CISC 7332X T6
LAN Switching

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Acknowledgements

- Some pictures used in this presentation were obtained from the Internet

- The instructor used the following references

  - Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 5th Edition, Elsevier, 2011

  - Andrew S. Tanenbaum, Computer Networks, 5th Edition, Prentice-Hall, 2010

Ethernet LAN: How to Expand?

- Expand an Ethernet local area network (LAN)

- Repeaters
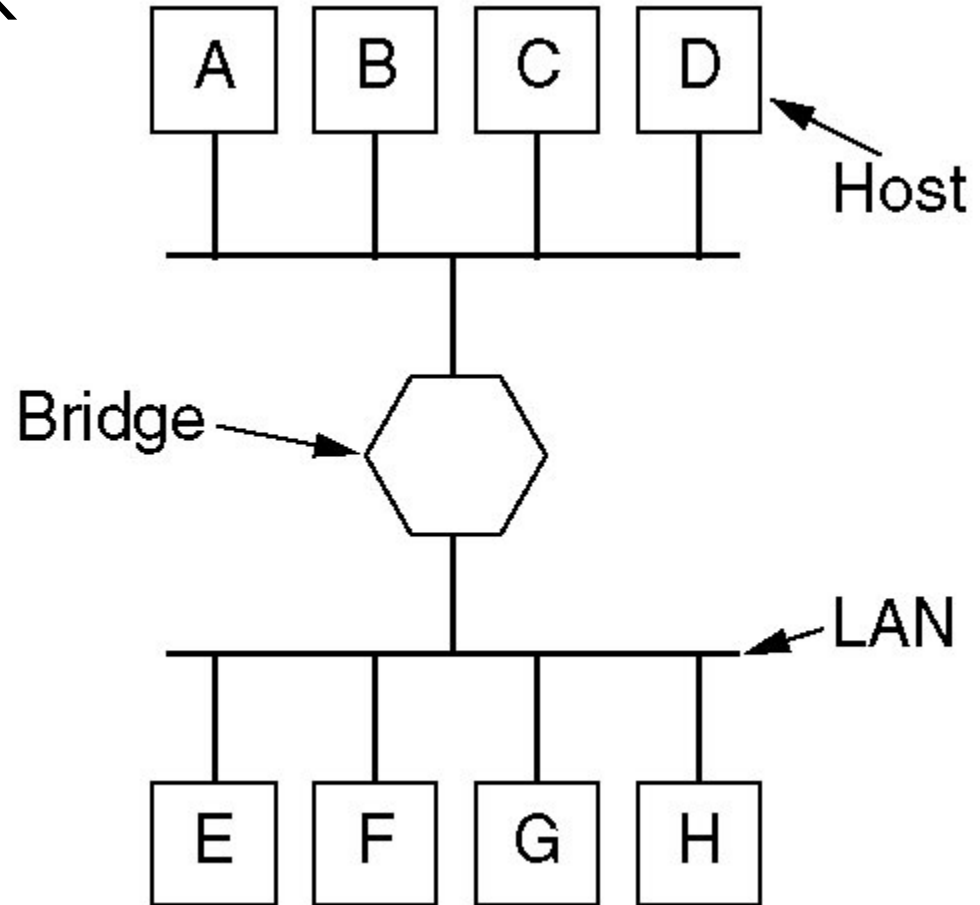
- Bridges (or Hubs)

- Switches

Repeaters

- Devices in physical layer

- Receive, amplify (regenerate), and retransmit signal in both directions.

