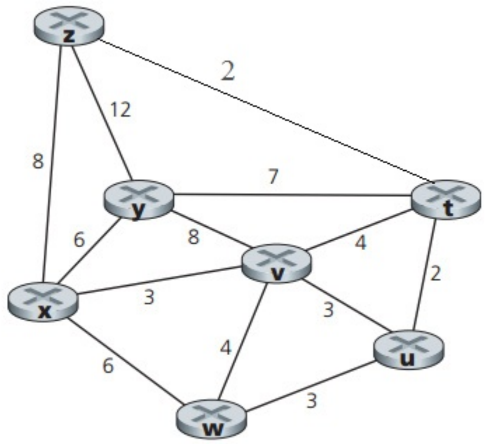
Problem 1

Consider the following network of routers where the numbers above each link indicate link costs:



Considering calculations from the perspective of node **z**:

1. Show a table showing iterations of the Link State routing algorithm.
2. Show a resulting routing table (next hop for each destination).

1.

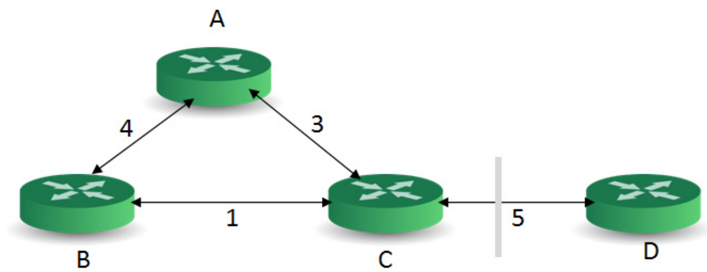
Step	N	y	x	v	t	w	u
0	z	12	8	∞	2	∞	∞
1	zt	9	8	6	2	∞	4
2	ztu	9	8	6	2	7	4
3	ztuv	9	8	6	2	7	4
4	ztuvw	9	8	6	2	7	4
5	ztuvwx	9	8	6	2	7	4
6	ztuvwxy	9	8	6	2	7	4

2.

Destination	Next Hop
y	t
x	x
v	t
t	t
w	t
u	t

Problem 2

Consider a network of 4 routers running Distance Vector routing algorithm where the numbers above each link indicate link costs.



1. Suppose, the link between C and D fails. Show that split horizon will not eliminate the count-to-infinity problem.

2. How can split horizon with poisoned reverse help in eliminating the count-to-infinity problem when the link between C and D fails?

1. A split horizon can be implemented such that:
   (a) A and B do not tell C that they can reach D
   (b) After the C-D failure, A learns from B that it can reach D, so A sends a new route to C
   (c) After C learns about the new route from A, it sends it to B
   (d) After B learns about the new route from C, it sends it to A
   (e) After A learns about the new route from B, it sends it to C

   This means that we have the count-to-infinity problem as an infinite update loop exists.

2. A split horizon with poisoned reverse can be implemented such that:
   (a) Because A and B must go through C to reach D, A and B advertise to C that their distance to D is ∞
   (b) After the C-D failure, C realizes it loses reachability to D
   (c) When C checks if A or B can reach D, it observes that both A and B have ∞ distances to D, so no routes are sent
   (d) A does not learn from B that it can reach D, so a new route is not sent to C

   This means that once we have introduced a split horizon with poisoned reverse, we have helped eliminate the count-to-infinity problem.

