Nathan Tung
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CS118 Homework 4

1. **(Cyclic Redundancy Check) Consider the 7-bit generator, G = 10011, and suppose that D has the value 1010101010. What is the value of R?**
→For this problem and the next, we are taking G to have 5 bits and r = 4. If instead G=0010011 with 7 bits, then r=6 and the answers will slightly vary.

   Since r = 4, we pad D with four 0s, then "divide" this value by G = 10011. The intermediate steps involve XORing the values rather than subtracting. We stop once all |D| = 10 bits are found and the remainder R has length r = |R| = 4.

   1010101010(0000) /10011 = 1011011100 with R=0100

   *For more details, see last attached page showing handwritten work.

2. **Consider the previous problem, but suppose that D has the value:**
→We follow the same method as before with a different D value.

   a. **1001010101**
   →1000110000 with R=0000
   b. **0101101010**
   →0101010101 with R=1111
   c. **1010100000**
   →1011010111 with R=1001

3. **Slotted ALOHA**
   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.**
   →In order to find a maximal p, we need to find the roots of the equation above using the derivative and determine if, at these values of p, the expression is at its maximum. We begin by using the product rule and chain rule.

   $f = Np(1-p)^{N-1}$
   $f = gh$
   $g = Np$
   $g' = N$
   $h = (1-p)^{N-1}$
   $h' = -(N-1)(1-p)^{N-2}$
   $f' = g'h + gh'$
   $f' = N(1-p)^{N-1} + -NP(N-1)(1-p)^{N-2}$
   $f' = N(1-p)^{N-2}[(1-p)-p(N-1)]$
   $f' = N(1-p)^{N-2}(1-Np)$

   Thus the roots are p=1 and p=1/N. However, at p=1, we know that f=0, unlike when p=1/N. Therefore, p=1/N maximizes this expression.

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b. **Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N approach infinity.**
→We simply let p=1/N and evaluate f where N approaches infinity. Let N approach infinity for the equations below.

$f = Np(1-p)^{N-1}$
$f = N(1/N)(1-1/N)^{N-1}$
$f = (1-1/N)^{N-1}$
$f = (1-1/N)^{N}$ Since N approaches infinity, N-1 approaches N.
$f = 1/e$

Therefore, maximum efficiency of slotted ALOHA with infinite N is 1/e, or about 0.368.

4. **Suppose nodes A and B are on the same 10Mbps 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?**
→Assuming that A transmits at time t=0 some frame with size of at least 512+64 bit times. Then in the worst case, B begins transmitting at t=324.

With a propagation delay of 325 times, the first packet of B is received at t=324+325=649 bit times. Since 649 bit times exceeds 576 bit times, then A may be able to finish transmitting before B is transmitted. (On the other hand, if the number of bit times taken to receive the first packet of B is less than 576 bit times, then A detects transmission of B – in this case, A would abort without finishing its own transmission.)

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1.)

```
           1011011100
10011 ) 10101010100000
        10011
          11001
          10011
           10100
           10011
             11110
             10011
              11010
              10011
               10010
               10011
                 0100   R
```

2a.)

```
           1000110000
10011 ) 10010101010000
        10011
           11010
           10011
            10011
            10011
                00000
                00000
                 0000   R
```

2b.)

```
           0101010101
10011 ) 01011010100000
         10011
           10110
           10011
             10110
             10011
               10100
               10011
                 11100
                 10011
                  1111   R
```

2c.)

```
           1011010111
10011 ) 10101000000000
        10011
          11000
          10011
           10110
           10011
             10100
             10011
               11100
               10011
                11110
                10011
                 11010
                 10011
                  1001   R
```