MPCS 54001, Winter 2021

Homework 6 - Solutions

Due: March 4 at 5:30 pm

Submit your assignment to Gradescope. This work must be entirely your own. If you need help, post questions to Ed Discussion and/or visit the staff during office hours. As a reminder, if you make a public post on Ed Discussion, please don't give away the answer!

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1. Error Detection and Correction

    a. Suppose the information content of a packet is the bit pattern 1101 1010 1111 0111. What are the parity bits for the case of a 4 × 4 two-dimensional even parity scheme? (10 points)

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1 1 0 1 | 1
1 0 1 0 | 0
1 1 1 1 | 0
0 1 1 1 | 1
---------
1 1 1 1 | 0
```

    b. For a cyclic redundancy check, consider the 5-bit generator G = 10011, and suppose that D has the value 1010101010. What is the value of R? What bit sequence is transmitted by the sender? (15 points)

    If we divide 10011 into 10101010100000, we get 1011011100, with a remainder of R = 0100. The transmitted sequence is 10101010100100.

2. Assume that it's after the fifth collision with CSMA/CD.

    a. What is the probability that a node chooses K = 4? (10 points)

    After the 5^{th} collision, the adapter chooses from {0, 1, 2, … , 2^5 - 1}. Therefore, the probability that it chooses 4 is 1/32.

b. The result K = 4 corresponds to a delay of how many seconds on a 10 Mbps Ethernet? (15 points)

   K · 512 bits = 2048 bits

   2048 bits / 10 Mbps = 204.8 microsecond delay

3. Address resolution protocol (ARP).
   a. Why is an ARP query sent within a broadcast frame? (5 points)

      An ARP query is sent in a broadcast frame because the querying host does not know which adapter address corresponds to the IP address in question.

   b. Why is an ARP response sent within a frame with a specific destination MAC address? (10 points)

      For the response, the sending node knows the adapter address to which the response should be sent, so there is no need to send a broadcast frame (which would have to be processed by all the other nodes on the LAN).

   c. Suppose a router with two different interfaces connected to two different LANs. This router will have two ARP modules (one for each interface). Each ARP module will have its own ARP table. Is it possible that the same MAC address appears in both ARP tables? Why or why not? (10 points)

      No, it is not possible. Each LAN has its own distinct set of adapters attached to it, with each adapter having a unique LAN address.

4. Consider link-layer switches. What are the columns in a switch table? How is each column used? (10 points)

   The three columns (and their uses) are the following:

Column	Usage
MAC address	Lookup index for table containing target MAC addresses
Switch interface	Identifies switch interface leading towards target MAC address (analogous to router interface leading to next hop towards IP prefix)
Entry timestamp	Allows switch to determine the time at which it should remove table entry according to the configured time-to-live (TTL)

5. The IEEE 802.3 standard (Ethernet) uses CRC32 for error detection. Suppose that you have a 1500-byte Ethernet frame. Explain whether or not the following errors can be detected using CRC32.
    a. 20 consecutive bit errors in frame payload. (5 points)

        Since CRC32 detects all burst errors ≤ 32 bits, errors can be detected in this scenario.

    b. 40 consecutive bit errors in frame payload. (5 points)

        Since CRC32 only guarantees detection for all burst errors ≤ 32 bits, errors might not be detected in this scenario.

    c. 63 isolated bit errors in frame payload. (5 points)

        Since CRC32 detects any odd number of isolated bit errors, errors

can be detected in this scenario.