- Example: Ethernet repeaters

Repeater

Host
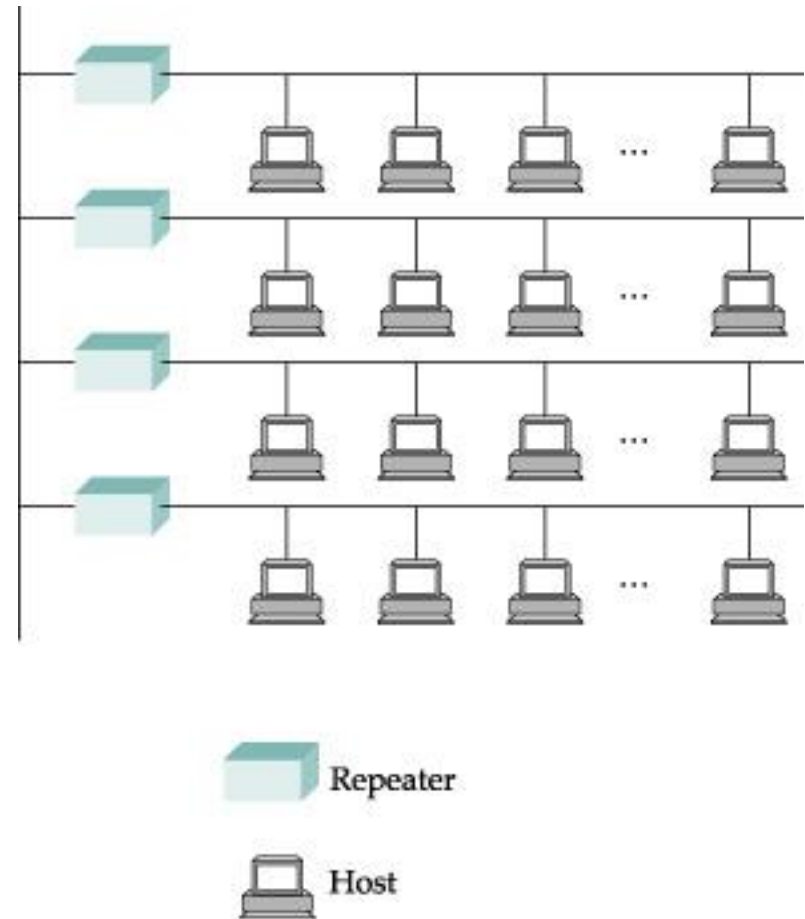
Bridges

- Devices in data link layer

- Operates in *promiscuous mode*

- Forward packets/frames to either connected networks

- Example: Ethernet bridges

A B C D ← Host

Bridge →

← LAN

E F G H
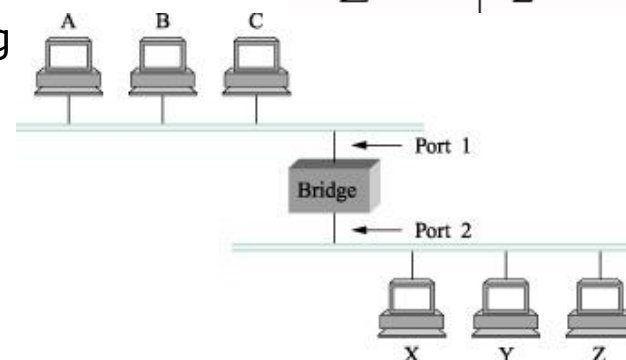
Learning Bridges

- Does the bridge need to forward a frame to every port when?

  - A → B?

  - A → X?

- Improvement

  - Do not forward unnecessarily

  - Relying on a **forwarding table** at each switch
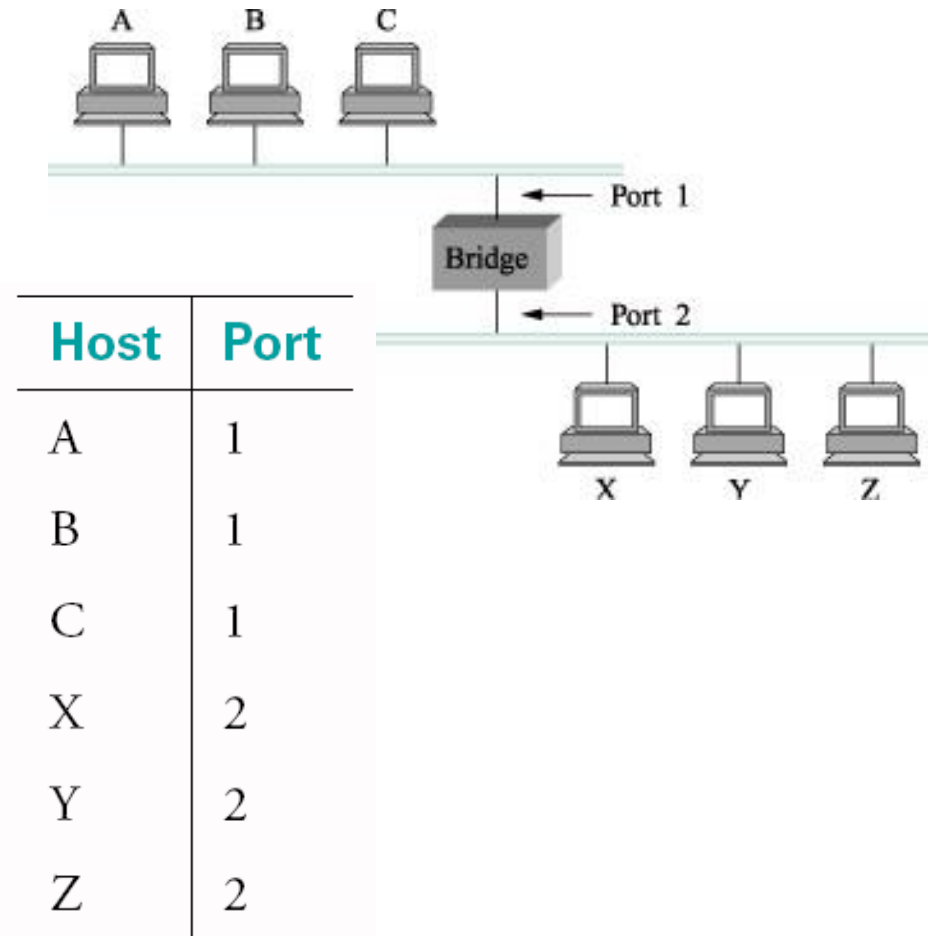
Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

