

Introduction to Web Science

Assignment 1, Group: " Lima "

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The main objective of this assignment is for you to use different tools with which you can understand the network that you are connected to or you are connecting to in a better sense. These tasks are not always specific to "Introduction to Web Science". For all the assignment questions that require you to write a code, make sure to include the code in the answer sheet, along with a separate python file. Where screen shots are required, please add them in the answers directly and not as separate files.

1 Ethernet Frame (5 Points)

Ethernet Frame is of the given structure:

Preamble	Destination MAC address	Source MAC address	Type/Length	User Data	Frame Check Sequence (FCS)
8	6	6	2	46 - 1500	4

Figure 1: Ethernet Frame Structure

Given below is an Ethernet frame without the Preamble and the Frame Check Sequence.

```
00 27 10 21 fa 48 00 13    10 e8 dd 52 08 06 00 01
08 00 06 04 00 01 00 13    10 e8 dd 52 c0 a8 02 01
00 00 00 00 00 00 c0 a8    02 67
```

Find:

1. Source MAC Address
2. Destination MAC Address
3. What protocol is inside the data payload?
4. Please mention what the last 2 fields hold in the above frame.

Answer:

1. According to the frame given the Source MAC address is 00:13:10:e8:dd:52
2. The Destination MAC address is 00:27:10:21:fa:48
3. The protocol is Advance Resolution Protocol inside the data payload because the Ether-type is 0x 08 06
4. In the above frame the last two fields are the target hardware address and target IP address. According to the frame the target hardware address is 00:00:00:00:00:00 and the target IP address is c0:a8:02:67

2 Cable Issue (5 Points)

Let us consider we have two cables of 20 meters each. One of them is in a 100MBps network while the other is in a 10MBps network. If you had to transfer data through each of them, how much time it would take for the first bit to arrive in each setting? (For your calculation you can assume that the speed of light takes the same value as in the videos.) Please provide formulas and calculations along with your results.

Answer:

1. In a 100MBps network to transfer first bit of data it takes 10 nanosecond to go a distance of 3 meters. So to travel 20 meters it would take $(10 \times 20) / 3 = 66.67$ ns
2. In a 10MBps network to transfer first bit of data it takes 100 nanosecond to go a distance of 30 meters. So to travel 20 meters it would take $(100 \times 20) / 30 = 66.67$ ns

3 Basic Network Tools (10 Points)

Listed below are some of the commands which you need to "google" to understand what they stand for:

1. *ipconfig / ifconfig*
2. *ping*
3. *tracert*
4. *arp*
5. *dig*

Consider a situation in which you need to check if www.wikipedia.org is reachable or not. Using the knowledge you gained above to find the following information:

1. The *% packet loss* if at all it happened after sending 100 packets.
2. *Size* of the packet sent to *Wikipedia* server
3. *IP address* of your machine and the *Wikipedia* server
4. *Query Time* for DNS query of the above url.
5. Number of *Hops* in between your machine and the server
6. MAC address of the device that is acting as your network gateway.

Do this once in the university and once in your home/dormitory network. With your answers, you must paste the screen shots to validate your find.

Answer:

1. Checking the amount of packet loss in 100 packets sent to www.wikipedia.org

Home Network:

0.0% packet loss. Command (`ping -c 100 www.wikipedia.org`)

University Network:

0.0% packet loss. Command (`ping -c 100 www.wikipedia.org`)

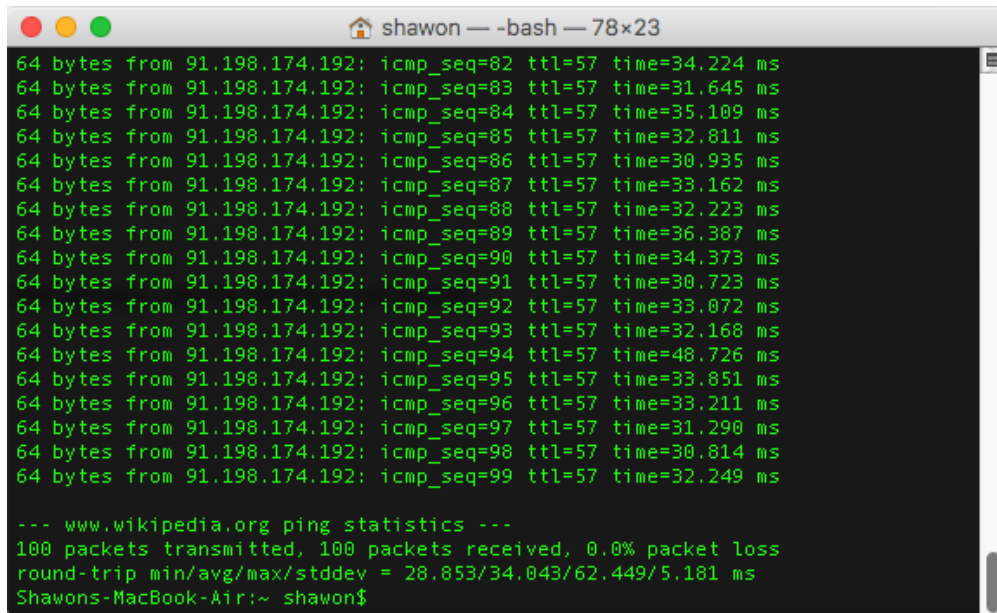
2. Checking the packet size sent to wikipedia server

Home Network:

56 bytes packet data sent to wikipedia server. Command (`ping www.wikipedia.org`)

University Network:

