Final Review

Final information

- The exam will cover **all** the material taught in class with more focus on **network layer and link layer**, i.e., chapters **4,5 and 6**.
- The final exam will be on **Dec. 11th at 9:00 am – 11:30 am** as indicated in: https://uwaterloo.ca/registrar/sites/ca.registrar/files/uploads/files/fall_2022_final_exam_schedule_4.pdf

How to do well on the midterm?

- Read through the lecture notes.
- Review tutorial sets and problem sets.
- Review problems from previous exams
- Ask questions:
  - PIAZZA
  - Additional office hours
  - email: am3abdelaziz@uwaterloo.ca

Chapter	Sections
Chapter 1: Introduction	1.1 – 1.5
Chapter 2: Application	2.1 2.2 (till 2.2.3) 2.4
Chapter 3: Transport	3.1 3.2 3.3 3.4 – excluding finite-state definitions FSM 3.5 3.6 3.7.1

How to do well on the final?

- Read through the lecture notes.
- Review tutorial sets and problem sets.
- Review problems from previous exams
- Ask questions:
  - PIAZZA
  - Additional office hours
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Chapter	Sections
Chapter 4: Network: Data plane	4.1 – 4.3 (excluding 4.3.4)
Chapter 5: Network: Control plane	5.1 – 5.4
Chapter 6: Link Layer	6.1 – 6.4.3 6.6 6.7

Problems

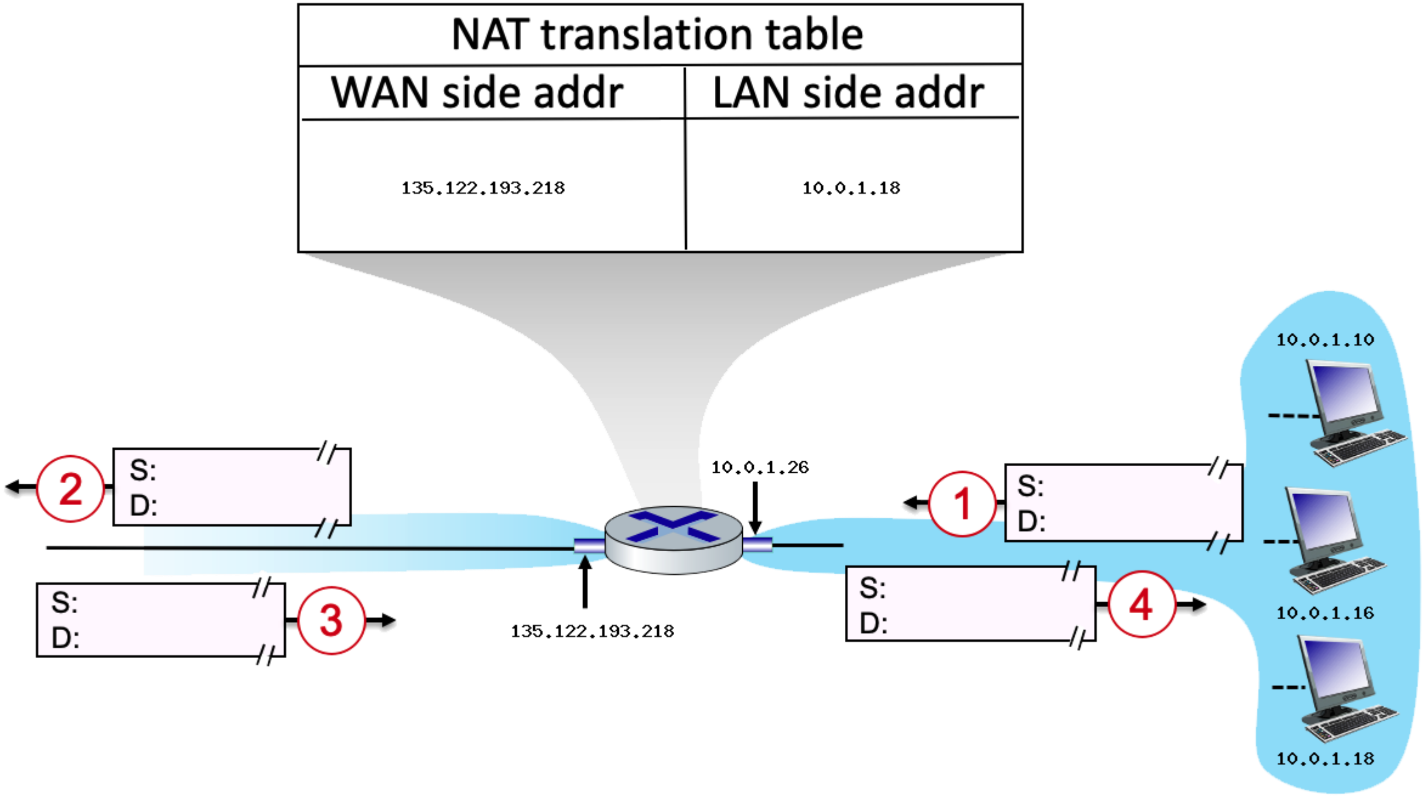
Chapter	Idea	Example
Chapter 4: Network layer: Data Plane	IP fragmentation	Slide 4-27
	Subnetting	Slides 4-37 and 4-38
	Longest prefix matching	Slide 4-56
	Address Aggregation	Slide 4-62
	NAT	Slide 4-67
Chapter 5: Network layer: Control Plane	Link state routing	Slides 5-76 to 5-78
	Distance Vector Routing	Problems from previous finals Q-10
	OSPF	Problems from previous finals Q-7
	BGP	Problems from previous finals Q-4
Chapter 6: Link Layer	Error detection and correction	Slides 6-12 and 6-15
	Random Access Collisions	Slide 6-25
	Self learning Switches	Slides 6-67 to 6-69

