CSE 461.
Problem Set 2.
Out: January 28 2005
Due: February 11, 2005.

Question 1.

For a broadcast-based network with n hosts, the probability that a given host has a message to send is 1/n. What is the probability that the message can be sent without a collision. Give your answer symbolically and show it as a graph

Question 2.

1. Problems 3.13, 3.14, 3.15, 3.22 from the book.

Question 3.

Assume two hosts are on a network having bandwidth B and one-way latency D, and that one host wishes to send a 10 megabyte file to the other. Packets are of size M, are not lost and arrive in the order sent.

1. How long will it take to send the file using a stop-and-wait protocol?
2. How long will it take to send the file using a sliding window protocol?

Question 4.

Define an experiment for determining the bandwidth delay product between your workstation and www.cs.washington.edu. Describe the experiment. Run it. Describe your results. What are the weaknesses in your methodology?

Question 5. TCP Packet Trace.

The following packet trace was output by tcpdump, a common program for monitoring network activity. It shows the exchange of packets seen by the machine "me" while serving a 9287 byte Web page. The output is fairly terse, and explained by the tcpdump man page, which is linked from the course web page for convenience.

```
18:16:35.149595 them > me: S 1629852695:1629852695(0) win 32120  (DF)
18:16:35.149648 me > them: S 2210326433:2210326433(0) ack 1629852696 win 16060 (DF)
18:16:35.242646 them > me: . ack 1 win 32120  (DF)
18:16:35.243773 them > me: P 1:726(725) ack 1 win 32120  (DF)
18:16:35.243809 me > them: . ack 726 win 15335  (DF)
18:16:35.244689 me > them: P 1:1449(1448) ack 726 win 16060  (DF)
18:16:35.244702 me > them: P 1449:2897(1448) ack 726 win 16060  (DF)
18:16:35.332742 them > me: . ack 1449 win 31856  (DF)
18:16:35.332780 me > them: P 2897:4345(1448) ack 726 win 16060  (DF)
18:16:35.332791 me > them: P 4345:5793(1448) ack 726 win 16060  (DF)
18:16:35.334370 them > me: . ack 2897 win 30408  (DF)
18:16:35.334401 me > them: P 5793:7241(1448) ack 726 win 16060  (DF)
18:16:35.334412 me > them: P 7241:8689(1448) ack 726 win 16060  (DF)
18:16:35.334423 me > them: FP 8689:9536(847) ack 726 win 16060  (DF)
18:16:35.425453 them > me: . ack 5793 win 31856  (DF)
18:16:35.425456 them > me: . ack 8689 win 30408  (DF)
18:16:35.425458 them > me: . ack 9537 win 30408  (DF)
18:16:35.440199 them > me: F 726:726(0) ack 9537 win 31856  (DF)
18:16:35.440230 me > them: . ack 727 win 16060  (DF)
```

Draw a packet time sequence diagram (of the kind shown in Peterson with time moving down the page) that shows all packets of the transfer. Your diagram should be approximately to scale. For each packet, label it with the type (SYN, ACK) and sequence number range.

Question 6. Flood and Learn.

Suppose we modify the solution for Fishnet Assignment 1 so that when forwarding a packet, each node sends it to the last neighbor that forwarded a packet from that source address, and broadcasts it to all neighbors if the node has never seen a packet from that source address. (This is like learning bridges.) Other rules, such as discarding packets we've already seen and decrementing the TTL at each hop are kept the same.

a) Is it possible packets would loop? If so, give an example. If not, explain why not.
b) What happens when a node moves? Give a simple fix that allows the network to deliver packets to nodes that have moved.

Question 7.

Problem 2.32

Question 8.

Problem 2.39

Question 9.

Recall the Learning Bridge algorithm discussed in class, where each bridge maintains a table of size T mapping observed hosts to output ports. Consider a network with one bridge having N ports, where each of N hosts is directly connected to the bridge. Assume that traffic destinations are uniformly distributed and that each host generates a message of size M every second, and that the bandwidth of each port is B.

1. What is the maximum aggregate bandwidth of the network? (note that maximum aggregate bandwidth is independent of the host's behavior)
2. In terms of T, M and N, what is the realized bandwidth of the network in steady state?
3. Graph the efficiency of the network of the network in steady state as a function of T, the table size. Mark the points along the X and Y axis where T=1, T=N, and T = 2N. (Efficiency is the realized bandwidth divided by the utilized bandwidth and is a percentage ranging from 0 to 100).

Question 10.

Consider an 11Mb/s wireless network that uses CSMA/CD with link level ack. RTS, CTS and Ack messages are each 50 bytes. Packet MTU is 1500 bytes. On a graph, show maximum throughput as a function of packet size.