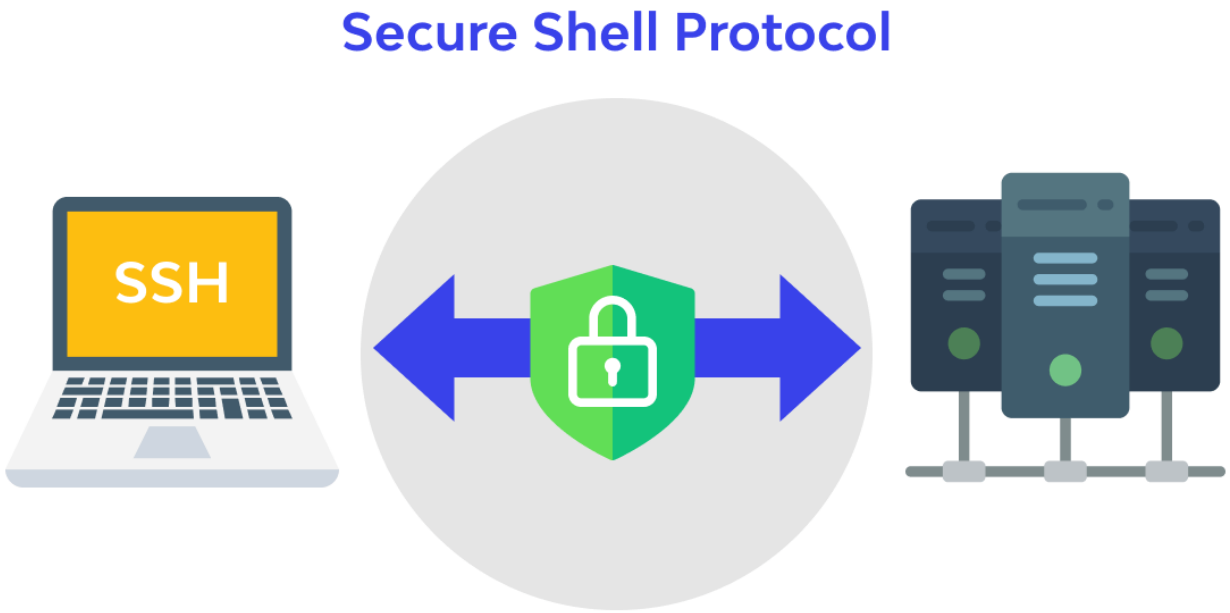
🚀 Assignment 8 — Secure GUI Access via SSH (X11) or VNC



Experiment: Basic Linux Data Networking Commands

Aim

To study and execute basic data networking commands in Linux using the command line interface.

Objectives

- To understand Linux network configuration.
- To test network connectivity.
- To diagnose network-related issues.
- To access and transfer data between systems using networking tools.

Requirements

- Linux Operating System (Ubuntu/Debian/Fedora/Kali etc.)
- Terminal access
- Basic knowledge of Linux commands
- Internet connection (optional)

Theory

Data networking in Linux is performed using built-in terminal commands. These commands help configure systems, test connections, and troubleshoot network problems.

Command	Purpose
`ifconfig` / `ip addr`	Shows network interface configuration
`ping`	Tests connectivity to another host
`hostname`	Displays system hostname
`traceroute`	Shows the route packets take
`netstat`	Displays active connections
`nslookup`	Queries DNS information
`ssh`	Secure remote login
`scp`	Secure file transfer

Procedure

🏠 Case 1: Friend's ubuntu and Ubuntu on the same network

☑Step 1: Enable SSH on Ubuntu

On Ubuntu, install and enable SSH:

```
sudo apt update
sudo apt install openssh-server
sudo systemctl enable ssh
sudo systemctl start ssh
```

```
ujjwaltyagi@ujjwaltyagi:~$ sudo useradd -m frienduser || true
[sudo] password for ujjwaltyagi:
useradd: user 'frienduser' already exists
ujjwaltyagi@ujjwaltyagi:~$ sudo systemctl enable --now ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/system
d/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
```

