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Reg. No.: 16BCE0081

Slot: L27 + L28

Sub: Networking Lab (CSE1004)

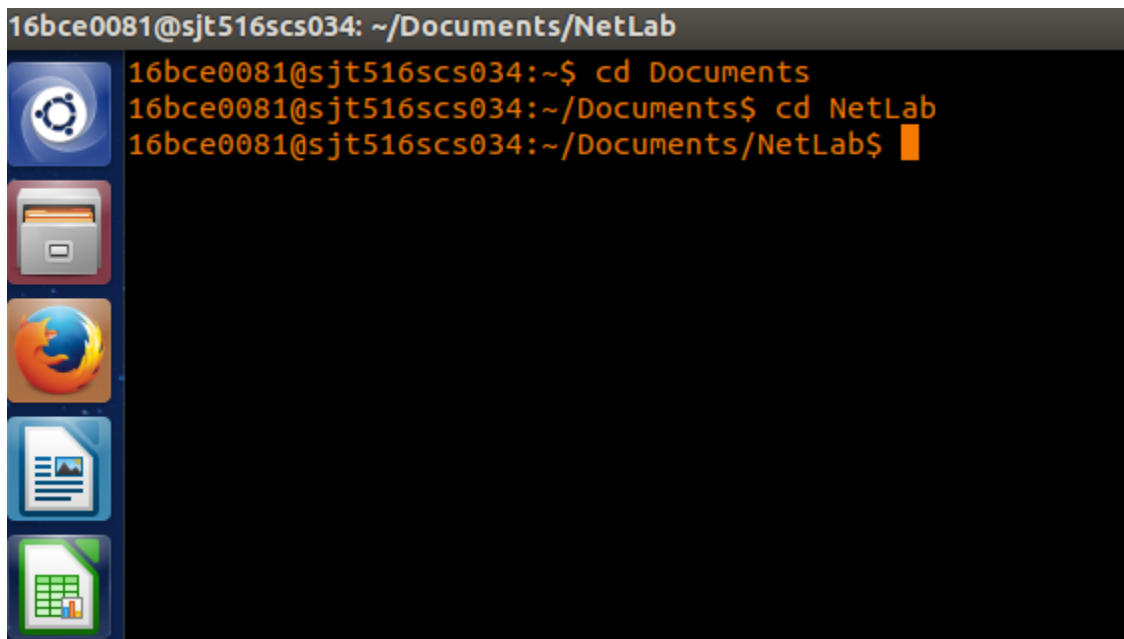
Basic Linux commands

1. Command: cd

Description: Change to new directory

Syntax: cd Documents

Output:

A terminal window screenshot with a dark background. The title bar at the top reads "16bce0081@sjt516scs034: ~/Documents/NetLab". On the left side, there is a vertical dock with five icons: a blue circle with a white gear, a red and white floppy disk, an orange and blue Firefox logo, a blue document icon, and a green spreadsheet icon. The terminal text shows the following sequence: "16bce0081@sjt516scs034:~\$ cd Documents", "16bce0081@sjt516scs034:~/Documents\$ cd NetLab", and "16bce0081@sjt516scs034:~/Documents/NetLab\$ " followed by a cursor. The text is in a yellowish-orange font.

