EECS 489 - Winter 2024

Discussion 7

The Midterm is coming up!

- Midterm: **Wednesday, March 6th @ 10:30 am - 12:00 pm EST**
  - Online, done during class time
  - Will be released on Canvas, open note but NO resources beyond class materials
  - Content will include **everything** up to the last lecture before the Midterm
- No discussions during the week of the exam
- OH will still being held

Today

- IP Questions
- TCP Congestion (again)

Q1: IP True or False

- IPv6 packet headers have fixed size and thus are more efficient to process. However, because an IPv6 header uses 128-bit source and destination addresses instead of 32-bit ones, it is larger than any IPv4 header.

Q1: IP True or False

- IPv6 packet headers have fixed size and thus are more efficient to process. However, because an IPv6 header uses 128-bit source and destination addresses instead of 32-bit ones, it is larger than any IPv4 header.
- False. IPv6 headers are always 40 B and IPv4 headers can be 20 - 60 B.

Q2: IP MCQ

- Which is NOT the four basic processes used in the IP to accomplish end-to-end transport?
  - Addressing packets with an IP address
  - Encapsulation
  - Guaranteed delivery
  - Routing
  - Decapsulation

Q2: IP MCQ

- Which is NOT the four basic processes used in the IP to accomplish end-to-end transport?
  - Addressing packets with an IP address
  - Encapsulation
  - **Guaranteed delivery**
  - Routing
  - Decapsulation
- IP only provides best-effort delivery
  - **Guaranteed delivery** is provided by Transport Layer (e.g.TCP).

Q3: IP Fragmentation

- Suppose a TCP message containing 2048 bytes of data and 20 bytes of TCP header is passed to IP for delivery across two networks of the Internet.
  - The first network has an MTU of 1024 bytes
  - The second network has an MTU of 512 bytes.
- Give the sizes and offsets of the fragments delivered to the network layer at the destination host.
  - Assume all IP headers are 20 bytes.
  - Assume we send out the largest fragments whenever we can.

Q3: IP Fragmentation

20B 2068B

IP Header IP Payload

IP Datagram: (2048+20+20) Bytes

IP Payload: (2048+20) Bytes

Network 1 **MTU: 1024B**

Fragmented payload:

$8n < 1024 - 20, \qquad n \in N$

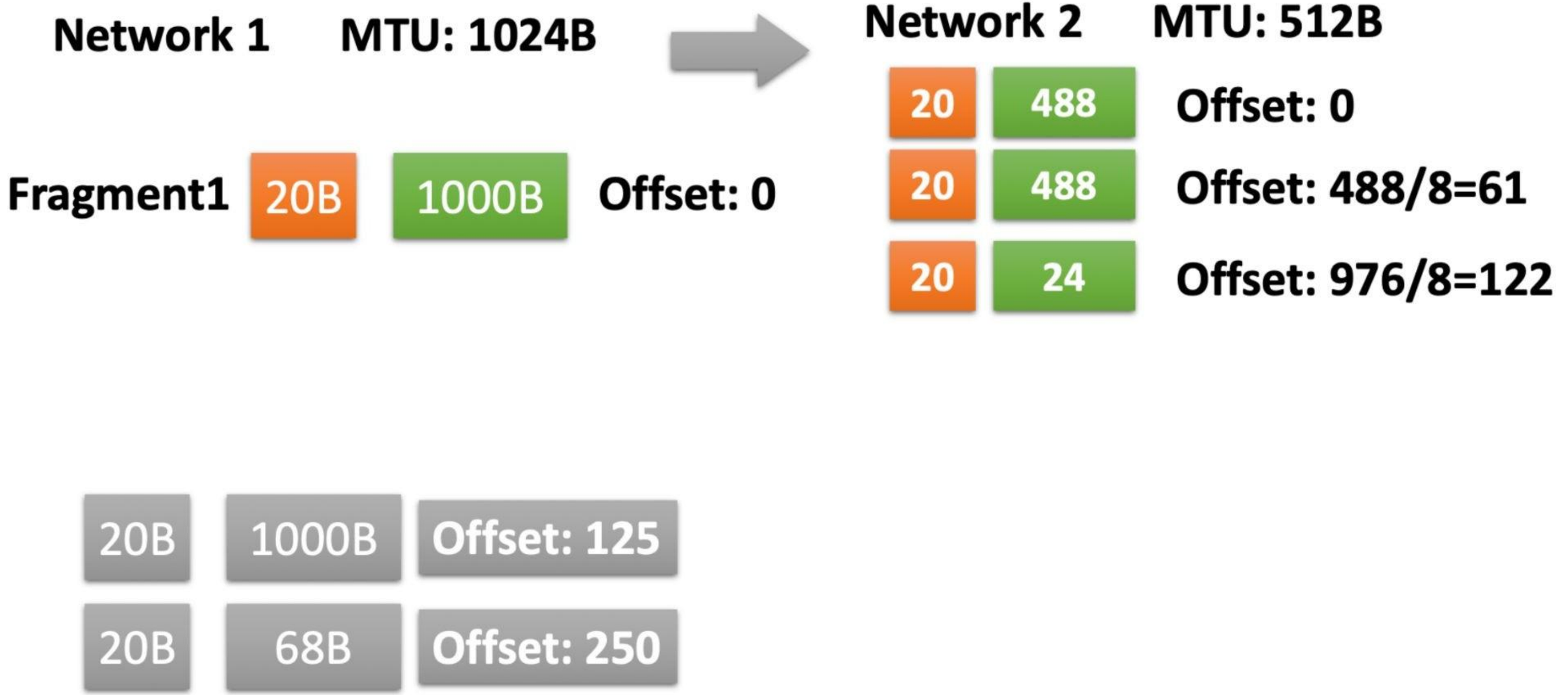
Payload: $8n = 1000$

Fragment1 20B 1000B **Offset: 0**

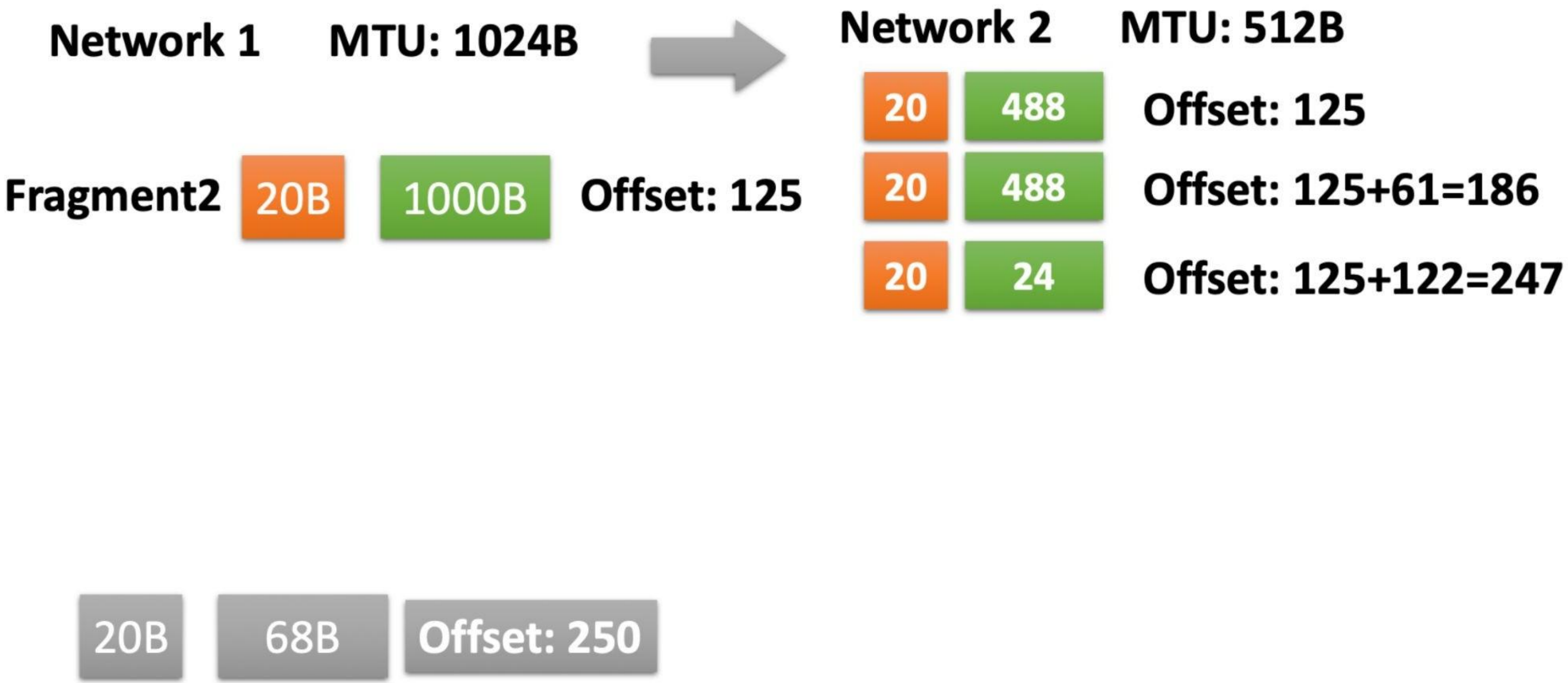
Fragment2 20B 1000B **Offset: 1000/8=125**

