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CN Assignment No. 02

Q.1] Find the CRC for 1110010101 with the divisor x^3+x^2+1

→ $x^3+x^2+1 \Rightarrow x^2+x^2+0x+1$

∴ The divisor is 1101

Degree of polynomial =3 so we will add 3 zeros at the end of 1110010101 i.e. 1110010101000

Sender :

```
               101000011
        1101 ) 1110010101000
               1101
               00 110
                    0
               ---------
                  1101
                  1101
               ---------
                000001010
                     1101
               ---------
                    01110
                     1101
               ---------
                    00110  => Remainder
```

Receiver :

```
        1110010101000
                00110
        -------------
        1110010101110
```

Divisor = 1101

Now again doing division with same technique.

```
1101) 1110010101110
      1101
      00110
          0
        1101
        1101
          001011
            1101
            01101
             1101
             00000  => Remainder
```

So, there is no transmission error.

Q.2 Suppose we want to transmit the message 11001001 & protect it from errors using the CRC polynomial x^3+1. Use polynomial long division to determine the message that should be transmitted. Corrupt the left most third bit of the transmitted message & show that the error is detected by the receiver using CRC technique.

→ $x^3 + 1 \Rightarrow x^2 + 0x^2 + 0x + 1 \Rightarrow$ divisor is 1001

Degree of polynomial = 3, so we will add 3 zero at the end of 11001001 i.e. 11001001000.

sender:

```
        11010011
1001) 11001001000
      1001
      01001
       1001
       00100
           0
         1000
         1001
         0001100
            1001
            01010
             1001
             0011  ———→ Remainder.
```

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```
Receiver :   11101001000
                    0011
             -----------
             11101001011
```

Divisor ⇒ 1001

Now again doing division with same technique

```
1001 ) 1110100100 11
       1001↓
       ----------
       01111
        1001
        ------
        01100
         1001
         ------
         01010
          1001
          ------
          00111
              0
           ------
           1110
           1001
           ------
           011  1
            1001
            ------
            01101
             1001
             ------
             0100   ⇒ Remainder
```

As the remainder is non-zero, there is transmission error.

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Q.3 Consider a message represented by the polynomial $M(x) = x^5 + x^4 + x$. Consider a generating polynomial $G(x) = x^3 + x^2 + 1$ (1101). Generate a 3 bit CRC & show what will be the transmitted frame. How is error detected by CRC?

→

Given :-

Data word : $x^5 + x^4 + x = 110010$

Generator polynomial : $x^3 + x^2 + 1 = 1101$

step : 1] Obtain the dividend

Dividend = Dataword + 3 zeros

i.e. Dividend is 110010000

step 2] Carry out the division :

```
1101) 110010000
      1101
      00011
          0
         110
        1101
          100   => Remainder
```

Step 3] obtain the transmitted frame:

Transmitted word = 110010100

Error detection :-

At the receiver, this word is dividend by the same divider used at the transmitter i.e. 1101

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```
              1001
1101 ) 1100101100
       1101↓
       00011
           0↓↓
         1101
         1101
          0000   => Remainder
```

A zero remainder indicates that there is no error in the received codeword.

Q.4 What is subnetting ? Given the class C network 192.168.10.0 use the subnet mask 255.255.255.192 to create subnets & answer the following.

1) What is the number of subnets ?
2) How many Hosts per subnet ?
3) Calculate the IP address of the first host, the last host and broadcast address of each subnet.

→ Given : IP address : 192.168.10.0 (class c)
subnet mask : 255.255.255.192

step 1: Number of subnets & number of Hosts :

255	255	255	192
11111111	11111111	11111111	11000000

The number of subnets are determined by the number of 1's is

∴ Number of extra 1's = 2

∴ Number of subnets $= 2^2 = 4$ .... Answer

The value of n is 26 which means the number of hosts per subnet is

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$2^{32-26} = 2^6 = 64$ ---- Answer

Step 2: IP address of the first host, last host & broadcast Address:

The following is the range of subnets

Subnet	Subnet range
1.	192.168.10.0 to 192.168.10.63
2.	192.168.10.64 to 192.168.10.127
3.	192.168.10.128 to 192.168.10.191
4.	192.168.10.192 to 192.168.10.255

IP address of first host : 193.129.65.1

IP address of last host : 254.190.126.62

Broadcast address : 255.191.127.63

Q.5 Explain the congestion control policy of TCP with an example.

