Homework 3 assignment for ECE671

Posted: 03/02/2021

Due: 03/11/2021

Note: *In all written assignments, please show as much of your work as you can. Even if you get a wrong answer, you can get partial credit if you show your work.* If you make a mistake, it will also help the grader show you where you made a mistake.

Problem 1 (20 Points):

Consider the network setup shown in Figure 1. Instead of the shown IP address the ISP instead assigns the router the address 129.119.112.235 and that the network address of the home network is 192.168.10/24.

a. Assign addresses to all interfaces in the home network.
b. Suppose each host has two ongoing TCP connections, all to port 80 at host 128.119.40.186. Provide the six corresponding entries in the NAT translation table.

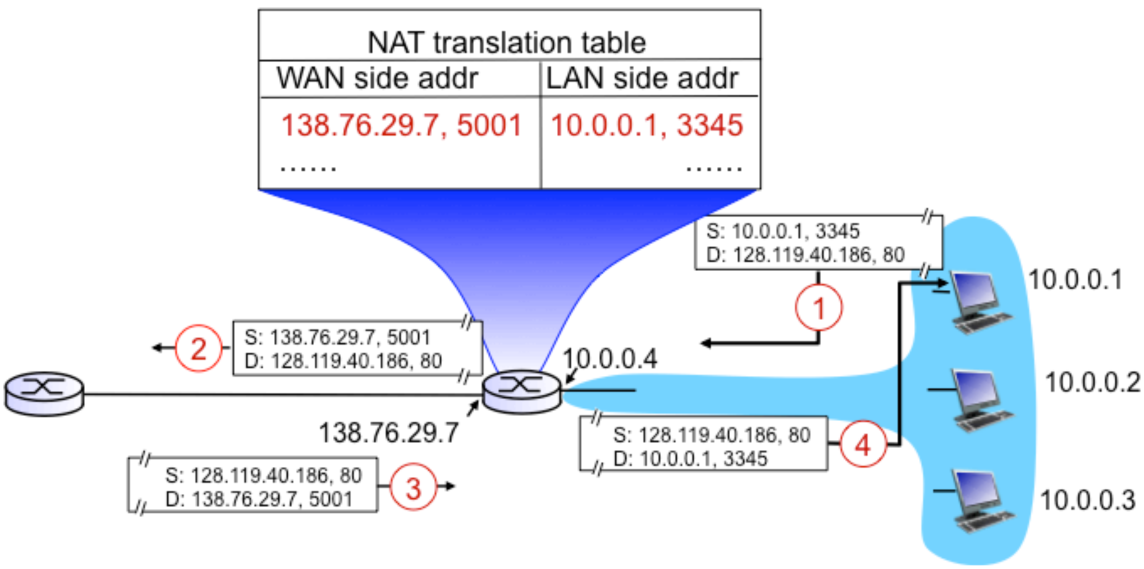


Figure 1

Solution:

a) Home addresses: 192.168.1.1, 192.168.1.2, 192.168.1.3 with the router interface being 192.168.1.4

b) NAT Translation Table

WAN Side	LAN Side
129.119.112.235, 4000	192.168.10.1, 3345
129.119.112.235, 4001	192.168.10.1, 3346
129.119.112.235, 4002	192.168.10.2, 3445
129.119.112.235, 4003	192.168.10.2, 3446

129.119.112.235, 4004	192.168.10.3, 3545
129.119.112.235, 4005	192.168.10.3, 3546

Problem 2 (25 Points):

You are the network administrator of a fast-growing startup and have to get IP addresses to connect 1200 computers to the Internet. You can get IP addresses from two providers, BestIP and IP.com. BestIP sells classA, class B and class C blocks, while IP.com sells CIDR blocks. As the IPv4 address space is scarce, you want to save money and get the smallest number of addresses possible.

a. If you get one block from BestIP, which class do you have to get? What is the problem with that?
b. If you get one block from IP.com, how many bits are there in the mask (e.g., is it /8, /22)? How many addresses are wasted? (Assume that the first and last addresses of the block are not counted as available or used, i.e., pretend, for the calculations, that they don't exist. The first address of a block is used as the network number, and the last one as the broadcast address for the subnet.)
c. Suppose you can get two blocks from IP.com, and they can be of different sizes. How many bits are there in the masks for each of the blocks? How many addresses are wasted now?

Assume you now work for IP.com and have a large number of consecutive addressed available starting at 198.17.0.0. You receive 2 requests for addresses, 4000 and 2000 in that order.

d. For each, give the first and last IP address assigned as well as the subnet mask.
e. Why is it best to minimize the number of CIDR blocks you allocate?
f. Why is it best to also minimize the size of the address blocks?

Assume the following routing table in a router.

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

What is the next hop for each of these addresses, given that you use longest-prefix matching?

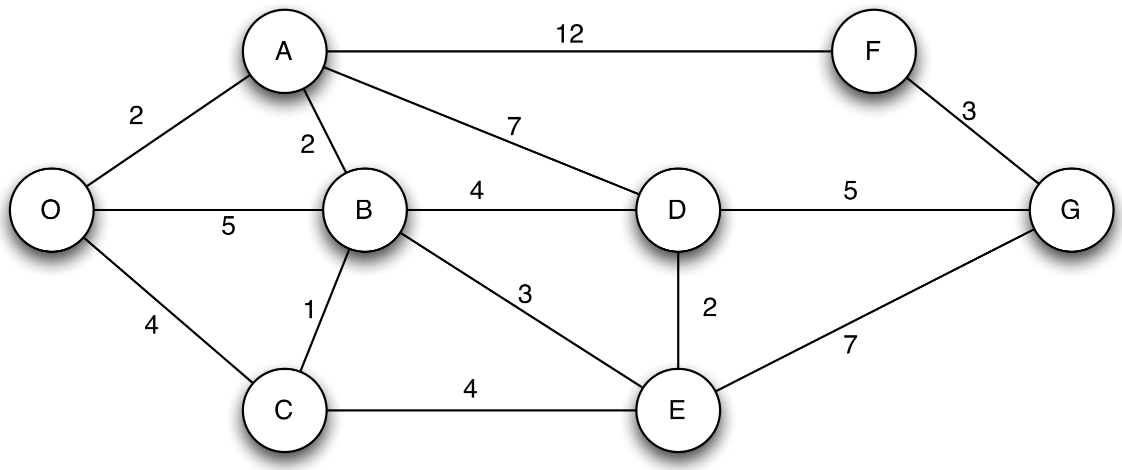
g. 135.46.63.10
h. 135.46.57.14
i. 192.53.40.7
j. 192.53.56.7

Solution:

a. You have to get a class B block from BestIP, because a class C only has addresses for 254 hosts. (The first address is the network number, and the last one is the broadcast address.) The problem with getting a class B block is that it allocates a space of 2^{16} addresses, and you only need 1200.
b. A CIDR block has to have an integral power of two addresses. The smallest power of two larger than 1200 is 2^{11}, which means that the network mask has $32-11 = 21$ bits. The number of wasted addresses is $2048-2-1200 = 846$. (We also accepted $2048 - 1200 = 848$, if you didn't take into account the first and the last addresses of the block.)
c. If we can get two blocks, we should get a /22 block, which will be good for 1024-2 = 1022 computers. For the remaining 178 computers, we need to get a /24 block, good for $2^8 - 2 = 254$ addresses. The number of wasted addresses is 254 - 178 = 76. (We also accepted 80 as the number of wasted addresses, if you didn't take into account the first and last addresses of the block for each of the blocks (1024 + 256) - 1200 = 80).
d. 4000: 198.17.0.0 through 198.17.15.255 (a 4096-address block), bitmask 32-12=20
   2000: 198.17.16.0 through 198.17.23.255 (a 2048-address block), bitmask 32-11=21
e. Because the larger the blocks allocated, the smaller the routing tables in upstream routers become.
f. Because we improve the utilization of the address space, by reducing wasted allocations.
g. Interface 1
h. Interface 0
i. Router 1
j. Router 2

Problem 3 (20 Points):

Consider the following network. With the indicated link costs, use Djikstra's shortest-path algorithm to compute the table of shortest paths from O to all other network nodes. Show how the algorithm works by computing a table below. Use column "N" for "all visited nodes in current step", and each row for "distance and parent of each destination node once a new node is visited".

