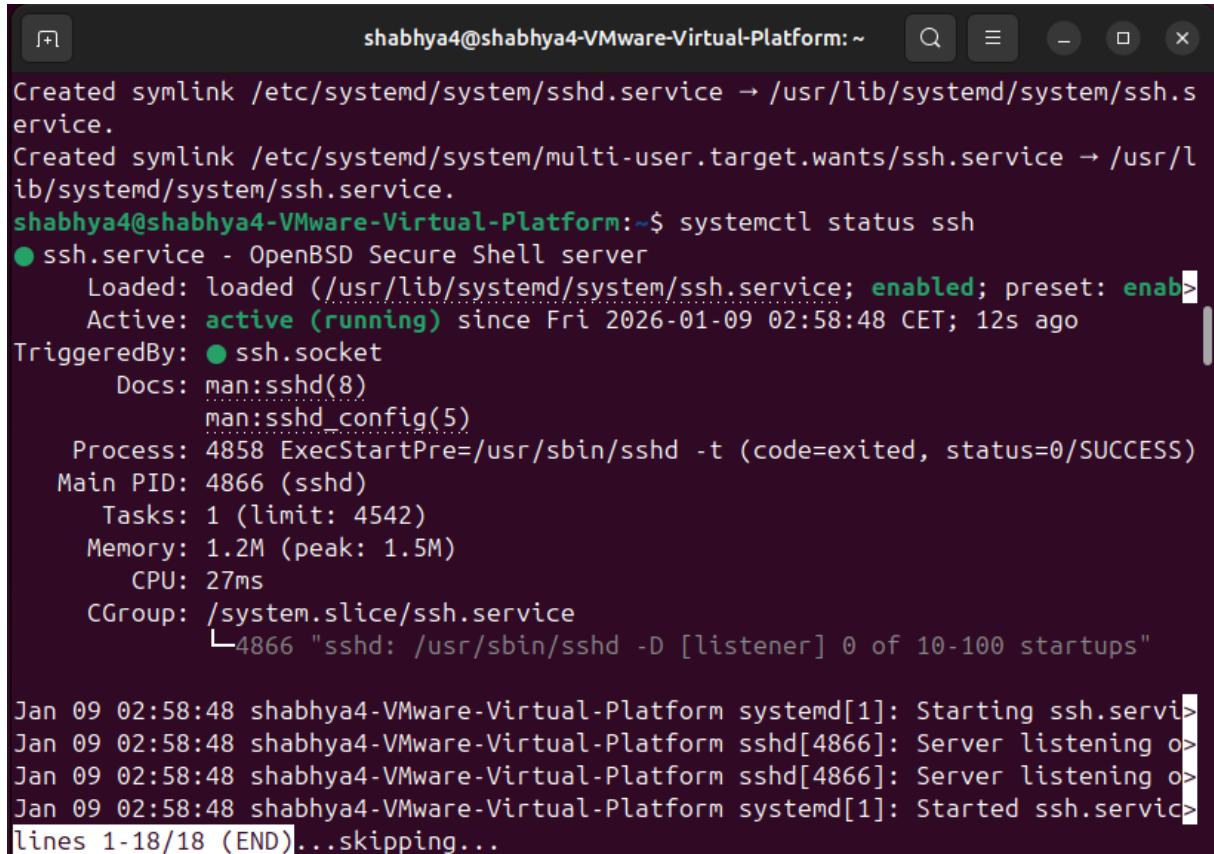


# Week 6 – Networking

Student number: 578438

## Assignment 6.1: Working from home

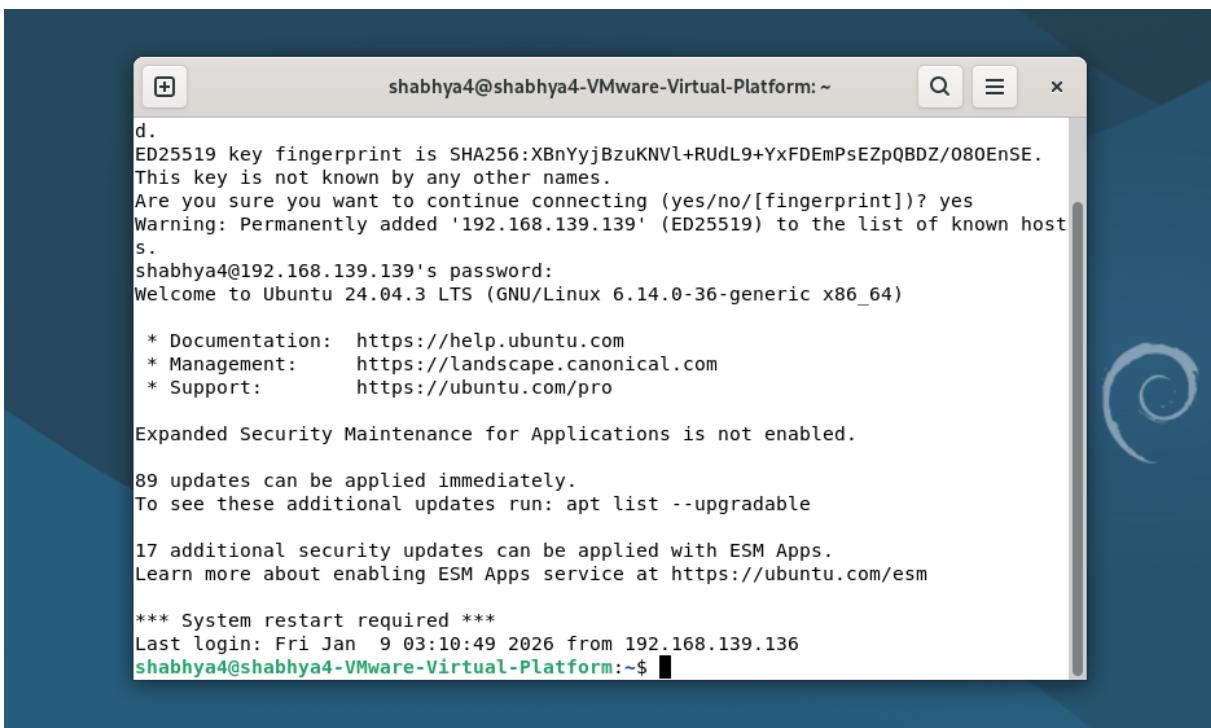
Screenshot installation openssh-server:



