

**CS 315: Computer Networks Lab**  
Spring 2024-25, IIT Dharwad

**Mid-semester Exam**

February 27, 2024

2:30 PM to 4:30 PM

**Total Marks: 68 marks**

**Instructions**

1. Login to the Ubuntu OS on your machine using the following credentials:
  - a. Username: cs101
  - b. Password: cprg@123
2. Use the provided Part\_1\_DNS\_UDP\_IP.pcapng file to solve Part 1, Part\_2\_HTTP\_Trace\_Embedded\_Objects\_Img\_and\_Video.pcapng for Part 2, and the Python Socket API docs to solve Part 3.
3. Archive your answers in a single .zip file named exclusively after your roll number containing the following files, and save it in the /home/cs101/mid\_sem\_cn\_lab\_25/ directory.
  - <your\_roll-number>\_traces.pdf (containing answers to Parts 1 and 2)
  - <your\_roll-number>\_client.py (containing the client program for Part 3)
  - <your\_roll-number>\_server.py (containing the server program for Part 3)
4. At the end of your exam, ensure that the /home/cs101/mid\_sem\_cn\_lab\_25/ folder contains only one zip file, which is your final submission created as per the above instructions.

**Part-1 [24.5 marks]:** Answer the following questions considering the Part\_1\_DNS\_UDP\_IP.pcapng file.

**Scenario:** The Part\_1\_DNS\_UDP\_IP.pcapng file was obtained by running the following commands (in the given order) on a client with IP Address 10.230.3.77.

- `resolvectl flush-caches`
- `nslookup drive.google.com ns3.google.com`
- `traceroute drive.google.com`
- `ping -c 8 gmail.com`
- `nslookup learn.microsoft.com 9.9.9.9`

1. [4 marks] How many DNS requests are launched by the client due to the above commands?
2. [2 marks] What are the different DNS record types requested in the DNS queries in question 1?
3. [4 marks] Fill in the following table.

domain	Record Type	Domain's IP address	The IP address of the DNS resolver used to resolve this domain
ns3.google.com	A		
drive.google.com	AAAA		
gmail.com	A		
learn.microsoft.com	AAAA		

4. [1+2+1 marks] Which transport layer protocol is used to resolve the domain gmail.com? Provide the source and destination port numbers for this DNS request message for A record. Based on the destination port number for this DNS request, what do you think about the nature of communication - is it encrypted or plain text?
5. [1 mark] How many ping requests are present in the trace file?
6. [4 marks] For the two nslookup commands used, provide the size of the UDP payload for the A and AAAA DNS responses.
7. [5.5 marks] State the path from the client to the drive.google.com by listing the ordered list of transit nodes.

**Part-2 [23.5 marks]:** Answer the following questions considering the Part\_2\_HTTP\_Trace\_Embedded\_Objects\_Img\_and\_Video.pcapng file.

**Scenario:** The Part\_2\_HTTP\_Trace\_Embedded\_Objects\_Img\_and\_Video.pcapng file was captured while fetching an HTML webpage containing embedded objects (an image and a video file).

8. [1 mark] How many HTTP GET requests are present in the trace?
9. [2 marks] What are the different status codes for the above GET requests, and what do these status code values signify?
10. [2 marks] What is the file size of 'video.mp4'? Where is this value present in the trace?
11. [4 marks] How many packets are present in the TCP stream of the 'image.jpg' file? Mention the Seq and Ack numbers for the three-way TCP handshake.
12. [1 mark] Which transport layer protocol establishes the connection between the client and the requested domain?
13. [1 mark] What version of IP is used for this HTTP request?
14. [1 mark] State the value of TTL value in the HTTP packets with status code 200.
15. [1 mark] What components contribute to the value of the Total Length field of the IPv4 header?
16. [1 mark] What is the maximum possible size of the IP payload in an IPv4 packet?
17. [5.5 marks] What are the fields in the IPv4 header, and what are their corresponding

sizes?

18. [1+3 marks] What is the value of the Length field in the IP header of an HTTP GET packet for the image file? Additionally, break down this length value into the individual contributions of the upper-layer protocols up to the application layer.

<b>Part-3 [20 marks]:</b> <i>Socket Programming</i>
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Develop a socket programming application that facilitates a number-guessing game between a client and the server.

1. Server Program

- [3 marks] Create a server socket that can accept a client connection and handle communication.
- [2 marks] Upon connection, receive a number from the client and ensure it is valid (i.e. greater than 1).
- [2 marks] Generate a random number between 1 and the client's number (exclusive). Compute the modulus operation:  
$$mod\_result = client\_number \% server\_generated\_number$$
- [2 marks] Send the *mod\_result* to the client and prompt them to guess the server-generated number.
- [2 marks] Receive the guessed number from the client and compare it with the server-generated number:
  - If the guess is correct, send a message: "Client correctly guessed the mod number", Otherwise, send "Client incorrectly guessed the mod number".
- [1 mark] After responding to the client, close the connection and keep the server running to accept new clients.

2. Client Program

- [3 marks] Establish a connection with the server.
- [1 mark] Prompt the user to enter a number and send it to the server.
- [1 mark] Receive and display the *mod\_result* from the server.
- [1 mark] Prompt the user to guess the server-generated number based on the modulus result and send the guess to the server.
- [1 mark] Receive and print the server's response, indicating whether the guess was correct or incorrect.
- [1 mark] Close the connection after the response is received.

*Sample Input and Output*

At Server

Waiting for a client connection...

Connected to ('127.0.0.1', 50000)

Client number: 10, Mod number: 7, Server Mod Result: 3

Client correctly guessed the mod number!

At Client

Enter a number greater than 1: 10

From Server - Mod result: 3

Guess the mod divisor used by the server: 7

From Server - Client correctly guessed the mod number!