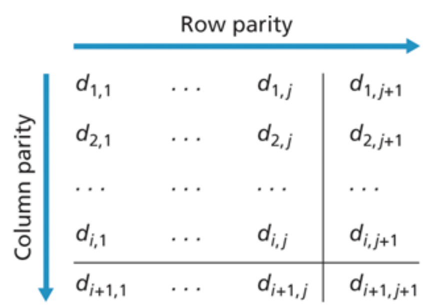
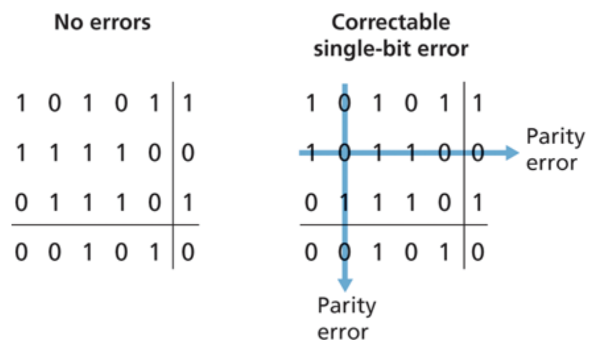
P2. Show (give an example other than the one in **Figure 6.5**) that two-dimensional parity checks can correct and detect a single bit error. Show (give an example of) a double-bit error that can be detected but not corrected.





P5. Consider the 5-bit generator, G=10011, and suppose that D has the value 1010101010. What is the value of R?

P8. In **Section 6.3**, we provided an outline of the derivation of the efficiency of slotted ALOHA. In this problem we'll complete the derivation.

a. Recall that when there are N active nodes, the efficiency of slotted ALOHA is $Np(1-p)^{N-1}$. Find the value of p that maximizes this expression.
b. Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N approach infinity. *Hint*: $(1-1/N)^N$ approaches $1/e$ as N approaches infinity.

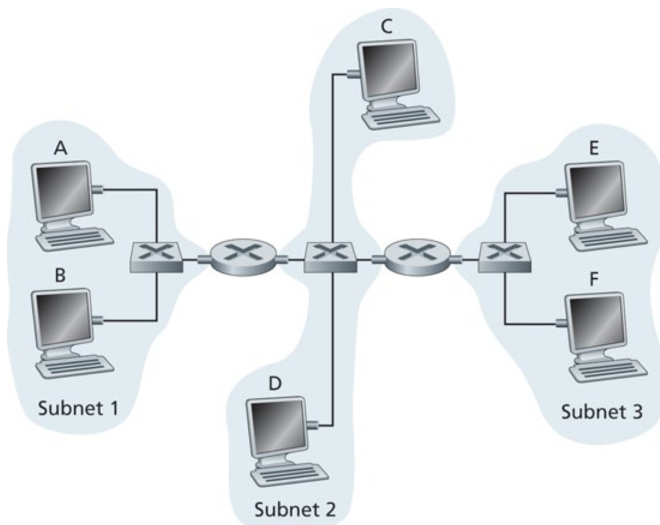
P11. Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

a. What is the probability that node A succeeds for the first time in slot 4?
b. What is the probability that some node (either A, B, C or D) succeeds in slot 5?
c. What is the probability that the first success occurs in slot 4?
d. What is the efficiency of this four-node system?

P13. 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?

P14. Consider three LANs interconnected by two routers, as shown in **Figure 6.33**.

a. Assign IP addresses to all of the interfaces. For Subnet 1 use addresses of the form 192.168.1.xxx; for Subnet 2 uses addresses of the form 192.168.2.xxx; and for Subnet 3 use addresses of the form 192.168.3.xxx.
b. Assign MAC addresses to all of the adapters.
c. Consider sending an IP datagram from Host E to Host B. Suppose all of the ARP tables are up to date. Enumerate all the steps, as done for the single-router example in **Section 6.4.1**.
d. Repeat (c), now assuming that the ARP table in the sending host is empty (and the other tables are up to date).



P17. Recall that with the CSMA/CD protocol, the adapter waits K · 512 bit times after a collision, where *K* is drawn randomly. For K=100, how long does the adapter wait until returning to Step 2 for a 100 Mbps broadcast channel? For a 1 Gbps broadcast channel?

P18. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 325 bit times. Suppose CSMA/CD and Ethernet packets are used for this broadcast channel. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was successfully transmitted without a collision. *Hint*: Suppose at time t=0 bits, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of 512+64 bit times. So A would finish transmitting the frame at t=512+64 bit times. Thus, the answer is no, if B's signal reaches A before bit time t=512+64 bits. In the worst case, when does B's signal reach A?

P21. Consider **Figure 6.33** in **problem P14**. Provide MAC addresses and IP addresses for the interfaces at Host A, both routers, and Host F. Suppose Host A sends a datagram to Host F. Give the source and destination MAC addresses in the frame encapsulating this IP datagram as the frame is transmitted *(i)* from A to the left router, *(ii)* from the left router to the right router, *(iii)* from the right router to F. Also give the source and destination IP addresses in the IP datagram encapsulated within the frame at each of these points in time.