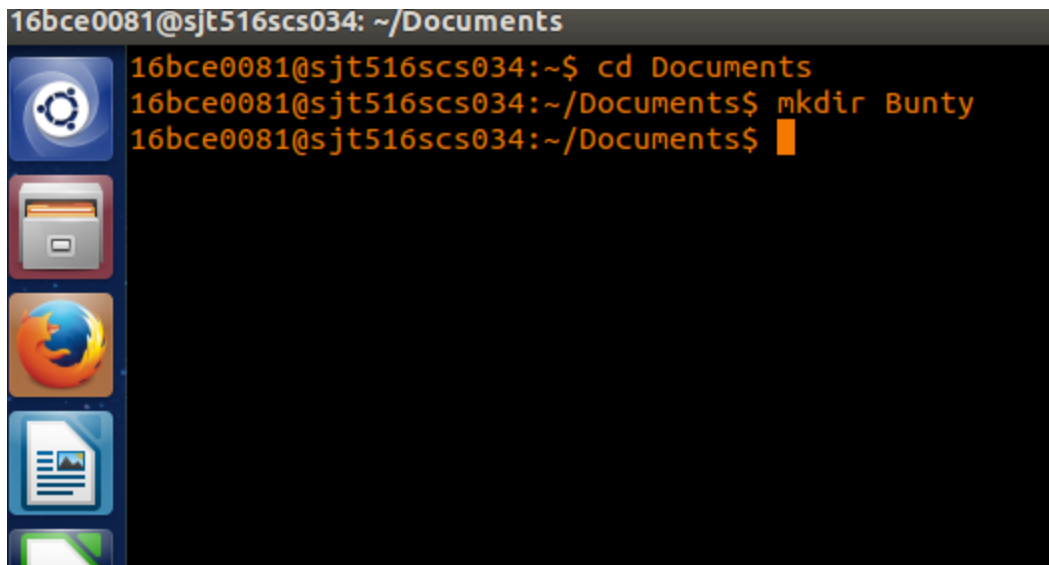
2. Command: mkdir

Description: create new directory

Syntax: mkdir Bunty

Output:

3.



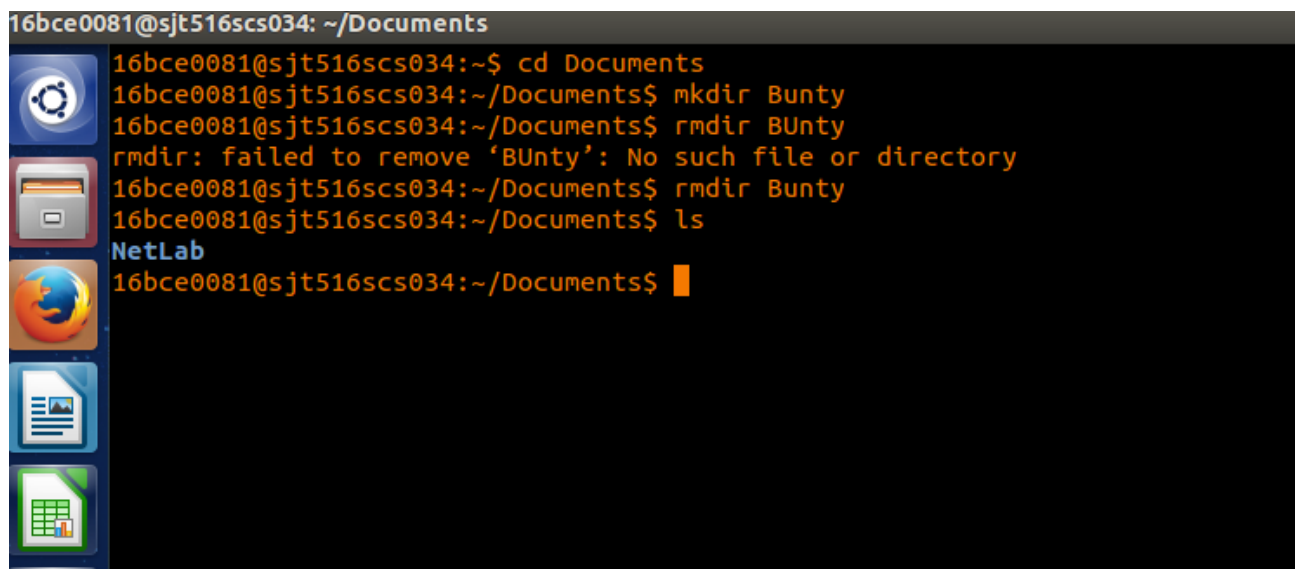
```
16bce0081@sjt516scs034: ~/Documents
16bce0081@sjt516scs034:~$ cd Documents
16bce0081@sjt516scs034:~/Documents$ mkdir Bunty
16bce0081@sjt516scs034:~/Documents$
```

