1. **Bit Stuffing.**

    1. A bit string, 1000111111010001111101l, needs to be transmitted at the data link layer. What is the string transmitted across the Link after bit stuffing by the sender? Assume the same start/end flags as the ones used in class.

        Add 01111110 at head and tail, whenever meet 5 1's, stuff a 0;

        01111110 100011111 0 10100011111 0 011 01111110

    2. A frame is received by the data link layer, which was transmitted using bit stuffing: 011111101111101100011111101101111110. What is the bit string that the link layer passes up the stack to the network layer after bit de-stuffing?

        Re-do the method above in reverse way

        11111110001111111

2. **Hamming Code.**

1. Encode the message 10011011 to send.

Bit poistion	1	2	3	4	5	6	7	8	9	10	11	12
Data bits	P1	P2	D1	P4	D2	D3	D4	P8	D5	D6	D7	D8
	0	1	1	0	0	0	1	1	1	0	1	1

2. What can be said about the correctness of the following received messages (Hint: Check for

   Hamming Code correctness using parity)?

   i. 111000101011

Bit position	1	2	3	4	5	6	7	8	9	10	11	12
Data bits	P1	P2	D1	P4	D2	D3	D4	P8	D5	D6	D7	D8
	1	1	1	0	0	0	1	0	1	0	1	1

