

Computer Network Midterm 103-1

1. (a) Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total) (b) Besides, you have to write the name of data unit of upper four layer. (寫出最上面四層資料單位的專有名稱，如 xx 層：yy) (8%)
2. Describe detailed operations of HTTP cookie, web caching and conditional GET. (6*3=18%) (說明其用處，並畫圖加解釋每步驟)
3. Consider the figure below, where a client is sending an HPPT GET message to a web server, gaia.cs.umass.edu. Suppose the client-to-server HTTP GET message is the following: (12%)

GET /kurose_ross/interactive/hello.htm HTTP/1.0

Host: gaia.cs.umass.edu

Accept: text/plain, text/html, text/xml, image/png, image/jpeg, audio/vnf.wave, audio/basic, video/mpeg, video/wmv, application/, */**

Accept-Language: en-us, en-gb;q=0.6, en;q=0.1, fr, fr-ch, de, ar

If-Modified-Since: Mon, 13 Nov 2013 09:00:58 EST

User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:10.0.2)

Gecko/20100101 Firefox/10.0.2

Answer the following questions:

- What is the name of the file that is being retrieved in this GET message? (2%)
 - What version of HTTP is the client running? (2%)
 - What languages is the browser indicating that it is willing to accept FIRST? (2%)
 - Does the client already have a (possibly out-of-date) copy of the requested file? (2%)
 - What is the type of client browser and the client's operating system? (4%)
4. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates $R_1=500\text{kbps}$, $R_2=2\text{Mbps}$, and $R_3=1\text{Mbps}$. (要有計算式或說明，以及最後答案) (8% total)
 - a. Assume no other traffic in the network, what is the throughput for the file transfer? (2%)
 - b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? (2%)
 - c. Repeat (a) and (b), but now with R_2 reduced to 100kbps . (2%) (2%)
 5. List three access technologies. Classify each one as home access, enterprise access, or wide-area wireless access. (12%)

Computer Network Midterm 103-1

6. Suppose within your web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that 3 DNS servers are visited before your host receives the IP address from DNS; visiting 2 of them incurs an RTT of D_1 per DNS and visiting each of remaining incurs an RTT of D_2 . Further suppose that the web page associated with the link contains 5 very small objects on the same server. Suppose the HTTP running is and let RTT_0 denote the RTT between the local host and the server for each object. Assume zero transmission time of each object, how much time elapses from when the client clicks on the link until the client receives all the objects? (a) non-persistent HTTP with no parallel TCP connections? (b) non-persistent HTTP with the browser configured for five parallel TCP connections? (c) Persistent HTTP with pipelining? (要寫出並說明每項動作的執行時間算式，不能只寫最後答案) (5% each, 15%)

7. (0.5%, 10%)

Application	Application layer protocol	Transport layer protocol	Data Loss	Elastic Bandwidth	Time Sensitive	Port
File transfer						Control: Data:
e-mail						
Web						

8. Explain the following questions. (7%)
- (a) What three services are provided by the domain name system? (3%)
 - (b) Authoritative DNS servers (2%)
 - (c) Network Throughput (2%)

Computer Network Midterm 103-1

1. (a) Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)
(b) Besides, you have to write the name of data unit of upper four layer. (寫出最上面四層資料單位的專有名稱，如 xx 層：yy) (8%)

Ans:

(a)

application: supporting network applications

transport: host-host data transfer

network: routing of datagrams from source to destination

link: data transfer between neighboring network elements

physical: bits "on the wire" (1% each layer's name, 1% each layer's functions, 10% total)

application
transport
network
link
physical

(b)