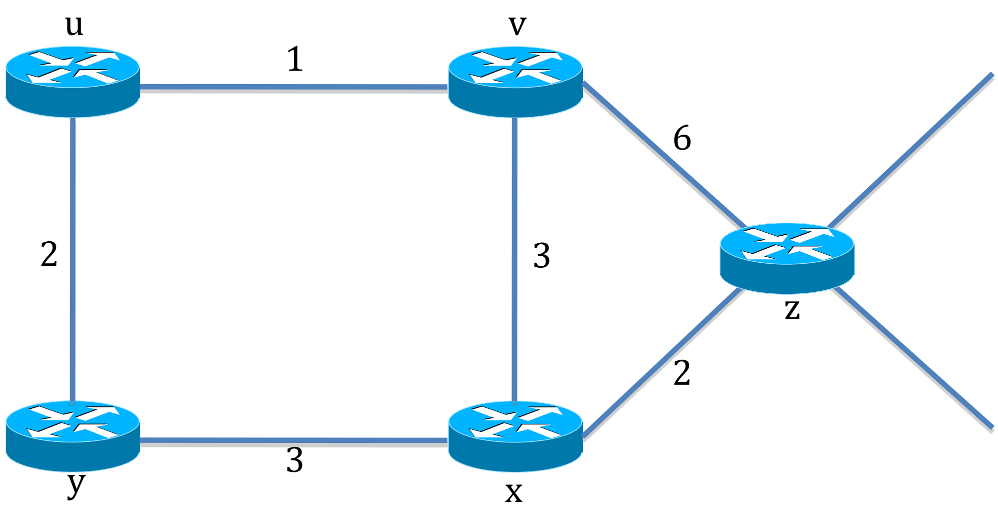


N	*D(A), P(A)*	*D(B), P(B)*	*D(C), P(C)*	*D(D), P(D)*	*D(E), P(E)*	*D(F), P(F)*	*D(G), P(G)*
O							
OA							
OAB							

Solution:

N	*D(A), P(A)*	*D(B), P(B)*	*D(C), P(C)*	*D(D), P(D)*	*D(E), P(E)*	*D(F), P(F)*	*D(G), P(G)*
O	*2,O*	*5,O*	*4,O*	*Inf*	*Inf*	*Inf*	*Inf*
OA	-	*4,A*	*4,O*	*9,A*	*Inf*	*14,A*	*Inf*
OAB	-	-	*4,O*	*8,B*	*7,B*	*14,A*	*Inf*
OABC	-	-	-	*8,B*	*7,B*	*14,A*	*Inf*
OABCE	-	-	-	*8,B*	-	*14,A*	*14,E*
OABCED	-	-	-	-	-	*14,A*	*13,D*
OABCEDG	-	-	-	-	-	*14,A*	-

Problem 4 (20 Points):
Consider the network shown below, and assume that each node initially knows the cost to each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node *z*. (Please show the intermediate steps until convergence is reached!)



		Cost to				
		u	v	x	y	z
	v	∞	∞	∞	∞	∞
From	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

Solution:

		Cost to				
		u	v	x	y	z
	v	∞	∞	∞	∞	∞
From	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

Cost to

u v x y z

		u	v	x	y	z
	v	1	0	3	∞	6
From	x	∞	3	0	3	2
	z	7	5	2	5	0

Cost to

		u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

Cost to

		u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

Problem 5 (15 Points):

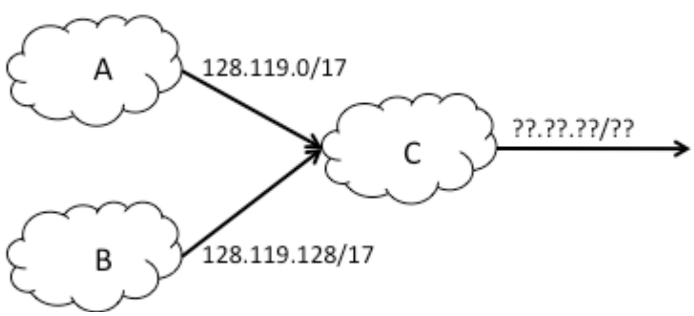


Figure 2

Consider Figure 2 for the following problem.

a. In this case, the two networks A and B are connected through network C to the rest of the Internet. What network address or addresses for A and B are advertised by the gateway router (that connects C to the Internet)? Specify network address and subnet mask?
b. Assume that the router that connects C to both A and B has interface 1 connected to A and interface 2 connected to B. For these two networks, specify the forwarding table entries in the router of network C.
c. Now assume that a host somewhere in the Internet (the host is not located in networks A, B, and C) sends a packet to *i)* a host in network A and *ii)* to a host in network B. Explain how the router (from problem b.) in network C determines which interface to send each of these packets.

Solution:

a. *128.119.0/16*
b. *128.119.0/17 | Interface 1, 128.119.128/17, Interface 2*
c. *longest prefix matching*