The screenshot shows a terminal window with the following output:

```
shabhy4@shabhy4-VMware-Virtual-Platform:~$ Created symlink /etc/systemd/system/sshd.service → /usr/lib/systemd/system/ssh.service.  
shabhy4@shabhy4-VMware-Virtual-Platform:~$ Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /usr/lib/systemd/system/ssh.service.  
shabhy4@shabhy4-VMware-Virtual-Platform:~$ systemctl status ssh  
● ssh.service - OpenBSD Secure Shell server  
  Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled; preset: enabled)  
  Active: active (running) since Fri 2026-01-09 02:58:48 CET; 12s ago  
TriggeredBy: ● ssh.socket  
    Docs: man:sshd(8)  
          man:sshd_config(5)  
  Process: 4858 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)  
 Main PID: 4866 (sshd)  
    Tasks: 1 (limit: 4542)  
   Memory: 1.2M (peak: 1.5M)  
     CPU: 27ms  
    CGroup: /system.slice/ssh.service  
           └─4866 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"  
  
Jan 09 02:58:48 shabhy4-VMware-Virtual-Platform systemd[1]: Starting ssh.service  
Jan 09 02:58:48 shabhy4-VMware-Virtual-Platform sshd[4866]: Server listening on port 22  
Jan 09 02:58:48 shabhy4-VMware-Virtual-Platform sshd[4866]: Server listening on port 22  
Jan 09 02:58:48 shabhy4-VMware-Virtual-Platform systemd[1]: Started ssh.service  
lines 1-18/18 (END)...skipping...
```

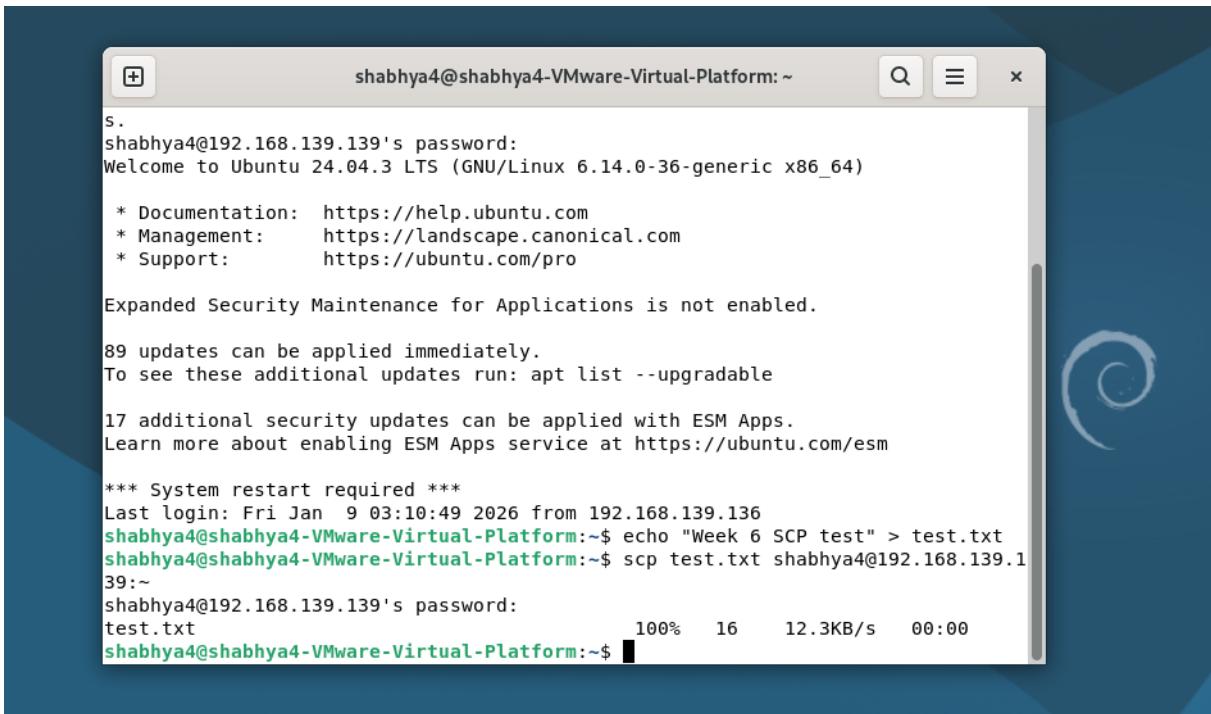
Screenshot successful SSH command execution:



