Problem 1

Solution

1.a)

sudo dhclient -v returns a list of the network interfaces that are configured to this system and displays the information in logs. *-v* enables verbose log messages.

1.b)

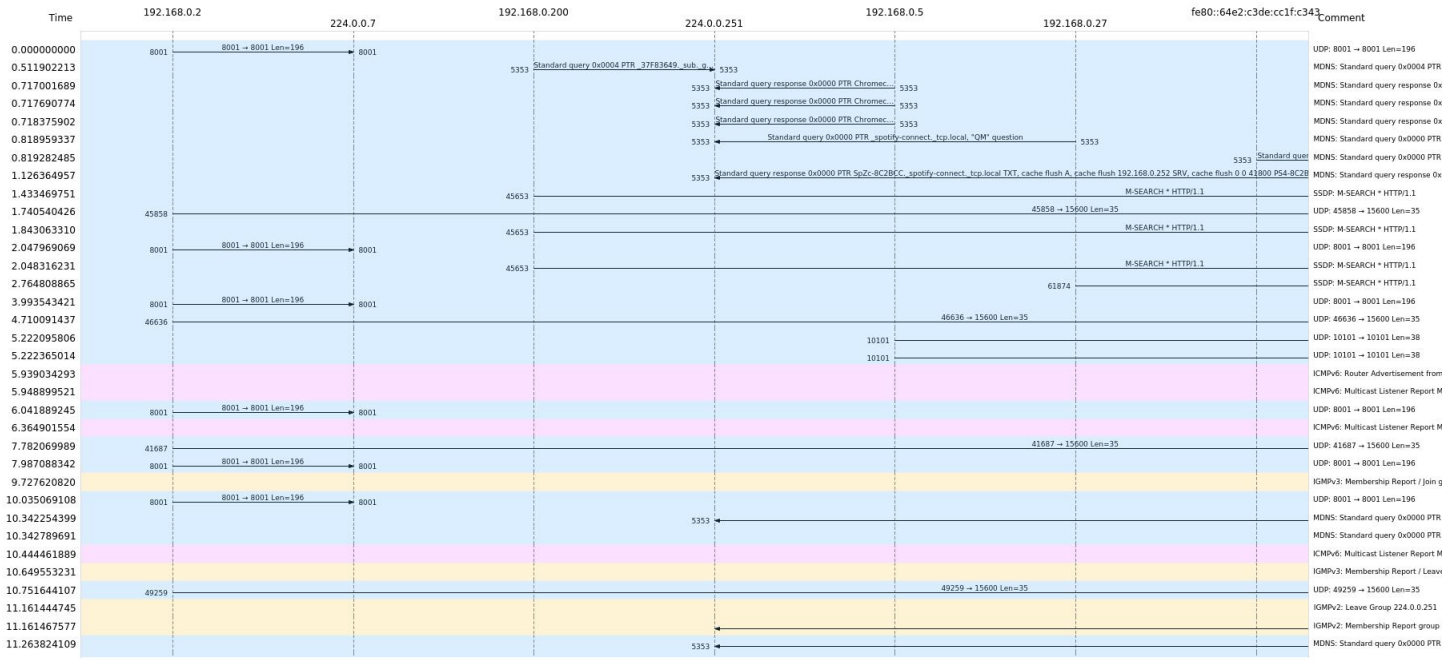
sudo dhclient -v -r does the same as the above command, the difference being this command tells dhclient to release the current lease it has from the server. It is used because some ISPs require their clients to notify the server if they want to release an assigned IP address.

1.c)

DHCP messages are sent over UDP. Here is a DHCP packet and you can see it is sent over UDP.

```
No.     Time           Source                Destination           Protocol Length Info
     46 14.877078017   0.0.0.0               255.255.255.255       DHCP     342    DHCP Discover - Transaction ID 0xf084c81c
Frame 46: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 68, Dst Port: 67
Dynamic Host Configuration Protocol (Discover)
```

1.d)



```
No.     Time           Source                Destination           Protocol Length Info
     46 14.877078017   0.0.0.0               255.255.255.255       DHCP     342    DHCP Discover - Transaction ID 0xf084c81c
Frame 46: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 68, Dst Port: 67
Dynamic Host Configuration Protocol (Discover)
No.     Time           Source                Destination           Protocol Length Info
     47 14.893968703   192.168.0.1           192.168.0.18          DHCP     348    DHCP Offer    - Transaction ID 0xf084c81c
Frame 47: 348 bytes on wire (2784 bits), 348 bytes captured (2784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.18
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (Offer)
No.     Time           Source                Destination           Protocol Length Info
     48 14.894128910   0.0.0.0               255.255.255.255       DHCP     342    DHCP Request  - Transaction ID 0xf084c81c
Frame 48: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 68, Dst Port: 67
Dynamic Host Configuration Protocol (Request)
No.     Time           Source                Destination           Protocol Length Info
     49 14.904703164   192.168.0.1           192.168.0.18          DHCP     376    DHCP ACK      - Transaction ID 0xf084c81c
Frame 49: 376 bytes on wire (3008 bits), 376 bytes captured (3008 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.18
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (ACK)
```

Yes, the port numbers are the same (67 and 68).

