College of Computing

Georgia Institute of Technology

CS 3251: Computer Networking: Spring 2013

Quiz I

There are 12 questions and 11 pages in this quiz booklet (including this page), plus one optional bonus question. **There are 90 total points.** Answer each question according to the instructions given. You have **85 minutes** to answer the questions.

The last page is an easy, optional set of questions. *Rip this page off of your exam for five bonus points.* Turn it in anonymously.

If you find a question ambiguous, write down any assumptions you make. **Be neat and legible.** If I can't understand your answer, I can't give you credit!

Use the empty sides of this booklet if you need scratch space. You may also use them for answers, although you shouldn't need to. *If you do use the blank sides for answers, make sure to clearly say so!*

Note well: Write your name in the space below AND your initials at the bottom of each page of this booklet.

THIS IS AN "CLOSED BOOK" QUIZ.
NO BOOKS, NO NOTES, NO OTHER MATERIALS, NO PHONES, NO COMPUTERS, NO LAPTOPS, NO PDAS.
ONE TWO-SIDED LETTER-SIZED NOTE SHEET IS ALLOWED. MAKE SURE YOU'VE READ ALL THE INSTRUCTIONS ABOVE!

Initial here to indicate that (1) you've read the instructions and (2) you agree to abide by the Georgia Tech Honor Code:

Do not write in the boxes below

1-5 (xx/20)	6-8 (xx/24)	9 (xx/14)	10-11 (xx/20)	12 (xx/12)	Bonus (xx+5)	Total (xx/90)

Name:

I Warmup

1. **[4 points]:** Which of the following are true about Classless Interdomain Routing (CIDR)?
(Circle ALL that apply)

   A. The prefix length for a CIDR prefix can be anywhere in the range from 0 to 32 bits.

   B. CIDR slowed the rate of Internet routing table growth because prefixes no longer had to be allocated in fixed-size blocks.

   C. In an Internet forwarding table with CIDR, there can only be one unique matching entry for any given IP address.

   D. The only sizes for an IP address allocation before CIDR were 8, 16, or 24 bits.

   E. All of the above.

2. **[4 points]:** Which of the following are true about how DNS lookups work?
(Circle ALL that apply)

   A. An MX-record query for a DNS lookup will return the IP address of the mail server for that domain.

   B. An NS-record query for a DNS lookup will return the name(s) of the authoritative name server(s) for that domain.

   C. A DNS A-record query for `google.com` will only return a single IP address at a time.

   D. All DNS PTR records are maintained by a single organization `in-addr.arpa`.

   E. If your local DNS resolver caches an NS record for `google.com` for multiple days, all clients who use that DNS resolver will continue using the same IP address to reach Google's Web server until that NS record expires.

3. [4 points]: Which of the following are true about traffic control with BGP?
(Circle ALL that apply)

A. A network operator can use BGP *AS path prepending* to control *inbound* traffic from his or her AS to a destination.

B. A network operator can use the BGP *local preference* attribute to control *inbound* traffic from his or her AS to a destination.

C. A network operator can use BGP *AS path prepending* to control *outbound* traffic from his or her AS to a destination.

D. A network operator can use the BGP *local preference* attribute to control *outbound* traffic from his or her AS to a destination.

E. All of the above.

4. [4 points]: Which of the following are true about layering?
(Circle ALL that apply)

A. The transport layer uses port numbers.

B. The network layer guarantees reliable, in-order delivery of packets.

C. The network layer has only a single protocol in widespread use today, representing what we call the "narrow waist".

D. The destination address in the link layer header is always the address of the next layer-3 node along an end-to-end IP path.

E. All of the above.

5. [4 points]: Which of the following are true about packet switching?
(Circle ALL that apply)

A. A user of a packet-switched network might occasionally get a "busy signal" if there are too many users on the network.

B. Traffic running over a packet-switched network between two endpoints will always experience predictable latency.

C. Traffic running over a packet-switched network between two endpoints will never be dropped by intermediate nodes along the path.

D. Once a connection is established between two endpoints in a packet switched network, the end-to-end route cannot change, or the connection must be re-established.

E. All of the above.

Initials:

II Routing and Addressing

6. [6 points]: Describe two advantages of link-state routing over distance-vector routing. Describe one disadvantage.

(Answer legibly in the space below.)

7. [10 points]: Suppose that you have an IP address `18.31.132.110` and the following prefixes in a forwarding table.

18.0.0.0/8
18.31.0.0/16
18.31.128.0/17
18.31.128.0/24

(a) Which of the following prefixes in the Internet routing table will this prefix match?
(b) How many IP addresses does each of these four IP prefixes represent?

(Answer legibly in the space below.)

