CSCD330 – Computer Networks

Final Exam, Winter 2021

Due: 18 MAR 2021, 11:59am PDT

Instructions: Write your answers to the following questions. A good idea would be to copy-and-paste these questions to your document followed by your answer (not needed for binary blocks in question 4). Add citations for anything you find not in the textbook or lecture notes. Also, include your name on your answer sheet **(6 points)**.

BE AWARE: NO LATE SUBMISSIONS WILL BE GRADED.

Question 1. (9 points)

Some IP Arithmetic

a. IPv6 uses 16-byte addresses. If a block of 1 million addresses is allocated every picosecond, how long will the addresses last?
b. Convert the IP address whose hexadecimal representation is C22F1582 to dotted decimal notation.
c. Suppose that instead of using 16 bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been?

Question 2. (10 points)

What conditions will cause a datagram to be fragmented? When a large datagram is fragmented into multiple smaller datagrams, where does this fragmentation occur? Where are these smaller datagrams reassembled into a single larger datagram?

Question 3. (10 points)

A DHCP client sends out broadcast messages in two occasions before it hops on the Internet. What are these two and why are they broadcast?

Question 4. (15 points)

On the attached sheet you will find 5 sets of 2-D error correction problems for sending 64 data bits and the associated parity bits. Each uses EVEN parity; the parity bits for each row and column are in **bold**. For each block, is it possible to determine if there has been some corruption of data? If corruption is detectable, give the position of the bits that are in error (e.g., zero-based index row and column).

Question 5. (10 points)

What is HOL blocking? Does it occur in input ports or output ports?

Question 6. (15 points)

I have developed a new algorithm to solve the multiple access problem: Priority Slotted ALOHA. Everything is the same as in Slotted ALOHA, but the probability can be different between nodes depending on the assigned priority of the node: High, p = 0.75; Normal, p = 0.50; Low, p = 0.25.

a. Is this a good idea? How well does the above algorithm meet the ideal properties that we want to achieve for solutions to the multiple access problem?
b. Are there any obvious problems with the above algorithm? Explain.

For the next 3 parts assume that there is one active node of each priority level attempting to send data across the shared link.

c. What is the maximum efficiency of the node with High priority?
d. What is the maximum efficiency of the node with Normal priority?
e. What is the maximum efficiency of the node with Low priority?

Question 7. (10 points)

In class we discussed the routing protocols, RIP and OSPF. What are some of the reasons you would choose to use OSPF over RIP within your network? Are there circumstances where it is preferable to use RIP over OSPF? Explain.

Question 8. (12 points)

A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organizations, Able, Baker, Charlie, and Delta, request 4000, 2000, 4000, and 8000 addresses, respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation.

Question 9. (18 points)

For the graph abstraction of a network with 6 nodes (Figure 1, shown below) with the cost of each link set near the link, compute the forwarding table (with associated cost) that would be generated for each of the six routers.

a. Router P
b. Router Q
c. Router R
d. Router S
e. Router T
f. Router U

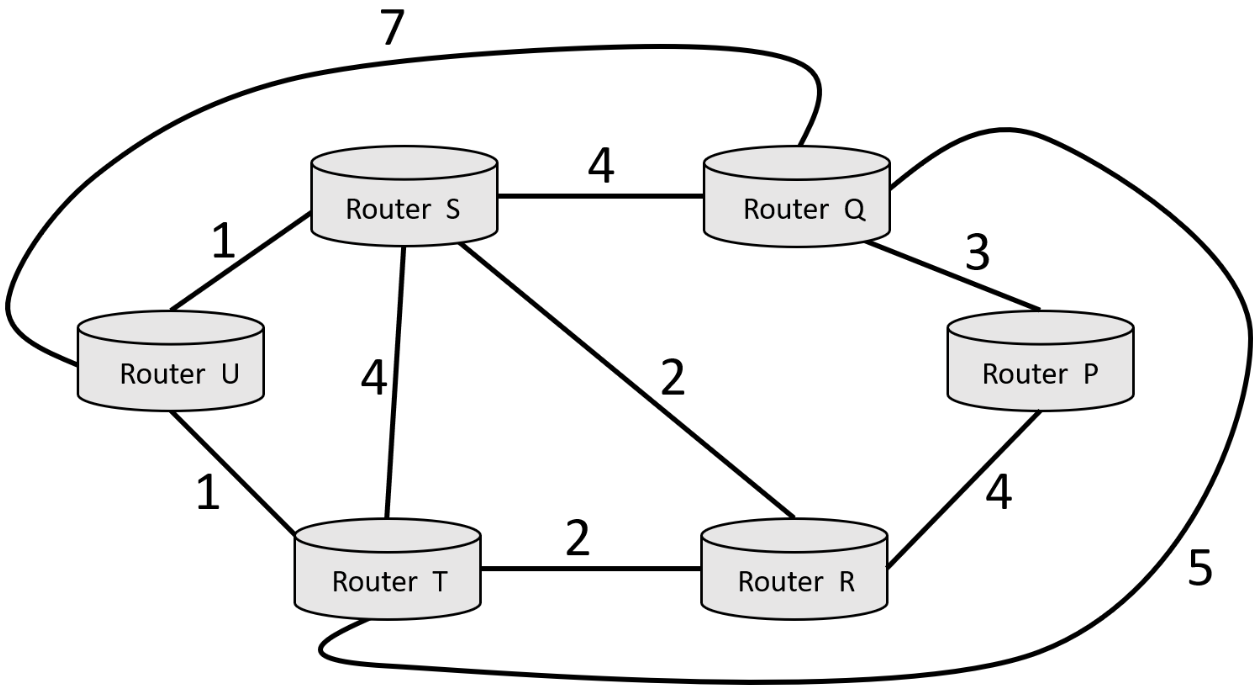

Figure 1. Question 9 Network

Question 10. (10 points)

