Homework 3: Forwarding Table

CSE 4/589 - Modern Networking Concepts
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NOTES:

- **Academic integrity**: Print the following statement at the very beginning of your homework file: "*I have read and understood the course academic integrity policy in the syllabus of the class. I confirm that the work presented in this report is my own. Where information has been derived from other sources, I confirm that this has been indicated in the report.*" Your homework will NOT be graded if you didn't print the sentence.
- For the calculation, you need to write down how the results are derived and your final answer also should be correct to obtain the credits for that question. Please state any assumptions you are making while answering a question.
- Submit the homework through UBLearns as PDF files.

Instructions

- Show all necessary steps for calculations.
- Submit electronically in PDF format.

Question 1: Applying Longest Prefix Matching to Identify the Interface

Question 1.1

[20 points] Consider the following forwarding table:

Prefix Pattern	**Interface**
10101100.00010000.01000000.000*****	0
10101100.00010000.********.********	1
10101100.00010000.10******.********	2
10101100.00010000.01100000.000*****	3
10101100.00010000.01010000.0*******	4
Otherwise	5

To which interface would packets with the following destination IP addresses be forwarded?

a) 10101100.00010000.01001011.01111001

b) 10101100.00010000.01100000.00001010

c) 10101100.00010000.01000000.00010001

d) 10101100.00010000.01010000.01000111

Question 1.2

[20 points] Given the following binary routing table:

Prefix Pattern	Interface
10101100.00010000.00001010.00000***	A
10101100.00010000.0000101*.********	B
10101100.00010000.00001***.********	C
10101100.00010000.0000****.********	D
10101100.00010000.********.********	E
Otherwise	F

Determine the forwarding interface for each of these destination addresses:

a) 10101100.00010000.00001010.00000101

b) 10101100.00010000.00001010.11111111

c) 10101100.00010000.00001011.00001111

d) 10101100.00010000.00000011.00001111

Question 2: Creating Longest Prefix Matching Tables

Question 2.1

[30 points] A network administrator needs to configure a router for a university campus with the following requirements:

1. The Computer Science department should use Interface 1
   (address range: 11000000.10101000.00001010.00000000 to 11000000.10101000.00001010.01111111).
2. The Engineering department should use Interface 2
   (address range: 11000000.10101000.00001010.10000000 to 11000000.10101000.00001010.11111111).
3. The Administration building should use Interface 3
   (address range: 11000000.10101000.00001011.00000000 to 11000000.10101000.00001011.00111111).
4. Faculty offices should use Interface 4
   (address range: 11000000.10101000.00001011.01000000 to 11000000.10101000.00001011.01111111).
5. Student housing should use Interface 5
   (address range: 11000000.10101000.00001011.10000000 to 11000000.10101000.00001011.11111111).
6. Research labs should use Interface 6
   (address range: 11000000.10101000.00001100.00000000 to 11000000.10101000.00001100.11111111).
7. All other university traffic (any other addresses starting with 11000000.10101000) should use Interface 7
8. External traffic should use the default Interface 0

Design an efficient longest prefix matching table that satisfies all requirements using the minimum number of entries.

Question 2.2

[30 points] An ISP has been allocated the address block starting with 11001011.00101101.1*******.******** and needs to create a forwarding table for its core router. The router needs to direct traffic according to these specifications:

1. Customers in the city center should be directed to Interface A
   (address range: 11001011.00101101.10000000.00000000 to 11001011.00101101.10001111.11111111).

2. Business customers should be directed to Interface B
   (address range: 11001011.00101101.10010000.00000000 to 11001011.00101101.10010111.11111111).

3. Residential customers are divided into four zones:

   - North zone (11001011.00101101.10011000.00000000 to 11001011.00101101.10011111.11111111)
     → Interface C
   - East zone (11001011.00101101.10100000.00000000 to 11001011.00101101.10101111.11111111)
     → Interface D
   - South zone (11001011.00101101.10110000.00000000 to 11001011.00101101.10111111.11111111)
     → Interface E
   - West zone (11001011.00101101.11000000.00000000 to 11001011.00101101.11111111.11111111)
     → Interface F

4. However, premium customers should be directed to a special Interface G
   (address range: 11001011.00101101.10110000.00000000 to 11001011.00101101.10110000.00011111).

5. The company's internal servers should be directed to Interface H
   (address range: 11001011.00101101.10011010.00000000 to 11001011.00101101.10011010.00111111).

6. All other traffic should use the default Interface X

Design the most efficient longest prefix matching table that correctly handles all these routing requirements.