OD - Lab 3: Networking

Exercise 1

Your tasks:

1. Examine the tools ip link, ip address, ip route and netstat and document their purposes and how they work.

```
$ ip link is used to show the devices interfaces.

$ ip address is used to show the ips that the devices interfaces hold.

$ ip route is used to show the networking routes of the device.

$ netstat is used to show current network connections.
```

Exercise 2

Your tasks:

1. Connect your computer to a switch or directly to another computer.
2. Assign an ip address to your network interface.
3. Create a routing entry for routing communication to the new network.
4. Spin up the Docker compose from the previous exercise.
5. Let your group visit your website through your ip.

1. Connecting to another computer

   ☑ ~~Connected~~

2. Assigning an ip adress to the network interface

   ```
   $ ip link show
   $ ip link set en7 up
   $ sudo ifconfig en7 192.168.1.20/24
   $ ping 192.168.1.21 (Another computer)
   ```

   Check this with the `ifconfig` command

3. Creating a routing entry (Doesn't work)
4. Spinning up a docker container (Doesn't work)
    a. But would be done by spinning up a container and let the other one connect to it with the hosts IP adress and a specific port

Exercise 3

Your tasks:

1. Discuss the differences between the OSI model and the TCP/IP model
    a. TCP/IP is protocol oriented and the OSI model is generic. Which means its based upon functionalities of each layer
    b. TCP/IP model has 4 layers while the OSI model has 7 layers
    c. OSI model gives guidelines on how communication needs to be done while TCP/IP looks like how the internet was developed. So, TCP/IP is a more practical model.
    d. In OSI, the model was developed first and then the protocols in each layer were developed. In the TCP/IP suite, the protocols were developed first and then the model was developed.
    e. The OSI Model is a logical and conceptual model that defines network communication used by systems open to interconnection and communication with other systems. On the other hand, TCP/IP helps you to determine how a specific computer should be connected to the internet and how you can be transmitted between them.
    f. OSI header is 5 bytes whereas TCP/IP header size is 20 bytes.
    g. OSI refers to Open Systems Interconnection whereas TCP/IP refers to Transmission Control Protocol.
    h. OSI follows a vertical approach whereas TCP/IP follows a horizontal approach.
    i. OSI model, the transport layer, is only connection-oriented whereas the TCP/IP model is both connection-oriented and connectionless.
    j. OSI model helps you to standardize router, switch, motherboard, and other hardware whereas TCP/IP helps you to establish a connection between different types of computers.

2. Which layers in the OSI model correspond to which layers in the TCP/IP model.

OSI to TCP/IP

OSI Model	TCP/IP Model
Application	Application
Presentation	Application
Session	Application
Transport	Transport
Network	Internet
Data Link	Network Access
Physical	Network Access

3. Take turns in explaining the different layers of the TCP/IP model to each other.
    a. What is the responsibility of the layer? What does it add/remove? How does addressing work on the layer? Do you know some details about how the layer is implemented?
        i. Application layer:
            - The topic three layers of the OSI Model: Application, Presentation and Sessions, when combined together, they perform similar functions as the Application Layer of the TCP/IP model
            - Multiple protocols are present in this layer, a few common ones have been mentioned below in brief: HTTP, NTP, TELNET, FTP
        ii. Transport layer:
            - The error-free delivery of data is the main function of this layer
            - There are two main protocols present in this layer: TCP & UDP
        iii. Internet layer:
            - Sending the data packets to their destination network is the main function of the Internet layer

- There are three different protocols used in this layer. These include: IP, ARP, ICMP

iv. Network access layer:

- The physical transmission of data takes place at this layer. Once the frames are transmitted by a network, encapsulating the IP datagram into these frames is done in this layer. Also, the mapping of IP address into physical address is done here.
- Mainly, the function of this layer is to transmit the data between two devices, connected in a network

Exercise 4

Your tasks:

1. Explain step by step how a package from *Computer A* with the ip 185.8.135.136 gets to *Computer B* with the ip 101.24.34.2.
   a. Since computer A already knows the IP for computer B, the computer A creates a layer 3 header with the source and destination information(src: 185.8.135.136 & dst:101.24.34.2)
   b. Then computer A needs to learn the default gateaways MAC address.
   c. Therefore an ARP request is sent by flooding the local network in the switch
   d. Both the other hosts on the network and the router gets a copy of this request
   e. All the hosts which doesn't have the correct IP address will just discard the request
   f. The router can see its for someone else and therefore accepts the request
   g. First the router learns the ARP mapping of computer A (And now has the MAC adress for computer A)
   h. Second, the router will create an ARP response and computer A now knows the routers ARP mapping
   i. Computer A create a layer 2 header and sends the packet

j. The switch receives the frame and since it already knows mapping for the port, it will just forward the frame out of the port that goes outside the world through the router
k. When the router receives the packet, it just strips the layer 2 header
l. Then the router sends a ARP request for the computer B's IP adress to learn the MAC adress
m. The switch receives the frame and will then flood all the hosts on the network.
n. By doing this, one of the hosts will accept the request as it has the correct MAC adress
o. The other hosts will discard the frame, meanwhile the correct host, which is computer B, will get the ARP request
p. Computer B now generates an ARP response
q. And just like that the switch gets to know the MAC adress for computer B
r. The switch will look up the mac adress and determine which port it should be forwarded out
s. The router will then receive the ARP response, and will learn computer B's ARP mapping
t. The router then creates the layer 2 header and sends the packet
u. The switch will get the packet, and since it knows the mapping for the different ports, the switch will frame out on a specific port that correlates to computer B.
v. And just like that, the computer B receives the packet
w. The layer 2 header will first be stripped, and then followed by a stripping of the layer 3 header
x. The computer B will now finally receive the data from computer A with the ip 185.8.135.136

2. Which layers (in the OSI model) does communication happen through?
    a. Physical layer