a
MACHINE_TYPE: e2-medium
PREEMPTIBLE:
INTERNAL_IP: 10.138.0.3
EXTERNAL_IP: 34.145.94.84
STATUS: RUNNING

NAME: course-vm
ZONE: us-west1-b
MACHINE_TYPE: e2-medium
PREEMPTIBLE:
INTERNAL_IP: 10.138.0.2
EXTERNAL_IP:
STATUS: TERMINATED
metens@cloudshell:~ (cloud-metens)$ gcloud compute instances start course-vm1 --zone=us-west1-a
Starting instance(s) course-vm1...done.
Updated [https://compute.googleapis.com/compute/v1/projects/cloud-metens/zones/us-west1-a/instances/course-vm1].
Instance internal IP is 10.138.0.3
Instance external IP is 34.145.94.84

metens@cloudshell:~ (cloud-metens)$ gcloud compute ssh course-vm1 --zone=us-west1-a
Updating project ssh metadata...working...Updated [https://www.googleapis.com/compute/v1/projects/cloud-metens].
Updating project ssh metadata...done.
Waiting for SSH key to propagate.
Warning: Permanently added 'compute.1864546938096979193' (ED25519) to the list of known hosts.
Linux course-vm1 6.1.0-25-cloud-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.1.106-3 (2024-08-26)
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: Thu Oct  3 18:45:27 2024 from 35.235.241.65
metens@course-vm1:~$ sudo apt update -y
Get:1 file:/etc/apt/mirrors/debian.list Mirrorlist [30 B]
Get:2 file:/etc/apt/mirrors.debian-security.list Mirrorlist [39 B]
Hit:7 https://dl.google.com/linux/chrome/deb stable InRelease
Hit:8 https://packages.cloud.google.com/apt google-compute-engine-bookworm-stable InRelease
Hit:3 https://deb.debian.org/debian bookworm InRelease

metens@course-vm1:~$ ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1460 qdisc mq state UP group default qlen 1000
    link/ether 42:01:0a:8a:00:03 brd ff:ff:ff:ff:ff:ff
    altname enp0s4
    inet 10.138.0.3/32 metric 100 scope global dynamic ens4
        valid_lft 49641sec preferred_lft 49641sec
    inet6 fe80::4001:aff:fe8a:3/64 scope link
        valid_lft forever preferred_lft forever
3: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN group default
    link/ether 02:42:9e:96:50:64 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
        valid_lft forever preferred_lft forever
metens@course-vm1:~$
```

The IP address is 10.138.0.3/32 and the hardware address is 42:01:0a:8a:00:03.

Using `netstat -rn` to examine the route table for the VM:

```
metens@course-vm1:~$ netstat -rn
Kernel IP routing table
Destination      Gateway        Genmask        Flags    MSS Window irtt Iface
0.0.0.0          10.138.0.1   0.0.0.0        UG        0 0        0 ens4
10.138.0.1       0.0.0.0      255.255.255.255 UH        0 0        0 ens4
169.254.169.254 10.138.0.1   255.255.255.255 UGH       0 0        0 ens4
172.17.0.0       0.0.0.0      255.255.0.0     U         0 0        0 docker0
metens@course-vm1:~$ █
```

The default router's IP address is 10.138.0.1.

