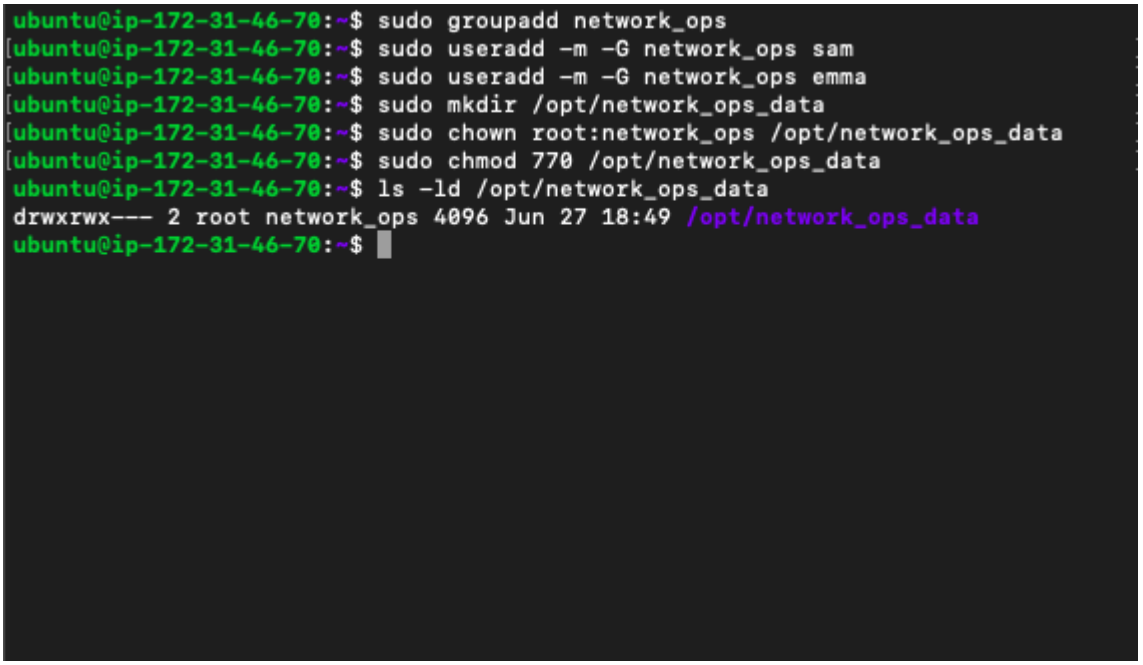
Part 1: User & Group Permissions



Create a group

```
sudo groupadd network_ops
```

Explanation: Creates a new group `network_ops` to manage permissions collectively.

Create two users and add them to the group

```
sudo useradd -m -G network_ops charlie
sudo useradd -m -G network_ops dana
```

Explanation: Creates users `charlie` and `dana` with home directories and adds them to `network_ops`.

Create shared directory

```
sudo mkdir /opt/network_data
```

Explanation: Creates a shared directory `/opt/network_data` for the team.

Change group ownership

```
sudo chown root:network_ops /opt/network_data
```

Explanation: Sets the directory's group ownership to `network_ops` so the group controls it.

Set permissions

```
sudo chmod 770 /opt/network_data
```

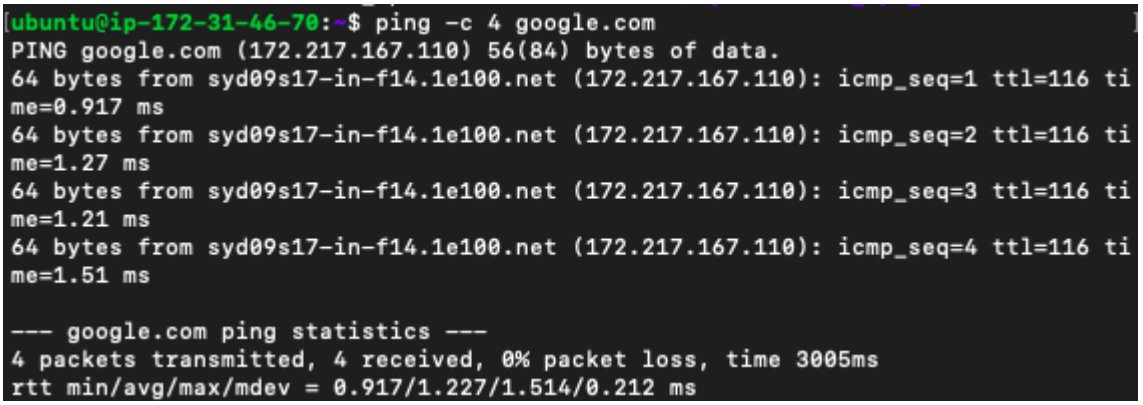
Explanation: Gives full permissions (read/write/execute) to owner and group, no access to others.