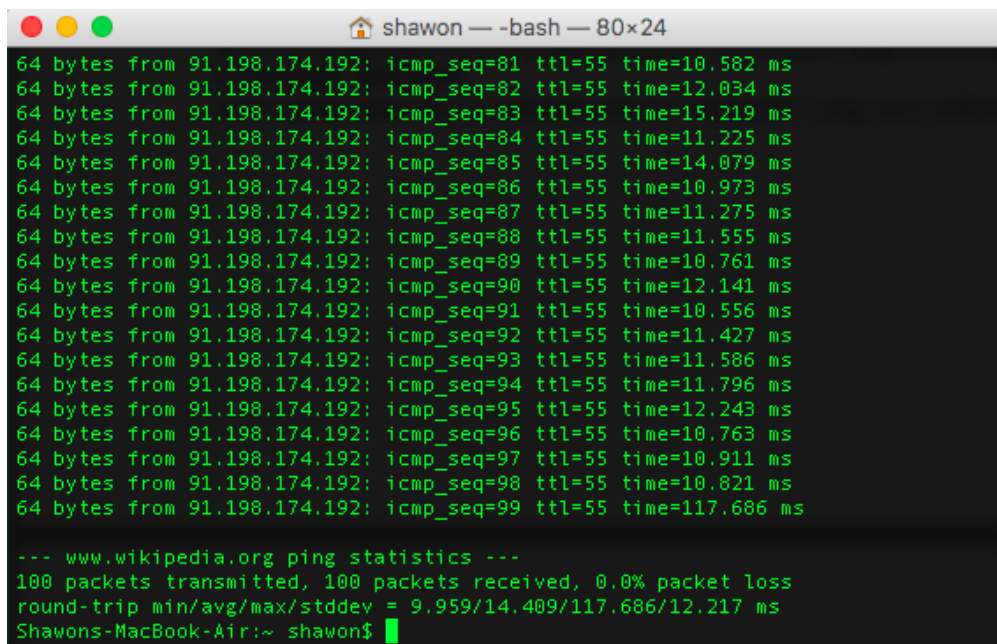
56 bytes packet data sent to wikipedia server. Command (`ping www.wikipedia.org`)

A terminal window titled 'shawon — -bash — 78x23' showing the results of a ping command to www.wikipedia.org. The output lists 100 packets with their sequence numbers, TTL values, and round-trip times. The statistics at the bottom show 0.0% packet loss and a round-trip time of approximately 34 ms.

```
shawon — -bash — 78x23
64 bytes from 91.198.174.192: icmp_seq=82 ttl=57 time=34.224 ms
64 bytes from 91.198.174.192: icmp_seq=83 ttl=57 time=31.645 ms
64 bytes from 91.198.174.192: icmp_seq=84 ttl=57 time=35.109 ms
64 bytes from 91.198.174.192: icmp_seq=85 ttl=57 time=32.811 ms
64 bytes from 91.198.174.192: icmp_seq=86 ttl=57 time=30.935 ms
64 bytes from 91.198.174.192: icmp_seq=87 ttl=57 time=33.162 ms
64 bytes from 91.198.174.192: icmp_seq=88 ttl=57 time=32.223 ms
64 bytes from 91.198.174.192: icmp_seq=89 ttl=57 time=36.387 ms
64 bytes from 91.198.174.192: icmp_seq=90 ttl=57 time=34.373 ms
64 bytes from 91.198.174.192: icmp_seq=91 ttl=57 time=30.723 ms
64 bytes from 91.198.174.192: icmp_seq=92 ttl=57 time=33.072 ms
64 bytes from 91.198.174.192: icmp_seq=93 ttl=57 time=32.168 ms
64 bytes from 91.198.174.192: icmp_seq=94 ttl=57 time=48.726 ms
64 bytes from 91.198.174.192: icmp_seq=95 ttl=57 time=33.851 ms
64 bytes from 91.198.174.192: icmp_seq=96 ttl=57 time=33.211 ms
64 bytes from 91.198.174.192: icmp_seq=97 ttl=57 time=31.290 ms
64 bytes from 91.198.174.192: icmp_seq=98 ttl=57 time=30.814 ms
64 bytes from 91.198.174.192: icmp_seq=99 ttl=57 time=32.249 ms

--- www.wikipedia.org ping statistics ---
100 packets transmitted, 100 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 28.853/34.043/62.449/5.181 ms
Shawons-MacBook-Air:~ shawon$
```

Figure 2: Packet loss count Home Network

A terminal window titled 'shawon — -bash — 80x24' showing the results of a ping command to www.wikipedia.org. The output lists 100 packets with their sequence numbers, TTL values, and round-trip times. The statistics at the bottom show 0.0% packet loss and a round-trip time of approximately 12 ms.

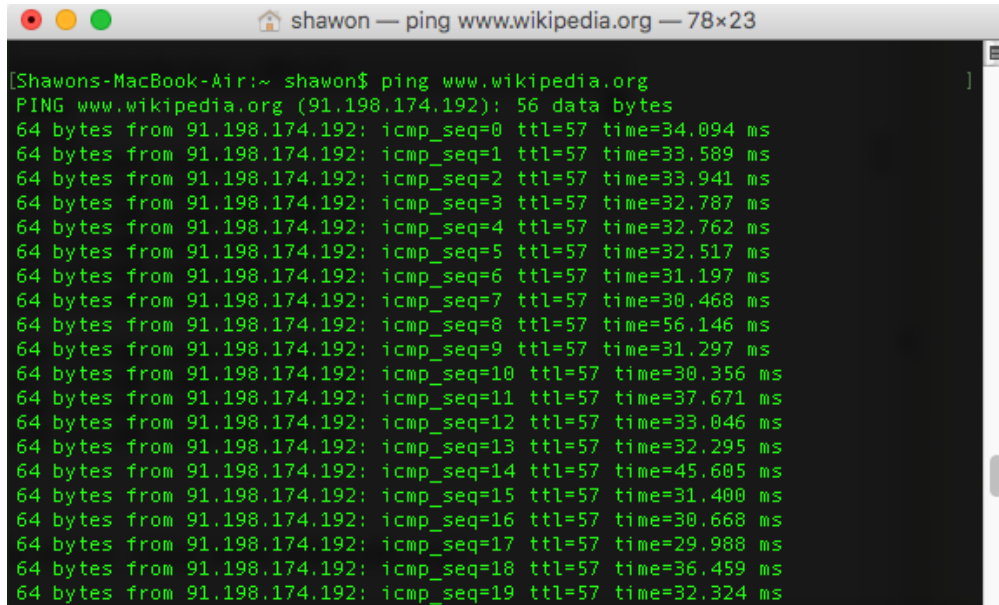
```
shawon — -bash — 80x24
64 bytes from 91.198.174.192: icmp_seq=81 ttl=55 time=10.582 ms
64 bytes from 91.198.174.192: icmp_seq=82 ttl=55 time=12.034 ms
64 bytes from 91.198.174.192: icmp_seq=83 ttl=55 time=15.219 ms
64 bytes from 91.198.174.192: icmp_seq=84 ttl=55 time=11.225 ms
64 bytes from 91.198.174.192: icmp_seq=85 ttl=55 time=14.079 ms
64 bytes from 91.198.174.192: icmp_seq=86 ttl=55 time=10.973 ms
64 bytes from 91.198.174.192: icmp_seq=87 ttl=55 time=11.275 ms
64 bytes from 91.198.174.192: icmp_seq=88 ttl=55 time=11.555 ms
64 bytes from 91.198.174.192: icmp_seq=89 ttl=55 time=10.761 ms
64 bytes from 91.198.174.192: icmp_seq=90 ttl=55 time=12.141 ms
64 bytes from 91.198.174.192: icmp_seq=91 ttl=55 time=10.556 ms
64 bytes from 91.198.174.192: icmp_seq=92 ttl=55 time=11.427 ms
64 bytes from 91.198.174.192: icmp_seq=93 ttl=55 time=11.586 ms
64 bytes from 91.198.174.192: icmp_seq=94 ttl=55 time=11.796 ms
64 bytes from 91.198.174.192: icmp_seq=95 ttl=55 time=12.243 ms
64 bytes from 91.198.174.192: icmp_seq=96 ttl=55 time=10.763 ms
64 bytes from 91.198.174.192: icmp_seq=97 ttl=55 time=10.911 ms
64 bytes from 91.198.174.192: icmp_seq=98 ttl=55 time=10.821 ms
64 bytes from 91.198.174.192: icmp_seq=99 ttl=55 time=117.686 ms

--- www.wikipedia.org ping statistics ---
100 packets transmitted, 100 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 9.959/14.409/117.686/12.217 ms
Shawons-MacBook-Air:~ shawon$
```

