

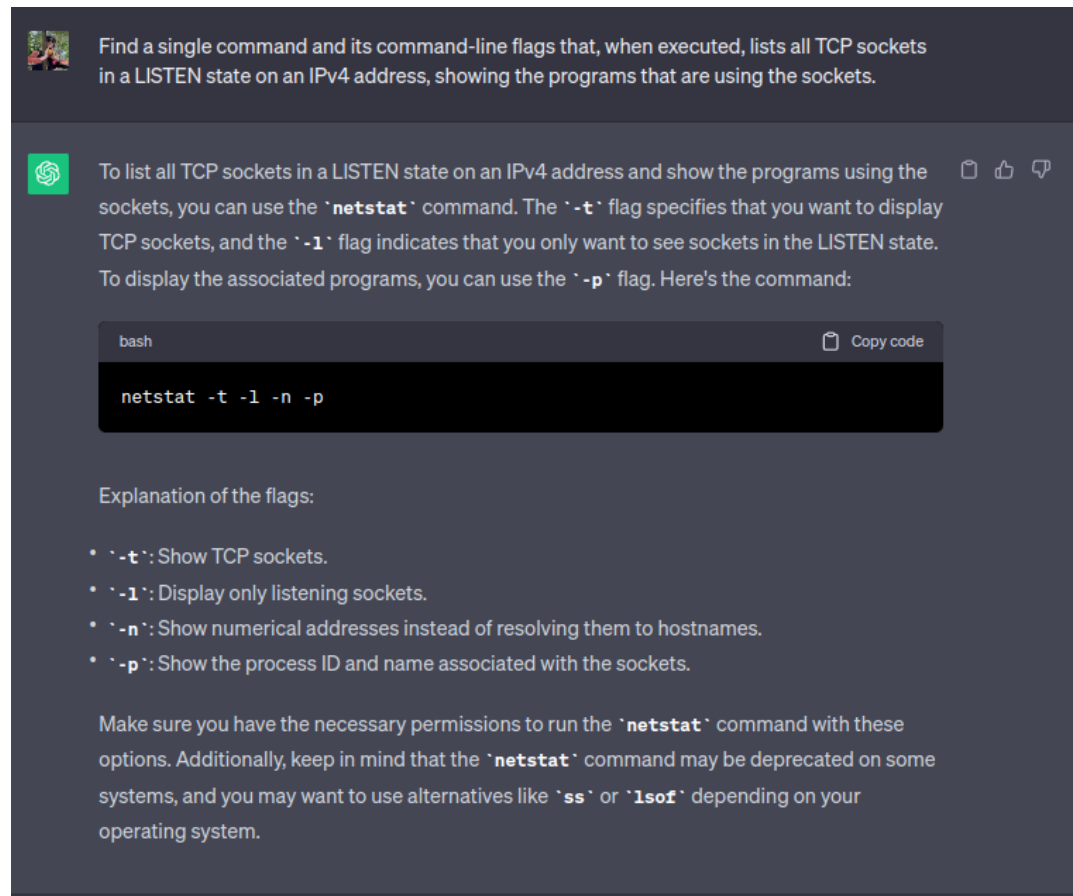
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I. Lab 2.1 - TCP, HTTP

1. TCP #1: Sockets

- Using ChatGPT, find a single command and its command-line flags that, when executed, lists all **TCP** sockets in a **LISTEN** state on an **IPv4** address, showing the **program** that is using it.
 - Take a screenshot of the prompt and the command that ChatGPT generates



- Run the command using **sudo** and take a screenshot of the output to include in your lab notebook.

```
meelz(amminer)@course-vm: ~
meelz(amminer)@course-vm:~$ sudo netstat -tlpn
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 127.0.0.53:53           0.0.0.0:*                LISTEN      366/systemd-resolve
tcp        0      0 127.0.0.1:37149         0.0.0.0:*                LISTEN      453/containerd
tcp        0      0 0.0.0.0:22              0.0.0.0:*                LISTEN      794/sshd: /usr/sbin
tcp6       0      0 :::1:3350                :::*                    LISTEN      560/xrdp-sesman
tcp6       0      0 :::3389                  :::*                    LISTEN      644/xrdp
tcp6       0      0 :::22                    :::*                    LISTEN      794/sshd: /usr/sbin
```

- List a service that can be contacted from any interface on the machine. List a service that can only be contacted by local processes.