application layer: message

transport layer: segment

network layer: datagram

link layer: frame

各 2% ，共 8%

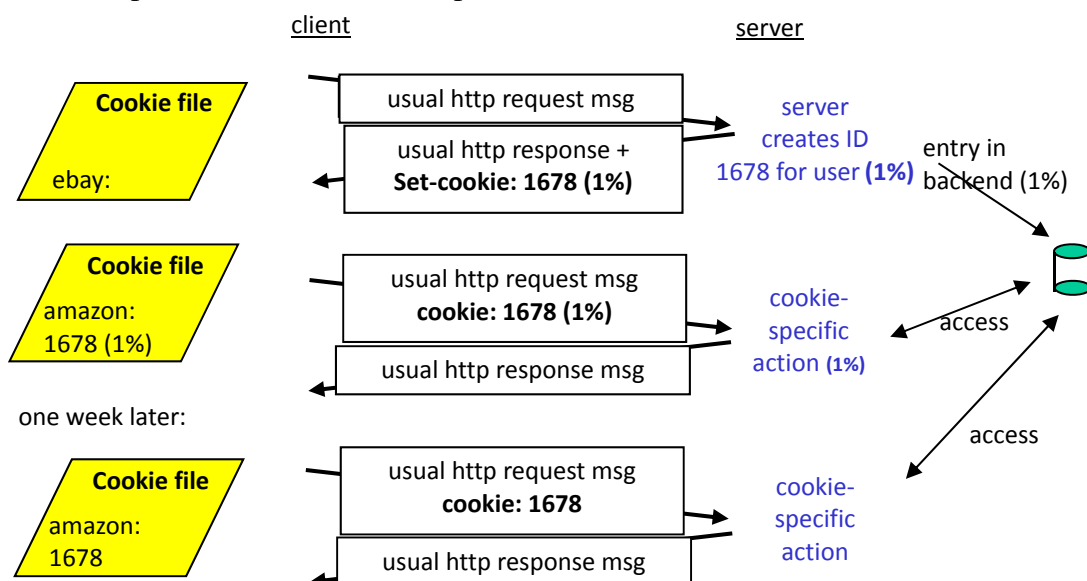
2. Describe detailed operations of HTTP cookie, web caching and conditional GET. (6*3=18%)
(說明其用處，並畫圖加解釋每步驟)

Ans:

□ cookie:

when a user visits a specific web site for first time and initial HTTP requests arrives at site, site creates a unique ID and creates an entry in backend database for recording user states of this ID.

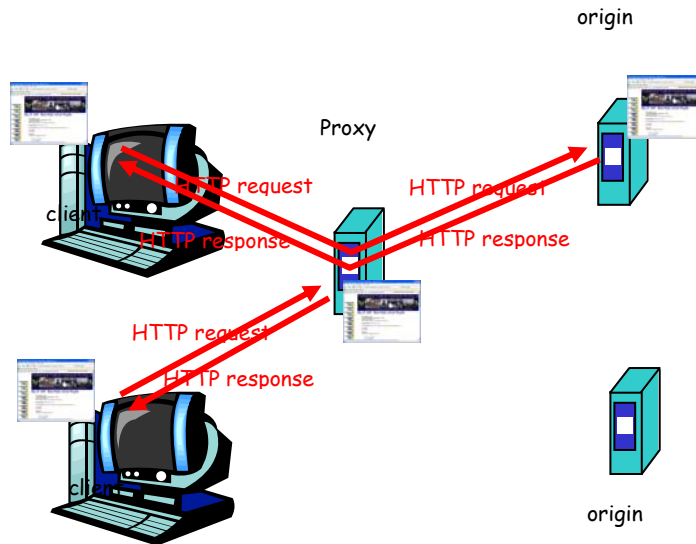
=> keep client's states (cookie-specific action)!



□ web caching:

Computer Network Midterm 103-1

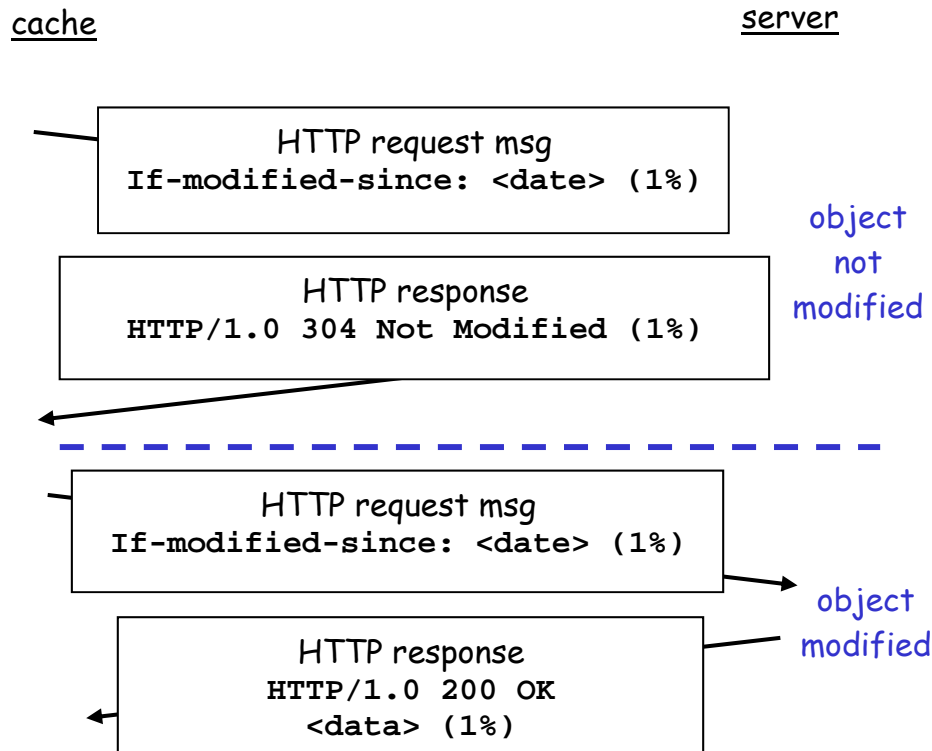
- user sets browser: Web accesses via cache
- browser sends all HTTP requests to cache (2%)
 - if object in cache
 - cache returns object (2%)
 - else
 - cache requests object from origin server, then returns object to client (2%)



conditional GET (6%)

- Conditional GET: don't send object if cache has up-to-date cached version (1%) => reduce traffic loads (delays) on network links! (1%)
 - cache: specify date of cached copy in HTTP request (1%)
 - If-modified-since: <date>** (1%)
 - server: response contains no object if cached copy is up-to-date: (1%)
 - HTTP/1.0 304 Not Modified** (1%)

Computer Network Midterm 103-1



3. Consider the figure below, where a client is sending an HTTP GET message to a web server, `gaia.cs.umass.edu`. Suppose the client-to-server HTTP GET message is the following: (12%)

```
GET /kurose_ross/interactive/hello.htm HTTP/1.0
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/png, image/jpeg, audio/vnf.wave, audio/basic, video/mpeg,
video/wmv, application/*, */*
Accept-Language: en-us, en-gb;q=0.6, en;q=0.1, fr, fr-ch, de, ar
If-Modified-Since: Mon, 13 Nov 2013 09:00:58 EST
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:10.0.2) Gecko/20100101 Firefox/10.0.2
```

Answer the following questions:

- What is the name of the file that is being retrieved in this GET message? (2%)
- What version of HTTP is the client running? (2%)
- What languages is the browser indicating that it is willing to accept FIRST? (2%)
- Does the client already have a (possibly out-of-date) copy of the requested file? (2%)
- What is the type of client browser and the client's operating system? (4%)

Ans:

- The file being fetched is /kurose_ross/interactive/hello.htm (2%)
- The client is running HTTP version 1.0. (2%)
- The FIRST accepted languages are en-us (*American English*). (2%)
- The time indicated in the browser's If-Modified-Since header field is approximately 45 minutes ago, indicating that it has a cached copy.

Computer Network Midterm 103-1

- The browser's User Agent: header field value of Mozilla/5.0 (Windows NT 6.1; WOW64; rv:10.0.2) Gecko/20100101 Firefox/10.0.2 indicates that the browser/OS type is Firefox 10.0 (2%), Win7 64-bit (2%).
- 4. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates $R_1=500\text{kbps}$, $R_2=2\text{Mbps}$, and $R_3=1\text{Mbps}$. (要有計算式或說明，以及最後答案) (8% total)
 - a. Assume no other traffic in the network, what is the throughput for the file transfer? (2%)
 - b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? (2%)
 - c. Repeat (a) and (b), but now with R_2 reduced to 100kbps . (2%) (2%)