Check permissions

```
ls -ld /opt/network_data
```

Explanation: Lists directory permissions and ownership details to verify changes.

Part 2: Network Tools & Real-Time Checks



```
ubuntu@ip-172-31-46-70:~$ traceroute google.com
traceroute to google.com (172.217.167.110), 30 hops max, 60 byte packets
 1  240.1.192.15 (240.1.192.15)  1.837 ms 240.1.192.12 (240.1.192.12)  1.818 ms
*
 2  242.4.121.65 (242.4.121.65)  1.775 ms 242.4.120.71 (242.4.120.71)  1.705 ms
242.4.120.193 (242.4.120.193)  1.713 ms
 3  * 99.83.112.104 (99.83.112.104)  1.639 ms *
 4  142.250.172.96 (142.250.172.96)  1.596 ms 99.83.112.105 (99.83.112.105)  1.5
73 ms 142.250.172.96 (142.250.172.96)  1.552 ms
 5  192.178.97.215 (192.178.97.215)  1.529 ms 192.178.97.219 (192.178.97.219)  1
.534 ms 192.178.97.215 (192.178.97.215)  1.511 ms
 6  209.85.253.177 (209.85.253.177)  1.488 ms  1.763 ms 209.85.253.181 (209.85.2
53.181)  1.826 ms
 7  syd09s17-in-f14.1e100.net (172.217.167.110)  1.630 ms  1.586 ms  1.570 ms
ubuntu@ip-172-31-46-70:~$
```

```
ubuntu@ip-172-31-46-70:~$ mtr --report google.com
Start: 2025-06-27T18:53:44+0000
HOST: ip-172-31-46-70             Loss%   Snt   Last   Avg  Best  Wrst StDev
  1.|-- ???                       100.0    10    0.0   0.0   0.0   0.0   0.0
  2.|-- 242.4.120.69               0.0%    10    1.3   1.2   0.4   2.8   0.7
  3.|-- ???                       100.0    10    0.0   0.0   0.0   0.0   0.0
  4.|-- 142.250.172.96             0.0%    10    0.4   0.5   0.4   1.3   0.3
  5.|-- 192.178.97.141             0.0%    10    2.3   1.9   1.6   2.3   0.2
  6.|-- 209.85.253.177             0.0%    10    1.8   1.9   1.4   2.7   0.4
  7.|-- syd09s17-in-f14.1e100.net  0.0%    10    1.6   1.2   1.0   1.6   0.2
ubuntu@ip-172-31-46-70:~$
```

2.2

```
ubuntu@ip-172-31-46-70:~$ sudo netstat -tuln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN
tcp6       0      0 :::22                   :::*                    LISTEN
udp        0      0 127.0.0.1:323           0.0.0.0:*
udp        0      0 127.0.0.53:53           0.0.0.0:*
udp        0      0 172.31.46.70:68         0.0.0.0:*
udp6       0      0 ::1:323                 :::*
ubuntu@ip-172-31-46-70:~$
```

```
ubuntu@ip-172-31-46-70:~$ sudo ss -tulwn
Netid State  Recv-Q Send-Q       Local Address:Port   Peer Address:Port Process
icmp6 UNCONN 0      0                *%eth0:58              *:*
udp   UNCONN 0      0              127.0.0.1:323         0.0.0.0:*
udp   UNCONN 0      0           127.0.0.53%lo:53         0.0.0.0:*
udp   UNCONN 0      0       172.31.46.70%eth0:68         0.0.0.0:*
udp   UNCONN 0      0                  [::1]:323            [::]:*
tcp   LISTEN 0      4096        127.0.0.53%lo:53         0.0.0.0:*
tcp   LISTEN 0      128              0.0.0.0:22         0.0.0.0:*
tcp   LISTEN 0      128                 [::]:22            [::]:*
ubuntu@ip-172-31-46-70:~$
```

```
ubuntu@ip-172-31-46-70:~$ telnet google.com 443
Trying 142.250.204.14...
Connected to google.com.
Escape character is '^]'.
Connection closed by foreign host.
ubuntu@ip-172-31-46-70:~$
```

```
ubuntu@ip-172-31-46-70:~$ nc -zv google.com 443
Connection to google.com (142.250.204.14) 443 port [tcp/https] succeeded!
ubuntu@ip-172-31-46-70:~$
```

