- **Print** your name.

Problem	Points	Score
1	2	
2	2	
3	2	
4	2	
5	2	
Total:	10	
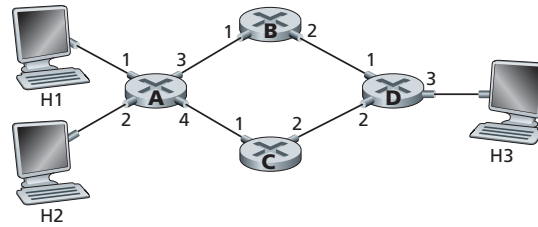
1. Consider the network above.

   (a) (1 point) Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

   > **Solution:** Data destined to host H3 is forwarded through interface 3
   > Destination Address H3: Link Interface 3

   (b) (1 point) Can you write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4? (Hint: this is a trick question.)

   > **Solution:** No, because forwarding rule is only based on destination address.

2. (2 points) Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
00	0
010	1
011	2
10	2
11	3

   For interface 2, give the associated range of destination host addresses and the number of addresses in the range.

   > **Solution:** Destination address range Link interface
   >
   > 11000000
   > through   3
   > 11111111
   >
   > Number of addresses for interface $3 = 2^6 = 64$

3. (2 points) Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix

223.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three net- work addresses (of the form a.b.c.d/x) that satisfy these constraints.

> **Solution:** 223.1.17.0/26
> 223.1.17.128/25
> 223.1.17.192/28

4. (2 points) Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

> **Solution:** The maximum size of data field in each fragment = 680 (because there are 20 bytes IP header). Thus the number of required fragments = $\lceil 2400 20/680 \rceil$ = 4 Each fragment will have Identification number 422. Each fragment except the last one will be of size 700 bytes (including IP header). The last datagram will be of size 360 bytes (including IP header). The offsets of the 4 fragments will be 0, 85, 170, 255. Each of the first 3 fragments will have flag=1; the last fragment will have flag=0.

5. (2 points) Consider the SDN OpenFlow network shown in the following figure. Suppose that the desired forwarding behavior for datagrams arriving from host h3 or h4 at s2 is as follows:

- any datagrams arriving from host h3 and destined for h1, h2, h5 or h6 should be forwarded in a clockwise direction in the network

- any datagrams arriving from host h4 and destined for h1, h2, h5 or h6 should be forwarded in a counter clockwise direction in the network
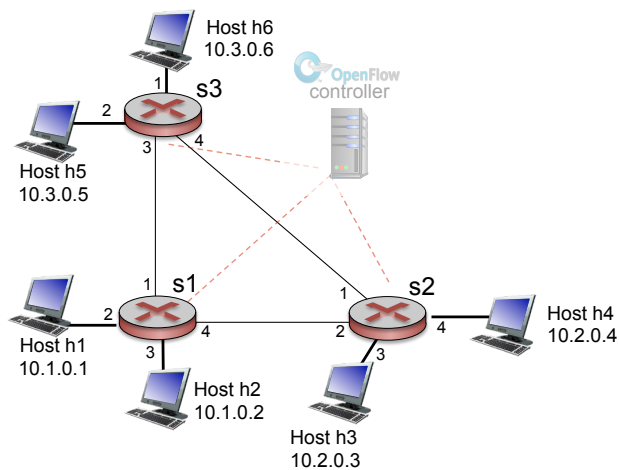
Specify the flow table entries in s2 that implement this forwarding behavior.

Solution:

S2 Flow Table	
Match	**Action**
Ingress Port = 3; IP Dst = 10.1.*.*	Forward (2)
Ingress Port = 3; IP Dst = 10.3.*.*	Forward (2)
Ingress Port = 4; IP Dst = 10.1.*.*	Forward (1)
Ingress Port = 4; IP Dst = 10.3.*.*	Forward (1)