

Introduction to Web Science

Assignment 1

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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 00 00 00 00 00 00
00 00 00 00 00 00 00 00    00 00 00 00
```

Find:

1. Source MAC Address

Answer : Source MAC Address is - 00 13 10 e8 dd 52

2. Destination MAC Address

Answer : Destination MAC Address is - 00 27 10 21 fa 48

3. What protocol is inside the data payload?

Answer : The protocol inside the data payload is Address Resolution Protocol (ARP)

4. Please mention what the last 2 fields hold in the above frame.

Answer : The last 2 fields held in the above frame is Target protocol address (TPA)

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:

Assumption : Signal travels at speed of light

1st Case : 100 MBps

Given:

Cable Length = 20 m

Speed of light = 3×10^8 m/s

We Know

1 Clock cycle occurs in $1 / 1 \times 10^8$ s

i.e. 10^{-8} s

Now,

In 1s : 1 bit travels : 3×10^8 meters

In 10^{-8} s : 1 bit travels : $3 \times 10^8 \times 10^{-8}$ meters

i.e. 3 meters

Therefore,

For 1 meter it takes $10^{-8} / 3$ s

For 20 meter it takes $(10^{-8} / 3) \times 20$ s

Time it takes for the first bit to arrive is 66.667 nano seconds (3 decimal places)

2nd Case : 10 MBps

Given:

Cable Length = 20 m

Speed of light = 3×10^8 m/s

We Know

1 Clock cycle occurs in $1 / 1 \times 10^7$ s

i.e. 10^{-7} s

Now,

In 1s : 1 bit travels : 3×10^8 meters

In 10^{-7} s 1 bit travels $3 \times 10^8 * 10^{-7}$ meters

i.e. 30 meters

For 1 meter it takes $10^{-7} / 30$

For 20 meter it takes $(10^{-7} / 30) \times 20$

Time it takes for the first bit to arrive is 66.667 nano seconds (3 decimal places)

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 3.1

Destination : At Home

Result : When 100 packets were sent we received 96 packets and there were 4 lost packets, hence 4% packet loss as shown in Figure 5 screenshot below.

