

CS3640 Final Exam

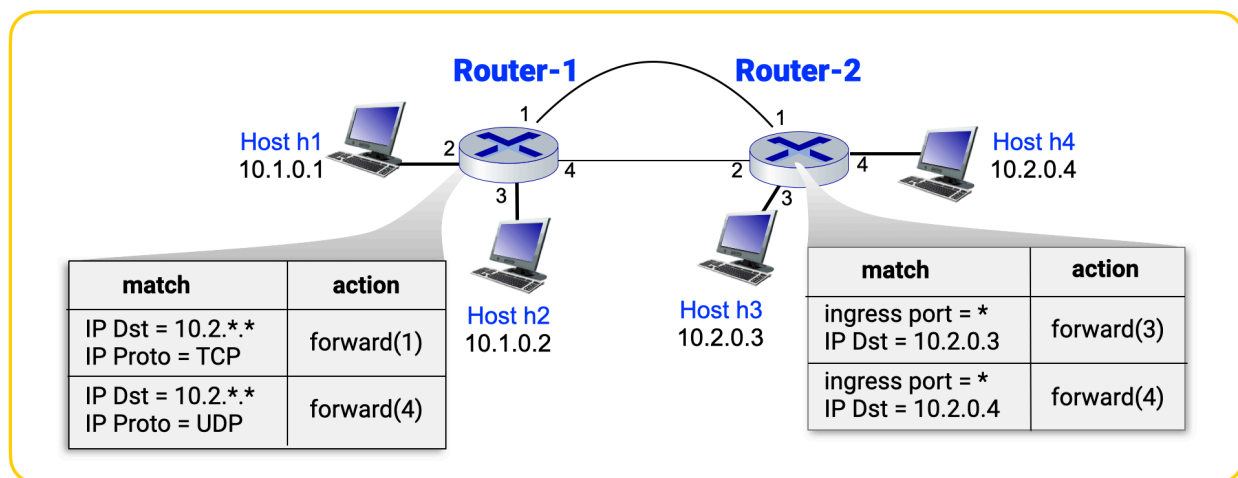
Name:

HawkID/university ID:

- ▶ This is a closed book, closed notes, closed electronics, but open minds exam
- ▶ You have four mandatory questions (Q1 – Q4), all of which carry 25 points
- ▶ There is an extra credit question (Q5). Points earned in Q5 can make up for points lost in other questions, but cannot take your score beyond 100
- ▶ Keep your answers brief and to the point. While the space provided here should be sufficient to write your answers, we will provide extra sheets if needed.
- ▶ You are welcome to clarify any doubts or concerns with the instructor, but cannot engage in discussions with your fellow students
- ▶ We expect you to exhibit highest levels of academic integrity and honesty

Q1. Software Defined Networking**25 points**

- (a) What is SDN's core abstraction of *match-plus-action*? Explain with an example. (10 points)
- (b) In the topology below, SDN flow tables at routers R1 and R2 govern how packets flow across the network. Use this understanding to explain how a TCP packet originating from host h1 and destined for host h4 would travel? Would anything change if the packet were to be of type UDP? (15 points)

