Computer Networks
Fall 2025
Assignment#2 (5A & 5C)

Due Date: Thursday, 18th September, 2025
Submission Mode & Time: Handwritten solutions to be submitted during the

lecture.

Please note the following:

1. No exceptions to the above date and time will be allowed. Inability to submit the assignment by the required time will result in zero marks.

2. To ensure self-completion of assignments and discourage plagiarism, the instructor or the relevant TA may randomly contact you and ask for an explanation of your answers. Where plagiarism and/or cheating is evident, you will be referred to the departmental disciplinary committee. In extreme cases of plagiarism an F may be awarded immediately with further referral to the university disciplinary committee.

3. All solutions must be **hand-written.**

4. **Assignment Solution Submission**: In case of **in person / physical lectures at the campus**, hard copy of the hand-written assignment's solutions will be submitted by **hand** by each student to the Instructor / TA directly during the lecture on the due date.

PART-1

Use the following text for completion of this part of the assignment:
Computer Networking - A Top-Down Approach 8th Edition by Kurose & Ross.

Solve the following problems from the back of **Chapter 2**. Every Question has equal marks i.e.

Review Questions: (3*4 = 12 marks) **[CLO 2]**

R4, R6, R13, R19

Problems: (3*4 = 12 marks) **[CLO 2]**

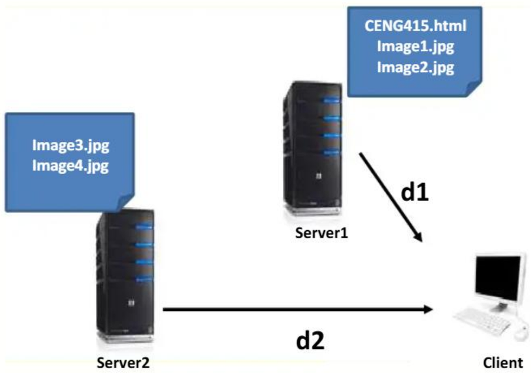
P1, P7, P8, P13

PART - 2

Question: 01 [2*4 = 8 Marks] [CLO 2]

An HTTP file ceng415.html with size L is located at server1, this file references 4 images: Image1.jpg (size L1), Image2.jpg (size L2), Image3.jpg (size L3) and Image4.jpg (size L4). The first 2 images are stored in server1, but Image3 and Image4 are stored in another server: server2. Server1 is located at a distance d1, while server2 is at distance d2 far away from the client. Assume that we have a constant bit rate R, and a line speed S over all the links. In terms of L, L1, L2, L3, L4, d1, d2, R and S, answer the following questions:

(1) Find the Round Trip Times RTT1 between the client and server1 and RTT2 between the client and server2.
(2) If we are using a Non-Persistent HTTP Protocol, Compute the total time that it would take the browser on the client to retrieve the entire document.
(3) Re-calculate the total time to retrieve the entire document, if the client browser is now using persistent http protocol without Pipelining.
(4) Re-calculate the time taken to retrieve the entire document, if Persistent HTTP with Pipelining is used (assume same distance and image length).



Question: 02 [4 * 2 = 8 Marks] [CLO 2]

In your web browser you enter a URL to obtain a Web page. The IP address for the associated URL is not cached, so a DNS lookup is necessary to obtain the IP address. Suppose that **4 DNS servers** are visited before your host receives the IP address from DNS. The 1st DNS server visited is the local DNS, with an RTT delay of **RTT_0 = 5 msecs**. The **2nd, 3rd & 4th DNS servers** contacted have **RTTs of 33, 35 & 4 msecs** respectively. Initially, let's suppose that the Web page associated with the link contains exactly one base object consisting of some HTML text. Suppose the RTT between the local client and the **HTTP Web server is RTTHTTP = 77 msecs**.

