

## Problem 1

Suppose you have a new computer just set up. `dig` is one of the most useful DNS lookup tool. You can check out the manual of `dig` at <http://linux.die.net/man/1/dig>. A typical invocation of `dig` looks like: `dig @server name type`.

Suppose that on April 19, 2017 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: (If a user just types “`dig google.com`” the default is `type=A`)

```
; <<>> 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.                 55414   IN      NS      ns4.google.com.
google.com.                 55414   IN      NS      ns2.google.com.
google.com.                 55414   IN      NS      ns1.google.com.
google.com.                 55414   IN      NS      ns3.google.com.

;; ADDITIONAL SECTION:
ns1.google.com.             145521  IN      A      216.239.32.10
ns2.google.com.             215983  IN      A      216.239.34.10
ns3.google.com.             215983  IN      A      216.239.36.10
ns4.google.com.             215983  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 2017
;; MSG SIZE rcvd: 180
```

1. What is the discovered IPv4 address of `google.com` domain?
2. If you issue the same command 1 minute later, how would “ANSWER SECTION” look like?
3. When would be the earliest (absolute) time the caching resolver would contact one of the `google.com` name servers again? (for issuing the same command “`dig google.com a`”)
4. When would be the earliest (absolute) time the caching resolver would contact one of the `.com` name servers? (for issuing the same command “`dig google.com a`”)

Write your answer here

## Problem 2

Suppose that you walked into Boelter Hall and get connected to CSD WiFi network, which automatically gave you IP address of the local caching resolver. However, initially, it doesn't allow you to do anything unless you type your username and password in a popup window (or if you try to go to any website in your browser).

1. Explain a mechanism of how does the “CSD” network achieve this / which features of DNS/HTTP make it possible.

[Write your answer here](#)

## Problem 3

Same context as Problem 2. After you successfully logged in, you can start using the Internet. Suppose the caching resolver has just rebooted and its cache is completely empty; RTT between your computer and the caching resolver is  $10ms$  and RTT between the caching resolver and any authoritative name server is  $100ms$ ; all responses have TTL 12 hours.

1. If you try to go to `ucla.edu`, what would be minimum amount of time you will need to wait before your web browser will be able to initiate connect to the UCLA's web server?
2. What would be the time, if a minute later you will decide to go to `ccle.ucla.edu`?
3. What would be the time, if another minute later you will decide to go to `piazza.com`?
4. What would be the time, if another minute later you will decide to go to `gradescope.com`?

[Write your answer here](#)

## Problem 4

How does SMTP mark the end of a message body? How about HTTP? Can HTTP use the same method as SMTP to mark the end of a message body? Explain.

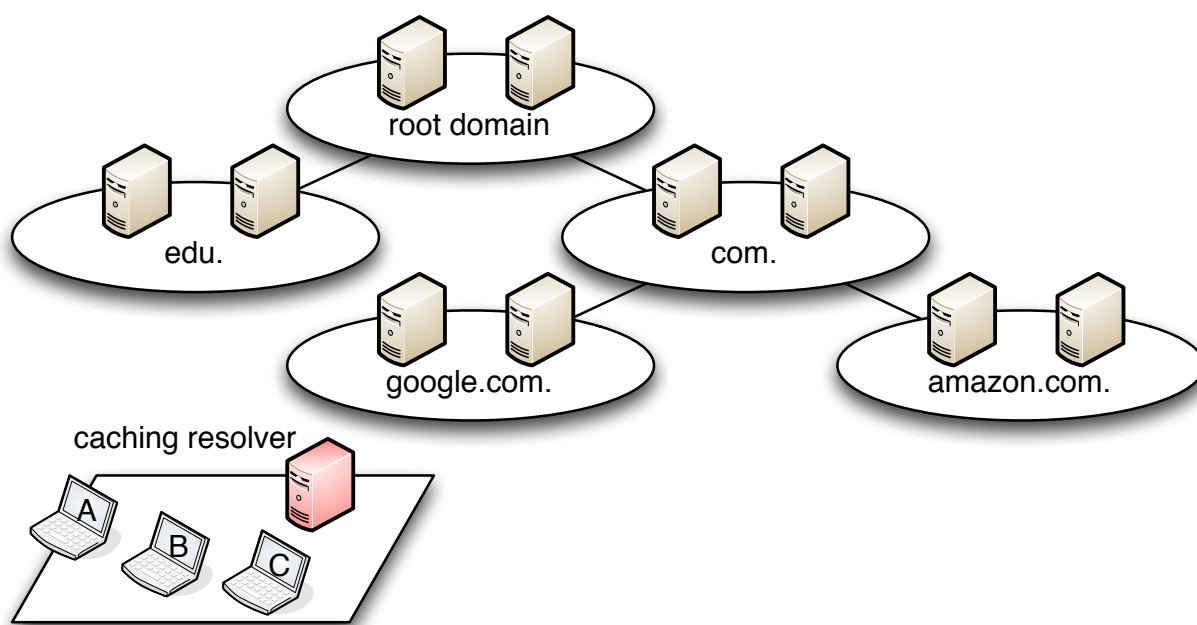
[Write your answer here](#)

## Problem 5

Consider the following environment with a local DNS caching resolver and a set of authoritative DNS name servers.

Assume that initially,

- the caching resolver cache is empty,
- TTL values for all records is 1 hour,
- RTT between stub resolvers (hosts A, B, and C) and the caching resolver is 20 ms,
- RTT between the caching resolver and any of the authoritative name servers is 150 ms,
- There are no packet losses,
- All processing delays are 0 ms



1. At  $T=0$  min, Host-A sends a query for A record for amazon.com, and after receiving the answer sends a query for A record for www.amazon.com. How long did it take to receive all the answers?
2. At  $T=40$  min, Host-B sends a query for MX record for google.com that returns

google.com.	3600	IN	MX	10 primary.google.com.
google.com.	3600	IN	MX	30 backup.google.com.
primary.google.com.	3600	IN	A	74.125.28.27
backup.google.com.	3600	IN	A	173.194.211.27

(Similar to NS records, the DNS server may return glue A/AAAA records in addition to the requested MX records.) How long did it take to get the answer?

3. At  $T=70$  min, Host-C sends a query for AAAA (IPv6) record for mail.google.com, following at  $T=75$  mins with a query for AAAA (IPv6) record for hangout.google.com. How long did it take for Host-C to receive each of the answers (i.e., relative to  $T=70$ min for the first, and relative to  $T=75$  mins for the second)?
4. List DNS records that the caching resolver has at  $T=90$  minutes

Write your answer here