Command: rmdir

Description: remove empty directory (remove files first)

Syntax: rmdir Bunty

Output:



```
16bce0081@sjt516scs034: ~/Documents
16bce0081@sjt516scs034:~$ cd Documents
16bce0081@sjt516scs034:~/Documents$ mkdir Bunty
16bce0081@sjt516scs034:~/Documents$ rmdir BUnty
rmdir: failed to remove 'BUnty': No such file or directory
16bce0081@sjt516scs034:~/Documents$ rmdir Bunty
16bce0081@sjt516scs034:~/Documents$ ls
NetLab
16bce0081@sjt516scs034:~/Documents$
```

4.

Command: mv

Description: change name of directory

Syntax: mv <Source> <Dest>

5.

Command: pwd

Description: show current directory

Syntax: pwd

6.

Command: date

Description: show date and time

Syntax: date

7. Command: history
Description: list of previously executed commands
Syntax: history
8. Command: cal
description: Prints a calendar for the specified month of the specified year.
Syntax: cal <mon> <year>
9. Command: man
description: show online documentation by program name
Syntax: man <command>
10. Command: w
Description: who is on the system and what they are doing
Syntax: w

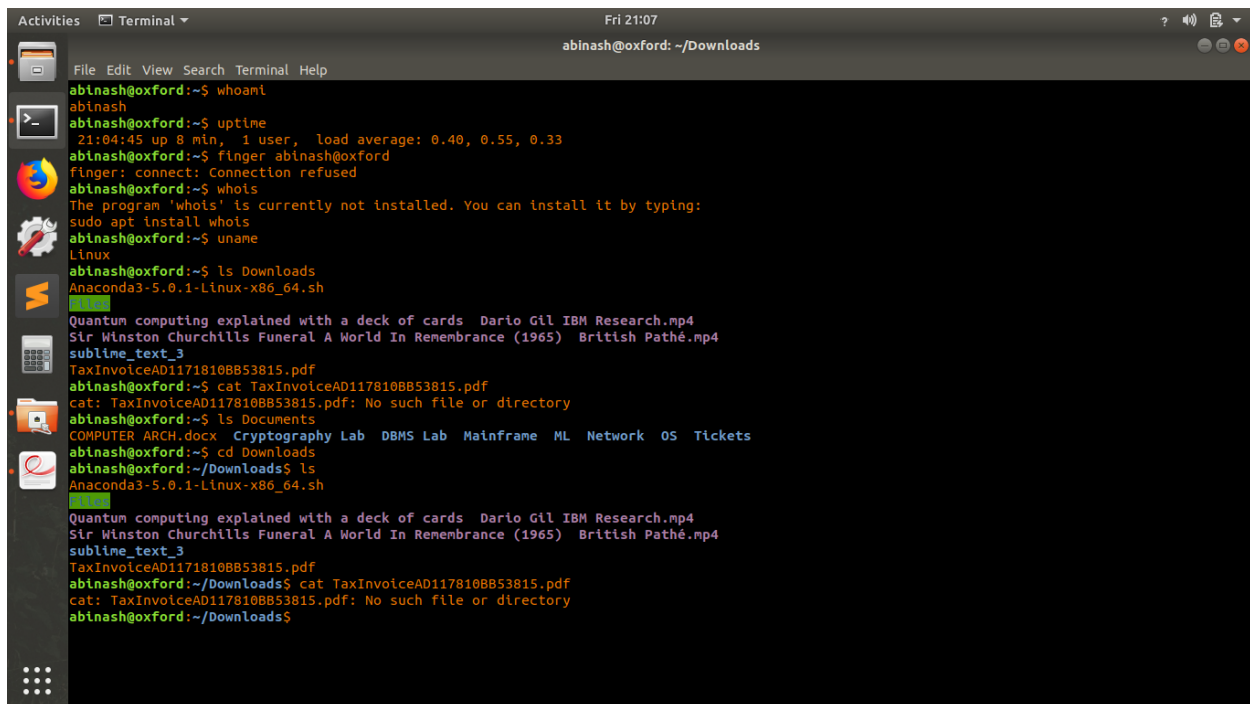