```
metens@course-vm1:~$ netstat -rn
Kernel IP routing table
Destination      Gateway        Genmask        Flags    MSS Window irtt Iface
0.0.0.0          10.138.0.1   0.0.0.0        UG        0 0        0 ens4
10.138.0.1       0.0.0.0      255.255.255.255 UH        0 0        0 ens4
169.254.169.254 10.138.0.1   255.255.255.255 UGH       0 0        0 ens4
172.17.0.0       0.0.0.0      255.255.0.0     U         0 0        0 docker0
metens@course-vm1:~$ arp 10.138.0.1
Address           HWtype  HWaddress            Flags Mask  Iface
_gateway          ether    42:01:0a:8a:00:01  C      ens4
metens@course-vm1:~$ █
```

Using `arp 10.138.0.1` gives us the hardware address 42:01:0a:8a:00:01.

4. Netsim

Netsim

Welcome to Netsim! If this is your first time playing, we recommend you start from the first level below, and work your way forward.

Please note that this project is still in **beta**. If you find any bugs, you can report them to [@errorinn](#) or open an issue on [Github](#).

Log out

Basics

- Getting started
- Packet fields
- Ping

Routing

Modems

Spoofs

IP Spoofing

Stealing packets

Denial of Service

Basic DoS

Distributed DoS

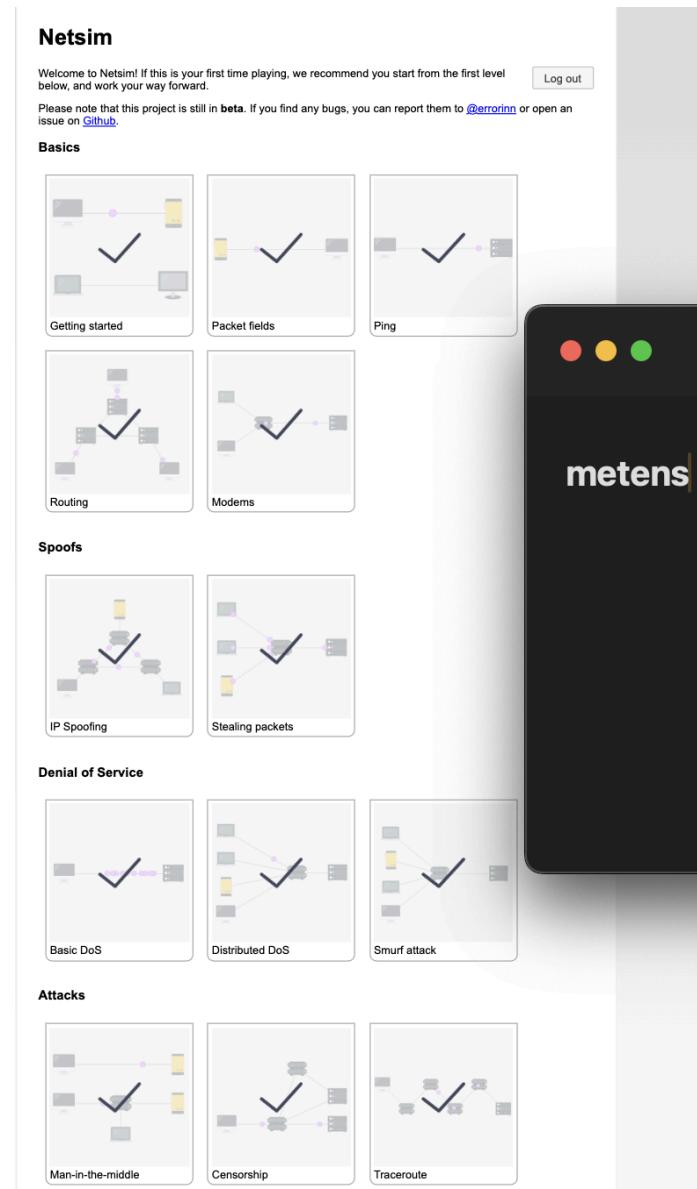
Smurf attack

Attacks

Man-in-the-middle

Censorship

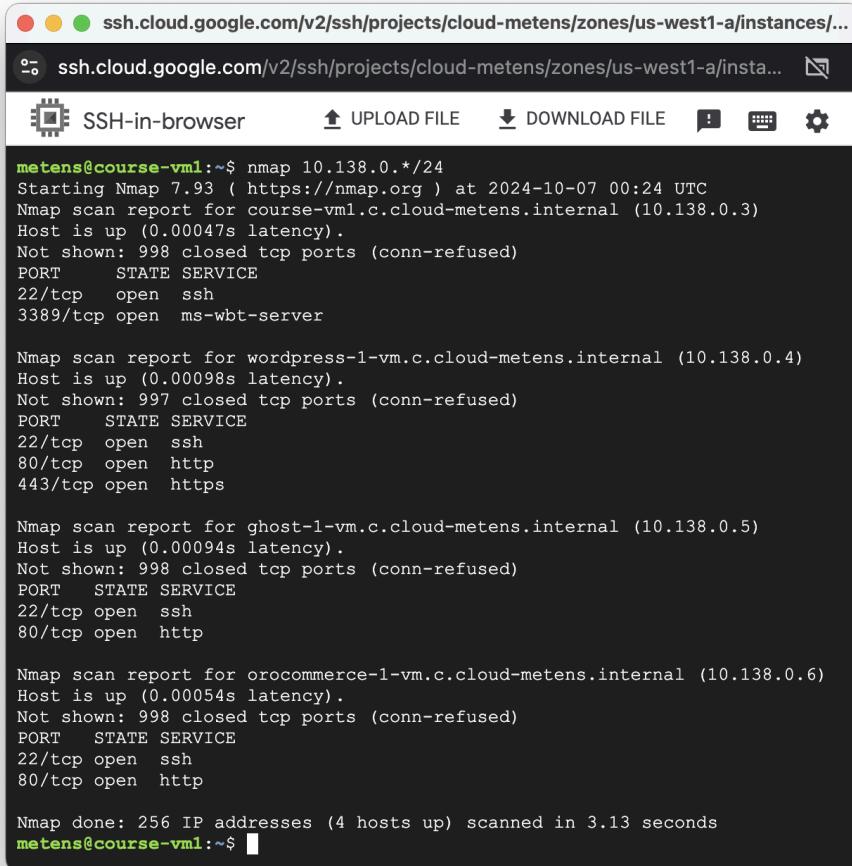
Traceroute

The image shows a screenshot of the Netsim application. At the top, there's a header with the title 'Netsim', a welcome message, and a 'Log out' button. Below the header, there are several sections: 'Basics' with three cards ('Getting started', 'Packet fields', 'Ping'); 'Spoofs' with two cards ('IP Spoofing', 'Stealing packets'); 'Denial of Service' with three cards ('Basic DoS', 'Distributed DoS', 'Smurf attack'); and 'Attacks' with three cards ('Man-in-the-middle', 'Censorship', 'Traceroute'). To the right of these sections is a large, dark gray placeholder area for a mobile device, featuring a red, yellow, and green status bar icon at the top and the word 'metens' in white lowercase letters below it.

1.3: Cloud Networking

3. Scan Targets for Services

Screenshot of `nmap 10.138.0.*/24` that lists the ports for Blog and CMS VMs that I deployed:



The screenshot shows a terminal window titled "SSH-in-browser" with the URL "ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west1-a/instances/...". The terminal displays the results of an nmap scan on the IP range 10.138.0.*/24. The output includes reports for four hosts: course-vm1 (IP 10.138.0.3), wordpress-1-vm (IP 10.138.0.4), ghost-1-vm (IP 10.138.0.5), and orocommerce-1-vm (IP 10.138.0.6). The report for each host shows the host is up, the number of closed ports (998), and the open ports (SSH and HTTP/HTTPS).

```
ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west1-a/instances/...
ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west1-a/insta...
SSH-in-browser UPLOAD FILE DOWNLOAD FILE ! ⌨ ⚙

metens@course-vm1:~$ nmap 10.138.0.*/24
Starting Nmap 7.93 ( https://nmap.org ) at 2024-10-07 00:24 UTC
Nmap scan report for course-vm1.c.cloud-metens.internal (10.138.0.3)
Host is up (0.00047s latency).
Not shown: 998 closed tcp ports (conn-refused)
PORT      STATE SERVICE
22/tcp    open  ssh
3389/tcp  open  ms-wbt-server

Nmap scan report for wordpress-1-vm.c.cloud-metens.internal (10.138.0.4)
Host is up (0.00098s latency).
Not shown: 997 closed tcp ports (conn-refused)
PORT      STATE SERVICE
22/tcp    open  ssh
80/tcp    open  http
443/tcp   open  https

