Name_______________ Student ID____________________ Department/Year__________

Midterm Examination

Introduction to Computer Networks
Class#: 901 E31110
Fall 2015

9:10-11:10 Wednesday
November 4, 2015

Prohibited

1. You are not allowed to write down the answers using pencils. Use only black- or blue-inked pens.
2. You are not allowed to read books or any references not on the question sheets.
3. You are not allowed to use calculators or electronic devices in any form.
4. You are not allowed to use extra sheets of papers.
5. You are not allowed to have any oral, visual, gesture exchange about the exam questions or answers during the exam.

Cautions

1. Check if you get 10 pages (including this title page), 6 questions.
2. Write your **name in Chinese**, student ID, and department/year down on top of the first page.
3. There are in total 100 points to earn. You have 100 minutes to answer the questions. Skim through all questions and start from the questions you are more confident with.
4. Use only English to answer the questions. Misspelling and grammar errors will be tolerated, but you want to make sure with those errors your answers will still make sense.
5. If you have any extra-exam emergency or problem regarding the exam questions, raise your hand quietly. The exam administrator will approach you and deal with the problem.

1. (Overview) Provided the following pictures.
    (1) List in order (from left to right) the Ethernet cable, the coaxial cable, and the optic fiber. (4%)
    (2) Which of these are made of copper? (4%)

(a)

(b)

(c)

Sample Solution:

(1) (b)(a)(c)

(2) (a)(b)

2. (Overview) Compare and contrast car network and train network based on your understanding of circuit switching and packet switching principle.
   (1) Is the car network more circuit switching or packet switching? Why do you think so? (4%)
   (2) Is the train network more circuit switching or packet switching? Why do you think so? (4%)

Sample Solution:

(1) Packet switching. There is no specific route being set and enforced during the transmission of the people in car.
(2) Circuit switching. The train tracks are scheduled and to be switched at a designated time to ensure the people in train follow a pre-determined path to the destination.

3. (Application) Consider the following ASCII characters captured by WinDump when the browser sent an HTTP GET message and when the server sent an HTTP REPLY message.

GET /cs453/index.html HTTP/1.1<cr><lf>
Host: gaia.cs.umass.edu<cr><lf>
User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1; en-US; rv:1.7.2)
Gecko/20040804 Netscape/7.2 (ax) <cr><lf>
Accept: ext/xml, application/xml, application/xhtml+xml, text/html;q=0.9,
text/plain;q=0.8,image/png,*/*;q=0.5<cr><lf>
Accept-Language: en-us,en;q=0.5<cr><lf>
Accept-Encoding: zip,deflate<cr><lf>
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7<cr><lf>
Keep-Alive: 300<cr><lf>
Connection: keep-alive<cr><lf>
<cr><lf>

HTTP/1.1 200 OK<cr><lf>
Date: Tue, 07 Mar 2007 12:28:34GMT<cr><lf>
Server: Apache/2.0.52 (Fedora) <cr><lf>
Last-Modified: Sat, 10 Dec2005 18:27:34GMT<cr><lf>
Content-Length: 3874<cr><lf>
Keep-Alive: timeout=max=100<cr><lf>
Connection: Keep-Alive<cr><lf>
Content-Type: text/html; charset=ISO-8859-1<cr><lf>
<cr><lf>
<!doctype html public “-//w3c//dtd html 4.0
transitional//en”><lf><html><lf><head><lf> <meta http-equiv=“Content-Type”
Content = “text/html; charset=iso-8859-1”><lf> …
<much more document text following here>

(1) What’s the URL of the doc requested? (4%)
(2) Is it a non-persistent or persistent connection being requested? (4%)
(3) Was the doc found successfully? (4%)
(4) How many bytes are there in the doc requested? (4%)
(5) What are the first 5 characters of the doc being returned? (4%)

Sample Solution:

(1) http://gaia.cs.umass.edu/cs453/index.html

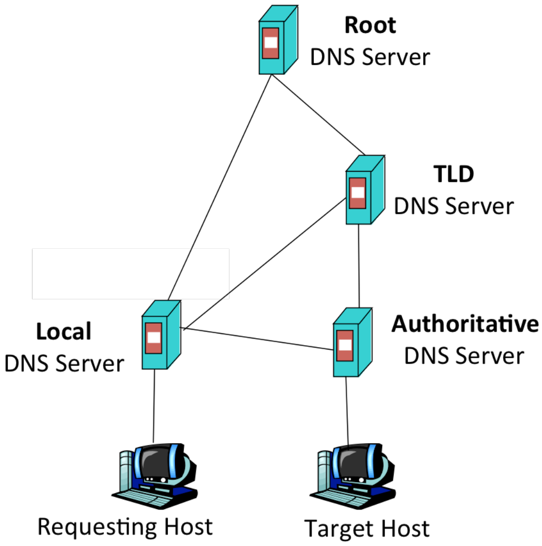
(2) Persistent connection

(3) Yes

(4) 3874

(5) <!doc

4. (Application) Consider the following network of DNS servers and hosts. And to simplify the analysis, assume the delay in between any of the 2 nodes is d and there's no loss at all over this network.



Let's start from a very primitive form of DNS where DNS queries are still recursive and the local DNS server does not maintain the <name, IP address> cache. Analyze next the benefit of applying the 'iterative query' technique.

(1) How long does it take for the DNS reply to come back with a recursive query? And how long if the recursive query is replaced by the iterative query? (4%)

(2) How many messages (including sent and received) does the root DNS server need to handle with a recursive query? And how many if the recursive query is replaced by the iterative query? (4%)

Next let's replace recursive query by the iterative query. Analyze next the benefit of apply the 'caching' technique.

(3) How long does it take for the DNS reply to come back if the <name, IP address> mapping being requested is already cached at the local DNS server? And how long if the mapping is not cached? (4%)

(4) How many messages (including sent and received) does the root DNS server need to handle with the <name, IP address> mapping requested is cached? And how many if not cached? (4%)

Lastly, compare the contrast quantitatively the 'iterative query' and 'caching' techniques based on the scenario provided above.

(5) Which of the 2 techniques help(s) reducing the delay? (4%)

(6) Which of the 2 techniques help(s) reducing the root DNS server load? (4%)

Sample Solution:

(1) 8d, 8d
(2) 4, 2
(3) 2d, 8d
(4) 0, 2
(5) caching
(6) both

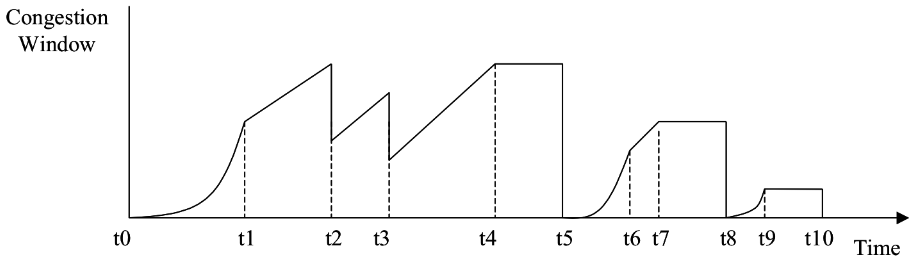
5. (Transport) Compare and contrast Go-Back-N (GBN) and Selective Repeat (SR).

   (1) Which method uses more network bandwidth to retransmit for losses? Why? (4%)
   (2) Which method requires more memory space at the receiver end? Why? (4%)
   (3) Which method requires more timers at the sender end? Why? (4%)
   (4) If the network bandwidth is abundant and memory is cheap which method would you choose to implement? Why? (4%)

Sample Solution:

(1) GBN. When a timeout event occurs, the whole batch of packets that are not yet ack'd will be retrainsmitted.
(2) SR. The receiver needs to buffer packets that arrive out of order.
(3) SR. Each packet transmitted and not yet ack'd is tracked by a timer.
(4) Pick and justify for your choice.

6. (Transport) Suppose the change of the congestion window size of a TCP connection is as depicted below.



(1) In what time periods the connection is in the slow start state? (4%)
(2) In what time periods the connection is in the congestion avoidance state? (4%)
(3) At what time points the connection is experiencing a packet loss due to triple duplicate acknowledgements? (4%)
(4) At what time points the connection is experiencing a packet loss due to timeout? (4%)
(5) At what time points the connection's congestion window size reaches the slow start threshold? (4%)
(6) At what time periods the connection is not receiving any acknowledgements? (4%)

Sample solution:

(1) t0-t1, t5-t6, t8-t10
(2) t1-t5, t6-t8
(3) t2, t3
(4) t5, t8, t10
(5) t1, t6
(6) t4-t5, t7-t8, t9-t10