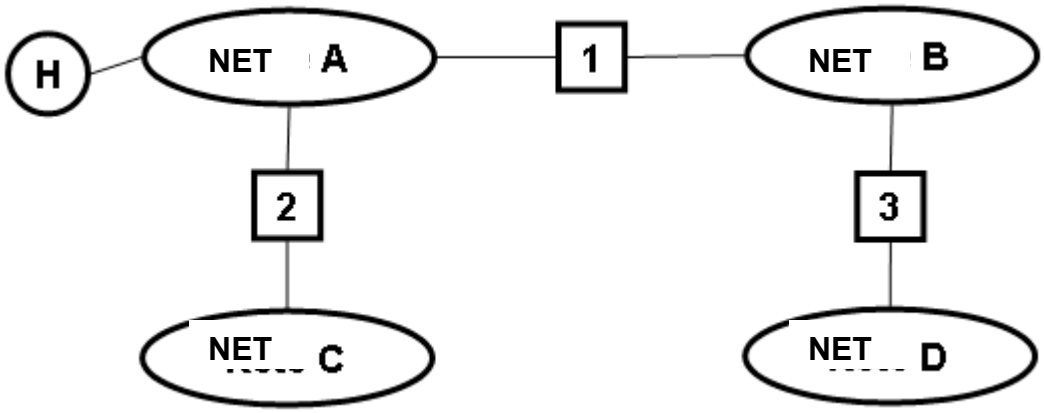
Computer Networks II – Master degree in Computer Engineering
Exam session: 11/02/2009 – Teacher: Emiliano Trevisani

Last name		Student Identification number	
First name			

You are only allowed to use a pen and a pocket calculator
Please write in a clear language and use a READABLE writing; it is important to MOTIVATE THE ANSWERS YOU GIVE.
Please only use the blank spaces at the bottom of every question
At the end of your exam, please return THESE sheets and those possibly received by the teacher to write a draft copy of your answers. The latter WILL NOT be considered during the process of correction.
Students copying or consulting course material will be expelled from the exam.

Question 1. [7 points]
Consider the following scenario and assume host H's routing table is the one given below:



Destination	Mask	Next hop
193.100.5.7	255.255.255.255	-
193.100.5.0	255.255.255.0	-
150.100.8.0	255.255.255.0	193.100.5.3
150.200.1.0	255.255.255.0	193.100.5.2
150.200.235.0	255.255.255.0	193.100.5.2

Fill in the table below, proposing, on the basis of the routing table above, a possible and consistent assignment of network addresses to subnets and, when possible, to router interfaces (explicitely indicating which interfaces have which address)

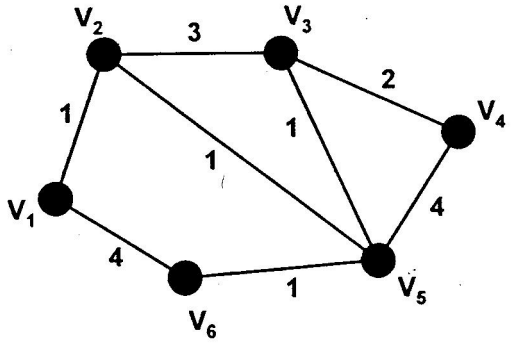
(question 1 continued)

Net	Address	Mask	Router	Address
Net A			Router 1	
Net B			Router 2	
Net C			Router 3	
Net D				

How can addresses be aggregated, so as to compress routing table at H?

Destination	Mask	Next hop

Question 2. [7 points]
Consider the graph in the picture, on which links are assumed to be bidirectional and with the same weight in both directions.

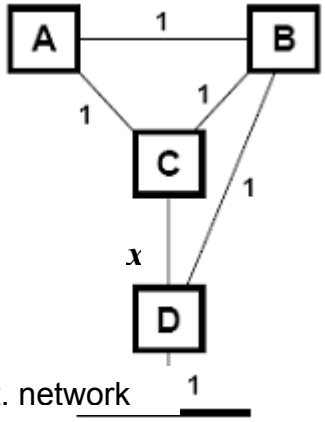


assuming V1 as root, complete the table below applying Dijkstra's algorithm. In the generic k-th iteration of the algorithm, for equal values of L(k) select the node with smaller label. Draw the minimum cost spanning tree routed at V1 thus computed.
Give an example of an IGP protocol that uses Dijkstra's algorithm to compute the optimal routing.

Step	T	L(2)	Path	L(3)	Path	L(4)	Path	L(5)	Path	L(6)	Path
1	1	1	1-2	∞	---	∞	---	∞	---	4	1-6
2											
3											
4											
5											
6											

(question 2 continued)

Question 3. [7 points]
Consider the following network scenario; A, B, C, D are 4 routers that execute the RIP protocol. *Consider only the routes computed by the routers towards the destination network*.



Assuming an initial equilibrium, assume link BD faults and consider the “counting to infinity” anomaly among routers A,B and C.
Express, as a function of x, a *necessary* condition for the anomaly to occur.
Assuming the necessary condition above holds, provide a *sufficient* condition for the anomaly to occur.

(question 3 continued)

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Question 4. [2 points]
Consider the OSPF protocol.
List the 5 types of packets used by the protocol; for each type, provide a synthetic description of the associated performed functionality (max. 2 lines)
Which packet type is used in the “Discovering Neighbors” procedure?
Which protocol is used to carry OSPF packets? How is reliability achieved? Use OSPF terminology in your answers

(question 4 continued)

Question 5. [2 points]
Considering the BGP protocol, briefly outline the protocol's UPDATE message. Specifically, describe the purpose of this message type and the information carried by it.

(question 5 continued)

Question 6. [2 points]
With reference to QoS in IP networks:
Define the concept of flow
Briefly describe the “per-flow QoS” and “aggregate traffic QoS” approaches, emphasizing their pros and cons.

Question 7. [3 points]
Consider a scenario in which IP private addressing is used and Internet access occurs over an IP router implementing port mapping based NAT. Let H be a host in the private network that wishes to offer an UDP-based Web service (in practice, an Internet reachable UDP server). We shall henceforth call SERVICE this service. Assume a [SERVICE_PUBLISHING_PROTOCOL] protocol is available, whose purpose is to spread over the Internet the IP address and UDP port over which SERVICE is reachable.
On the basis of this information, synthetically outline the sequence of actions that host H should execute to publish SERVICE and keep it reachable over the Internet.
Assume the NAT service is full-cone and is known to H.
The NAT router's IP address is public and unknown to H. The router's NAT mapping table is empty (no active binding). Furthermore, a remote STUN server is available and H can act as a STUN client. No Virtual server service can be used.

I herewith authorize, in compliance with law number 675 of 31/12/96, the teacher to publish the results of my exam on the Web.

Readable
signature