Outputs from 4 to 10

```
16bce0081@sjt516scs034: ~  
16bce0081@sjt516scs034:~$ cd Documents  
16bce0081@sjt516scs034:~/Documents$ mkdir Bunty  
16bce0081@sjt516scs034:~/Documents$ rmdir BUnty  
rmdir: failed to remove 'BUnty': No such file or directory  
16bce0081@sjt516scs034:~/Documents$ rmdir Bunty  
16bce0081@sjt516scs034:~/Documents$ ls  
NetLab  
16bce0081@sjt516scs034:~/Documents$ man mv  
16bce0081@sjt516scs034:~/Documents$ mv NetLab Netlab  
16bce0081@sjt516scs034:~/Documents$ ls  
Netlab  
16bce0081@sjt516scs034:~/Documents$ cd  
16bce0081@sjt516scs034:~$ cd  
16bce0081@sjt516scs034:~$ cal jan 2017  
January 2017  
Su Mo Tu We Th Fr Sa  
1 2 3 4 5 6 7  
8 9 10 11 12 13 14  
15 16 17 18 19 20 21  
22 23 24 25 26 27 28  
29 30 31  
16bce0081@sjt516scs034:~$ cal dec 2017  
December 2017  
Su Mo Tu We Th Fr Sa  
3 4 5 6 7 8 9  
10 11 12 13 14 15 16  
17 18 19 20 21 22 23  
24 25 26 27 28 29 30  
31  
16bce0081@sjt516scs034:~$ pwd  
/home/likewise-open/VITUNIVERSITY/16bce0081  
16bce0081@sjt516scs034:~$ date  
Fri Dec 1 11:20:52 IST 2017  
16bce0081@sjt516scs034:~$
```