   False

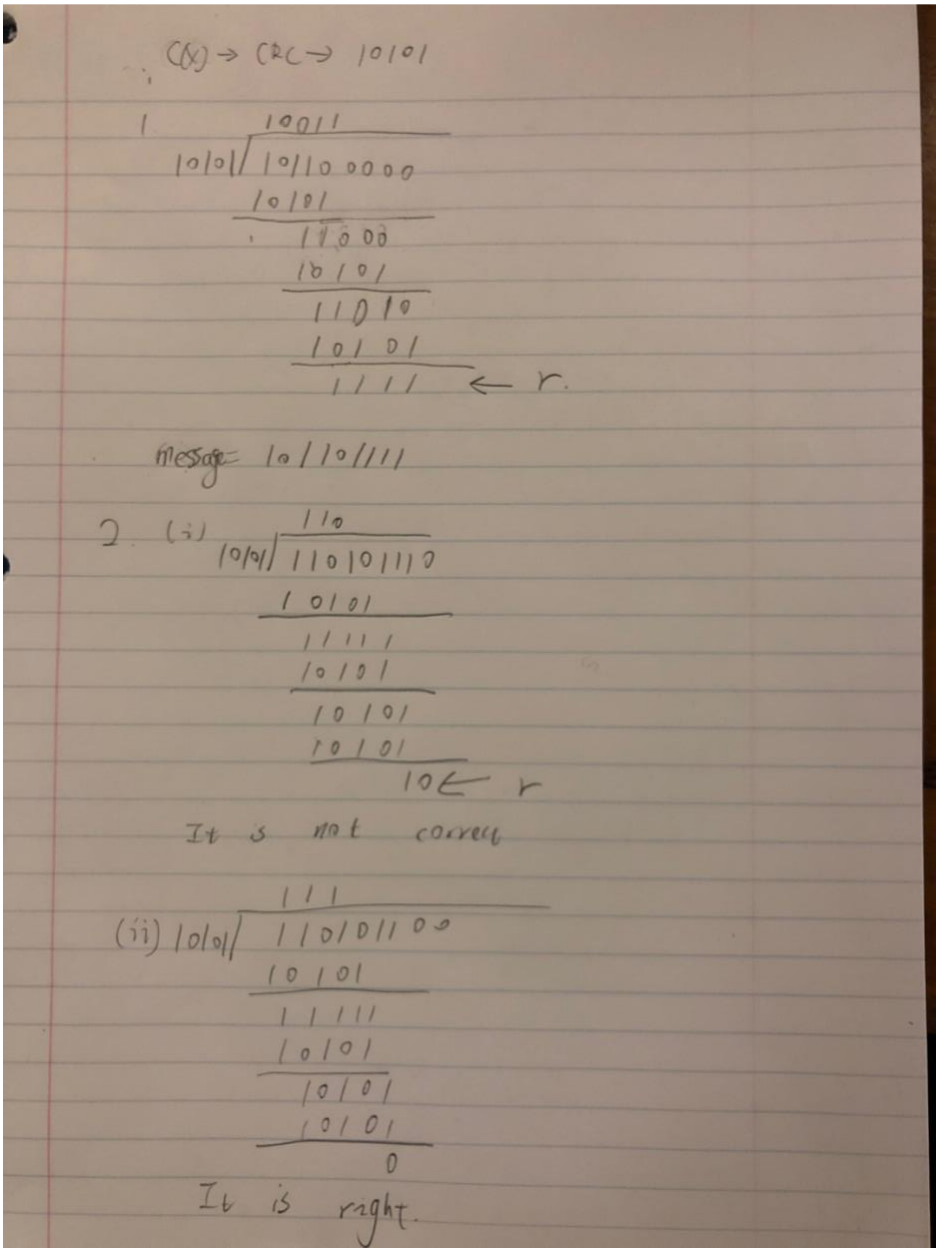
   ii. 01110011011

Bit position	1	2	3	4	5	6	7	8	9	10	11
Data bits	P1	P2	D1	P4	D2	D3	D4	P8	D5	D6	D7
	0	1	1	1	0	0	1	1	0	1	1

   False

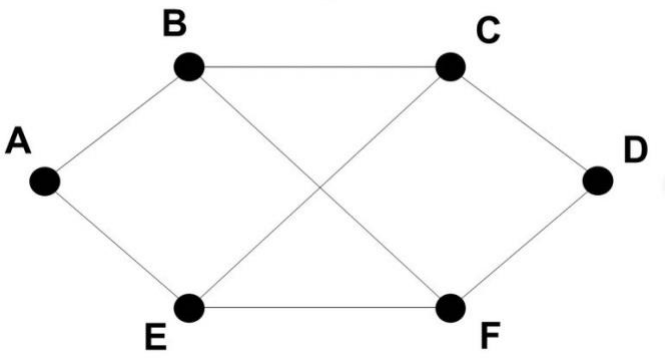
3. **CRC Code.** Assume the $C(x) = x^4 + x^2 + 1$.

1. Encode the message 10110 with CRC.
2. What can be said about the correctness of the following received messages?
   i. 110101110
   ii. 110101100



4. **Distance Vector Routing. Distance Vector Routing.** Consider the subnet shown below. Distance vector routing is used, and the following distance vectors have just come in to router C: **B**: (6, 0, 8, 10, 5, 5); from **D**: (4, 9, 7, 0, 8, 6); and from **E**: (7, 7, 4, 8, 0, 5). The measured distances/costs from C to **B**, **D**, and **E** are 5, 5, and 4, respectively. What will C's new routing table be after this update? Show both the outgoing router to use and the cost.

Routing Table Format:



Destination	Cost	Next Hop
A	9	D
B	5	B
C	0	C
D	5	D
E	4	E
F	9	E

5. **TCP Sequence Numbers.** To get around the problem of sequence numbers wrapping around while old TCP packets still exist, TCP could use 64-bit sequence numbers instead of 32 bits. However, theoretically, an optical fiber can run at 100 Terabits per second. What maximum packet lifetime would be required to prevent sequence number wrap-around even with 64-bit sequence numbers? Assume that each byte of a packet has its own sequence number (as TCP does).

The maximum bits of packet that can stay in the fiber is 2^(64) * 8(bits/byte)
The total time of transmission is 2^(64)*2^(3)/ 100T(bits/second) = 1342177.28 s

6. **DNS.** Using an online whois lookup service like whois.net, look up duke.edu. On what date was the domain registered? When does it expire? What are the DNS servers for this domain? Include a screenshot of your source.

