Computer Network Midterm 102-1

1. Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)

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 a message that is $8*10^6$ bits long that is to be sent from source to destination through two packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 8000 packets, with each packet being 1000 bits long. How long does it take to move message from source to destination with message segmentation (10%)

4. Suppose you click a hyperlink (http://www.ncue.edu.tw) to obtain a Web page. The IP address for the associated URL is NOT cached in your local host, so a DNS lookup is needed to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1,…, RTT_n. Further suppose the HTML file references six very small objects on the same server. Assuming RTT_0 denotes the round trip time between your host and the server containing the object. Assuming zero transmission time of the object, how much time elapses with (a) nonpersistent HTTP with no parallel TCP connections, (b) persistent HTTP without pipelining, (c) persistent HTTP with pipelining, from when the client clicks on the link until the client receives the Web page and the five objects? (說明每項的動作，畫出過程的時間圖，並解釋如何計算時間，12%)

5. (a) What is the process? (2%)
   (b) What are the Client process and Server process? (4%)
   (c) Does IP address of host on which process runs suffice for identifying the process? Why? (2%)
   (d) Which two identifiers are used to identify a process? (4%) (12% total)

6. List four broad classes of services that a transport protocol can provide (8%).

7. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? (2%) How many RTTs do UDP and TCP need? (4%) Why? (4%) (10% total)

8. An application-layer protocol defines four items. What are they? (8%)

9. 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%)

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GET /kurose_ross/interactive/quotation2.htm HTTP/1.1
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%)

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1. Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)

Ans: 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

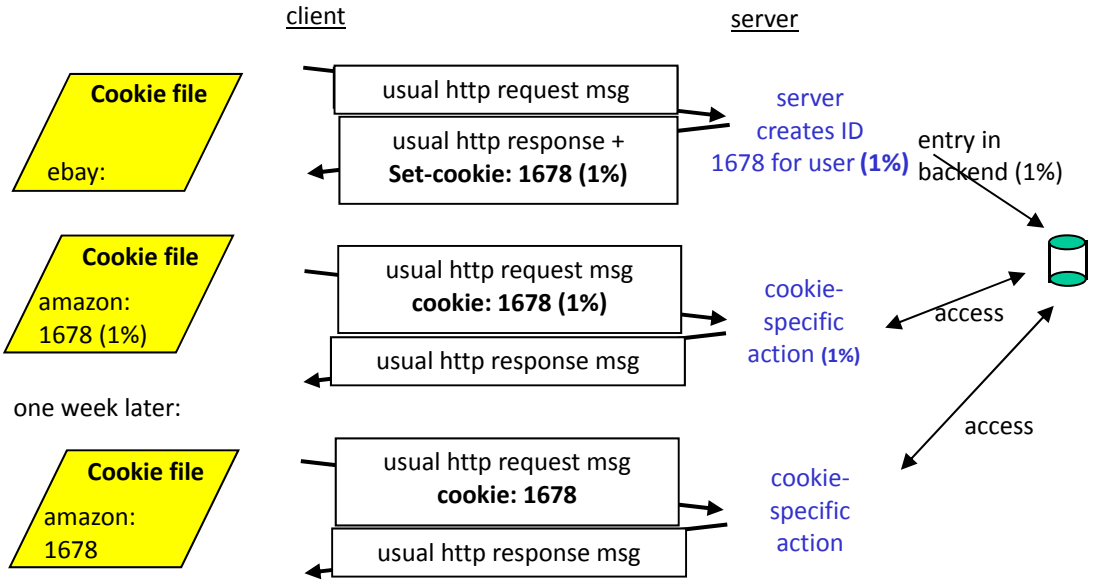
2. Describe detailed operations of HTTP cookie, web caching and conditional GET. (6*3=18%)
（說明其用處，並畫圖加解釋每步驟）

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)!