sshd can be contacted from any interface on the machine. containerd can only be contacted by local processes.

- ```

meelz@meelzBox: ~
meelzBox:~ > ssh amminer@linux.cs.pdx.edu
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-75-generic x86_64)

=====
This machine is for the exclusive use of those associated with
the Maseeh College of Engineering and Computer Science.

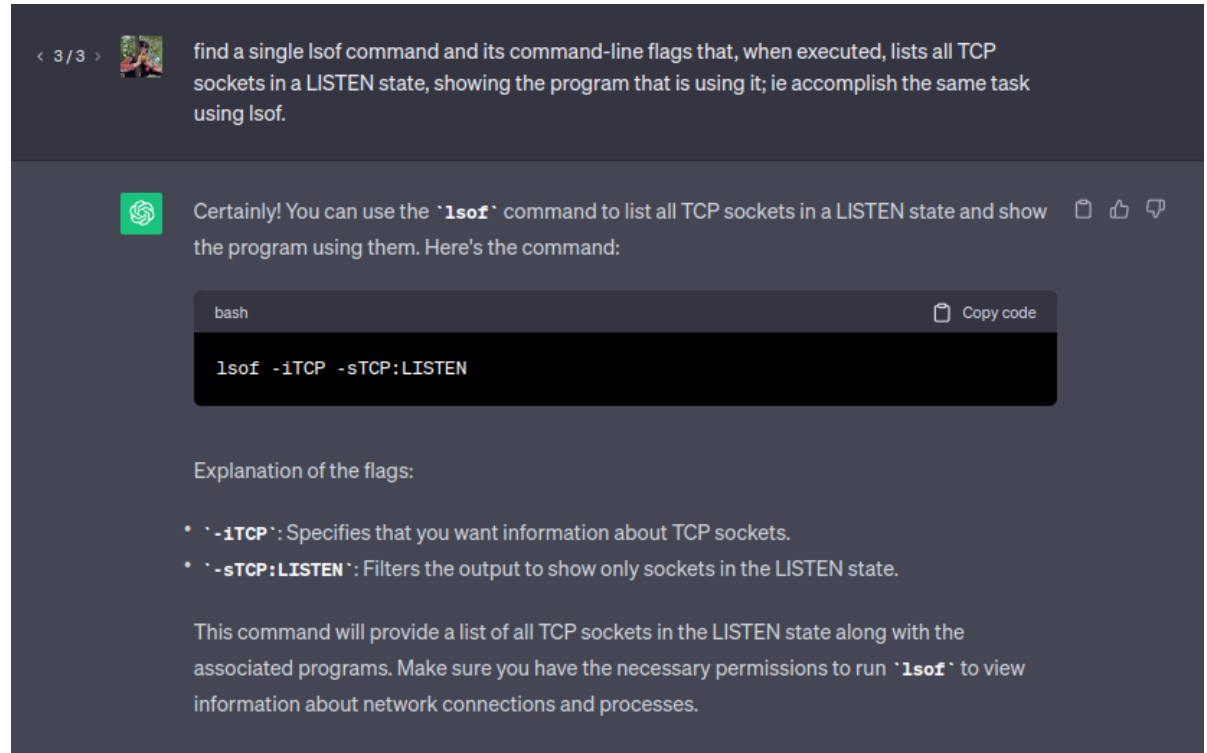
ALL ACTIVITY MAY BE RECORDED
=====
* CAT Support: https://cat.pdx.edu/
* Email: support@cat.pdx.edu
* Phone: 503-725-5420
* Chat: https://support.cat.pdx.edu
* Location: FAB 82-01

Last login: Sun Oct 8 07:10:54 2023 from 104.220.249.53
amminer@ada:~ > netstat -tlnp
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address Foreign Address State PID/Program name
tcp 0 0 0.0.0.0:22 0.0.0.0:* LISTEN -
tcp 0 0 0.0.0.0:22 0.0.0.0:* LISTEN -
tcp6 0 0 :::22 :::* LISTEN -
tcp 0 0 0.0.0.0:111 0.0.0.0:* LISTEN -
tcp6 0 0 :::111 :::* LISTEN -
tcp 0 0 0.0.0.0:113 0.0.0.0:* LISTEN -
tcp6 0 0 :::113 :::* LISTEN -
tcp 0 0 0.0.0.0:115 0.0.0.0:* LISTEN -
tcp6 0 0 :::115 :::* LISTEN -
tcp 0 0 0.0.0.0:135 0.0.0.0:* LISTEN -
tcp6 0 0 :::135 :::* LISTEN -
tcp 0 0 0.0.0.0:137 0.0.0.0:* LISTEN -
tcp6 0 0 :::137 :::* LISTEN -
tcp 0 0 0.0.0.0:139 0.0.0.0:* LISTEN -
tcp6 0 0 :::139 :::* LISTEN -
tcp 0 0 0.0.0.0:143 0.0.0.0:* LISTEN -
tcp6 0 0 :::143 :::* LISTEN -
tcp 0 0 0.0.0.0:144 0.0.0.0:* LISTEN -
tcp6 0 0 :::144 :::* LISTEN -
tcp 0 0 0.0.0.0:146 0.0.0.0:* LISTEN -
tcp6 0 0 :::146 :::* LISTEN -
tcp 0 0 0.0.0.0:147 0.0.0.0:* LISTEN -
tcp6 0 0 :::147 :::* LISTEN -
tcp 0 0 0.0.0.0:148 0.0.0.0:* LISTEN -
tcp6 0 0 :::148 :::* LISTEN -
tcp 0 0 0.0.0.0:150 0.0.0.0:* LISTEN -
tcp6 0 0 :::150 :::* LISTEN -
tcp 0 0 0.0.0.0:151 0.0.0.0:* LISTEN -
tcp6 0 0 :::151 :::* LISTEN -
tcp 0 0 0.0.0.0:152 0.0.0.0:* LISTEN -
tcp6 0 0 :::152 :::* LISTEN -
tcp 0 0 0.0.0.0:153 0.0.0.0:* LISTEN -
tcp6 0 0 :::153 :::* LISTEN -
tcp 0 0 0.0.0.0:154 0.0.0.0:* LISTEN -
tcp6 0 0 :::154 :::* LISTEN -
tcp 0 0 0.0.0.0:155 0.0.0.0:* LISTEN -
tcp6 0 0 :::155 :::* LISTEN -
tcp 0 0 0.0.0.0:156 0.0.0.0:* LISTEN -
tcp6 0 0 :::156 :::* LISTEN -
tcp 0 0 0.0.0.0:157 0.0.0.0:* LISTEN -
tcp6 0 0 :::157 :::* LISTEN -
tcp 0 0 0.0.0.0:158 0.0.0.0:* LISTEN -
tcp6 0 0 :::158 :::* LISTEN -
tcp 0 0 0.0.0.0:159 0.0.0.0:* LISTEN -
tcp6 0 0 :::159 :::* LISTEN -
tcp 0 0 0.0.0.0:160 0.0.0.0:* LISTEN -
tcp6 0 0 :::160 :::* LISTEN -
tcp 0 0 0.0.0.0:161 0.0.0.0:* LISTEN -
tcp6 0 0 :::161 :::* LISTEN -
tcp 0 0 0.0.0.0:162 0.0.0.0:* LISTEN -
tcp6 0 0 :::162 :::* LISTEN -
tcp 0 0 0.0.0.0:163 0.0.0.0:* LISTEN -
tcp6 0 0 :::163 :::* LISTEN -
tcp 0 0 0.0.0.0:164 0.0.0.0:* LISTEN -
tcp6 0 0 :::164 :::* LISTEN -
tcp 0 0 0.0.0.0:165 0.0.0.0:* LISTEN -
tcp6 0 0 :::165 :::* LISTEN -
tcp 0 0 0.0.0.0:166 0.0.0.0:* LISTEN -
tcp6 0 0 :::166 :::* LISTEN -
tcp 0 0 0.0.0.0:167 0.0.0.0:* LISTEN -
tcp6 0 0 :::167 :::* LISTEN -
tcp 0 0 0.0.0.0:168 0.0.0.0:* LISTEN -
tcp6 0 0 :::168 :::* LISTEN -
tcp 0 0 0.0.0.0:169 0.0.0.0:* LISTEN -
tcp6 0 0 :::169 :::* LISTEN -
tcp 0 0 0.0.0.0:170 0.0.0.0:* LISTEN -
tcp6 0 0 :::170 :::* LISTEN -
tcp 0 0 0.0.0.0:171 0.0.0.0:* LISTEN -
tcp6 0 0 :::171 :::* LISTEN -
tcp 0 0 0.0.0.0:172 0.0.0.0:* LISTEN -
tcp6 0 0 :::172 :::* LISTEN -
tcp 0 0 0.0.0.0:173 0.0.0.0:* LISTEN -
tcp6 0 0 :::173 :::* LISTEN -
tcp 0 0 0.0.0.0:174 0.0.0.0:* LISTEN -
tcp6 0 0 :::174 :::* LISTEN -
tcp 0 0 0.0.0.0:175 0.0.0.0:* LISTEN -
tcp6 0 0 :::175 :::* LISTEN -
tcp 0 0 0.0.0.0:176 0.0.0.0:* LISTEN -
tcp6 0 0 :::176 :::* LISTEN -
tcp 0 0 0.0.0.0:177 0.0.0.0:* LISTEN -
tcp6 0 0 :::177 :::* LISTEN -
tcp 0 0 0.0.0.0:178 0.0.0.0:* LISTEN -
tcp6 0 0 :::178 :::* LISTEN -
tcp 0 0 0.0.0.0:179 0.0.0.0:* LISTEN -
tcp6 0 0 :::179 :::* LISTEN -
tcp 0 0 0.0.0.0:180 0.0.0.0:* LISTEN -
tcp6 0 0 :::180 :::* LISTEN -
tcp 0 0 0.0.0.0:181 0.0.0.0:* LISTEN -
tcp6 0 0 :::181 :::* LISTEN -
tcp 0 0 0.0.0.0:182 0.0.0.0:* LISTEN -
tcp6 0 0 :::182 :::* LISTEN -
tcp 0 0 0.0.0.0:183 0.0.0.0:* LISTEN -
tcp6 0 0 :::183 :::* LISTEN -
tcp 0 0 0.0.0.0:184 0.0.0.0:* LISTEN -
tcp6 0 0 :::184 :::* LISTEN -
tcp 0 0 0.0.0.0:185 0.0.0.0:* LISTEN -
tcp6 0 0 :::185 :::* LISTEN -
tcp 0 0 0.0.0.0:186 0.0.0.0:* LISTEN -
tcp6 0 0 :::186 :::* LISTEN -
tcp 0 0 0.0.0.0:187 0.0.0.0:* LISTEN -
tcp6 0 0 :::187 :::* LISTEN -
tcp 0 0 0.0.0.0:188 0.0.0.0:* LISTEN -
tcp6 0 0 :::188 :::* LISTEN -
tcp 0 0 0.0.0.0:189 0.0.0.0:* LISTEN -
tcp6 0 0 :::189 :::* LISTEN -
tcp 0 0 0.0.0.0:190 0.0.0.0:* LISTEN -
tcp6 0 0 :::190 :::* LISTEN -
tcp 0 0 0.0.0.0:191 0.0.0.0:* LISTEN -
tcp6 0 0 :::191 :::* LISTEN -
tcp 0 0 0.0.0.0:192 0.0.0.0:* LISTEN -
tcp6 0 0 :::192 :::* LISTEN -
tcp 0 0 0.0.0.0:193 0.0.0.0:* LISTEN -
tcp6 0 0 :::193 :::* LISTEN -
tcp 0 0 0.0.0.0:194 0.0.0.0:* LISTEN -
tcp6 0 0 :::194 :::* LISTEN -
tcp 0 0 0.0.0.0:195 0.0.0.0:* LISTEN -
tcp6 0 0 :::195 :::* LISTEN -
tcp 0 0 0.0.0.0:196 0.0.0.0:* LISTEN -
tcp6 0 0 :::196 :::* LISTEN -
tcp 0 0 0.0.0.0:197 0.0.0.0:* LISTEN -
tcp6 0 0 :::197 :::* LISTEN -
tcp 0 0 0.0.0.0:198 0.0.0.0:* LISTEN -
tcp6 0 0 :::198 :::* LISTEN -
tcp 0 0 0.0.0.0:199 0.0.0.0:* LISTEN -
tcp6 0 0 :::199 :::* LISTEN -
tcp 0 0 0.0.0.0:200 0.0.0.0:* LISTEN -
tcp6 0 0 :::200 :::* LISTEN -
tcp 0 0 0.0.0.0:201 0.0.0.0:* LISTEN -
tcp6 0 0 :::201 :::* LISTEN -
tcp 0 0 0.0.0.0:202 0.0.0.0:* LISTEN -
tcp6 0 0 :::202 :::* LISTEN -
tcp 0 0 0.0.0.0:203 0.0.0.0:* LISTEN -
tcp6 0 0 :::203 :::* LISTEN -
tcp 0 0 0.0.0.0:204 0.0.0.0:* LISTEN -
tcp6 0 0 :::204 :::* LISTEN -
tcp 0 0 0.0.0.0:205 0.0.0.0:*
```