1.e)

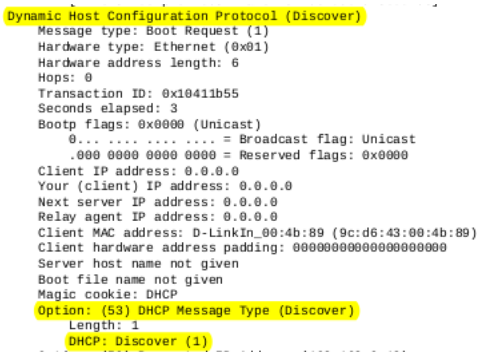
My Ethernet Address is: 9c:d6:43:00:4b:89

```
No.     Time           Source                Destination           Protocol Length Info
     46 14.877078017   0.0.0.0               255.255.255.255       DHCP     342    DHCP Discover - Transaction ID 0xf084c81c
Frame 46: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 68, Dst Port: 67
Dynamic Host Configuration Protocol (Discover)
```

1.f)

The Request message has Type 3 and the Discover message has Type 1

```
No.     Time           Source                Destination           Protocol Length Info
    565 13.733045465   0.0.0.0               255.255.255.255       DHCP     342    DHCP Request  - Transaction ID 0x10411b55
Frame 565: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 68, Dst Port: 67
Dynamic Host Configuration Protocol (Request)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x10411b55
    Seconds elapsed: 3
    Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 0.0.0.0
    Next server IP address: 0.0.0.0
    Relay agent IP address: 0.0.0.0
    Client MAC address: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (Request)
        Length: 1
        DHCP: Request (3)
```



1.g)
The IP Address of my DHCP server is 192.168.0.1

```
No.     Time           Source                Destination           Protocol Length Info
    566 13.744909737   192.168.0.1           192.168.0.18          DHCP     376    DHCP ACK      - Transaction ID 0x10411b55
Frame 566: 376 bytes on wire (3008 bits), 376 bytes captured (3008 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.18
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (ACK)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x10411b55
    Seconds elapsed: 3
    Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.0.18
    Next server IP address: 192.168.0.1
    Relay agent IP address: 0.0.0.0
    Client MAC address: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (ACK)
        Length: 1
        DHCP: ACK (5)
    Option: (54) DHCP Server Identifier (192.168.0.1)
        Length: 4
        DHCP Server Identifier: 192.168.0.1
```

1.h)
My client is offered 192.168.0.18 by the DHCP server. The offer message contains the DHCP address offered by the server

```
No.     Time           Source                Destination           Protocol Length Info
    564 13.732950205   192.168.0.1           192.168.0.18          DHCP     348    DHCP Offer    - Transaction ID 0x10411b55
Frame 564: 348 bytes on wire (2784 bits), 348 bytes captured (2784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.18
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x10411b55
    Seconds elapsed: 3
    Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.0.18
    Next server IP address: 192.168.0.1
```

1.i)

These values are all found in the DHCP Offer message. They are highlighted below:

```
No.     Time           Source                Destination           Protocol Length Info
    564 13.732950205   192.168.0.1           192.168.0.18          DHCP     348    DHCP Offer    - Transaction ID
Frame 564: 348 bytes on wire (2784 bits), 348 bytes captured (2784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.18
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x10411b55
    Seconds elapsed: 3
    Bootp flags: 0x0000 (Unicast)
        0... .... .... .... = Broadcast flag: Unicast
        .000 0000 0000 0000 = Reserved flags: 0x0000
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.0.18
    Next server IP address: 192.168.0.1
    Relay agent IP address: 0.0.0.0
    Client MAC address: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (Offer)
        Length: 1
        DHCP: Offer (2)
    Option: (54) DHCP Server Identifier (192.168.0.1)
        Length: 4
        DHCP Server Identifier: 192.168.0.1
    Option: (51) IP Address Lease Time
        Length: 4
        IP Address Lease Time: (604800s) 7 days
    Option: (58) Renewal Time Value
        Length: 4
        Renewal Time Value: (302400s) 3 days, 12 hours
    Option: (59) Rebinding Time Value
        Length: 4
        Rebinding Time Value: (529200s) 6 days, 3 hours
    Option: (1) Subnet Mask (255.255.255.0)
        Length: 4
        Subnet Mask: 255.255.255.0
    Option: (28) Broadcast Address (192.168.0.255)
        Length: 4
        Broadcast Address: 192.168.0.255
    Option: (3) Router
        Length: 4
        Router: 192.168.0.1
    Option: (6) Domain Name Server
        Length: 4
        Domain Name Server: 192.168.0.1
    Option: (15) Domain Name
        Length: 12
        Domain Name: cogeco.local
    Option: (255) End
        Option End: 255
```