→ TCP Conjestion Control:-

TCP uses a conjestion window & a conjestion policy that avoid conjestion. Previously, we assumed that only receiver can dictate the sender's window size. we ignored another enity here the network.

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Conjestion policy in TCP :-

1) Slow start phase :- starts slowly, increment is exponental threshold.

2) Conjestion Avoidance Phase :- After reaching the threshold increment by 1.

3] Conjestion Detection Phase :- Sender goes back to slow start phase or conjestion avoidance phase.

1) Slow start phase :- exponential increment -
In this phase after every RTT the congestion window size increments exponentially

initially cawnd = 1
After 1RTT, cwnd = 2^(1) = 2
2 RTT, cwnd = 2^(2) = 4
3 RTT, cwnd = 2^(3) = 8

2) Congestion Avoidance phase :- additive increment
This phase starts after the threshold value also denoted as ssthresh. The size of cwnd (congestion window) increases additive. After each RTT cawnd = cwnd + 1.

initially cwnd = 1
After 1 RTT, cwnd = 1+1
2 RTT cwnd = 1+2
3 RTT, cwnd = 1+3

3) Congestion Detection Phase :-

multiplicative decrement-

If congestion occurs, the congestion window size is decreased. The only way a sender can guess that congestion has occured is the need to retransmit a segment. Retransmission is needed to recover a missing pachet which is assumed to have been dropped by a router due to congestion. Retransmission can occur in one of two cases: when the RTO timer times out or when three duplicate ACKs are received.

Case 1:- Retransmission due to timeout
in this case congestion possibility is high
(a) ss thresh is reduced to half of the current window size.
(b) set ~~cow~~ cwnd = 1.
(c) starts with slow start phase again.

Case 2:- Retransmission due to 3 Acknowledgement Duplicates.
a) ssthress value reduces to half of the current window size.
b) set cwnd = ssthresh
c) starts with congestion avoidance phase.

Example:-

Assume a TCP protocal experiencing the behaviour of slow start. At 5th transmission round with a threshold value of 32 goes into congestion avoidance phase & continues till 10th ~~ex~~ transmission

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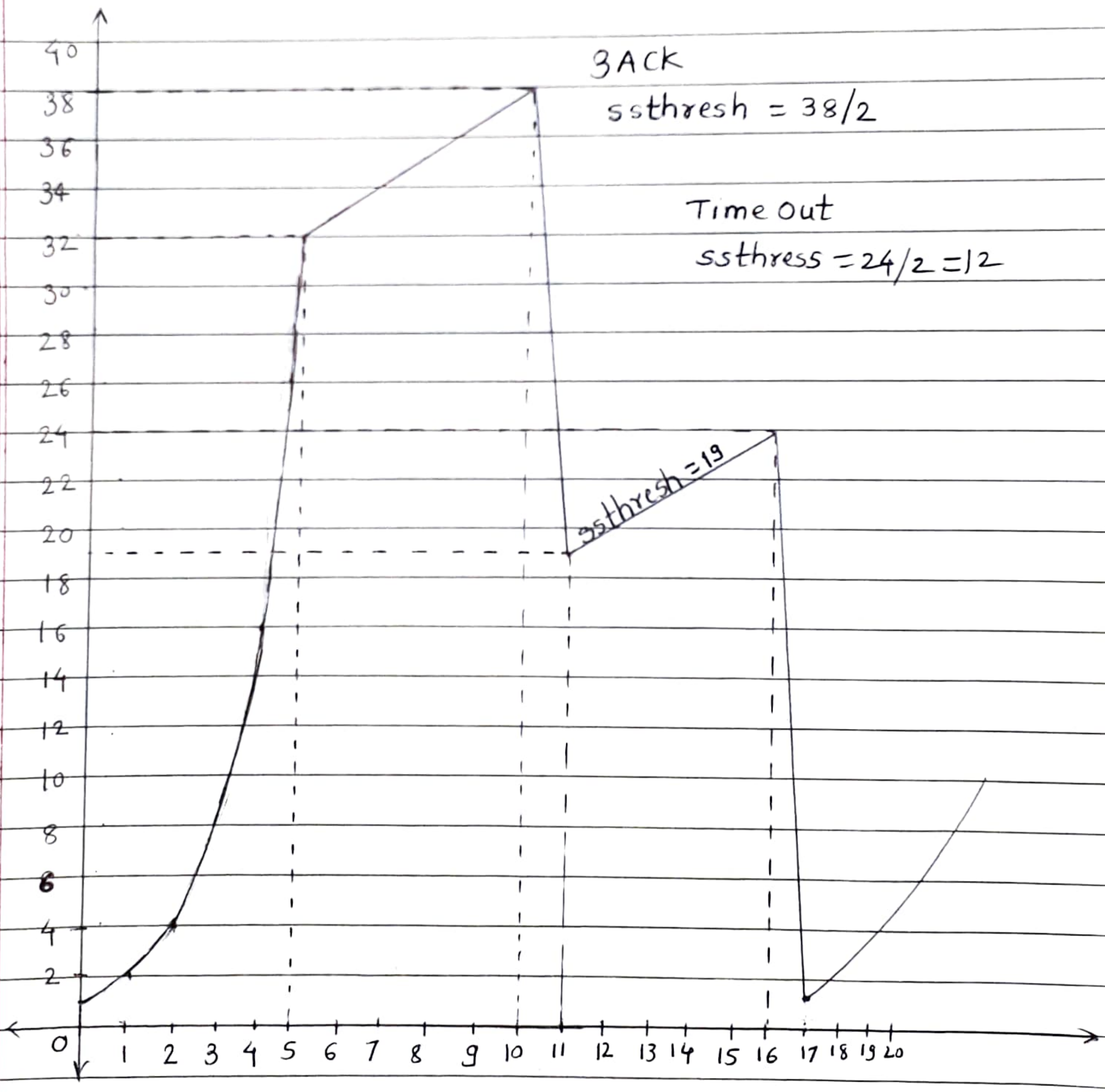
At 10th transmission round, 3 duplicates ACks are received by the receiver and enter into additive increase mode. Timeout occurs at 16th transmission round (time) vs congestion window size of TCP segments.



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Q.5 Explain the TCP segment Format.

→ TCP segment format with Diagram is shown in the figure below.

<table>
<tr><td colspan="2"></td><td colspan="7"></td></tr>
<tr><td colspan="8">Sourceport #</td><td>Dest port #</td></tr>
<tr><td colspan="9">Sequence Number</td></tr>
<tr><td colspan="9">Acknowledgement number</td></tr>
<tr><td>Header Length</td><td>Unused</td><td>URG</td><td>ACK</td><td>PSH</td><td>RST</td><td>SYN</td><td>FIN</td><td>Receive Window</td></tr>
<tr><td colspan="8">Internet checksum</td><td>Urgent data pointer.</td></tr>
<tr><td colspan="9">Options</td></tr>
<tr><td colspan="9">Data.</td></tr>
</table>

- The TCP segment consists of header fields & a data field. The data field contains a chunk of application data. The MSS (Maximum segment size) limits the maximum size of a segment is data field.

- Interactive applications, however often transmit data chunks that are smaller than the MSS; for example, with remote ~~again~~ login applications like Telnet, the data field in the TCP segment is often only one byte. Because the TCP header is typically 20 bytes (12 bytes more than the UDP header) segments sent by Telnet may be 21 bytes in length.

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Also with UDP, the header includes a checksum field. A TCP segment header also contains the followin fields:

- The 32-bit sequence number field and the 32-bit acknowledgement number field are used by the TCP sender & receiver in implementing a reliable data transfer service as discussed below.

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- The 16-bit receive window field is used for flow control.

- The 4-bit header length field specifies the length of the TCP header in 32-bit words. The TCP header in 32-bit words. The TCP header can be of variable length due to TCP options fields.

- The flag field contains 6 bits. The ACK bit is used to indicate that the value carried in the acknowledgement. For a segment that has been successfully received - The RST, SYN, & FIN bits are used for connection setup & teardown setting the PSH bit indicates that the receiver should pass the data to the upper layer immediately. Finally the URG bit is used to indicate that there is data in this segment that the sending-side upper layer entity has marked as "urgent". The location of the last byte of this urgent data is indicated by the 16-bit urgent data pointer field. TCP must inform the receiving-side upper layer entity when urgent data exists & pass it to a pointer ~~to~~ the end of the urgen data.