Matt Hurt

Homework 7 (80 points) Due Date*: 10:00am 04/13/2020 Cutoff Deadline: 10:00am 04/15/2020**

Late penalty will apply for past-due late submission; ****Submission will NOT be accepted after the cutoff deadline

Submission: Upload and submit it on **Blackboard**. If your homework is in hand-written, please try to SCAN it into a .pdf file or take a clear photo, and then upload/submit it. (NO Paper/Hardcopy or Email submission please!)

Please 1) **include your First Name and Last Name** on the page(s) that you upload & submit on Blackboard
2) name your HW file as "**HW<#><LastName><FirstName>**", e.g., **HW6PolisJared.pdf** for HW6.
Grading: I will also grade it in Adobe Acrobat and post the graded work on Blackboard for everyone who submits it.
3) **leave me some space for grading and writing corrections** beside your solution to every problem. Thanks!

PLEASE ORGANIZE YOUR WORK IN THE SEQUENCE GIVEN IN THE ASSIGNMENT!!!

Problem A. Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 through 11100001 01111111 11111111 11111111	2
Otherwise	3

a. Provide a **forwarding table** that has **five entries**, uses ***longest prefix matching***, and forwards packets to the correct link interfaces.
b. Describe how your forwarding table determines the appropriate link inter-face for datagrams with destination addresses:
11001000 10010001 01010001 01010101
11100001 01000000 11000011 00111100
11100001 10000000 00010001 01110111
(Hint: There is an example discussed in class and included in the in-class notes & PPT slides for Chapter 4)

Problem B. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
1	0
10	1
111	2
otherwise	3

For **each of the four interfaces**, give the ***associated range of destination host addresses*** and the ***number of addresses in the range***.

Problem C. Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation? (**Hint**: You may assume that the length of the IP header is 20 bytes.)

Problem D. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in these subnets are required to have the prefix 134.39.176.0/22. Also suppose that Subnet 1 needs to support at least 450 interfaces, Subnet 2 needs to support at least 200 interfaces, and Subnet 3 needs to support at least 160 interfaces. Provide three network addresses (a.b.c.d/x) that satisfy these constraints.

Problem E. Rewrite the following forwarding table using the a.b.c.d/x notation:

Prefix Match	Link Interface
11100000 00****** ******** ********	0
11100000 01000000 ******** ********	1
1110000* ******** ******** ********	2
11100001 1******* ******** ********	3

Problem A

a)

Prefix match	Link Interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3
— — — — — or — — — — —	
11100000 00	0
11100000 01000000	1
1110000	2
11100001 0	3
otherwise	3

b) Prefix match for first address is 5th entry: link interface 3

Prefix match for second addres is 3rd entry: link interface 2

Prefix match for third address is 4th entry: link interface 3

Problem B

Prefix Match	Interface	Address Range	Available IP Addresses
1	0	11000000 - 11011111	$2^5 = 32$
10	1	10000000 - 10111111	$2^6 = 64$
111	2	11100000 - 11111111	$2^5 = 32$
Otherwise	3	00000000 - 01111111	$2^7 = 128$

Problem C

Datagram size = 2400 bytes
MTU = 700 bytes
Stamped ID # = 422
MTU maximum xmt unit internet protocol
IP header = 20 bytes

Maximum Data field size = (MTU - IP header) $\longrightarrow$ (700 - 20) bytes
= 680 bytes

Fragments = $\left(\frac{\text{Datagram} - \text{IP header}}{\text{MTU} - \text{IP header}}\right)$

$= \frac{2400-20}{700-20} = \frac{2380}{680} = \frac{238}{68} \approx 3.5 \longrightarrow$ 4 fragments

Prob C cont...

Fragment Value	Datagram field (bytes)	IP #	Offset Fragmentation	Flag
1	700-20 = 680	422	start location 0	1 (Move Frag)
2	700-20 = 680		(data inserted 85x8 = 680 bytes) 85	1 (Move Frag)
3	700-20 = 680		170	
4	2380-3(680) = 340		255	

Problem D

Required prefix: 134.39.176.0/22 — 134.39.10110000.00000000/22

Network: 134.39.101100xx.xxxxxxxx = 2^{10} = 1024 interfaces

134.39.10111000.xxxxxxxx = 2^9 = 512 ⟶ subnet 1

134.39.10111001.xxxxxxxx = 2^9 = 512 ⟶ split

134.39.10110010.xxxxxxxx = 2^8 = 256 ⟶ subnet 2

subnet 1: 134.39.176.0/23 -or- 134.39.10110000.00000000/23

subnet 2: 134.39.178.0/24 -or- 134.39.10110010.00000000/24

subnet3: 134.39.179.0/24 -or- 134.39.10110011.00000000/24

Problem E

Prefix match	a.b.c.d/x	Link Interface
11100000 00	224.0.0.0/10	0
11100000 01000000	224.64.0.0/16	1
1110000	224.0.0.0/8	2
11100001 1	225.128.0.0/9	3