

CS118 Discussion 1B, Week 3

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Outline

- Review
- Application Layer:
 - DNS, P2P, CDN...
- Transport Layer Protocol:
 - UDP, TCP, ...
 - Principles of reliable data transfer

Review: SMTP

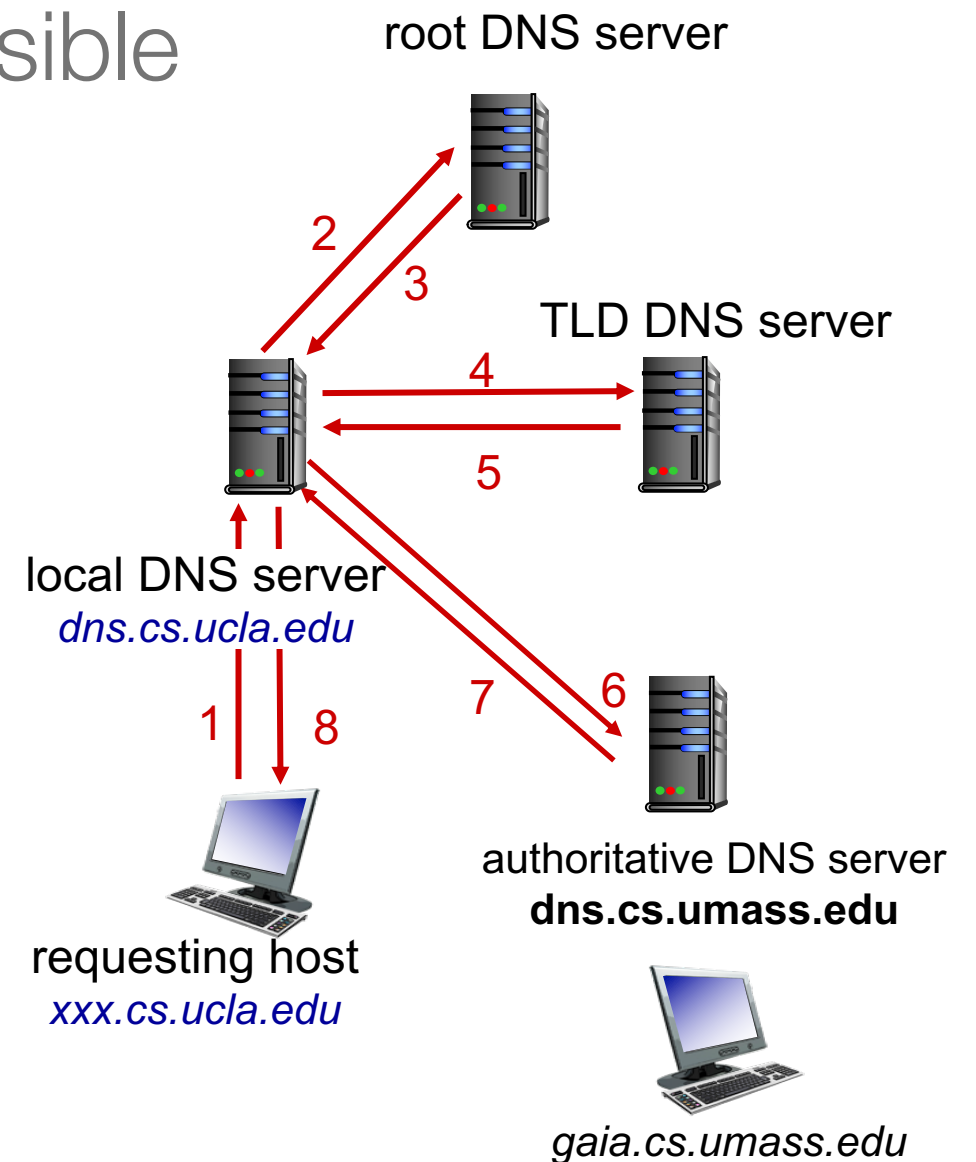
- Can it directly send a binary file?
 - What if the binary file contains CRLF.CRLF ?
 - Connection closed will be closed since the CRLF.CRLF marks the end of the message body
- How can it transmit binary file with CRLF.CRLF
 - It is necessary to convert the binary attachment into a stream of text characters (ASCII) before it is put into the part of the mail message that will be reserved for the attachment.
 - Base64 encoding converts a sequence of binary data into a sequence of characters. It expands the attachment by a factor of 4/3. So a 3 kB binary file would convert into a 4 kB text attachment.