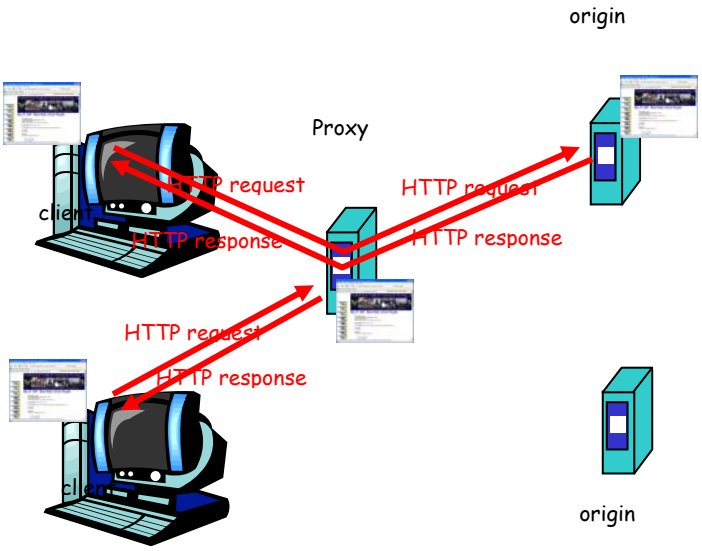
- web caching:
  - user sets browser: Web accesses via cache
  - browser sends all HTTP requests to cache (2%)

    if object in cache

      cache returns object (2%)

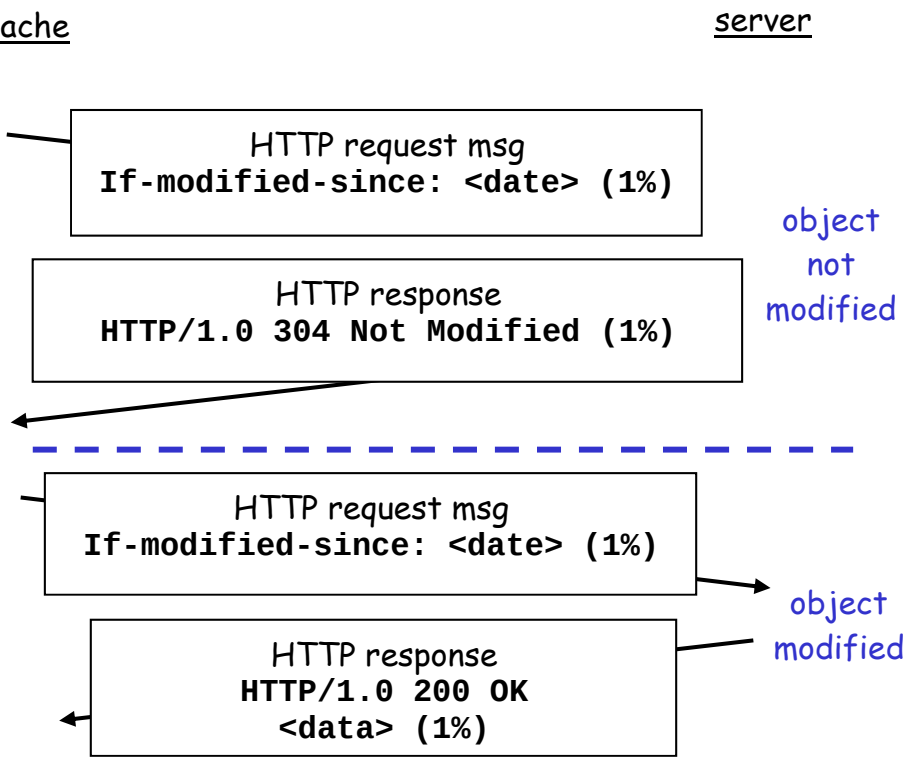
    else

      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%)



3. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination through two packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 8000 packets, with each packet being 1000 bits

long. How long does it take to move message from source to destination with message segmentation (10%)

Ans:

a) Time to send 1st packet from source host to first packet switch = $\frac{1\times10^3}{1\times10^6}\sec = 1\,m\sec$. (2%)