```
Administrator: Command Prompt
C:\WINDOWS\system32>ping -n 100 www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=73ms TTL=60
Reply from 91.198.174.192: bytes=32 time=62ms TTL=60
Reply from 91.198.174.192: bytes=32 time=41ms TTL=60
Reply from 91.198.174.192: bytes=32 time=170ms TTL=60
Reply from 91.198.174.192: bytes=32 time=63ms TTL=60
Reply from 91.198.174.192: bytes=32 time=61ms TTL=60
Reply from 91.198.174.192: bytes=32 time=52ms TTL=60
Reply from 91.198.174.192: bytes=32 time=52ms TTL=60
Reply from 91.198.174.192: bytes=32 time=49ms TTL=60
Reply from 91.198.174.192: bytes=32 time=59ms TTL=60
Reply from 91.198.174.192: bytes=32 time=62ms TTL=60
Request timed out.
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=57ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=27ms TTL=60
Reply from 91.198.174.192: bytes=32 time=26ms TTL=60
Reply from 91.198.174.192: bytes=32 time=47ms TTL=60
Reply from 91.198.174.192: bytes=32 time=31ms TTL=60
Reply from 91.198.174.192: bytes=32 time=26ms TTL=60
Reply from 91.198.174.192: bytes=32 time=30ms TTL=60
Reply from 91.198.174.192: bytes=32 time=51ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=27ms TTL=60
Reply from 91.198.174.192: bytes=32 time=52ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=34ms TTL=60
Reply from 91.198.174.192: bytes=32 time=151ms TTL=60
Reply from 91.198.174.192: bytes=32 time=49ms TTL=60
Reply from 91.198.174.192: bytes=32 time=47ms TTL=60
Reply from 91.198.174.192: bytes=32 time=35ms TTL=60
Reply from 91.198.174.192: bytes=32 time=32ms TTL=60
Reply from 91.198.174.192: bytes=32 time=38ms TTL=60
```

Figure 2: Packet loss percentage - At home Part 1

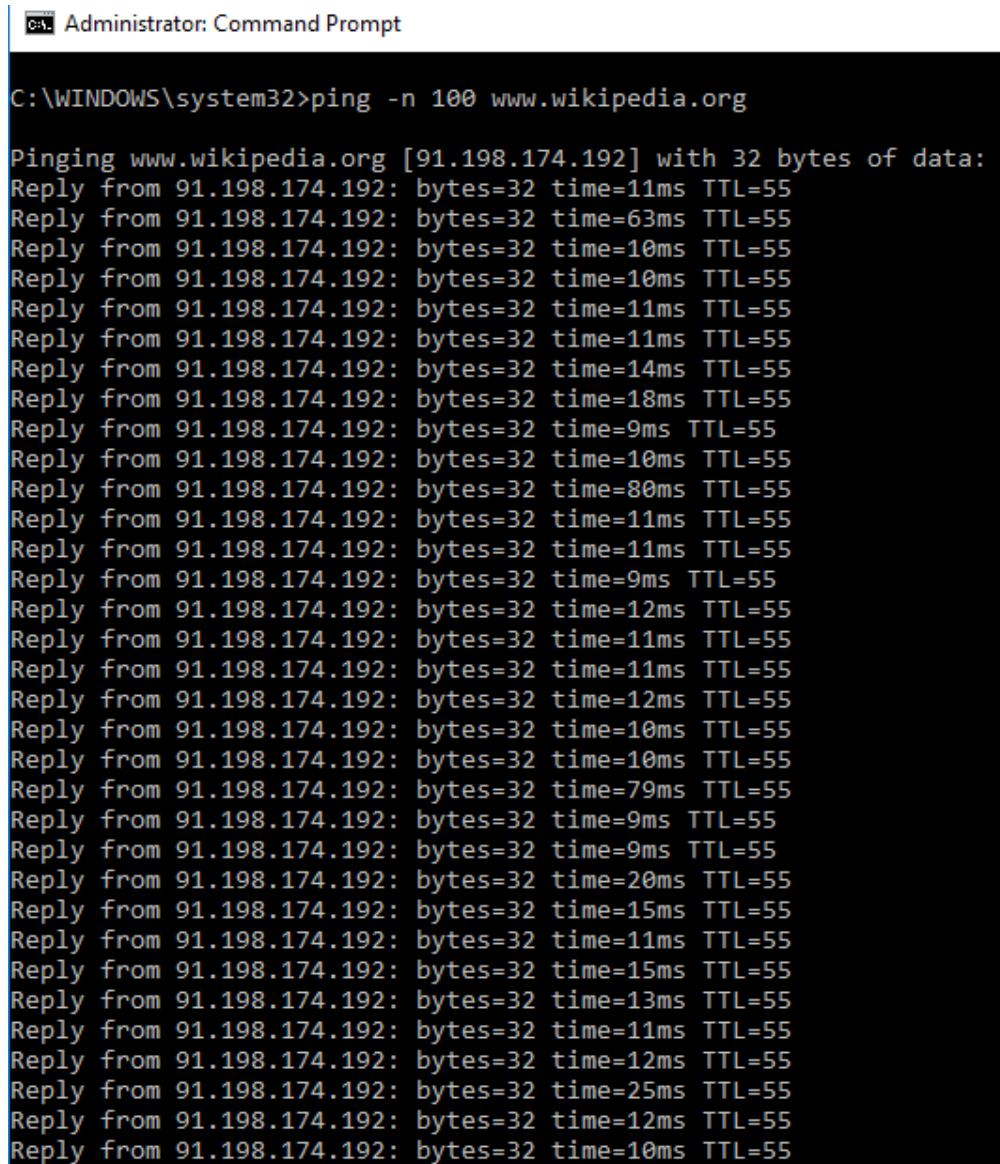
```
Reply from 91.198.174.192: bytes=32 time=20ms TTL=60
Reply from 91.198.174.192: bytes=32 time=32ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=27ms TTL=60
Reply from 91.198.174.192: bytes=32 time=26ms TTL=60
Reply from 91.198.174.192: bytes=32 time=33ms TTL=60
Reply from 91.198.174.192: bytes=32 time=30ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=30ms TTL=60
Reply from 91.198.174.192: bytes=32 time=44ms TTL=60
Reply from 91.198.174.192: bytes=32 time=41ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=27ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=37ms TTL=60
Reply from 91.198.174.192: bytes=32 time=30ms TTL=60
Reply from 91.198.174.192: bytes=32 time=39ms TTL=60
Reply from 91.198.174.192: bytes=32 time=32ms TTL=60
Request timed out.
Reply from 91.198.174.192: bytes=32 time=50ms TTL=60
Reply from 91.198.174.192: bytes=32 time=57ms TTL=60
Reply from 91.198.174.192: bytes=32 time=51ms TTL=60
Request timed out.
Request timed out.
Reply from 91.198.174.192: bytes=32 time=26ms TTL=60
Reply from 91.198.174.192: bytes=32 time=38ms TTL=60
Reply from 91.198.174.192: bytes=32 time=59ms TTL=60
Reply from 91.198.174.192: bytes=32 time=39ms TTL=60
Reply from 91.198.174.192: bytes=32 time=60ms TTL=60
Reply from 91.198.174.192: bytes=32 time=45ms TTL=60
Reply from 91.198.174.192: bytes=32 time=52ms TTL=60
Reply from 91.198.174.192: bytes=32 time=42ms TTL=60
Reply from 91.198.174.192: bytes=32 time=38ms TTL=60
Reply from 91.198.174.192: bytes=32 time=44ms TTL=60