WHOIS LOOKUP

duke.edu is already registered*

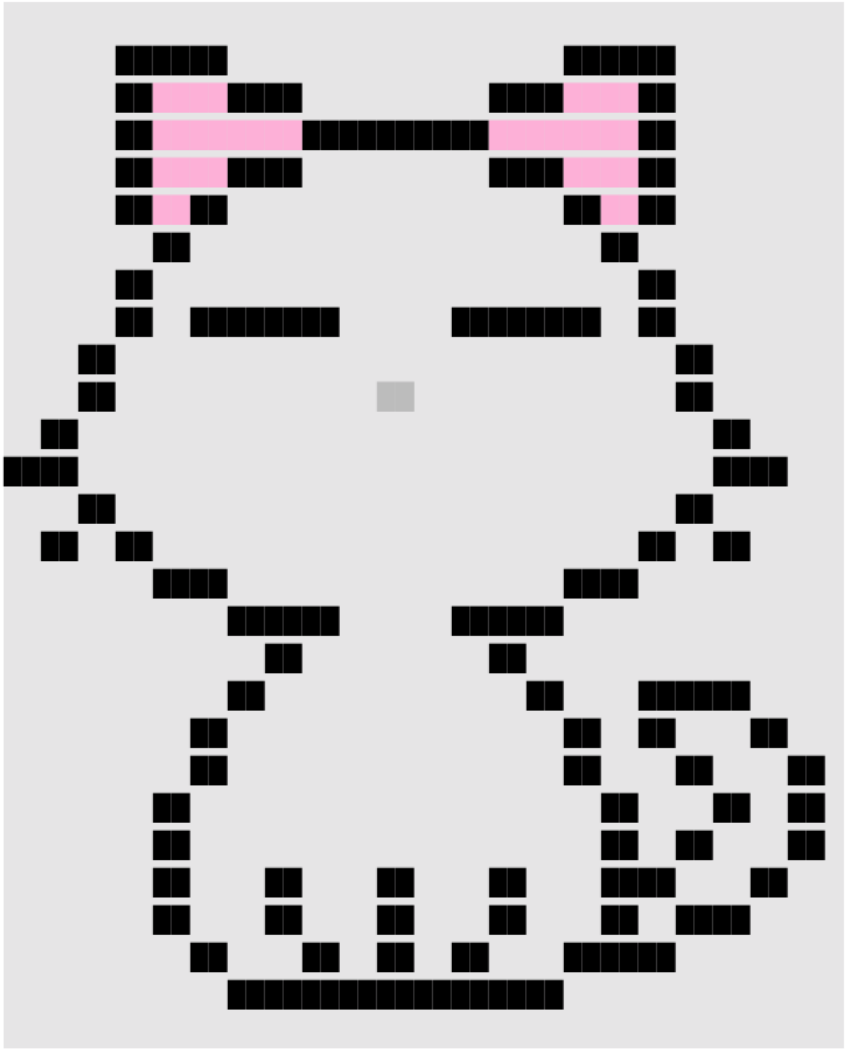
Domain Name: DUKE.EDU
Registry Domain ID: 5059_DOMAIN_EDU-VRSN
Registrar WHOIS Server: whois.educause.net
Registrar URL: http://www.educause.edu/edudomain
Updated Date: 2018-06-08T13:57:29Z
Creation Date: 1986-06-02T04:00:00Z
Registry Expiry Date: 2021-07-31T11:59:59Z
Registrar: Educause
Registrar IANA ID: 365
Registrar Abuse Contact Email:
Registrar Abuse Contact Phone:
Domain Status: clientDeleteProhibited https://icann.org/epp#clientDeleteProhibited
Domain Status: clientTransferProhibited https://icann.org/epp#clientTransferProhibited
Domain Status: clientUpdateProhibited https://icann.org/epp#clientUpdateProhibited
Name Server: DNS-AUTH-01.OIT.DUKE.EDU
Name Server: DNS-AUTH-02.OIT.DUKE.EDU
Name Server: DNS-NC1-01.OIT.DUKE.EDU
DNSSEC: unsigned
URL of the ICANN Whois Inaccuracy Complaint Form: https://www.icann.org/wicf/
>>> Last update of whois database: 2018-06-13T13:34:24Z <<<

Start: 1986-06-02T04:00:00Z
Expire: 2021-07-31T11:59:59Z
Name Server: DNS-AUTH-01.OIT.DUKE.EDU
Name Server: DNS-AUTH-02.OIT.DUKE.EDU
Name Server: DNS-NC1-01.OIT.DUKE.EDU

7.Internet Services. Using netcat (the ‘nc’ command) in a terminal, manually display the following URL to the console.
http://rabihyounes.com/awesome.txt

Printf "GET http://rabihyounes.com/awesome.txt HTTP/1.1\r\nHost: rabihyounes.com\r\n\r\n" |

nc rabihyounes.com 80



MacBook-Pro-7:sx61-proj3 shulinxiang$ sed $'s/$/\r/'