New York University
Computer Science Department
Courant Institute of Mathematical Sciences

Course Title: Data Communication & Networks   **Course Number:** CSCI-GA.2662-001
Instructor: Jean-Claude Franchitti   **Session:** 2

Assignment #2

I.   **Due**

Thursday September 23, 2021 at the beginning of class.

II.   **Objectives**

1. Learn application layer concepts.
2. Learn about delay (transmission, propagation, queuing etc.)

III.   **References**

1. Slides and handouts posted on the course Web site
2. Textbook chapters 1 and 2

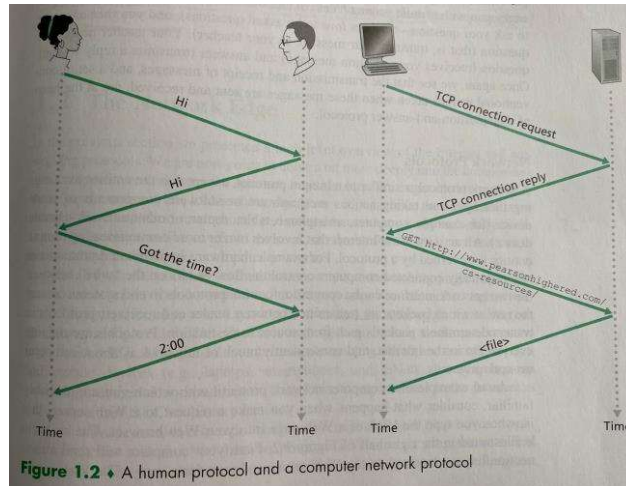IV.   **Software Required**

1. Microsoft Word.
2. Win Zip as necessary.

V.   **Assignment**

1. Problem 1 – Application Level Protocols:

Design and describe an application level protocol for a soda vending machine?

Draw the operation of your protocol similar to Figure 1.2 from course textbook shown below.

Figure 1.2 ♦ A human protocol and a computer network protocol

2. Problem 2 – Networking Terminology:
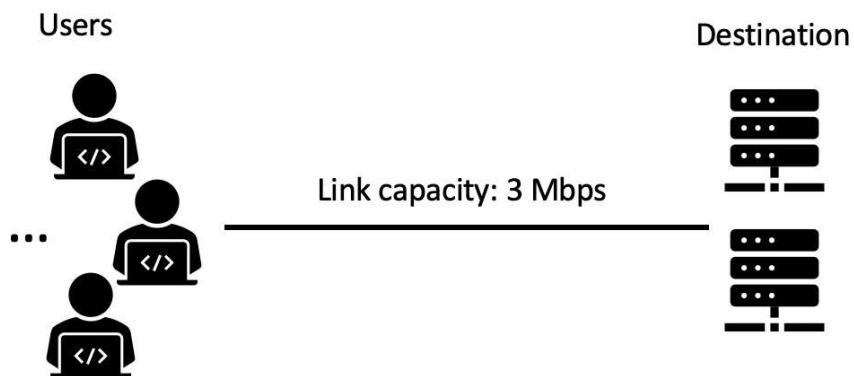
   (a) Explain the following terms briefly:

      i. Network edge
      ii. Network core
      iii. Store and forward packet switching
      iv. Bandwidth
      v. Thoughput

   (b) Explain the advantage of both circuit-switched and packet-switched networks.

3. Problem 3 - Packets Transmission and Delays

   (a) Consider the following scenario. A link with capacity of 3Mbps is shared by multiple users.

      i. How many users can use the link at the same time when circuit switching is used, and each user transmits at 15Kbps?

ii. How many users can use the link at the same time when circuit switching is used, and each user transmits at 1.5Mbps?

iii. If packet switching is used, with 4 users and each user transmits only 10% of the time, what will be the probability that the 4 users are transmitting at the same time?

iv. If packet switching is used, with 4 users and each user transmits only 10% of the time, what will be the probability that the 2 users are transmitting at the same time?