Ping statistics for 91.198.174.192:
    Packets: Sent = 100, Received = 96, Lost = 4 (4% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 25ms, Maximum = 170ms, Average = 39ms
```

Figure 3: Packet loss percentage - At home Part 2

Destination : At University

Result : When 100 packets were sent we received 99 packets and there was 1 lost packet, hence 1% packet loss as shown in Figure 5 screenshot below.



```
Administrator: Command Prompt

C:\WINDOWS\system32>ping -n 100 www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=63ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=14ms TTL=55
Reply from 91.198.174.192: bytes=32 time=18ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=80ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=79ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=20ms TTL=55
Reply from 91.198.174.192: bytes=32 time=15ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=15ms TTL=55
Reply from 91.198.174.192: bytes=32 time=13ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=25ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Request timed out.
```

Figure 4: Packet loss percentage - At University Part 1


```
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=18ms TTL=55
Reply from 91.198.174.192: bytes=32 time=57ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=14ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=66ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=16ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=14ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=13ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=16ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=13ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=16ms TTL=55
Reply from 91.198.174.192: bytes=32 time=17ms TTL=55
Reply from 91.198.174.192: bytes=32 time=12ms TTL=55
Request timed out.
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55

Ping statistics for 91.198.174.192:
    Packets: Sent = 100, Received = 99, Lost = 1 (1% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 9ms, Maximum = 84ms, Average = 16ms
```

Figure 5: Packet loss percentage - At University Part 2

Answer 3.2

Destination : At Home

The size of the packet sent to Wikipedia server is 32 bytes.

```
C:\WINDOWS\system32>ping www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=25ms TTL=60
Reply from 91.198.174.192: bytes=32 time=26ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=128ms TTL=60

Ping statistics for 91.198.174.192:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 25ms, Maximum = 128ms, Average = 51ms
```

Figure 6: Packet sent to Wikipedia Server

Destination : At University

The size of the packet sent to Wikipedia server is 32 bytes.