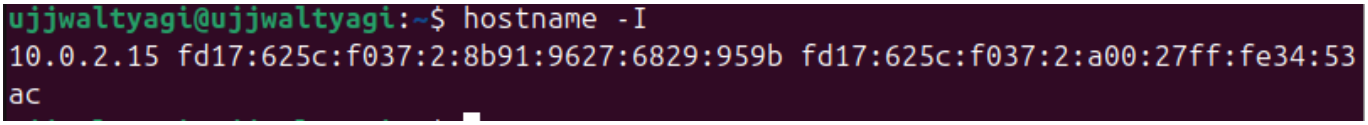
Check it's running:

```
sudo systemctl status ssh
```

☑ Step 2: Find Ubuntu's local IP address

Run:

```
hostname -I
```



You'll get something like 192.168.1.42.

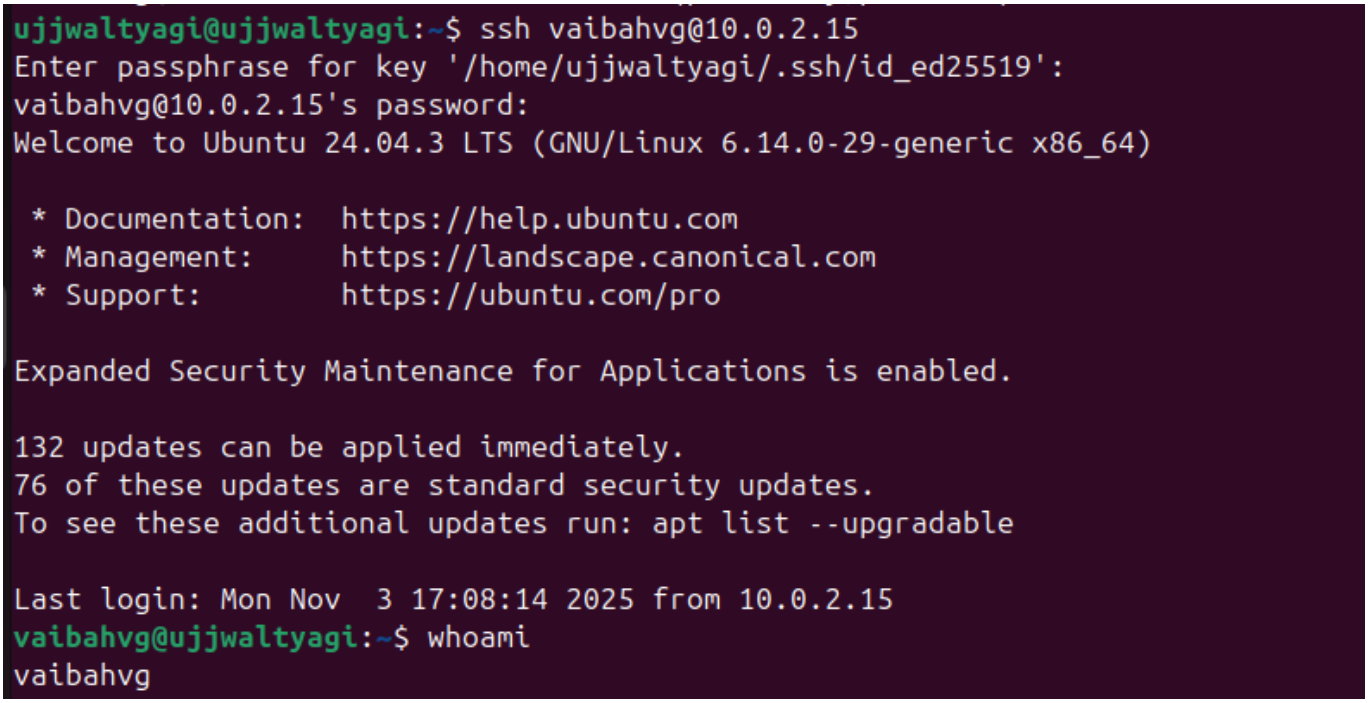
☑ Step 3: Connect from friends ubuntu

On your friends ubuntu, open Terminal and run:

```
ssh username@192.168.1.42
```

Replace username with your Ubuntu username.