Initials:

8. [8 points]: Consider the following traceroute from Georgia Tech to BBC `news.bbc.co.uk`. Each row in the output below shows one IP "hop" along the path from Georgia Tech to `news.bbc.co.uk`, along with the round-trip latency to that hop in milliseconds (there are three measurements of round-trip latency for each hop).

```
% traceroute news.bbc.co.uk
traceroute to news.bbc.co.uk (212.58.246.84), 30 hops max, 60 byte packets
 1  cc-cisco-143out4.cc.gt.atl.ga.us (143.215.131.1)  1.255 ms  1.748 ms  1.099 ms
 2  ni-rtr-gorillanet.gatech.edu (130.207.251.1)  1.730 ms  1.710 ms  1.549 ms
 3  campus2-rtr-130-207-254-45.gatech.edu (130.207.254.45)  2.463 ms  2.463 ms  2.458 ms
 4  gateway2-rtr.gatech.edu (130.207.254.185)  2.010 ms  2.002 ms  1.975 ms
 5  atx-edge-04.inet.qwest.net (65.114.55.137)  47.960 ms  47.956 ms  47.931 ms
 6  atx-brdr-01.inet.qwest.net (67.14.14.138)  1.949 ms  1.362 ms  1.268 ms
 7  63.146.27.198 (63.146.27.198)  1.558 ms  1.849 ms  1.821 ms
 8  ash-bb3-link.telia.net (80.91.251.85)  16.709 ms 16.716 ms 15.520 ms
 9  ldn-bb2-link.telia.net (80.91.251.208)  91.007 ms 92.489 ms 90.481 ms
10  ldn-b3-link.telia.net (80.91.249.176)  89.620 ms 90.773 ms 90.458 ms
11  atos-ic-124708-ldn-b2.c.telia.net (213.248.104.70)  101.540 ms  100.094 ms  99.794 ms
12  * * *
13  * * *
14  ae0.er01.cwwtf.bbc.co.uk (132.185.254.93)  90.664 ms  95.325 ms  91.188 ms
15  132.185.255.165 (132.185.255.165)  95.860 ms  99.814 ms  99.818 ms
16  bbc-vip005.cwwtf.bbc.co.uk (212.58.246.84)  89.450 ms  90.388 ms  89.411 ms
```

(a) Which hop is the first hop on the *other side* of the Atlantic Ocean? Why?

(b) How many autonomous systems (ASes) are likely on this path? How did you figure out your answer?

(c) How does the `traceroute` tool map from the IP addresses along the path to provide human-readable names, as above? (A one-sentence answer is sufficient here.)

(d) Why is the last hop on the traceroute "bbc-vip005.cwwtf.bbc.co.uk", even though the IP address of the last hop is `212.58.246.84`, which is the IP address for "news.bbc.co.uk"? (in other words, why do the names not match?)

Initials:

III Domain Name System

9. [14 points]: Consider the following (abridged) "dig" trace. Remember that the "trace" option forces an iterative lookup, even if certain DNS records are cached in the local resolver.

```
% dig nytimes.com +trace
; <<>> DiG 9.7.3 <<>> nytimes.com +trace
;; global options: +cmd
. 308148 IN NS b.root-servers.net.
. 308148 IN NS c.root-servers.net.
. 308148 IN NS d.root-servers.net.
. 308148 IN NS e.root-servers.net.
. 308148 IN NS a.root-servers.net.
;; Received 512 bytes from 130.207.17.21#53(130.207.17.21) in 2 ms

com. 172800 IN NS g.gtld-servers.net.
com. 172800 IN NS m.gtld-servers.net.
com. 172800 IN NS j.gtld-servers.net.
com. 172800 IN NS b.gtld-servers.net.
com. 172800 IN NS d.gtld-servers.net.
com. 172800 IN NS k.gtld-servers.net.
;; Received 489 bytes from 199.7.91.13#53(d.root-servers.net) in 40 ms

nytimes.com. 172800 IN NS dns.sea1.nytimes.com.
nytimes.com. 172800 IN NS dns.ewr1.nytimes.com.
;; Received 107 bytes from 192.48.79.30#53(j.gtld-servers.net) in 177 ms

nytimes.com. 500 IN A 170.149.168.130
nytimes.com. 500 IN A 170.149.172.130
;; Received 61 bytes from 170.149.173.133#53(dns.sea1.nytimes.com) in 96 ms
```