```
C:\WINDOWS\system32>ping www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=13ms TTL=55
Reply from 91.198.174.192: bytes=32 time=39ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55

Ping statistics for 91.198.174.192:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 10ms, Maximum = 39ms, Average = 18ms
```

Figure 7: Packet sent to Wikipedia Server

Answer 3.3

Destination : At Home

IP address of the machine : 192.168.2.106

```
C:\WINDOWS\system32>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter WiFi:

    Connection-specific DNS Suffix  . : local
    Link-local IPv6 Address . . . . . : fe80::d137:572:dfc8:1a85%15
    IPv4 Address. . . . . : 192.168.2.106
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.2.1

Ethernet adapter Bluetooth Network Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Tunnel adapter isatap.local:

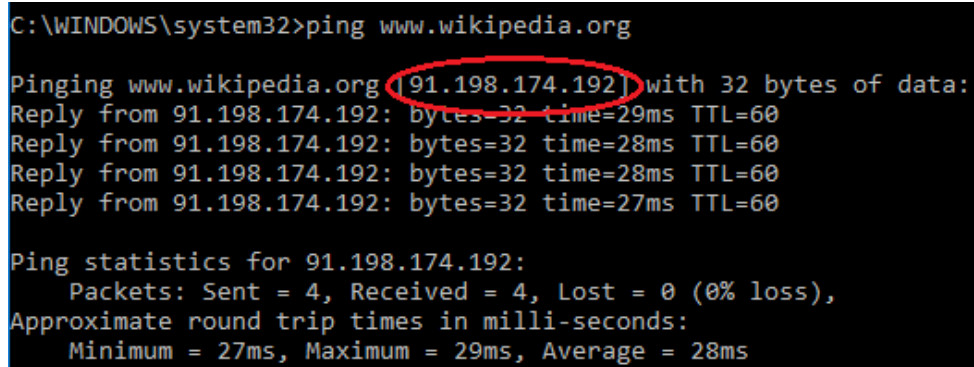
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : local

Tunnel adapter Teredo Tunneling Pseudo-Interface:

    Connection-specific DNS Suffix  . :
    IPv6 Address. . . . . : 2001:0:9d38:6abd:2840:2f71:4dfc:d010
    Link-local IPv6 Address . . . . . : fe80::2840:2f71:4dfc:d010%17
    Default Gateway . . . . . : ::
```

Figure 8: IP address of your machine

IP address of the Wikipedia server : 91.198.174.192



```
C:\WINDOWS\system32>ping www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=29ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=28ms TTL=60
Reply from 91.198.174.192: bytes=32 time=27ms TTL=60

Ping statistics for 91.198.174.192:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 27ms, Maximum = 29ms, Average = 28ms
```

Figure 9: IP address of Wikipedia Server

Destination : At University

IP address of the machine : 141.26.186.78 as shown below in Figure 10

```
C:\WINDOWS\system32>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter WiFi:

    Connection-specific DNS Suffix  . : uni-koblenz.de
    Link-local IPv6 Address . . . . . : fe80::d137:572:dfc8:1a85%15
    IPv4 Address. . . . . : 141.26.186.78
    Subnet Mask . . . . . : 255.255.240.0
    Default Gateway . . . . . : 141.26.176.1

Ethernet adapter Bluetooth Network Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Tunnel adapter Teredo Tunneling Pseudo-Interface:

    Connection-specific DNS Suffix  . :
    IPv6 Address. . . . . : 2001:0:9d38:6abd:811:3f8d:72e5:45b1
    Link-local IPv6 Address . . . . . : fe80::811:3f8d:72e5:45b1%17
    Default Gateway . . . . . : ::

Tunnel adapter isatap.uni-koblenz.de:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : uni-koblenz.de
```

Figure 10: IP address of your machine

IP address of the Wikipedia server : 91.198.174.192

