

How packets find their way across the Internet

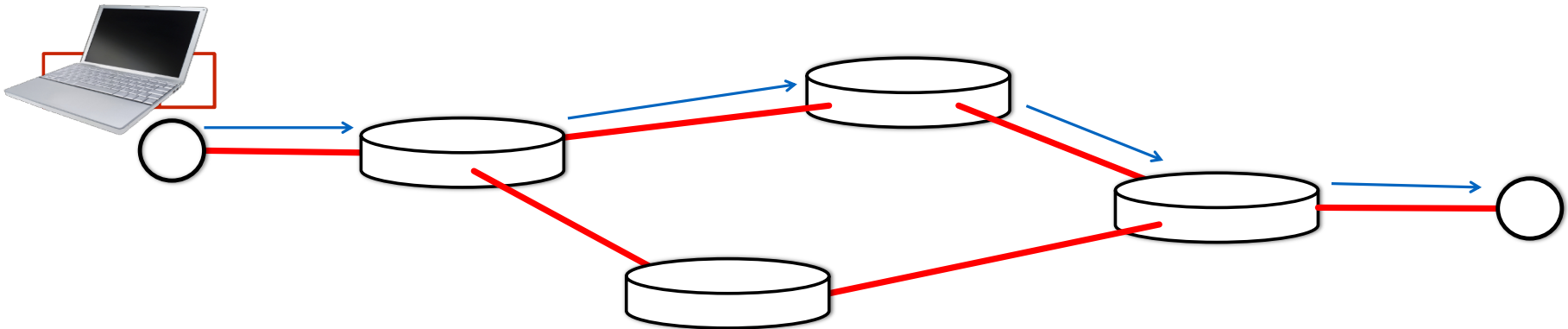


Nick McKeown

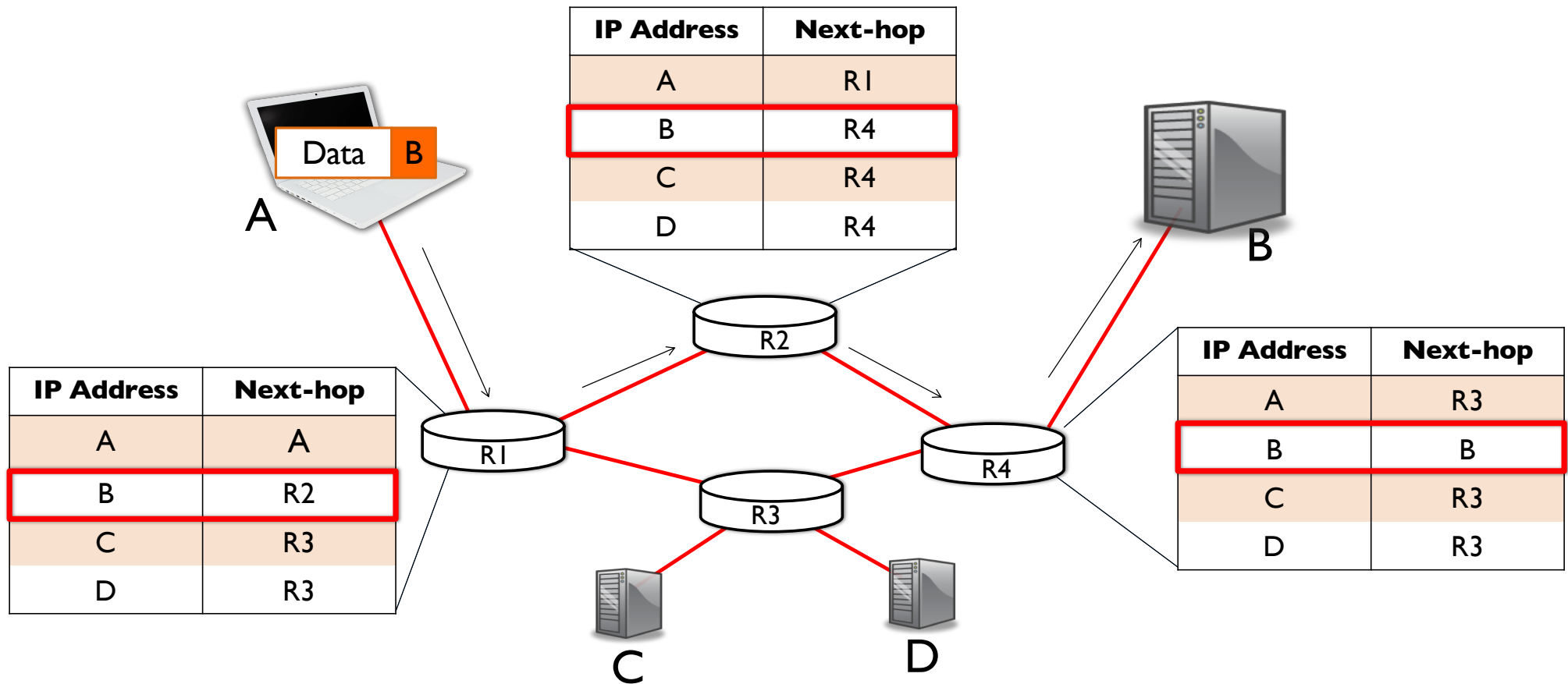
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Routers forward IP datagrams **one at a time**