Ans :

- a) $\min\{500\text{kbps}, 2\text{Mbps}, 1\text{Mbps}\}=500\text{kbps}$ (2%)
- b) $4 \times 10^6 \times 8 / (500 \times 10^3) = 64$ seconds (2%)
- c) $\min\{500\text{kbps}, 100\text{kbps}, 1\text{Mbps}\}=100\text{kbps}$; (2%)
 $4 \times 10^6 \times 8 / (100 \times 10^3) = 320$ seconds (2%)

5. List three access technologies. Classify each one as home access, enterprise access, or wide-area wireless access. (12%)

Ans: (任選三者，配對要正確)

1. Dial-up modem (2%) over telephone line: home; (2%)
2. DSL over telephone line (2%): home or small office; (2%)
3. Cable to HFC: home;
4. 100 Mbps switched Ethernet: enterprise;
5. Wifi (802.11): home and enterprise;
6. 3G and 4G: wide-area wireless.

6. Suppose within your web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that 3 DNS servers are visited before your host receives the IP address from DNS; visiting 2 of them incurs an RTT of D_1 per DNS and visiting each of remaining incurs an RTT of D_2 . Further suppose that the web page associated with the link contains 5 very small objects on the same server. Suppose the HTTP running is and let RTT_0 denote the RTT between the local host and the server for each object. Assume zero transmission time of each object, how much time elapses from when the client clicks on the link until the client receives all the objects? (a) non-persistent HTTP with no parallel TCP connections? (b) non-persistent HTTP with the browser configured for five parallel TCP connections? (c) Persistent HTTP with pipelining? (要寫出並說明每項動作的執行時間算式，不能只寫最後答案) (5% each, 15%)

Ans:

- a) The total time to get the IP address is $2D_1 + 1D_2$. After this, $2RTT_0$ is required to set up each of the 5 TCP connections and to request and receive each HTTP object. Thus, the total response time is $2D_1 + 1D_2$ (1%) + $1 RTT_0$ (TCP handshaking) + $1 RTT_0$ (HTTP request/response for web page)

Computer Network Midterm 103-1

$(1\%) + 5 * [1 \text{ RTT}_0 \text{ (parallel TCP handshaking)} + 1 \text{ RTT}_0 \text{ (HTTP request/response for 5 objects)}]$

$(1\%) = 2D_1 + D_2 + 12 \text{ RTT}_0 (2\%)$

b) $2D_1 + 1D_2 + 1 \text{ RTT}_0 \text{ (TCP handshaking)} + 1 \text{ RTT}_0 \text{ (HTTP request/response for web page)} + 1 \text{ RTT}_0 \text{ (parallel TCP handshaking)} + 1 \text{ RTT}_0 \text{ (HTTP request/response for 5 objects)} = 2D_1 + D_2 + 4 \text{ RTT}_0$

c) $2D_1 + 1D_2 + 1 \text{ RTT}_0 \text{ (TCP handshaking)} + 1 \text{ RTT}_0 \text{ (HTTP request/response for web page)} + 1 \text{ RTT}_0 \text{ (HTTP request/response for 5 objects)} = 2D_1 + D_2 + 3 \text{ RTT}_0$

7. (0.5%, 10%)

Application	Application layer protocol	Transport layer protocol	Data Loss	Elastic Bandwidth	Time Sensitive	Port
File transfer	FTP	TCP	No	Yes	No	Control: 21 Data: 20
e-mail	SMTP	TCP	No	Yes	No	25
Web	HTTP	TCP	No	Yes	No	80

8. Explain the following questions. (7%)

(a) What three services are provided by the domain name system? (3%)

(b) Authoritative DNS servers (2%)

(c) Network Throughput (2%)

Ans:

(a) DNS services (3%)

- hostname to IP address translation
- host aliasing (Canonical, alias names)
- mail server aliasing

(b) Authoritative DNS server (2%)

- organization's DNS servers, providing authoritative hostname to IP mappings for organization's servers

(c) Network Throughput: rate (bits/time unit) at which bits transferred between sender/receiver (2%)