DNS

- What is the transport layer protocol?
- How the scalability is achieved?
- Who will use iterative/recursive query?
- Why is DNS resolver needed?

DNS

- Why does DNS use iterative/recursive scheme?
- Can you imagine some other possible solutions for DNS?
- Any possible issues?



Suppose that on April 19, 2019 at 15:35:21, you have issued “dig google.com A” to get an IPv4 address for google.com domain from your caching resolver and got the following result:

```
; <<>> DiG 9.8.3-P1 <<>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 17779
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 4

;; QUESTION SECTION:
google.com.                IN      A

;; ANSWER SECTION:
google.com.                239     IN      A      172.217.4.142

;; AUTHORITY SECTION:
google.com.                12412   IN      NS      ns4.google.com.
google.com.                12412   IN      NS      ns2.google.com.
google.com.                12412   IN      NS      ns1.google.com.
google.com.                12412   IN      NS      ns3.google.com.

;; ADDITIONAL SECTION:
ns1.google.com.           13462   IN      A      216.239.32.10
ns2.google.com.           13462   IN      A      216.239.34.10
ns3.google.com.           13462   IN      A      216.239.36.10
ns4.google.com.           13462   IN      A      216.239.38.10

;; Query time: 81 msec
;; SERVER: 128.97.128.1#53(128.97.128.1)
;; WHEN: Wed Apr 19 15:35:21 2019
;; MSG SIZE rcvd: 180
```

- (a) What is the discovered IPv4 address of google.com domain?
- (b) If you issue the same command 1 minute later, how would ANSWER SECTION" look like?

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```

- (c) If the client keeps issuing dig google.com A every second, when would be the earliest (absolute) time the local DNS server would contact one of the google.com name servers again?
- (d) If the client keeps issuing dig google.com A every second, when would be the earliest (absolute) time the local DNS server would contact one of the .com name servers?

