CS 352 Midterm 2
Version A
Spring 2004

Name:
Student ID:
Section:

- Do not open the exam until you are told to begin.
- Write your name on every page.
- You have 80 minutes to complete the exam.
- There is no leaving the room while taking the exam. If you think you might need to leave the room during the exam, you must do so *before* starting the exam.
- No electronic devices are allowed. You can leave numeric answers as fractions in the form $\frac{a}{b}$.
- No cheat sheets or notes are allowed for the mid-term.
- The exam has 7 questions, 91 points total.
- Not all points are created equal. Go for the easy points first!
- Make sure you have all 9 pages, including the cover page, of the exam before you hand it in.

For TA grading use only:

1	2	3	4	5	6	7	Total

1 TCP Timeouts (10 points)

Assume a basic TCP time-out algorithm where the timeout is based only on the smoothed RTT with $\alpha = 0.8$ and the β co-efficient.

A. (5 points) Given the table of the round trip times below, fill in the corresponding values in for the computed smoothed RTT and resulting timeout when $\alpha = 0.8$ and $\beta = 4.0$

Measured RTT	Smoothed RTT	Timeout
0.8s	0.8s	
1.2s		
1.0s		

B. (5 points) Write a general closed-form equation describing the TCP timeout in terms of the first 4 observed RTTs R_1, R_2, R_3, R_4, $\alpha = 0.9$ and $\beta = 5.0$.

2 Link State Routing (20 points)

A router, R, is connected to routers A and B. R receives the following link-state packets:

Time Received (sec)	Source Router	Incomming Link	Sequence #	Time To Live	Neighbor/Link Cost		
1	D	B	10	5	A/4	B/2	E/3
2	B	B	200	2	R/4	D/3	
3	D	A	5	5	A/3	B/2	E/3
4	A	A	50	1	R/6	D/2	E/2
7	D	B	12	1	A/4	B/2	E/2
8	E	A	50	2	A/2	D/3	

A. For each packet above, show to which routers the LSP's are forwarded. Outgoing LSP's are delayed by 1 ms after the corresponding incomming LSP is received. Show all fields of the packet. Note: not all rows of the table may be required.

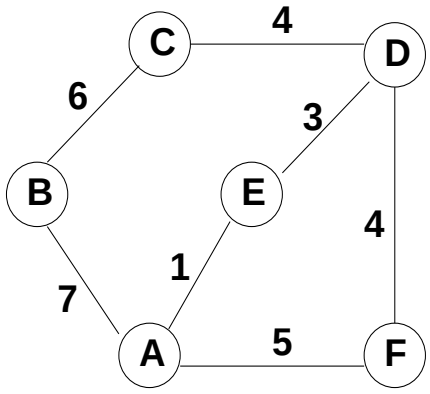
Time sent (sec)	Source Router	Outgoing Link	Sequence #	Time To Live	Neighbor/Link Cost		

B. Router R also sends the following packets. Show router R's representation of the network as a **directed** graph at time 10 seconds:

Time sent (sec)	Source Router	Outgoing Link	Sequence #	Time To Live	Neighbor/Link Cost		
5	B	A	10	7	A/1	B/1	
6	B	B	11	7	A/2	B/2	
9	B	A	12	7	A/3	B/3	

3 Distance Vector Routing (15 points)

Given a network topology in the figure below: the number on each line is the cost of the line.



Show two structures, first, the global distance vector table, which is how far each node thinks it is to the other nodes. Second, the routing table at node A. You can assume unknown routes have their length set to ∞.