Enter your password when prompted — you're in! ☑



☑ Step 4: Create a File on Remote Computer

```
echo "This file was created remotely using SSH" > ~/ssh_test.txt
```

☑ Step 5: Verify the File**

```
cat ~/ssh_test.txt
```

☑ Step 6: Delete the File

```
rm ~/ssh_test.txt
```

☑ Step 7: Exit SSH

```
exit
```

```
vaibahvg@ujjwaltyagi:~$ cat ~/.ssh/authorized_keys
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIIF2VoiSW9boxOH9etpllHkPWkz0KyysCxt9f04bbXDu
 ujjwaltyagi@ujjwaltyagi
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQCrj9pWlhK52jqKxYIwGZTR202UUPI0DzUXzvrpb3Ua
hTBzy7oBbj2wOe7dTqaFojwf0s4xR39o3hy8mIUvU8S4cZs26R8iGwz/cOdDFYzhSYJOW8WofsdXfnwf
4N6PDcYgKFHHkHu/kI1e1k54xkjYGK+5zOjajS5K+YVCn6uhdFTlB+yC5JaFG0v8B8fltuuvkseepE5/
Tevg1D+MjzD9Z+XLxUEgP+N/MGwdcsHohmz3ezuKtTVIc0Kwc2N9ykwT0z6xsnXE1m9CY/hfhtgBz2gV
oujFsGgZ7BBG7TkOIAp4QLBFXAeVq62U9/WWELdku6nV2qhyH5sy1UZ14k5B vaibahvg@ujjwaltyag
i
vaibahvg@ujjwaltyagi:~$ exit
logout
Connection to 10.0.2.15 closed.
ujjwaltyagi@ujjwaltyagi:~$
```

🌐 Case 2: Ubuntu and Ubuntu on different networks (e.g., home ↔ office or remote server)

☑ ◇ Option 1: Connect to a remote Ubuntu server (e.g., cloud VM)

Step 1: View IP Address and Network Interfaces

```
ip addr show
```

Step 2:Display hostname

```
hostname
```

```
ujjwaltyagi@ujjwaltyagi:~$ hostname
ujjwaltyagi
```

step 3:Test Network connectivity(ping)

```
ping google.com -c 4
```

```
ujjwaltyagi@ujjwaltyagi:~$ ping google.com -c 4
PING google.com (142.250.76.78) 56(84) bytes of data.
64 bytes from tzdela-aq-in-f14.1e100.net (142.250.76.78): icmp_seq=1 ttl=255 tim
e=55.6 ms
64 bytes from tzdela-aq-in-f14.1e100.net (142.250.76.78): icmp_seq=2 ttl=255 tim
e=20.2 ms
64 bytes from tzdela-aq-in-f14.1e100.net (142.250.76.78): icmp_seq=3 ttl=255 tim
e=18.4 ms
64 bytes from tzdela-aq-in-f14.1e100.net (142.250.76.78): icmp_seq=4 ttl=255 tim
e=29.2 ms

--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3510ms
rtt min/avg/max/mdev = 18.406/30.845/55.581/14.850 ms
```

Step 4: Trace Route to Remote Host

```
traceroute google.com
```

```
ujjwaltyagi@ujjwaltyagi:~$ traceroute google.com
traceroute to google.com (142.250.76.78), 30 hops max, 60 byte packets
 1  _gateway (10.0.2.2)  8.226 ms  1.374 ms  1.060 ms

 2  * * *
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
```