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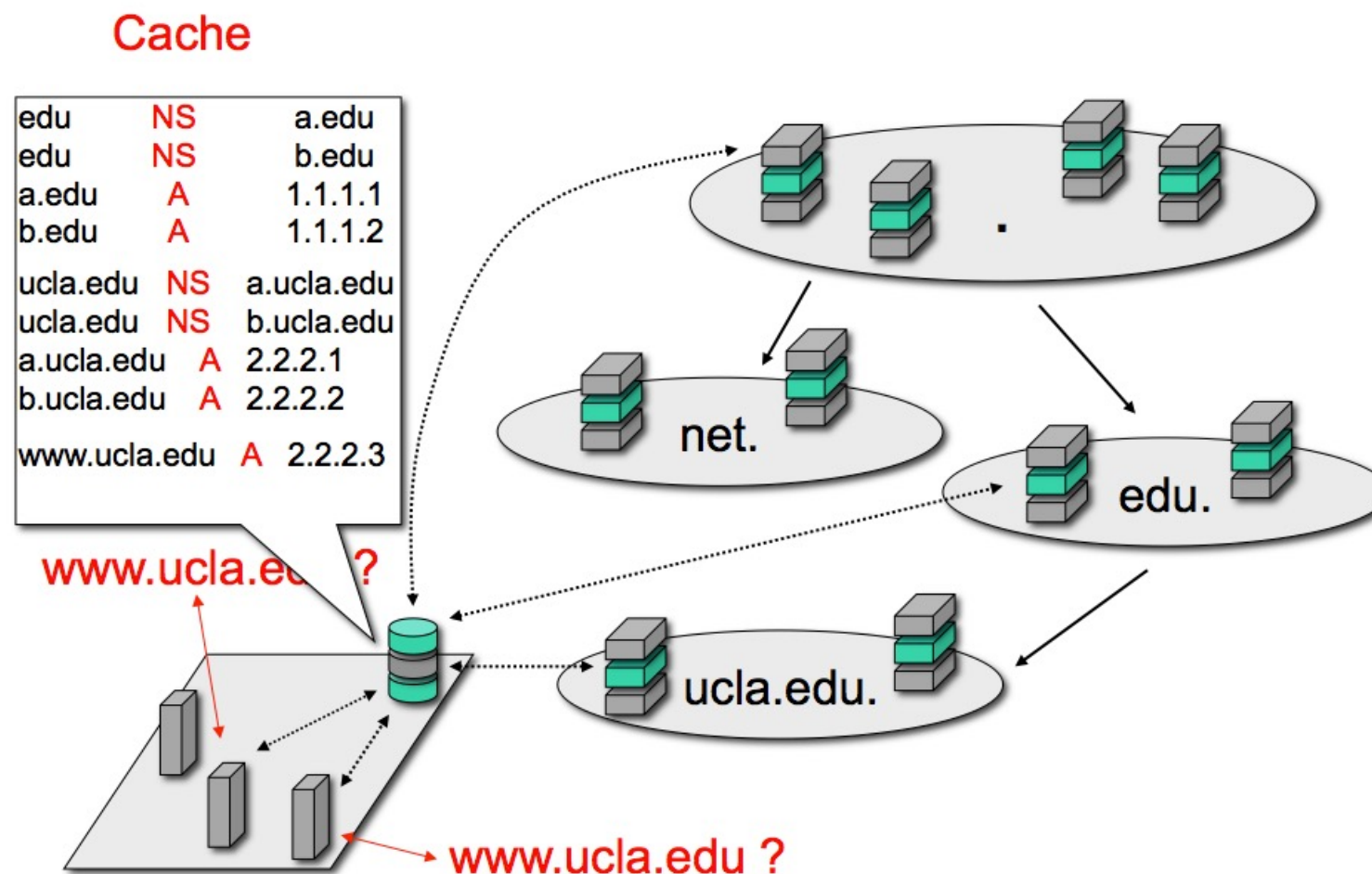
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```

- (a) 172.217.4.142
- (b) google.com. 179 IN A 172.217.4.142
- (c) (Wed Apr 17 15:35:21 2019 + 239 sec)
- (d) (Wed Apr 17 15:35:21 2019 + 12412 sec)

DNS protocol: exercise

- Assume the cache is empty initially
- Host A queries www.ucla.edu, how many queries should the resolver issue?



DNS protocol: exercise

- Assume the cache is empty initially
- Host A queries www.ucla.edu, how many queries should the resolver issue?
- After A's DNS query, host B queries www.mit.edu, how many queries should the resolver issue?

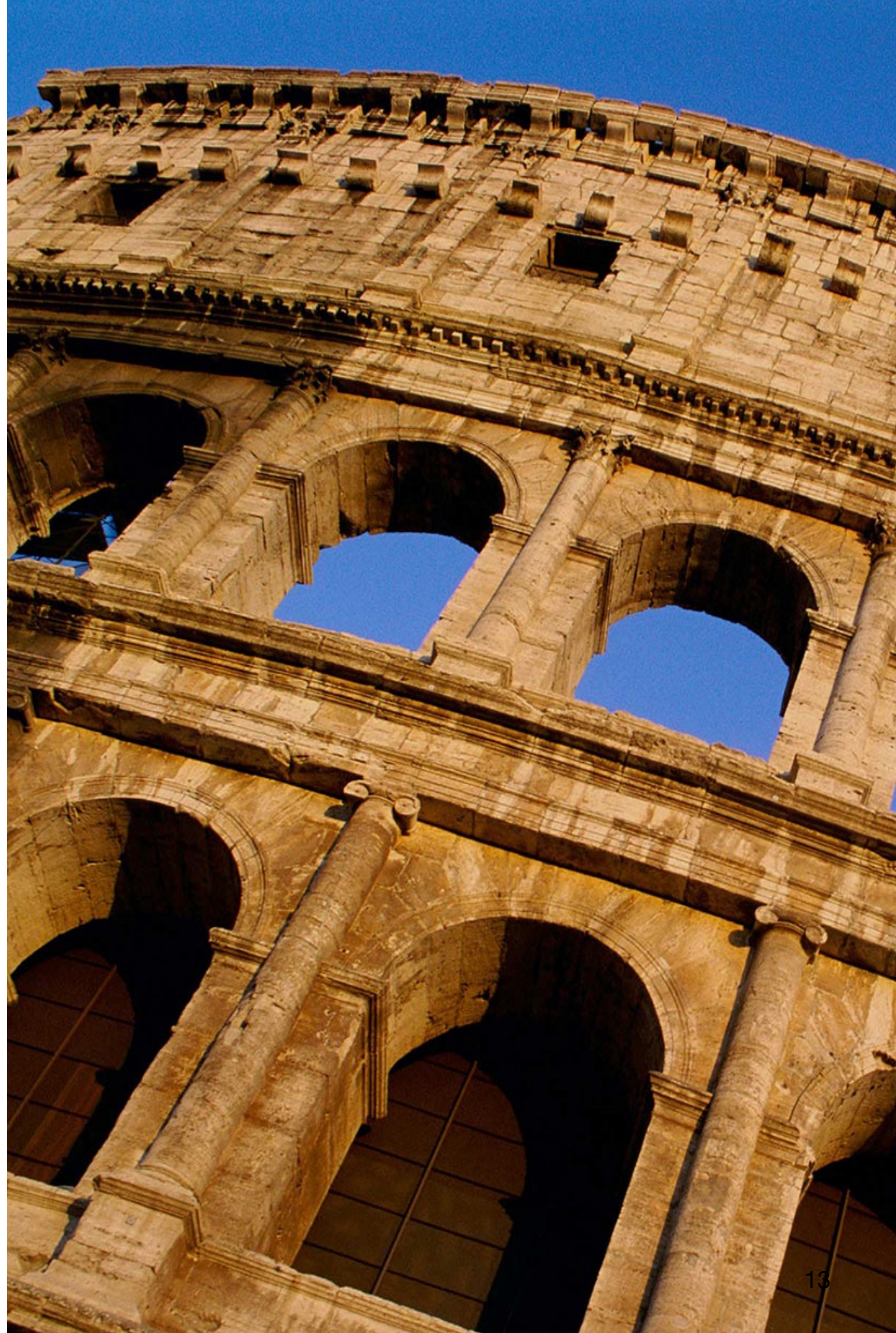
Application Layer: CDN

- CDN: Content Distribution Network
 - Globally distributed network of web servers
 - Stores and replicates images, videos and other files
 - <https://eclass.uoa.gr/modules/document/file.php/D245/2015/cdn.02f.ppt>

Internet video

- Multimedia streaming: perspectives
 - Rate control
 - Error control
- Streaming protocols:
 - Stream description: SDP , SMIL ...
 - Stream control: RTSP — Remote control the session
 - Media transport: RTP — Error control and flow control
 - Resource reservation (if any!): DiffServ, RSVP — provide QoS
- HTTP-based: DASH (Dynamic Adaptive Streaming over HTTP)

Transport Layer



Why do we need transport layer?