Forwarding Algorithm

| Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

- Destination address in frame header indicates which host a frame is addressed to

- Source address in frame header indicates which host a frame is originated

- Each bridge maintains a "forwarding" table

- Algorithm

  - On receiving a frame *(src, dst, receiving port)*, look up *dst* in the forwarding table

    - If *dst* is found

      - If port in forwarding table = receiving port, discard the frame;

      - otherwise, forward to the forwarding port

    - <u>Otherwise, forward to all ports (flooding)</u>

Exercise 1

- Build a complete "forwarding" table for the Ethernet switch
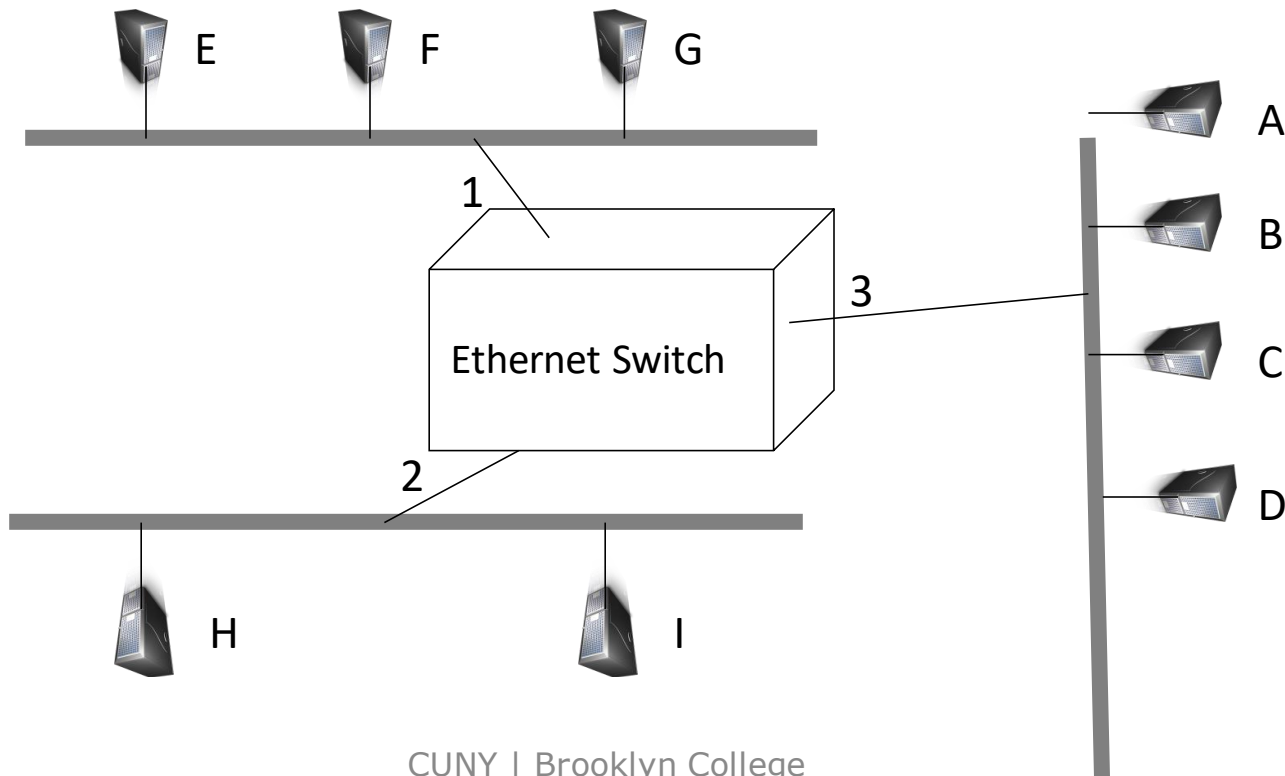
Questions?

