ECE/CSC 570 – Section 3, Computer Networks, Homework #1
(Total 91 points + up to 30 extra points, Due on Sept. 11, 2019)

You are strongly recommended to read Chapter 1 of our references (Tanenbaum and/or Kurose & Ross, either of them is ok) and revisit lecture notes and the Class Exercises. Then, solve the following problems. Some of them are taken from these references but retyped here for your convenience (just in case you don't have the books).

Throughout the course, we assume $1k = 10^3$, $1M = 10^6$, so on. DO NOT assume $1k = 2^{10}$, etc.

Submission Instruction:

- On-campus students: submit your hard copy in class by the beginning of the class. No need to type your solution. *No online submission allowed.*
- EOL (DE) students: visit wolfware Moodle course website, and look for "HW1 online submission link for DE/EOL students". The HW for EOL students will be due by around midnight on the day it's due (11:45PM EST, Sept. 11th for HW#1 for instance). Note that it's Eastern Time (so if you are in CA you must submit HW by 8:45PM on the day it's due), and we have set it up in a way that after this time you won't be able to submit your HW. Typically, scanned pdf file or any other electronic file should be ok. Make sure it's clearly legible; pictures or multiple files are not acceptable. If you (EOL students) have any trouble in submitting HW, please let the TA know.

1. (a) the transport layer
(b) Network
(c) link. (PPT).

Problems:

1. **(6 points)** Which of the OSI layers or sub-layers (if appropriate) handle each of the following:
   (a) Providing reliable, connection-oriented path between source and destination. ~~network~~.
   (b) Determining alternate route for packets when the original route gets congested (e.g., routers on that path are dead).
   (c) Determining which user 'owns' the wireless channel to the access point in 802.11b.

2. **(10 points)**: A factor in the delay of a store-and-forward packet-switching system is how long it takes to store and forward a packet through a switch/router. If switching time is 50μsec, is this likely to be a major factor in the response of a client-server system where the client is at NCSU and the server is in San Francisco (SF), CA?

   Assume the propagation speed in copper and fiber to be 2/3 the speed of light in vacuum, i.e., $v = \frac{2}{3} \cdot c = 2 \times 10^8$ m/s, and the distance between NCSU and SF along the route is about 5000km. Assume that there are about 15 routers/switches (the store-and-forward devices) along the route between NCSU and SF.

2. $d_{trans} = \frac{5\times10^6 m}{2\times10^8 m/s} = 25$
$d_{prop} = 15\times50us = 0.75ms$
$d = 50us + 15\times50us + 25ms = 25.8m$

3. **(10 points)** Compare the delay in sending an x-bit message over a k-hop path in a circuit-switched network and in a lightly loaded (no queueing delay) packet-switched network. Ignore

x bits long p bits
$\frac{x}{p} = n$ # of pkgs
1 $d_{trans} = \frac{P}{b}$
(i) Circuit: $T_1 = s + \frac{P}{b}\times n + k\cdot d = s + \frac{px}{b} + k\cdot d$