# CS3640 Written Assignment-1

Due: Feb 16, 2021 midnight
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**Part-A** (based on the paper, *End-To-End Arguments in System Design* [Saltzer 1984])

A1. Summarize the end-to-end argument in your own words (copying the definition verbatim from the paper earns no points). **5 points**

Primary focus here is to test the ability to paraphrase a key concept without copying the words. It is ok to be a bit less accurate, or a bit more verbose. If we see a strong overlap with the definition used in the paper (or Wikipedia), no points would be awarded.

A2. Give a real world example where the end-to-end principle works well (other than the design of the core Internet), and a counter example where it caused a problem. **20 points**

Examples from section-5 of the paper should be fine. Or any other real-world examples.

A3. In the description of *careful file transfer* (section 2.1 of the paper), the authors list five threats to the transaction. Then, they go on to explain why a communication system that provides a reliable data transmission is neither necessary nor sufficient. Imagine that you are allowed to play god, and completely eliminate one or more of these five threats. Which of these threats need to be eliminated in order to make reliable communication network a good design choice? Explain your answer. **20 points**

All four except the communication systems one (i.e., #4). Student's explanation should convince us that they understand why it has to be "all four".

## Part-B

B1. We learnt the packet transmission delay between a pair of networking elements is L/R, where L is the length of the packet in bits and R is the transmission rate of the link connecting the two elements. Find the delay in (i) sending the same packet of length L over a network path consisting of N identical links, each with the transmission rate R, (ii) sending P such packets back-to-back over the same N links. **15 points**

(i) N*(L/R)

(ii) (N+P-1)*(L/R). At time N*(L/R) the first packet has reached the destination, the second packet is stored in the last router, the third packet is stored in the next-to-last router, etc. At time N*(L/R) + L/R, the second packet has reached the destination, the third packet is stored in the last router, etc. Continuing with this logic, we see that at time N*(L/R) + (P-1)*(L/R) = (N+P- 1)*(L/R) all packets have reached the destination.

B2. You are responsible for quickly and economically transferring 200 terabytes of data from Iowa City, IA to a cloud provider in Mountain View, CA (~2000 miles). Your network provides an average end-to-end throughput of 100 Mbps. Compare and contrast the following two methods: (i) transmit data over the aforementioned network, or (ii) ship the disks using FedEx overnight delivery. List advantages and disadvantages of both methods. **20 points**

200 terabytes of data = 200 * $10^{12}$ * 8 bits = 16 * $10^{14}$ bits. With an end-to-end throughput of 100 Mbps, the transmission time = 16 * $10^{14}$ bits / 100 * $10^{6}$ bits per sec = 16 * $10^{6}$sec = 185.2 days. Overnight FedEx would get the data across within one day.

Considerations other than time include cost, security, human effort, and error recovery/ correction. If none of these are mentioned, students will not get full points.

B3. Perform a *traceroute* from your home/university to a destination within the continental U.S. at three different times of the day. Report (i) the average round-trip delay, (ii) number of routers in the path, (iii) number of ISPs in the path. Do any of these vary over time? Repeat the above steps for a destination outside of the continental U.S. **20 points**

The goal here is to test student's proficiency in interpreting the *traceroute* output. We will make sure the numbers are not copied from others/Internet, or otherwise artificially concocted.

B4 (bonus question). Skype allows an Internet connected computer to place a call to an ordinary telephone. Describe the networking element needed to make this happen. **10 points**

Skype is a Voice over IP (VoIP) application that is part of the packet-switched Internet, whereas the ordinary telephone is part of the circuit switched telephone network. Two distinct types of networks are connected using what is called a "gateway", a networking device that understands both technologies and thus, allows data to flow from one to the other.

So, when a Skype user calls an ordinary telephone, a circuit is established between the gateway and the telephone user over the circuit switched network. Skype user's voice is sent in packets over the Internet to the gateway. At the gateway, the voice signal is reconstructed and then sent

over the circuit. In the other direction, the voice signal is sent over the circuit switched network to the gateway, which then packetizes the voice signal and sends them to the Skype user.

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*Note on bonus question: points earned in B4 can make up for any points lost in other questions but cannot take your score beyond 100.*