```
C:\WINDOWS\system32>ping www.wikipedia.org

Pinging www.wikipedia.org [91.198.174.192] with 32 bytes of data:
Reply from 91.198.174.192: bytes=32 time=9ms TTL=55
Reply from 91.198.174.192: bytes=32 time=24ms TTL=55
Reply from 91.198.174.192: bytes=32 time=10ms TTL=55
Reply from 91.198.174.192: bytes=32 time=11ms TTL=55

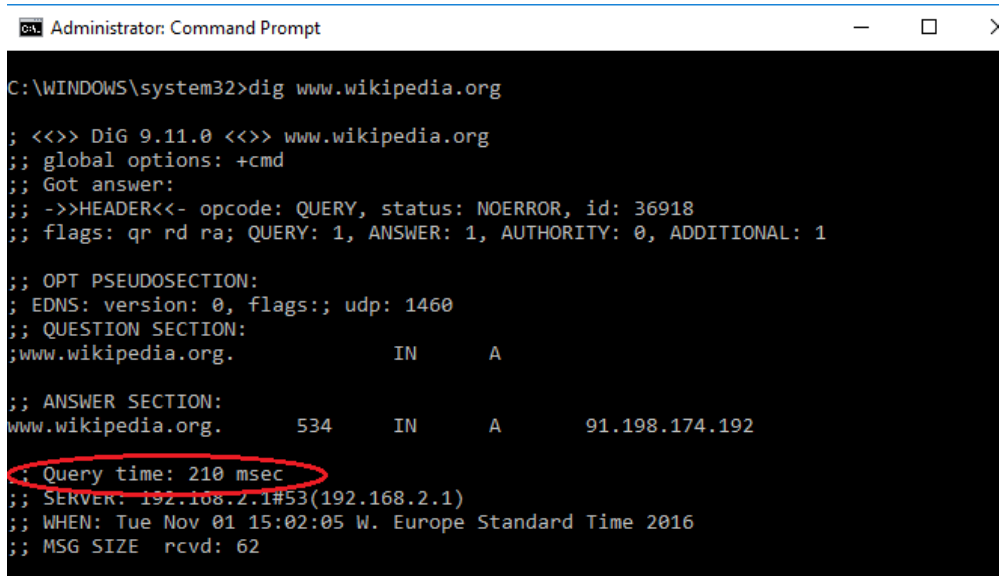
Ping statistics for 91.198.174.192:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 9ms, Maximum = 24ms, Average = 13ms
```

Figure 11: IP address of Wikipedia Server

Answer 3.4

Destination : At Home

Query Time for DNS query for www.wikipedia.org : 210 msec



```
C:\WINDOWS\system32>dig www.wikipedia.org

; <<>> DiG 9.11.0 <<>> www.wikipedia.org
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 36918
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1460
;; QUESTION SECTION:
;www.wikipedia.org.          IN      A

;; ANSWER SECTION:
www.wikipedia.org.          534     IN      A      91.198.174.192

; Query time: 210 msec
;; SERV: 192.168.2.1#53(192.168.2.1)
;; WHEN: Tue Nov 01 15:02:05 W. Europe Standard Time 2016
;; MSG SIZE rcvd: 62
```

Figure 12: Query Time for DNS query for www.wikipedia.org

Destination : At University

Query Time for DNS query for www.wikipedia.org : 3 msec

```
C:\WINDOWS\system32>dig www.wikipedia.org

; <<>> DiG 9.11.0 <<>> www.wikipedia.org
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 65434
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 6, ADDITIONAL: 13

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.wikipedia.org.                IN      A

;; ANSWER SECTION:
www.wikipedia.org.        65      IN      A      91.198.174.192

;; AUTHORITY SECTION:
org.                      65450   IN      NS      d0.org.afiliias-nst.org.
org.                      65450   IN      NS      a2.org.afiliias-nst.info.
org.                      65450   IN      NS      a0.org.afiliias-nst.info.
org.                      65450   IN      NS      c0.org.afiliias-nst.info.
org.                      65450   IN      NS      b0.org.afiliias-nst.org.
org.                      65450   IN      NS      b2.org.afiliias-nst.org.

