HW #3: Networking Questions
Spring 2020

Submit electronically as a PDF file called `hw3_netID.pdf` on Gradescope
(see course website for due date)

Note: This assignment includes a written portion (this document) and a programming portion (separate document). Be sure to submit both!

1. **Bit Stuffing.**

a. A bit string, 1000111111010001111101, 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.

01111110100011111010100011111001101111110

b. A frame is received by the data link layer, which was transmitted using bit stuffing: 01111110111111011000111111011011111110. What is the bit string that the link layer passes up the stack to the network layer after bit de-stuffing?

011111110001111111

2. **Hamming Code.**

a. Encode the message 10011011 to send.

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

b. What can be said about the correctness of the following received messages (Hint: Check for Hamming Code correctness using parity)?

i. 111000101011

ii. 01110011011

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

wrong, D5 should be flipped

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

wrong , D7 should be flipped

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

a. Encode the message 10110 with CRC.

101101111

b. What can be said about the correctness of the following received messages?

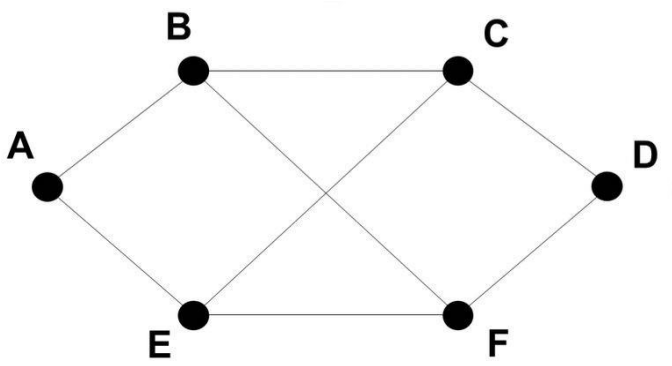
i. 110101110

wrong

ii. 110101100

correct

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).
   2^27/100
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.
   1986-06-02T04:00:00Z
   2021-07-31T11:59:59Z
   DNS-AUTH-01.OIT.DUKE.EDU
   DNS-AUTH-02.OIT.DUKE.EDU
   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

```
✘ js@ubuntu ~ printf "GET /awesome.txt HTTP/1.1\r\nHost: rabihyounes.com\r\nAccept: */
*\r\n\r\n" | nc rabihyounes.com 80
HTTP/1.1 200 OK
Date: Sat, 22 Feb 2020 03:44:58 GMT
Server: Apache
Upgrade: h2,h2c
Connection: Upgrade
Last-Modified: Fri, 08 Feb 2019 18:43:41 GMT
Accept-Ranges: bytes
Content-Length: 2360
Cache-Control: max-age=604800
Expires: Sat, 29 Feb 2020 03:44:58 GMT
Vary: Accept-Encoding
host-header: c2hhcmVkLmJsdWVob3N0LmNvbQ==
X-Endurance-Cache-Level: 4
Content-Type: text/plain
```