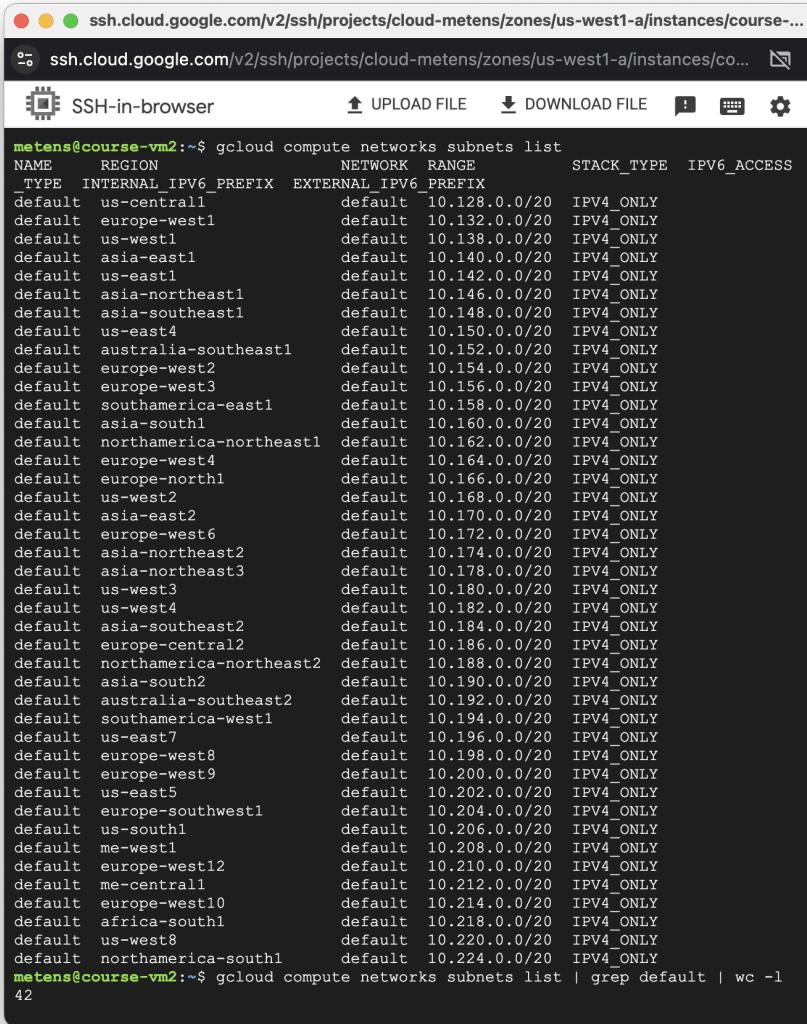
Nmap scan report for ghost-1-vm.c.cloud-metens.internal (10.138.0.5)
Host is up (0.00094s latency).
Not shown: 998 closed tcp ports (conn-refused)
PORT      STATE SERVICE
22/tcp    open  ssh
80/tcp    open  http

Nmap scan report for orocommerce-1-vm.c.cloud-metens.internal (10.138.0.6)
Host is up (0.00054s latency).
Not shown: 998 closed tcp ports (conn-refused)
PORT      STATE SERVICE
22/tcp    open  ssh
80/tcp    open  http