2.4

```
ubuntu@ip-172-31-46-70:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 9001
        inet 172.31.46.70  netmask 255.255.240.0  broadcast 172.31.47.255
        inet6 fe80::4ed:c9ff:fee9:3311  prefixlen 64  scopeid 0x20<link>
        ether 06:ed:c9:e9:33:11  txqueuelen 1000  (Ethernet)
        RX packets 413652  bytes 275968449 (275.9 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 285837  bytes 32350496 (32.3 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 4160  bytes 474229 (474.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 4160  bytes 474229 (474.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
ubuntu@ip-172-31-46-70:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t 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
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 9001 qdisc fq_codel state UP grou
p default qlen 1000
    link/ether 06:ed:c9:e9:33:11 brd ff:ff:ff:ff:ff:ff
    inet 172.31.46.70/20 metric 100 brd 172.31.47.255 scope global dynamic eth0
       valid_lft 2236sec preferred_lft 2236sec
    inet6 fe80::4ed:c9ff:fee9:3311/64 scope link
       valid_lft forever preferred_lft forever
ubuntu@ip-172-31-46-70:~$
```

2.5

```
ubuntu@ip-172-31-46-70:~$ nslookup google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.204.14
Name:   google.com
Address: 2404:6800:4006:814::200e
```

```
ubuntu@ip-172-31-46-70:~$ dig google.com

; <<>> DiG 9.18.30-0ubuntu0.22.04.2-Ubuntu <<>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49128
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;google.com.                    IN      A

;; ANSWER SECTION:
google.com.             262     IN      A       142.250.204.14

;; Query time: 0 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Fri Jun 27 18:59:45 UTC 2025
;; MSG SIZE  rcvd: 55
```

2.6

```
ubuntu@ip-172-31-46-70:~$ wget https://example.com/testfile.txt
--2025-06-27 19:01:12--  https://example.com/testfile.txt
Resolving example.com (example.com)... 23.192.228.84, 23.215.0.136, 23.215.0.138
, ...
Connecting to example.com (example.com)|23.192.228.84|:443... connected.
HTTP request sent, awaiting response... 404 Not Found
2025-06-27 19:01:13 ERROR 404: Not Found.

ubuntu@ip-172-31-46-70:~$ curl -O https://example.com/testfile.txt
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  1256  100  1256    0     0   1853      0 --:--:-- --:--:-- --:--:--  1852
ubuntu@ip-172-31-46-70:~$
```

```
ubuntu@ip-172-31-46-70:~$ sudo iftop -i eth0
interface: eth0
IP address is: 172.31.46.70
MAC address is: 06:ed:c9:e9:33:11
ubuntu@ip-172-31-46-70:~$ sudo nload eth0
ubuntu@ip-172-31-46-70:~$
```

Check connectivity

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

Explanation: Sends 4 ICMP echo requests to check if Google is reachable.

```
traceroute google.com
```

Explanation: Traces the route packets take to reach Google, useful for diagnosing hops.

```
mtr --report google.com
```

Explanation: Combines ping and traceroute into a continuous report showing path performance.

Check open ports and listening services

```
sudo netstat -tuln
```

Explanation: Displays listening network sockets with protocol, addresses, and port numbers.

```
sudo ss -tulwn
```

Explanation: Faster modern alternative to netstat, showing similar socket and port info.

Test remote port connectivity

```
telnet google.com 443
```

Explanation: Checks if port 443 (HTTPS) is open and reachable on Google.

```
nc -zv google.com 443
```

Explanation: Uses netcat to check if port 443 is open without opening a session.

Check network interfaces

```
ifconfig
```

Explanation: Displays detailed info on each network interface (deprecated on some systems).

```
ip addr
```

Explanation: Modern alternative to ifconfig, shows IP addresses and interface details.

DNS lookups

```
nslookup google.com
```

Explanation: Queries DNS to resolve Google's IP address.

```
dig google.com
```

Explanation: Provides detailed DNS query information, including answers and timing.

Download test files

```
wget https://example.com/testfile.txt
```

Explanation: Downloads a file using wget.

```
curl -O https://example.com/testfile.txt
```

Explanation: Downloads the file with curl and saves using original name (`-O` option).

