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, 100011111101000111111011, 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.

Ans:

Assume start/end flag 01111110 is used. The string after bit stuffing will be:
01111110100011111010100011111001101111110.

b. A frame is received by the data link layer, which was transmitted using bit stuffing: 01111101111101100011111101101111110. What is the bit string that the link layer passes up the stack to the network layer after bit de-stuffing?

Ans:

11111110001111111

2. **Hamming Code.**

a. Encode the message 10011011 to send.

Ans:

011000111011

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

i. 111000101011
The 9th bit is wrong.

ii. 01110011011
The 11th bit is wrong.

c. **CRC Code.** Assume the C(x) = x4 + x2 + 1.

a. Encode the message 10110 with CRC.

Ans:

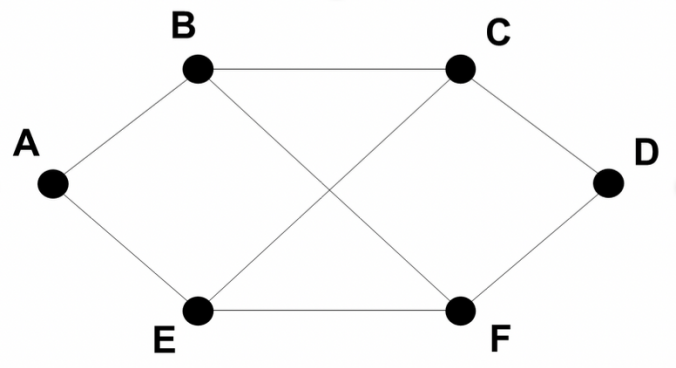
101101111

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

i. 110101110
The redundance is 0010. There is error in the message.

ii. 110101100
The redundance is 0000. There is no error in the message.

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).

Max packet lifetime = $(2^{64}$ byte * 8 bits/byte) / (100 * 2^{40} bits/second)
= $2^{27}/100$ s = 1342177.28 s ≈ 15.53 days

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.

Ans:

Registered date: 02-JUN-1986
Expires date: 31-JUL-2021
DNS servers: DNS-AUTH-02.OIT.DUKE.EDU
DNS-AUTH-01.OIT.DUKE.EDU
DNS-NC1-01.OIT.DUKE.EDU

Whois Record for Duke.edu

Domain Profile

Registrant Org	Duke University
Registrar Status	
Dates	12,692 days old Created on 1986-06-02 Expires on 2021-07-31 Updated on 2020-12-26
Tech Contact	Domain Administrator
IP Address	152.3.72.197 is hosted on a dedicated server
IP Location	- North Carolina - Durham - Duke University
ASN	AS13371 DUKE-INTERCHANGE, US (registered Oct 03, 2006)
IP History	3 changes on 3 unique IP addresses over 15 years
Hosting History	2 changes on 2 unique name servers over 10 years

Website

Website Title	500 SSL negotiation failed:
Response Code	500

```
Domain Name: DUKE.EDU

Registrant:
        Duke University
        905 W. Main Street, Suite 18B
        Suite 2106
        Durham, NC 27701
        US

Administrative Contact:
        Domain Administrator
        Duke University
        334 Blackwell St.
        Suite 2106
        Durham, NC 27701
        US
        +1.9196845300
         datacom-hostmaster@duke.edu

Technical Contact:
        Domain Administrator
        Duke University
        334 Blackwell St.
        Suite 2106
        Durham, NC 27701
        US
        +1.9196842200
         datacom-hostmaster@duke.edu

Name Servers:
        DNS-AUTH-02.OIT.DUKE.EDU
        DNS-AUTH-01.OIT.DUKE.EDU
        DNS-NC1-01.OIT.DUKE.EDU

Domain record activated:    02-Jun-1986
Domain record last updated: 26-Dec-2020
Domain expires:             31-Jul-2021
```

7. **Internet Services.** Using netcat (the 'nc' command) in a terminal, manually display the following URL to the console.

http://rabihyounes.com/awesome.txt

```
xl350@vcm-18311:~$ echo -e "GET http://rabihyounes.com/awesome.txt HTTP/1.1\r\nHost: rabihyounes.com\r\n\r\n" | nc rabihyounes.com 80
HTTP/1.1 200 OK
Date: Tue, 02 Mar 2021 09:20:57 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=21600
Expires: Tue, 02 Mar 2021 15:20:57 GMT
Vary: Accept-Encoding
host-header: c2hhcmVkLmJsdWVob3N0LmNvbQ==
X-Endurance-Cache-Level: 3
Content-Type: text/plain
```