Problem 2

Solution
I used the hostname www.cuhk.edu.hk a school in China I found online
2.a)
My Host: 192.168.0.18
Destination: 13.248.241.65

```
No.     Time           Source                Destination           Protocol Length Info
    400 25.509275014   192.168.0.18          13.248.241.65         ICMP     98     Echo (ping) request  id=0x0003, seq=10/2560,
ttl=64 (reply in 401)
Frame 400: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: 02:00:00:00:00:04 (02:00:00:00:00:04)
Internet Protocol Version 4, Src: 192.168.0.18, Dst: 13.248.241.65
Internet Control Message Protocol
```

2.b)
Because ICMP packets are designed to communicate network-layer information between hosts and routers, not between application layer processes.
2.c)
Type: 8
Code: 0
The other fields are: Checksum, Identifier, Sequence Number, Response Frame, Timestamp Frame and Data. Checksum, Sequence and Identifier are all **2 bytes**

```
No.     Time           Source                Destination           Protocol Length Info
    400 25.509275014   192.168.0.18          13.248.241.65         ICMP     98     Echo (ping) request  id=0x
ttl=64 (reply in 401)
Frame 400: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: 02:00:00:00:00:04 (02:00:00:00:00:04)
Internet Protocol Version 4, Src: 192.168.0.18, Dst: 13.248.241.65
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0x7072 [correct]
    [Checksum Status: Good]
    Identifier (BE): 3 (0x0003)
    Identifier (LE): 768 (0x0300)
    Sequence number (BE): 10 (0x000a)
    Sequence number (LE): 2560 (0x0a00)
    [Response frame: 401]
    Timestamp from icmp data: Nov 24, 2021 22:41:50.000000000 EST
    [Timestamp from icmp data (relative): 0.607796835 seconds]
    Data (48 bytes)
0000  22 46 09 00 00 00 00 00 10 11 12 13 14 15 16 17   "F..............
0010  18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 26 27   ........ !"#$%&'
0020  28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37   ()*+,-./01234567
```

2.d)
Type: 0
Code: 0
The other fields are: Checksum, Identifier, Sequence Number, Response Frame, Timestamp Frame and Data. Checksum, Sequence and Identifier are all **2 bytes**

```
No.     Time           Source                Destination           Protocol Length Info
    401 25.537924407   13.248.241.65         192.168.0.18          ICMP     98     Echo (ping) reply    id=0x0
ttl=121 (request in 400)
Frame 401: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface wlx9cd643004b89, id 0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Internet Protocol Version 4, Src: 13.248.241.65, Dst: 192.168.0.18
Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0x7872 [correct]
    [Checksum Status: Good]
    Identifier (BE): 3 (0x0003)
    Identifier (LE): 768 (0x0300)
    Sequence number (BE): 10 (0x000a)
    Sequence number (LE): 2560 (0x0a00)
    [Request frame: 400]
    [Response time: 28.649 ms]
    Timestamp from icmp data: Nov 24, 2021 22:41:50.000000000 EST
    [Timestamp from icmp data (relative): 0.636446228 seconds]
    Data (48 bytes)
0000  22 46 09 00 00 00 00 00 10 11 12 13 14 15 16 17   "F..............
0010  18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 26 27   ........ !"#$%&'
0020  28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37   ()*+,-./01234567
      Data: 22460900000000001011121314151617181 91a1b1c1d1e1f…
      [Length: 48]
```