The screenshot shows a terminal window titled "shabhy4@shabhy4-VMware-Virtual-Platform: ~". The terminal displays the following output:

```
d.  
ED25519 key fingerprint is SHA256:XBnYyjBzuKNVl+RUDL9+YxFDEmPsEZpQBDZ/080EnSE.  
This key is not known by any other names.  
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes  
Warning: Permanently added '192.168.139.139' (ED25519) to the list of known hosts.  
shabhy4@192.168.139.139's password:  
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.14.0-36-generic x86_64)  
  
* Documentation: https://help.ubuntu.com  
* Management: https://landscape.canonical.com  
* Support: https://ubuntu.com/pro  
  
Expanded Security Maintenance for Applications is not enabled.  
  
89 updates can be applied immediately.  
To see these additional updates run: apt list --upgradable  
  
17 additional security updates can be applied with ESM Apps.  
Learn more about enabling ESM Apps service at https://ubuntu.com/esm  
  
*** System restart required ***  
Last login: Fri Jan 9 03:10:49 2026 from 192.168.139.136  
shabhy4@shabhy4-VMware-Virtual-Platform:~$
```

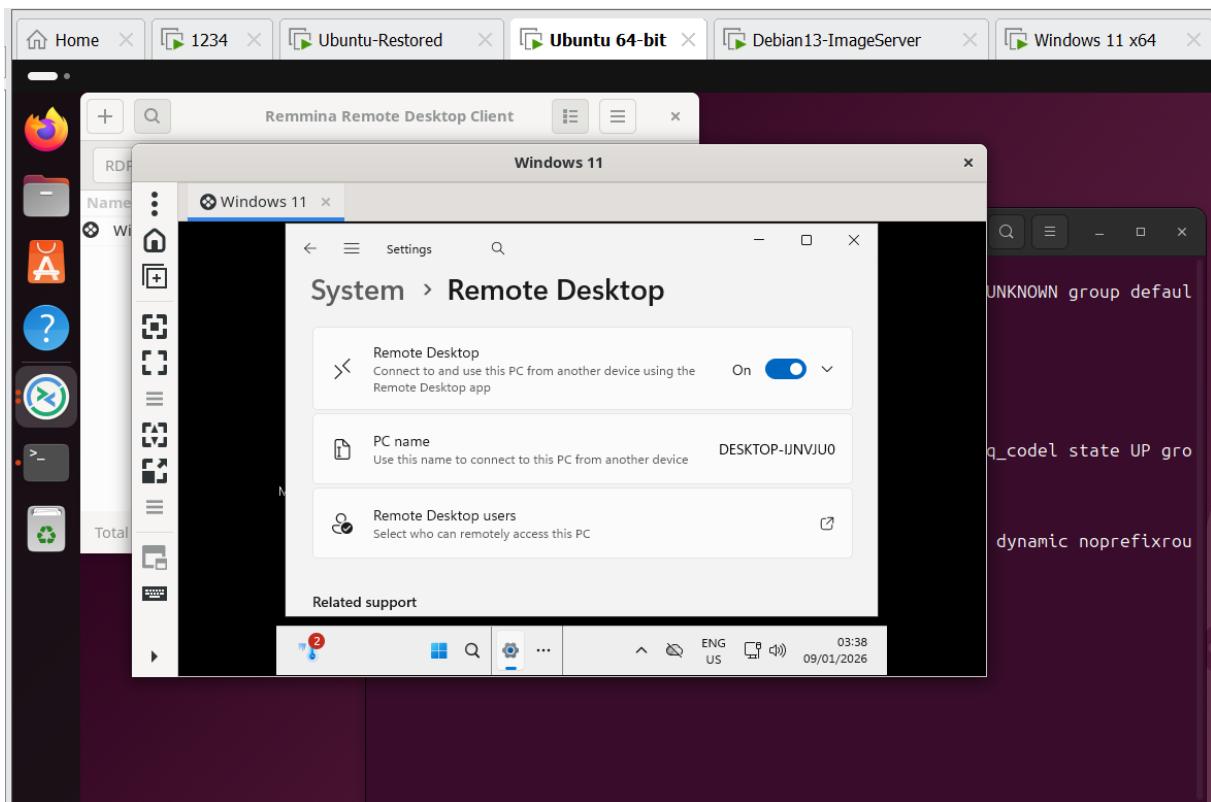
Screenshot successful execution SCP command:



The screenshot shows a terminal window titled "shabhy4@shabhy4-VMware-Virtual-Platform: ~". The terminal displays the following output:

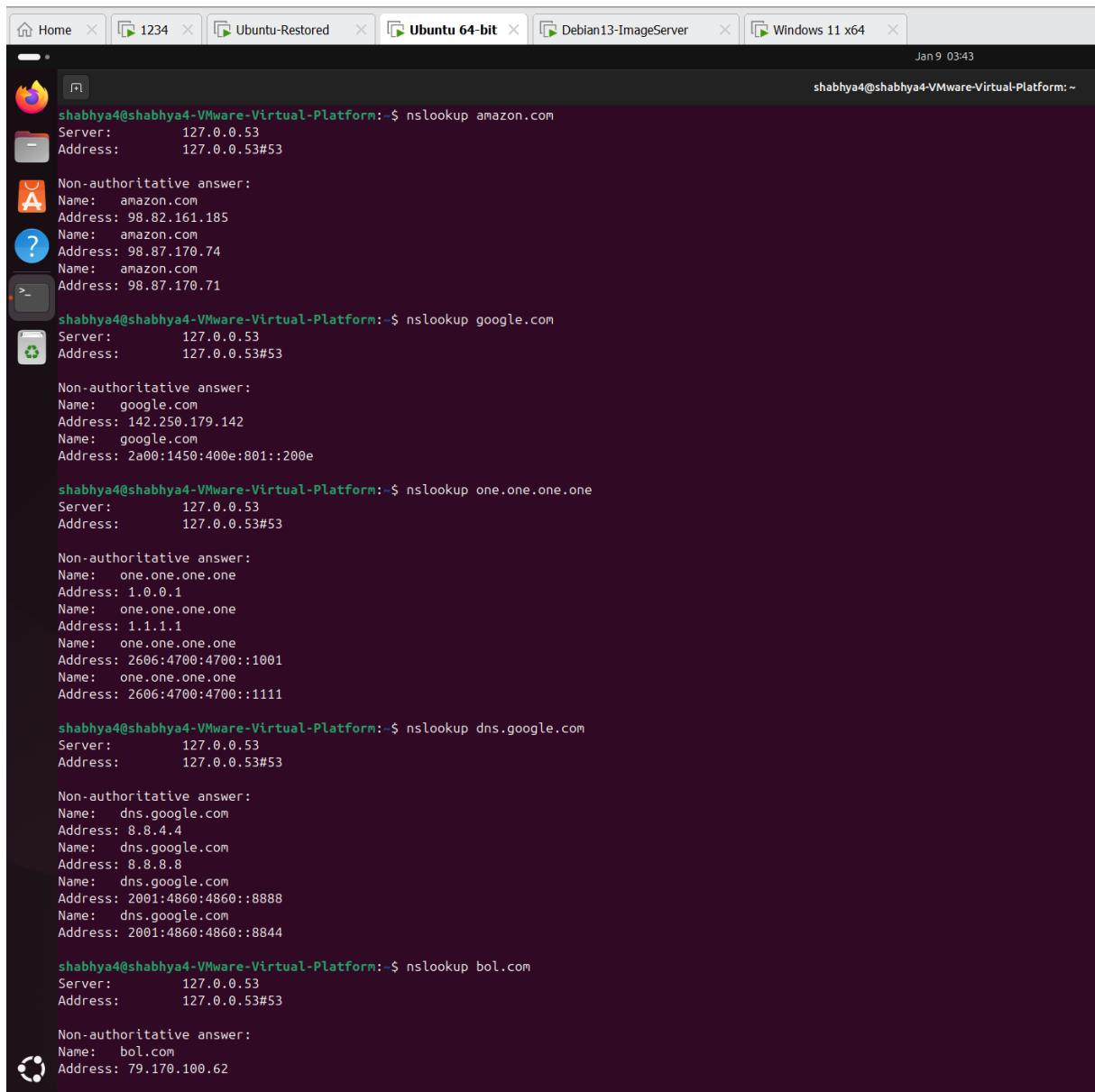
```
s.  
shabhy4@192.168.139.139's password:  
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.14.0-36-generic x86_64)  
  
* Documentation: https://help.ubuntu.com  
* Management: https://landscape.canonical.com  
* Support: https://ubuntu.com/pro  
  
Expanded Security Maintenance for Applications is not enabled.  
  
89 updates can be applied immediately.  
To see these additional updates run: apt list --upgradable  
  
17 additional security updates can be applied with ESM Apps.  
Learn more about enabling ESM Apps service at https://ubuntu.com/esm  
  
*** System restart required ***  
Last login: Fri Jan 9 03:10:49 2026 from 192.168.139.136  
shabhy4@shabhy4-VMware-Virtual-Platform:~$ echo "Week 6 SCP test" > test.txt  
shabhy4@shabhy4-VMware-Virtual-Platform:~$ scp test.txt shabhy4@192.168.139.139:~/  
shabhy4@192.168.139.139's password:  
test.txt                                              100%   16     12.3KB/s   00:00  
shabhy4@shabhy4-VMware-Virtual-Platform:~$
```

Screenshot remmina:



## Assignment 6.2: IP addresses websites

Relevant screenshots nslookup command:



The screenshot shows a terminal window with several tabs at the top: Home, 1234, Ubuntu-Restored, Ubuntu 64-bit, Debian13-ImageServer, and Windows 11 x64. The current tab is "Ubuntu 64-bit". The date and time "Jan 9 03:43" are displayed at the top right. The terminal output is as follows:

```
shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup amazon.com
Server:      127.0.0.53
Address:     127.0.0.53#53#53

Non-authoritative answer:
Name:  amazon.com
Address: 98.82.161.185
Name:  amazon.com
Address: 98.87.170.74
Name:  amazon.com
Address: 98.87.170.71

shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup google.com
Server:      127.0.0.53
Address:     127.0.0.53#53#53

Non-authoritative answer:
Name:  google.com
Address: 142.250.179.142
Name:  google.com
Address: 2a00:1450:400e:801::200e

shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup one.one.one.one
Server:      127.0.0.53
Address:     127.0.0.53#53#53

Non-authoritative answer:
Name:  one.one.one.one
Address: 1.0.0.1
Name:  one.one.one.one
Address: 1.1.1.1
Name:  one.one.one.one
Address: 2606:4700:4700::1001
Name:  one.one.one.one
Address: 2606:4700:4700::1111

shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup dns.google.com
Server:      127.0.0.53
Address:     127.0.0.53#53#53

Non-authoritative answer:
Name:  dns.google.com
Address: 8.8.4.4
Name:  dns.google.com
Address: 8.8.8.8
Name:  dns.google.com
Address: 2001:4860:4860::8888
Name:  dns.google.com
Address: 2001:4860:4860::8844

shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup bol.com
Server:      127.0.0.53
Address:     127.0.0.53#53#53

Non-authoritative answer:
Name:  bol.com
Address: 79.170.100.62
```

```
shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup bol.com
Server:      127.0.0.53
Address:     127.0.0.53#53

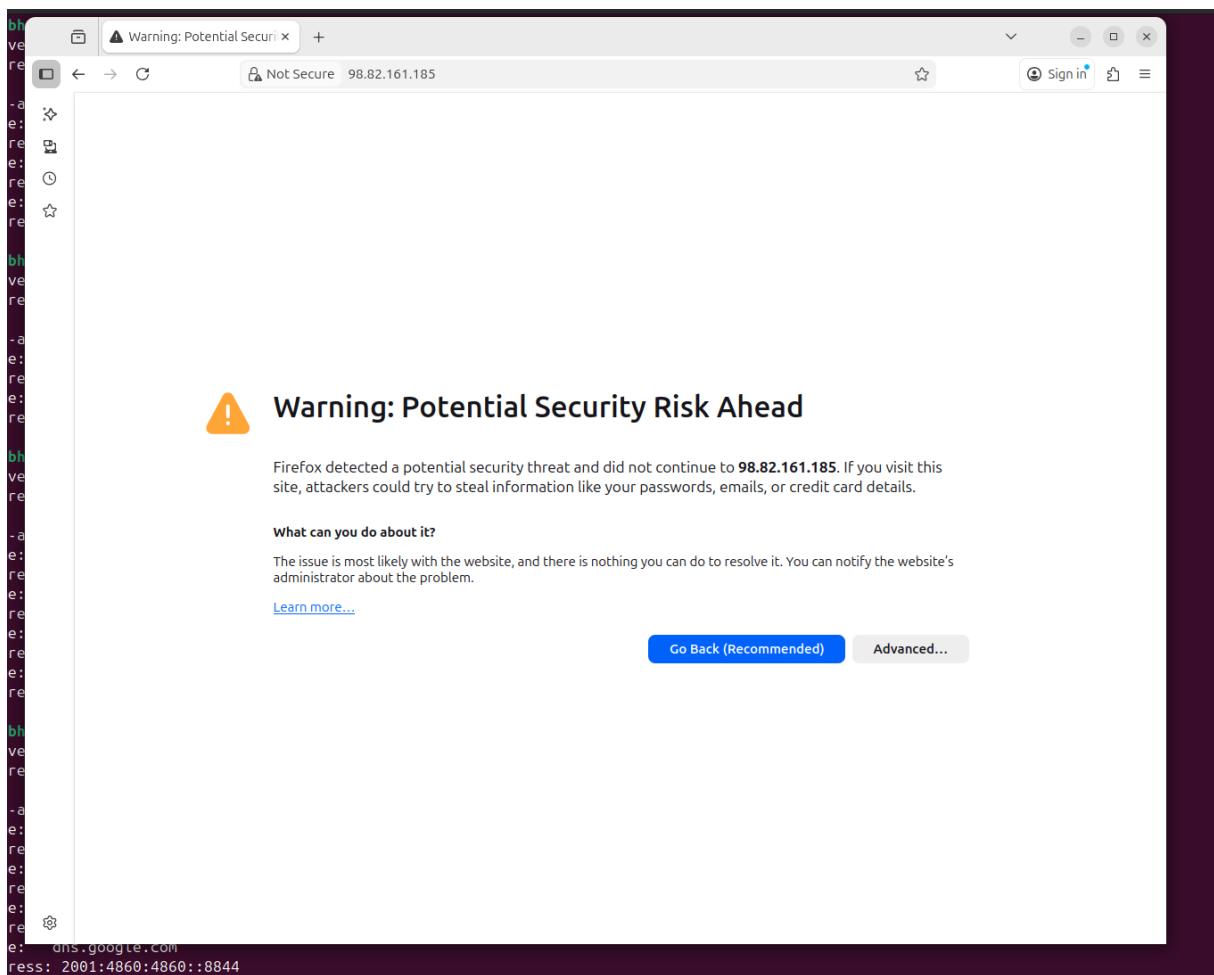
Non-authoritative answer:
Name:   bol.com
Address: 79.170.100.62

shabhy4@shabhy4-VMware-Virtual-Platform:~$ nslookup w3schools.com
Server:      127.0.0.53
Address:     127.0.0.53#53

Non-authoritative answer:
Name:   w3schools.com
Address: 76.223.115.82
Name:   w3schools.com
Address: 13.248.240.135

shabhy4@shabhy4-VMware-Virtual-Platform:~$
```

Screenshot website visit via IP address:



### Assignment 6.3: subnetting

How many IP addresses are in this network configuration 192.168.110.128/25?

- There are 128 IP addresses in the network 192.168.110.128/25.

What is the usable IP range to hand out to the connected computers?

- The usable host range is 192.168.110.129 up to 192.168.110.254, which gives 126 usable IP addresses.

Check your two previous answers with this Linux command: `ipcalc 192.168.110.128/25`

```
shabhy4@shabhy4-VMware-Virtual-Platform:~$ ipcalc 192.168.110.128/25
Address: 192.168.110.128      11000000.10101000.01101110.1 00000000
Netmask: 255.255.255.128 = 25 11111111.11111111.11111111.1 00000000
Wildcard: 0.0.0.127          00000000.00000000.00000000.0 1111111
=>
Network: 192.168.110.128/25 11000000.10101000.01101110.1 00000000
HostMin: 192.168.110.129    11000000.10101000.01101110.1 00000001
HostMax: 192.168.110.254    11000000.10101000.01101110.1 1111110
Broadcast: 192.168.110.255  11000000.10101000.01101110.1 1111111
Hosts/Net: 126              Class C, Private Internet

shabhy4@shabhy4-VMware-Virtual-Platform:~$
```

