# CMSC 491 - Homework Assignment #4 - Solution

## Due Date: Saturday April 29th, 2023 - 11:59pm

## Questions:

You are required to answer the following questions from the attached document:

| Question | Question |
|---|---|
| P.4 (only parts a & b) | P.17 |
| P.10 | P.19 |
| P.12 | P.21 |
| P.13 | P.26 |

### Problem 4

a) Data destined to host H3 is forwarded through interface 3

| Destination Address | Link Interface |
|---|---|
| H3 | 3 |

b) No, because forwarding rule is only based on destination address.

### Problem 10

a)

| Prefix Match | Link Interface |
|---|---|
| 11100000 00 | 0 |
| 11100000 01000000 | 1 |
| 1110000 | 2 |
| 11100001 1 | 3 |
| otherwise | 3 |

b) Prefix match for first address is 5th entry: link interface 3
Prefix match for second address is 3nd entry: link interface 2
Prefix match for third address is 4th entry: link interface 3

### Problem 12

| Destination Address Range | Link Interface |
|---|---|
| 11000000 through (32 addresses) 11011111 | 0 |
| 10000000 through(64 addresses) 10111111 | 1 |
| 11100000 through (32 addresses) 11111111 | 2 |
| 00000000 through (128 addresses) 01111111 | 3 |

## Problem 13

223.1.17.0/26
223.1.17.128/25
223.1.17.192/28

## Problem 17

From 214.97.254.0/23, possible assignments are

a) Subnet A: 214.97.255.0/24 (256 addresses)
Subnet B: 214.97.254.0/25 - 214.97.254.0/29 (128-8 = 120 addresses)
Subnet C: 214.97.254.128/25 (128 addresses)

Subnet D: 214.97.254.0/31 (2 addresses)
Subnet E: 214.97.254.2/31 (2 addresses)
Subnet F: 214.97.254.4/30 (4 addresses)

b) To simplify the solution, assume that no datagrams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upper-left interior subnets, respectively.

**Router 1**

| **Longest Prefix Match** | **Outgoing Interface** |
|---|---|
| 11010110 01100001 11111111 | Subnet A |
| 11010110 01100001 11111110 0000000 | Subnet D |
| 11010110 01100001 11111110 000001 | Subnet F |

**Router 2**

| **Longest Prefix Match** | **Outgoing Interface** |
|---|---|
| 11010110 01100001 11111111 0000000 | Subnet D |
| 11010110 01100001 11111110 0 | Subnet B |
| 11010110 01100001 11111110 0000001 | Subnet E |

**Router 3**

| **Longest Prefix Match** | **Outgoing Interface** |
|---|---|
| 11010110 01100001 11111111 000001 | Subnet F |
| 11010110 01100001 11111110 0000001 | Subnet E |
| 11010110 01100001 11111110 1 | Subnet C |

## Problem 19

The maximum size of data field in each fragment = 680 (because there are 20 bytes IP header). Thus the number of required fragments $= \left\lceil \frac{2400-20}{680} \right\rceil = 4$

Each fragment will have Identification number 422. Each fragment except the last one will be of size 700 bytes (including IP header). The last datagram will be of size 360 bytes (including IP header). The offsets of the 4 fragments will be 0, 85, 170, 255. Each of the first 3 fragments will have flag=1; the last fragment will have flag=0.

## Problem 21

a) Home addresses: 192.168.1.1, 192.168.1.2, 192.168.1.3 with the router interface being 192.168.1.4

b) NAT Translation Table

| WAN Side | LAN Side |
|---|---|
| 24.34.112.235, 4000 | 192.168.1.1, 3345 |
| 24.34.112.235, 4001 | 192.168.1.1, 3346 |
| 24.34.112.235, 4002 | 192.168.1.2, 3445 |
| 24.34.112.235, 4003 | 192.168.1.2, 3446 |
| 24.34.112.235, 4004 | 192.168.1.3, 3545 |
| 24.34.112.235, 4005 | 192.168.1.3, 3546 |

## Problem 26

| *Step* | *N'* | *D(t),p(t)* | *D(u),p(u)* | *D(v),p(v)* | *D(w),p(w)* | *D(y),p(y)* | *D(z),p(z)* |
|---|---|---|---|---|---|---|---|
| 0 | x | ∞ | ∞ | 3,x | 6,x | 6,x | 8,x |
| 1 | xv | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |
| 2 | xvu | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |
| 3 | xvuw | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |
| 4 | xvuwy | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |
| 5 | xvuwyt | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |
| 6 | xvuwytz | 7,v | 6,v | 3,x | 6,x | 6,x | 8,x |