New York University
Computer Science Department
Courant Institute of Mathematical Sciences

Course Title: Data Communication & Networks
Course Number: CSCI-GA.2262-001
Instructor: Jean-Claude Franchitti
Session: 7-8

Assignment #7

I. Due

Wednesday, December 22, 2020 at the latest

II. Objectives

1. Learn network forwarding and routing concepts.

III. References

1. Slides and handouts posted on the course Web site
2. Textbook chapters 4 and 5

IV. Software Required

1. Microsoft Word.
2. Win Zip as necessary.

V. Assignment

Network Layer (Data Plane) Questions:

1. **Question 1:**

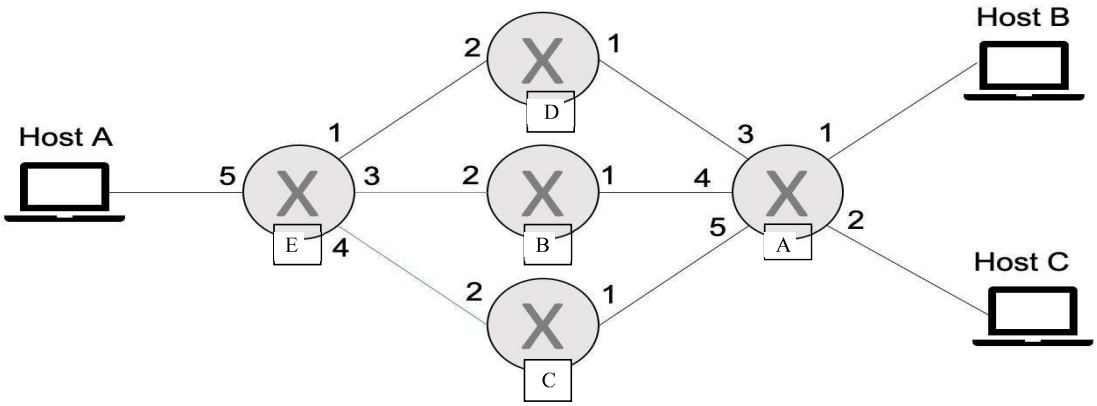
   Identify the two planes of the network layer and explain their functionalities and roles in Network layer.

2. **Question 2:**

   Suppose host A send a datagram to host B. Once host B receives the datagram, how does host B know which protocols to use (UDP vs. TCP) to pass the data along to the upper layer?

3. **Question 3:**

Consider the following setup shown in the figure below. Circles (represented with X in the center) are routers.



a. Show the forwarding table in router A, with the assumption that the traffic originating from Host B to destination Host A is forwarded via interface 3, and that the traffic originating from Host C to destination Host A is forwarded via interface 5.

b. Show the forwarding table in router E, with the assumption that any packet targeted for Host B is forwarded via interface 3, and that any packet targeted for Host C is forwarded via interface 4.

4. Question 4:

Consider the following scenario in which a router forwards packets to one of its 4 interfaces based on a given 32-bit destination address. The range that the router uses to decide which interface to choose is shown below:

Destination Address Range	Link Interface
11110000 00000000 00000000 00000000 through 11110000 00000000 00000000 11111111	0
11110000 00000000 00000001 00000000 through 11110000 00000000 00000001 11111111	1
11110000 00000000 00000010 00000000 through 11110000 00000000 00000011 11111111	2
Otherwise	3

a. Provide a forwarding table with entries that uses the longest prefix matching,

and forwards packets to the correct interfaces.

b. Determine the forwarding link interface for the following destination IP address:

Prefix	Link Interface
11110000 00110000 11000000 00000000	
11110000 00000000 00000001 10000011	
11110001 00000000 00000010 00000000	
11110000 00000000 00000011 01100001	

c. Rewrite the forwarding table in question 4.a with a.b.c.d/x notation instead of the binary string notation

5. Question 5:

Assume that the following 2000 byte datagram is being forwarded into a link that has MTU of 580 bytes. The initial ID is 176 as shown below.

	length =2000	ID =176	fragflag =0	offset =0	

a. How many fragments are generated?

b. What will be the ID number in each fragment?

c. What will be offsets in each fragment?