Time at which 2nd packet is received at the first switch = time at which 1st packet is received at the second switch = $2\times1\,m\sec = 2\,m\sec$

Time at which 1st packet is received at the destination host = $1\,m\sec\times3\,hops = 3\,m\sec$. (2%)

After this, every 1msec one packet will be received; thus time at which last (8000th) packet is received = $3m\sec+7999*1m\sec = 8.002\sec$. (6%)

4. Suppose you click a hyperlink (http://www.ncue.edu.tw) to obtain a Web page. The IP address for the associated URL is NOT cached in your local host, so a DNS lookup is needed to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1,…, RTT_n. Further suppose the HTML file references six very small objects on the same server. Assuming RTT_0 denotes the round trip time between your host and the server containing the object. Assuming zero transmission time of the object, how much time elapses with (a) nonpersistent HTTP with no parallel TCP connections, (b) persistent HTTP without pipelining, (c) persistent HTTP with pipelining, from when the client clicks on the link until the client receives the Web page and the five objects? (說明每項的動作，畫出過程的時間圖，並解釋如何計算時間，12%)

Ans:

Once the IP address is known by querying DNS servers, RTT_O elapses to set up the TCP connection and another RTT_O elapses to request and receive the Web object.

(a) nonpersistent HTTP without parallel TCP connections:

At most one object is sent over a TCP connection. *(2%)*

RTT_1+…+RTT_n+[1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response)]* 7 objects (1 Web page + 6 objects) = RTT_1+…+RTT_n+14 RTT_0 (2%)

(b) persistent HTTP without pipelining:

Multiple objects can be sent over single TCP connection between client and server. The browser first waits to receive a HTTP response from the server before issuing a new HTTP request. *(2%)*

RTT_1+…+RTT_n+1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response) * 7 objects = RTT_1+…+RTT_n+8 RTT_0 (2%)

(c) persistent HTTP with pipelining:

The browser issues requests as soon as it has a need to do so, without waiting for response messages from the server. (*2%)*

RTT_1+…+RTT_n+1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response for web page) + 1 RTT_0 (HTTP request/response for 6 objects) = RTT_1+…+RTT_n+3 RTT_0 (2%)

12% total

5. (a) What is the process? (2%)
(b) What are the Client process and Server process? (4%)

(c) Does IP address of host on which process runs suffice for identifying the process? Why? (2%)

(d) Which two identifiers are used to identify a process? (4%) (12% total)

Ans:

(a) A program running within a host (2%)

(b) Client process: process that initiates communication (2%)
Server process: process that waits to be contacted (2%)

(c) No, many processes can be running on same host (2%)

(d) Identifier includes both IP address and port numbers associated with process on host (4%)

6. List four broad classes of services that a transport protocol can provide (8%).

Ans:

a) Reliable data transfer (2%)

b) A guarantee that a certain value for throughput will be maintained (2%)

c) A guarantee that data will be delivered within a specified amount of time (2%)

d) Security (2%)

7. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? (2%) How many RTTs do UDP and TCP need? (4%) Why? (4%) (10% total)

Ans: You would use UDP. (2%)

With UDP, the transaction can be completed in one roundtrip time (RTT) (2%)- the client sends the transaction request into a UDP socket, and the server sends the reply back to the client's UDP socket.

With TCP, a minimum of two RTTs (2%) are needed - one to set-up the TCP connection (2%), and another for the client to send the request, and for the server to send back the reply. (2%)

8. An application-layer protocol defines four items. What are they? (8%)

Ans:

(i) The types of messages exchanged (2%), for example, request messages and response Messages.

(ii) The syntax of the various message types (2%), such as the fields in the message and how the fields are delineated.

(iii) The semantics of the fields (2%), that is, the meaning of the information in the fields.

(iv) Rules for determining when and how a process sends messages and responds to messages. (2%)

9. 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%)

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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

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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:

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- 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/quotation2.htm (2%)
- The client is running HTTP version 1.1. (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 is has a cached copy.
- 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%).