Figure 3: Packet loss count University Network

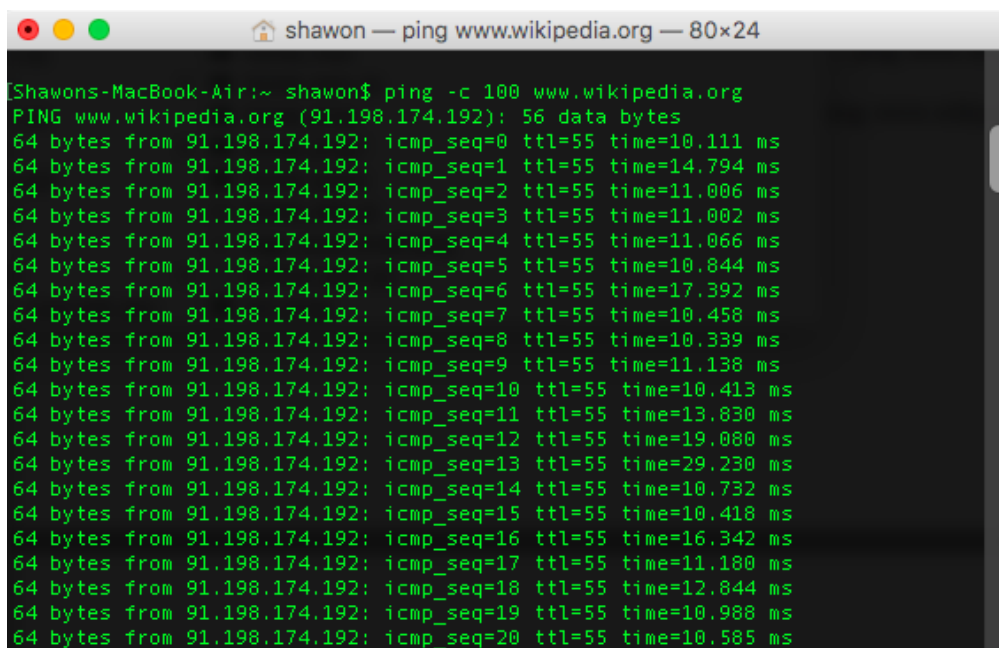
3. Finding IP address of local machine and wikipedia server

Home Network:



```
[Shawons-MacBook-Air:~ shawon$ ping www.wikipedia.org]
PING www.wikipedia.org (91.198.174.192): 56 data bytes
64 bytes from 91.198.174.192: icmp_seq=0 ttl=57 time=34.094 ms
64 bytes from 91.198.174.192: icmp_seq=1 ttl=57 time=33.589 ms
64 bytes from 91.198.174.192: icmp_seq=2 ttl=57 time=33.941 ms
64 bytes from 91.198.174.192: icmp_seq=3 ttl=57 time=32.787 ms
64 bytes from 91.198.174.192: icmp_seq=4 ttl=57 time=32.762 ms
64 bytes from 91.198.174.192: icmp_seq=5 ttl=57 time=32.517 ms
64 bytes from 91.198.174.192: icmp_seq=6 ttl=57 time=31.197 ms
64 bytes from 91.198.174.192: icmp_seq=7 ttl=57 time=30.468 ms
64 bytes from 91.198.174.192: icmp_seq=8 ttl=57 time=56.146 ms
64 bytes from 91.198.174.192: icmp_seq=9 ttl=57 time=31.297 ms
64 bytes from 91.198.174.192: icmp_seq=10 ttl=57 time=30.356 ms
64 bytes from 91.198.174.192: icmp_seq=11 ttl=57 time=37.671 ms
64 bytes from 91.198.174.192: icmp_seq=12 ttl=57 time=33.046 ms
64 bytes from 91.198.174.192: icmp_seq=13 ttl=57 time=32.295 ms
64 bytes from 91.198.174.192: icmp_seq=14 ttl=57 time=45.605 ms
64 bytes from 91.198.174.192: icmp_seq=15 ttl=57 time=31.400 ms
64 bytes from 91.198.174.192: icmp_seq=16 ttl=57 time=30.668 ms
64 bytes from 91.198.174.192: icmp_seq=17 ttl=57 time=29.988 ms
64 bytes from 91.198.174.192: icmp_seq=18 ttl=57 time=36.459 ms
64 bytes from 91.198.174.192: icmp_seq=19 ttl=57 time=32.324 ms
```