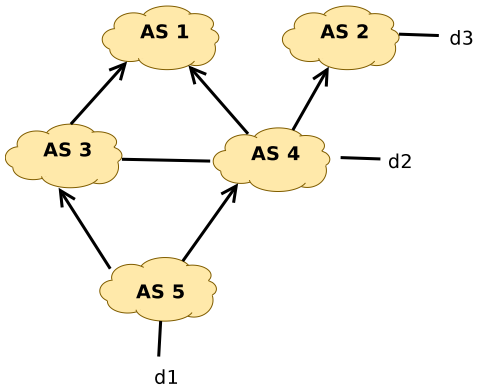
(a) Which of the records above were likely already in the local DNS resolver's cache when this lookup was performed? Explain how you arrived at your answer.
(b) Which of these DNS records will be kept in the local DNS resolver's cache for the shortest amount of time? How long will those records be cached?
(c) What are the authoritative DNS name servers for `nytimes.com`?
(d) How much time did it take for the above DNS query to complete? Show your work.
(e) If a regular A-record query for `nytimes.com` were run again immediately (without the "trace" option), about how long would you expect the query to take? Why?

(Answer legibly in the space below.)

Initials:

IV Border Gateway Protocol

10. [10 points]: Consider the autonomous system graph below. Assume that a directed edge represents a relationship from a customer to a provider, and that an undirected edge represents a peering link.



(a) Which ASes will learn at least one route to d_1?
(b) Which ASes will learn at least one route to d_2?
(c) Which ASes will learn at least one route to d_3?
(d) Suppose that AS 3 learns a route to d_1 via AS 4 and AS 5. Which route will it prefer, and why?

(Answer legibly in the space below.)

Initials:

11. [10 points]: Consider the routing table dump excerpt for `1.0.0.0/24`.

	Network	Next Hop	Local Preference	AS Path
*	1.0.0.0/24	72.36.126.8	100	40387 2381 15169
*		202.147.61.12	90	10026 15169
*		218.189.6.129	80	9304 15169

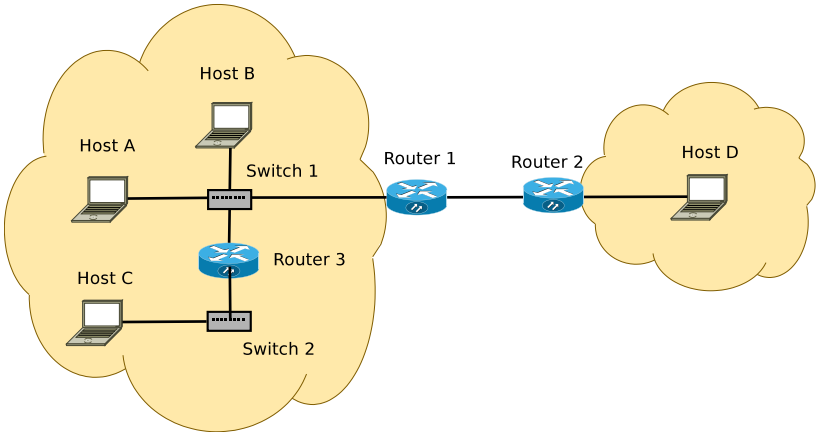
(a) Which route in the table above will be the preferred route?
(b) Based on the settings of local preference on the routes above and the AS paths in the table, which ASes are likely the customer, peer, and provider AS for the autonomous system where this routing table was collected?

(Answer legibly in the space below.)

Initials:

V Putting It All Together

Consider the network diagram below. Suppose that switches construct layer 2 spanning trees, and routers perform IP routing between networks (both between subnets within an AS and between ASes).



12. [12 points]: Suppose hosts A, B, C, and D have all been sending traffic to each other continually for some time.
(a) What nodes will have entries in Host A's ARP table?
(b) What nodes will have entries in Switch 1's switch table?
(c) What routing protocols will Host A use to construct a route to Host B, if any?
(d) What routing protocols will Host C use to construct a route to Host B, if any?
(e) What routing protocols will Host A use to construct a route to Host D, if any?

(Answer legibly in the space below.)

Initials:

VI Bonus: Redesigning ARP

13. [5 points]: Bonus Design Question! Optional! George Burdell finds the current ARP broadcast protocol incredibly wasteful as a lookup protocol. "A host has to broadcast to every other host on the network to learn the MAC address for a single IP address. Why can't we just use the DNS?" Imagine you could put IP addresses into the DNS. How might you do it? (*hint:* Consider how reverse lookups work.) How might your design be similar or different from the way reverse DNS lookups work to map IP addresses to domain names? (Consider things like TTL values, whether you might need fewer or more "authoritative servers", etc.)

(Answer legibly in the space below.)

Anonymous Course Feedback

This page is anonymous. Rip this off from your exam, and turn it in separately if you like. You'll get five points for simply ripping off the last page of the exam, but I'd prefer if you fill it out and hand it in in a separate stack.

What are the things you like most about the course so far? Anything is fair game here (topics, course structure, board technique, etc.).

What are the things you like least about the course so far? Again, anything is fair game.

What topics would you like to see covered?

Initials: