ECE697AA
Spring ‘08 – Exam II

Prof. Wolf

Name: ____

ID Number: ____

	Maximum	Achieved
Question 1	22	
Question 2	11	
Question 3	10	
Question 4	7	
Total	50	

This exam is closed book, closed notes. One single page handwritten notes is allowed. No electronic devices (other than calculators) are allowed. Be concise, but show your work. Write legibly.

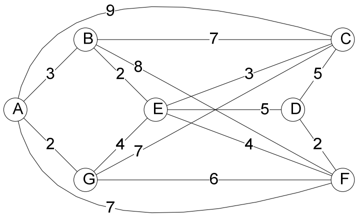
Time: 75 minutes.

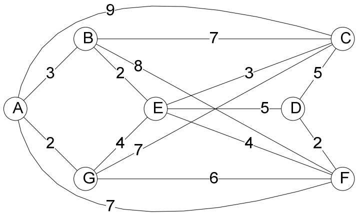
Question 1 (22 points):

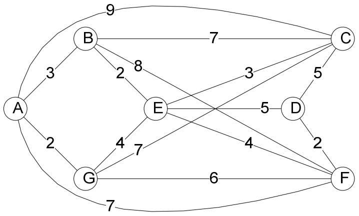
Answer the following questions regarding shortest path routing.

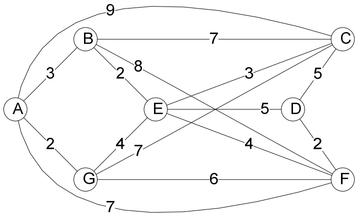
a) Show the iterations of Dijkstra’s algorithm on node A in the following scenario. Show each pair of shortest known distance D(x) and predecessor p(x) for all steps. Circle the node that chosen next to be added. Mark in each topology figure the links that belong to the shortest path tree. (12 points)

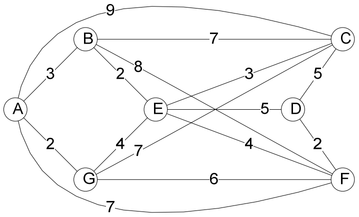
D(B),p(B)	D(C),p(C)	D(D),p(D)	D(E),p(E)	D(F),p(F)	D(G),p(G)

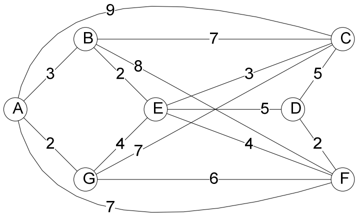






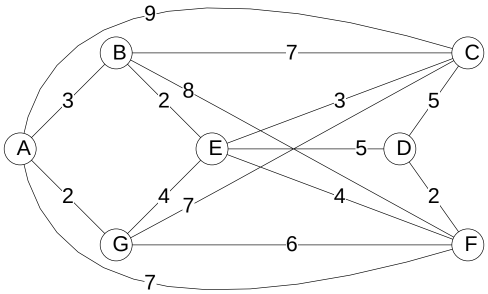






b) Dijkstra’s algorithm gives you the shortest path from a source to a destination. Assume you want to get a second path (a backup path) that does not have any link in common with the shortest path (it can have routers in common). How can you extend Dijkstra’s algorithm to give you this second path (if it exists)? (2 points)

c) Assume the network shown below uses a distance vector routing protocol and all nodes are in their initial state. Assume C sends an update to all its neighbors and then E sends an update to all its neighbors. Show the complete distance vector table of B in the state after it has received both updates. (6 points)

