**ECE 448/528 – Homework #1 Solution**

**1. Network Commands and Analysis** Execute the following commands inside the course VM:

ifconfig

route -n

Now, answer the questions based on the output:

**i) How many network interfaces are there and what are their names?**

* The ifconfig command lists all network interfaces. Common ones are eth0, wlan0, lo (loopback), etc.
* Count the number of interfaces and list their names.

**ii) List the MAC addresses of the network interfaces if there are any.**

* The MAC address is labeled as HWaddr or ether in ifconfig output.
* Each network interface should have a unique MAC address (except virtual ones).

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

* Look at the inet (IPv4) and inet6 (IPv6) fields in ifconfig output.
* The subnet mask (e.g., 255.255.255.0) will be listed under Mask.

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

* The route -n command displays the routing table.
* Count the number of rows to determine the number of rules.
* The default gateway is listed under the Gateway column, typically the rule with 0.0.0.0 in the Destination column.

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

* The routing table follows the longest prefix match rule.
* The rule with the lowest metric and correct destination range will be chosen.

**2. TCP vs. UDP Header Formats and Packet Size**

* **TCP Header**:
  + 20+ bytes in size (without options).
  + Includes sequence numbers, acknowledgment numbers, and error-checking fields.
  + Provides reliable transmission, flow control, and congestion control.
* **UDP Header**:
  + Only 8 bytes.
  + Contains only essential fields: source port, destination port, length, and checksum.
  + No error correction or retransmission mechanism, making it lighter than TCP.

**3. DHCP and IP Address Allocation** **Why is DHCP required?**

* It dynamically assigns IP addresses to devices in a network.
* Reduces manual configuration errors.
* Ensures efficient IP address management.

**In which networks is DHCP beneficial?**

* Large corporate or university networks.
* Public Wi-Fi networks.
* Home networks with multiple devices.

**How does DHCP allocate IP addresses?**

1. **Discover**: Client broadcasts a DHCPDISCOVER request.
2. **Offer**: DHCP server responds with a DHCPOFFER containing an available IP.
3. **Request**: Client requests the offered IP with a DHCPREQUEST.
4. **Acknowledge**: Server confirms allocation with a DHCPACK.

**4. Java Code to Reverse a String Without StringBuilder**

import java.nio.charset.StandardCharsets;

public class ReverseString {

public static String reverse(String input) {

byte[] bytes;

String encoding;

// Determine encoding (assuming only UTF-8 and UTF-16)

if (input.equals(new String(input.getBytes(StandardCharsets.UTF\_8), StandardCharsets.UTF\_8))) {

encoding = "UTF-8";

bytes = input.getBytes(StandardCharsets.UTF\_8);

} else {

encoding = "UTF-16";

bytes = input.getBytes(StandardCharsets.UTF\_16);

}

// Reverse bytes

int n = bytes.length;

for (int i = 0; i < n / 2; i++) {

byte temp = bytes[i];

bytes[i] = bytes[n - 1 - i];

bytes[n - 1 - i] = temp;

}

// Convert back to string

return new String(bytes, encoding.equals("UTF-8") ? StandardCharsets.UTF\_8 : StandardCharsets.UTF\_16);

}

public static void main(String[] args) {

String input = "Hello, World!";

String reversed = reverse(input);

System.out.println("Reversed: " + reversed);

}

}