11. Command: whoami
Description: who is logged onto this terminal
Syntax: whoami
12. Command: uptime
Description; show one line summary of system status
Syntax: uptime
13. Command: tty
Description: know the terminal name
Syntax: tty
14. Command: uname
Description: print system information
Syntax: uname
15. Command: cat
Description: view files

Syntax: cat <filename>

16. Command: ls
Description: list files in a directory and their attributes
Syntax: ls
17. Command: vi
Description: full-featured screen editor for modifying text files
Syntax: vi
18. Command: echo \$\$
Description: process id of current shell
Syntax: echo \$\$
19. Command: ps
Description: process status
Syntax: ps



```
ablnash@oxford: ~/$ whoami
ablnash
ablnash@oxford: ~/$ uptime
21:04:45 up 8 min, 1 user, load average: 0.40, 0.55, 0.33
ablnash@oxford: ~/$ finger ablnash@oxford
finger: connect: Connection refused
ablnash@oxford: ~/$ whois
The program 'whois' is currently not installed. You can install it by typing:
sudo apt install whois
ablnash@oxford: ~/$ uname
Linux
ablnash@oxford: ~/$ ls Downloads
Anaconda3-5.0.1-Linux-x86_64.sh
Quantum computing explained with a deck of cards Dario Gil IBM Research.mp4
Sir Winston Churchills Funeral A World In Remembrance (1965) British Pathé.mp4
subline_text_3
TaxInvoiceAD1171810BB53815.pdf
ablnash@oxford: ~/$ cat TaxInvoiceAD1171810BB53815.pdf
cat: TaxInvoiceAD1171810BB53815.pdf: No such file or directory
ablnash@oxford: ~/$ ls Documents
COMPUTER ARCH.docx Cryptography Lab DBMS Lab Mainframe ML Network OS Tickets
ablnash@oxford: ~/$ cd Downloads
ablnash@oxford: ~/Downloads$ ls
Anaconda3-5.0.1-Linux-x86_64.sh
Quantum computing explained with a deck of cards Dario Gil IBM Research.mp4
Sir Winston Churchills Funeral A World In Remembrance (1965) British Pathé.mp4
subline_text_3
TaxInvoiceAD1171810BB53815.pdf
ablnash@oxford: ~/Downloads$ cat TaxInvoiceAD1171810BB53815.pdf
cat: TaxInvoiceAD1171810BB53815.pdf: No such file or directory
ablnash@oxford: ~/Downloads$
```

```
Activities Terminal Fri 21:07
abinash@oxford: ~/Downloads

VIM - Vi IMproved
      version 8.0.550
      by Bram Moolenaar et al.
Modified by pkg-vim-maintainers@lists.alioth.debian.org
Vim is open source and freely distributable

  Help poor children in Uganda!
type  :help iccf<Enter>      for information

type  :q<Enter>              to exit
type  :help<Enter> or <F1>   for on-line help
type  :help version8<Enter> for version info

  Running in Vi compatible mode
type  :set nocomp<Enter>    for Vim defaults
type  :help cp-default<Enter> for info on this

Activities Terminal Fri 21:07
abinash@oxford: ~/Downloads

abinash@oxford:~$ uptime
 21:04:45 up 8 min, 1 user, load average: 0.40, 0.55, 0.33
abinash@oxford:~$ finger abinash@oxford
finger: connect: Connection refused
abinash@oxford:~$ whois
The program 'whois' is currently not installed. You can install it by typing:
sudo apt install whois
abinash@oxford:~$ uname
Linux
abinash@oxford:~$ ls Downloads
Anaconda3-5.0.1-Linux-x86_64.sh
10149
Quantum computing explained with a deck of cards Dario Gil IBM Research.mp4
Sir Winston Churchills Funeral A World In Remembrance (1965) British Pathé.mp4
subline_text_3
TaxInvoiceAD1171810BB53815.pdf
abinash@oxford:~$ cat TaxInvoiceAD1171810BB53815.pdf
cat: TaxInvoiceAD1171810BB53815.pdf: No such file or directory
abinash@oxford:~$ ls Documents
COMPUTER ARCH.docx Cryptography Lab DBMS Lab Mainframe ML Network OS Tickets
abinash@oxford:~$ cd Downloads
abinash@oxford:~/Downloads$ ls
Anaconda3-5.0.1-Linux-x86_64.sh
10149
Quantum computing explained with a deck of cards Dario Gil IBM Research.mp4
Sir Winston Churchills Funeral A World In Remembrance (1965) British Pathé.mp4
subline_text_3
TaxInvoiceAD1171810BB53815.pdf
abinash@oxford:~/Downloads$ cat TaxInvoiceAD1171810BB53815.pdf
cat: TaxInvoiceAD1171810BB53815.pdf: No such file or directory
abinash@oxford:~/Downloads$ vi
abinash@oxford:~/Downloads$ echo $$
2315
abinash@oxford:~/Downloads$ ps
  PID TTY          TIME CMD
 2315 pts/0    00:00:00 bash
 2508 pts/0    00:00:00 ps
abinash@oxford:~/Downloads$
```