- Packet switching in extended LAN
- Forwarding table and forwarding algorithm in extended LAN

Learning Bridges and Forwarding Table

- Improvement
  - Forwarding table
  - Do not forward unnecessarily to receiving port.
- How to maintain the table?
  - Manually?
  - Automatically?
- Learning bridges
  - automatically maintain the table without human intervention → "learning" from received frames → Ethernet switches = Learning bridges
- How does it learn?

Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2
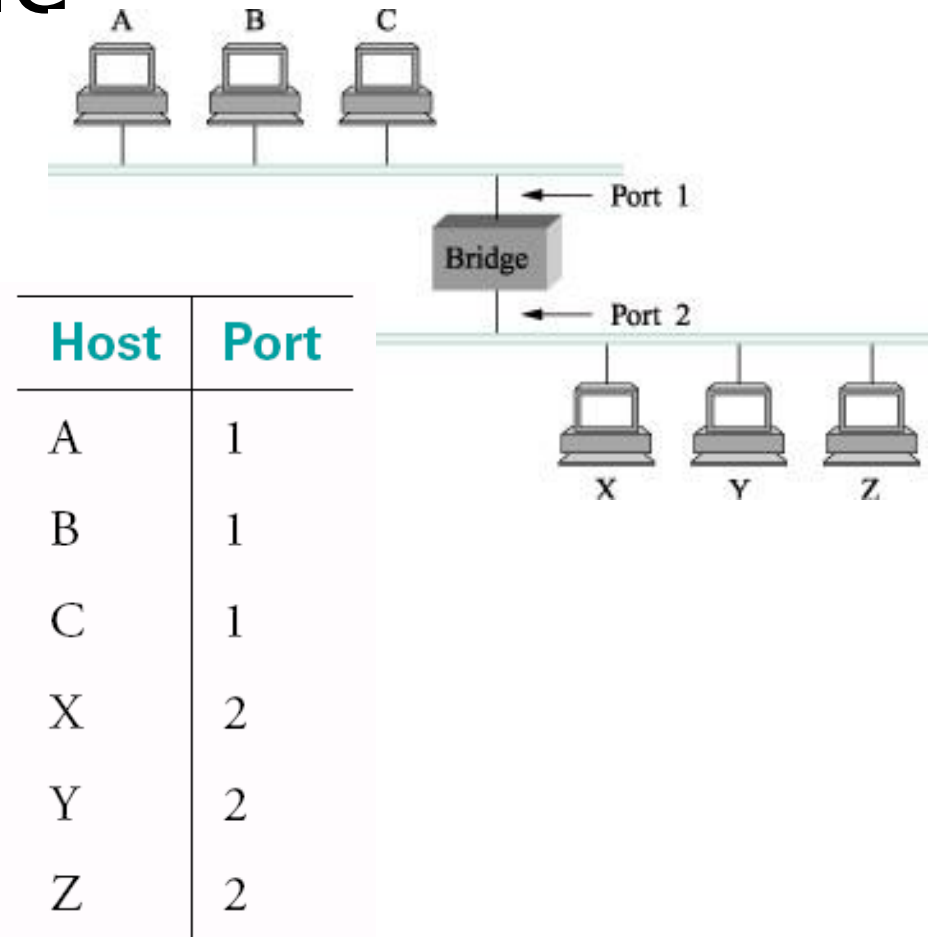
Forwarding Table: Learning from Received Frame