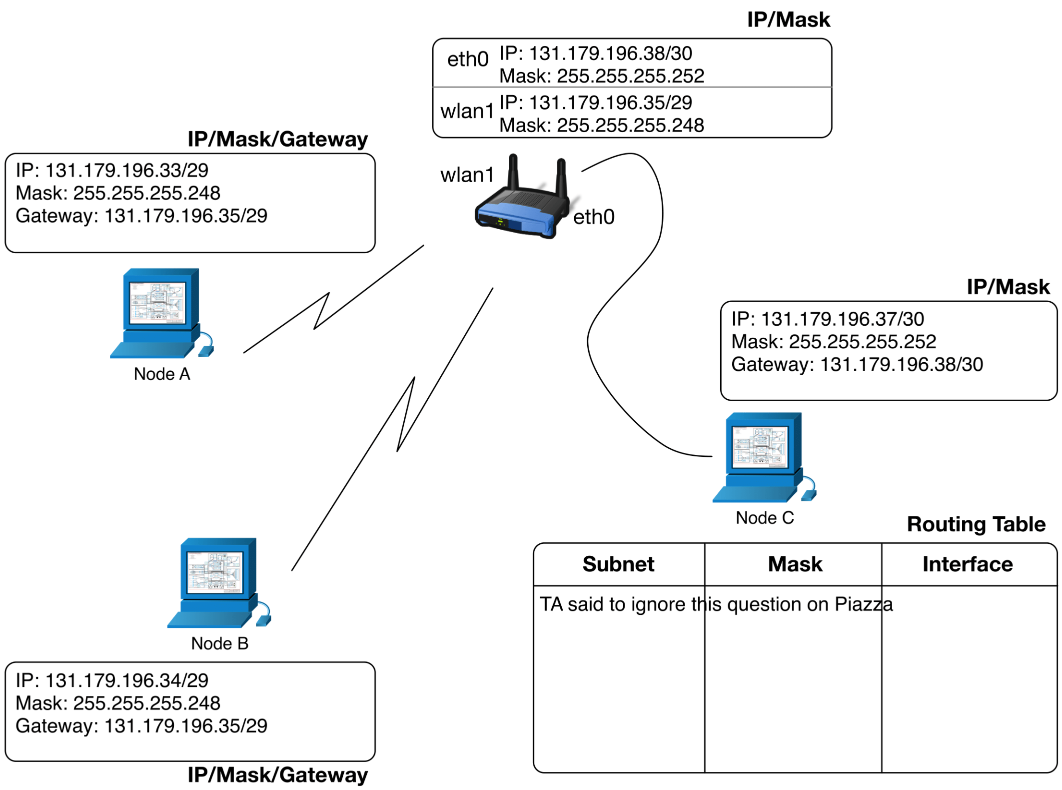
Problem 3

Consider a simple network with one WiFi router and 3 hosts on the Figure. Host A and B are connected to the router over wireless interface, host C is connected using wired Ethernet interface.

1. Assign IP (IPv4) addresses, network masks, and next hop gateways (where applicable) addresses so that all of them can communicate with each other.

   Consider that have been given 131.179.196.32/27 address block and all assignments should be made from that block. **Your assignment must use the most conservative IP address allocation.** That is, assign IP addresses to hosts using as many network bits (the largest possible subnet mask) as possible.

2. Fill the content of the Host C's routing table, **without using the default route**.



Problem 4

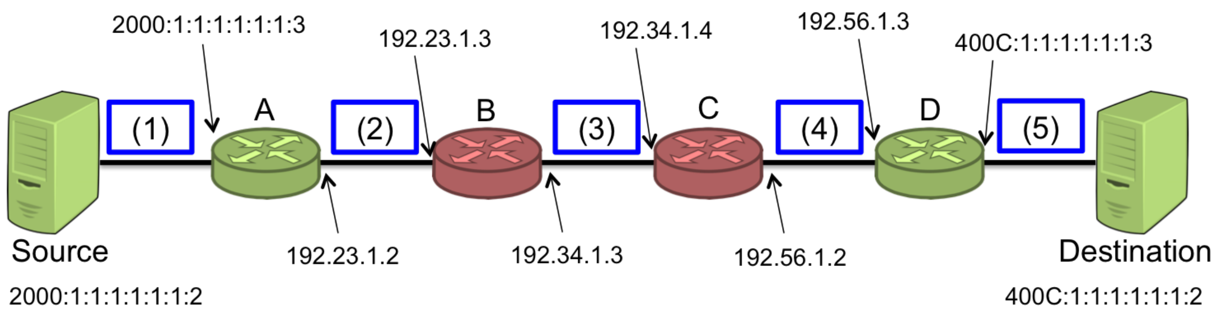
Answer the following questions regrading to IP.

1. Suppose Host A receives an IP datagram. How does the network layer in Host A know it should pass the segment (that is, the payload of the datagram) to TCP rather than to UDP or to something else?
2. Can a host have more than one IP address? Justify your answer briefly.
3. How does Skype work between two hosts which are behind two different NAT boxes?
4. Compare IPv4 and IPv6 headers. What are the common fields?

1. The IP datagram has an IP header with a protocol field that identifies the upper layer that the payload of the datagram should be delivered to.
2. Yes. An IP address identifies unique attachment points or interfaces. A single host is connected to many other hosts and each interface of this host must be identified uniquely. Thus, this host has more than one IP address.
3. For two hosts behind two different NAT boxes, Skype operates by interacting with a Skype relay. First, a connection to the relay is initiated by a NATted host. Then, a connection to the relay is initiated by the client. Once the relaying is established and care is taken to keep the NAT open, the two hosts can communicate. The relay essentially bridges the packets between the connections.
4. IPv4 and IPv6 have many different and common fields. Specifically, the version, source address, destination address are fields that have the same name and represent the same thing in both header types. Some values have new names and new positions but represent the same idea. The type of service, total length, time to live, and protocol fields of IPv4 are loosely related to the priority, payload length, next header, and hop limit fields of IPv6.

Problem 5

Consider a network with four routers. Router A and D are IPv6 routers while router B and C are IPv4 routers. Assume that the source host sends an IPv6 packet to the destination host. The blue boxes in the figure represent the packet's location. Show source IP address and destination IP address of the packet located at (1) through (5).



1. IPv6 Header:
   Source IP address: 2000:1:1:1:1:1:1:2
   Destination IP address: 400C:1:1:1:1:1:1:2
2. IPv4 Header:
   Source IP address: 192.23.1.2
   Destination IP address: 192.56.1.3
   IPv6 Header inside the IPv4 datagram:
   Source IP address: 2000:1:1:1:1:1:1:2
   Destination IP address: 400C:1:1:1:1:1:1:2
3. IPv4 Header:
   Source IP address: 192.23.1.2
   Destination IP address: 192.56.1.3
   IPv6 Header inside the IPv4 datagram:
   Source IP address: 2000:1:1:1:1:1:1:2
   Destination IP address: 400C:1:1:1:1:1:1:2
4. IPv4 Header:
   Source IP address: 192.23.1.2
   Destination IP address: 192.56.1.3
   IPv6 Header inside the IPv4 datagram:
   Source IP address: 2000:1:1:1:1:1:1:2
   Destination IP address: 400C:1:1:1:1:1:1:2
5. IPv6 Header:
   Source IP address: 2000:1:1:1:1:1:1:2
   Destination IP address: 400C:1:1:1:1:1:1:2