CSE2712: Computer Networks
Odd Sem 2021
Assignment 1

Due Friday Sep 17 8:30 pm

Instructions:

1. This is an **open-book** and **open-note** quiz.
2. There are **six** questions in total, each of which has several sub-questions, with a total of 100 points. You have roughly **four days** to answer the questions.
3. Please make sure to write down your name and student id. on your answer sheets.
4. Partial credit is possible for an answer; please include intermediate steps as appropriate. Please try to be as concise and make your exam as neat as possible. We *must* be able to read your handwriting in order to be able to grade your exam.
5. **Please work on the quiz *individually, by yourself only!* No discussion among the students in the class, or with others, is allowed. If you find your answers from the Internet (e.g., via some sites or social groups) or from students who have taken the course before, please cite your sources. You CANNOT simply copy the answers! Any violation of the University's *Student Conduct Code* will be reported to both the department and the University, and you may be suspended or expelled! Please note that if you let another student to copy your answers, you are also in violation of the University's *Student Conduct Code*.**
6. Good luck!

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1. General True/False Questions: (15 points total. Approx. 10 minutes)

Please record your answer to the following **true or false** *questions. Explain in detail and not just mention true or false*

a. (5 points) **True or False:** Circuit switched networks do not suffer from queueing delay.

b. (5 points) **True or False:** Packet switching is used in computer networks because it is cheaper.

c. (5 points) **True or False:** POP3 is an example of "request-n-reply" application layer protocol.

2. DNS (15 points total. Approx. 20 minutes)

a. (5 points) In your own words, briefly describe the key function of the Internet Domain Name System (DNS). (One or two sentences should suffice.)

b. (5 points) When your laptop sends a DNS query to the local DNS server, the local DNS server uses the *recursive* DNS query to resolve and find the corresponding IP address. Provide two main advantages of using the recursive DNS query here. What could be a possible disadvantage?

c. (5 points) Briefly explain why it is a bad idea for a top-level domain name server (e.g., for `.edu`) to use the recursive DNS query mechanism for answering DNS queries.

3. Circuit Switching vs. Packet Switching (10 points; 10 minutes)

Do Problem P3, Chapter 1 (page 70) in the textbook (the 7th edition). In case you do not have the current version of the textbook, the problem is reproduced below for you.

> P3. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:
>
> a. Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?
>
> b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

4. Statistical Multiplexing: Circuit Switching vs. Packet Switching (20 points; 25 minutes)

Suppose that many users share a 10Mbps bottleneck link. Also assume that each user needs 100 Kbps when transmitting, but each user transmits only 10% of time.

Please answer the following questions. (Note: please make sure to illustrate your calculations clearly; you may receive partial credits even if your final answer is incorrect.)

(a) (5 points) When circuit switching is used, how many users can be supported simultaneously.

(b) (5 points) For the remainder of this problem, suppose that packet switching is used instead. Find the probability a given user is transmitting.

(c) (5 points) Suppose there are 200 users. Find the probability that at any given time, exactly 150 users are transmitting simultaneously. (Hint: Think *Binomial* distribution. Note that writing down a formula suffices!)

(d) (5 points) Find the probability that there are 20 or more users transmitting simultaneously.

5. Network delay for circuit switching vs. packet switching (20 points; 25 minutes)

Do Problem P31, Chapter 1 (page 76) in the textbook (the 7th edition). In case you do not have the current version of the textbook, the problem is reproduced below for you.

P31. In modern packet-switched networks, including the Internet, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as *message segmentation*. Figure 1.27 illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is $8 \cdot 10^6$ bits long that is to be sent from source to destination in Figure 1.27. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays.

a. Consider sending the message from source to destination *without* message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from source host to destination host?

b. Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch?

c. How long does it take to move the file from source host to destination host when message segmentation is used? Compare this result with your answer in part (a) and comment.

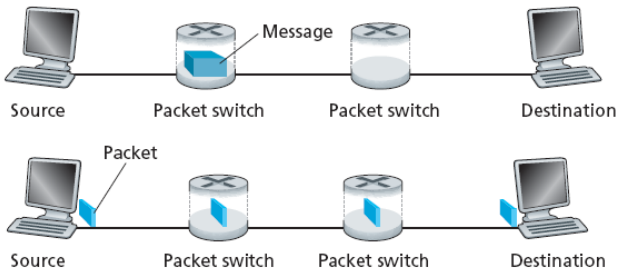

Figure 1.27 ♦ End-to-end message transport: (a) without message segmentation; (b) with message segmentation

d. In addition to reducing delay, what are reasons to use message segmentation?

e. Discuss the drawbacks of message segmentation.

6. Name Resolution, DNS and HTTP (20 points; 20 minutes)

1. (10 points) Do Problem P7, Chapter 2 (page 175) in the textbook (the 7th edition). In case you do not have the current version of the textbook, the problem is reproduced below for you.

> P7. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of $RTT_1, \ldots, RTT_n$. Further suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object?

2. (10 points) Do Problem P8, Chapter 2 (page 175) in the textbook (the 7th edition). In case you do not have the current version of the textbook, the problem is reproduced below for you.

> P8. Referring to Problem P7, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with
>
> a. Non-persistent HTTP with no parallel TCP connections?
>
> b. Non-persistent HTTP with the browser configured for 5 parallel connections?
>
> c. Persistent HTTP?