- From a received frame, an Ethernet switch knows

  - Destination address and source address



64	48	48	16		32
Preamble	Dest addr	Src addr	Type	Body	CRC
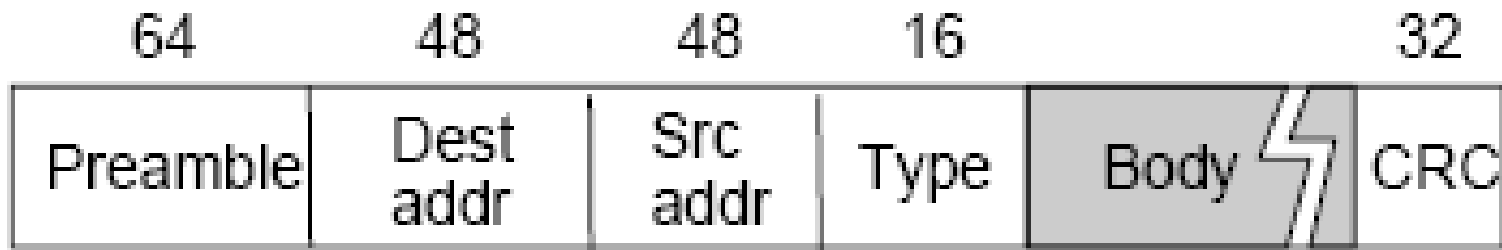
- Also knows receiving port number on the switch

Forwarding Table: Learning Algorithm

Host	Port
A	1
B	1
C	1
X	2
Y	2
Z	2

- Destination address in frame header indicates which host a frame is addressed to

- Source address in frame header indicates which host a frame is originated

- Each bridge maintains a "forwarding" table, initially empty

- Algorithm (running at each switch)

  - On receiving a frame *(src, dst, receiving port)*, look up *src* in the forwarding table

    - If *src* is not found

      - Insert (src, receiving port number) to the forwarding table
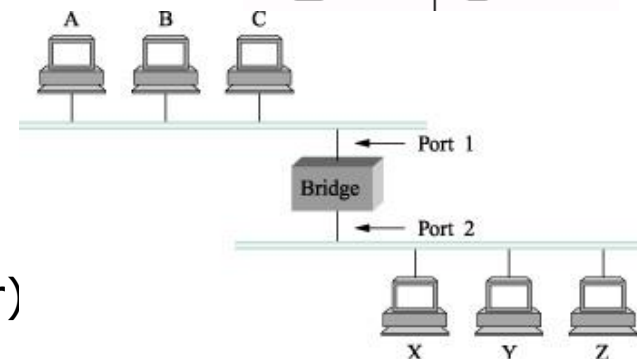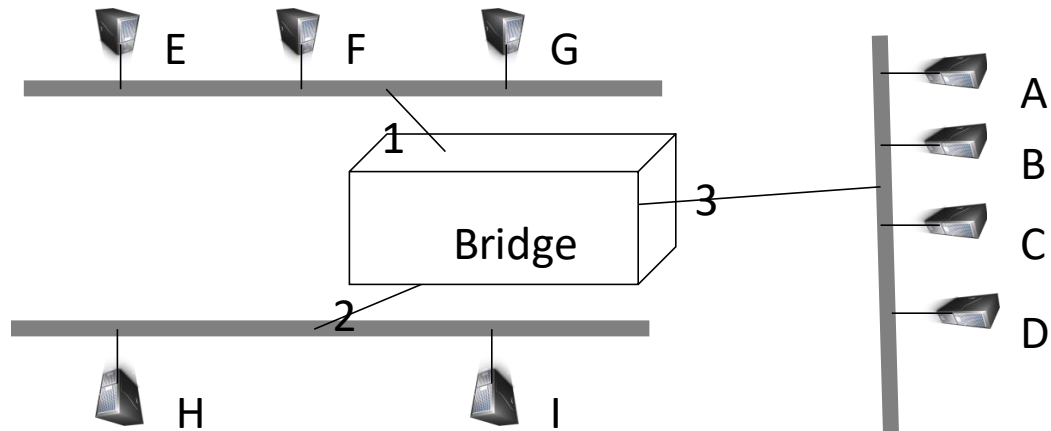
Learning Algorithm: Example

- Describe the table built by the switch as the following frames arrives

    - Starting with the table as follows

Host	Port
B	3

- The following frames (indicated by sending hosts) are received by the bridge as time goes

    - I, H, B, F (reads, first I, then H, then B, and then F)

    - Please draw four tables to show the resulting table after each frame is processed

Learning Algorithm: Example: Example: Answer

0. Initial table

Host	Port
B	3

1. Frame sent from Host I arrives

Host	Port
B	3
I	2

2. Frame sent from Host H arrives

Host	Port
B	3
I	2
H	2

3. Frame sent from Host B arrives

Host	Port
B	3
I	2
H	2

4. Frame sent from Host F arrives

Host	Port
B	3
I	2
H	2
F	1

Example: Question 1

0. Initial table

Host	Port
B	3

Q: which hosts will see the frame sent from Host I?