- It looks like only ssh is available to external connections on linux.cs.pdx.edu.

## 2. LSOF

- Using ChatGPT, find a single `lsof` command and its command-line flags that, when executed, lists all `TCP` sockets in a `LISTEN` state on an `IPv4` address, showing the `program` that is using it. Note that you can leverage the conversation in the previous step and simply ask ChatGPT to repeat the task using `lsof`.
  - Take a screenshot of the prompt and the command that ChatGPT generates.



- Run the command using `sudo` and take a screenshot of the output to include in your lab notebook.

```
meelz(amminer)@course-vm:~$ sudo lsof -iTCP -sTCP:LISTEN
COMMAND PID USER FD TYPE DEVICE SIZE/OFF NODE NAME
systemd-r 366 systemd-resolve 14u IPv4 16321 0t0 TCP localhost:domain (LISTEN)
container 453 root 8u IPv4 17389 0t0 TCP localhost:37149 (LISTEN)
xrdp-sesm 560 root 7u IPv6 17910 0t0 TCP ip6-localhost:3350 (LISTEN)
xrdp 644 xrdp 11u IPv6 17166 0t0 TCP *:ms-wbt-server (LISTEN)
sshd 794 root 3u IPv4 17368 0t0 TCP *:ssh (LISTEN)
sshd 794 root 4u IPv6 17370 0t0 TCP *:ssh (LISTEN)
meelz(amminer)@course-vm:~$
```

### 3. TCP #2: Throughput

- VMs instantiated:

NAME: vm-europe-west1-d  
INTERNAL\_IP: 10.132.0.2  
EXTERNAL\_IP: 35.195.100.133

NAME: vm-us-west1-b  
INTERNAL\_IP: 10.138.0.6  
EXTERNAL\_IP: 34.168.52.191

NAME: vm-us-east1-b  
INTERNAL\_IP: 10.142.0.3  
EXTERNAL\_IP: 34.74.3.81

NAME: vm-australia-southeast1-b  
INTERNAL\_IP: 10.152.0.2  
EXTERNAL\_IP: 35.189.16.39

## 4. - iperf

- On each foreign machine, run `sudo iperf -s -p 80`.
- On the local machine, run `iperf -c <IP address> -p 80` for each foreign machine's internal IP.
- Show a screenshot of the measured bandwidth available between your us-west1-b VM and each of the other Compute Engine VMs. Explain the relative differences (or lack thereof) in your results.

```
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2
> do
> iperf -c $addr -p 80 | tee $addr.txt
> done

Client connecting to 10.132.0.2, TCP port 80
TCP window size: 85.0 KByte (default)

[1] local 10.138.0.6 port 46862 connected with 10.132.0.2 port 80
[ID] Interval Transfer Bandwidth
[1] 0.0000-10.2068 sec 185 MBytes 152 Mbits/sec

Client connecting to 10.142.0.3, TCP port 80
TCP window size: 85.0 KByte (default)

[1] local 10.138.0.6 port 47144 connected with 10.142.0.3 port 80
[ID] Interval Transfer Bandwidth
[1] 0.0000-10.0767 sec 435 MBytes 362 Mbits/sec

Client connecting to 10.152.0.2, TCP port 80
TCP window size: 85.0 KByte (default)

[1] local 10.138.0.6 port 38712 connected with 10.152.0.2 port 80
[ID] Interval Transfer Bandwidth
[1] 0.0000-10.2228 sec 173 MBytes 142 Mbits/sec
amminer@vm-us-west1-b:~$ ls
10.132.0.2.txt 10.142.0.3.txt 10.152.0.2.txt
amminer@vm-us-west1-b:~$
```

(in the same order as above: eu-west, us-east, aus-southeast).

Bandwidth values correspond roughly with discrepancies I would expect based on physical distances between the machines. Interestingly, when I run traceroute to these machines, discrepancies in the number of hops are minimal, presumably because I'm routing over gcloud's internal network which creates a sort of virtual data link over the actual routers that underlie it, like what we were talking about last week in lecture?

```
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr | wc -l; done
2
2
2
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr; done
traceroute to 10.132.0.2 (10.132.0.2), 30 hops max, 60 byte packets
 0 vm-europe-west1-d.europe-west1-d.c.cloud-miner-amminer.internal (10.132.0.2) 135.685 ms 135.638 ms *
 1 * * *
 2 * * *
 3 * * *
 4 * * *
 5 vm-us-east1-b.us-east1-b.c.cloud-miner-amminer.internal (10.142.0.3) 65.189 ms * *
traceroute to 10.152.0.2 (10.152.0.2), 30 hops max, 60 byte packets
 0 vm-australia-southeast1-b.australia-southeast1-b.c.cloud-miner-amminer.internal (10.152.0.2) 149.845 ms * 149.791
 1 * * *
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr | wc -l; done
2
2
2
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr | wc -l; done
2
2
2
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr | wc -l; done
2
2
2
amminer@vm-us-west1-b:~$ for addr in 10.132.0.2 10.142.0.3 10.152.0.2; do traceroute $addr | wc -l; done
2
2
2
amminer@vm-us-west1-b:~$
```

## 5. HTTP #3: Requests

- Using chrome, visit <http://google.com> in incognito mode with quic/http3 enabled. Take a screenshot of the initial 3 requests that the browser makes:

The screenshot shows the Chrome DevTools Network tab with the 'All' filter selected. The first three requests are highlighted in blue, indicating they are the initial requests. The table below shows the details of these requests:

| Name       | Status | Type     | Initiator | Size         | Time    | Waterfall |
|------------|--------|----------|-----------|--------------|---------|-----------|
| google.com | 307    | docum... | Other     | 0 B          | Pending |           |
| google.com | 301    | docum... | (index)   | 0 B          | Pending |           |
| google.com | 200    | docum... | (index)   | (disk ca...) | Pending |           |

The screenshot also shows a terminal window with the following output:

```
meelz@meelzBox: ~
meelzBox:~> psu
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-75-generic x86_64)

This machine is for the exclusive use of those associated with
the Maseeh College of Engineering and Computer Science.

ALL ACTIVITY MAY BE RECORDED

* CAT Support: https://cat.pdx.edu/
* Email: support@cat.pdx.edu
* Phone: 503-725-5420
* Chat: https://support.cat.pdx.edu
* Location: FAB 82-01

Last login: Sun Oct 8 07:11:21 2023 from 104.220.249.53
amminer@ada:~> whoami
amminer
amminer@ada:~>
```

- For each of the initial 3 requests:
  - What is the URL being requested?

<http://google.com>,

<https://google.com>,

and <http://google.com>

- Explain the HTTP status code that is returned and what the code indicates

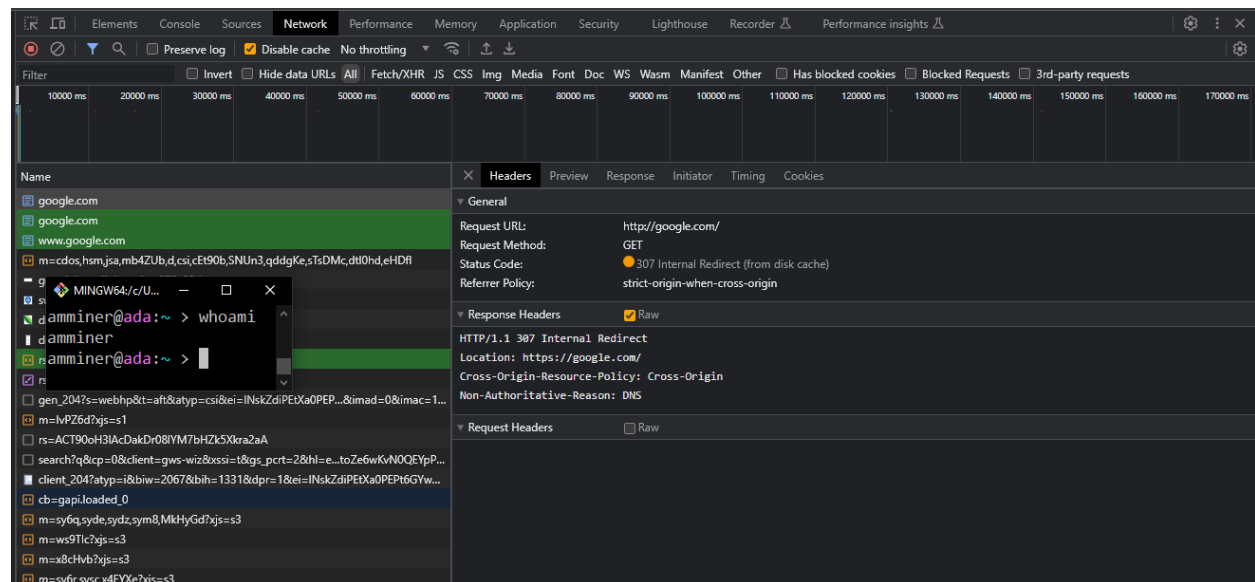
307-temporary redirect. The response includes a new address to which the resource has been “temporarily” moved.

301-moved permanently. The response includes a new address to which the resource has been “permanently” moved.

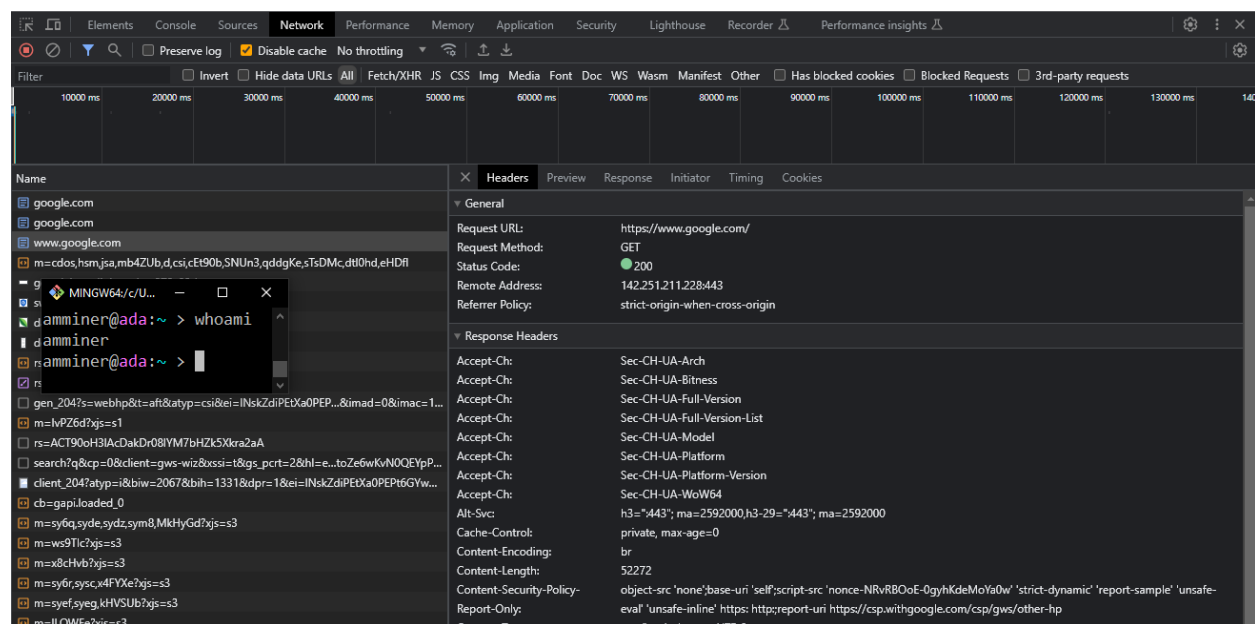
200-ok. The request was successful - here’s those bits you asked for.

- Take a screenshot indicating the version of the HTTP protocol that is used for each request. (Hint: look at the response status line and `alt-svc`: HTTP response headers indicating HTTP/2 or HTTP/3).

My first request shows http/1.1. The other requests aren’t showing any version info in their headers. alt-svc in the responses doesn’t mean anything to me - what’s wrong with my setup? Chrome also occasionally mixes up the wrong status code/name combinations, like 200-internal redirect, etc.







- Find the **Location** response header for the two redirections.
  - What URL does the first redirection send the browser to?

`https://google.com`

- What URL does the second redirection send the browser to?

`https://www.google.com/`

- Examine the HTTP request and response headers for cookies throughout the requests.