1. Routers use IP address as a key into a forwarding table, then
2. Send datagram to a router closer to the destination.



The Internet forwards datagrams **hop-by-hop**



How do the routers **know**
what forwarding table to use?

What techniques can you think of?

Here are three ways

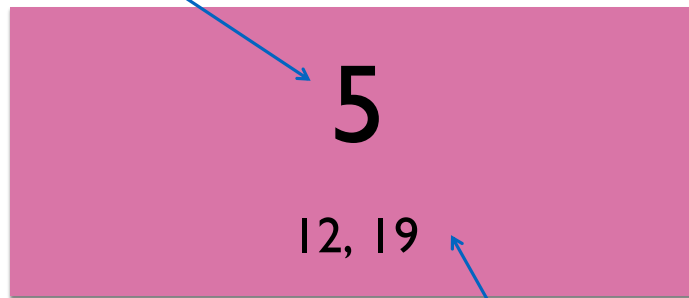
1. **Flooding:** Every router sends arriving packet to every neighbor
2. **Source Routing:** End host lists the routers to visit along the way (in each packet)
3. **Distributed Algorithm:** Routers talk to each other and construct forwarding tables using a clever algorithm

You are going to figure this out on your own!!!

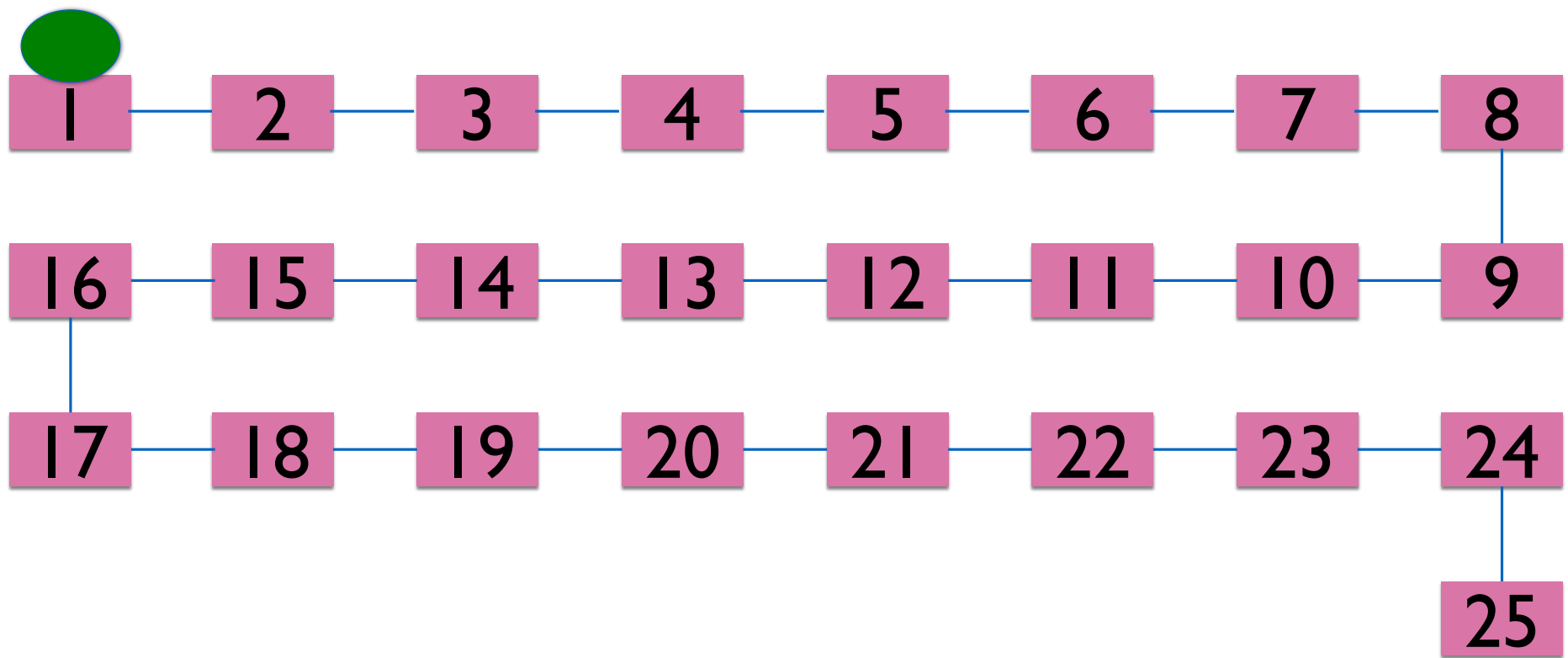
Game: Routing Competition

Task 1

Your router
ID

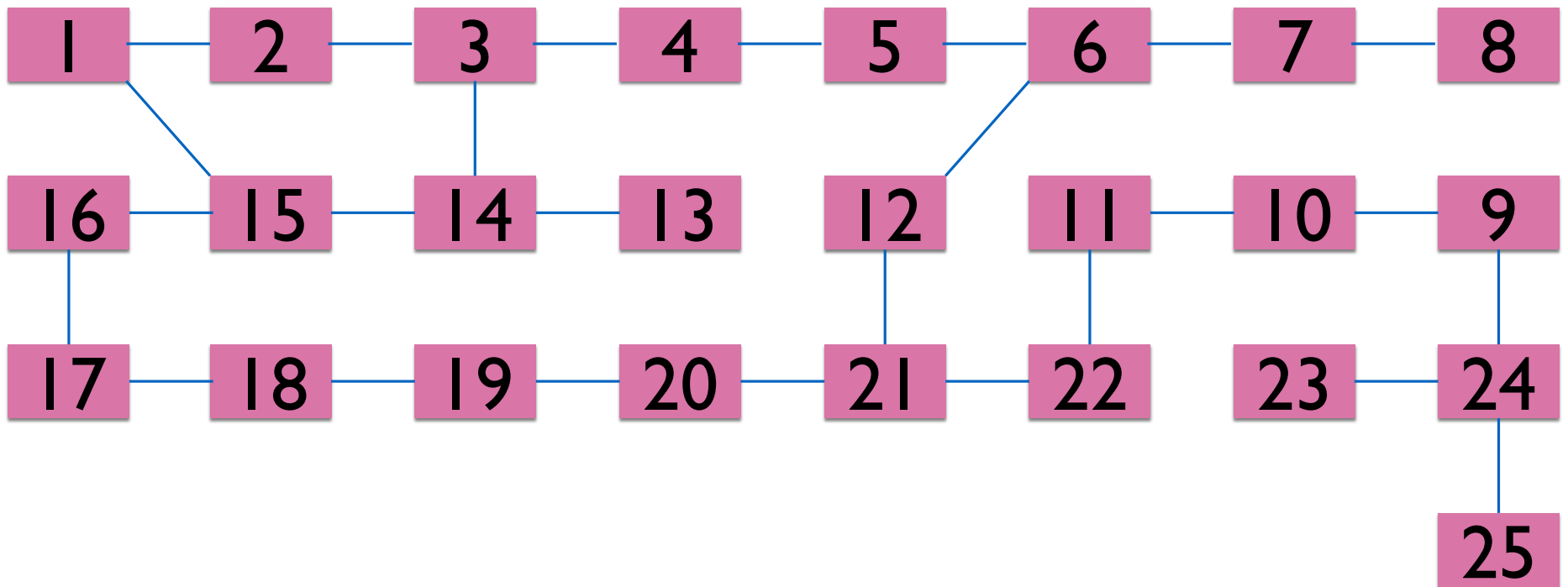


The IDs of your neighbors



Task 2

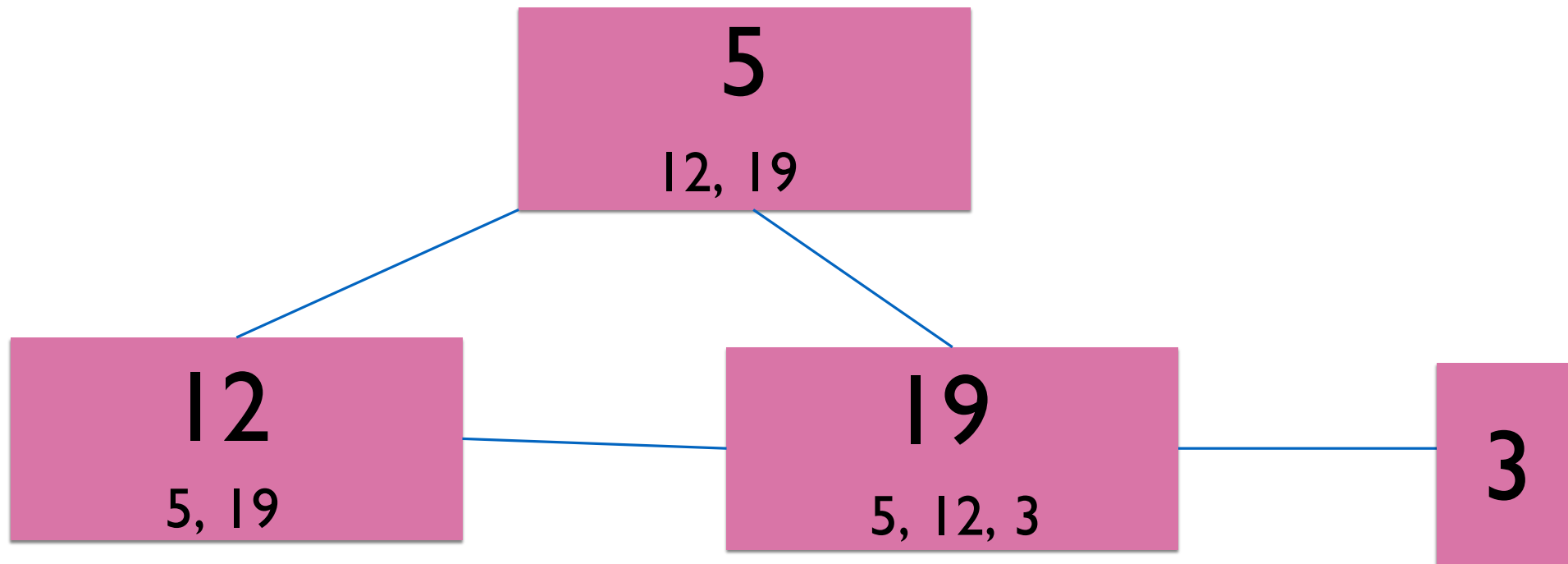
Find the shortest path



Task 3

In a real network, the routers don't know
what the network looks like.

This time, *I won't show you the network.*



Rules

You may not

- ▶ Pass your card to anyone else
- ▶ Leave your seat
- ▶ Write anything down

You may

- ▶ Ask nearby friends (in your group) for advice
- ▶ Shout to other participants (anything you want!!!)
- ▶ Say bad things about Nick

You must: *Participate*

Task 3

Find the shortest path from
Node 1 to Node 40.

When you are done, you must be able
to repeat it correctly.

The first group to finish is the champion!!