;; ADDITIONAL SECTION:
a0.org.afiliias-nst.info. 65450   IN      A      199.19.56.1
a0.org.afiliias-nst.info. 65450   IN      AAAA   2001:500:e::1
a2.org.afiliias-nst.info. 65450   IN      A      199.249.112.1
a2.org.afiliias-nst.info. 65450   IN      AAAA   2001:500:40::1
b0.org.afiliias-nst.org.  65450   IN      A      199.19.54.1
b0.org.afiliias-nst.org.  65450   IN      AAAA   2001:500:c::1
b2.org.afiliias-nst.org.  65450   IN      A      199.249.120.1
b2.org.afiliias-nst.org.  65450   IN      AAAA   2001:500:48::1
c0.org.afiliias-nst.info. 65450   IN      A      199.19.53.1
c0.org.afiliias-nst.info. 65450   IN      AAAA   2001:500:b::1
d0.org.afiliias-nst.org.  65450   IN      A      199.19.57.1
d0.org.afiliias-nst.org.  65450   IN      AAAA   2001:500:f::1

;; Query time: 3 msec
;; SERVER: 141.26.64.60#53(141.26.64.60)
;; WHEN: Tue Nov 01 17:45:33 W. Europe Standard Time 2016
;; MSG SIZE rcvd: 464
```

Figure 13: Query Time for DNS query for www.wikipedia.org

Answer 3.5

Destination : At Home

Number of Hops in between our machine and the server is : 8

```
C:\WINDOWS\system32>tracert www.wikipedia.org

Tracing route to www.wikipedia.org [91.198.174.192]
over a maximum of 30 hops:
  0  3 ms    1 ms    1 ms  easy.box.local [192.168.2.1]
  1  43 ms   17 ms   17 ms  dslb-178-003-044-001.178.003.pools.vodafone-ip.de [178.3.44.1]
  2  *        *        *      Request timed out.
  3  *        *        *      Request timed out.
  4  *        *        *      Request timed out.
  5  19 ms   18 ms   17 ms  92.79.212.201
  6  34 ms   38 ms   36 ms  145.254.2.233
  7  45 ms   35 ms   31 ms  ae2.cr2-esams.wikimedia.org [80.249.209.176]
  8  41 ms   42 ms   37 ms  text-lb.esams.wikimedia.org [91.198.174.192]

Trace complete.
```

Figure 14: Number of Hops in between our machine and the server

Destination : At University

Number of Hops in between our machine and the server is : 11

```
C:\WINDOWS\system32>tracert www.wikipedia.org

Tracing route to www.wikipedia.org [91.198.174.192]
over a maximum of 30 hops:
  0  *        3 ms    1 ms  wlanrouter.uni-koblenz.de [141.26.176.1]
  1  3 ms     2 ms    1 ms  g-uni-ko-1.rlp-net.net [217.198.241.129]
  2  10 ms    1 ms     2 ms  g-hbf-ko-1.rlp-net.net [217.198.240.69]
  3  5 ms     4 ms     3 ms  217.198.247.117
  4  7 ms     3 ms     3 ms  g-interxion-1.rlp-net.net [217.198.240.13]
  5  7 ms     4 ms     4 ms  r1fra3.core.init7.net [80.81.192.67]
  6  13 ms    13 ms    14 ms  r1ams1.core.init7.net [77.109.128.154]
  7  15 ms    13 ms    13 ms  r1ams2.core.init7.net [77.109.128.146]
  8  77 ms    10 ms    12 ms  gw-wikimedia.init7.net [77.109.134.114]
  9  9 ms     10 ms    9 ms  ae1-403.cr2-esams.wikimedia.org [91.198.174.254]
 10  11 ms    18 ms    10 ms  text-lb.esams.wikimedia.org [91.198.174.192]

