Homework 5: Application Layer

Started: Mar 4 at 9:13am

Quiz Instructions

This is the end of chapter 2 homework assignment. Please read through all the problems before attempting to answer them. Some problems require extra work beyond just a simple answer. If you are not sure how to proceed, follow the reference link at the end of the question to study the relevant section.

You have three attempts for this assignment. Please do not exhaust all attempts right away. If you are absolutely sure about your first answer, it is quite possible that it is my mistake - please contact me as soon as possible. Thanks.

TA responsible for grading Question 10: Suchinthaka

Please direct your questions about grading to the TA responsible.

Question 1 10 pts

Answer True or False to the following statements:

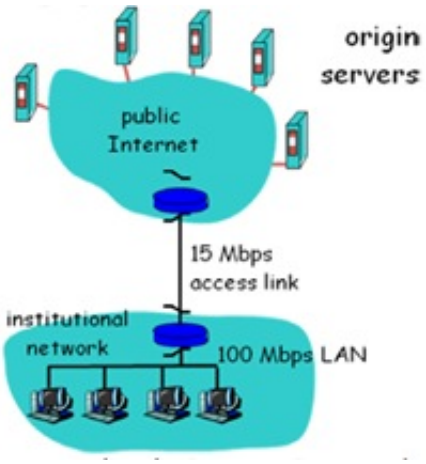
- To get a Web page with some text and three images, a browser needs to send 1 request message and receives 4 response messages: FALSE
- Two pages (e.g. www.uky.edu/research.html and www.uky.edu/index.html) can be sent over the same persistent connection: TRUE
- With non-persistent connections, it is possible for a single TCP segment to carry two distinct HTTP request messages: FALSE
- HTTP response messages never have an empty message body: FALSE
- One reason for having a proxy server is to provide caching: TRUE

Reference: **HTTP, Mail, and DNS**

(https://canvas.ucdavis.edu/courses/870402/pages/g1fff41362c47c7cb1bca7a3f696196cc)

Question 2 13 pts

Consider the following figure



There is an institutional network connected to the Internet. Suppose that the average object size is 900,000 bits and that the average request rate from the institution's browsers to the origin servers is 15 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 two 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 D/(1-Db), where D is the average time required to send an object over the access link and b is the arrival rate of objects to the access link. Now suppose a cache is installed in the institutional LAN. Suppose the hit rate is 0.4. Find the total response time.

Reference: HTTP, DNS, and Email
(https://canvas.ucdavis.edu/courses/870402/pages/g1fff41362c47c7cb1bca7a3f696196cc?wrap=1)

- (•) 2.1 seconds
- ( ) 2.6 seconds
- ( ) 1.3 seconds
- ( ) 0.1 seconds

Question 3 10 pts

Consider sending over HTTP/2 a Web page that consists of one video clip, and five images. Suppose that the video clip is transported as 2000 frames, and each image has three frames. If all the video frames are sent first without interleaving, how many frame times are needed until all five images are sent? What about with interleaving?

Reference: **HTTP, Mail, and DNS (https://canvas.ucdavis.edu/courses/870402/pages/g1fff41362c47c7cb1bca7a3f696196cc)**

- (•) 2015, 18
- ( ) 2015, 415
- ( ) 2015, 50
- ( ) 2015, 15

Question 4 10 pts

Consider the following resource records which are answers to a series of DNS iterated queries your local DNS server posts when trying to get to the website www.networkutopia.com. In what order (from earlier to latest) do theses RR arrive?

R1: (www.networkutopia.com, 212.212.212.16, A)

R2: (networkutopia.com, dns1.networkutopia.com, NS)

R3: (dns1.networkutopia.com, 212.212.212.1, A)

Reference: **HTTP, Mail, and DNS (https://canvas.ucdavis.edu/courses/870402/pages/g1fff41362c47c7cb1bca7a3f696196cc)**

- ( ) R1, R2, R3
- ( ) R2, R1, R3
- ( ) R3, R2, R1

R2, R3, R1

Question 5 12 pts

In this problem, we explore the hierarchy of DNS servers. Recall that a DNS server in the DNS hierarchy delegates a DNS query to a DNS server lower in the hierarchy, by sending back to the DNS client the name of that lower-lever DNS server. While this is usually done automatically, you can use commands like "dig" in Linux/MacOS or "nslookup" in windows to manually trace out the names of all DNS servers in the delegation chain.

For this question, try to identify one possible chain in querying the IP address of gaia.cs.umass.edu by first starting the query with the root DNS server at a.root-servers.net.