A. (5 points): Each router has just come up. The routers only know the distances to their immediate neighbors. Show the two tables in this case:

Global distance vector table						
Router	Distance to each router					
	A	B	C	D	E	F
A						
B						
C						
D						
E						
F						

Routing Table for Router A		
Destination	Distance	Next Hop
B		
C		
D		
E		
F		

B. (5 points): Each router reports the information it had in the preceding step to its immediate neighbors:

Global distance vector table						
Router	Distance to each router					
	A	B	C	D	E	F
A						
B						
C						
D						
E						
F						

Routing Table for Router A		
Destination	Distance	Next Hop
B		
C		
D		
E		
F		

C. (5 points): Step (B) happens a second time. I.e. two exchange between the routers have finished:

Global distance vector table						
Router	Distance to each router					
	A	B	C	D	E	F
A						
B						
C						
D						
E						
F						

Routing Table for Router A		
Destination	Distance	Next Hop
B		
C		
D		
E		
F		

4 Subnetting (18 points)

Your company has purchased the address range 213.125.69.0/8 and would like to design five subnets as follows:

- Subnet 1: 25 hosts
- Subnet 2: 30 hosts
- Subnet 3: 20 hosts
- Subnet 4: 82 hosts
- Subnet 5: 30 hosts

A. (1 point) What class of address space is this?

B. (15 points) For each of the 5 subnets, what are: (1) the address range, (2) the base address and (3) the address mask?.

C. (2 points) Based on your scheme, which subnet(s) do the following address belong to: (1) 213.125.69.170, and (2) 213.125.69.100? Justify your answer(s) for full credit.

5 IP Forwarding (10 points)

Based on the routing table below:

Destination	Gateway	Mask	Flags	Interface
165.230.198.64	165.230.198.119	255.255.255.192	U	eth0
192.168.1.0	192.168.1.1	255.255.255.0	U	eth1
127.0.0.0	127.0.0.1	255.0.0.0	U	lo0
default	165.230.198.65	255.255.255.255	UG	eth0

A. (2 points) What layer-2 interface would a packet with a destination IP address of 192.168.1.1 be sent to?

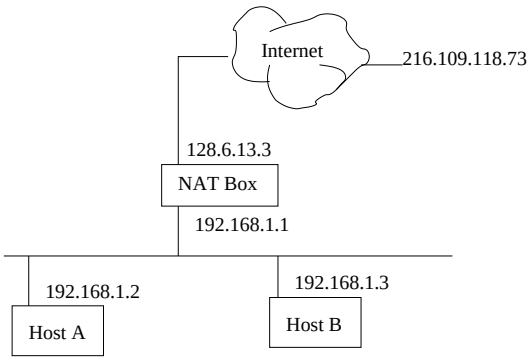
B. (2 points) What would be the next hop of the above packet? Justify your answer for full credit.

C. (3 points) How many local subnets is this machine attached to? Justify your answer for full credit.

D. (3 points) How many IP addresses can this machine reach in 1 hop? Justify your answer for full credit.

6 Network Address Translation (10 points)

The figure below shows a set-up with a private IP network and public NAT box. The NAT box has a public address of 128.6.13.3. and private IP address of 192.168.1.1. The two hosts attached to the same network as the NAT box have the IP addresses as shown.



A. (2 points) Host A in the figure sends a TCP SYN packet to IP address 216.109.118.73, port 80, with it's local port set to 6798. Show the resulting entry in the NAT box (you make have to improvise some of the fields, anything consistent is OK).

B. (2 points) Supposed just after part (A) above, host B sends a SYN packet to the same destination address and port, with it's local port also set to 6798. Show the resulting entry in the NAT box (you make have to improvise some of the fields, anything consistent with part (A) is OK).

C. (2 points) What will the host at 216.109.118.73 receive for the destination,source addresses and destination,source ports for (A) above?

D. (4 points) Describe how the ACK for SYN sent in part (A) will reach host A, even though host A's network number (192.168.2) is not in any intermediate routers on the Internet.

7 Address Resolution Protocol (8 points)

Suppose two hosts, A and B, are mistakenly assigned the same IP address on the same sub-net. Host B starts up after host A.

A. (4 points) What will happen to host A's TCP connections after B boots?

B. (4 points) Explain how "self ARP" — a machine doing an ARP for its own IP address during boot — might help solve this problem.