

- **Print** your name.
- Homework submitted in class in a timely fashion. Check <https://cis.temple.edu/~tug29203/teaching/fall2018-3329/index.html> for late policy.

Problem	Points	Score
1	3	
2	7	
Total:	10	

1. **Written questions (essay, computational)** Suppose Host A wants to send a large file to Host B. The path from A to B has three links, of rates $R_1 = 500kbps$, $R_2 = 2Mbps$, and $R_3 = 1Mbps$
- (a) (1 point) Assume no other traffic in the network, what is the throughput for the file transfer?

- (b) (2 points) Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?

2. **Written questions (essay, computational)** Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 20 percent of the time.

(a) (2 points) When circuit switching is used, how many users can be supported?

(b) (2 points) For the remainder of this problem, suppose packet switching is used. To prevent queuing delay, what is the maximum number of users that can transmit at the same time?

(c) (1 point) Find the probability that a given user is transmitting.

(d) (2 points) Suppose now there are three users. Find the probability that at any given time, all three users are transmitting simultaneously. Find the fraction of time during which the queue grows.