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Questions and Solutions

# Question 1

Execute the commands ifconfig and route -n inside the course VM. Answer  
the following questions based on the output

A screenshot of a computer program

AI-generated content may be incorrect.

Figure 1: Execution of ifconfig command in the Linux terminal.

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AI-generated content may be incorrect.

Figure 2: Execution of route -n command in the Linux terminal.

## Sub-question 1

How many network interfaces are there and what are their names?

There are two network interfaces when the command ifconfig is run in the terminal as shown in Figure 1. These are:

ens160: This is the primary Ethernet interface which has the IP address 172.16.225.128.

lo: 127.0.0.14 is the IP address of the loopback interface. A unique virtual network interface called the loopback interface enables self-communication within the system.

## Sub-question 2

List the MAC addresses of the network interfaces if there are any

There is only a single MAC address 00:0c:29:db:e3:36. This Ethernet interface is physical and has a valid MAC address.

Since loopback interfaces are utilized for internal communication, MAC addresses are not required.

## Sub-question 3

What are the IP addresses and subnets associated with each interface?

The following are the IP address (IPv4 and IPv6) and subnet masks from Figure 1:

ens 160 Interface:

IPv4 address - 172.16.225.128

IPv4 Subnet Mask - 255.255.255.0

IPv6 address - fe80::20c:29ff:fedb:e336/64

lo (Loopback Interface)

IPv4 address - 127.0.01

IPv4 Subnet Mask - 255.0.0.0

IPv6 address - ::1/128

## Sub-question 4

How many rules are there in the routing table? What is the address of the default gateway?

From the execution of command route -n as shown in Figure 2, the following information is gathered.

Routing Rules

Default Route:

Gateway: 172.16.225.2

Interface: ens160

If there are no other rules, this is the default gateway route for all traffic.

Local Network Route:

Gateway: 0.0.0.0 (direct connection)

Interface: ens160

Traffic inside the local subnet is managed by this rule.

Default Gateway

172.16.225.2 is the default gateway address, which is used to route traffic to locations outside the local network.

## Sub-question 5

Which rule will apply if we need to send a packet to the default gateway?

The first rule in the routing table would be used to deliver a packet to the default gateway (172.16.225.2) is:

0.0.0.0 UG 100 0 0 ens160 172.16.225.2 0.0.0.0

With a destination of 0.0.0.0 and a netmask of 0.0.0.0, this rule is the default path. This is a gateway-based "up" route, as indicated by the UG flags. This default gateway will be used for any traffic that other routing rules do not specifically match.

# Question 2

Research TCP and UDP header formats and explain why UDP is considered a  
lighter protocol than TCP in terms of packet size.

UDP and TCP header structure comparison:



Table 1: TCP and UDP comparison.

UDP is a lighter protocol than TCP primarily due to its simpler header structure and reduced overhead. This is because of its set 8-byte header size, which is substantially smaller than TCP's variable header size of 20–60 bytes, UDP can maintain a shorter footprint. The total packet size and processing demands are directly impacted by this size discrepancy.

TCP's three-way handshake and other connection formation procedures are superseded by UDP's connectionless nature. Furthermore, complicated control mechanisms like flow control, packet reordering, and acknowledgment systems are not present in UDP. Although reliability is sacrificed, UDP's streamlined structure makes it perfect for real-time applications where speed is essential.

# Question 3

Why is DHCP required on a network? In what type of network would DHCP  
be beneficial? Research and explain how DHCP efficiently allocates IP  
addresses on a network.

Requirement of DHCP on a Network

Modern networks require DHCP (Dynamic Host Configuration Protocol) since it automates network configuration and IP address assigning. Without it, managers would have to individually set up the network settings on each device, which would take a lot of time and be prone to mistakes. By centralizing setup, avoiding IP conflicts, and dynamically managing address pools, the protocol makes network management easier. Large networks or settings with a lot of device connections and disconnections benefit greatly from this automation.

Benefits of DHCP

In public access points, huge enterprise networks, and educational institutions where many devices need network connectivity, DHCP is helpful. It is particularly useful in settings where there is a lot of device turnover, including coffee shops, hotels, and college campuses, where it would be time-consuming and difficult to manually configure IP addresses.

Allocation of IP addresses by DHCP on a network

By assigning temporary addresses from a predefined pool with predetermined lease times, DHCP effectively distributes IP addresses through dynamic allocation. Because IPs may be recovered and redistributed when devices disconnect, this guarantees effective address utilization. Clients broadcast discovery messages, receive offers from servers, request their chosen IP, and receive confirmation as part of the allocation process, which follows the DORA sequence (Discover, Offer, Request, Acknowledge). To guarantee dependable address allocation throughout the network, our automated procedure incorporates conflict detection.

# Question 4

Assume that StringBuilder is unavailable for reversing the string (refer to  
the ReverseString class in Lecture 5). Write Java code to reverse the string  
without utilizing any libraries. Your function should identify the encoding  
scheme of the string. Assume there are only two types: UTF-8 and UTF-16.  
You may need to research about how UTF-8 and UTF-16 encode strings.

The following is the Java code to reverse the string without utilizing any libraries:



Code 1: Java code for string reverse without library utilization.