Step 5: View Active Network Ports

```
netstat -tulnp
```

```
ujjwaltyagi@ujjwaltyagi:~$ netstat -tulnp
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 127.0.0.54:53           0.0.0.0:*               LISTEN      -
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN      -
tcp6       0      0 :::22                   :::*                    LISTEN      -
tcp6       0      0 ::1:631                 :::*                    LISTEN      -
udp        0      0 127.0.0.54:53           0.0.0.0:*                           -
udp        0      0 127.0.0.53:53           0.0.0.0:*                           -
udp        0      0 0.0.0.0:58272           0.0.0.0:*                           -
udp        0      0 0.0.0.0:5353            0.0.0.0:*                           -
udp6       0      0 :::39957                :::*                                -
udp6       0      0 :::5353                 :::*                                -
```

Step 6: DNS Lookup

```
nslookup google.com
```

```
ujjwaltyagi@ujjwaltyagi:~$ nslookup google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.76.78
Name:   google.com
Address: 2404:6800:4002:830::200e
```

Step 7: Remote Login using SSH

```
ssh user@192.168.1.10
```

```
ujjwaltyagi@ujjwaltyagi:~$ ssh vaibahvg@10.0.2.15
Enter passphrase for key '/home/ujjwaltyagi/.ssh/id_ed25519':
vaibahvg@10.0.2.15's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.14.0-29-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

Expanded Security Maintenance for Applications is enabled.

132 updates can be applied immediately.
76 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Last login: Mon Nov  3 17:23:09 2025 from 10.0.2.15
```

Step 8: File Transfer using SCP

```
scp test.txt user@192.168.1.10:/home/user/
```

```
ujjwaltyagi@ujjwaltyagi:~$ echo "Hello from ujjwal" >test2.txt
ujjwaltyagi@ujjwaltyagi:~$ scp test2.txt vaibahvg@10.0.2.15:/home/vaibahvg/
sign_and_send_pubkey: signing failed for ED25519 "/home/ujjwaltyagi/.ssh/id_ed25519" from agent: agent refused operation
vaibahvg@10.0.2.15's password:
test2.txt                                     100%   18     3.0KB/s   00:00
ujjwaltyagi@ujjwaltyagi:~$
```

🏠 GUI

☑ 1) Prepare & secure the remote machine (run on friend’s laptop)

Run these on the friend’s laptop (they must have sudo):

install SSH and optional VNC

```
sudo apt update
sudo apt install -y openssh-server tigervnc-standalone-server
```

```
ujjwaltyagi@ujjwaltyagi:~$ sudo apt install tightvncserver xfce4 xfce4-goodies -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
tightvncserver is already the newest version (1:1.3.10-8).
The following package was automatically installed and is no longer required:
  libllvm19
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  7zip accountsservice-ubuntu-schemas avahi-utils bamfdaemon bzip2 desktop-base elementary-xfce-icon-theme exo-utils
  fonts-quicksand gir1.2-dbusmenu-glib-0.4 gnome-bluetooth gnome-screensaver greybird-gtk-theme indicator-applet
  indicator-application indicator-appmenu indicator-bluetooth indicator-common indicator-datetime indicator-keyboard
  indicator-messages indicator-power indicator-printers indicator-session indicator-sound jayatana libaccounts-glib0
  libasound2-plugins libatkmm-1.6-1v5 libbamf3-2t64 libburn4t64 libcairomm-1.0-1v5 libexo-2-0 libexo-common
  libfcitx-config4 libfcitx-gclient1 libfcitx-utils0 libgarcon-1-0 libgarcon-common libgarcon-gtk3-1-0
  libglibmm-2.4-1t64 libgnome-panel3 libgtk-layer-shell0 libgtkmm-3.0-1t64 libgtksourceview-4-0
  libgtksourceview-4-common libido3-0.1-0 libindicator3-7 libisofs6t64 libjack-jackd2-0 libkeybinder-3.0-0
  liblightdm-gobject-1-0 libmessaging-menu0 libmousepad0 libpangomm-1.4-1v5 libqrencode4 libsigc++-2.0-0v5 libtagc0
  libthunarx-3-0 libtumbler-1-0t64 libunity-gtk2-parser0 libunity-gtk3-parser0 libunity-settings-daemon1 libutempter0
  libxfce4panel-2.0-4 libxfce4ui-2-0 libxfce4ui-common libxfce4ui-utils libxfce4util-bin libxfce4util-common
  libxfce4util7 libxfconf-0-3 libxnvctrl0 libxpresent1 light-locker light-locker-settings lightdm lm-sensors mousepad
  p7zip-full pavucontrol policykit-1-gnome pulseaudio-utils python3-psutil ristretto system-config-printer
  tango-icon-theme thunar thunar-archive-plugin thunar-data thunar-media-tags-plugin thunar-volman tumbler
  tumbler-common ubuntu-touch-sounds unity-greeter unity-gtk-module-common unity-gtk2-module unity-gtk3-module
  unity-settings-daemon unity-settings-daemon-schemas xarchiver xfburn xfce4-appfinder xfce4-battery-plugin
```