(b) Suppose a packet with size 5M bits will be transmitted over a link of transmission rate 500Kbs, with distance 7,500km, with propagation speed of 2.5 x 10 km/s.

i. What will be the propagation delay?
ii. What will be the transmission delay?

(c) Suppose a router with infinite buffer capacity. Answer the following questions with yes/no:

i. Can packets be dropped?
ii. Would there ever be a delay sending the packets to outgoing links?

(d) Consider a scenario where 10 packets arrive to a router where currently there is no queue. Given each packet has a length of 100Kbits and transmission rate of 10Kbs. What will be the average queuing delay?

4. Problem 4 – Traceroute:

(a) The traceroute program relies on a protocol X to calculate the delay between source and the different routers in the path of destination.

i. What is the name of protocol X?
ii. Which field in the IP header is utilized by traceroute to send packets to particular router in the path?

(b) Use the traceroute program for 3 hostnames. Provide screenshots and answer the following question.

i. Can you identify the Internet Service Provider (ISP) from the hostnames?
ii. Why does the delay for the same router fluctuates (remember traceroute send 3 packets)?

5. Problem 5 – Web Application Architectures

Explain how Web architectures were developed and refined to increasingly support applications with informational, interactive, transactional, and delivery requirements? Please relate to specific architectures, their corresponding protocols, and describe the improvements that were made over time.

6. Problem 6 – Real-Time Messaging Applications

   List at least four mainstream real-time messaging applications. Document the protocols they use (along with references to corresponding IETF RFCs) and explain in detail how they differ. Please provide references and/or links to all documentation sources used to answer this question.

7. Problem 7 – Email Applications

   List at least five mainstream email applications. Document the protocols they use (along with references to corresponding IETF RFCs) to send and receive emails and explain in detail how they differ. Please provide references and/or links to all documentation sources used to answer this question.

8. Problem 8 – Network Management Utilities

   a. Explain what the following utilities are used for: traceroute, ping, nslookup, ipconfig, dig?
   b. Identify at least three more utilities and explain what they are used for.
   c. For each one of the utilities introduced in 8.a. and 8.b., provide a detailed usage scenario along with corresponding screenshots as needed to fully document your example.

9. Problem 9 – Overlay Networks

   a. How is peer churn managed in P2P applications such as file-sharing, conferencing, and content distribution?
   b. Provide specific examples of P2P applications, explain how they specifically handle churn, and estimate the performance improvements achieved in each case. Please provide references and/or links to all documentation sources used to answer this question.

10. Save the file as a Word document.

11. Name the file as follows:

    "**firstname_lastname_hw_#.docx**" (e.g., "john_doe_hw_2.docx").

12. Submit your assignment electronically via NYU Classes by the due date.

Use the following naming convention in the subject line of the eMail:
"DCN - firstname lastname - homework #" (e.g.: "DCN – John Doe - homework 2").

In the case source code is submitted, include your name as a comment at the top of each file (Note: all files submitted should include your name).

VI. **Deliverables**

1. Electronic:

   Your assignment file must be submitted via NYU Brightspace. The file must be created and sent by the beginning of class. After the class period, the homework is late. The email clock is the official clock.

2. Cover page and other formatting requirements:

   The cover page supplied on the next page must be the first page of your assignment file.

   Fill in the blank area for each field.

   NOTE:

   The sequence of the electronic submission is:

   1. **Cover sheet**
   2. **Assignment Answer Sheet(s)**

VII. **Sample Cover Sheet:**

Name _____ Date: _____
　　　(last name, first name)
Section: _____

Assignment 2

Assignment Layout:

o Assignment is neatly assembled on 8 1/2 by 11 layout.
o Cover page with your name (last name first followed by a comma then first name), username and section number with a signed statement of independent effort is included.
o Answers to Questions V.1 to V.9 are correct.
o File name is correct.

Answers to Individual Questions:

(100 points total, all questions weighted equally)

o Assumptions provided when required.

Total in points (100 points total):　　　_____

Professor's Comments:

Affirmation of my Independent Effort:　　_____
　　　　　　　　　　　　　　　　　　　　　　　(Sign here)