Pink Group

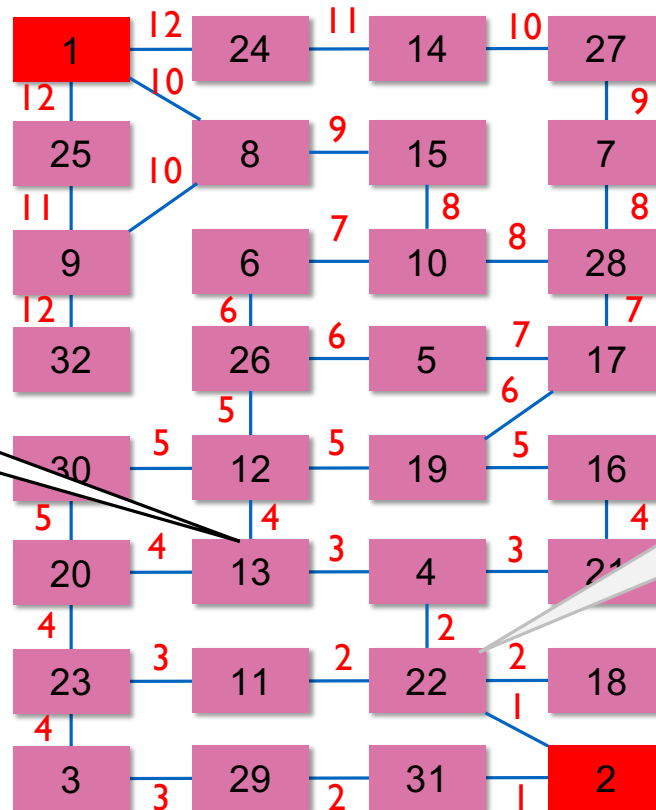


1	...	...	...	...	...	2	...
...
...
...	...	3	...	...	...	...	...
...	...	...	...	...	...	...	40

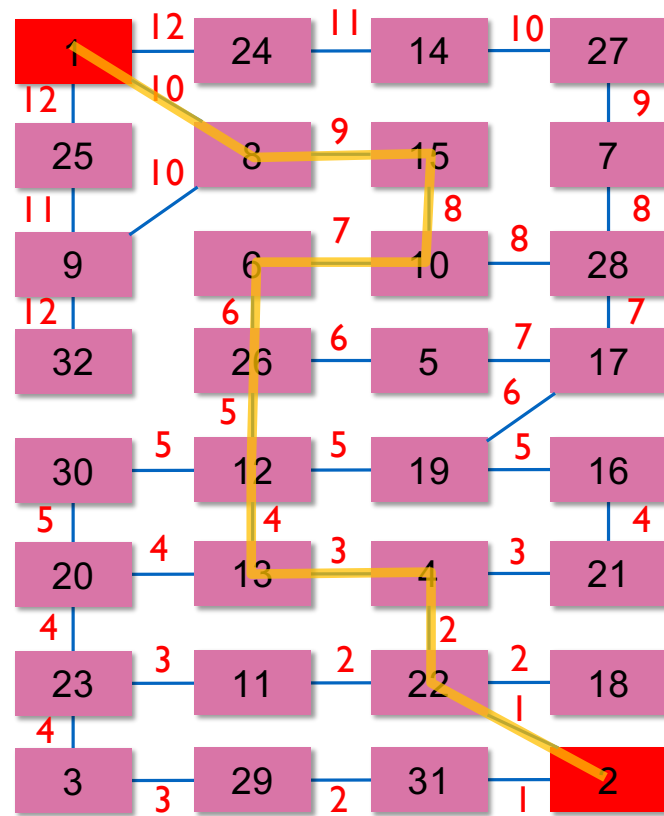
Go!