Network Address Translation

Consider the scenario in which three hosts, with private IP addresses in a local network behind a NAT'd router.

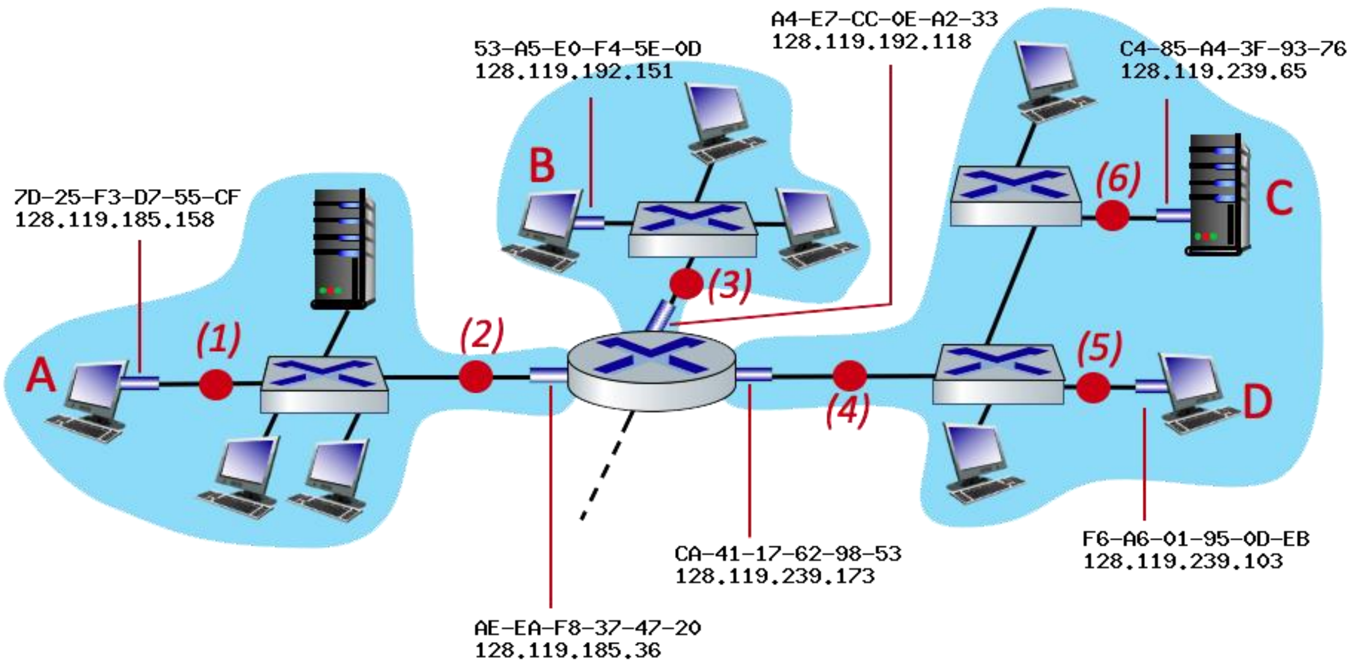
Suppose that the host with IP address **10.0.1.18** sends an IP datagram destined to host **128.119.160.187**. The source port is **3378**, and the destination port is **80**.

<u>Q:</u> What are source and destination **<u>IP address</u>** and **<u>port numbers</u>** for packets 1—4? State your assumptions.



LINK LAYER (AND NETWORK LAYER) ADDRESSING AND FORWARDING

- Consider an IP datagram being sent from node A to node D.
- List the points where, the MAC addresses change.



