# IS 504 – Homework #1

Submission and Grading Policy

- Submit your assignments to the corresponding assignment link in https://odtuclass.metu.edu.tr.
- Solutions should be submitted in a single doc, docx or pdf file named: <metu-username>_HW_1.<extension> (e.g., "e123456_HW_1.pdf").
- Late submissions will be accepted by February 26, 2020, 23:30 with 15% per day penalty.
- **This is an individual assignment. You have to adhere to the academic integrity principles.**

Questions
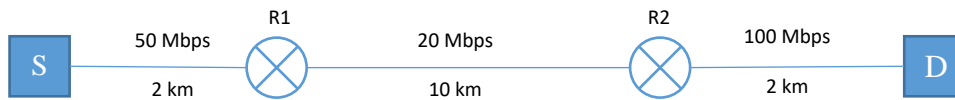
In the network given above,

- Hosts S and D are interconnected by routers R1 and R2 by the links with the rates and lengths indicated in the figure,
- Signal propagation speed in the links is $2*10^8$ m/sec,
- Routers operate in the store-and-forward mode,
- Links are reliable (i.e., there is no packet loss and bit error in the links/routers), and
- Processing delays in routers/hosts are very short and they can be ignored.
- Each data packet sent by S consists of a 200-bit (25 bytes) header and, at most, 800-bit (100 bytes) data field. Hence, the maximum packet size is 125 bytes in the links.
- Suppose, adapters in the hosts/routers (i.e., transmitters and receivers) have their own memory blocks to store packets being transmitted/received. That is, the packets that are being transmitted/received do not consume buffer space in the routers/hosts.

1. (20 pts) Suppose host S is going to transfer a single 1000-bit packet to host D, the transmission starts at time t=0, and there is no other traffic in the network. When does host D completely receive the packet? (find the earliest possible time)
2. Host S is going to transfer a 1Mbyte ($8*10^6$ bits) file to host D by dividing the file into several packets. Suppose the transmission starts at time t=0, routers have infinite buffer space and there is no other traffic in the network.
   a. (20 pts) When does host D completely receive these packets? (find the earliest possible time)
   b. (10 pts) Calculate **the long term average throughput** during the file transfer.
   c. (20 pts) Calculate **the maximum** queuing delay experienced by the packets in R1 and R2.
3. Host S is going to transfer a 1Mbyte ($8*10^6$ bits) file to host D by dividing the file into several packets. Suppose the transmission starts at time t=0, each router has a 100-kbyte (800000 bits) buffer to store packets to be forwarded, and there is no other traffic in the network.
   a. (15 pts) When does the first packet loss occur? (find the earliest possible time)
   b. (15 pts) How many packets will be lost in the routers and how many packets will be delivered to D during this transfer?