Figure 4: Packet size Home Network



```
[Shawons-MacBook-Air:~ shawon$ ping -c 100 www.wikipedia.org]
PING www.wikipedia.org (91.198.174.192): 56 data bytes
64 bytes from 91.198.174.192: icmp_seq=0 ttl=55 time=10.111 ms
64 bytes from 91.198.174.192: icmp_seq=1 ttl=55 time=14.794 ms
64 bytes from 91.198.174.192: icmp_seq=2 ttl=55 time=11.006 ms
64 bytes from 91.198.174.192: icmp_seq=3 ttl=55 time=11.002 ms
64 bytes from 91.198.174.192: icmp_seq=4 ttl=55 time=11.066 ms
64 bytes from 91.198.174.192: icmp_seq=5 ttl=55 time=10.844 ms
64 bytes from 91.198.174.192: icmp_seq=6 ttl=55 time=17.392 ms
64 bytes from 91.198.174.192: icmp_seq=7 ttl=55 time=10.458 ms
64 bytes from 91.198.174.192: icmp_seq=8 ttl=55 time=10.339 ms
64 bytes from 91.198.174.192: icmp_seq=9 ttl=55 time=11.138 ms
64 bytes from 91.198.174.192: icmp_seq=10 ttl=55 time=10.413 ms
64 bytes from 91.198.174.192: icmp_seq=11 ttl=55 time=13.830 ms
64 bytes from 91.198.174.192: icmp_seq=12 ttl=55 time=19.080 ms
64 bytes from 91.198.174.192: icmp_seq=13 ttl=55 time=29.230 ms
64 bytes from 91.198.174.192: icmp_seq=14 ttl=55 time=10.732 ms
64 bytes from 91.198.174.192: icmp_seq=15 ttl=55 time=10.418 ms
64 bytes from 91.198.174.192: icmp_seq=16 ttl=55 time=16.342 ms
64 bytes from 91.198.174.192: icmp_seq=17 ttl=55 time=11.180 ms
64 bytes from 91.198.174.192: icmp_seq=18 ttl=55 time=12.844 ms
64 bytes from 91.198.174.192: icmp_seq=19 ttl=55 time=10.988 ms
64 bytes from 91.198.174.192: icmp_seq=20 ttl=55 time=10.585 ms
```

Figure 5: Packet size University Network

The IP address of local machine is 192.168.0.15 and wikipedia server IP is 91.198.174.192

University Network:

The IP address of local machine is 141.26.185.11 and wikipedia server IP is 91.198.174.192

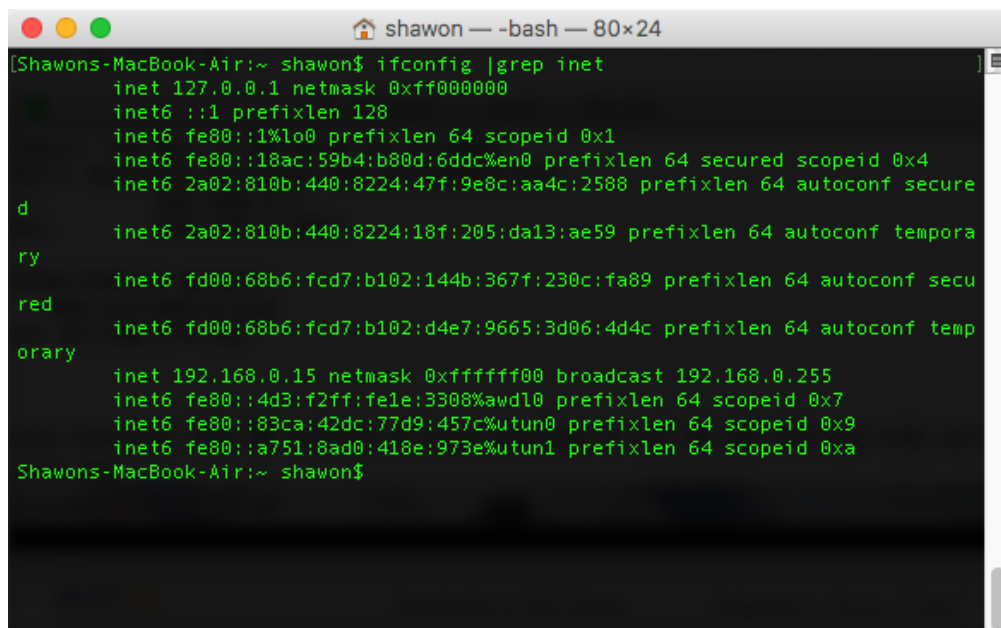
4. Finding query time for wikipedia

Home Network:

DNS query time 44 msec

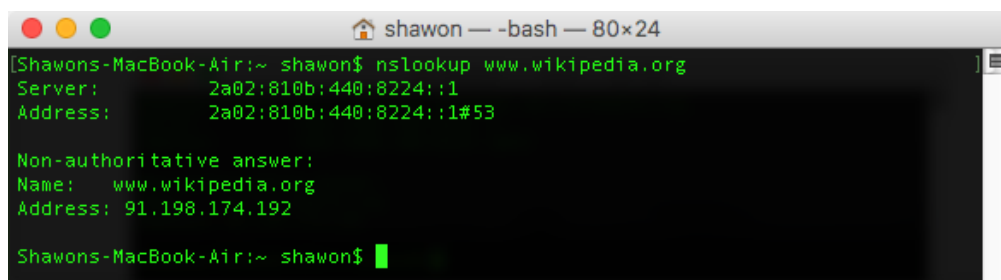
University network:

DNS query time 73 msec



```
shawon — -bash — 80x24
[Shawons-MacBook-Air:~ shawon$ ifconfig |grep inet
    inet 127.0.0.1 netmask 0xff000000
    inet6 ::1 prefixlen 128
    inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
    inet6 fe80::18ac:59b4:b80d:6ddc%en0 prefixlen 64 secured scopeid 0x4
    inet6 2a02:810b:440:8224:47f:9e8c:aa4c:2588 prefixlen 64 autoconf secure
d
ry
    inet6 2a02:810b:440:8224:18f:205:da13:ae59 prefixlen 64 autoconf tempora
red
    inet6 fd00:68b6:fcd7:b102:144b:367f:230c:fa89 prefixlen 64 autoconf secu
orary
    inet6 fd00:68b6:fcd7:b102:d4e7:9665:3d06:4d4c prefixlen 64 autoconf temp
    inet 192.168.0.15 netmask 0xfffff00 broadcast 192.168.0.255
    inet6 fe80::4d3:f2ff:fe1e:3308%awdl0 prefixlen 64 scopeid 0x7
    inet6 fe80::83ca:42dc:77d9:457c%utun0 prefixlen 64 scopeid 0x9
    inet6 fe80::a751:8ad0:418e:973e%utun1 prefixlen 64 scopeid 0xa
Shawons-MacBook-Air:~ shawon$
```