An algorithm to find the shortest path

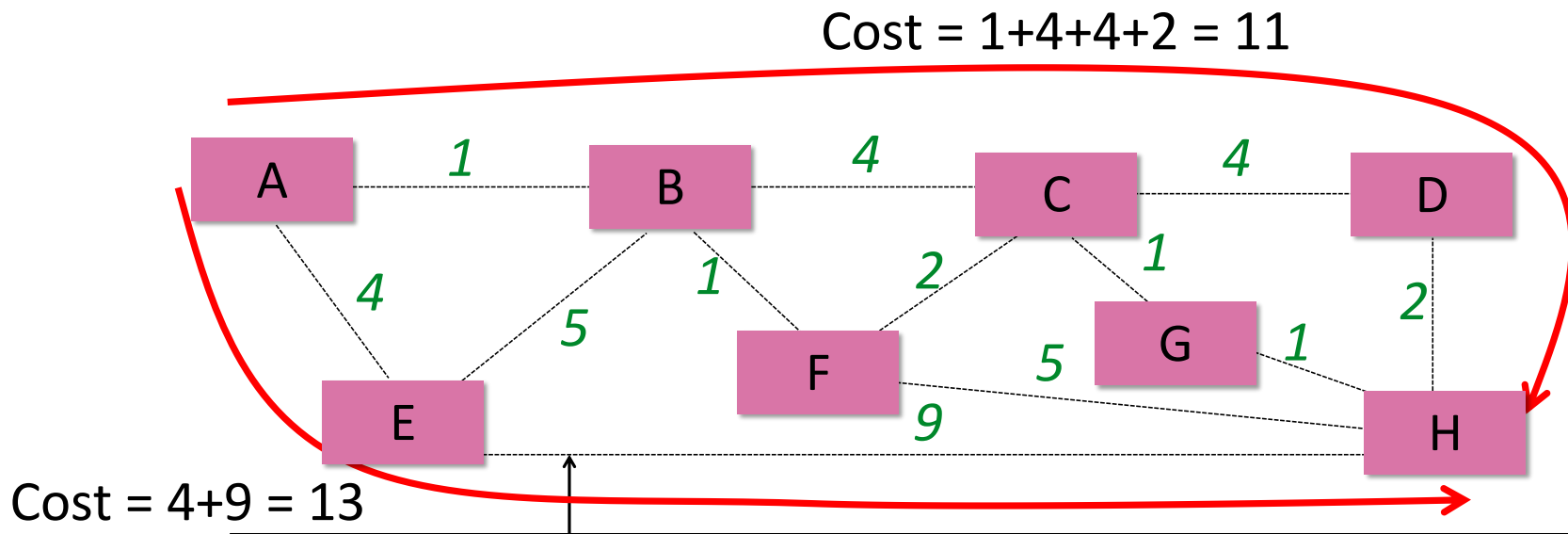
IP Address	Next-hop
Node 2	Node 4



“You can reach node 2 in 1 hop from node 22”



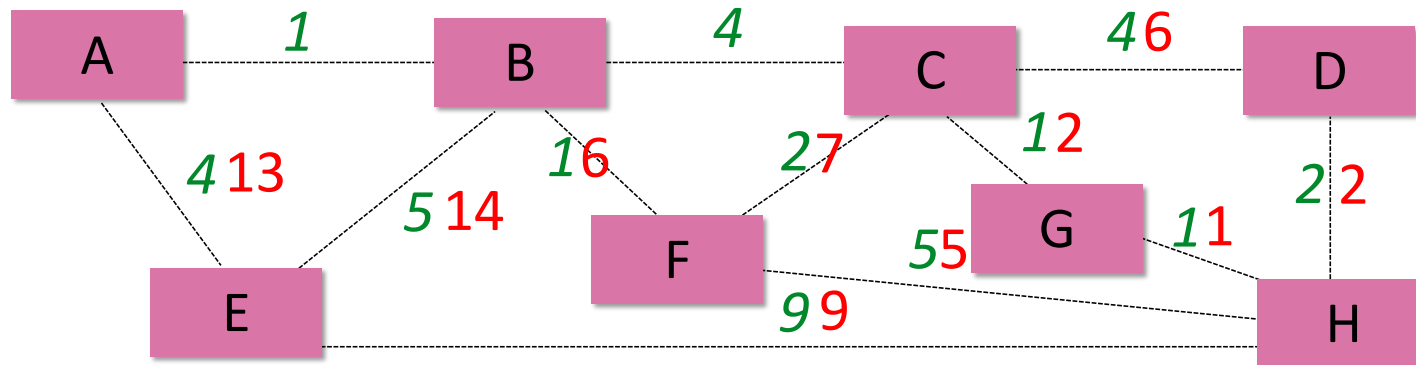
What if each link has a “cost”?