2.e)
The ping command is *ping -i <interval> hostname* where interval is the amount of time between ping's.

```
sawyer@sawyer-System-Product-Name:~$ ping -i 2.0 www.cuhk.edu.hk
PING p3ureb8hc.cdn2.mlycdn.com (13.226.142.108) 56(84) bytes of data.
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=1 ttl=246 time=16.3 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=2 ttl=246 time=24.2 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=3 ttl=246 time=28.4 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=4 ttl=246 time=23.7 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=5 ttl=246 time=28.0 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=6 ttl=246 time=97.1 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=7 ttl=246 time=21.6 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=8 ttl=246 time=24.3 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=9 ttl=246 time=94.5 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=10 ttl=246 time=14.7 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=11 ttl=246 time=64.9 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=12 ttl=246 time=12.9 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=13 ttl=246 time=19.9 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=14 ttl=246 time=14.8 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=15 ttl=246 time=22.3 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=16 ttl=246 time=24.8 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=17 ttl=246 time=19.0 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=18 ttl=246 time=12.9 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=19 ttl=246 time=16.0 ms
64 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=20 ttl=246 time=13.7 ms
```

2.f)
The ping command is *ping -i <size> hostname* where size is the size of the packet.

```
sawyer@sawyer-System-Product-Name:~$ ping -s 500 www.cuhk.edu.hk
PING p3ureb8hc.cdn2.mlycdn.com (13.226.142.108) 500(528) bytes of data.
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=1 ttl=246 time=15.4 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=2 ttl=246 time=24.9 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=3 ttl=246 time=27.5 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=4 ttl=246 time=24.0 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=5 ttl=246 time=25.7 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=6 ttl=246 time=39.8 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=7 ttl=246 time=16.8 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=8 ttl=246 time=25.3 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=9 ttl=246 time=25.0 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=10 ttl=246 time=23.7 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=11 ttl=246 time=24.0 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=12 ttl=246 time=25.6 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=13 ttl=246 time=27.4 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=14 ttl=246 time=24.5 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=15 ttl=246 time=28.6 ms
508 bytes from server-13-226-142-108.yto50.r.cloudfront.net (13.226.142.108): icmp_seq=16 ttl=246 time=25.2 ms
```

2.g)
The command is *ping -t <ttl> hostname* where ttl is the Time to Live of the packet.

```
sawyer@sawyer-System-Product-Name:~$ ping -t 30 www.cuhk.edu.hk
PING p3ureb8hc.cdn2.mlycdn.com (76.223.111.166) 56(84) bytes of data.
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=1 ttl=121 time=47.2 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=2 ttl=121 time=27.8 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=3 ttl=121 time=24.7 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=4 ttl=121 time=14.6 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=5 ttl=121 time=25.6 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=6 ttl=121 time=13.2 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=7 ttl=121 time=25.1 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=8 ttl=121 time=24.6 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=9 ttl=121 time=30.2 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=10 ttl=121 time=22.8 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=11 ttl=121 time=24.2 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=12 ttl=121 time=30.1 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (76.223.111.166): icmp_seq=13 ttl=121 time=31.7 ms
```

2.h)
The command is *ping -b -c <count> hostname* where it will stop after *count* number of replies, and *-b* means it will ping broadcast.

```
sawyer@sawyer-System-Product-Name:~$ ping -b -c 10 www.cuhk.edu.hk
PING p3ureb8hc.cdn2.mlycdn.com (13.248.241.65) 56(84) bytes of data.
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=1 ttl=121 time=18.8 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=2 ttl=121 time=23.2 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=3 ttl=121 time=25.0 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=4 ttl=121 time=24.3 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=5 ttl=121 time=32.7 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=6 ttl=121 time=24.1 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=7 ttl=121 time=22.8 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=8 ttl=121 time=22.0 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=9 ttl=121 time=22.6 ms
64 bytes from a5ac5a2245795d4e9.awsglobalaccelerator.com (13.248.241.65): icmp_seq=10 ttl=121 time=22.9 ms

--- p3ureb8hc.cdn2.mlycdn.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9012ms
rtt min/avg/max/mdev = 18.846/23.835/32.693/3.352 ms
```

Problem 3

Solution

This image can be used for parts **a** and **b**

```
No.     Time           Source                Destination           Protocol Length Info
     22 0.727329       D-LinkIn_00:4b:89     02:00:00:00:00:04     0x0800   446    IPv4
Frame 22: 446 bytes on wire (3568 bits), 446 bytes captured (3568 bits) on interface \Device\NPF_{E708B963-B682-4347-BFE0-C62985987AA0},
id 0
Ethernet II, Src: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89), Dst: 02:00:00:00:00:04 (02:00:00:00:00:04)
Data (432 bytes)
0000  45 00 01 b0 39 60 40 00 80 06 89 a9 c0 a8 00 12   E...9`@.........
0010  80 77 f5 0c fd af 00 50 fa 94 54 85 e3 8d 8f c8   .w.....P..T.....
0020  50 18 02 01 ce 88 00 00 47 45 54 20 2f 77 69 72   P.......GET /wir
0030  65 73 68 61 72 6b 2d 6c 61 62 73 2f 48 54 54 50   eshark-labs/HTTP
0040  2d 65 74 68 65 72 65 61 6c 2d 6c 61 62 2d 66 69   -ethereal-lab-fi
0050  6c 65 33 2e 68 74 6d 6c 20 48 54 54 50 2f 31 2e   le3.html HTTP/1.
0060  31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e 63 73   1..Host: gaia.cs
```