Figure 6: Local IP Home Network

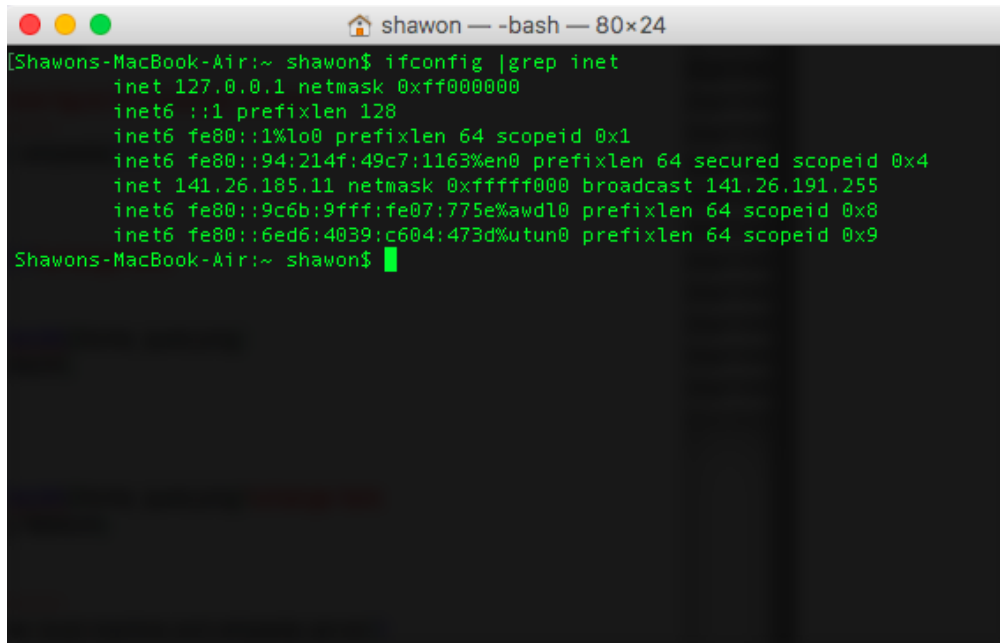


```
shawon — -bash — 80x24
[Shawons-MacBook-Air:~ shawon$ nslookup www.wikipedia.org
Server:      2a02:810b:440:8224::1
Address:     2a02:810b:440:8224::1#53

Non-authoritative answer:
Name:   www.wikipedia.org
Address: 91.198.174.192

Shawons-MacBook-Air:~ shawon$
```

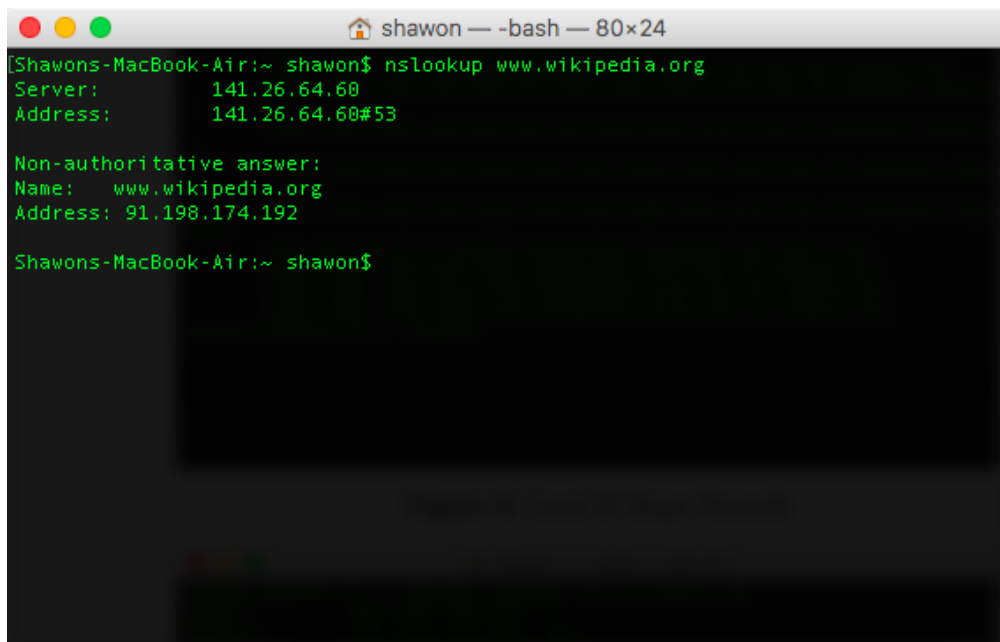
Figure 7: Wikipedia IP Home Network

A terminal window titled 'shawon — -bash — 80x24' on a Mac. The prompt is '[Shawons-MacBook-Air:~ shawon\$]'. The command 'ifconfig | grep inet' has been executed, showing the following output:

```
inet 127.0.0.1 netmask 0xff000000
inet6 ::1 prefixlen 128
inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
inet6 fe80::94:214f:49c7:1163%en0 prefixlen 64 secured scopeid 0x4
inet 141.26.185.11 netmask 0xffff000 broadcast 141.26.191.255
inet6 fe80::9c6b:9fff:fe07:775e%awdl0 prefixlen 64 scopeid 0x8
inet6 fe80::6ed6:4039:c604:473d%utun0 prefixlen 64 scopeid 0x9
```

The prompt is now 'Shawons-MacBook-Air:~ shawon\$'.

Figure 8: Local IP University Network

A terminal window titled 'shawon — -bash — 80x24' on a Mac. The prompt is '[Shawons-MacBook-Air:~ shawon\$]'. The command 'nslookup www.wikipedia.org' has been executed, showing the following output:

```
Server:      141.26.64.60
Address:     141.26.64.60#53

Non-authoritative answer:
Name:   www.wikipedia.org
Address: 91.198.174.192
```

The prompt is now 'Shawons-MacBook-Air:~ shawon\$'.

Figure 9: Wikipedia IP University Network

5. Counting hops between local machine and wikipedia server

Home Network:

6 hops. Command (traceroute www.wikipedia.org)

University Network:

8 hops. Command (traceroute www.wikipedia.org)