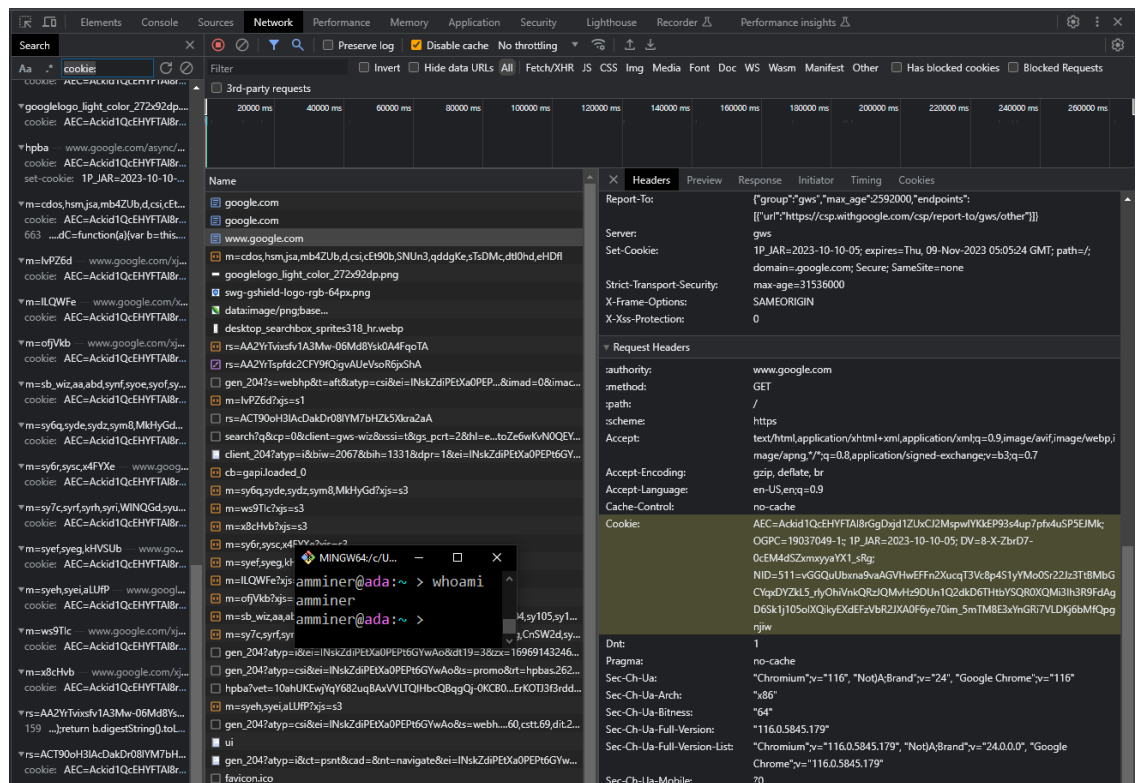
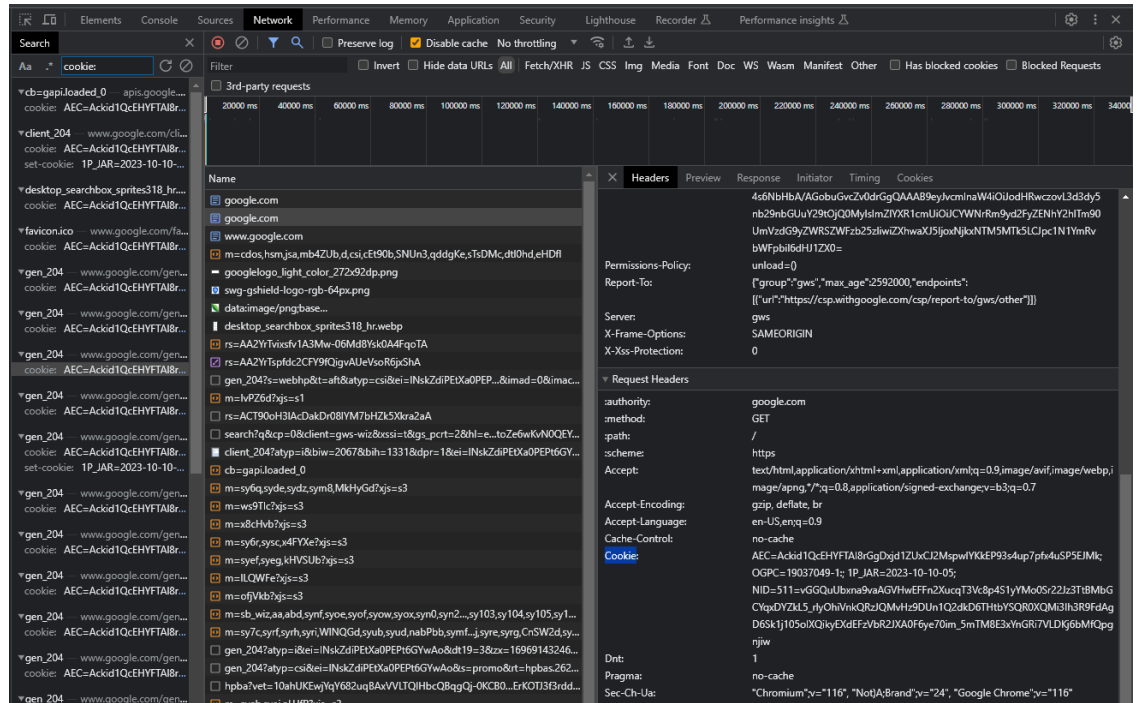
- Take a screenshot of when cookies are set via Set-Cookie:

In the third request:

The screenshot shows the Chrome DevTools Network tab with the third request selected. The Headers panel is expanded, showing the following response headers:

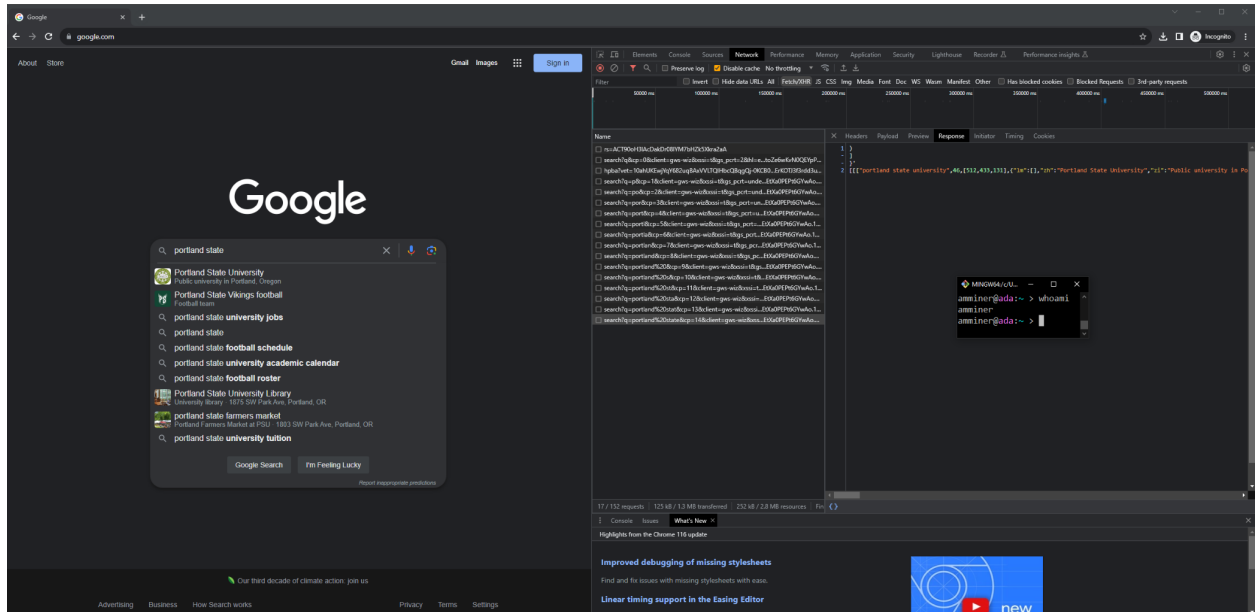
| Header                     | Value                                                                                                                                                                                                               |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Status Code                | 200                                                                                                                                                                                                                 |
| Remote Address             | 142.251.211.228:443                                                                                                                                                                                                 |
| Referrer Policy            | strict-origin-when-cross-origin                                                                                                                                                                                     |
| Accept-Ch                  | Sec-CH-UA-Arch                                                                                                                                                                                                      |
| Accept-Ch                  | Sec-CH-UA-Bitness                                                                                                                                                                                                   |
| Accept-Ch                  | Sec-CH-UA-Full-Version                                                                                                                                                                                              |
| Accept-Ch                  | Sec-CH-UA-Full-Version-List                                                                                                                                                                                         |
| Accept-Ch                  | Sec-CH-UA-Model                                                                                                                                                                                                     |
| Accept-Ch                  | Sec-CH-UA-Platform                                                                                                                                                                                                  |
| Accept-Ch                  | Sec-CH-UA-Platform-Version                                                                                                                                                                                          |
| Accept-Ch                  | Sec-CH-UA-WoW64                                                                                                                                                                                                     |
| Alt-Svc                    | h3="443"; ma=2592000,h3-29="443"; ma=2592000                                                                                                                                                                        |
| Cache-Control              | private, max-age=0                                                                                                                                                                                                  |
| Content-Encoding           | br                                                                                                                                                                                                                  |
| Content-Length             | 52272                                                                                                                                                                                                               |
| Content-Security-Policy    | object-src 'none';base-uri 'self';script-src 'nonce-NRvRBOoE-0gyhKdeMoVa0w' 'strict-dynamic' 'report-sample' 'unsafe-eval' 'unsafe-inline' https://report-uri https://csp.withgoogle.com/csp/gws/other-hp           |
| Content-Type               | text/html; charset=UTF-8                                                                                                                                                                                            |
| Cross-Origin-Opener-Policy | same-origin-allow-popups; report-to="gws"                                                                                                                                                                           |
| Date                       | Tue, 10 Oct 2023 05:05:24 GMT                                                                                                                                                                                       |
| Expires                    | -1                                                                                                                                                                                                                  |
| Origin-Trial               | Ap+qNlnLzjDKSmEHjzMSilaa908GuehlqGb6ezME5lkhelj20qVzfV06zPmQ3LodoeuZuphAolmhnPA8w4AIAAAB8eyJcmInaW4iOlJodHRwczovL3d3dy5nb29nbGUuY29kQ0MyYslmZlYXR1cmUuOlJQZSxtaXNzaW9uc1BvbGJlVubG9hZCIsImV4c2l6MTY4NTY2MzksOXA0=   |
| Origin-Trial               | AvudrjMZqL7335p1KL2lHo1kxdlMelN0dU115dOCPz9dovVLCcXk8OAqjho1DX4s6NbHbA/AGobuGvZv0drGgQAAAB9eyJcmInaW4iOlJodHRwczovL3d3dy5nb29nbGUuY29kQ0MyYslmZlYXR1cmUuOlJQZSxtaXNzaW9uc1BvbGJlVubG9hZCIsImV4c2l6MTY4NTY2MzksOXA0= |
| Permissions-Policy         | unload=()                                                                                                                                                                                                           |
| Report-To                  | [{"group":"gws","max_age":2592000,"endpoints":[{"url":"https://csp.withgoogle.com/csp/report-to/gws/other"}]}                                                                                                       |
| Server                     | gws                                                                                                                                                                                                                 |
| Set-Cookie                 | TP_JAR=2023-10-10-05; expires=Thu, 09-Nov-2023 05:05:24 GMT; path=/; domain=.google.com; Secure; SameSite=none                                                                                                      |
| Strict-Transport-Security  | max-age=31536000                                                                                                                                                                                                    |