Fragment3 20B 68B **Offset: 2000/8=250**

Q3: IP Fragmentation



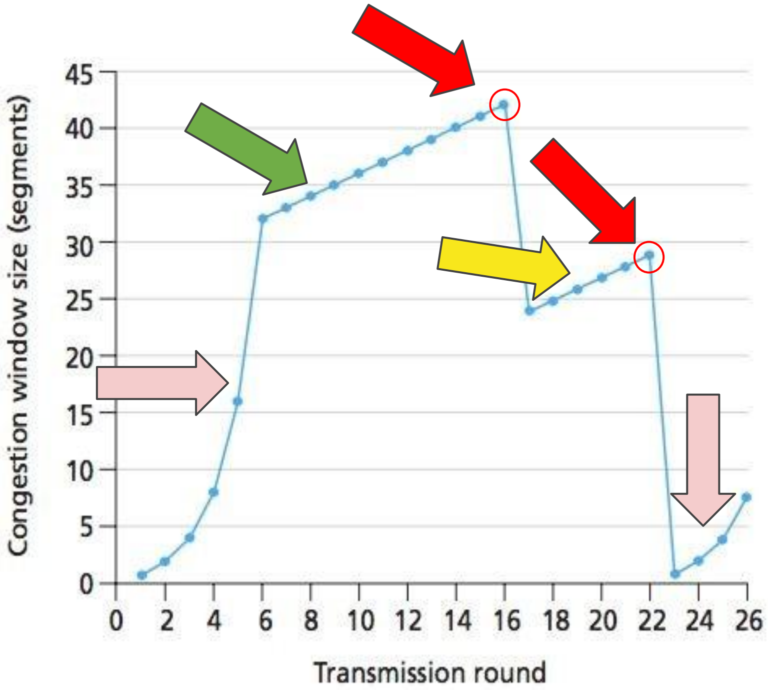
Q3: IP Fragmentation



Q3: IP Fragmentation

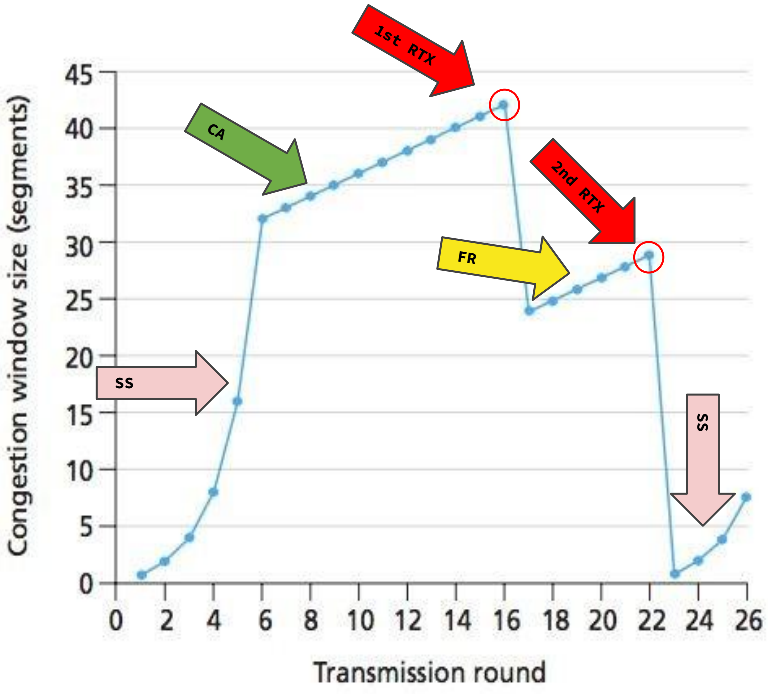
Q4: TCP Congestion Control

- Identify the following:
  - Slow Start (SS)
  - Congestion Avoidance (CA)
  - Fast Recovery (FR)
  - Retransmission (RTX)