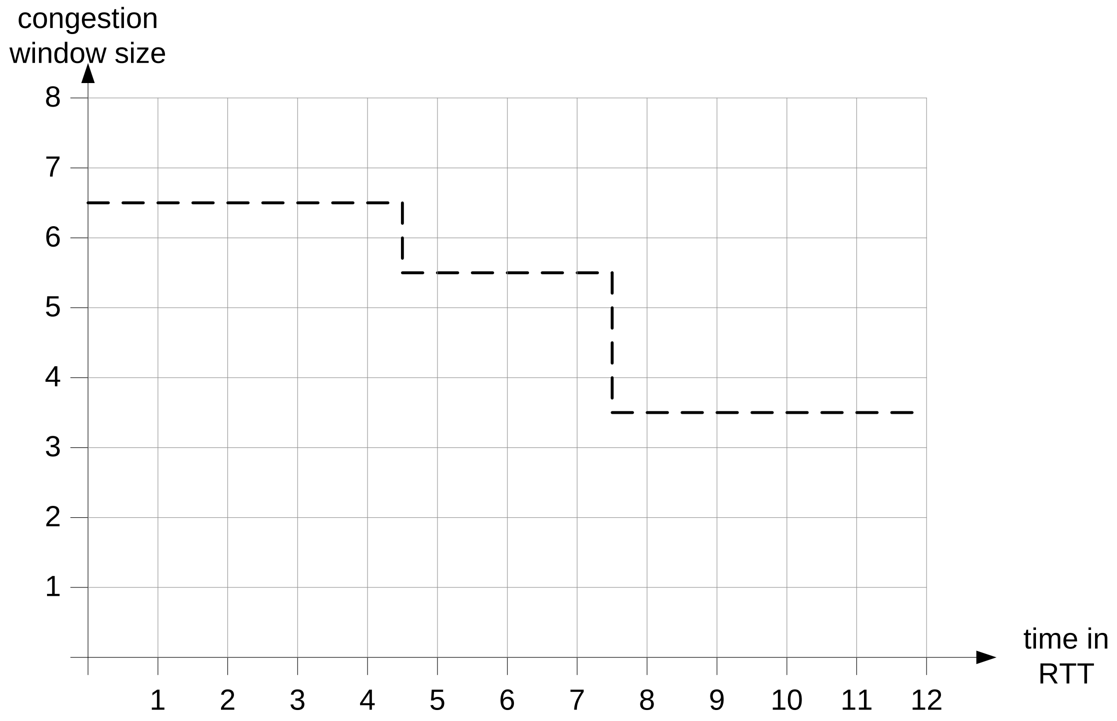


d) Assume a network uses distance vector routing and all nodes start up at the same time. Assume that all nodes send updates at the same fixed interval. How long does it take in the worst case until all distance vector tables have stabilized? (2 points)

Question 2 (11 points):

Answer the following questions regarding congestion control.

a) Assume a TCP Reno implementation. Show the congestion window size in the figure below (up to and including t=12). Assume the initial congestion window size at time t=1 is 1 and the threshold value is initially set to 8. The available bandwidth (same unit as congestion window per RTT) is shown as a dashed line. If TCP's congestion window exceeds this value, packet loss occurs. Assume that a triple duplicate ACK event occurs when the available bandwidth is greater than 4. A timeout event occurs when it is less than 4. (6 points)



b) What is the total amount of data transferred (from the perspective of the receiver) up to and including t=12? (1 point)

c) Assume a UDP video application wants to communicate in a TCP-friendly manner. It observes a packet loss probability of 0.01 (=1%) and a round-trip time of 5ms. Its maximum segment size is 1024 bytes. What is the maximum throughput at which it can send? (3 points)

d) For what loss rate in c) is the throughput doubled? (1 point)

Question 3 (10 points):
Answer the following questions regarding security and cryptography in computer networks.

a) Assume you use a computer that is connected to the Internet. In order to avoid that the computer gets “hacked” (i.e., remotely accessed by an unauthorized user who may possibly exploit vulnerabilities in the operating system or other software), what measures would you take? List the easiest / most effective measure first. (Note: this is an open-ended question, 2 points)

b) Assume that user *A* wants to send message *M* securely to user *B*. Also assume that they use public key cryptography, and a secure public key distribution mechanism is in place. Describe (1) what operations *A* needs to do with *M*, (2) what *A* needs to transmit, and (3) what *B* needs to do to verify the security property in order to achieve the security properties listed below. Please describe the *minimal* set of operations to achieve the required properties. For notation, please use “K_A^+” as public key of *A* and “K_A^-” as private key of *A* (similarly for *B*). (6 points)

Authenticity:

(1)

(2)

(3)

Privacy:

(1)

(2)

(3)

Non-Repudiability:

(1)

(2)

(3)

c) Assume you monitor a link with a passive measurement system. What difference do you expect see between traffic that uses SSL and traffic that uses IPSec? (2 points)

Question 4 (note: very similar to a question in Exam I, 7 points):
Answer the following questions regarding transport protocols and their performance. Assume a network uses 100 Mbps links with a 5 ms end-to-end delay between two nodes. Also assume that these nodes use a sliding window transport protocol with a maximum window size of 4 packets and a fixed packet size of 1250 bytes (50 bytes of headers and 1200 bytes of payload). Assume acknowledgement packets are 50 bytes in size. There is no connection setup.

a) What is the throughput of this protocol from the point of view of the end-system application? Assume queuing and processing delays are zero, but consider transmission delays. Please report your results in bits per second, not bytes per second. (5 points)

b) What window size would be necessary to achieve 100 Mbps throughput? (2 points)