Q1 Web caching (1)

10 Points

Q1.1

5 Points

We understand that web caching reduces access latency. Please mark all the correct descriptions below:

- [ ] If the latency of transmitting a bit from the client to the server is less than that to the cache server (assuming same process time), caching will not reduce the latency.
- [ ] If the cache hit rate is lower than 50%, caching will not reduce the latency.
- [x] If the client is the only user in the network, the latency reduction (in seconds) should be proportional to the cache hit rate.
- [x] Caching may also help reduce the latency for those cache-miss content, because it causes less congestion in the route to the original server.
- [x] Caching may increase the latency (compared to no caching) when the cache miss rate is high.

Q1.2
5 Points

Please mark all the correct descriptions for CDN:

- [ ] CDN service reduces the link bandwidth required on the client side.
- [x] CDN service reduces the link bandwidth required on the server side.
- [x] A CDN server can provide caching for multiple original servers.
- [ ] If the client is accessing a server hosted on CDN, local caching will not reduce the latency (compared to no caching).
- [ ] The largest latency component CDN saved is transmission time.

Q2 Web caching (2)

21 Points

Assume a group of students in UIUC want to access a private server A outside of UIUC. The bottleneck link from UIUC to this server supports a bitrate of $1\mathrm{MB}/\mathrm{s}$. Assume the average request rate from UIUC is $90\mathrm{times}/\mathrm{s}$ and each request is $0.01\mathrm{MB}$. Assuming there is no other traffic within or outside of UIUC, answer the following questions. Assume that queueing delay dominates so you can neglect the much smaller propagation delays, transmit times, and processing delays.

Q2.1

7 Points

What is the average access time for a student in UIUC to access this server? Assume the queuing delay is $1/(1-L)$ milliseconds, where L is the fraction of link usage. (Please enter a numeric value only and your answer should be in milliseconds)

10

Q2.2

7 Points

To improve network performance, we now increase the bitrate of this bottleneck link to $5\mathrm{MB}/\mathrm{s}$. Calculate the average access time again. Please enter a numeric value only; your unit should be milliseconds and be computed up to 2 decimal places.

1.22

Q2.3
7 Points

Another way to improve network performance is to add a cache server within UIUC without increasing the bandwidth of bottleneck link. The bitrate to the cache server is $10\mathrm{MB}/\mathrm{s}$. Assume there is a 80% cache hit rate. The queuing delay for both cache server and server A follows the formula in Q2.1. Calculate the average access time in this case. (Assume the network knows cache server so no additional delays are needed to find that cache server; also, your unit should be milliseconds, computed to 2 decimal places, and please enter a numeric value only).

1.34

Q3 DNS

5 Points

Please marks all the metrics that Iterative DNS excels over Recursive DNS. Bracket indicates the better metric, e.g. (less) means the lower the better.

- [ ] Total link opened (less).
- [x] Links opened simultaneously (less).
- [ ] Link opened at the local DNS server (less).
- [x] Link opened at the root DNS server (less).
- [x] Caching at the local DNS server (more hit)

Q4 Trace route

15 Points

The figure below shows the result of running traceroute (with the -q 1 option to send one probe per hop) from a machine located in UIUC. Please answer the following questions.

```
traceroute to www.auckland.ac.nz (130.216.159.127), 64 hops max, 52 byte packets
 1  0148-cslgeneral-net.gw.uiuc.edu (192.17.100.1)  0.967 ms
 2  t-core1-1.gw.uiuc.edu (172.20.101.25)  0.536 ms
 3  t-exit1.gw.uiuc.edu (130.126.0.242)  0.407 ms
 4  t-fw1.gw.uiuc.edu (130.126.0.134)  0.666 ms
 5  t-exite1.gw.uiuc.edu (130.126.0.141)  0.937 ms
 6  t-dmzo.gw.uiuc.edu (130.126.0.202)  12.626 ms
 7  ur1rtr-uiuc.ex.ui-iccn.org (72.36.127.1)  1.051 ms
 8  t-ur2rtr.ix.ui-iccn.org (72.36.126.66)  1.576 ms
 9  internet2-710rtr.ex.ui-iccn.org (72.36.127.158)  4.107 ms
10  et-7-1-0.4070.rtsw.kans.net.internet2.edu (198.71.45.15)  21.305 ms
11  et-4-1-0.4070.rtsw.salt.net.internet2.edu (198.71.45.19)  41.337 ms
12  et-4-1-0.4070.rtsw.salt.net.internet2.edu (198.71.45.19)  41.280 ms
13  aarnet-1-is-jmb-776.lsanca.pacificwave.net (207.231.241.149)  81.268 ms
14  et-1-2-1.pe1.a.koa.aarnet.net.au (113.197.15.86)  205.814 ms
15  et-1-2-1.pe1.a.koa.aarnet.net.au (113.197.15.86)  205.753 ms
16  et-1-0-0-202.and12-nsh.reannz.co.nz (182.255.119.201)  205.921 ms
17  br-cpf1-north.net.auckland.ac.nz (130.216.95.106)  206.111 ms
18  cxj-alfa-430.net.auckland.ac.nz (130.216.95.122)  208.200 ms
19  cxj-alfa-430.net.auckland.ac.nz (130.216.95.122)  207.881 ms
20  *
21  www.auckland.ac.nz (130.216.159.127)  206.567 ms
```