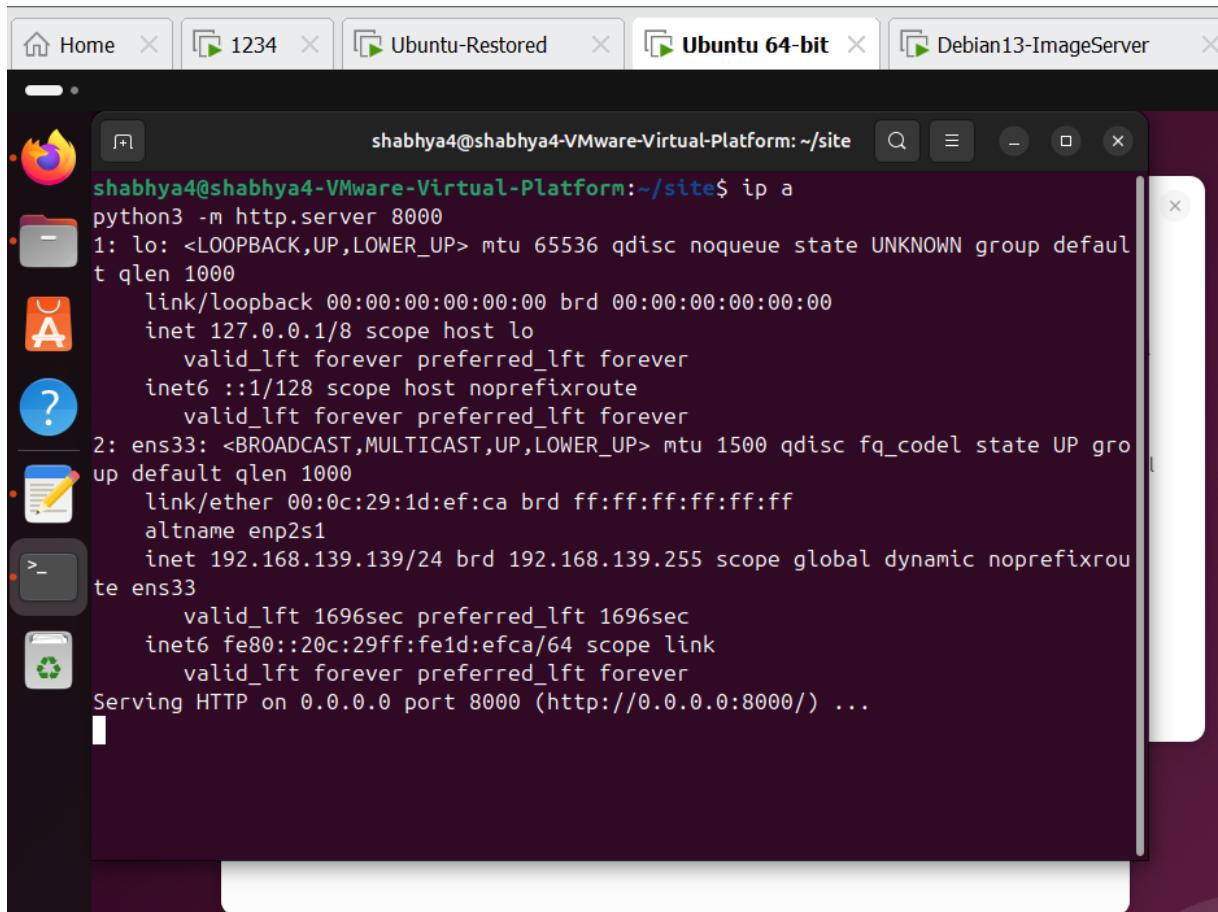
Running ipcalc 192.168.110.128/25 confirms my answers: it shows Network 192.168.110.128, HostMin 192.168.110.129, HostMax 192.168.110.254 and Hosts/Net 126

Explain the above calculation in your own words.

- *The “/25” means 25 bits are used for the network part and the remaining 7 bits are for hosts. With 7 host bits there are  $2^7 = 128$  total addresses in this subnet. The subnet range is from 192.168.110.128 to 192.168.110.255. The first address (192.168.110.128) is the network address, and the last address (192.168.110.255) is the broadcast address, so they cannot be assigned to devices. All addresses in between (192.168.110.129–192.168.110.254) are usable for hosts, which gives  $128 - 2 = 126$  usable host addresses*