create non-root user if needed (won't fail if exists)

```
sudo useradd -m frienduser || true
```

```
ujjwaltyagi@ujjwaltyagi:~$ sudo adduser vaibahvg
info: Adding user `vaibahvg' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `vaibahvg' (1002) ...
info: Adding new user `vaibahvg' (1002) with group `vaibahvg (1002)' ...
info: Creating home directory `/home/vaibahvg' ...
info: Copying files from `/etc/skel' ...
New password:
BAD PASSWORD: The password fails the dictionary check - it is too simplistic/systematic
Retype new password:
passwd: password updated successfully
Changing the user information for vaibahvg
Enter the new value, or press ENTER for the default
        Full Name []: vaibhavg
        Room Number []: 34
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] y
info: Adding new user `vaibahvg' to supplemental / extra groups `users' ...
info: Adding user `vaibahvg' to group `users' ...
```

enable and start SSH

```
sudo systemctl enable --now ssh
```

```
ujjwaltyagi@ujjwaltyagi:~$ sudo systemctl status ssh
[sudo] password for ujjwaltyagi:
○ ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/usr/lib/systemd/system/ssh.service; disabled; preset: enabled)
     Active: inactive (dead)
TriggeredBy: ● ssh.socket
       Docs: man:sshd(8)
             man:sshd_config(5)
ujjwaltyagi@ujjwaltyagi:~$
```