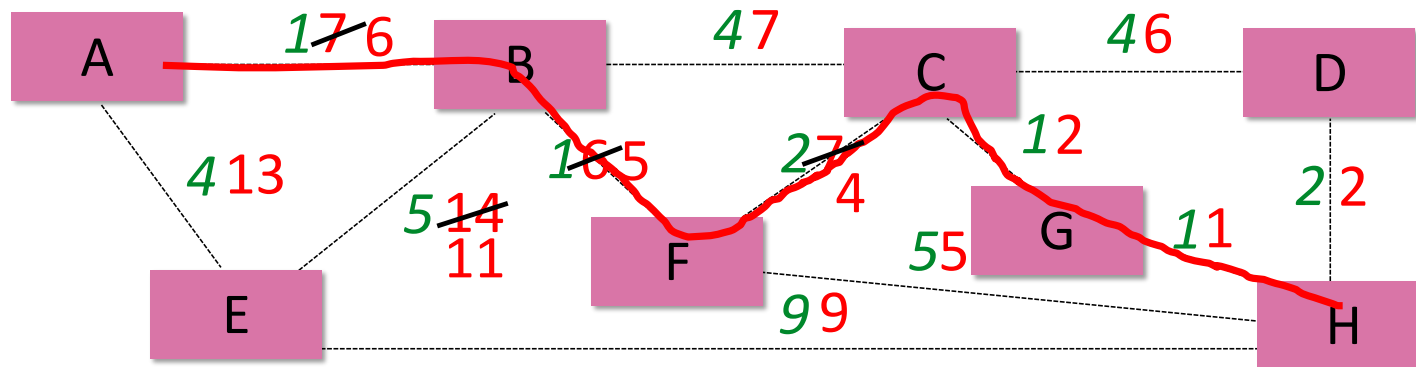
“Expensive link”:

It might be very long. e.g. a link from Europe to USA.
Or it might be very busy. e.g. it connects to Google or CNN.
Or it may be very slow. e.g. 1Mb/s instead of 100Mb/s.

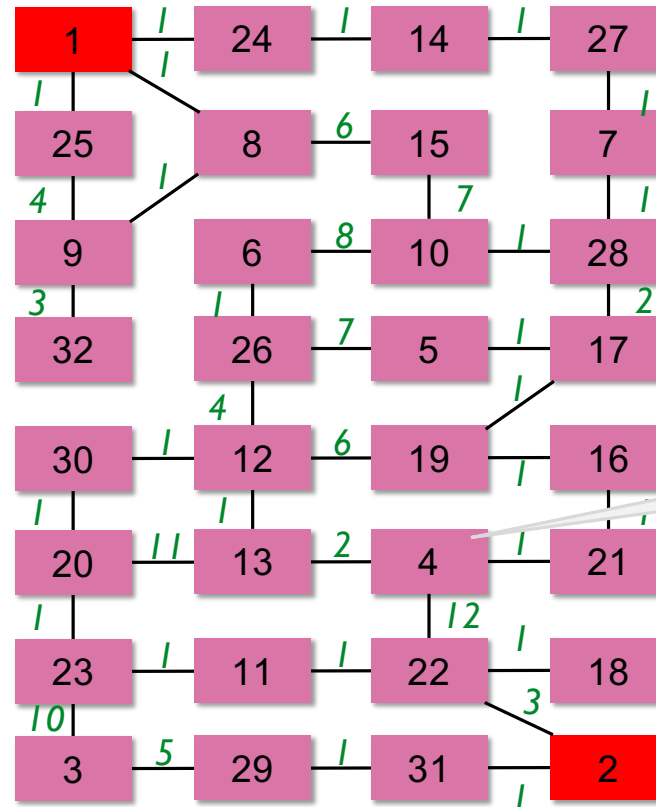
Find lowest cost path to H



Find lowest cost path to H



Find the lowest cost path



Router 4 tells its neighbors:
"I can reach 2 with a cost of 15"

Solution