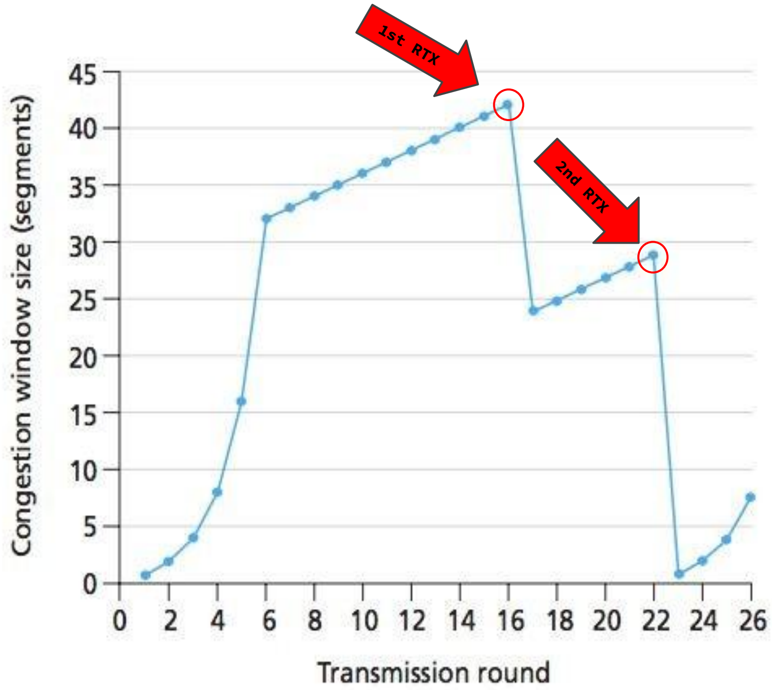
Q4: TCP Congestion Control

- Identify the following:
  - Slow Start (SS)
  - Congestion Avoidance (CA)
  - Fast Recovery (FR)
  - Retransmission (RTX)
- Reason:
  - SS is exponential until we hit our ssthresh
  - CA is just linear increases
  - RTX cuts the ssthresh and CWND
  - FR occurs after an RTX (depending on what happened)



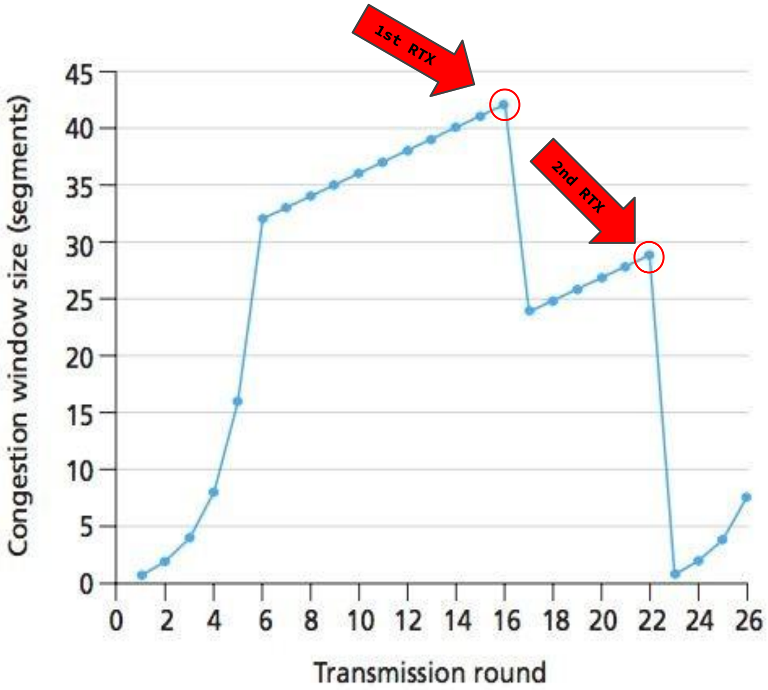
Q4: TCP Congestion Control

- What triggers the first retransmission? How about the second?