6. Question 6:

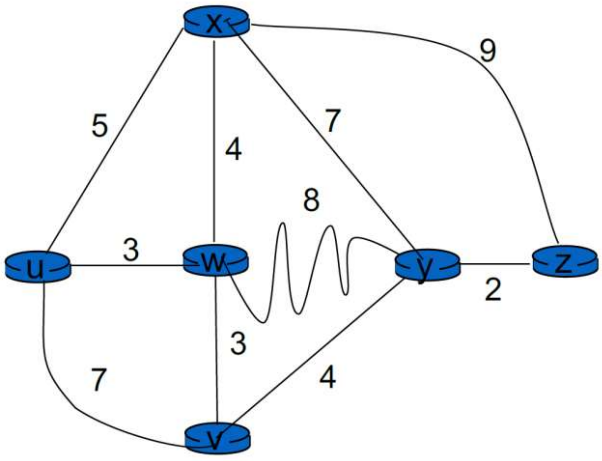
Consider a datagram network using a 8-bit host address. Suppose a router uses longest prefix matching and has the following forwarding table. For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

Prefix match	Interface
1	0
10	1
111	2
Otherwise	3

Network Layer (Control Plane) Questions:

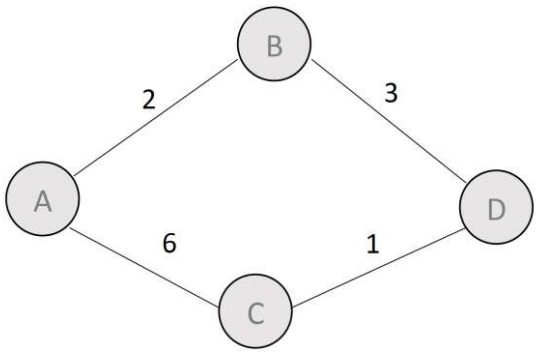
7. **Question 7:**

   Consider the following network example from our class slides (Network Layer: Control Plane). Link costs between each node indicated in the figure given below. Using Dijkstra's shortest path algorithm, compute the shortest path from node y to all other nodes. Show how the algorithms work by providing a table similar to Table 5.1 of Chapter 5 in the course textbook.



8. **Question 8:**

   Consider the following network example. Link costs between each node are indicated in the figure below. Assume that each node initially knows the costs to each of its neighbor. Moreover, at the end of every time step, each node broadcasts its distance vector to its neighboring nodes and as a result each node updates its table. Using the distance-vector algorithm, calculate and show the distance table entries at each node for 2-more time steps. Time 1 is already given below, calculate similar tables at Time 2 and Time 3.



cost to

from	A	B	C	D
A	0	2	6	∞
B	∞	∞	∞	∞
C	∞	∞	∞	∞

cost to

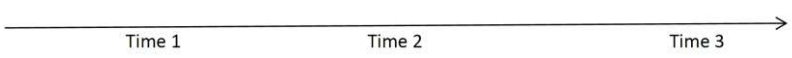
from	A	B	C	D
A	∞	∞	∞	∞
B	2	0	∞	3
D	∞	∞	∞	∞

cost to

from	A	B	C	D
A	∞	∞	∞	∞
C	6	∞	0	1
D	∞	∞	∞	∞

cost to

from	A	B	C	D
B	∞	∞	∞	∞
C	∞	∞	∞	∞
D	∞	3	1	0



Homework Submission Guidelines:

1. Save the file as a Word document.

2. Name the file "**firstname_lastname_hw_7.docx**" (e.g., "john_doe_hw_7.docx").

3. Submit your assignment electronically via NYU Brightspace by the due date.

   Use the following naming convention in the subject line of the eMail:
   "**DCN - firstname lastname - homework 7"**
   (e.g.: "DCN – John Doe - homework 7").

   In the case source code is submitted, include your name as a comment at the top of each file.

   (Note: all files submitted should include your name).

VI. Deliverables

1. Electronic:

   Your assignment file must be submitted via NYU Brightspace. The file must be created and sent by the deadline. After the deadline, the assignment is late. The email clock is the official clock.

   The cover page supplied on the next page must be the first page of your assignment file.

   Fill in the blank area for each field.

   NOTE:

   The sequence of the hardcopy submission is:

   1. **Cover sheet**
   2. **Assignment Answer Sheet(s)**

VII. Sample Cover Sheet:

Name _____ Username: _____ Date: _____
(last name, first name)
Section: _____

Assignment 7

Assignment Layout (25%)

- Assignment is neatly assembled on 8 1/2 by 11 page layout.
- Cover page with your name (last name first followed by a comma then first name), username and section number with a signed statement of independent effort is included.
- Answers to Questions 1 to 8 are correct.
- File name is correct.

Total in points _____
Professor's Comments:

Affirmation of my Independent Effort: _____
(Sign here)