CSC458: Problem Set 1

Due on Sunday, Sep 30, 2018

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Problem 1

Thoughput

a)
The throughput of the link would be the lowest-rate-link's rate, 500kbps.

b)
$4\ million\ bytes = 4 \times 8 = 32\ Mega\ bits$
$500\ kbps = 0.5\ Mbps$
$\frac{32\ Mb}{0.5\ Mbps} = 64s$

c)
The new throughput would be 100kbps
$100\ kbps = 0.1\ Mbps$
The time to tranfer the file would be $\frac{32\ Mb}{0.1\ Mbps} = 320s$

Problem 2

Circuit-switched network

a)
There maximum number of simultaneous connections will be 16, four between every two adjacent switches.

b)
There maximum number of simultaneous connections between A and C will be 8, 4 through switch B, 4 through switch D.

c)
Yes we can.
For A and C: two connections on $A \to B \to C$, two connections on $A \to D \to C$.
For B and D: two connections on $B \to C \to D$, two connections on $B \to A \to D$.

Problem 3

Network Delay

a)
Propagation Dalay = 150 $km \div 100$ $km/hour$ = 1.5 hour = 90 minute
Transmition Delay for one tollbooth = $12s \times 10$ = 120s = 2 minute
Suppose we start before tollbooth 1 and end after tollbooth 3, we need to pass 3 tollbooths. So the total delay would be $2 \times 3 + 90 = 96$ miniutes
if we only need to pass two tollbooths, the total delay would be $2 \times 2 + 90 = 94$ miniutes

b)
Propagation Dalay not changed
Transmition Delay for one tollbooth = $12s \times 8$ = 96s = 1.6 minute
Suppose we start before tollbooth 1 and end after tollbooth 3, we need to pass 3 tollbooths. So the total delay would be $1.6 \times 3 + 90 = 94.8$ miniutes = 94 min 48 s
if we only need to pass two tollbooths, the total delay would be $1.6 \times 2 + 90 = 93.2$ minutes = 93 min 12 s

Problem 4

Voice delay

Time to generate a packet = $\frac{56 \times 8}{64 * 1000}$ = 0.007 sec = 7 msec
Transmission Delay = $\frac{56 \times 8}{2 \times 10^6}$ = 0.000224 sec = 0.224 msec
Total delay = $7 + 0.224 + 10 = 17.224$ msec

Problem 5

Gradient descent with momentum

a)
Transmission delay for router i = L/R_i.
propagation delay for router i = d_i/s_i.
The packet switch delays each packet by d_{proc}
So the total end-to-end delay = $\sum\limits_{i=1}^{3}(L/R_i + d_i/s_i) + 2 \times d_{proc}$

b)
With the values, we got

$$\left(\frac{1500 \times 8}{2 \times 10^6} + \frac{5000 \times 10^3}{2.5 \times 10^8}\right) + \left(\frac{1500 \times 8}{2 \times 10^6} + \frac{4000 \times 10^3}{2.5 \times 10^8}\right) + \left(\frac{1500 \times 8}{2 \times 10^6} + \frac{1000 \times 10^3}{2.5 \times 10^8}\right) + 2 \times 3 \times 10^{-3} = 0.064 sec = 64 msec$$

Problem 6

Data transfer

1TB = 10^6 MB
$\frac{8 \times 40 \times 10^6}{100} = 3.2 \times 10^6$ $sec = 888.89$ $hour$
Since 888.89 hours is about a month, it is way faster to transfer the data using FeDex overnight.

Problem 7

CheckSum

The sum of 4 bit words = $1001 + 1100 + 1010 + 0011 = 100010$
Adding the carryout '10' to LSB: $0010 + 10 = 0100$, we got the 1's complement sum
Its 1's complement is 1011, which is the checksum.

Problem 8

Momentum performance

a)
$[(640 \times 480) \times 3] \times 8 \times 30 = 221184000$ $bits/second$

b)
$[(160 \times 120) \times 1] \times 8 \times 5 = 768000$ $bits/second$

c)
650 $MB \div 75$ $min = 8.6667$ $MB/min = 0.1444$ $MB/s = 1.1556Mbps$

d)
Since the picture is black and white, we need 1 bit for each pixel.
$[(8 \times 72) \times (10 \times 72)] \times 1 \div (14.4 \times 1000) = 28.8$ sec

Problem 9

Long Division

$$\begin{array}{r}
x^4 + 0 + x^2 - x \\
x^3+1 \overline{\big)\, x^7 + 0x^6 + x^5 + 0x^4 + 0x^3 + 0x^2 + 0x + 1} \\
x^7 + 0 + 0 + x^4 \qquad\qquad\qquad\qquad \\
\hline
x^5 - x^4 + 0 + 0 + 0 + 1 \\
x^5 + 0 + 0 + x^2 \qquad\quad \\
\hline
-x^4 + 0 - x^2 + 0 + 1 \\
-x^4 - 0 - 0 - x \qquad \\
\hline
-x^2 + x + 1
\end{array}$$

The remainder is $(-x^2 + x + 1)$

Problem 10

CRC

a)
The message should be sent is 11100011100, where the last three bit '100' is remainder.

$$\begin{array}{r}
1\,1\,1\,1\,1\,1\,0\,0 \\
1001 \overline{\big)\, 1\,1\,1\,0\,0\,0\,1\,1\,0\,0\,0} \\
1\,0\,0\,1 \qquad\qquad\qquad\quad \\
\hline
1\,1\,1\,0 \qquad\qquad\quad \\
1\,0\,0\,1 \qquad\qquad\quad \\
\hline
1\,1\,1\,0 \qquad\qquad \\
1\,0\,0\,1 \qquad\qquad \\
\hline
1\,1\,1\,1 \qquad\quad \\
1\,0\,0\,1 \qquad\quad \\
\hline
1\,1\,0\,1 \qquad \\
1\,0\,0\,1 \qquad \\
\hline
1\,0\,0\,0 \quad \\
1\,0\,0\,1 \quad \\
\hline
1\,0\,0
\end{array}$$

b)

Since we got a remainder when dividing the received message by the generator, it signals that there is an error during the transmission. There shouldn't be a remainder if the transmitted message is correct.

```
              1101110
1001 ) 01100011100
        1001
        ----
        1010
        1001
        ----
        001111
          1001
          ----
          1101
          1001
          ----
           1000
           1001
           ----
             10
```