CSE489/589: Modern Networking Concepts
Homework 1

Due Date: March 12th (11:59 PM)

NOTES:

- **Academic integrity**: Print the following statement at the very beginning of your homework file: *"I have read and understood the course academic integrity policy in the syllabus of the class. I confirm that the work presented in this report is my own. Where information has been derived from other sources, I confirm that this has been indicated in the report."* Your homework will NOT be graded if you didn't print the sentence.
- For the calculation, you need to write down how the results are derived and your final answer also should be correct to obtain the credits for that question. Please state any assumptions you are making while answering a question.
- Submit the homework through UBLearns as PDF files.

Question 1

A client sequentially downloads files from three servers, denoted as S_1, S_2, and S_3. The download sequence is as follows:

1. From S_1: Five objects, each with a size of 4 Mbit.
2. From S_2: Two objects, each with a size of 10 Mbit.
3. From S_3: Three objects, each with a size of 8 Mbit.

The distances between the client and the servers are as follows:

1. S_1: 1500 km
2. S_2: 600 km
3. S_3: 1200 km

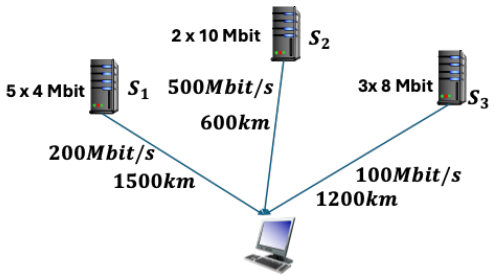

Figure 1: Downloading files using http.

The data rates of the links between the client and the servers are:

1. S_1: 200 Mbit/s
2. S_2: 500 Mbit/s
3. S_3: 100 Mbit/s

Assume that data travels at the speed of light, 3×10^8 m/s. Calculate the time required for the client to download all files from the three servers using both non-persistent HTTP and persistent HTTP. (40 points)

Question 2

Consider a video with the following specifications:

- Frame rate: 30 frames per second (fps)
- Resolution: 2000×1000 pixels, with each pixel represented by 20 bits

- Total duration: 20 seconds, divided into four equal 5-second chunks
- Chunk sizes: 20 Mbit, 30 Mbit, 40 Mbit, and 50 Mbit

Answer the following questions:

1. Calculate the compression ratio for each chunk of the video. (10 points)
2. Discuss whether the compression ratio is uniform across all chunks. If not, elucidate why variations in compression ratio among chunks may occur. If it is uniform, explain why there can still be discrepancies in chunk sizes. (10 points)
3. If the video is continuously downloaded at a rate of 300 Mbit/s, determine the time required to complete the download process. (10 points)

Question 3

One of the advantages of peer-to-peer systems is that there is often no central point of control, making these systems resilient to failures. Explain why the version of BitTorrent we introduced in the lecture is not fully decentralized. (30 points)