Basic network commands

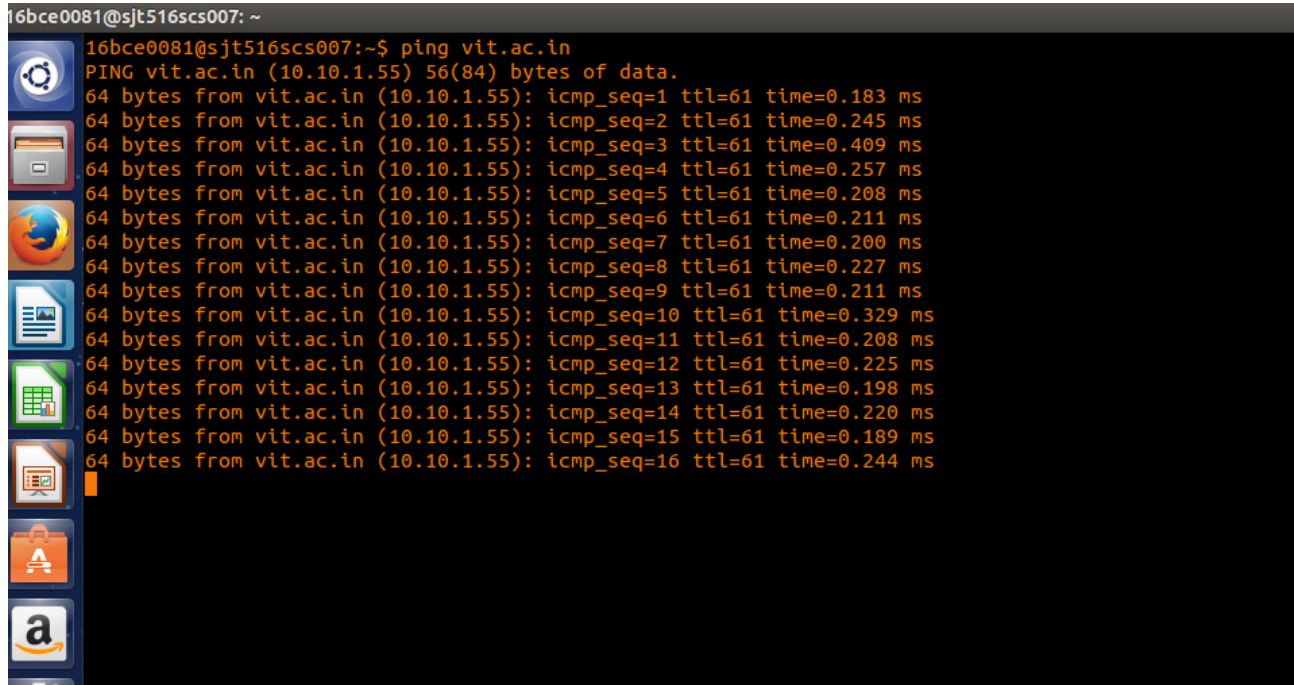
1. ping

Description: sends echo requests to the host specified on the command line, and lists the responses received.

Command name: ping

Command Syntax: ping ipAddress or hostname

Output:



```
16bce0081@sjt516scs007: ~  
16bce0081@sjt516scs007:~$ ping vit.ac.in  
PING vit.ac.in (10.10.1.55) 56(84) bytes of data.  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=1 ttl=61 time=0.183 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=2 ttl=61 time=0.245 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=3 ttl=61 time=0.409 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=4 ttl=61 time=0.257 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=5 ttl=61 time=0.208 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=6 ttl=61 time=0.211 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=7 ttl=61 time=0.200 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=8 ttl=61 time=0.227 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=9 ttl=61 time=0.211 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=10 ttl=61 time=0.329 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=11 ttl=61 time=0.208 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=12 ttl=61 time=0.225 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=13 ttl=61 time=0.198 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=14 ttl=61 time=0.220 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=15 ttl=61 time=0.189 ms  
64 bytes from vit.ac.in (10.10.1.55): icmp_seq=16 ttl=61 time=0.244 ms
```

2. netstat

Description: It will tell us what the status of ports are ie. open, closed, waiting connections. It is used to display the TCP/IP network protocol statistics and information.