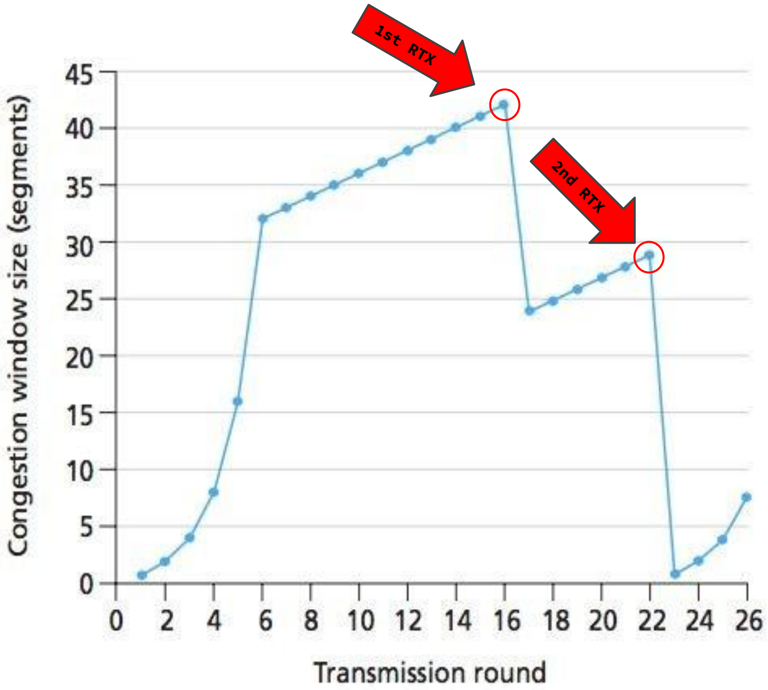
Q4: TCP Congestion Control

- What triggers the first retransmission? How about the second?
- First: Duplicate ACK
  - Cut the ssthresh in half and set CWND to ssthresh + 3 since we are in fast recovery
- Second: Timeout
  - Return to slow start



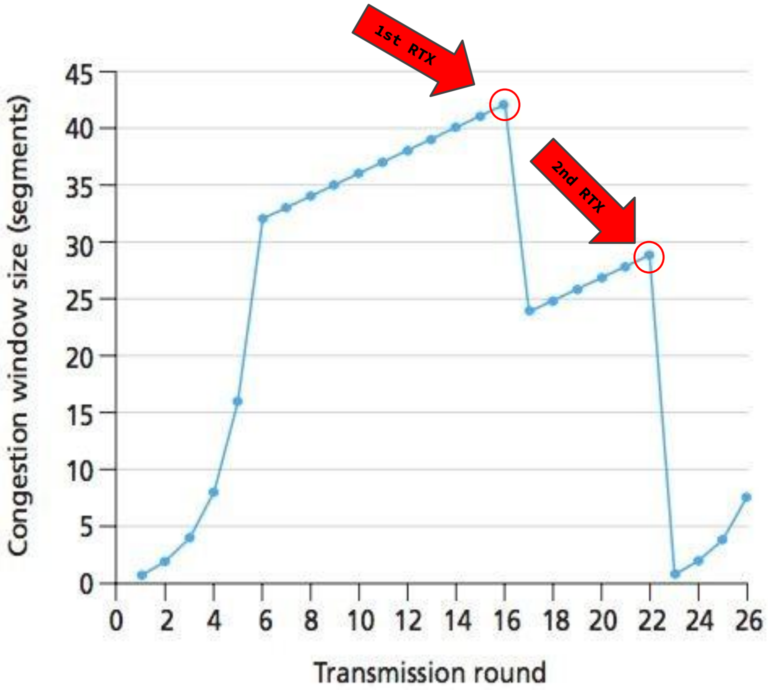
Q4: TCP Congestion Control

- What is the size of the CWND at the 17th round?