A router has the following (CIDR) entries in its routing table:

Address/mask	Next hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.0/23	Router 1
default	Router 2

For each of the following IP addresses, what does the router do if a packet with that address arrives?

a. 135.46.63.10
b. 135.46.57.14
c. 135.46.52.2
d. 192.53.40.7
e. 192.53.56.7

Question 11. (20 points)

Now, you get to be creative in designing your own secure, efficient, reliable long-distance messaging protocol. For this problem, you are to become “A Washingtonian in King Arthur’s Court” (or you can be transported to Westeros if you’re more of a *GoT* fan). Obviously, the Internet, phones and most other forms of communication do not exist. The King has commissioned you to set up a communication network to send message across the country faster than they can be carried by a group of humans manning relay stations. What solution would you propose?

Think about the protocols that we’ve studied during this quarter. Can you or do you need to implement some of these? How would that be done and how does that affect your system? Is there a restriction on the size or types of messages within your protocol? Are there other restrictions in your method (weather, health, distance of messages, etc.) that need to be addressed? Can you acknowledge messages? Do you need to? What about breakdowns in the communication medium/method you intend to use? Is there a way to add security to your messaging network? Cost? Other concerns?

Write a short spec proposal to the king laying out your ideas and how they would be implemented, what limits there are, and how you would identify and handle them plus the potential for breakdowns in the network. Use your creativity and imagination.

EXTRA CREDIT. (up to 10 points)

What are the bit values for the letters (**A** through **I**) if the below binary message is for an Extended (255, 247) Hamming Code with even parity?

```
A B C 1 D 1 0 1 E 1 1 0 1 1 1 1
F 1 0 0 0 0 1 1 0 0 0 0 0 0 0 1
G 1 0 0 0 0 0 0 1 0 0 1 0 1 0 1
0 0 0 1 0 0 0 1 1 1 1 0 1 1 0 1
H 0 1 0 1 1 0 0 1 0 1 0 0 0 0 0
0 0 0 0 0 0 0 1 0 1 1 0 1 1 1 1
1 0 0 0 0 1 0 1 0 0 0 1 0 1 0 1
1 0 0 0 0 0 0 1 0 0 0 0 1 1 0 1
I 1 1 0 0 0 1 0 1 1 1 1 1 0 0 0
0 0 0 0 1 1 1 0 1 1 1 1 0 0 0 1
0 1 1 0 1 1 1 1 1 1 1 1 0 1 1 0
1 1 1 0 0 1 0 1 1 0 0 0 1 0 0 1
1 0 0 0 1 0 1 1 1 1 0 0 0 1 0 0
0 0 0 0 0 1 0 0 1 0 1 0 1 0 0 1
1 1 1 1 1 1 0 0 0 0 0 1 1 0 1 1
0 1 1 0 0 1 0 0 1 1 1 0 1 1 0 0
```

SUPPLEMENTAL SHEET for Question 4

4a. 0 0 0 0 1 0 0 0 **0**
1 0 1 0 1 0 1 1 **1**
0 1 0 0 1 1 0 1 **0**
1 1 1 1 0 0 0 0 **0**
0 0 0 0 1 1 1 0 **1**
1 1 0 0 0 0 1 1 **0**
0 1 0 1 0 0 1 1 **0**
1 0 0 0 0 1 1 0 **1**
0 0 0 0 1 1 1 0 0

4b. 0 1 0 0 0 0 0 1 **0**
1 0 0 0 1 1 0 0 **1**
0 1 0 1 1 0 1 0 **0**
1 0 1 1 0 0 1 1 **1**
0 0 1 1 1 0 1 0 **1**
1 0 0 0 0 0 0 1 **0**
1 1 1 1 1 0 0 1 **0**
0 1 1 1 1 1 1 0 **0**
0 0 0 1 1 0 0 0 0

4c. 0 1 1 1 1 1 1 1 **1**
0 0 1 1 1 1 0 1 **0**
0 0 0 0 0 1 0 0 **1**
1 1 1 0 1 0 0 1 **1**
0 0 0 1 1 0 0 0 **0**
0 0 1 0 0 1 1 1 **1**
0 0 1 1 1 0 0 1 **0**
1 0 1 1 0 0 1 0 **0**
0 0 0 1 1 0 0 1 1

4d. 0 0 1 0 0 0 1 0 **0**
0 0 1 1 0 1 0 1 **0**
0 0 1 1 1 1 0 1 **1**
0 1 0 1 0 0 1 1 **0**
0 1 0 1 1 1 1 0 **1**
0 1 1 0 1 1 1 0 **0**
0 0 1 1 0 1 0 0 **1**
1 0 0 0 0 1 0 0 **0**
1 1 0 1 1 0 0 1 0

4e. 0 0 1 0 0 1 1 1 **0**
0 1 1 0 0 1 0 1 **0**
0 0 0 1 1 1 1 1 **1**
1 1 1 1 1 0 0 1 **0**
1 1 0 1 1 0 0 1 **1**
0 1 1 0 1 1 1 0 **1**
1 1 0 0 0 0 1 1 **0**
0 1 1 0 1 0 0 0 **1**
1 0 1 1 1 0 0 0 0