BELLMAN FORD DISTANCE VECTOR ALGORITHM (FOR COMPUTING LEAST COST PATHS)

Consider the given 6-node network, with the indicated link costs:

1. What are the initial distance vectors for router **'U'**?

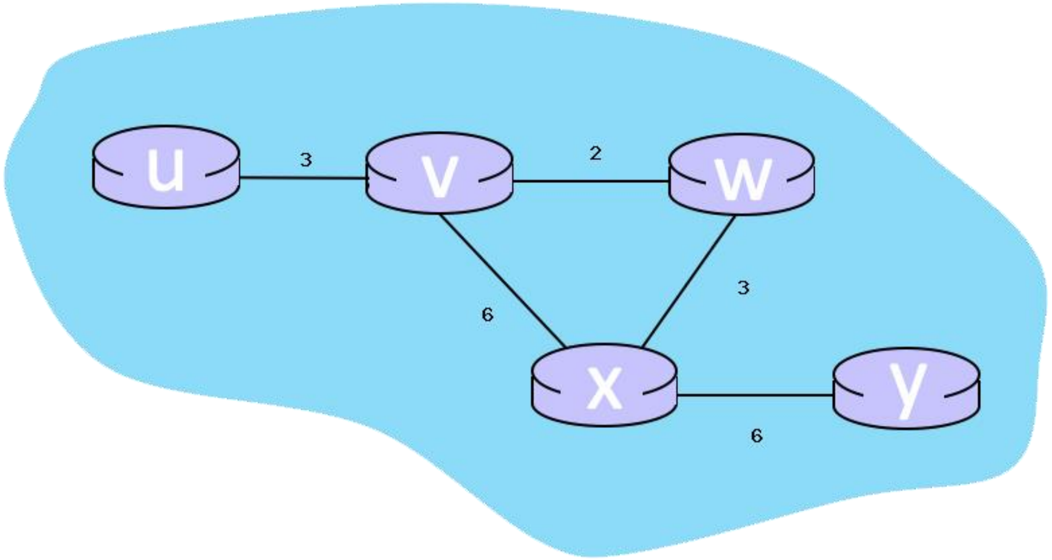
(u,v,w,x,y) = (0,3, ∞, ∞, ∞)

2. When the algorithm converges, what are the distance vectors from router **'V'** to all routers?

(u,v,w,x,y) = (3,0,2,5,11)

3. The phrase 'Good news travels fast' is very applicable to distance vector routing when link costs decrease; what is the name of the problem that can occur when link costs increase?

It is called the 'Count to Infinity' problem.



DIJKSTRA'S LINK STATE ALGORITHM

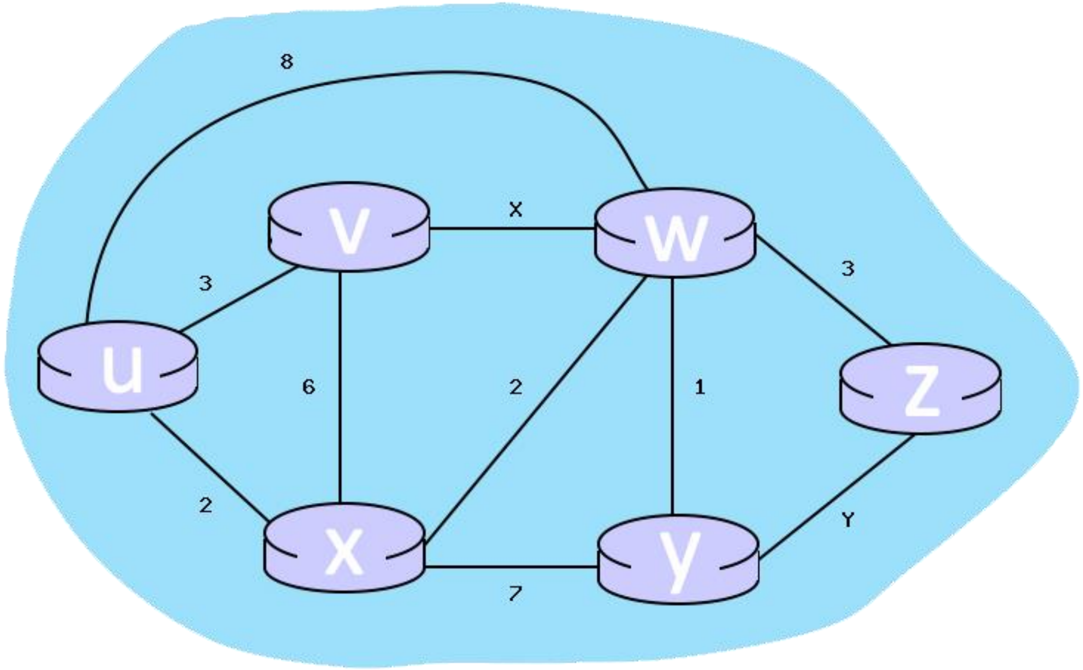
Consider the incomplete 6-node network shown below, with the given link costs and the completed table below, which calculates the shortest distance to all nodes from V:

1. For link X, what is the cost associated with this link?

6

2. For link Y, what is the cost associated with this link?

1



Node	Shortest distance from V	Previous Node
V	0	n/a
U	3	V
X	5	U
W	6	V
Y	7	W
Z	8	Y

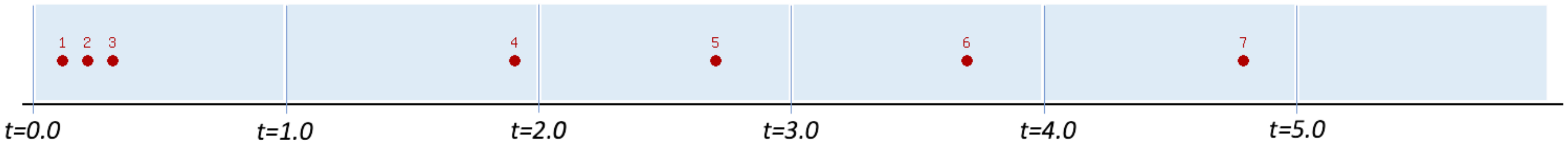
MULTIPLE ACCESS PROTOCOLS: COLLISIONS

Consider the figure below, which shows the arrival of 7 messages for transmission at different multiple access wireless nodes at times t = <0.1, 0.2, 0.3, 1.9, 2.7, 3.7, 4.8> and each transmission requires exactly one time unit.

Suppose all nodes are implementing Carrier Sense Multiple Access (CSMA), with collision detection (**CSMA/CD**). Suppose that the time from when a message transmission begins until it is beginning to be received at other nodes **is 0.4 time units**, and assume that a node can stop transmission instantaneously when a message collision is detected.

(Thus if a node begins transmitting a message at t=2.0 and transmits that message until t=3.0, then any node performing carrier sensing in the interval [2.4, 3.4] will sense the channel busy.)

Assume that all retransmissions occur outside the considered duration and thus can be ignored for the question purposes.



1. For each message, indicate the time at which each message transmission begins, or indicate that message transmission does not begin due to a channel that is sensed busy?

0.1,0.2,0.3,1.9,s,3.7,s

2. Which messages transmitted successfully?

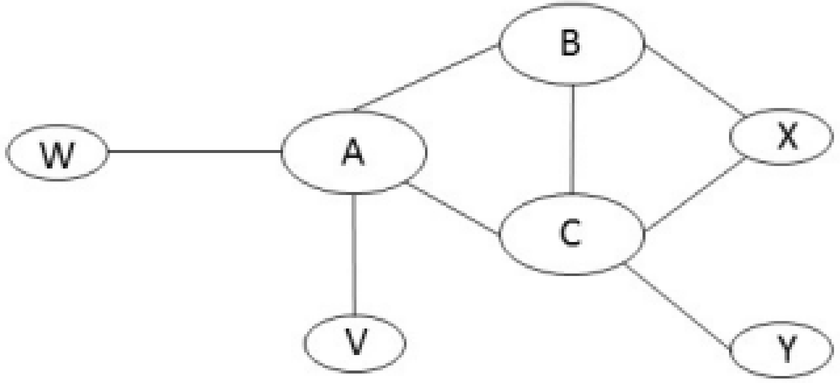
4,6

3. At what time did each message stop transmitting due to a collision?

0.6,0.5,0.5,x,x,x,x

BGP Routing

The following figure shows the interconnection of seven autonomous systems, A, B, C, V, W, X, and Y. The solid lines represent physical links. Suppose that B and C have a peering relationship, and A is a customer of both B and C.
Suppose that A would like to have the traffic destined to W to come from E only, and the traffic destined to V from either B or C.



1. How should A advertise its routes to B and C?
A should advise to B two routes, AS-paths A-W and A-V. A should advise to only one route, A-V

2. What AS paths does C receive following the advertisements sent by A?
C receives AS paths: B-A-W, B-A-V, A-V

3. What should A do to prevent X and Y from using A as a transit AS in case links B-C and X-C fail?
If A receives an AS-PATH B-X, it does not advertise a path A-B-X to C. Similarly, if A receives an AS-PATH C-Y, it does not advertise A-C-Y to B.