Command name: netstat

Command Syntax: netstat

Output:

```

16bce0081@sjt516scs007: ~
unix 3 [ ] STREAM CONNECTED 86487 @16bce0081-com.canonical.Unity.Scope.applications.T83478012061001
unix 3 [ ] STREAM CONNECTED 81464
unix 3 [ ] STREAM CONNECTED 81341 @/tmp/dbus-02uKAXstnX
unix 3 [ ] STREAM CONNECTED 78754
unix 3 [ ] STREAM CONNECTED 78994
unix 3 [ ] STREAM CONNECTED 78724 @/tmp/dbus-02uKAXstnX
unix 3 [ ] STREAM CONNECTED 78852
unix 3 [ ] STREAM CONNECTED 78753 @/tmp/dbus-vI42Gb8Ga5
unix 3 [ ] STREAM CONNECTED 78395 /var/run/dbus/system_bus_socket
unix 3 [ ] STREAM CONNECTED 14015 /var/lib/likewise-open/.regsd
unix 3 [ ] STREAM CONNECTED 79403 @/tmp/dbus-vI42Gb8Ga5
unix 3 [ ] STREAM CONNECTED 78988
unix 3 [ ] STREAM CONNECTED 2756
unix 3 [ ] STREAM CONNECTED 94590
unix 3 [ ] STREAM CONNECTED 79685
unix 3 [ ] STREAM CONNECTED 80275 @/tmp/.X11-unix/X0
unix 3 [ ] STREAM CONNECTED 79373
unix 3 [ ] STREAM CONNECTED 14216 /var/lib/likewise-open/.lsassd
unix 3 [ ] STREAM CONNECTED 14035 /var/lib/likewise-open/.regsd
unix 2 [ ] STREAM CONNECTED 85974
unix 3 [ ] STREAM CONNECTED 86486 @16bce0081-com.canonical.Unity.Scope.scopes.T83477990521232
unix 3 [ ] STREAM CONNECTED 24048
unix 2 [ ] STREAM CONNECTED 82581 @/tmp/dbus-KA7hgmS9
unix 2 [ ] STREAM CONNECTED 79636 @/dbus-vfs-daemon/socket-CkvVKFVu
unix 3 [ ] STREAM CONNECTED 79410 @/tmp/dbus-02uKAXstnX
unix 3 [ ] STREAM CONNECTED 80954
unix 3 [ ] STREAM CONNECTED 14649
unix 3 [ ] STREAM CONNECTED 14014
unix 3 [ ] STREAM CONNECTED 12294 /var/run/dbus/system_bus_socket
unix 2 [ ] STREAM CONNECTED 100575 @/dbus-vfs-daemon/socket-K0mtV1Qj
unix 3 [ ] STREAM CONNECTED 76639 @/tmp/.X11-unix/X0
unix 3 [ ] STREAM CONNECTED 87620
unix 3 [ ] STREAM CONNECTED 79652
unix 3 [ ] STREAM CONNECTED 79533 @/tmp/.X11-unix/X0
unix 3 [ ] STREAM CONNECTED 81261 @/tmp/.X11-unix/X0
unix 3 [ ] STREAM CONNECTED 78850 @/tmp/dbus-02uKAXstnX
unix 3 [ ] STREAM CONNECTED 12625
unix 3 [ ] STREAM CONNECTED 80258 /var/run/dbus/system_bus_socket
unix 3 [ ] STREAM CONNECTED 77724
unix 3 [ ] STREAM CONNECTED 18195 /var/run/dbus/system_bus_socket
unix 3 [ ] STREAM CONNECTED 78741 /var/run/dbus/system_bus_socket

```

3. tcpdump

Description: This is a sniffer, a program that captures packets off a network interface and interprets them.

Command name: tcpdump

Command Syntax: tcpdump

Output:

4.

```

File Edit View Search Terminal Help
16bce0081@sjt516scs007:~$ tcpdump
tcpdump: no suitable device found
16bce0081@sjt516scs007:~$ man tcpdump
16bce0081@sjt516scs007:~$ █

```

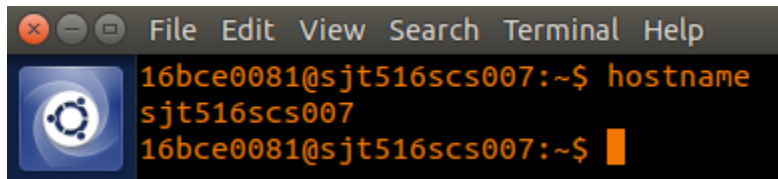
hostname

Description: Tells the user the host name of the computer they are logged into.