1. a.root-servers.net (root DNS server)

2. g.edu-servers.net (should be a TLD DNS server)

3. ns1.umass.edu (should be Umass' Authoritative DNS server)

4. IP address of gaia.cs.umass.edu is 128.119.245.12

To answer this question, you need to study how to use dig or nslookup. Check out this page (https://www.a2hosting.com/kb/getting-started-guide/internet-and-networking/troubleshooting-dns-with-dig-and-nslookup#:~:text=Microsoft%20Windows%20does%20not%20include,Open%20a%20DOS%20command%) or simply Google these commands.

Reference: HTTP, Mail, and DNS (https://canvas.ucdavis.edu/courses/870402/pages/g1fff41362c47c7cb1bca7a3f696196cc)

Question 6 15 pts

Consider the minimum time for P2P file distribution, as discussed in text. Suppose the upload rate of the server is 10 Mbps, the upload rates of all peers is 1 Mbps, and the download rates of all peers is 10 Mbps. Further suppose that there are 100 peers and the file is 100 million bits. The minimum

distribution time is

Reference: P2P, Video streaming, and CDN (https://canvas.ucdavis.edu/courses/870402/pages/gf88f9bf59ee4f87b9e3b0b2db8f8d6a8)

- ○ approximately 1000 seconds
- ○ approximately 1 second
- ◉ approximately 100 seconds
- ○ approximately 10 seconds

Question 7 15 pts

Consider distributing a file of F=15 Gbits to N peers. The server has an upload rate of u_s = 30 Mbps, and each peer has a download rate of d = 2Mbps and an upload rate of u. For N = 10, 100, and 1000 and u = 300Kbps, 700 kbps, and 2 Mbps, complete the following table for each of the combinations of N and u for P2P distribution. Note that in this question, please use 1Kb = 1024b.

P2P

	N=10	N=100	N=1000
u=300Kbps	7680	25904	47559
u=700Kbps	7680	15616	21525
u=2Mbps	7680	7680	7680

Reference: P2P, Video streaming, and CDN (https://canvas.ucdavis.edu/courses/870402/pages/gf88f9bf59ee4f87b9e3b0b2db8f8d6a8)

Question 8 15 pts

This question is for you to record a short video (< 1 minute) that clearly explains your solution to the following homework problem and upload it onto YouTube.

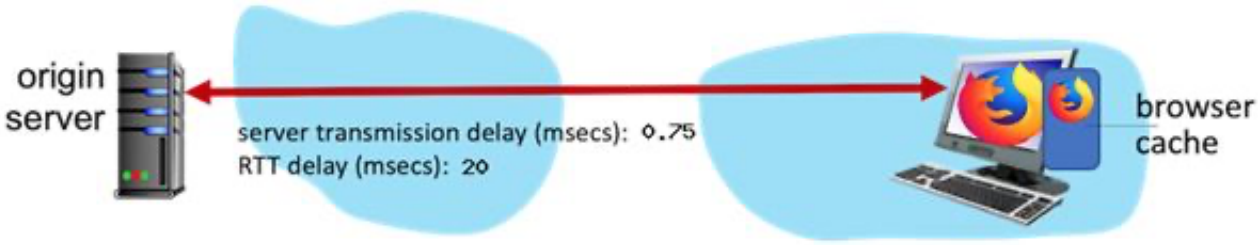
You can go through your work linearly on a piece of paper or go fancy with a PowerPoint presentation. The idea is to clearly lay out the concepts needed to derive your final solution.

There are many ways to record a video of your desktop. The easiest way is to use Microsoft Powerpoint. The instruction can be found here (https://support.microsoft.com/en-us/office/record-your-screen-in-powerpoint-0b4c3f65-534c-4cf1-9c59-402b6e9d79d0) .

Please upload your final solution and your YouTube link in a pdf file here.

This is the problem:

Browser Caching. Consider an HTTP server and client as shown in the figure below. Suppose that the RTT delay between the client and server is 20 msecs; the time a server needs to transmit an object into its outgoing link is 0.75 msecs; and any other HTTP message not containing an object has a negligible (zero) transmission time. Suppose the client makes 40 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 (persistent HTTP) and the IF-MODIFIED-SINCE header line. Assume 60% of the objects requested have NOT changed since the client downloaded them (before these 40 download requests are performed). How much time elapses (in milliseconds) between the client transmitting the first request, and the completion of the last request (ignoring TCP connection setup time)?

Upload q8.pdf

Your file has been successfully uploaded.

Quiz saved at 7:11pm Submit Quiz