Homework 2

Problem 1

> What is the difference between an ARP request and an ARP reply in terms of the number of destinations?

According to the ARP process, an ARP request is a broadcast message while an ARP reply is a unicast message. Therefore, the number of destinations are:

- **ARP request:** $\mathbf{N}$, all devices in the network.
- **ARP reply:** $\mathbf{1}$, only the target device.

Problem 2

> Give all fields of a UDP header and their sizes.

User datagrams in UDP packets reserve 8 **bytes** for the header.

$$ \underbrace{1 \dots 8}_{\textsf{Header}} \
\underbrace{9 \dots N}_{\textsf{Data}} $$

Problem 3

> An IP datagram arrives with $HLEN = C$ (hex) and Total length $=$ 0038 (hex).
>
> a. Are there any options?
> b. How many bytes of data does this packet carry?

Problem 4

> Compare TCP and UDP in terms of reliability.

Problem 5

> A host with the IP address `173.16.5.9` and the physical address `C1:D4:56:78:9A:BC` sends data to the destination with the IP address `193.168.1.11` and the physical address `BB:13:56:CA:9A:D2`. The next hop has the IP address `173.16.5.1` and the physical address `00:1C:42:AA:BB:CC`. Show all the fields of the ARP request and reply packets. The Ethernet protocol is implemented at the data link layer.

Problem 6

> An IP packet starts with the following hex digits: `45000064 1C4620F0`. It's the 2nd fragment.
>
> a. How many bytes of data does it carry?
> b. Is there the next fragment?
> c. If yes, what is its offset?

Problem 7

> An IP datagram with no options whose total length is $5,000$ bytes needs to be fragmented. $MTU = 1,500$ bytes. All but the last fragment are max-sized.
>
> a. How many fragments are there?
> b. How many bytes of data does each fragment carry?
> c. What is the offset of the 3rd fragment?
> d. What is the total size of the last fragment?

Problem 8

> Consider a TCP client with $rwnd = 3,000$, $cwnd = 3,500$, and last received $ACK = 1,000$.
>
> a. Draw and explain the sliding window diagram.
> b. What data can be sent now?

Problem 9

> An IP packet arrives with $HLEN = 1,110$ (binary). Is this a valid IP packet?

Problem 10

> A UDP datagram with the destination port $61,284$ has arrived. The control-block table shows that this port is IN-USE but no queue has been assigned to it. Is it possible?

Problem 11

> Consider an ARP packet with $OPERATION = 1$ and a the target hardware address field filled with a valid address. Is it possible? Explain your answer.

Problem 12

> The last TCP acknowledgment that a client successfully sent to a server is $12,623$. The server sends $1,000$ bytes of data in each segment. At subsequent moments $t_1 < t_2 < t_3$ the client received from the server TCP segments with the following sequence numbers:
>
> - $t_1 : 13,623$
> - $t_2 : 14,623$
> - $t_3 : 12,623$
>
> The 3rd segment was delayed. What acknowledgment did the client send after receiving each of these three segments?

Problem 13

> Here is a TCP header in the hex format:
>
> ```
> 0532 0035 0000 0050 0000 00A1 5002 2000 0270 0000
> ```
>
> a. What is the source port and the destination port?

b. What is the sequence number?
c. What does the acknowledgment number mean?
d. What is the header length in bytes?
e. Which TCP flags are set, and what do they indicate?
f. What is the window size?