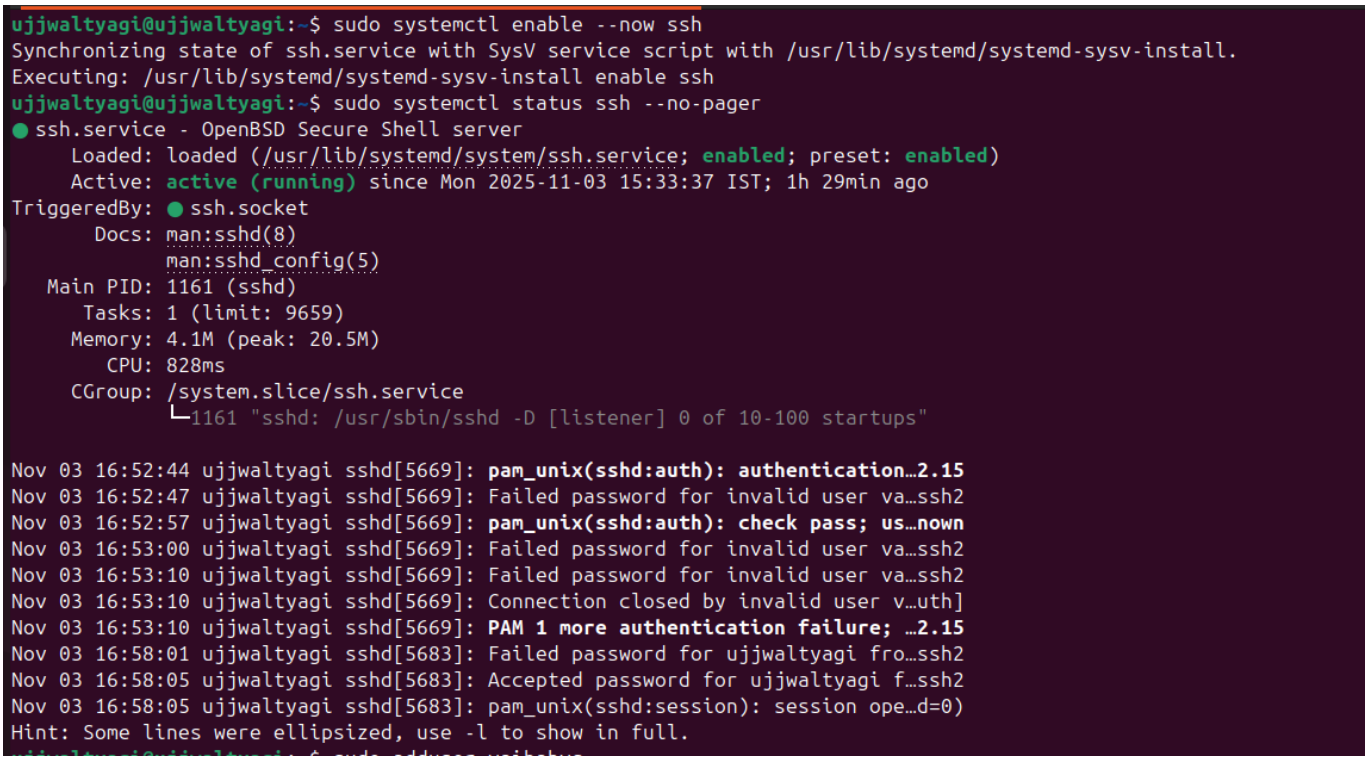
add your public key (replace) and set safe permissions

```
sudo -u frienduser mkdir -p /home/frienduser/.ssh
echo "<your-pubkey>" | sudo tee -a /home/frienduser/.ssh/authorized_keys
sudo chmod 700 /home/frienduser/.ssh
sudo chmod 600 /home/frienduser/.ssh/authorized_keys
sudo chown -R frienduser:frienduser /home/frienduser/.ssh
```

```
ujjwaltyagi@ujjwaltyagi:~$ mkdir -p ~/.ssh
ujjwaltyagi@ujjwaltyagi:~$ chmod 700 ~/.ssh
ujjwaltyagi@ujjwaltyagi:~$ touch ~/.ssh/authorized_keys
ujjwaltyagi@ujjwaltyagi:~$ chmod 600 ~/.ssh/authorised_keys
chmod: cannot access '/home/ujjwaltyagi/.ssh/authorised_keys': No such file or directory
ujjwaltyagi@ujjwaltyagi:~$ chmod 600 ~/.ssh/authorized_keys
```

Verify sshd is running:

```
sudo systemctl status ssh --no-pager
# or
ss -tlnp | grep :22
```



☑ 2) Test X11 forwarding (single GUI app) — from your laptop

Preflight on your laptop:

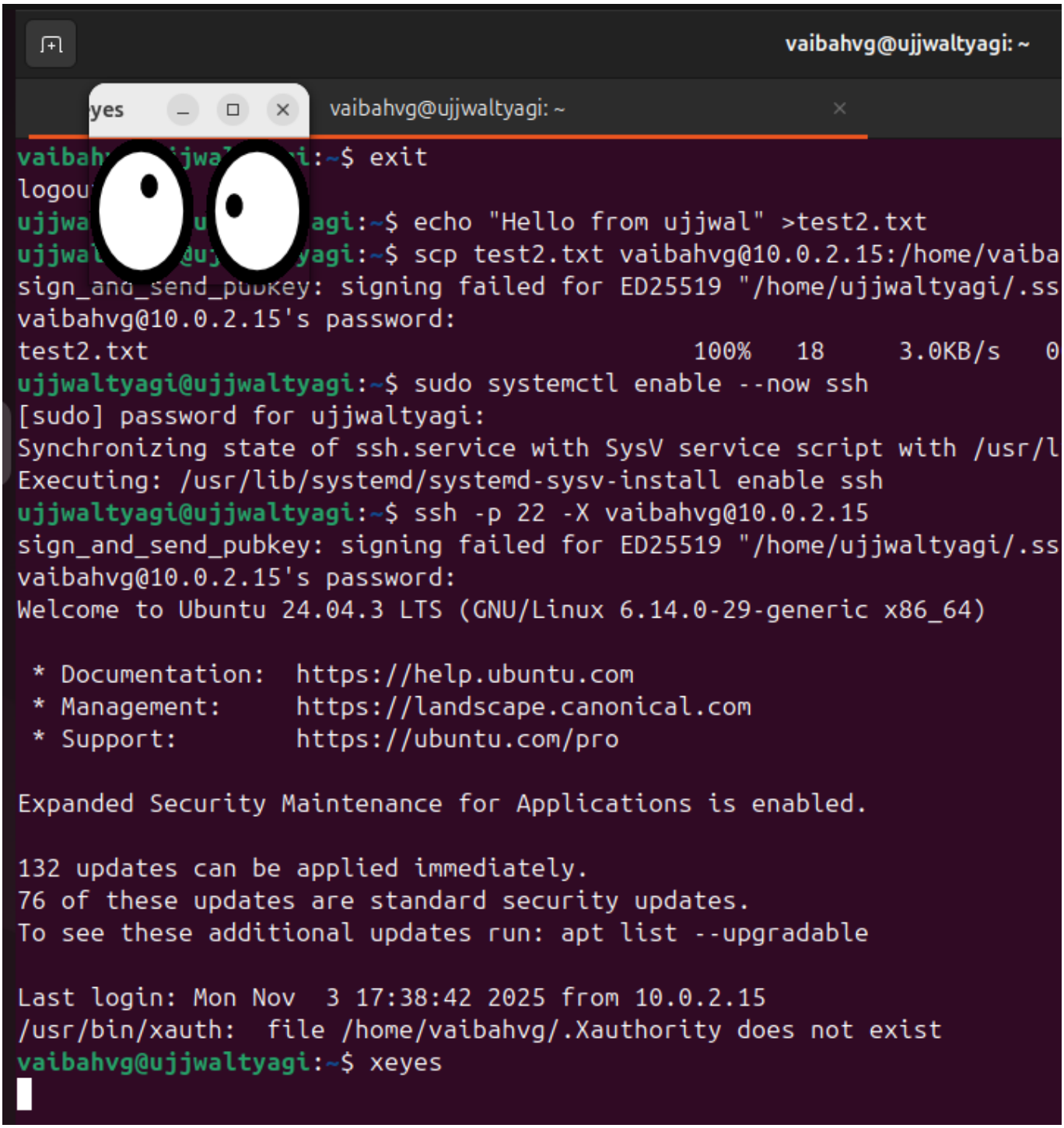
Linux: usually ready.

macOS: install & run XQuartz and start it before SSH.

Windows: install an X server like VcXsrv or Xming and run it.

Then on your laptop run:

```
ssh -p 22 -X frienduser@FRIEND_IP
``
# once connected, run a simple GUI test:
```bash
xeyes &    # or gedit & or xclock &
```
```



Success criteria: the GUI app window appears on your laptop and is responsive.

Troubleshooting quick checks:

If you see Warning: No xauth data; using fake or X apps fail: try -Y (trusted) instead of -X: ssh -Y -p 22 frienduser@FRIEND_IP.

Ensure DISPLAY is set on the SSH session (run echo $DISPLAY — should show something like localhost:10.0).

Ensure client X server (XQuartz/VcXsrv) is running and allowing connections.

Security note: X11 forwards every GUI app over SSH, but X11 is older and can let remote apps access local X resources — use only with trusted machines. For stronger isolation, prefer the VNC-over-SSH approach below.