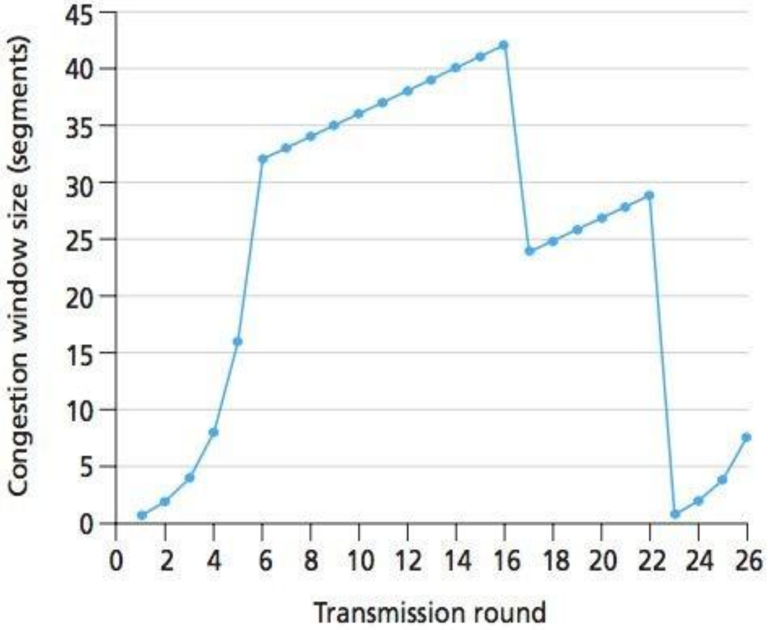
Q4: TCP Congestion Control

- What is the size of the CWND at the 17th round?
- CWND = 42 / 2 + 3 = 24
    - Per fast recovery, we will cut ssthresh in half, then set CWND to the new sstresh + 3



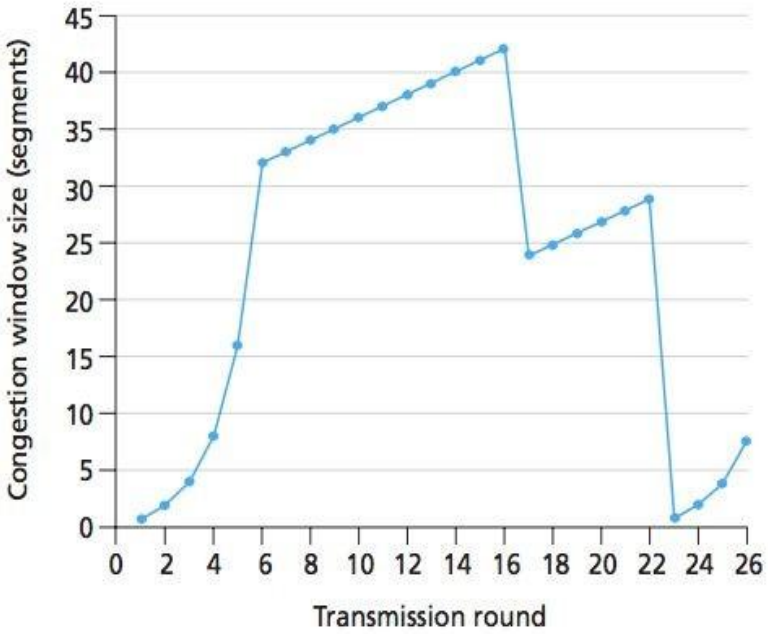
Q4: TCP Congestion Control

- What is the ssthresh at the 1st round, 18th round, 24th round?



Q4: TCP Congestion Control

- What is the ssthresh at the 1st round, 18th round, 24th round?
- 1st: **32**
  - Slow Start -> Congestion Avoidance
- 18th: 42 / 2 = **21**
  - CWND / 2
- 24th: 29 / 2 = **14**
  - CWND / 2



Q5: Forwarding

- Consider a datagram network using 32-bit addressing. Suppose a router has 4 links, and packets are to be forwarded as follows below
- Provide a forwarding table using longest prefix matching.

Destination Address Range	Interface
11100000 00000000 00000000 00000000 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 11100001 01111111 11111111 11111111	2
Otherwise	3

Q5: Forwarding

- Note: Interface 2's range cannot be described with a single prefix! We need to split it

Destination Address Range	Interface
11100000 00000000 00000000 00000000 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 11100001 01111111 11111111 11111111	2
Otherwise	3

Q5: Forwarding

- Split for Interface 2:

11100000 01000001 00000000 00000000 11100000 11111111 11111111 11111111
11100001 00000000 00000000 00000000 11100001 01111111 11111111 11111111

Destination Address Range	Interface
11100000 00000000 00000000 00000000 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 11100001 01111111 11111111 11111111	2
Otherwise	3

Q5: Forwarding

- Final Prefix Table:

Destination Address Range	Interface
11100000 00(/10)	0
11100000 01000000(/16)	1
11100000 (/8)	2
11100001 0(/9)	2
Otherwise	3

Wrap-Up

- Thanks for coming!
- Start studying for the Midterm, if you have not already
- **No discussion the week of the Midterm!**
- Assignment 3 will be released after the Midterm

<u>Good Luck on the Midterm!</u>