Nmap done: 256 IP addresses (4 hosts up) scanned in 3.13 seconds
metens@course-vm1:~$ █
```

5. Navigating Default Networks

There are 42 default networks created, which means that there are 42 different regions:

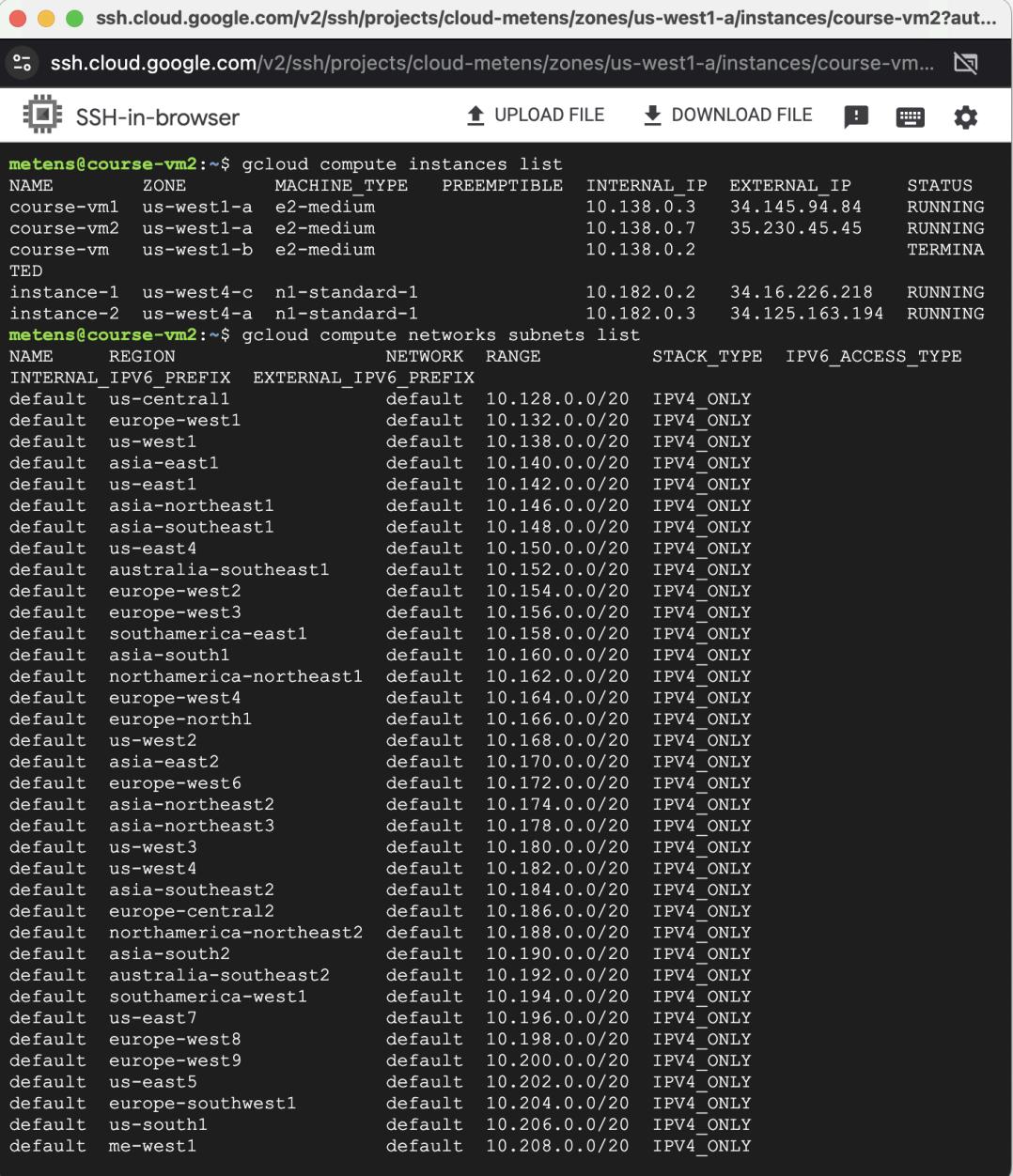


The screenshot shows a terminal window titled "SSH-in-browser" connected to "ssh.cloud.google.com". The command "gcloud compute networks subnets list" is run, displaying a table of 42 rows. The columns are: NAME, REGION, NETWORK, RANGE, STACK_TYPE, and IPV6_ACCESS. All rows show "default" in the NAME column and "us-west1-a" in the REGION column. The NETWORK column is mostly blank or contains "default". The RANGE column lists various CIDR ranges from 10.128.0.0/20 to 10.224.0.0/20. The STACK_TYPE column is mostly "IPV4_ONLY" with one "IPV4_ONLY" entry. The IPV6_ACCESS column is mostly blank or contains "IPV4_ONLY". The bottom of the terminal shows the command "gcloud compute networks subnets list | grep default | wc -l" and the number "42".

NAME	REGION	NETWORK	RANGE	STACK_TYPE	IPV6_ACCESS
default	us-central1		default 10.128.0.0/20	IPV4_ONLY	
default	europe-west1		default 10.132.0.0/20	IPV4_ONLY	
default	us-west1		default 10.138.0.0/20	IPV4_ONLY	
default	asia-east1		default 10.140.0.0/20	IPV4_ONLY	
default	us-east1		default 10.142.0.0/20	IPV4_ONLY	
default	asia-northeast1		default 10.146.0.0/20	IPV4_ONLY	
default	asia-southeast1		default 10.148.0.0/20	IPV4_ONLY	
default	us-east4		default 10.150.0.0/20	IPV4_ONLY	
default	australia-southeast1		default 10.152.0.0/20	IPV4_ONLY	
default	europe-west2		default 10.154.0.0/20	IPV4_ONLY	
default	europe-west3		default 10.156.0.0/20	IPV4_ONLY	
default	southamerica-east1		default 10.158.0.0/20	IPV4_ONLY	
default	asia-south1		default 10.160.0.0/20	IPV4_ONLY	
default	northamerica-northeast1		default 10.162.0.0/20	IPV4_ONLY	
default	europe-west4		default 10.164.0.0/20	IPV4_ONLY	
default	europe-north1		default 10.166.0.0/20	IPV4_ONLY	
default	us-west2		default 10.168.0.0/20	IPV4_ONLY	
default	asia-east2		default 10.170.0.0/20	IPV4_ONLY	
default	europe-west6		default 10.172.0.0/20	IPV4_ONLY	
default	asia-northeast2		default 10.174.0.0/20	IPV4_ONLY	
default	asia-northeast3		default 10.178.0.0/20	IPV4_ONLY	
default	us-west3		default 10.180.0.0/20	IPV4_ONLY	
default	us-west4		default 10.182.0.0/20	IPV4_ONLY	
default	asia-southeast2		default 10.184.0.0/20	IPV4_ONLY	
default	europe-central2		default 10.186.0.0/20	IPV4_ONLY	
default	northamerica-northeast2		default 10.188.0.0/20	IPV4_ONLY	
default	asia-south2		default 10.190.0.0/20	IPV4_ONLY	
default	australia-southeast2		default 10.192.0.0/20	IPV4_ONLY	
default	southamerica-west1		default 10.194.0.0/20	IPV4_ONLY	
default	us-east7		default 10.196.0.0/20	IPV4_ONLY	
default	europe-west8		default 10.198.0.0/20	IPV4_ONLY	
default	europe-west9		default 10.200.0.0/20	IPV4_ONLY	
default	us-east5		default 10.202.0.0/20	IPV4_ONLY	
default	europe-southwest1		default 10.204.0.0/20	IPV4_ONLY	
default	us-south1		default 10.206.0.0/20	IPV4_ONLY	
default	me-west1		default 10.208.0.0/20	IPV4_ONLY	
default	europe-west12		default 10.210.0.0/20	IPV4_ONLY	
default	me-central1		default 10.212.0.0/20	IPV4_ONLY	
default	europe-west10		default 10.214.0.0/20	IPV4_ONLY	
default	africa-south1		default 10.218.0.0/20	IPV4_ONLY	
default	us-west8		default 10.220.0.0/20	IPV4_ONLY	
default	northamerica-south1		default 10.224.0.0/20	IPV4_ONLY	

metens@course-vn2:~\$ gcloud compute networks subnets list | grep default | wc -l
42

Given that the CIDR prefix for each subnetwork is $10.*.*.*/20$, this means that there are 12 of the 32 bits available for hosts. Since we use bits (binary) we know that each subnetwork can support $2^{12} = 4096$ total hosts.



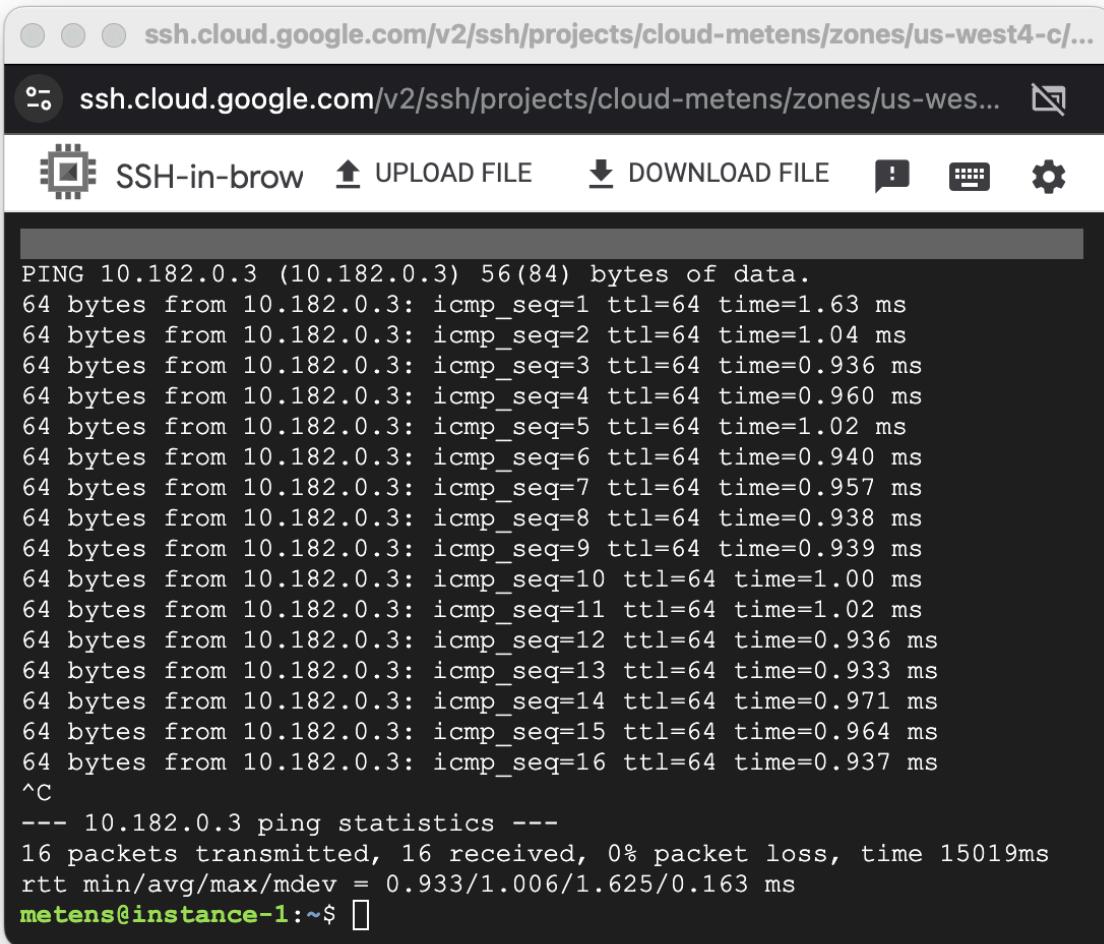
The screenshot shows a terminal window within an SSH-in-browser interface. The URL in the address bar is `ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west1-a/instances/course-vm2?aut...`. The terminal output displays two commands run by the user `metens`:

```

metens@course-vm2:~$ gcloud compute instances list
NAME          ZONE      MACHINE_TYPE  PREEMPTIBLE  INTERNAL_IP  EXTERNAL_IP    STATUS
course-vm1    us-west1-a  e2-medium      False        10.138.0.3   34.145.94.84  RUNNING
course-vm2    us-west1-a  e2-medium      False        10.138.0.7   35.230.45.45  RUNNING
course-vm     us-west1-b  e2-medium      False        10.138.0.2   -           TERMINATED
TED
instance-1    us-west4-c  n1-standard-1  False        10.182.0.2   34.16.226.218  RUNNING
instance-2    us-west4-a  n1-standard-1  False        10.182.0.3   34.125.163.194  RUNNING
metens@course-vm2:~$ gcloud compute networks subnets list
NAME          REGION      NETWORK      RANGE          STACK_TYPE  IPV6_ACCESS_TYPE
INTERNAL_IPV6_PREFIX  EXTERNAL_IPV6_PREFIX
default        us-central1  default      10.128.0.0/20  IPV4_ONLY
default        europe-west1  default      10.132.0.0/20  IPV4_ONLY
default        us-west1     default      10.138.0.0/20  IPV4_ONLY
default        asia-east1   default      10.140.0.0/20  IPV4_ONLY
default        us-east1     default      10.142.0.0/20  IPV4_ONLY
default        asia-northeast1  default      10.146.0.0/20  IPV4_ONLY
default        asia-southeast1  default      10.148.0.0/20  IPV4_ONLY
default        us-east4     default      10.150.0.0/20  IPV4_ONLY
default        australia-southeast1  default      10.152.0.0/20  IPV4_ONLY
default        europe-west2   default      10.154.0.0/20  IPV4_ONLY
default        europe-west3   default      10.156.0.0/20  IPV4_ONLY
default        southamerica-east1  default      10.158.0.0/20  IPV4_ONLY
default        asia-south1   default      10.160.0.0/20  IPV4_ONLY
default        northamerica-northeast1  default      10.162.0.0/20  IPV4_ONLY
default        europe-west4   default      10.164.0.0/20  IPV4_ONLY
default        europe-north1  default      10.166.0.0/20  IPV4_ONLY
default        us-west2     default      10.168.0.0/20  IPV4_ONLY
default        asia-east2   default      10.170.0.0/20  IPV4_ONLY
default        europe-west6   default      10.172.0.0/20  IPV4_ONLY
default        asia-northeast2  default      10.174.0.0/20  IPV4_ONLY
default        asia-northeast3  default      10.178.0.0/20  IPV4_ONLY
default        us-west3     default      10.180.0.0/20  IPV4_ONLY
default        us-west4     default      10.182.0.0/20  IPV4_ONLY
default        asia-southeast2  default      10.184.0.0/20  IPV4_ONLY
default        europe-central2  default      10.186.0.0/20  IPV4_ONLY
default        northamerica-northeast2  default      10.188.0.0/20  IPV4_ONLY
default        asia-south2   default      10.190.0.0/20  IPV4_ONLY
default        australia-southeast2  default      10.192.0.0/20  IPV4_ONLY
default        southamerica-west1  default      10.194.0.0/20  IPV4_ONLY
default        us-east7     default      10.196.0.0/20  IPV4_ONLY
default        europe-west8   default      10.198.0.0/20  IPV4_ONLY
default        europe-west9   default      10.200.0.0/20  IPV4_ONLY
default        us-east5     default      10.202.0.0/20  IPV4_ONLY
default        europe-southwest1  default      10.204.0.0/20  IPV4_ONLY
default        us-south1   default      10.206.0.0/20  IPV4_ONLY
default        me-west1    default      10.208.0.0/20  IPV4_ONLY

```

Both instances (us-west4-a and us-west4-b) are in the us-west4 CIDR subnetwork of 10.182.0.0/20 and correctly correspond to their region.

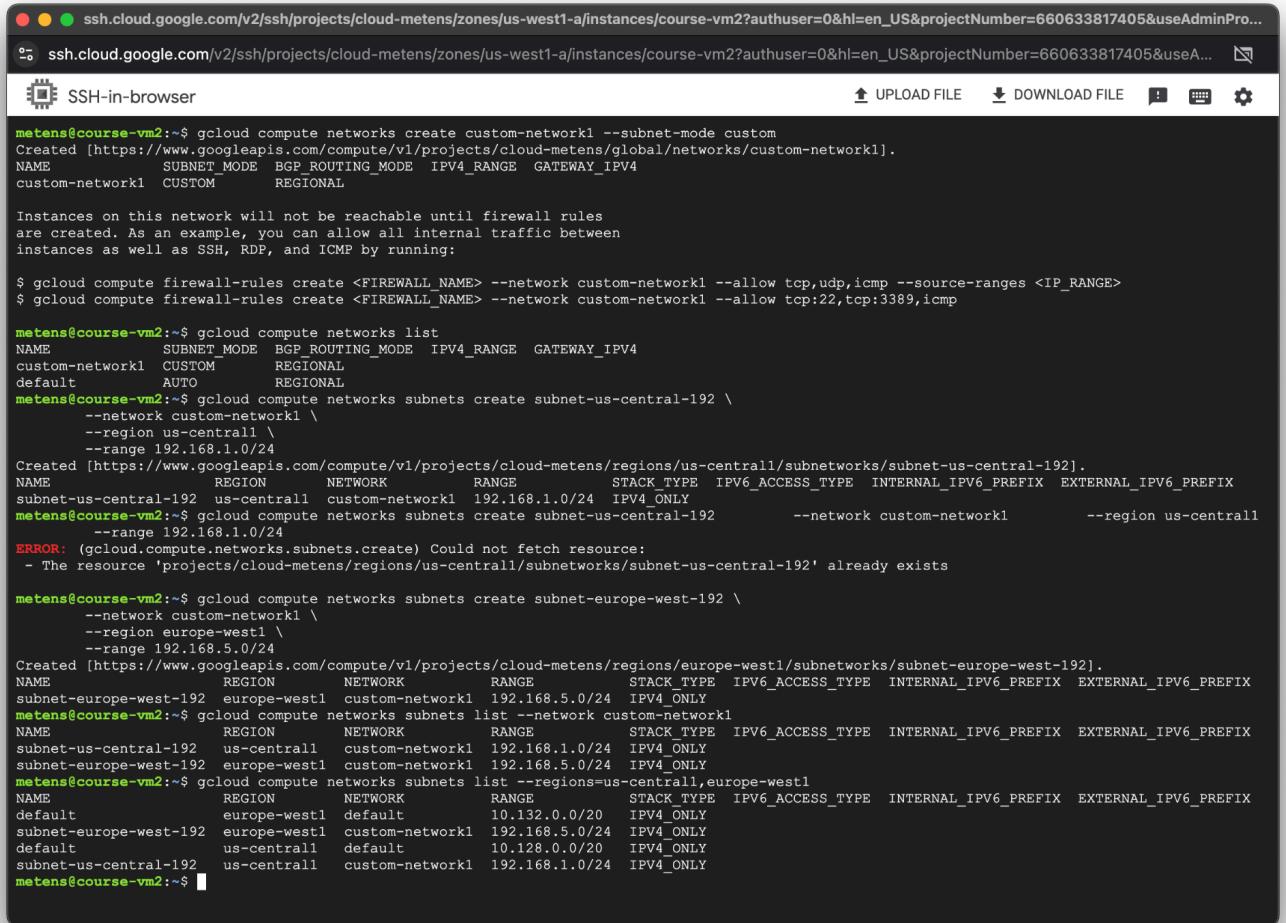


The screenshot shows an SSH session titled "SSH-in-brow" with the URL "ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west4-c/...". The session window displays the following terminal output:

```
PING 10.182.0.3 (10.182.0.3) 56(84) bytes of data.
64 bytes from 10.182.0.3: icmp_seq=1 ttl=64 time=1.63 ms
64 bytes from 10.182.0.3: icmp_seq=2 ttl=64 time=1.04 ms
64 bytes from 10.182.0.3: icmp_seq=3 ttl=64 time=0.936 ms
64 bytes from 10.182.0.3: icmp_seq=4 ttl=64 time=0.960 ms
64 bytes from 10.182.0.3: icmp_seq=5 ttl=64 time=1.02 ms
64 bytes from 10.182.0.3: icmp_seq=6 ttl=64 time=0.940 ms
64 bytes from 10.182.0.3: icmp_seq=7 ttl=64 time=0.957 ms
64 bytes from 10.182.0.3: icmp_seq=8 ttl=64 time=0.938 ms
64 bytes from 10.182.0.3: icmp_seq=9 ttl=64 time=0.939 ms
64 bytes from 10.182.0.3: icmp_seq=10 ttl=64 time=1.00 ms
64 bytes from 10.182.0.3: icmp_seq=11 ttl=64 time=1.02 ms
64 bytes from 10.182.0.3: icmp_seq=12 ttl=64 time=0.936 ms
64 bytes from 10.182.0.3: icmp_seq=13 ttl=64 time=0.933 ms
64 bytes from 10.182.0.3: icmp_seq=14 ttl=64 time=0.971 ms
64 bytes from 10.182.0.3: icmp_seq=15 ttl=64 time=0.964 ms
64 bytes from 10.182.0.3: icmp_seq=16 ttl=64 time=0.937 ms
^C
--- 10.182.0.3 ping statistics ---
16 packets transmitted, 16 received, 0% packet loss, time 15019ms
rtt min/avg/max/mdev = 0.933/1.006/1.625/0.163 ms
metens@instance-1:~$ 
```

Because the two instances are in the same region but in different zones and are part of the same CIDR internal IP address group, the connectivity runs through the virtual switch, not the VPN gateway.

6) Creating Custom Networks



The screenshot shows an SSH-in-browser session on a Mac OS X desktop. The terminal window has a dark background and white text. At the top, it says "ssh.cloud.google.com/v2/ssh/projects/cloud-metens/zones/us-west1-a/instances/course-vm2?authuser=0&hl=en_US&projectNumber=660633817405&useAdminPro...". Below that is the title "SSH-in-browser" and a toolbar with icons for upload, download, and settings.

