CSX3005Computer Networks Pre-midterm Assignment 1/2023 Key

1.1. Wireless links, such as those provided by cellular and Wi-Fi networks, are multiple access links. True
1.2. Routing is the process of determining how to forward messages toward the destination node based on its address. True
1.3. Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. True
1.4. The presentation layer concerns the router format exchanged between peers. False
1.5. the application interacts with the transport layer protocols for calculating IP addresses in the layered Internet architecture. False
1.6. In Internet architecture, the transport layer divides the data stream into small units called packets. True
1.7. A network link is a physical medium carrying signals in the form of electromagnetic waves. True
1.8. The Manchester encoding scheme never doubles the rate of signal transitions. False
1.9. The extra bits transmitted with the message are called error-detecting codes. True
1.10. A major goal in designing error detection algorithms is to maximize the probability of detecting errors using many redundant bits. False
1.11. The Internet is a globally connected network system that uses TCP/IP to transmit data via various media types. True
1.12. Internet technology reveals the details of network hardware and permits computers to communicate independently of their physical network connections. False
1.13. Routers use the destination network, not the destination computer, when forwarding a packet. True
1.14. Protocols allow one to specify or understand network communication with the knowledge of particular network hardware. False
1.15. An IP address uniquely identifies the source and destination of data transmitted with the Internet Protocol. True
1.16. In subnetting, the subnet mask covers the Internet and the physical network portions of the address to distinguish the network and host IP addresses. True
1.17. 196.168.1.0 is a class B network address. False
1.18. In a classless address scheme, subnet addressing is permitted to use the network prefix of the address to be an arbitrary length and is not fixed. True
1.19. In subnetting, the subnet mask covers the Internet and the physical network portions of the address to distinguish the network and host IP addresses. True
1.20. TCP/IP uses the term host to refer to an end system that attaches to the internet. True

2. [3 Points] What three main stakeholders are required to develop a computer network? Briefly describe the functions of each stakeholder.

- An **application programmer** would list the ***services*** that his or her application needs: guarantee that each message the application sends will be delivered without error within a certain amount of time.
- A **network operator** would list the characteristics of a system that is easy to administer and manage: faults can be easily isolated, new devices can be added to the network and configured correctly, and it is easy to account for usage.
- A **network designer** would list the properties of a cost-effective design: network resources are efficiently utilized and fairly allocated to different users.

3. [2 Points] Consider a digital library program being asked to fetch a 20MB (megabyte) size. Suppose the channel has a bandwidth of 10 Mbps (millions of bits per second). Calculate the throughput of the channel (show your calculation steps).

It will take the **16s** to transmit the image ($20 \times 10^6 \times 8$-bits / $(10 \times 10^6) = 16$s).

Throughput = Transfer Size / Transfer Time = $(20 \times 10^6 \times 8) / 16$ = **10M**

4. [3 Points] Briefly describe the non-return to zero (NRZ) encoding issues.

First problem: In decoding the digital signal, the receiver calculates the average power of the received signal, and this average is called the **baseline**. A **long string of 0s** and **1s** can cause a **drift in the baseline** (called **baseline wandering**) and make it difficult for a **receiver to decode correctly.**

Second problem is the clock recovery problem: The sender's and the receiver's clock signals have to be precisely synchronized for the receiver to recover the same bits the sender transmits. If the receiver's clock is slightly faster/slower than the sender's, it cannot decode the signal correctly.

5. [3 Points] Show the non-return to zero inverted (NRZI) encoding result of the following **16-bit** data: **1010110011011101**

NRZI concept: For bit 1, there will be a change in the voltage level (bit level), and for bit 0, there won't be any change in the voltage level (where bit 1 is the positive voltage and bit 0 is the negative voltage).

Therefore, the NRZI encoded result of 1010110011011101 is 0011 0111 0110 1001

6. [4 Points] Show the **4B/5B encoding** on the following **16-bit data** with the help of the 4B to 5Bconversion shown in Figure1: **0110011101001010**

Step 1: 4B to 5B conversion with the help of the conversion table.

0110 0111 0100 1010 (4B) = 01110 01111 01010 10110 (5B)

Step 2: Apply NRZI encoding on the 5B data to get 4B/5B encoded data:

01110 01111 01010 10110 (5B) = 01011 10101 10011 00100

7. [2 Points] Find **the checksum scheme** of the following two 8-bit data: **1010 1010** and **11010110**

1's complement of 1010 1010 = 0101 0101

1's complement of 1101 0110 = 0010 1001

After adding these two values = 0111 1110

Take the 1's complement of the result (0111 1110) is the checksum and is <u>1000 0001</u>

8. [4 Points] Assume that the original transmission message (in polynomial) **M(x) = x^7+x^5+x^4+x^3** and the channel divisor polynomial **C(x) = x^3+x^1+1**. Calculate the **Cyclic Redundancy Check (CRC) polynomial of the network** (or show its binary equivalent).