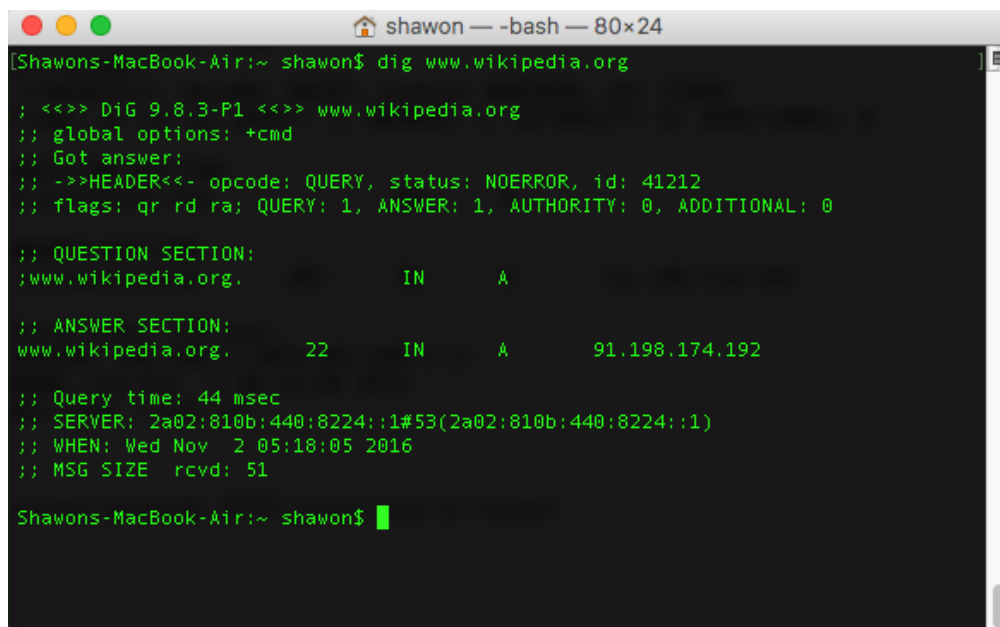
6. Finding network gateway MAC address

Home Network:

Network gateway device MAC address 68:b6:fc:d7:b1:2 Command (arp - a)

University Network:

Network gateway device MAC address 14:18:77:45:b1:bd Command (arp - a)



```
shawon — -bash — 80x24
[Shawons-MacBook-Air:~ shawon$ dig www.wikipedia.org]

; <<>> DiG 9.8.3-P1 <<>> www.wikipedia.org
;; global options: +cmd
;; Got answer:
;; ->HEADER<<- opcode: QUERY, status: NOERROR, id: 41212
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;www.wikipedia.org.      IN      A

;; ANSWER SECTION:
www.wikipedia.org.      22      IN      A      91.198.174.192

;; Query time: 44 msec
;; SERVER: 2a02:810b:440:8224::1#53(2a02:810b:440:8224::1)
;; WHEN: Wed Nov  2 05:18:05 2016
;; MSG SIZE rcvd: 51

Shawons-MacBook-Air:~ shawon$
```

Figure 10: DNS query Home Network

```
shawon — -bash — 81x42
Shawons-MacBook-Air:~ shawon$ dig www.wikipedia.org

; <<>> DiG 9.8.3-P1 <<>> www.wikipedia.org
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 31562
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 6, ADDITIONAL: 12

;; QUESTION SECTION:
;www.wikipedia.org.                IN      A

;; ANSWER SECTION:
www.wikipedia.org.                568     IN      A      91.198.174.192

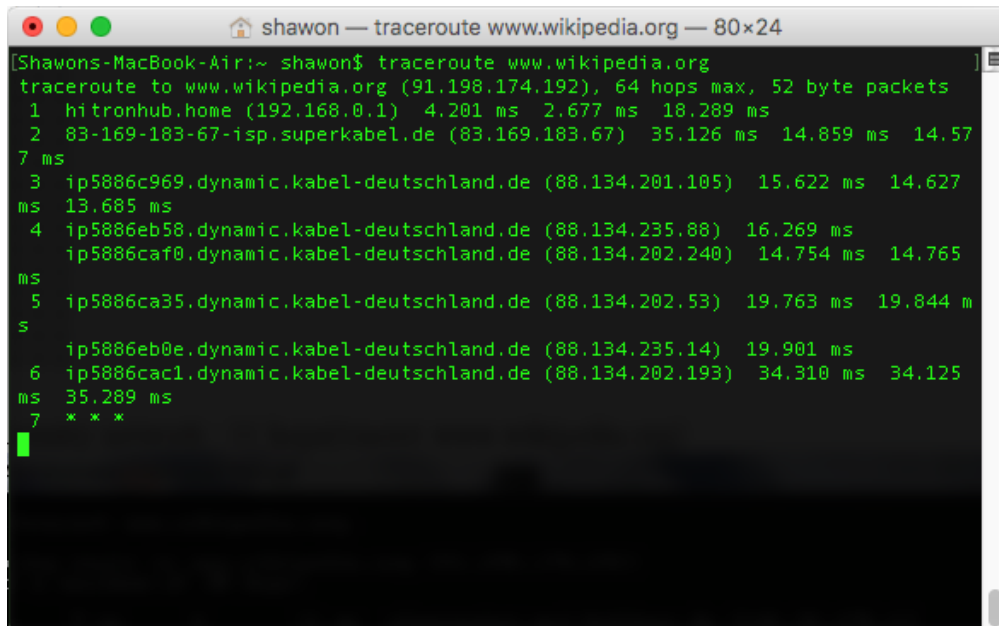
;; AUTHORITY SECTION:
org.                             165991  IN      NS      b2.org.afiliast-nst.org.
org.                             165991  IN      NS      a0.org.afiliast-nst.info.
org.                             165991  IN      NS      a2.org.afiliast-nst.info.
org.                             165991  IN      NS      c0.org.afiliast-nst.info.
org.                             165991  IN      NS      b0.org.afiliast-nst.org.
org.                             165991  IN      NS      d0.org.afiliast-nst.org.

;; ADDITIONAL SECTION:
a0.org.afiliast-nst.info. 165991  IN      A      199.19.56.1
a0.org.afiliast-nst.info. 165991  IN      AAAA   2001:500:e::1
a2.org.afiliast-nst.info. 165991  IN      A      199.249.112.1
a2.org.afiliast-nst.info. 165991  IN      AAAA   2001:500:40::1
b0.org.afiliast-nst.org. 165991  IN      A      199.19.54.1
b0.org.afiliast-nst.org. 165991  IN      AAAA   2001:500:c::1
b2.org.afiliast-nst.org. 165991  IN      A      199.249.120.1
b2.org.afiliast-nst.org. 165991  IN      AAAA   2001:500:48::1
c0.org.afiliast-nst.info. 165991  IN      A      199.19.53.1
c0.org.afiliast-nst.info. 165991  IN      AAAA   2001:500:b::1
d0.org.afiliast-nst.org. 165991  IN      A      199.19.57.1
d0.org.afiliast-nst.org. 165991  IN      AAAA   2001:500:f::1

;; Query time: 73 msec
;; SERVER: 141.26.64.60#53(141.26.64.60)
;; WHEN: Wed Nov 2 08:50:10 2016
;; MSG SIZE rcvd: 453

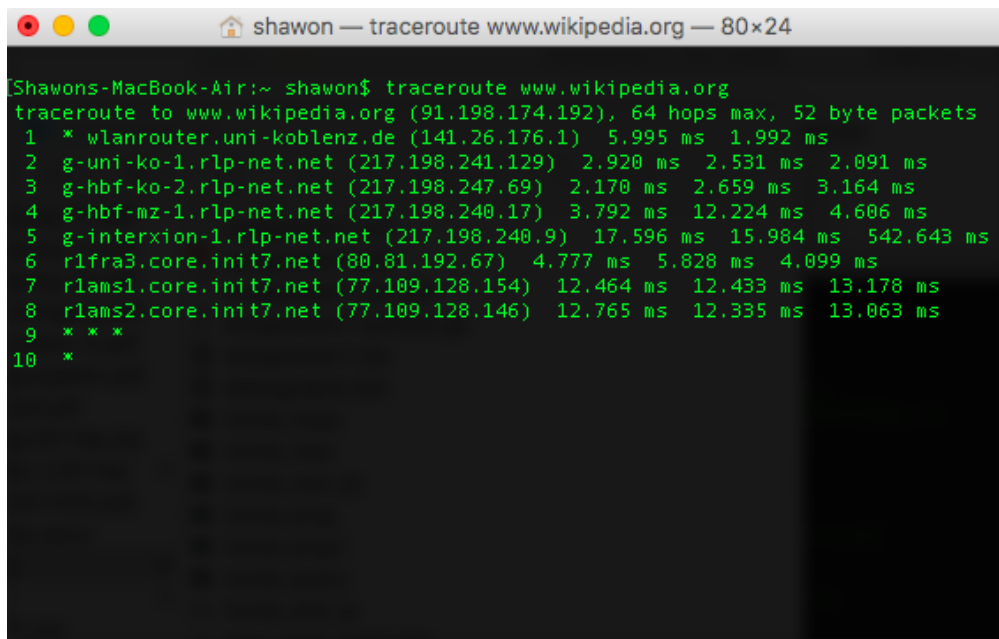
Shawons-MacBook-Air:~ shawon$
```

