

CS-542 Computer Networks I: Fundamentals

Summer 2025 HW2 (45 points)

Submission instructions

- *Due date: Friday, June 27, 11:59 pm Central Time (i.e. local time in Chicago)*
- *Late submissions and submissions violating these instructions will NOT be accepted.*
- *No handwritten submissions. No credit will be given for such submissions.*
- *Teamwork is allowed (max. 3 students/team). Individual submissions are also OK.*
- *Upload your assignment (pdf format only) to Canvas or Lumina (Beacon students). Submissions in formats other than pdf will be disregarded.*
- *One submission per team only. Type names, A#, and section numbers of all the team members on the front page. Do not submit multiple copies of your HW (e.g. by each team member). It is very confusing and will be penalized (25% of your score). Clearly indicate how each team member contributed to your teamwork.*
- *Show your work and explain every step of your solution for full credit. Only partial credit will be given for a correct final answer with missing calculations, no supporting explanations or unclear justifications.*
- *My TA Manushi Patel (mpatel188@hawk.iit.edu) is responsible for grading this HW assignment. Feel free to ask questions if something is not clear but don't send me or my TA:*
 - *Your partial solutions with inquiries “Is that what you expect?”.*
 - *Questions, the answers to, may give explicit hints on how to solve the HW problems*

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1. **(1 point)** What is the difference between an ARP request and an ARP reply in terms of the number of destinations?
 2. **(2 points)** Give all fields of a UDP header and their sizes.

3. **(2 points)** An IP datagram arrives with *HLEN* = C (hex) and *Total Length* = 0038 (hex).
- Are there any options?
 - How many bytes of data does this packet carry?
4. **(2 points)** Compare TCP and UDP in terms of reliability.
5. **(6 points)** 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.
6. **(4 points)** An IP packet starts with the following hex digits: 45000064 1C4620F0. It's the 2nd fragment.
- How many bytes of data does it carry?
 - Is there the next fragment?
 - If yes, what is its offset?
7. **(8 points)** An IP datagram with no options whose total length is 5000 bytes needs to be fragmented. *MTU* = 1500 bytes. All but the last fragment are max-sized.
- How many fragments are there?
 - How many bytes of data does each fragment carry?
 - What is the offset of the 3rd fragment?
 - What is the total size of the last fragment?
8. **(4 points)** Consider a TCP client with *rwnd* = 3000, *cwnd* = 3500, and last received *ACK* = 1000.
- Draw and explain the sliding window diagram.
 - What data can be sent now?

9. **(1 point)** An IP packet arrives with $HLEN = 1110$ (binary). Is this a valid IP packet?
10. **(1 point)** A UDP datagram with the destination port 61284 has arrived. The control-block table shows that this port is *IN-USE* but no queue has been assigned to it. Is it possible?
11. **(1 point)** 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.
12. **(6 points)** The last TCP acknowledgment that a client successfully sent to a server is 12623. The server sends 1000 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: $t_1:13623$, $t_2:14623$, $t_3:12623$. The 3rd segment was delayed. What acknowledgment did the client send after receiving each of these three segments?
13. **(7 points)** Here is a TCP header in the hex format:
- 0532 0035 0000 0050 0000 00A1 5002 2000 0270 0000
- What is the source port and the destination port?
 - What is the sequence number?
 - What does the acknowledgment number mean?
 - What is the header length in bytes?
 - Which TCP flags are set, and what do they indicate?
 - What is the window size?