Due Oct 5th before 10 am on Gradescope

Problem 1. [3 points]

Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

(a) Provide a forwarding table that has five entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

(b) Describe how your forwarding table determines the appropriate link interface for datagrams with destination addresses:
1) 11001000 10010001 01010001 01010101
2) 11100001 01000000 11000011 00111100
3) 11100001 10000000 00010001 01110111

Problem 2. [4 points]

Consider the arrival of 12 packets to an output link at a router in the interval of time [0, 5], as indicated by the figure below. We’ll consider time to be “slotted”, with a slot beginning at t = 0, 1, 2, 3, etc. Packets can arrive at any time during a slot, and multiple packets can arrive during a slot. At the beginning of each time slot, the packet scheduler will choose one packet, among those queued (if any), for transmission according to the packet scheduling discipline (that you will select below). Each packet requires exactly one slot time to transmit, and so a packet selected for transmission at time t, will complete its transmission at t+1, at which time another packet will be selected for transmission, among those queued.

For each of the scheduling algorithms below, indicate the departure time of each of these 12 packets. There are three classes of traffic (1, 2, 3), with lower class numbers having higher priority.

(a) Priority scheduling

(b) WFQ with queue quotas of 4, 2, and 1 for the priority classes 1, 2, and 3 respectively.
Problem 3. [2 points]

Consider a general topology (that is, not the specific network shown above) and a synchronous version of the distance-vector algorithm. Suppose that at each iteration, a node exchanges its distance vectors with its neighbors and receives their distance vectors. Assuming that the algorithm begins with each node knowing only the costs to its immediate neighbors, what is the maximum number of iterations required before the distributed algorithm converges? Justify your answer.

Problem 4. [2 points] Consider the count-to-infinity problem in the distance vector routing. Will the count-to-infinity problem occur if we decrease the cost of a link? Why? How about if we connect two nodes which do not have a link?

Problem 5. [3 points] Consider the network fragment shown below. x has only two attached neighbors, w and y. w has a minimum-cost path to destination u (not shown) of 5, and y has a minimum-cost path to u of 6. The complete paths from w and y to u (and between w and y) are not shown. All link costs in the network have strictly positive integer values.

(a) Give x’s distance vector for destinations w, y, and u. (b) Give a link-cost change for either $c(x,w)$ or $c(x,y)$ such that x will inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm. (c) Give a link-cost change for either $c(x,w)$ or $c(x,y)$ such that x will not inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm.

Problem 6. [2 points] Show (give an example other than the one in Figure 5.5) that two-dimensional parity checks can correct and detect a single bit error. Show (give an example of) a double-bit error that can be detected but not corrected.

Problem 7. [2 points] Consider a broadcast channel with N nodes and a transmission rate of R bps. Suppose the broadcast channel uses polling (with an additional polling node) for multiple access. Suppose the amount of time from when a node completes transmission until the subsequent node is permitted to transmit (that is, the polling delay) is $d_{poll}$. Suppose that within a polling round, a given node is allowed to transmit at most Q bits. What is the maximum throughput of the broadcast channel?