- Transport layer protocols: TCP, UDP, SCTP, RTP, etc.
- Transport: bridging the gap between what the network provides and what the applications need
 - Providing services that suits application need: e.g. TCP for reliability, UDP for lightweight transport
 - Multiplexing: multiple apps on a single host
- Question: Can we build reliable transport with UDP?
When do we need it?

Transport Layer V.S. Network Layer

- Network layer: logical communication between **hosts**
 - **IP address** is used for identifying a host
- Transport layer: logical communication between **processes**
 - **IP address and port number** are used for identifying a process

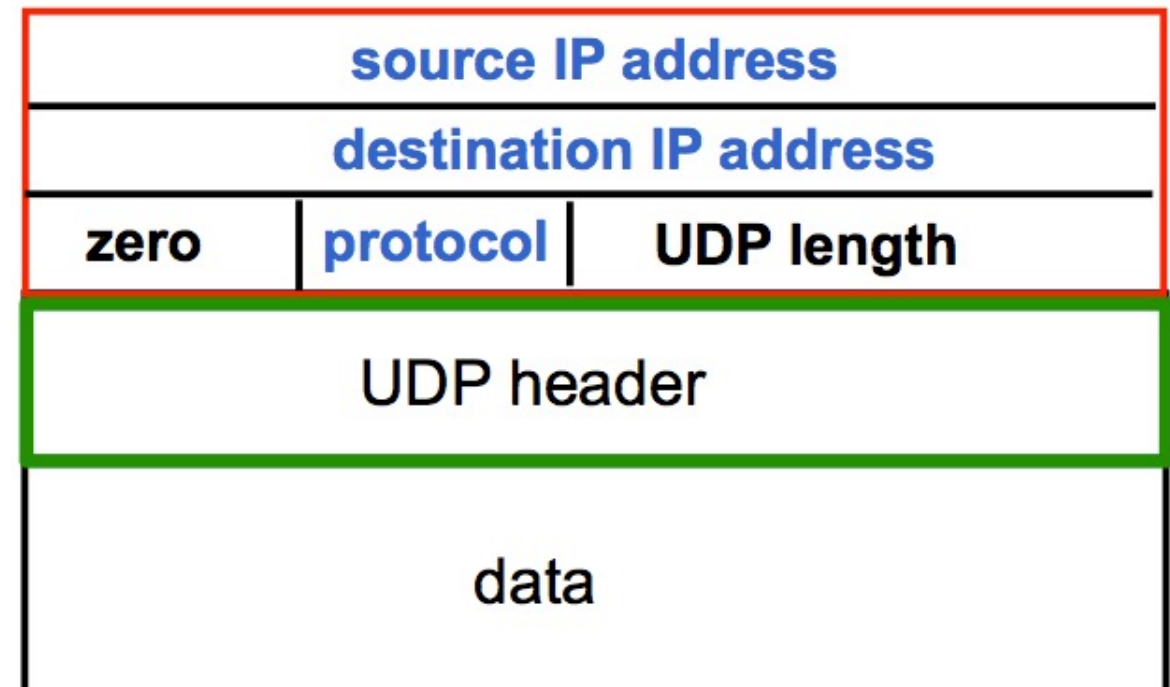
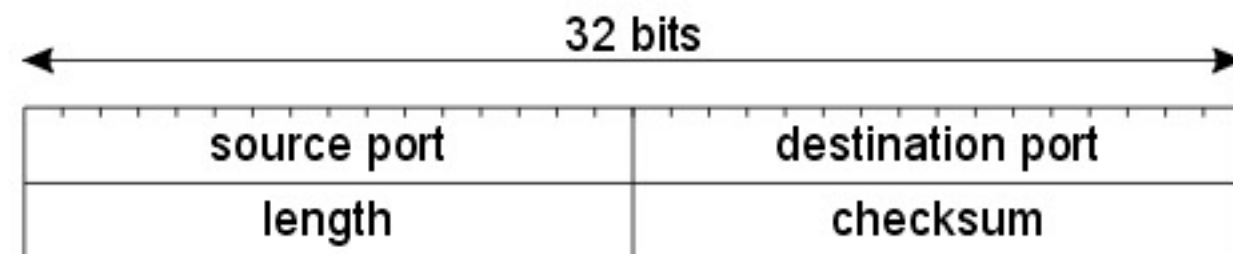
Multiplexing and De-multiplexing