Trace complete.
```

Figure 15: Number of Hops in between our machine and the server

Answer 3.6

Destination : At Home

Firstly the network gateway was obtained by using the command *ipconfig /all* which was 192.168.2.1 as shown in the screenshot below - Figure 16.

Thus with the command *arp -a* we were able to associate the default gateway - 192.168.2.1 to the MAC address of the device which was b4-a5-ef-2d-0d-40

```
Wireless LAN adapter WiFi:

Connection-specific DNS Suffix . : local
Description . . . . . : Intel(R) Centrino(R) Wireless-N 1030
Physical Address. . . . . : 4C-EB-42-69-DF-25
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes
Link-local IPv6 Address . . . . . : fe80::d137:572:dfc8:1a85%15(Preferred)
IPv4 Address. . . . . : 192.168.2.106(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Lease Obtained. . . . . : 31 October 2016 19:07:38
Lease Expires . . . . . : 30 January 2038 04:14:06
Default Gateway . . . . . : 192.168.2.1
DHCP Server . . . . . : 192.168.2.1
DHCPv6 IAID . . . . . : 105704258
DHCPv6 Client DUID. . . . . : 00-01-00-01-1D-EE-50-80-84-8F-69-C7-E4-6A
DNS Servers . . . . . : 192.168.2.1
NetBIOS over Tcpip. . . . . : Enabled
```

Figure 16: Default Gateway

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

Interface: 192.168.2.106 --- 0xf
Internet Address      Physical Address      Type
192.168.2.1           b4-a5-ef-2d-0d-40     dynamic
192.168.2.255         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
224.0.0.253           01-00-5e-00-00-fd     static
239.255.255.250       01-00-5e-7f-ff-fa     static
255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Figure 17: MAC Address of the device

Destination : At University

Similarly, the network gateway was obtained by using the command *ipconfig /all* which was 141.26.176.1 as shown in the screenshot below - Figure 18.

Thus with the command *arp -a* we were able to associate the default gateway - 141.26.186.78 to the MAC address of the device which was 14-18-77-45-b1-bd

```
Wireless LAN adapter WiFi:

Connection-specific DNS Suffix  . : uni-koblenz.de
Description . . . . . : Intel(R) Centrino(R) Wireless-N 1030
Physical Address. . . . . : 4C-EB-42-69-DF-25
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes
Link-local IPv6 Address . . . . . : fe80::d137:572:dfc8:1a85%15(Preferred)
IPv4 Address. . . . . : 141.26.186.78(Preferred)
Subnet Mask . . . . . : 255.255.240.0
Lease Obtained. . . . . : 01 November 2016 17:36:04
Lease Expires . . . . . : 01 November 2016 18:14:11
Default Gateway . . . . . : 141.26.176.1
DHCP Server . . . . . : 141.26.64.70
DHCPv6 IAID . . . . . : 105704258
DHCPv6 Client DUID. . . . . : 00-01-00-01-1D-EE-50-80-84-8F-69-C7-E4-6A
DNS Servers . . . . . : 141.26.64.60
                        141.26.64.61
                        141.26.64.2
                        141.26.64.1
                        141.26.64.2
NetBIOS over Tcpip. . . . . : Enabled
```

Figure 18: Default Gateway

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

Interface: 141.26.186.78 --- 0xf
Internet Address      Physical Address      Type
141.26.176.1          14-18-77-45-b1-bd    dynamic
141.26.191.255         ff-ff-ff-ff-ff-ff    static
224.0.0.2             01-00-5e-00-00-02    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
224.0.0.253           01-00-5e-00-00-fd    static
239.255.255.250       01-00-5e-7f-ff-fa    static
255.255.255.255       ff-ff-ff-ff-ff-ff    static
```