☑ 3) Full desktop: VNC server on friend’s laptop + SSH tunnel from your laptop

On friend’s laptop (as frienduser):

start a VNC server on display :1 (creates :1 -> TCP 5901)

```
vncserver :1
# optionally stop with: vncserver -kill :1
```

(Configure desktop environment in ~/.vnc/xstartup if needed — many distros auto-configure.)

On your laptop: create a local SSH tunnel (keeps VNC server bound to localhost on remote; only SSH port open externally)

create an SSH tunnel mapping your localhost:5901 to friend's localhost:5901

```
ssh -L 5901:localhost:5901 -p 22 frienduser@FRIEND_IP -N &
# -N = no remote command; & runs in background (adjust as preferred)
```

```
ujjwaltyagi@ujjwaltyagi:~$ ssh -L 5901:localhost:5901 -p 22 vaibahvg@10.0.2.15 -N &
[1] 9487
exit
logout
There are stopped jobs.

[1]+  Stopped                 ssh -L 5901:localhost:5901 -p 22 vaibahvg@10.0.2.15 -N
```

Then open your VNC viewer and connect to:

```
localhost:5901
```

```
ujjwaltyagi@ujjwaltyagi:~$ vncserver :1

New 'X' desktop is ujjwaltyagi:1

Starting applications specified in /home/ujjwaltyagi/.vnc/xstartup
Log file is /home/ujjwaltyagi/.vnc/ujjwaltyagi:1.log

ujjwaltyagi@ujjwaltyagi:~$ vncviewer

TigerVNC Viewer v1.13.1
Built on: 2024-04-01 08:26
Copyright (C) 1999-2022 TigerVNC Team and many others (see README.rst)
See https://www.tigervnc.org for information on TigerVNC.

Mon Nov  3 18:51:47 2025
 DecodeManager: Detected 5 CPU core(s)
 DecodeManager: Creating 4 decoder thread(s)
 CConn:       Connected to host localhost port 5901

Mon Nov  3 18:51:52 2025
 CConn:       End of stream
 CConn:       The connection was dropped by the server before the session could
              be established.
 DecodeManager:   Total: 0 rects, 0 pixels
 DecodeManager:          0 B (1:-nan ratio)
```

Output / Observations

Command	Result
`ip addr`	Lists network interfaces and IP addresses
`ping`	Replies received indicate connectivity
`traceroute`	Displays the route path to the destination
`nslookup`	Shows DNS IP information
`ssh`	Connects to a remote machine securely
`scp`	Transfers files securely over SSH

Result

Basic Linux networking commands were successfully executed and network connectivity and configuration were verified.

Conclusion

Linux provides powerful built-in commands for networking tasks such as configuration, troubleshooting, monitoring, and secure communication between systems.

Viva Questions

❓ What is the purpose of the `ping` command?

✨ The `ping` command is used to test network connectivity between the source and a destination host. It sends ICMP Echo Request packets and waits for Echo Reply packets to verify whether the destination is reachable and to measure round-trip time.

❓ What is the difference between SSH and Telnet?

✨| Feature | SSH (Secure Shell) | Telnet |

|----------|--------------------|--------| | Security | Encrypted communication | No encryption | | Default Port | 22 | 23 | | Usage | Secure remote login | Unsecure remote login | | Current Status | Widely used | Mostly outdated |

SSH is preferred over Telnet because it provides secure communication.

❓ How does `traceroute` help in network troubleshooting?

✨`traceroute` displays the path taken by packets from the local system to a remote host. It shows each intermediate router (hop) along the path and the time taken. It helps identify:

- Network delays
- Connection failures
- Routing issues

❓ Why is DNS used in networking?

✨DNS (Domain Name System) translates human-friendly domain names like `www.google.com` into machine-readable IP addresses like `142.250.182.14`. This is necessary because computers communicate using IP addresses, not domain names.

❓ How can you transfer a file securely in Linux?

✨Files can be transferred securely in Linux using the `scp` (Secure Copy) command, which uses SSH encryption.

Example:

```
scp file.txt user@192.168.1.10:/home/user/
```