Q1:
The following shows an HTTP GET request message sent from a client to a web server:

```
GET /electrical-software/index.html HTTP/1.1
Host: schulich.ucalgary.ca
User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1; en-US;
rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax)
Accept: ext/xml, application/xml, application/xhtml+xml
Accept-Language: en-us,en;q=0.5
Connection: keep-alive
```

The following is a reply sent from the server in response to the above HTTP GET message:

```
HTTP/1.1 200 OK
Date: Tue, 07 Mar 2008 12:39:45 GMT
Server: Apache/2.0.52 (Fedora)
Last-Modified: Sat, 10 Dec 2005 18:27:46 GMT
ETag: "526c3-f22-a88a4c80"
Accept-Ranges: bytes
Content-Length: 3874
Keep-Alive: timeout=max=100
Connection: Keep-Alive
Content-Type: text/html; charset= ISO-8859-1
<much more document text following here (not shown)>
```

(a) What is the URL of the document requested by the browser?
(b) What version of HTTP is the browser running?
(c) Does the browser request a non-persistent or a persistent connection?
(d) Was the server able to successfully find the document or not?
(e) What time was the document reply provided?
(f) When was the document last modified?
(g) How many bytes are there in the document being returned?

a) The url is /electrical-software/index.html

b) Version 1.1

c) Persistent due to the "connection: keep-alive"

d) Yes as it got a "200 OK" response

e) The reply was provided on Tue, 07 Mar 2008 12:39:45 GMT

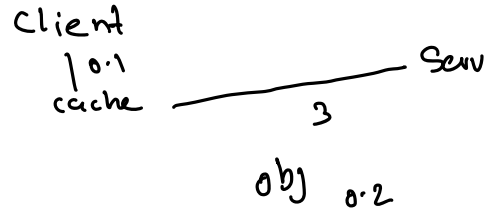
f) As seen on the last-modified it is Sat, 10 Dec 2005

g) As seen by the content length "3874" is the length

Q2:
Consider an HTTP 1.0 client and server. The RTT delay between the client and server is 3 seconds. Suppose the time a server needs to transmit an object into its outgoing link is 1 second. Assume that an HTTP message not containing an object sent by the client and server has a negligible (zero) transmission time. Suppose the client makes 200 requests, one after the other, waiting for a reply to a request before sending the next request.

(a) Using HTTP 1.0, how much time elapses between the client transmitting the first request, and the receipt of the last requested object?
(b) Using HTTP 1.1, how much time elapses between the client transmitting the first request, and the receipt of the last requested object?

(c) Using HTTP 1.1, how much time elapses between the client transmitting the first request, and the receipt of the last requested object, assuming the client has browser caching and uses the IF-MODIFIED-SINCE header line, and 40% of the objects requested have not changed since the client downloaded them (before these 200 downloads are performed)?
(d) Assuming now there is a local web cache (no browser caching), with a 0.1 seconds RTT to the client, a 3 seconds RTT delay to the server, and an object transmission time of 0.2 seconds. Using HTTP 1.1, how much time elapses between the client transmitting the first request, and the receipt of the last requested object, assuming all requests first go to the cache, no use of IF-MODIFIED-SINCE header line, and 40% of the objects requested are "hits" (found) in the local cache?



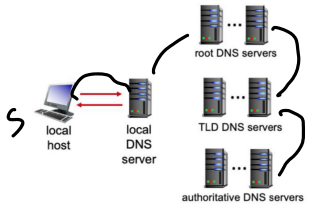
a) $200 \times (3+3+1) = 1200$

b) $200 \times (3+1) + 3 = 803$

c) $(.6 \times (3+1) \times 200) + (0.4 \times 3 \times 200) + 3 = 723$

d) $0.1 + 3 + (200 \times 0.1) + (200 \times 0.2) + (0.6 \times 200 \times 1) + (200 \times 0.6 \times 3) = 543.1$

Q3:
Suppose that the local DNS server caches all information coming in from all root, TLD, and authoritative DNS servers for 20 time units. Assume also that the local cache is initially empty, that iterative DNS queries are always used, that DNS requests are just for name-to-IP-address translation, that 1 time unit is needed for each server-to-server or host-to-server (one way) request or response.



Consider the following DNS requests, made by the local host at the given times:

- *t=0,* the local host requests that the name *schulich.ucalgary.ca* be resolved to an IP address.
- *t=1,* the local host requests that the name *taylorinstitute.ucalgary.ca* be resolved to an IP address.
- *t=4,* the local host requests that the name *arts.ucalgary.ca* be resolved to an IP address.
- *t=5,* the local host requests that the name *cs.mit.edu* be resolved to an IP address.
- *t=10,* the local host *again* requests that the name *schulich.ucalgary.ca* be resolved to an IP address.
- *t=12*, the local host requests that the name *ece.mit.edu* be resolved to an IP address.
- *t=25,* the local host *again* requests that the name *schulich.ucalgary.ca* be resolved to an IP address.

Calculate how many time units are needed for each of the above requests.

t 0) 8 must go through all servers

t 1) 8 must go through all servers

t 4) 4 DNS cached so directly gets auth

t 5) 8 new domain

t 10) 2 DNS cached still

t 12) 4 at t=8 DNS for mit.edu cached

t 25) 2 at t=10 ucalgary.ca is cached