Figure 11: DNS query University Network



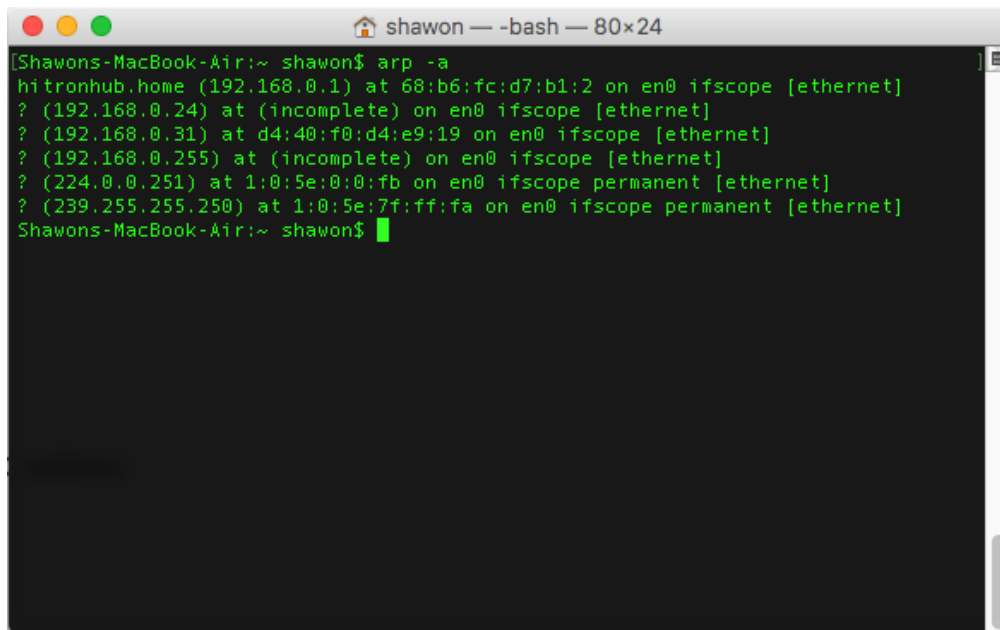
```
shawon — traceroute www.wikipedia.org — 80x24
[Shawons-MacBook-Air:~ shawon$ traceroute www.wikipedia.org
traceroute to www.wikipedia.org (91.198.174.192), 64 hops max, 52 byte packets
 1 hitronhub.home (192.168.0.1)  4.201 ms  2.677 ms  18.289 ms
 2 83-169-183-67-isp.superkabel.de (83.169.183.67)  35.126 ms  14.859 ms  14.57
7 ms
 3 ip5886c969.dynamic.kabel-deutschland.de (88.134.201.105)  15.622 ms  14.627
ms  13.685 ms
 4 ip5886eb58.dynamic.kabel-deutschland.de (88.134.235.88)  16.269 ms
ip5886caf0.dynamic.kabel-deutschland.de (88.134.202.240)  14.754 ms  14.765
ms
 5 ip5886ca35.dynamic.kabel-deutschland.de (88.134.202.53)  19.763 ms  19.844 m
s
ip5886eb0e.dynamic.kabel-deutschland.de (88.134.235.14)  19.901 ms
 6 ip5886cac1.dynamic.kabel-deutschland.de (88.134.202.193)  34.310 ms  34.125
ms  35.289 ms
 7 * * *
```

Figure 12: Hops count Home Network



```
shawon — traceroute www.wikipedia.org — 80x24
[Shawons-MacBook-Air:~ shawon$ traceroute www.wikipedia.org
traceroute to www.wikipedia.org (91.198.174.192), 64 hops max, 52 byte packets
 1 * wlanrouter.uni-koblenz.de (141.26.176.1)  5.995 ms  1.992 ms
 2 g-uni-ko-1.rlp-net.net (217.198.241.129)  2.920 ms  2.531 ms  2.091 ms
 3 g-hbf-ko-2.rlp-net.net (217.198.247.69)  2.170 ms  2.659 ms  3.164 ms
 4 g-hbf-mz-1.rlp-net.net (217.198.240.17)  3.792 ms  12.224 ms  4.606 ms
 5 g-interxion-1.rlp-net.net (217.198.240.9)  17.596 ms  15.984 ms  542.643 ms
 6 r1fra3.core.init7.net (80.81.192.67)  4.777 ms  5.828 ms  4.099 ms
 7 r1ams1.core.init7.net (77.109.128.154)  12.464 ms  12.433 ms  13.178 ms
 8 r1ams2.core.init7.net (77.109.128.146)  12.765 ms  12.335 ms  13.063 ms
 9 * * *
10 *
```