- Multiplexing at send host: gather data from multiple sockets
- De-multiplexing at receiving host: deliver received segments to the right socket
- **Five tuples** (src_ip, src_port, dst_ip, dst_port, protocol) are used for multiplexing/demultiplexing
- How to identify a TCP/UDP socket? **lsof -i**
- Can TCP and UDP share the same port numbers? **Yes!**
e.g. DNS

UDP

- No connection establishment
- No connection state
- Small packet overhead (8 byte)
- How to calculate checksum?
 - **Pseudo header** + **UDP header**
+ data
- Also applicable to TCP
- Why pseudo header?

UDP header format



I KNOW A GREAT UDP JOKE



BUT YOU MIGHT NOT GET IT.

Principles of Reliable Data Transfer

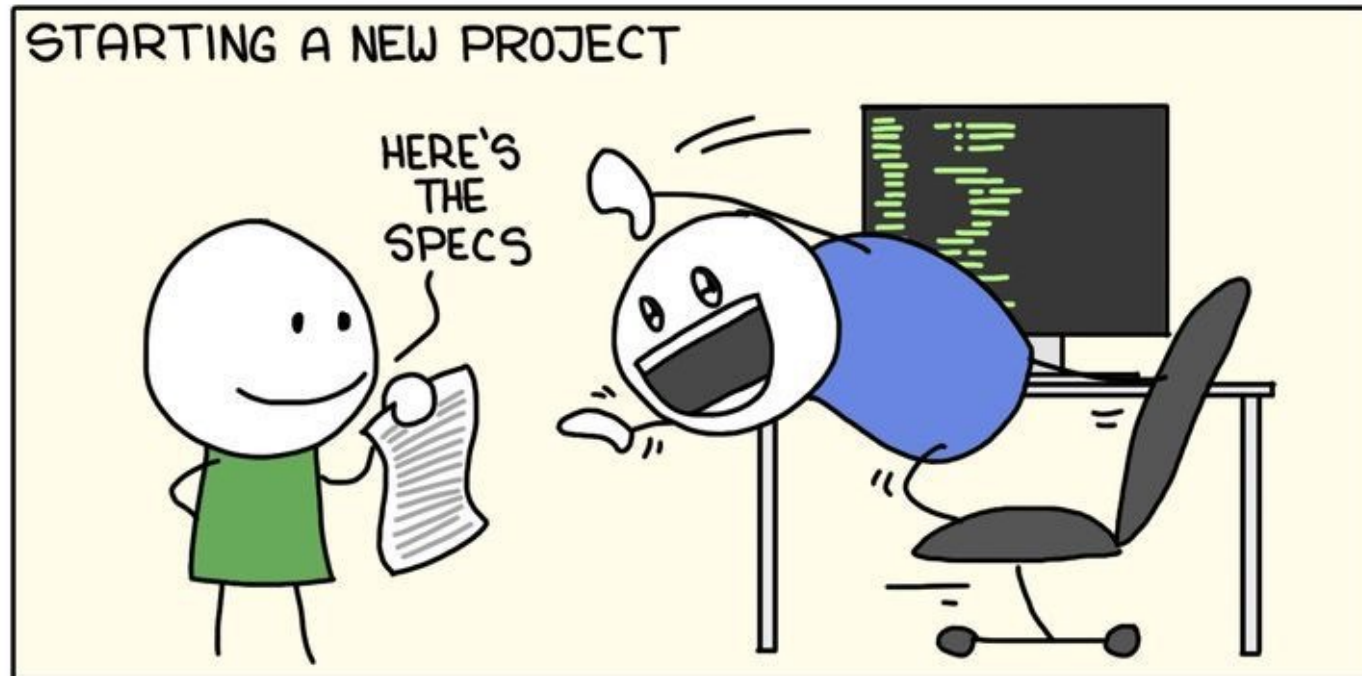
- How to deal with bit errors?
 - Error detection (e.g. checksum)
 - Receiver feedback
 - Retransmission
 - Why not error correction?
- How to deal with duplicate packets due to retransmission? **Sequence number**
- How can the sender detect that ACK or data is lost? **Timer**

