Homework 03

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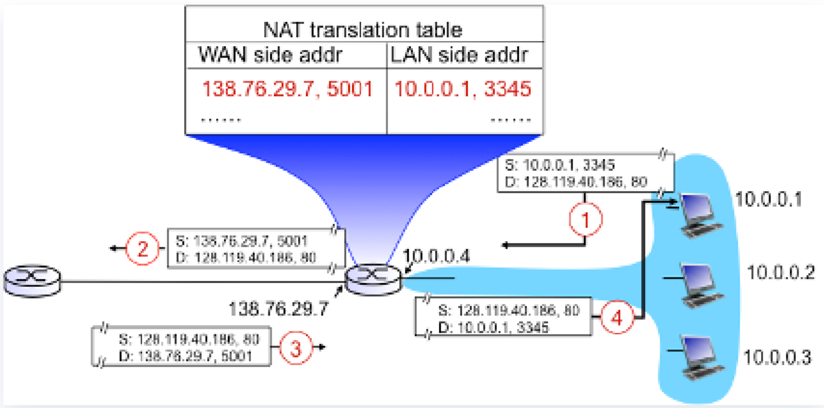
Problem 01:

Consider the network setup shown in **Figure 1.** Instead of the shown IP address the ISP instead assigns the router the address 129.109.112.235 and that the network address of the home network is 192.168.1/24.



1. **Assign addresses to all interfaces in the home network.**

   Since the network address of the home network is `192.168.1/24`, we can have the router's address set as `192.168.1.1`, and the hosts' addresses set as `192.168.1.2`, `192.168.1.3`, and `192.168.1.4`.

2. **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.**

   In the table, we will have:

	WAN side address	LAN side address
1	129.109.112.235, 5001	192.168.1.2, 3345
2	129.109.112.235, 5002	192.168.1.2, 3346
3	129.109.112.235, 5003	192.168.1.3, 3345
4	129.109.112.235, 5004	192.168.1.3, 3346
5	129.109.112.235, 5005	192.168.1.4, 3345
6	129.109.112.235, 5006	192.168.1.4, 3346

Problem 02

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.

1. **If you get one block from BestIP, which class do you have to get? What is the problem with that?**

   You should get a class B block. Since the class C would only give you $2^8 - 2 = 254$ IP addresses, the next best thing would be class B block. However, one block would contain $2^{16} - 2 = 65534$ IP addresses, which is way too much than 1200 IP addresses that we are looking for.

2. **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.)**

   Since $log_2 1200 \approx 10.2288$, therefore, we need to buy a CIDR block with 2^{11} hosts. Then, that leaves $32 - 11 = 21$ bits for the mask. Therefore, the network mask would be $/21$. However, doing so will leave $2^{11} - 2 - 1200 = 846$ IP addresses unused.

3. **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?**

   We can get a CIDR $/22$ block and a CIDR $/24$ block. In total, these 2 blocks would give us $2^{10} - 2 + 2^8 - 2 = 1022 + 254 = 1276$ IP addresses. As a result, we are only wasting $1276 - 1200 = 76$ IP addresses.

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

1. **For each, give the first and last IP address assigned as well as the subnet mask.**

   As for 4000 consecutive IP addresses, we can do a CIDR $/20$ block, which gives $2^{32-20} - 2 = 4094$ IP addresses. Therefore, we can assign the IP addresses as `198.17.0.0` to `198.17.15.255`, with a subnet mask of `255.255.240.0`.

   And for 2000 consecutive IP addresses, we can do a CIDR $/21$ block, which gives $2^{32-21} - 2 = 2046$ IP addresses. Therefore, we can assign the IP addresses as `198.17.16.0` to `198.17.23.255`, with a subnet mask of `255.255.248.0`.

2. **Why is it best to minimize the number of CIDR blocks you allocate?**

   When we allocate the CIDR block, we also need to decide the next hop entries in routes that forward to different physical locations. As a result, the larger the block we allocate, the larger the routing table becomes.