1. Convert message polynomial **M(x)** into binary data:

M(x) = $x^7 + x^5 + x^4 + x^3 = x^7 + 0 + x^5 + x^4 + x^3 + 0 + 0 + 0$ = 1 0 1 1 1 0 0 0

2. Add 3 zeros (**2^3 = 8-bit** data, hence **k = 3**) at the beginning of the above binary data to get T(x):

T(x) = 1 0 1 1 1 0 0 0 0 0 0

3. Convert divisor polynomial **C(x)** into data:

C(x) = $x^3+x^1+x^0 = x^3 + 0 + x^1 + x^0$ = 1011

4. Apply **polynomial long division** on **T(x) by C(x)** (**T(x)/ C(x)) and find its remainder:**

T(x)/ C(x) = 1 0 1 1 1 0 0 0 0 0 0 / 1011

Remainder after the polynomial long division = 101

5. Next is finding the (**T(x) – Remainder**) value:

The **minus operation in polynomial arithmetic** is the **logical XOR (⊕)** operation. Therefore,

1 0 1 1 1 0 0 0 0 0 0 ⊕ 101 = <u>10111000101</u>

6. Use this result to find the data error during transmission. The recipient divides the received polynomial by $\boldsymbol{C(x)}$ and, if the result is **0**, concludes that there were **no errors**.

9. [5 Points] Consider a network with the address **211.165.13.0**. Subnetting the network with the **starting 4-bit value of the last octet** of its address. Show all of its valid subnet addresses (in dotted decimal form). What is its subnet mask?

Ans:

211.165.13.0001 0000 = 211.165.13.16

211.165.13.0010 0000 = 211.165.13.32

211.165.13.0011 0000 = 211.165.13.48

211.165.13.0100 0000 = 211.165.13.64

211.165.13.0101 0000 = 211.165.13.80

211.165.13.0110 0000 = 211.165.13.96

211.165.13.0111 0000 = 211.165.13.112

211.165.13.1000 0000 = 211.165.13.128

211.165.13.1001 0000 = 211.165.13.144

211.165.13.1010 0000 = 211.165.13.160

211.165.13.1011 0000 = 211.165.13.176

211.165.13.1100 0000 = 211.165.13.192

211.165.13.1101 0000 = 211.165.13.208

211.165.13.1110 0000 = 211.165.13.224

Subnet mask = 255.255.255.240 =/28

10. [4 Points] Show all the **/25** subnets that exist in the **132.42.6.0/23** address block?

Ans:

132.42.6.0 = 10000100 00101010 00000110 00000000

/25 = 11111111 11111111 11111111 10000000

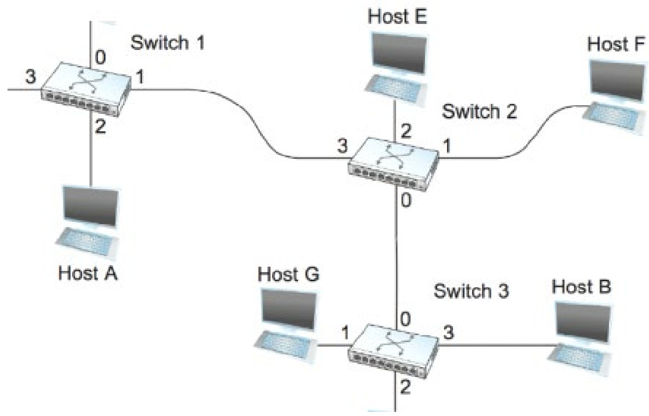
/23 = 11111111 11111111 11111110 00000000

There are four /25 subnets in a /23 address block (i.e., $2^{25\text{-}23} = 2^2 = 4$).

The 2 subnet bits (25-23) are located as the consecutive bits on the 4th octet after the /23rd bits).

