15-441/641 Homework #3
Due February 22, 2019 at 5PM to Gradescope
V 1.0 2/15/2019

Part 1: DNS

For this exercise, you will use the dig tool like we did in class. However, instead of allowing a recursive resolver to do the requests for you, you will make all the requests yourselves. Recall that a DNS server higher in the hierarchy delegates responsibility to DNS servers that are lower in the hierarchy, by sending back the name of the lower DNS server to ask. Using the information you learn from your query to the root server, you will query the next server and so on.

Record the servers that you query, starting with the root server and ending with the final domain name and IP address.

1) dig +norecurse @a.root-servers.net cmu.edu
The last entry should say "cmu.edu" and have its IP address.

SERVER DNS NAME	SERVER IP ADDRESS
a.root-servers.net	199.9.14.201

1) dig +norecurse @a.root-servers.net myheartisinthenetwork.com
The last entry should say “myheartisinthenetwork.edu” and have its IP address.

SERVER DNS NAME	SERVER IP ADDRESS
a.root-servers.net	199.9.14.201

Part 2: IP Addressing

You manage a router with the following routing table.

Prefix	Nexthop
16.0.0.0/8	A
16.43.128.0/24	B
17.0.0.0/8	C
17.255.0.128/25	D
17.255.0.64/26	E
17.255.0.64/27	F
default	G

1. Rewrite the above table entries in binary, underlining the prefix.

Prefix	Nexthop
	A
	B
	C
	D
	E
	F
	G

2. What nexthop would a packet destined to 16.43.32.98 take?

3. What nexthop would a packet destined to 17.56.32.98 take?

4. What nexthop would a packet destined to 17.214.32.98 take?

5. What nexthop would a packet destined to 17.255.0.134 take?

Part 3: IPv4 Protocol
Hint: Look at the IP header!

1. You are building the world's longest IP network. There are 300 routers in a very long chain from source to destination, all performing IP routing. However, you find that your packets cannot reach their destination. What is wrong?

2. You and your friends Scotty and Andrew decide to connect your independent link-layer networks to build an internet. You will do this using the IP protocol

| Andrew's Network | ------- | Scotty's Network | -------- | Your Network |

Andrew's network has the following properties: 64kbps links, MTU 500 bytes, RIP routing

Scotty's network has the following properties: 32kbps links, MTU 112 bytes, OSPF routing

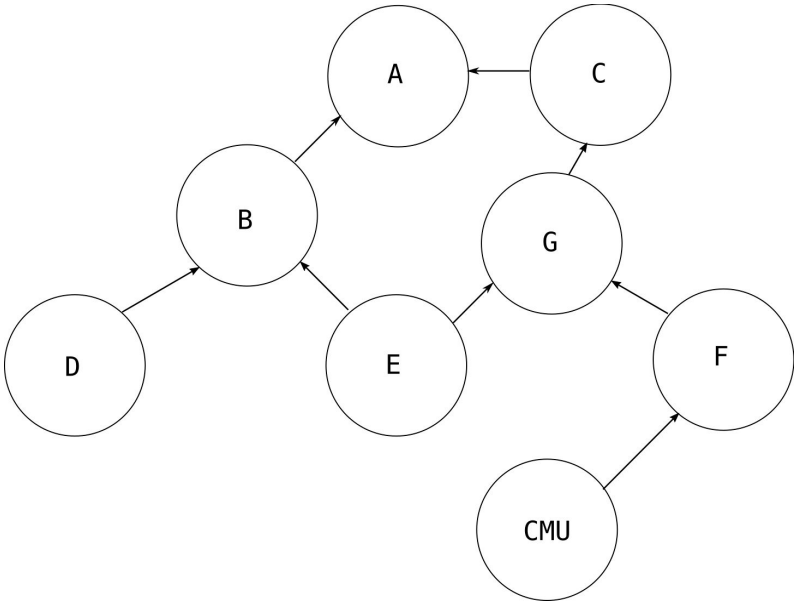
Your network has the following properties: 100Kbps links, MTU 192 bytes, RIP routing

Once again you find that your packets are not being delivered. Why is this?

3. What is special about the IP address 255.255.255.255?

Part 4: BGP

1. Your best friend, Henrietta K. Bovik is interviewing for the position of network administrator at CMU. You, as a good friend and serial procastinator, have agreed to help her prepare. She comes to you with the following AS level topology. Help her figure out what paths the packets from each sender take to the receiver. Note that for the arrows, Customer→Provider.



(a) sender = D, receiver = F

(b) sender = E, receiver = CMU

(c) sender = G, receiver = B

(d) sender = CMU, receiver = B

2. Ms. Bovik comes back from her interview and it turns out the interviewers cared more about concepts than they did about application. Maybe you can help her figure out what she missed:

(a) Why don't we just use a Distance Vector Protocol to figure out routes on the internet?

(b) B and G (figure 1) seem to be exchanging a lot of traffic. What can their network admins do to cut costs?

3. One day, CMU's internet seems to have stopped working properly. Ms. Bovik investigates and finds out that Cranberry-Lemon University (CLU), located next door, has been masquerading as CMU and advertising CMU's IP Prefix (128.2.0.0/16) to the world. So, some of the traffic meant for CMU is going to CLU. Ms. Bovik contacts you, her trusty friend, to help solve this problem. How can Ms. Bovik attract traffic back to CMU's prefix by changing her BGP configuration? (She cannot complain to CLU, change her peering, or upgrade anyone else's infrastructure -- she can only change CMU's BGP configuration!).