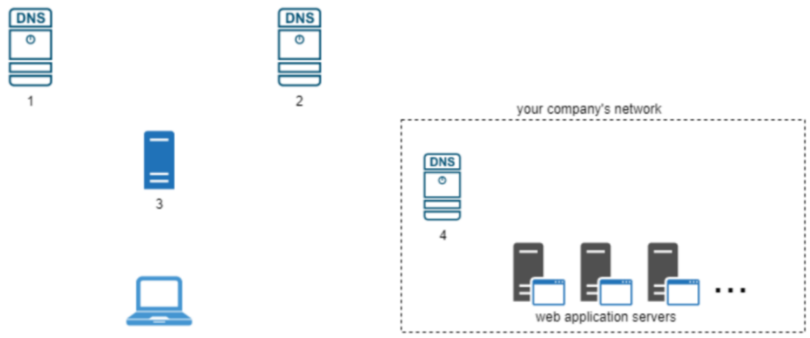
(1) Assuming zero transmission time for the HTML object (base file), how much time (in msec) elapses from when the client clicks on the link until the client receives the object? (Assume processing and queuing delays are also zero).
(2) Now suppose the HTML object (base file) references **10 very small objects** on the same server. Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all **10 additional referenced objects** are received from web server to the client, assuming **non-persistent HTTP and no parallel TCP connections and no pipelining?** (Assume processing and queuing delays are also zero).

(3) Suppose the HTML base object references **10 very small reference objects** on the same server but assume that the client is configured to support a **maximum of 5 parallel TCP connections with non-persistent HTTP (non pipelining).** Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all **10 additional referenced objects** are received from the web server to the client? (Assume processing and queuing delays are also zero).

(4) Suppose the HTML base object references 10 very small reference objects on the same server but assume that the client is configured to support a **maximum of 5 parallel TCP connections with persistent HTTP (no pipelining).** Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all **10 additional referenced objects** are received from the web server to the client? (Assume processing and queuing delays are also zero).

Question: 03 [2 + 4 = 6 Marks] [CLO 2]

Suppose you would like to create a startup and register its domain name called **www.TheBestCompany.com**. In order to register a domain name, you will have to go to the DNS registrar to enter Resource Records (RR) in the DNS distributed database. You are required to write the two RRs needed to make this whole system work (in a table form)? Moreover, in the below diagram, draw arrows (in order of how request will move — there will be 8 arrows) and label each arrow with a sequence number (1 to 8):



Question: 04 [1*2 = 4 Marks] [CLO 2]

Consider Figure 2.12, for which there is an institutional network connected to the Internet. Suppose that the average object size is 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 16 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use $\Delta/(1 - \Delta\beta)$, where Δ is the average time required to send an object over the access link and β is the arrival rate of objects to the access link.

(a) Find the total average response time.

(b) Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.

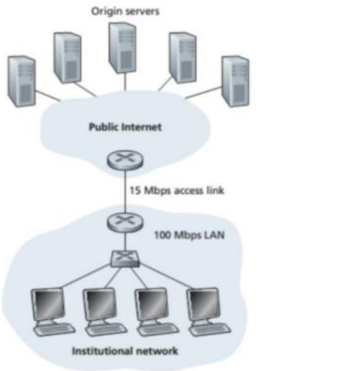


Figure 2.12 • Bottleneck between an institutional network and the Internet

Question: 05 [4 Marks] [CLO 2]

Consider an HTTP server and client as shown in the figure below. Suppose that the RTT delay between the client and server is 30 msecs; the time a server needs to transmit an object into its outgoing link is 1 msecs; and any other HTTP message not containing an object has a negligible (zero) transmission time. Suppose the client again makes 100 requests, one after the other, waiting for a reply to a request before sending the next request. Assume the client is using HTTP 1.1 and the IF-MODIFIED-SINCE header line. Assume 60% of the objects requested have NOT changed since the client downloaded them (before these 100 downloads are performed). How much time elapses (in milliseconds) between the client transmitting the first request, and the completion of the last request?