

You have 50 minutes to complete this exam. Time begins promptly at 1:00 PM and ends promptly 50 minutes later. You may not read the exam questions before 1:00 PM, but you may read these instructions.

Please record your answers in a Word file, in a text file, or on a piece of paper (which could be this printed exam or any other paper). You can answer some questions one way (e.g., as Word) and others the other way (e.g., by writing on paper). At the top of every piece of paper or every file in which you write an answer, write your name and the date. If you answer any questions using Word or a text file, submit that file on ELMS and **also** email it to **both** oard@umd.edu and mwalker1380@gmail.com. If you answer any questions on paper, turn in that paper. Make sure your name is on everything that you turn in! And if you use both paper and a file, make a note on each about what can be found in the other so that we don't miss any of your answers.

You may use any information and software that existed before the start of this exam. This means (among other things) that you may search the Web. You may NOT communicate with any person other than the instructor for any purpose during the exam period, either in person or in any other way, and you may not post anything to any location for any purpose during the exam period. Note that this means you may not have skype, email or any instant messaging application active on any device that you use during the exam, and that that even if you leave the exam room early you may not talk with anyone about anything, you may not send or receive any email, etc. until the exam period ends at 1:50 PM. In addition, you may not discuss anything about this exam with any student in the class who has not taken the exam, even after the exam period ends.

Hand write and sign (or, if you type your answers, hand type it – no cut and paste – followed by your name) the honor pledge on this exam. (For reference, the honor pledge as stated at <http://shc.umd.edu/SHC/HonorPledgeUse.aspx>, is: “I pledge on my honor that I have not given or received any unauthorized assistance on this exam.”)

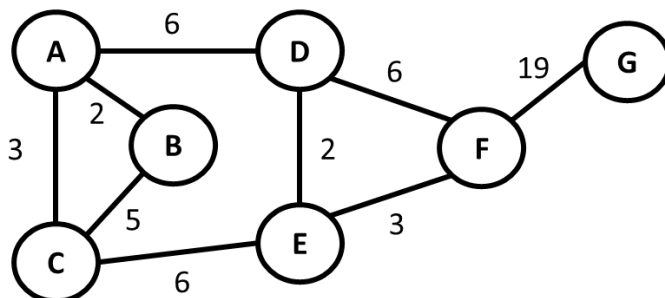
As strategies for completing the exam, keep the following in mind:

- If you find a question to be ambiguous or unclear, you can come to the front and quietly ask a question. If the answer does not resolve your question, please explain your confusion and any reasonable assumptions that you have made in order to answer the question, and include that explanation and those assumptions with your answer so that they can be considered during grading.
- You are more likely to get partial credit for an incorrect answer if you show your work.
- **Be careful not to spend too much time on any one question.** The total available credit on this exam is 20 points. Plan ahead, and don't devote more time to a question than it is worth.

*** WRITE YOUR NAME! ***

Answer **any five** of the following seven questions (if you answer more than five, we will grade only the lowest numbered five that you answer):

1. [4 points] Explain how WiFi local area networks deal with the problem that two different computers might try to send data at the same time. A complete answer should explain both how WiFi tries to keep that from happening and what will be done to recover from the problem if it does happen.
2. [4 points] The Transmission Control Protocol (TCP) in the transport layer guarantees that all bits (i.e., all the ones and zeros) sent by an application using TCP will be delivered to the corresponding application at the receiving computer in the same order in which they were sent. TCP uses the network layer's Internet Protocol (IP) to accomplish this, but the network layer does not guarantee that packets will be delivered in order, and indeed it doesn't guarantee they will be received at all! Explain how TCP handles out of order arrival of packets in a way that ensures that the bits will actually be received by the application layer in the right order.
3. [4 points] Routers typically have many inputs (i.e., many different links on which packets may arrive) and many outputs (i.e., many different links on which packets might be sent). If packets that are destined for a specific output link arrive faster than they can be sent, they will be buffered until it is their turn to be sent. If this continues for too long, the buffer will become full and some packet(s) will simply be dropped. Explain how the Transmission Control Protocol (TCP) in the transport layer detects and recovers from this problem so that delivery can be guaranteed.
4. [4 points] Create an optimal shortest path routing table for node F in the network shown below. The numbers adjacent to each link in the diagram indicate the total average amount of time that it would take to send a packet along that link (considering all possible causes for delays). Each row in your routing table should show (a) the destination node, (b) the first (i.e., "next") node to which a packet should be sent in order to ultimately reach that destination node using the optimal shortest path, and (3) the total estimated delay to reach the destination node using the optimal shortest path.



5. [4 points] United States law does not make Internet providers (such as Internet Service Providers (ISP's) or the companies that lay the cables and run the satellite links) responsible in any way for the nature of the content that their networks carry. In China, by contrast, Internet providers are required to block specific types of content, or content that originates from some specific sources. Provide at least one good rationale for the policy that the United States has adopted. Then provide at least one good rationale for the policy that China has adopted. To receive credit, the rationale you describe must be based on a policy goal, not a philosophy (i.e., you can't just say that you think the US is more "open" than China, but -- if it were true -- you might say that one rationale for the US policy is that it helps to reduce childhood poverty -- note that that's not true, but it is an example of a policy goal).
6. [4 points] The Secure Sockets Layer (SSL) is an application-layer protocol that uses encryption to prevent unauthorized parties from eavesdropping on a TCP connection. During the SSL setup process the two communicating systems negotiate choices for both a public key encryption algorithm and a symmetric key encryption algorithm. Explain how SSL uses the public key encryption algorithm (i.e., what does SSL use the public key encryption algorithm for?)
7. [4 points] Consider the case of a streaming video application such as YouTube in which a server sends video to a client, and in which the client begins playing that video before the entire file has been received. Use realistic examples for video file size and transmission rate to explain how a suitable buffer size (expressed in Megabytes) should be chosen. No credit will be given for answers that describe an approach to computing these values in general terms; a specific numeric value for the buffer size, expressed in Megabytes, must be given, and that buffer size must be consistent with your specific and reasonable examples of video file size and transmission rate.

***** WRITE AND SIGN THE HONOR PLEDGE *****