```
metens@course-vm2:~$ gcloud compute networks create custom-network1 --subnet-mode custom
Created [https://www.googleapis.com/compute/v1/projects/cloud-metens/global/networks/custom-network1].
NAME      SUBNET_MODE  BGP_ROUTING_MODE  IPV4_RANGE  GATEWAY_IPV4
custom-network1  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:

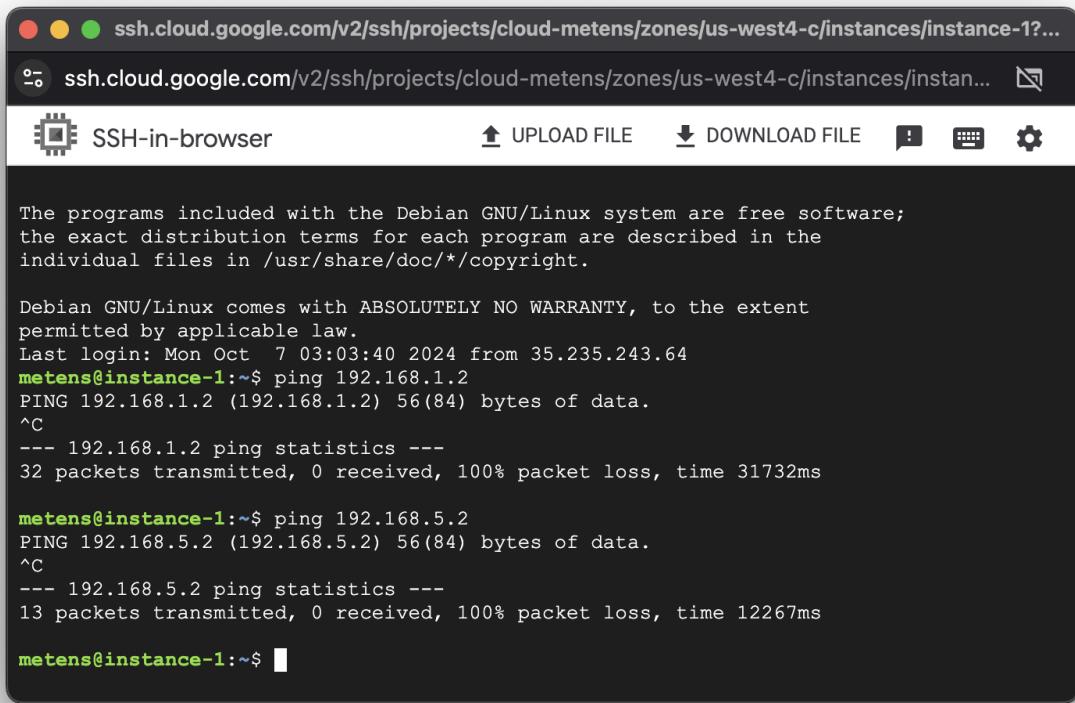
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network custom-network1 --allow tcp,udp,icmp --source-ranges <IP_RANGE>
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network custom-network1 --allow tcp:22,tcp:3389,icmp

metens@course-vm2:~$ gcloud compute networks list
NAME      SUBNET_MODE  BGP_ROUTING_MODE  IPV4_RANGE  GATEWAY_IPV4
custom-network1  CUSTOM        REGIONAL
default    AUTO         REGIONAL

metens@course-vm2:~$ gcloud compute networks subnets create subnet-us-central-192 \
--network custom-network1 \
--region us-central1 \
--range 192.168.1.0/24
Created [https://www.googleapis.com/compute/v1/projects/cloud-metens/regions/us-central1/subnetworks/subnet-us-central-192].
NAME      REGION      NETWORK      RANGE      STACK_TYPE  IPV6_ACCESS_TYPE  INTERNAL_IPV6_PREFIX  EXTERNAL_IPV6_PREFIX
subnet-us-central-192  us-central1  custom-network1  192.168.1.0/24  IPV4_ONLY
metens@course-vm2:~$ gcloud compute networks subnets create subnet-us-central-192 \
--network custom-network1 \
--region us-central1 \
--range 192.168.1.0/24
ERROR: (gcloud.compute.networks.subnets.create) Could not fetch resource:
- The resource 'projects/cloud-metens/regions/us-central1/subnetworks/subnet-us-central-192' already exists