More details in next week ...

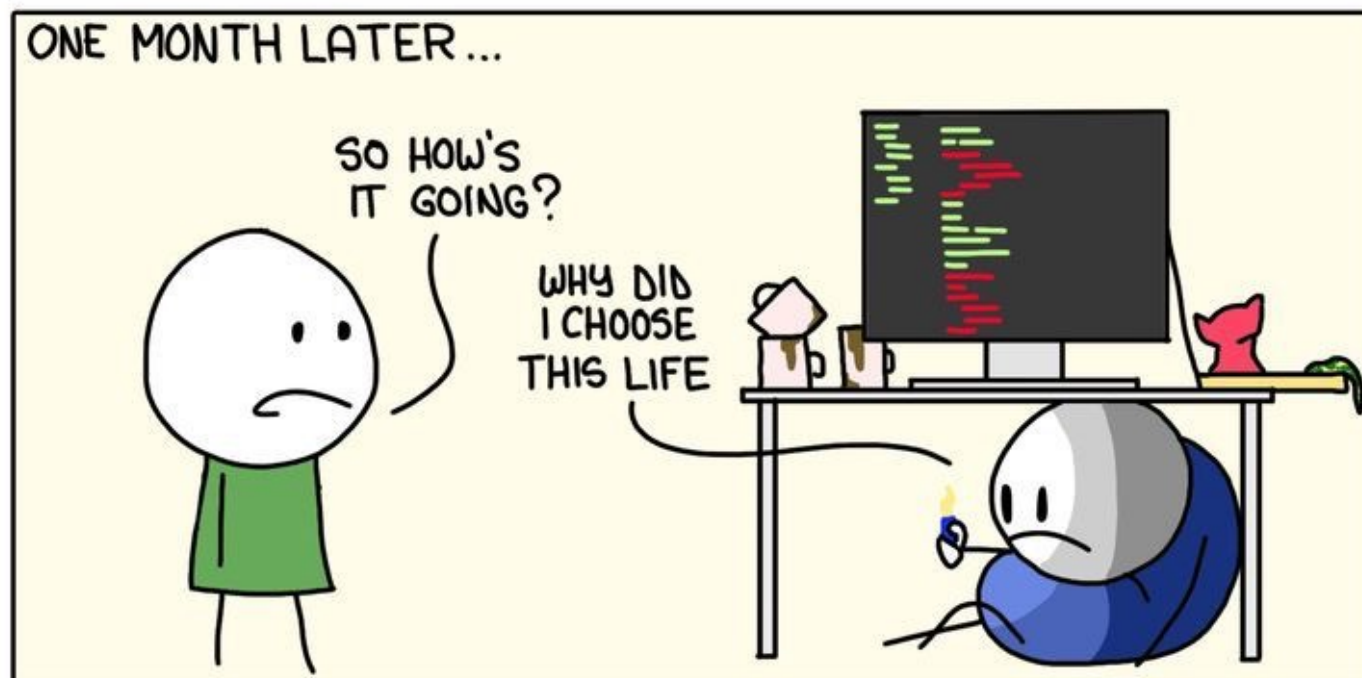
Project 1 Q&A

#EVERYTIME

STARTING A NEW PROJECT



ONE MONTH LATER...



MONKEYUSER.COM