Q4.1

5 Points

Which hop(s) (if any) is transoceanic with one end in the United States?

- ○ Does not exist.
- ○ 5-6
- ○ 9-10
- ○ 10-11
- ○ 12-13
- ○ 13-14

Q4.2
5 Points

Based on the RTT to the last hop, calculate the furthest distance at which the server could possibly be located? (Note: use average speed of packet propagation: $2 \times 10^8 m/s$.) Choose the closest value from the following.

- ○ 10000km
- ○ 20000km
- ○ 40000km

Q4.3
5 Points

Sometimes the RTT of a subsequent hop is lower than the RTT of a previous one. Mark all that are correct

- ☑ Subsequent packets may take different routes.
- ☑ Network condition may have changed between two packets.
- ☑ A packet may take different routes when going out and coming back.
- ☑ A server may reply slow but forward fast.

Q5 HTTP
21 Points

Suppose a webpage has nothing but 8 large images each of size $10MB$. A client wants to access the webpage and load the images in his browser. The RTT between the client and the server is $30ms$ and the transmission rate at the server is $1GB/s$. How long will it take to load the webpage in each of the following cases. (Note: the size of the webpage is negligible.) Assume $1GB = 1000MB$. For all answers, please answer in milliseconds and enter a numeric value only.

Q5.1
7 Points

Using Non-Persistent HTTP?

620

Q5.2
7 Points

Using Persistent HTTP?

380

Q5.3
7 Points

Using Pipelined Persistent HTTP?

170

Q6 Assorted Questions
28 Points

Q6.1
4 Points

Between the following two networks, which one is better on average? (1) a network that guarantees average throughput of 1000 bps, or (2) a network that guarantees average latency of 1ms.

- 1
- 2

Q6.2
4 Points

True or False: At any given time, a single host can have only one active HTTP connection to a server.

- True
- False

Q6.3
4 Points

In HTTP, a conditional GET offers benefits because (select the most appropriate answer):

- it fetches the new object only if it has changed.
- it prevents the cache from giving stale information.
- most of the time the cached copy is not stale.
- the transmit time of the object over all the links can be substantial.

Correct Answer:
the transmit time of the object over all the links can be substantial.

Q6.4
4 Points

Which type of DNS records need to be provided to the registrar to create a new domain (select all correct answers):

- [x] A
- [x] NS
- [ ] CNAME
- [ ] MX

Q6.5
4 Points

The following application benefits more from time division multiplexing (TDM) than frequency division multiplexing (FDM):

- ( ) High speed car racing games
- ( ) High volume data back (like Dropbox)
- ( ) Sensors that have bursty traffic to send out, such as traffic intersection cameras counting cars.
- (•) Battery operated IoT devices that must send data periodically, such as soil moisture sensors in agricultural farms.

Q6.6
4 Points

Which of the following function is NOT what cookies can provide

- ( ) Have the user stayed logged in after the browser is closed.
- (•) Store the user's browsing history across different websites.
- ( ) Store the user's preferences on a website.
- ( ) Identify the user when they visit again.

Q6.7
4 Points

The TLD server communicates the following resource record(RR) to the Root DNS server: RR(downtown.nunet.com, 128.34.55.12, A). From this, we can say that (select all correct statements):

- [ ] Iterative DNS is in progress.
- [x] Recursive DNS is in progress.
- [ ] downtown.nunet.com is an authoritative DNS server.
- [ ] downtown.nunet.com is a mail server.
- [x] downtown.nunet.com is neither an authoritative nor a mail server.