#### Assignment 6.4: HTML

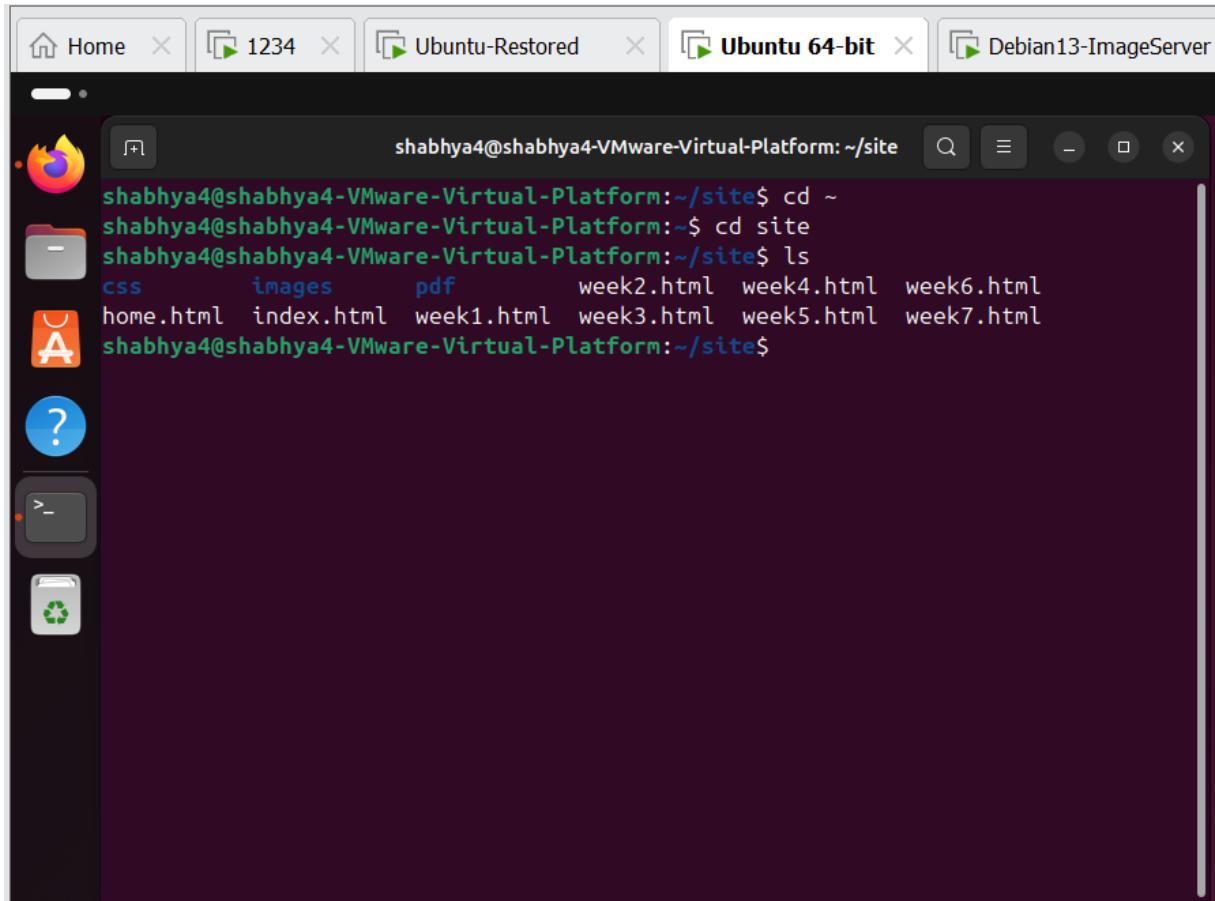
Screenshot IP address Ubuntu VM:



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "Ubuntu 64-bit". The command "ip a" is run, displaying network interface information. The output shows two interfaces: "lo" (loopback) and "ens33" (ethernet). The "ens33" interface has an IP address of 192.168.139.139. The terminal also shows the command "python3 -m http.server 8000" running, which serves HTTP on port 8000.

```
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$ ip a
python3 -m http.server 8000
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:1d:ef:ca brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.139/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
        valid_lft 1696sec preferred_lft 1696sec
    inet6 fe80::20c:29ff:fe1d:efca/64 scope link
        valid_lft forever preferred_lft forever
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/)
```

Screenshot of Site directory contents:

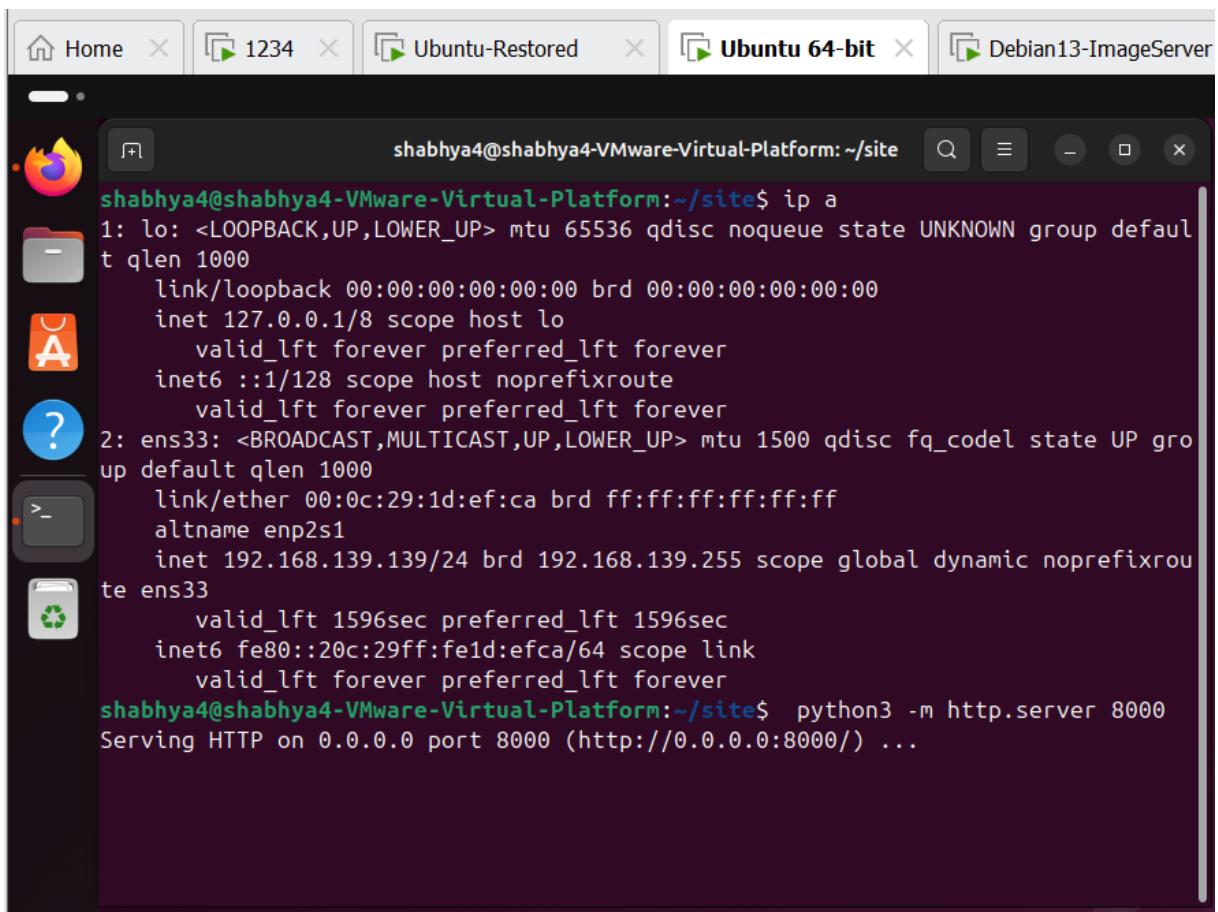


The screenshot shows a terminal window titled "Ubuntu 64-bit" with the command line interface. The user has run several commands to navigate and list files in their home directory:

```
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$ cd ~  
shabhy4@shabhy4-VMware-Virtual-Platform:~$ cd site  
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$ ls  
css      images      pdf      week2.html  week4.html  week6.html  
home.html index.html week1.html  week3.html  week5.html  week7.html  
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$
```

The terminal window is part of a desktop environment, with a dock visible on the left containing icons for Home, 1234, Ubuntu-Restored, and other applications.

Screenshot python3 webserver command:



The screenshot shows a terminal window titled "Ubuntu 64-bit" with the command "ip a" being run. The output lists two network interfaces: "lo" (loopback) and "ens33" (ethernet). The "lo" interface has an IP of 127.0.0.1/8. The "ens33" interface has an IP of 192.168.139.139/24. Following this, the command "python3 -m http.server 8000" is run, which starts an HTTP server on port 8000. The terminal window is part of a desktop environment with icons for a browser, file manager, terminal, and others.

```
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:1d:ef:ca brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.139/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
        valid_lft 1596sec preferred_lft 1596sec
    inet6 fe80::20c:29ff:fe1d:efca/64 scope link
        valid_lft forever preferred_lft forever
shabhy4@shabhy4-VMware-Virtual-Platform:~/site$ python3 -m http.server 8000
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

Screenshot web browser visits your site

The screenshot shows a web browser window with multiple tabs open at the top. The active tab is titled "IT Fundamentals" and displays a URL "Not secure 192.168.139.139:8000/home.html". The main content area of the browser shows a page titled "My Hobby: Football". The page contains a short text paragraph about playing football and two images: one of a football on grass and another of two players in action on a field.

### Assignment 6.5: Network segment

Remember that bitwise java application you've made in week 2? Expand that application so that you can also calculate a network segment as explained in the PowerPoint slides of week 6. Use the bitwise & AND operator. You need to be able to input two Strings. An IP address and a subnet.

IP: 192.168.1.100 and subnet: 255.255.255.224 for /27

Example: 192.168.1.100/27

Calculate the network segment

IP Address: 11000000.10101000.00000001.01100100

Subnet Mask: 11111111.11111111.11111111.11100000

-----

Network Addr: 11000000.10101000.00000001.01100000

This gives 192.168.1.96 in decimal as the network address.

For a /27 subnet, each segment (or subnet) has 32 IP addresses ( $2^5$ ).

The range of this network segment is from 192.168.1.96 to 192.168.1.127.

Paste source code here, with a screenshot of a working application.

```
import java.util.Scanner;

public class NetworkSegment {
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter IP address (e.g. 192.168.1.100): ");
        String ipStr = sc.nextLine().trim();

        System.out.print("Enter subnet mask (e.g. 255.255.255.224): ");
        String maskStr = sc.nextLine().trim();

        int[] ip = parseIp(ipStr);
        int[] mask = parseIp(maskStr);
        int[] net = new int[4];

        // bitwise AND each octet
        for (int i = 0; i < 4; i++) {
            net[i] = ip[i] & mask[i];
        }

        System.out.println("Network address: "
                + net[0] + "." + net[1] + "." + net[2] + "." + net[3]);
    }

    // Convert "192.168.1.100" to {192, 168, 1, 100}
    private static int[] parseIp(String s) {
        String[] parts = s.split("\\.");
        if (parts.length != 4) {
```

```

        throw new IllegalArgumentException("Invalid IP format: " + s);
    }

    int[] result = new int[4];

    for (int i = 0; i < 4; i++) {

        result[i] = Integer.parseInt(parts[i]);
    }

    return result;
}

```

The screenshot shows a Linux desktop environment with several windows open in a window manager. One window is a terminal window titled 'Ubuntu 64-bit' with the following command history:

```

shabhy4@shabhy4-Virtual-Platform:~/week6java
shabhy4@shabhy4-Virtual-Platform:~/week6java$ java -version
openjdk version "21.0.9" 2025-10-21
OpenJDK Runtime Environment (build 21.0.9+10-Ubuntu-124.04)
OpenJDK 64-Bit Server VM (build 21.0.9+10-Ubuntu-124.04, mixed mode, sharing)
shabhy4@shabhy4-Virtual-Platform:~/week6java$ mkdir -p ~/week6java
shabhy4@shabhy4-Virtual-Platform:~/week6java$ cd ~/week6java
shabhy4@shabhy4-Virtual-Platform:~/week6java$ nano NetworkSegment.java
shabhy4@shabhy4-Virtual-Platform:~/week6java$ javac NetworkSegment.java
shabhy4@shabhy4-Virtual-Platform:~/week6java$ java NetworkSegment
Enter IP address (e.g. 192.168.1.100): 192.168.1.100
Enter subnet mask (e.g. 255.255.255.224): 255.255.255.224
Network address: 192.168.1.96
shabhy4@shabhy4-Virtual-Platform:~/week6java$ 

```

Ready? Save this file and export it as a pdf file with the name: **week6.pdf**