Example: Question 2

0. Initial table

Host	Port
B	3

Q: which hosts will see the frame sent from Host B?

1. Frame sent from Host I arrives

Host	Port
B	3
I	2

2. Frame sent from Host H arrives

Host	Port
B	3
I	2
H	2

Exercise 2

- Starting with an empty forwarding table at each switch, step-by-step build a forwarding table for each switch of the Ethernet shown as the following transmissions happen
  - A sends to C; C sends to A; E sends to I; I sends to E; E sends to B

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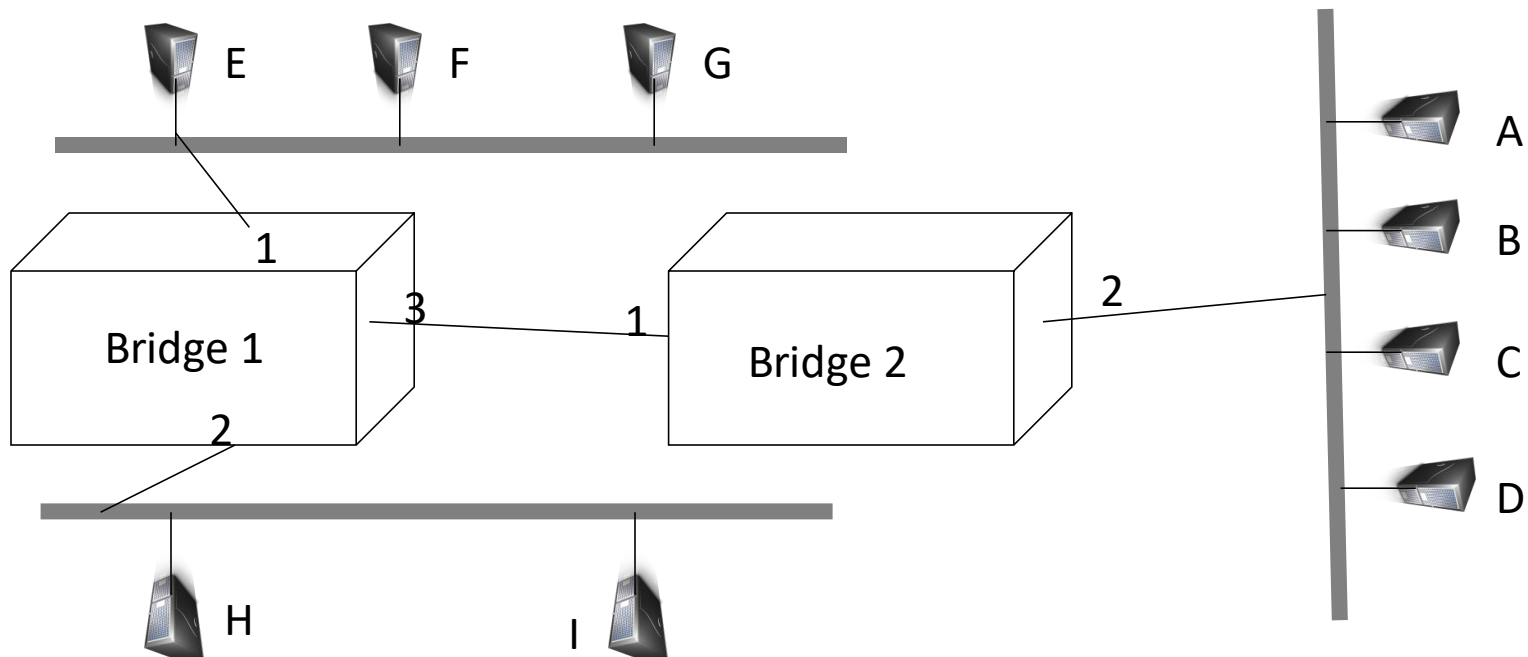
Questions?

- Learning algorithm of learning bridge/switch in extended LAN