metens@course-vm2:~$ gcloud compute networks subnets create subnet-europe-west-192 \
--network custom-network1 \
--region europe-west1 \
--range 192.168.5.0/24
Created [https://www.googleapis.com/compute/v1/projects/cloud-metens/regions/europe-west1/subnetworks/subnet-europe-west-192].
NAME      REGION      NETWORK      RANGE      STACK_TYPE  IPV6_ACCESS_TYPE  INTERNAL_IPV6_PREFIX  EXTERNAL_IPV6_PREFIX
subnet-europe-west-192  europe-west1  custom-network1  192.168.5.0/24  IPV4_ONLY
metens@course-vm2:~$ gcloud compute networks subnets list --network custom-network1
NAME      REGION      NETWORK      RANGE      STACK_TYPE  IPV6_ACCESS_TYPE  INTERNAL_IPV6_PREFIX  EXTERNAL_IPV6_PREFIX
subnet-us-central-192  us-central1  custom-network1  192.168.1.0/24  IPV4_ONLY
subnet-europe-west-192  europe-west1  custom-network1  192.168.5.0/24  IPV4_ONLY
metens@course-vm2:~$ gcloud compute networks subnets list --regions=us-central1,europe-west1
NAME      REGION      NETWORK      RANGE      STACK_TYPE  IPV6_ACCESS_TYPE  INTERNAL_IPV6_PREFIX  EXTERNAL_IPV6_PREFIX
default    europe-west1  default    10.132.0.0/20  IPV4_ONLY
subnet-europe-west-192  europe-west1  custom-network1  192.168.5.0/24  IPV4_ONLY
default    us-central1  default    10.128.0.0/20  IPV4_ONLY
subnet-us-central-192  us-central1  custom-network1  192.168.1.0/24  IPV4_ONLY
metens@course-vm2:~$
```

From instance-1 we cannot ping instance-3 nor instance-4 with the Internal IP addresses. When we did a ping from instance-1 to instance-2, the two instances were in the same region and zone. Here, instance-1 cannot reach either instances 3 or 4 because they are in different subnets and different regions which are unreachable:



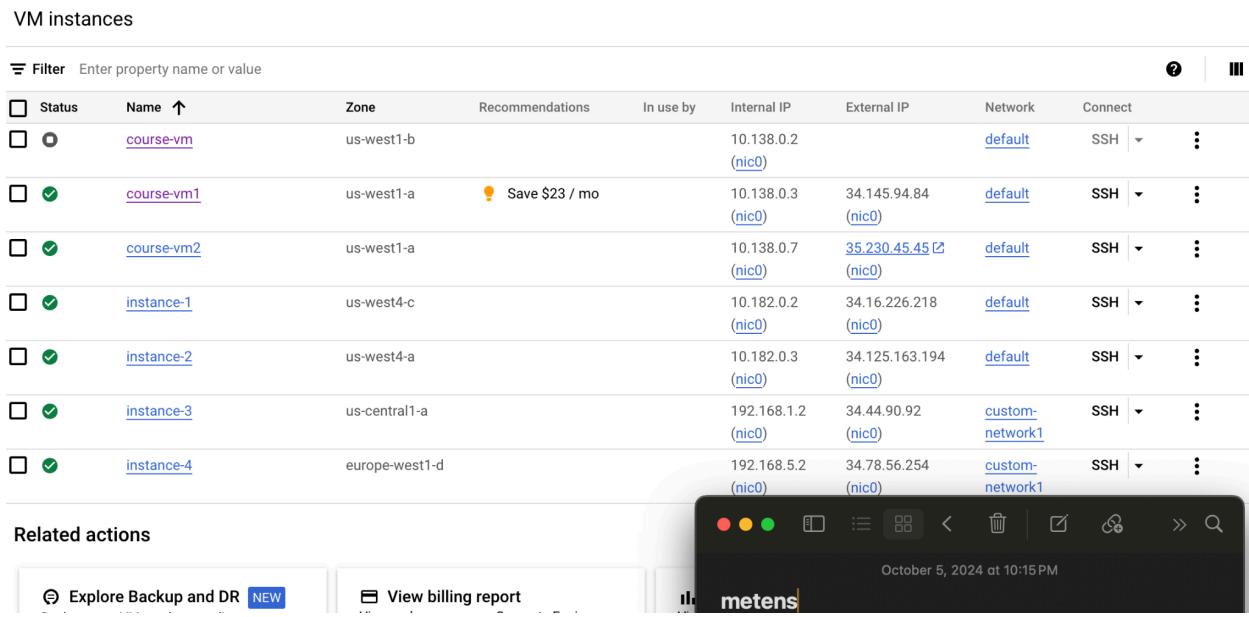
```
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Oct  7 03:03:40 2024 from 35.235.243.64
metens@instance-1:~$ ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
^C
--- 192.168.1.2 ping statistics ---
32 packets transmitted, 0 received, 100% packet loss, time 31732ms

metens@instance-1:~$ ping 192.168.5.2
PING 192.168.5.2 (192.168.5.2) 56(84) bytes of data.
^C
--- 192.168.5.2 ping statistics ---
13 packets transmitted, 0 received, 100% packet loss, time 12267ms

metens@instance-1:~$
```

Here is a capture of the 4 instances:



Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Network	Connect
<input type="checkbox"/>	course-vm	us-west1-b			10.138.0.2 (nic0)		default	SSH
<input type="checkbox"/>	course-vm1	us-west1-a	💡 Save \$23 / mo		10.138.0.3 (nic0)	34.145.94.84	default	SSH
<input type="checkbox"/>	course-vm2	us-west1-a			10.138.0.7 (nic0)	35.230.45.45	default	SSH
<input type="checkbox"/>	instance-1	us-west4-c			10.182.0.2 (nic0)	34.16.226.218	default	SSH
<input type="checkbox"/>	instance-2	us-west4-a			10.182.0.3 (nic0)	34.125.163.194	default	SSH
<input type="checkbox"/>	instance-3	us-central1-a			192.168.1.2 (nic0)	34.44.90.92	custom-network1	SSH
<input type="checkbox"/>	instance-4	europe-west1-d			192.168.5.2 (nic0)	34.78.56.254	custom-network1	SSH

Related actions

- [Explore Backup and DR](#) NEW
- [View billing report](#)

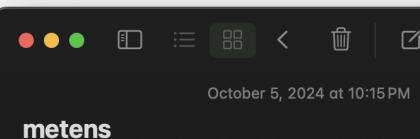
October 5, 2024 at 10:15PM

Here are subnetwork instances from the custom-network1 and default networks:

custom-network1

Subnets									
Subnets									
Subnets									
Filter Enter property name or value									
Name	Region	Stack Type	Primary IPv4 range	Secondary IPv4 ranges	IPv6 ranges	Reserved internal ranges	Gateway	Private Google Cloud	Autoscaling
subnet-europe-west-192	europe-west1	IPv4	192.168.5.0/24			None	192.168.5.1	Off	
subnet-us-central-192	us-central1	IPv4	192.168.1.0/24			None	192.168.1.1	Off	

Reserved proxy-only subnets for load balancing



default

Subnets									
Subnets									
Subnets									
Filter Enter property name or value									
Name	Region	Stack Type	Primary IPv4 range	Secondary IPv4 ranges	IPv6 ranges	Reserved internal ranges	Gateway	Private Google Cloud	Autoscaling
default	africa-south1	IPv4	10.218.0.0/20			None	10.218.0.1	Off	
default	asia-east1	IPv4	10.140.0.0/20			None	10.140.0.1	Off	
default	asia-east2	IPv4	10.170.0.0/20			None	10.170.0.1	Off	
default	asia-northeast1	IPv4	10.146.0.0/20			None	10.146.0.1	Off	
default	asia-northeast2	IPv4	10.174.0.0/20			None	10.174.0.1	Off	
default	asia-northeast3	IPv4	10.178.0.0/20			None	10.178.0.1	Off	
default	asia-south1	IPv4	10.160.0.0/20			None	10.160.0.1	Off	
default	asia-south2	IPv4	10.190.0.0/20			None	10.190.0.1	Off	
default	asia-southeast1	IPv4	10.148.0.0/20						
default	asia-southeast2	IPv4	10.184.0.0/20						
default	australia-southeast1	IPv4	10.152.0.0/20						