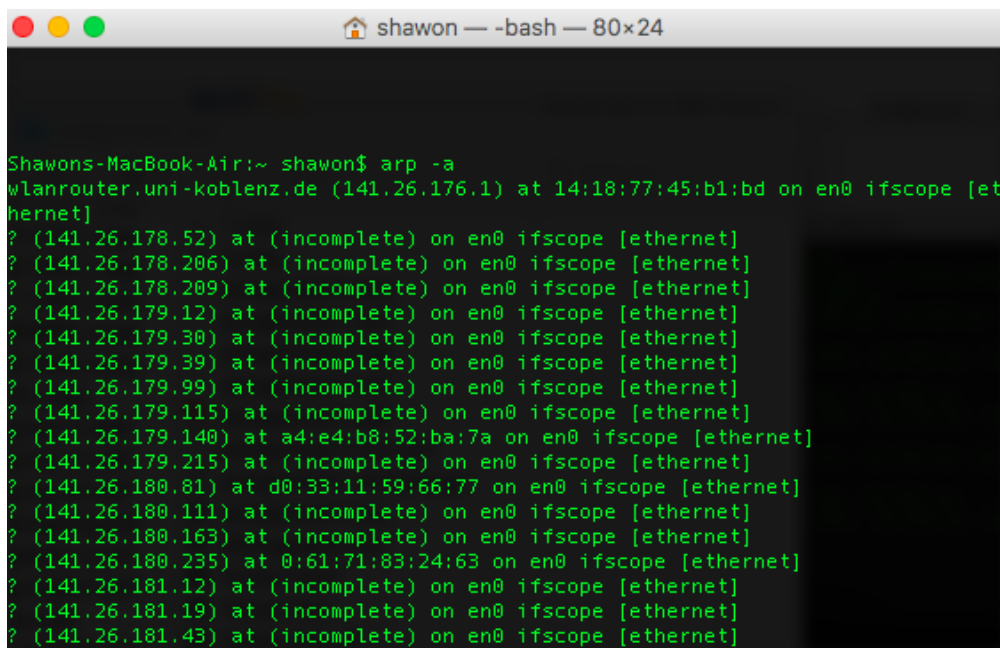
Figure 13: Hops count University Network



A terminal window titled "shawon — -bash — 80x24" on a Mac. The user has executed the command `arp -a`. The output shows the ARP table for the Home Network, listing IP addresses, MAC addresses, and interface information for several devices, including the gateway.

```
[Shawons-MacBook-Air:~ shawon$ arp -a
hitronhub.home (192.168.0.1) at 68:b6:fc:d7:b1:2 on en0 ifscope [ethernet]
? (192.168.0.24) at (incomplete) on en0 ifscope [ethernet]
? (192.168.0.31) at d4:40:f0:d4:e9:19 on en0 ifscope [ethernet]
? (192.168.0.255) at (incomplete) on en0 ifscope [ethernet]
? (224.0.0.251) at 1:0:5e:0:0:fb on en0 ifscope permanent [ethernet]
? (239.255.255.250) at 1:0:5e:7f:ff:fa on en0 ifscope permanent [ethernet]
Shawons-MacBook-Air:~ shawon$
```

Figure 14: MAC address of gateway device Home Network



A terminal window titled "shawon — -bash — 80x24" on a Mac. The user has executed the command `arp -a`. The output shows the ARP table for the University Network, listing IP addresses, MAC addresses, and interface information for several devices, including the gateway.

```
Shawons-MacBook-Air:~ shawon$ arp -a
wlanrouter.uni-koblenz.de (141.26.176.1) at 14:18:77:45:b1:bd on en0 ifscope [ethernet]
? (141.26.178.52) at (incomplete) on en0 ifscope [ethernet]
? (141.26.178.206) at (incomplete) on en0 ifscope [ethernet]
? (141.26.178.209) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.12) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.30) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.39) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.99) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.115) at (incomplete) on en0 ifscope [ethernet]
? (141.26.179.140) at a4:e4:b8:52:ba:7a on en0 ifscope [ethernet]
? (141.26.179.215) at (incomplete) on en0 ifscope [ethernet]
? (141.26.180.81) at d0:33:11:59:66:77 on en0 ifscope [ethernet]
? (141.26.180.111) at (incomplete) on en0 ifscope [ethernet]
? (141.26.180.163) at (incomplete) on en0 ifscope [ethernet]
? (141.26.180.235) at 0:61:71:83:24:63 on en0 ifscope [ethernet]
? (141.26.181.12) at (incomplete) on en0 ifscope [ethernet]
? (141.26.181.19) at (incomplete) on en0 ifscope [ethernet]
? (141.26.181.43) at (incomplete) on en0 ifscope [ethernet]
```

Figure 15: MAC address of gateway device University Network

4 Simple Python Programming (10 Points)

Write a simple python program that does the following:

1. Generate a random number sequence of 10 values between 0 to 90.
2. Perform **sine** and **cosine** operation on numbers generated.
3. Store the values in two different arrays named SIN & COSIN respectively.
4. Plot the values of SIN & COSIN in two different colors.
5. The plot should have labeled axes and legend.

Answer:

```
import numpy as nump
import random as rand
import matplotlib.pyplot as plot

x=set()
for m in range(0,10):
    x.add(rand.randint(0,90))
x=sorted(x)
m=list(x)

ySin = nump.sin(m)
yCos = nump.cos(m)
#Set title and plot the graph, set green color for Sin and Red for Cos
plot.title('Sin and Cos functions')
plot.plot(x, ySin,'g' ,x,yCos,'r')

# Get plot axis and change y axis limits
x1,x2,y1,y2 = plot.axis()
plot.axis((x1,x2,-3,3))

#Add labels, legend and show the graph
plot.xlabel('X - Axis')
plot.ylabel('Y - Axis')
plot.legend(['Sine', 'Cosine'])
plot.show()
```

Important Notes

Submission

- Solutions have to be checked into the github repository. Use the directory name `groupname/assignment1, Group: " Lima "/` in your group's repository.
- The name of the group and the names of all participating students must be listed on each submission.
- Solution format: all solutions as *one* PDF document. Programming code has to be submitted as Python code to the github repository. Upload *all* .py files of your program! Use UTF-8 as the file encoding. *Other encodings will not be taken into account!*
- Check that your code compiles without errors.
- Make sure your code is formatted to be easy to read.
 - Make sure you code has consistent [indentation](#).
 - Make sure you comment and document your code adequately in English.
 - Choose consistent and intuitive names for your identifiers.
- Do *not* use any accents, spaces or special characters in your filenames.

Acknowledgment

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