- Take a screenshot of when cookies are attached via Cookie:  
In the second and third requests:



## 6. - Asynchronous HTTP requests

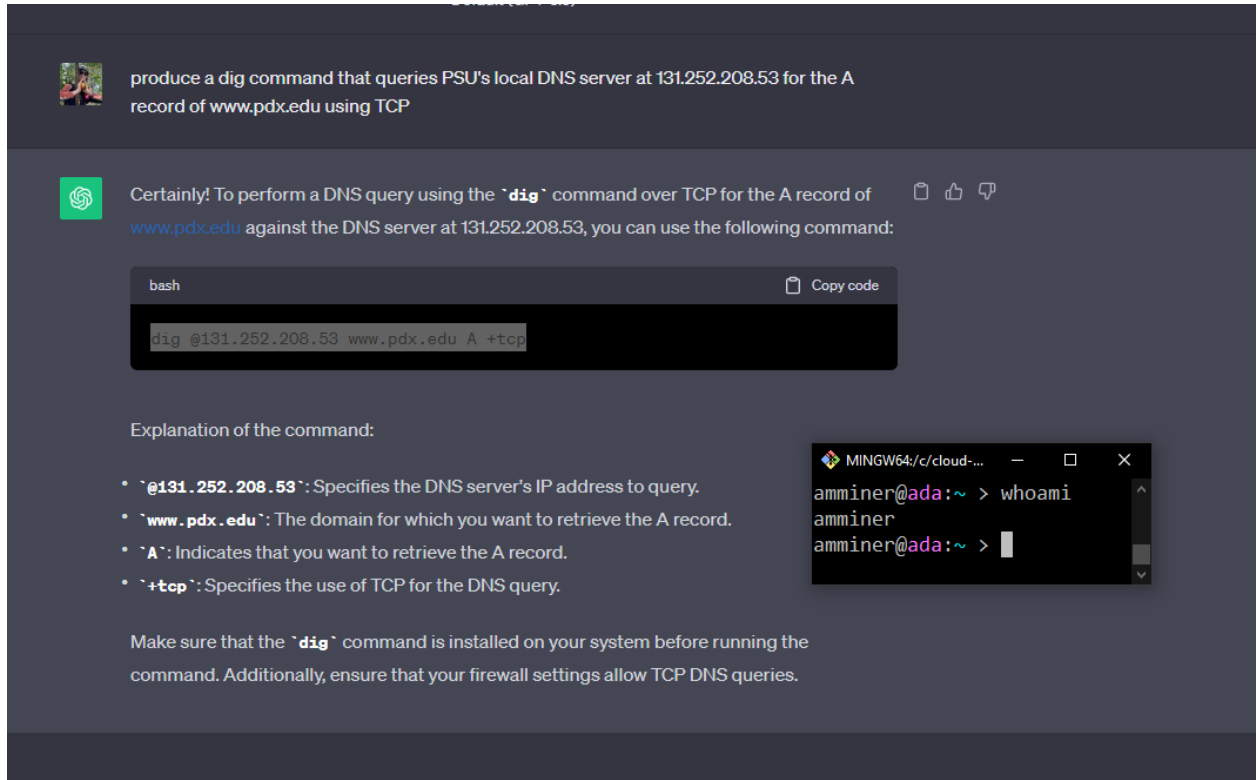
- Show the asynchronous HTTP requests made by typing in the search bar:



## II. Lab 2.2 - TODO

### 1. DNS reconnaissance #1 (dig)

- Using ChatGPT, produce a `dig` command that queries PSU's local DNS server at 131.252.208.53 for the `A` record of `www.pdx.edu` using TCP.



The screenshot shows a ChatGPT interface. At the top, a user prompt asks for a `dig` command to query PSU's local DNS server at 131.252.208.53 for the A record of `www.pdx.edu` using TCP. The ChatGPT response provides the command: `dig @131.252.208.53 www.pdx.edu A +tcp`. Below the command, an "Explanation of the command:" section lists the parts of the command: `@131.252.208.53` for the DNS server IP, `www.pdx.edu` for the domain, `A` for the record type, and `+tcp` for using TCP. To the right of the explanation is a terminal window snippet showing a user running `whoami` and getting the output `amminer`. At the bottom, a note states that the `dig` command must be installed and that firewall settings must allow TCP DNS queries.

produce a `dig` command that queries PSU's local DNS server at 131.252.208.53 for the A record of `www.pdx.edu` using TCP

Certainly! To perform a DNS query using the `dig` command over TCP for the A record of `www.pdx.edu` against the DNS server at 131.252.208.53, you can use the following command:

```
bash
```

```
dig @131.252.208.53 www.pdx.edu A +tcp
```

Copy code

Explanation of the command:

- `@131.252.208.53`: Specifies the DNS server's IP address to query.
- `www.pdx.edu`: The domain for which you want to retrieve the A record.
- `A`: Indicates that you want to retrieve the A record.
- `+tcp`: Specifies the use of TCP for the DNS query.

Make sure that the `dig` command is installed on your system before running the command. Additionally, ensure that your firewall settings allow TCP DNS queries.

```
MINGW64:/c/cloud-...
amminer@ada:~ > whoami
amminer
amminer@ada:~ >
```

- Run the command to find the record. Then, use `dig` to do the same for the `MX` record of `pdx.edu`.

```
MINGW64/c/cloud-miner-amminer
amminer@ada:~ > dig @131.252.208.53 www.pdx.edu A +tcp

; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> @131.252.208.53 www.pdx.edu A +
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27036
;; flags: qr rd ra; QUERY: 1, ANSWER: 4, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags;; udp: 4096
; COOKIE: 6be0bb9ac38971c6010000006524e1a787ff7611cc8e0942 (good)
;; QUESTION SECTION:
;www.pdx.edu. IN A

;; ANSWER SECTION:
www.pdx.edu. 60 IN A 18.161.6.84
www.pdx.edu. 60 IN A 18.161.6.120
www.pdx.edu. 60 IN A 18.161.6.112
www.pdx.edu. 60 IN A 18.161.6.96

;; Query time: 15 msec
;; SERVER: 131.252.208.53#53(131.252.208.53) (TCP)
;; WHEN: Mon Oct 09 22:31:19 PDT 2023
;; MSG SIZE rcvd: 132

amminer@ada:~ > dig @131.252.208.53 pdx.edu MX

; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> @131.252.208.53 pdx.edu MX
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 3088
;; flags: qr rd ra; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags;; udp: 4096
; COOKIE: 6c40b37c9a25fe72010000006524e1aa46cdc55930328b08 (good)
;; QUESTION SECTION:
;pdx.edu. IN MX

;; ANSWER SECTION:
pdx.edu. 61457 IN MX 10 alt4.aspmx.l.google.com.
pdx.edu. 61457 IN MX 10 alt3.aspmx.l.google.com.
pdx.edu. 61457 IN MX 1 aspmx.l.google.com.
pdx.edu. 61457 IN MX 5 alt1.aspmx.l.google.com.
pdx.edu. 61457 IN MX 5 alt2.aspmx.l.google.com.

;; Query time: 0 msec
;; SERVER: 131.252.208.53#53(131.252.208.53) (UDP)
;; WHEN: Mon Oct 09 22:31:22 PDT 2023
;; MSG SIZE rcvd: 182

amminer@ada:~ >
```

Using the IP addresses contained in these records, utilize IP address information services at <https://www.iplocation.net/> to answer the following questions

- What cloud provider hosts the web site for [www.pdx.edu](http://www.pdx.edu)?