3. **Why is it best to also minimize the size of the address blocks?**

   In this way, there will be less IP addresses get wasted during the allocation.

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?

1. 135.46.63.10

   Interface 1.

2. 135.46.57.14

   Interface 0.

3. 192.53.40.7

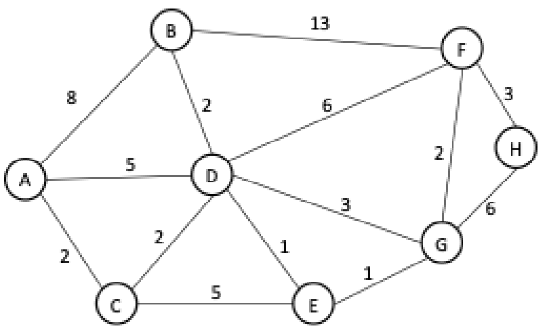
   Router 1.

4. 192.53.56.7

   Router 2.

Problem 03

Consider the following network. With the indicated link costs, use Djikstra's shortest-path algorithm to compute the table of shortest paths from *A* to all other network nodes. Show how the algorithm works by computing the 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".

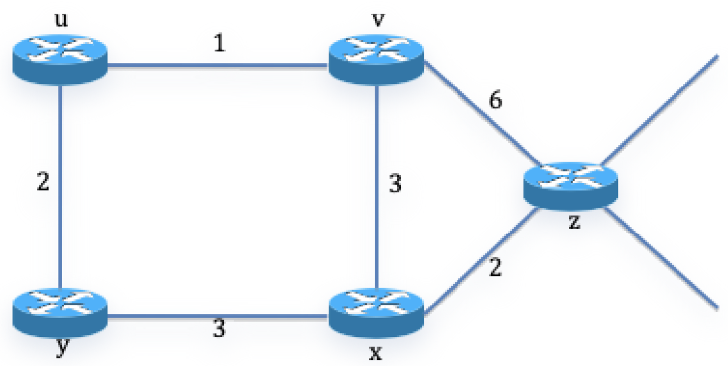


N'	D(B), P(B)	D(C),P(C)	D(D), P(D)	D(E), P(E)	D(F), P(F)	D(G), P(G)	D(H), P(H)
A	8, A	2, A	5, A	∞	∞	∞	∞
AC	8, A	-	4, C	7, C	∞	∞	∞

N'	D(B), P(B)	D(C),P(C)	D(D), P(D)	D(E), P(E)	D(F), P(F)	D(G), P(G)	D(H), P(H)
ACD	6, D	-	-	5, D	10, D	7, D	∞
ACDE	6, D	-	-	-	10, D	6, E	∞
ACDEG	6, D	-	-	-	8, G	-	12, G
ACDEGB	-	-	-	-	8, G	-	12, G
ACDEGBF	-	-	-	-	-	-	11, G

Problem 04

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

Step a

	u	v	x	y	z
v	∞	∞	∞	∞	∞
x	∞	∞	∞	∞	∞
z	∞	6	2	∞	0

Step b

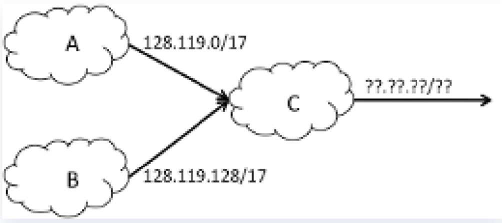
	u	v	x	y	z
v	1	0	3	∞	6
x	∞	3	0	3	2
z	7	5	2	5	0

Step c

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

Then, we are finished at Step c.

Problem 05



Consider the figure above for the following problem.

1. **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?**

   In this case, it is advertising `128.119.0.0/16` with a subnet mask `255.255.0.0`.

2. **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.**

   The forwarding table in C would be:

Destination	Next Hop
128.119.0.0/17	Interface 1
128.119.128.0/17	Interface 2

3. **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.**

We can use the longest prefix matching to determine whether the destination of the packet is in network A or in network B.