/23	**=**	**11111111 11111111 11111110 00000000**
132.42.6.0/25	**=**	**10000100 00101010 00000110 00000000**
132.42.6.128/25	**=**	**10000100 00101010 00000110 10000000**
132.42.7.0/25	**=**	**10000100 00101010 00000111 00000000**
132.42.7.128/25	**=**	**10000100 00101010 00000111 10000000**

[5 Points] Consider a datagram network illustrated in the Figure below. In which the hosts have addresses A, B, C, and so on. Assume that **Host A** wants to send a packet to **Host G**. Construct the **forwarding (routing) tables** for the switches that support the packet transmission from **A** to **G** (assume that during a routing process, when a data packet turns up, the forwarding table will have the right information to forward/switch the packet).



Switch1:

Destination	Port
A	2
E	1
F	1
G	1
B	1

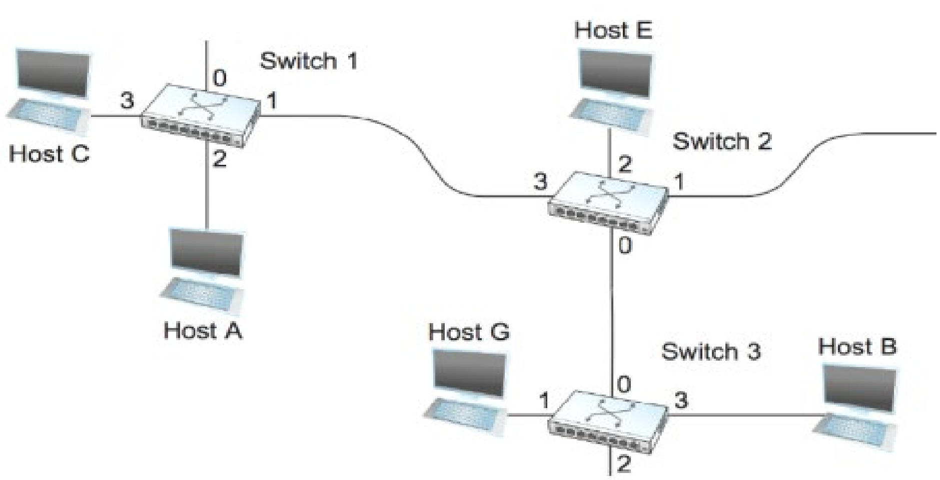
Switch2:

Destination	Port
A	3
E	2
F	1
G	0
B	0

Switch3:

Destination	Port
A	0
E	0
F	0
G	1
B	3

13. [5 Points] Consider a virtual circuit network illustrated in Figure below, in which the hosts have addresses A, B, C, and so on. Assume that **Host A** wants to send packets to **Host G**. Show the **virtual circuit (VC) table entry** for switches that are involved in packet routing from **A** to **G** (assume your **virtual circuit identifier (VCI)** for each switch).



VC Table Entry for Switch1:

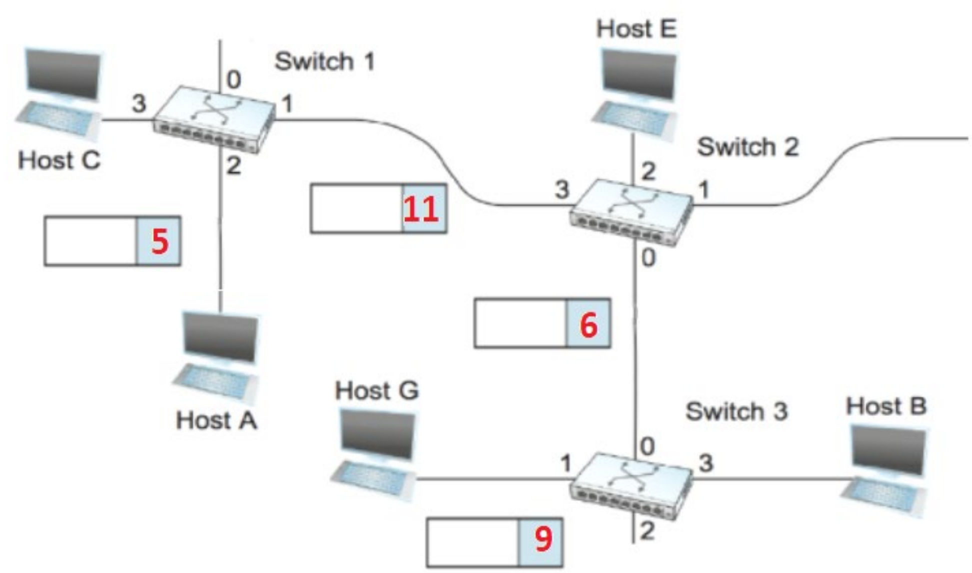
Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
2	5	1	11