Amazon.

- What cloud provider handles mail for pdx.edu?

Google.

- Use `dig` to find the authoritative server (NS record type, AUTHORITY section response) for [mashimaro.cs.pdx.edu](http://mashimaro.cs.pdx.edu) and then query that server for the A record of [mashimaro.cs.pdx.edu](http://mashimaro.cs.pdx.edu).

```
MINGW64/c/cloud-miner-amminer
amminer@ada:~ > dig mashimaro.cs.pdx.edu NS

; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> mashimaro.cs.pdx.edu NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49205
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;mashimaro.cs.pdx.edu. IN NS

;; AUTHORITY SECTION:
cs.pdx.edu. 300 IN SOA walt.ee.pdx.edu. support.cat.pdx.edu. 2023100302 600 300 1209600 300

;; Query time: 7 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Mon Oct 09 22:34:00 PDT 2023
;; MSG SIZE rcvd: 105

amminer@ada:~ > dig @walt.ee.pdx.edu mashimaro.cs.pdx.edu A

; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> @walt.ee.pdx.edu mashimaro.cs.pdx.edu A
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 12901
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 4096
;; COOKIE: 15def9c0f80e1d9f010000006524e27945012ec1b5840806 (good)
;; QUESTION SECTION:
;mashimaro.cs.pdx.edu. IN A

;; ANSWER SECTION:
mashimaro.cs.pdx.edu. 14400 IN A 131.252.220.66

;; Query time: 0 msec
;; SERVER: 131.252.208.38#53(walt.ee.pdx.edu) (UDP)
;; WHEN: Mon Oct 09 22:34:49 PDT 2023
;; MSG SIZE rcvd: 93

amminer@ada:~ >
```



## 2. Iterative DNS lookups

- dig told me the f root server is named f.root-servers.net.
- dig f.root-servers.net told me the f root server's IP address is 192.5.5.241. Now we can really start. I'll resolve example.com:
- dig @192.5.5.241 example.com NS +tcp points us toward several .com TLD servers and conveniently includes their A records in addition to the requested NS records. I'll go with f.gtld-servers.net. 172800 IN A 192.35.51.30.
- dig @192.35.51.30 example.com NS +tcp points us down another layer to a server owned by IANA, as we would expect for example.com. Annoyingly we don't get free A records back this time. An additional query to the same TLD server for the A record associated with a.iana-servers.net yields 199.43.135.53 - this looks to be the authoritative server.
- Finally:

```
amminer@ada:~ > dig @199.43.135.53 example.com A +tcp

; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> @199.43.135.53 example.com A +tcp
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27290
;; flags: qr aa rd; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags;; udp: 4096
;; QUESTION SECTION:
;example.com. IN A

;; ANSWER SECTION:
example.com. 86400 IN A 93.184.216.34

;; Query time: 27 msec
;; SERVER: 199.43.135.53#53(199.43.135.53) (TCP)
;; WHEN: Mon Oct 09 22:47:32 PDT 2023
;; MSG SIZE rcvd: 56

amminer@ada:~ >
```

## 3. Reverse DNS lookups

- Using ChatGPT, produce a single command line with commands `dig`, `egrep`, and `awk`, to list all IPv4 addresses that `espn.go.com` points to.





Using ChatGPT, produce a single command line with commands `dig`, `egrep`, and `awk`, to list all IPv4 addresses that `espn.go.com` points to.



Certainly! Here's a command line that uses `dig`, `egrep`, and `awk` to list all IPv4 addresses associated with `espn.go.com`:



bash

Copy code

```
dig +short espn.go.com | egrep '([0-9]{1,3}\.){3}[0-9]{1,3}' | awk '{print $1}'
```

This command performs the following steps:

1. `dig +short espn.go.com`: Uses `dig` to query the DNS for the IPv4 addresses associated with `espn.go.com` and outputs them in a short format.
2. `egrep '([0-9]{1,3}\.){3}[0-9]{1,3}'`: Uses `egrep` to filter out lines containing IPv4 addresses using a regular expression.
3. `awk '{print $1}'`: Uses `awk` to print the first field (IPv4 address) from the filtered output.

This should give you a list of IPv4 addresses associated with `espn.go.com`.

- Run the command

MINGW64/c/cloud-miner-amminer

```
amminer@ada:~ > dig +short espn.go.com | egrep '([0-9]{1,3}\.){3}[0-9]{1,3}' | awk '{print $1}'
18.161.6.80
18.161.6.38
18.161.6.94
18.161.6.89
amminer@ada:~ >
```

- Find the flag for `dig` that allows one to perform reverse lookups on IPv4 addresses. Take that list of addresses and create a single for loop in the shell that iterates over the list and performs a reverse lookup of each IP address to find each address's associated DNS name. Pipe output of the loop to `egrep` and `awk` so that the output consists only of the DNS names.

MINGW64/c/cloud-miner-amminer

```
amminer@ada:~ > addrs=$(dig +short espn.go.com | egrep '([0-9]{1,3}\.){3}[0-9]{1,3}' | awk '{print $1}')
amminer@ada:~ > echo $addrs
18.161.6.89 18.161.6.80 18.161.6.94 18.161.6.38
amminer@ada:~ > for a in $addrs; do dig -x $a | egrep "$a.+" | awk '{print $5}'; done
server-18-161-6-89.hio52.r.cloudfront.net.
server-18-161-6-80.hio52.r.cloudfront.net.
server-18-161-6-94.hio52.r.cloudfront.net.
server-18-161-6-38.hio52.r.cloudfront.net.
amminer@ada:~ >
```

## 4. Host enumeration

- Using a `for` loop, perform a reverse DNS lookup for each IP address on the `131.252.220.0/24` subnet. Note that some addresses on the subnet do not have names bound to them and will not return a record. Take the output of the loop and pipe it to `egrep` and `awk` to list just the names of the hosts, then redirect the final output to a file called `220hosts.txt`, using the `>` character to perform output redirection to a file.
- Within the range of hosts is a set of car manufacturer names. Using the `head` and `tail` commands, craft a command in the format below that returns their names.

```
cat 220hosts.txt | head -<number_of_lines_1> | tail -<number_of_lines_2>
```

```
MINGW64/c/cloud-miner-amminer
amminer@ada:~ > for ip in {1..254}; do dig -x 131.252.220.$ip +short; done | awk '{print $1}' > 220hosts.txt
amminer@ada:~ > cat 220hosts.txt | head -185 | tail -30
acura.cs.pdx.edu.
astonmartin.cs.pdx.edu.
audi.cs.pdx.edu.
bentley.cs.pdx.edu.
bmw.cs.pdx.edu.
cadillac.cs.pdx.edu.
ferrari.cs.pdx.edu.
fiat.cs.pdx.edu.
ford.cs.pdx.edu.
honda.cs.pdx.edu.
hummer.cs.pdx.edu.
jaguar.cs.pdx.edu.
jeep.cs.pdx.edu.
lamborghini.cs.pdx.edu.
landrover.cs.pdx.edu.
lexus.cs.pdx.edu.
lotus.cs.pdx.edu.
maserati.cs.pdx.edu.
mazda.cs.pdx.edu.
mclaren.cs.pdx.edu.
mercedes.cs.pdx.edu.
nissan.cs.pdx.edu.
panoz.cs.pdx.edu.
porsche.cs.pdx.edu.
subaru.cs.pdx.edu.
toyota.cs.pdx.edu.
tvr.cs.pdx.edu.
ultima.cs.pdx.edu.
volvo.cs.pdx.edu.
vw.cs.pdx.edu.
amminer@ada:~ >
```

One could automate this easily if the first and last manufacturers are known.