This image can be used for parts **c** and **d**

```
No.     Time           Source                Destination           Protocol Length Info
     24 0.734152       02:00:00:00:00:04     D-LinkIn_00:4b:89     0x0800   66     IPv4
Frame 24: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{E708B963-B682-4347-BFE0-C62985987AA0},
0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: D-LinkIn_00:4b:89 (9c:d6:43:00:4b:89)
Data (52 bytes)
0000  45 00 00 34 00 00 40 00 2c 06 18 86 80 77 f5 0c   E..4..@.,....w..
0010  c0 a8 00 12 00 50 fd b0 a4 81 de 95 63 d3 02 53   .....P......c..S
0020  80 12 72 10 df 73 00 00 02 04 05 b4 01 01 04 02   ..r..s..........
0030  01 03 03 07                                       ....
```

3.a)
The Ethernet Address of my Computer is: 9c:d6:43:00:4b:89

3.b)
The Ethernet Address of the destination is: 02:00:08:00:00:04
This is the address of my Router (Gateway to the Internet)

3.c)
The Ethernet Address of the source of the response is: 02:00:00:00:00:04
This is the address of my Router (Gateway to my Computer)

3.d)
The Ethernet Address of the destination of the response is: 9c:d6:43:00:4b:89
This is the Ethernet address of my computer

3.e)
The command is **arp -a**. It shows all the entries of the ARP cache or table.

```
PS C:\WINDOWS\system32> arp -a

Interface: 192.168.0.18 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           02-00-00-00-00-04     dynamic
  192.168.0.2           d4-9d-c0-fb-69-7a     dynamic
  192.168.0.5           a4-77-33-bd-7c-1e     dynamic
  192.168.0.14          4c-3b-df-60-b6-e7     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

3.f)
The command is **arp -d ip**, where "ip" is the IP address of the entry you want to delete. To delete the entire table: **arp -d *.**

```
PS C:\WINDOWS\system32> arp -d 192.168.0.14
PS C:\WINDOWS\system32> arp -a

Interface: 192.168.0.18 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           02-00-00-00-00-04     dynamic
  192.168.0.2           d4-9d-c0-fb-69-7a     dynamic
  192.168.0.5           a4-77-33-bd-7c-1e     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
PS C:\WINDOWS\system32>
```

3.g)
The command is **arp -s**. To add a static entry in an ARP table, write arp -s command along with the IP address and MAC address of the device in a command prompt.

```
PS C:\WINDOWS\system32> arp -s 192.168.43.160 00-aa-00-62-c6-09
PS C:\WINDOWS\system32> arp -a

Interface: 192.168.0.18 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           02-00-00-00-00-04     dynamic
  192.168.0.2           d4-9d-c0-fb-69-7a     dynamic
  192.168.0.5           a4-77-33-bd-7c-1e     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  192.168.43.160        00-aa-00-62-c6-09     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

3.h)
The command is **proxy-arp**, but I could not get it working.

```
C:\WINDOWS\system32>proxy-arp
'proxy-arp' is not recognized as an internal or external command,
operable program or batch file.
```

Problem 4

Solution

```
No.     Time           Source                Destination           Protocol Length Info
     12 2.818919       02:00:00:00:00:04     Broadcast             ARP      42     Who has 192.168.0.2? Tell 192.168.0.1
Frame 12: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{E708B963-B682-4347-BFE0-C62985987A
0
Ethernet II, Src: 02:00:00:00:00:04 (02:00:00:00:00:04), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
    Destination: Broadcast (ff:ff:ff:ff:ff:ff)
    Source: 02:00:00:00:00:04 (02:00:00:00:00:04)
    Type: ARP (0x0806)
Address Resolution Protocol (request)
```

4.a)
The values are: 02:00:00:00:00:04 (Source) and ff:ff:ff:ff:ff:ff (Destination).
The destination address corresponds to Broadcast (since my router is trying to fill its ARP table), and the source address corresponds to my router.
4.b)
The value is: 0x086
It corresponds to ARP.