Monitor bandwidth

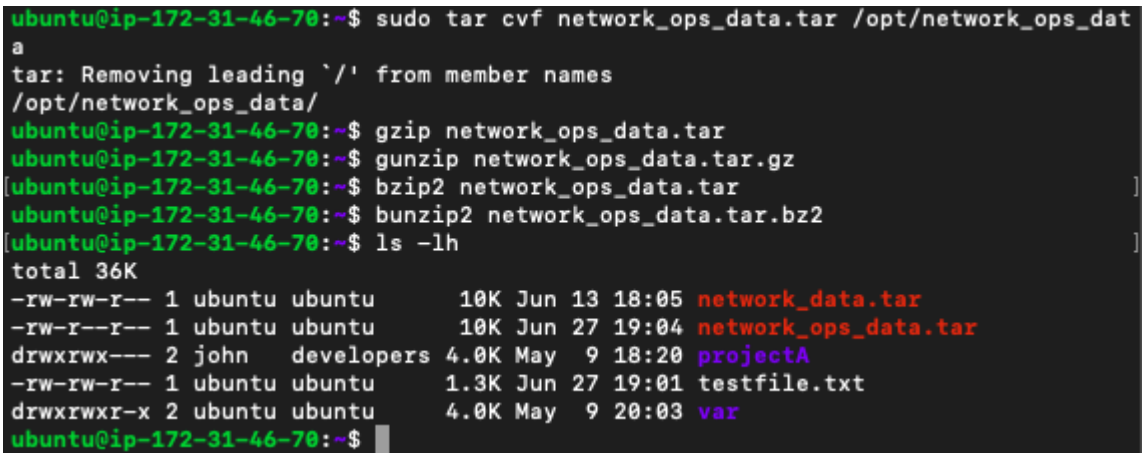
```
sudo iftop -i eth0
```

Explanation: Displays real-time bandwidth usage per connection on interface eth0.

```
sudo nload eth0
```

Explanation: Graphical real-time network traffic monitor for interface eth0.

Part 3: Compression & Decompression



Create tar archive

`tar cvf network_data.tar /opt/network_data`

Explanation: Archives `/opt/network_data` into a single tar file.

Compress with gzip

`gzip network_data.tar`

Explanation: Compresses `network_data.tar` into `network_data.tar.gz` to save space.

Decompress gzip

`gunzip network_data.tar.gz`

Explanation: Restores the tar file from the compressed `.gz` archive.

Compress with bzip2

`bzip2 network_data.tar`

Explanation: Compresses `network_data.tar` into `network_data.tar.bz2`, usually smaller than gzip.

Decompress bzip2

`bunzip2 network_data.tar.bz2`

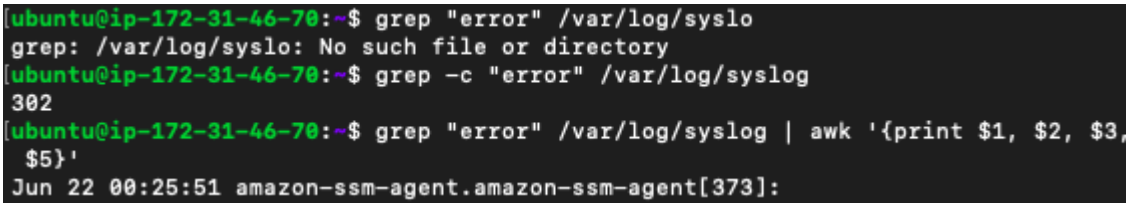
Explanation: Extracts the original tar file from the `.bz2` archive.

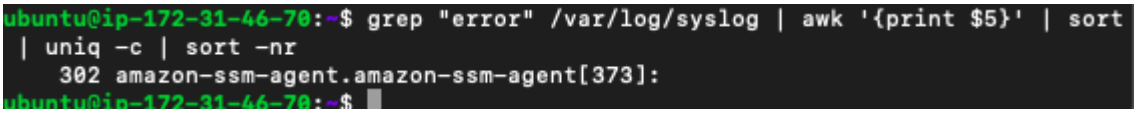
Check file sizes

```
ls -lh
```

Explanation: Lists files with human-readable sizes to compare before and after compression.

Part 4: Text Processing with grep & awk





Search for "error"

```
grep "error" /var/log/syslog
```

Explanation: Displays all lines containing "error" in syslog logs.

Count errors

```
grep -c "error" /var/log/syslog
```

Explanation: Counts the number of lines containing "error" in syslog.

Extract timestamps and source

```
grep "error" /var/log/syslog | awk '{print $1, $2, $3, $5}'
```

Explanation: Shows date, time, and service name from error lines.

Summarize error sources

```
grep "error" /var/log/syslog | awk '{print $5}' | sort | uniq -c | sort -nr
```

Explanation: Lists unique sources of errors and counts them, sorted most frequent