## 5. Geographic DNS #2

- Visit <https://www.iplocation.net/> and look up the geographical location of the following DNS servers: `131.252.208.53` and `198.82.247.66`. What geographic locations do ipinfo.io and DB-IP return?

ipinfo.io says Portland, OR. DB-IP is not on the results page.

- Then, using `dig`, resolve `www.google.com` from each of the DNS servers. As Google forward deploys its web content close to its users, its name will resolve differently in different geographic locations.

```
dig @<DNS_server_IP> www.google.com
```

- Record one address for `www.google.com` from each result for your lab notebook.

@131.252.208.53: `www.google.com` resolves to 142.251.215.228.

@198.82.247.66: `www.google.com` resolves to 142.251.163.106.

- What are the geographic coordinates of each DNS server and the IP address it resolves for `www.google.com`?

142.251.215.228 looks to be in Seattle.

142.251.163.106 looks to be in Mountain View, CA, but `ipinfo.io` seems to think it's in Ashburn, VA. My inclination is to expect google to obfuscate things through their mountain view facilities, so I would guess Ashburn, final answer...

- traceroute the DNS servers and the IPs you found for `google.com`:

```
MINGW64/c/cloud-miner-aminer
amminer@ada:~$ > for addr in 131.252.208.53 198.82.247.66 142.251.215.228 142.251.163.106; do traceroute $addr; done
traceroute to 131.252.208.53 (131.252.208.53), 30 hops max, 60 byte packets
 1 rdns.cat.pdx.edu (131.252.208.53) 0.573 ms 0.427 ms 0.290 ms
traceroute to 198.82.247.66 (198.82.247.66), 30 hops max, 60 byte packets
 1 radiant.seas.pdx.edu (131.252.208.212) 1.712 ms 1.688 ms 1.655 ms
 2 CORE1.net.pdx.edu (131.252.5.142) 3.177 ms 3.007 ms 2.845 ms
 3 131.252.5.213 (131.252.5.213) 0.539 ms 0.420 ms 0.363 ms
 4 port-psu-pe-01.net.linkoregon.org (199.165.177.48) 0.430 ms 0.334 ms 0.380 ms
 5 eugn-oh-vpn-01.net.linkoregon.org (207.98.126.3) 12.352 ms eugn-oh-pe-01.net.linkoregon.org (207.98.126.55) 12.330 ms eugn-oh-vpn-01.net.linkoregon.org (207.98.126.3) 12.119 ms
 6 eugn-oh-pe-02.net.linkoregon.org (207.98.126.57) 12.358 ms 12.321 ms 12.538 ms
 7 bois-gtwy-pe-01-loren.net.linkoregon.org (163.253.5.65) 12.285 ms 12.190 ms 12.076 ms
 8 hundredge-0-0-0-24.703.core1.bois.net.internet2.edu (163.253.5.64) 13.759 ms 13.632 ms 13.571 ms
 9 fourhundredge-0-0-0-0.4079.core2.salt.net.internet2.edu (163.253.1.249) 66.709 ms 69.047 ms 68.960 ms
10 fourhundredge-0-0-0-23.4079.core1.salt.net.internet2.edu (163.253.1.32) 66.818 ms fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168) 69.122 ms 69.063 ms
11 fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170) 68.312 ms 68.237 ms fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251) 67.583 ms
12 fourhundredge-0-0-0-22.4079.core1.kans.net.internet2.edu (163.253.1.54) 67.573 ms 67.496 ms fourhundredge-0-0-0-0.4079.core1.kans.net.internet2.edu (163.253.1.243) 67.430 ms
13 fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244) 68.083 ms 68.012 ms 68.002 ms
14 fourhundredge-0-0-0-3.4079.core2.eqch.net.internet2.edu (163.253.2.19) 69.118 ms 66.444 ms 67.553 ms
15 fourhundredge-0-0-0-0.4079.core2.clev.net.internet2.edu (163.253.2.16) 66.832 ms 66.742 ms 67.257 ms
16 fourhundredge-0-0-0-3.4079.core2.ashb.net.internet2.edu (163.253.1.138) 65.865 ms 68.474 ms 68.417 ms
17 192.122.175.14 (192.122.175.14) 65.548 ms 65.447 ms 65.430 ms
18 vtacs-1.msap.cns.vt.edu (192.70.187.18) 67.044 ms 66.938 ms 66.906 ms
19 lab-core-7-0-0-0.cns.vt.edu (128.173.0.202) 69.106 ms 69.026 ms 69.127 ms
20 cas-core.100.2000.cns.vt.edu (198.82.1.143) 68.280 ms 68.151 ms 68.082 ms
21 jeru.cns.vt.edu (198.82.247.66) 68.886 ms 68.705 ms 68.831 ms
traceroute to 142.251.215.228 (142.251.215.228), 30 hops max, 60 byte packets
 1 radiant.seas.pdx.edu (131.252.208.212) 1.022 ms 1.102 ms 1.794 ms
 2 CORE1.net.pdx.edu (131.252.5.142) 6.566 ms 6.479 ms 6.358 ms
 3 131.252.5.213 (131.252.5.213) 0.613 ms 0.496 ms 0.378 ms
 4 google.nwax.net (198.32.195.34) 4.091 ms 3.918 ms 3.857 ms
 5 108.170.245.97 (108.170.245.97) 5.432 ms 108.170.245.113 (108.170.245.113) 4.328 ms 108.170.245.97 (108.170.245.97) 5.188 ms
 6 216.239.56.223 (216.239.56.223) 4.596 ms 142.251.241.137 (142.251.241.137) 4.385 ms 4.313 ms
 7 sea09s35-in-f4.1e100.net (142.251.215.228) 3.888 ms 4.521 ms 4.611 ms
traceroute to 142.251.163.106 (142.251.163.106), 30 hops max, 60 byte packets
 1 radiant.seas.pdx.edu (131.252.208.212) 1.101 ms 2.032 ms 2.037 ms
 2 CORE1.net.pdx.edu (131.252.5.142) 0.872 ms 0.759 ms 0.648 ms
 3 131.252.5.213 (131.252.5.213) 0.845 ms 0.730 ms 0.618 ms
 4 google.nwax.net (198.32.195.34) 4.246 ms 3.865 ms 4.299 ms
 5 74.125.243.198 (74.125.243.198) 5.176 ms 74.125.243.189 (74.125.243.189) 4.813 ms 74.125.243.178 (74.125.243.178) 4.745 ms
 6 172.253.77.194 (172.253.77.194) 10.212 ms 216.239.50.20 (216.239.50.20) 11.493 ms 11.351 ms
 7 192.178.74.218 (192.178.74.218) 55.010 ms 192.178.74.216 (192.178.74.216) 95.606 ms 192.178.74.222 (192.178.74.222) 48.992 ms
 8 192.178.72.200 (192.178.72.200) 59.634 ms 192.178.72.195 (192.178.72.195) 58.157 ms 192.178.72.197 (192.178.72.197) 58.600 ms
 9 * * 192.178.81.238 (192.178.81.238) 73.298 ms
10 142.251.66.133 (142.251.66.133) 72.812 ms 172.253.67.44 (172.253.67.44) 73.704 ms 216.239.57.97 (216.239.57.97) 71.219 ms
11 142.250.235.95 (142.250.235.95) 72.105 ms 71.306 ms 142.250.235.87 (142.250.235.87) 74.728 ms
12 * * *
13 * * *
14 * * *
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 vv-in-f106.1e100.net (142.251.163.106) 70.114 ms * 72.549 ms
amminer@ada:~$ >
amminer@ada:~$ >
```

## 6. Wireshark Lab #3

TODO