Figure 19: MAC Address of the device

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 4.1

```
1 #10 random number between 0 to 90
2 from random import randint
3 x = [randint(1,89) for p in range (0,10)]
4 print(x)
```

Answer 4.2

```
6 #performing sine and cosine on above generated random numbers
7 import numpy as np
8 print(np.cos(x))
9 print(np.sin(x))
```

Answer 4.3

```
11 #storing values of sine and cosine value on variable SIN and COSIN
12 import numpy as np
13 SIN = np.sin(x)
14 COSIN = np.cos(x)
```

Answer 4.4 and 4.5

```
16 #plotting value of SIN and COSIN in two different colors
17 from random import randint
18 import numpy as np
19 import matplotlib.pyplot as plt
20 x = [randint(0,90) for p in range (0,10)]
21 SIN = np.sin(x)
22 COSIN = np.cos(x)
23
24 plt.plot(SIN, color = "red", label = 'Sine')
25 plt.plot(COSIN, color = "black", label = 'Cosine')
26 plt.xlabel("Random number Index")
27 plt.ylabel("Values")
28 plt.legend(loc=(0,-0.4), ncol = 2)
29 plt.show()
```

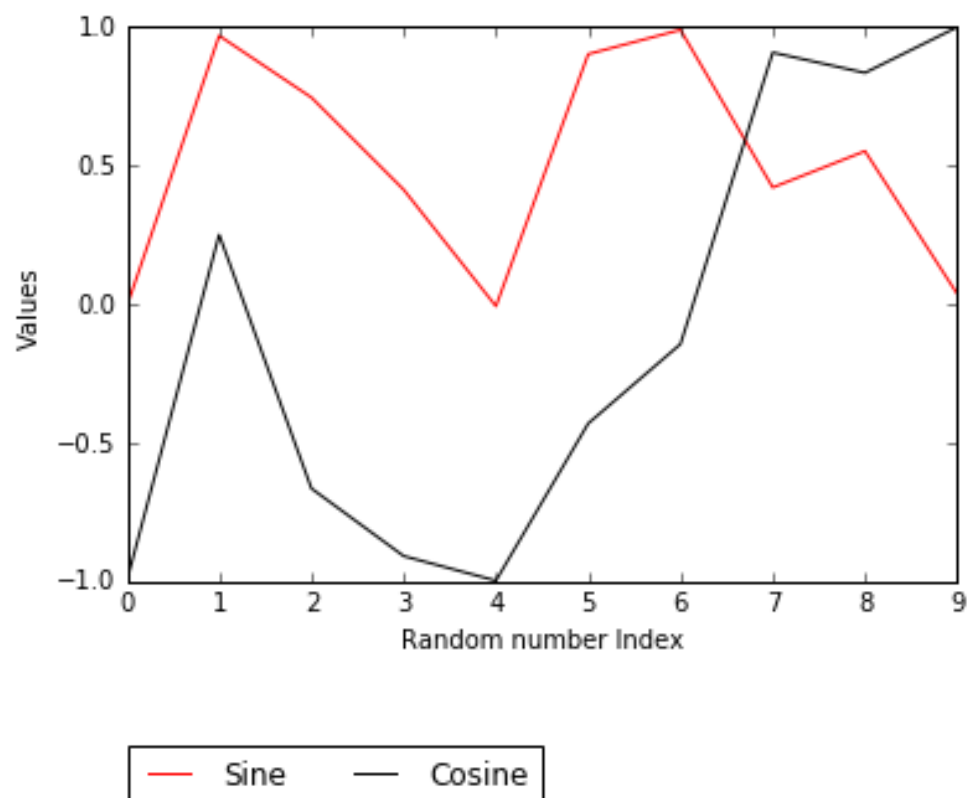


Figure 20: Plot for values of SIN and COSIN

Important Notes

Submission

- Solutions have to be checked into the github repository. Use the directory name `groupname/assignment1/` 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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