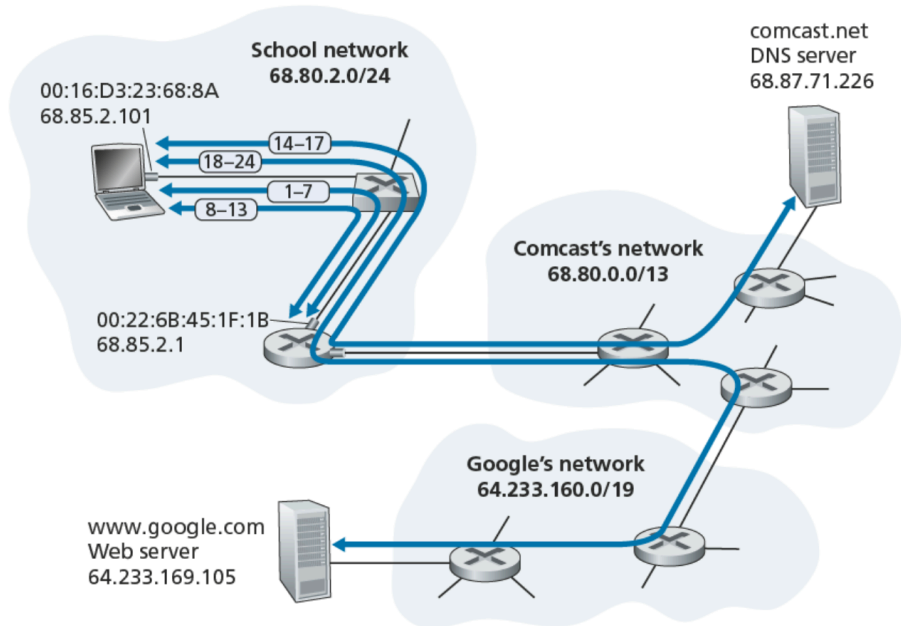


Q2. A Day in the Life of a Web Page Request

25 points

Trinity boots her laptop up and plugs it into an Ethernet cable, which is connected to her department's Ethernet switch. Her goal is to use the website www.google.com

In steps 1 - 7, Trinity's laptop procures an IP address for itself, learns about the IP address of its first-hop router (68.85.2.1), and the IP address of the DNS server (68.87.71.226).



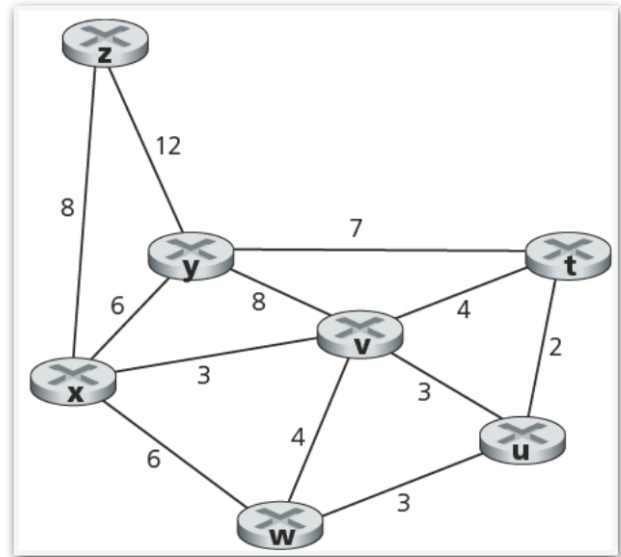
Explain steps 8–17 in full technical detail i.e., explain all the protocols, their control and data flows involved in resolving the DNS name of www.google.com into Google web server's IP address. *You do not have to number each step in your answer, but make sure all the key details are covered.* (25 points)

Q3. Link-State Routing: Dijkstra's Algorithm

25 points

Here is a network with seven routers.

- (a) Use Dijkstra's algorithm to compute the shortest path from **u** to all other routers. Remember to clearly write your link-state table. (15 points)
- (b) Based on the routing information you calculated above, compose the forwarding table for **u**. (10 points)

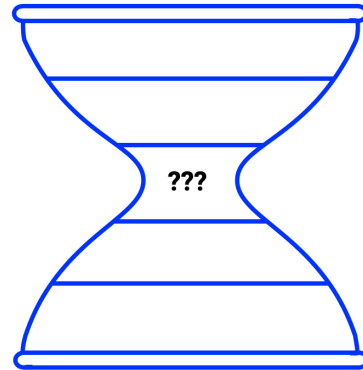


Q4. Internet's Hourglass Model

25 points

The original designers of the Internet protocols envisioned them as fitting an hour glass model.

- (a) Name the protocol(s) at the waist of the hourglass, and explain why this is both **necessary** and **sufficient**. (15 points)
- (b) How are middleboxes altering this model? Justify your answer by using an example middlebox. (10 points)



Q5. Bonus question**10 points**

This question concerns resource provisioning in datacenters.

- (a) Define horizontal scaling. How is it different from vertical scaling. (5 points)
- (b) Why is it more challenging to horizontally scale networks as opposed to say, data storage or compute? (5 points)