VC Table Entry for Switch2:

Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
3	11	0	6

VC Table Entry for Switch3:

Incoming Interface	Incoming VCI	Outgoing Interface	Outgoing VCI
0	6	1	9



A packet with VCI makes its way to the destination (from HostA to HostG)

14. [6 Points] Consider a simple internetwork illustrated in **Figure (a),** where **H** denotes a **host,** and **R** denotes **a router**. Assume that a **1556-byte datagram** (**20-byte IP header** plus **1536-byte data**) is sent from **host H4** to **host H8**. The MTU of **network1, network2,** and **network4** is **1556-byte.** But the **MTU** of **network 3** is **532 bytes** (**20-byte IP header plus 512-byte data**). The IP datagram traversing a sequence of unfragmented and fragmented datagrams through the physical networks is shown in **Figure (b)**. Show the **data, flag,** and **offset** values of fragmented and unfragmented IP datagrams in **a**, **b**, **c, d,** and **e**.

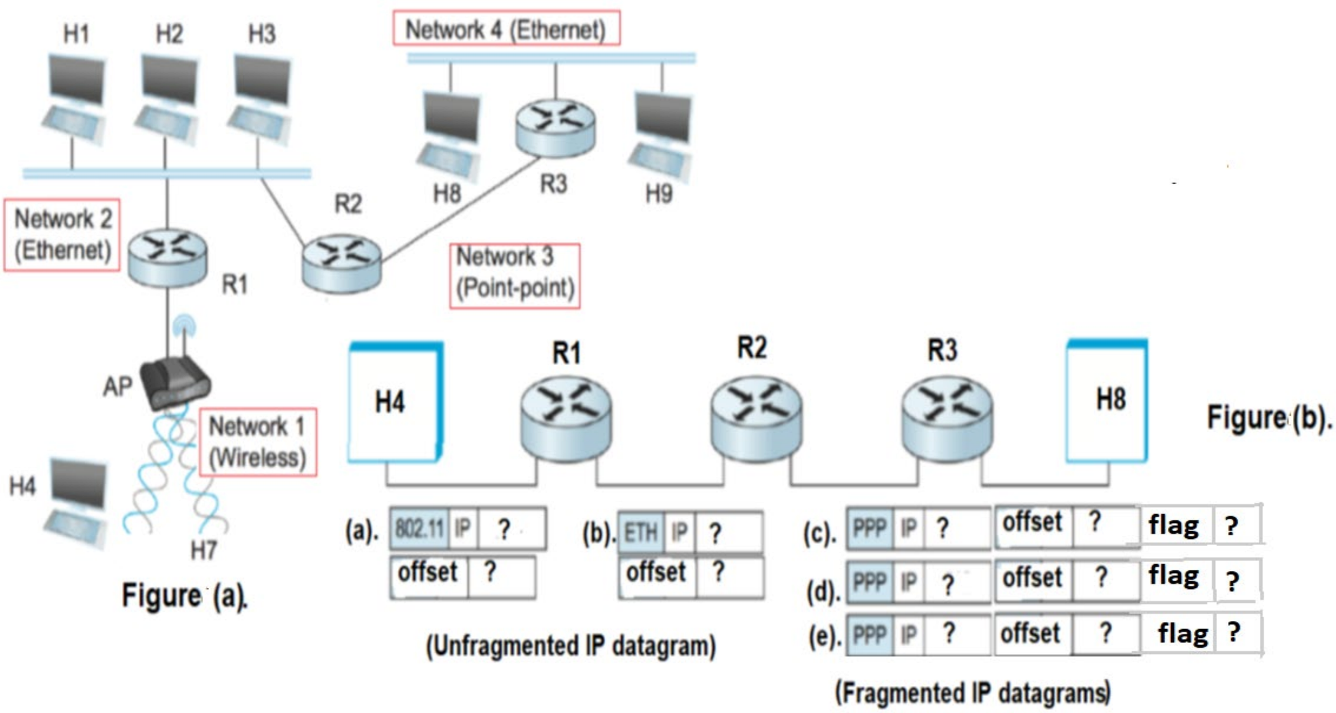


Figure (a).

Figure (b).

a)	802.11	IP	1536	flag = 0	offset = 0
b)	ETH	IP	1536	flag = 0	offset = 0
c)	PPP	IP	512	flag = 1	offset = 0
d)	PPP	IP	512	flag = 1	offset = 64
e)	PPP	IP	512	flag = 0	offset = 128