Command name: hostname

Command Syntax: hostname

Output:



```
File Edit View Search Terminal Help
16bce0081@sjt516scs007:~$ hostname
sjt516scs007
16bce0081@sjt516scs007:~$
```

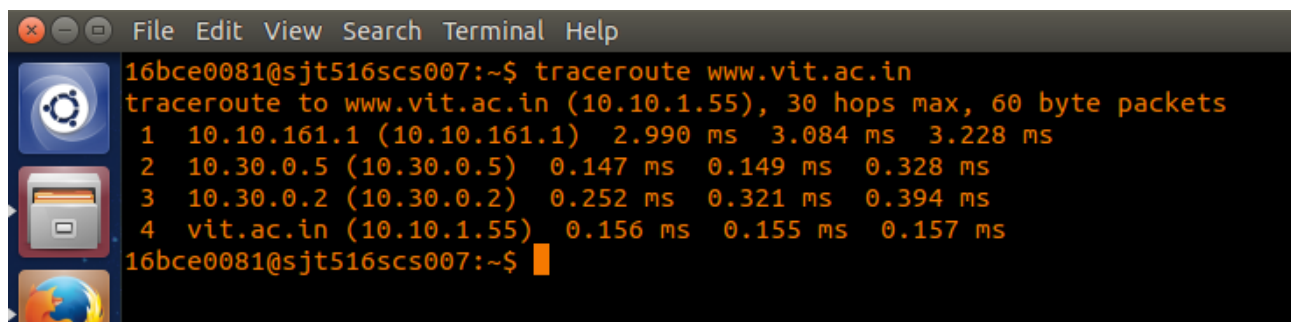
5. traceroute

Description: traceroute will show the route of a packet. It attempts to list the series of hosts through which our packets travel on their way to a given destination.

Command name: traceroute

Command Syntax: traceroute machineName or ip

Output:



```
File Edit View Search Terminal Help
16bce0081@sjt516scs007:~$ traceroute www.vit.ac.in
traceroute to www.vit.ac.in (10.10.1.55), 30 hops max, 60 byte packets
 1  10.10.161.1 (10.10.161.1)  2.990 ms  3.084 ms  3.228 ms
 2  10.30.0.5 (10.30.0.5)  0.147 ms  0.149 ms  0.328 ms
 3  10.30.0.2 (10.30.0.2)  0.252 ms  0.321 ms  0.394 ms
 4  vit.ac.in (10.10.1.55)  0.156 ms  0.155 ms  0.157 ms
16bce0081@sjt516scs007:~$
```

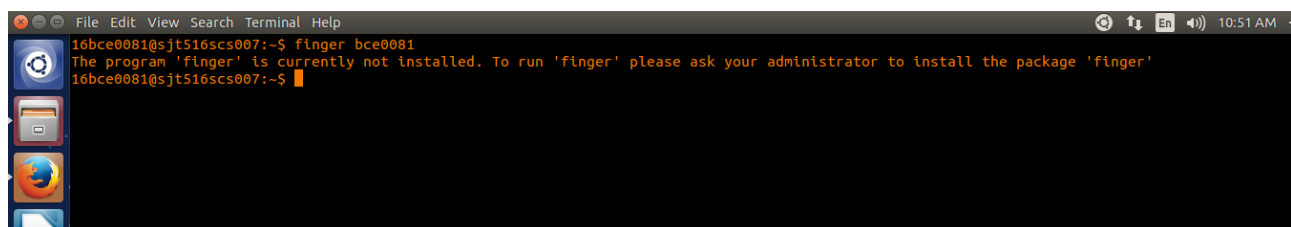
6. finger

Description: Retrieves information about the specified user.

Command name: finger

Command Syntax: finger bce0081

Output:



```
File Edit View Search Terminal Help
16bce0081@sjt516scs007:~$ finger bce0081
The program 'finger' is currently not installed. To run 'finger' please ask your administrator to install the package 'finger'
16bce0081@sjt516scs007:~$
```

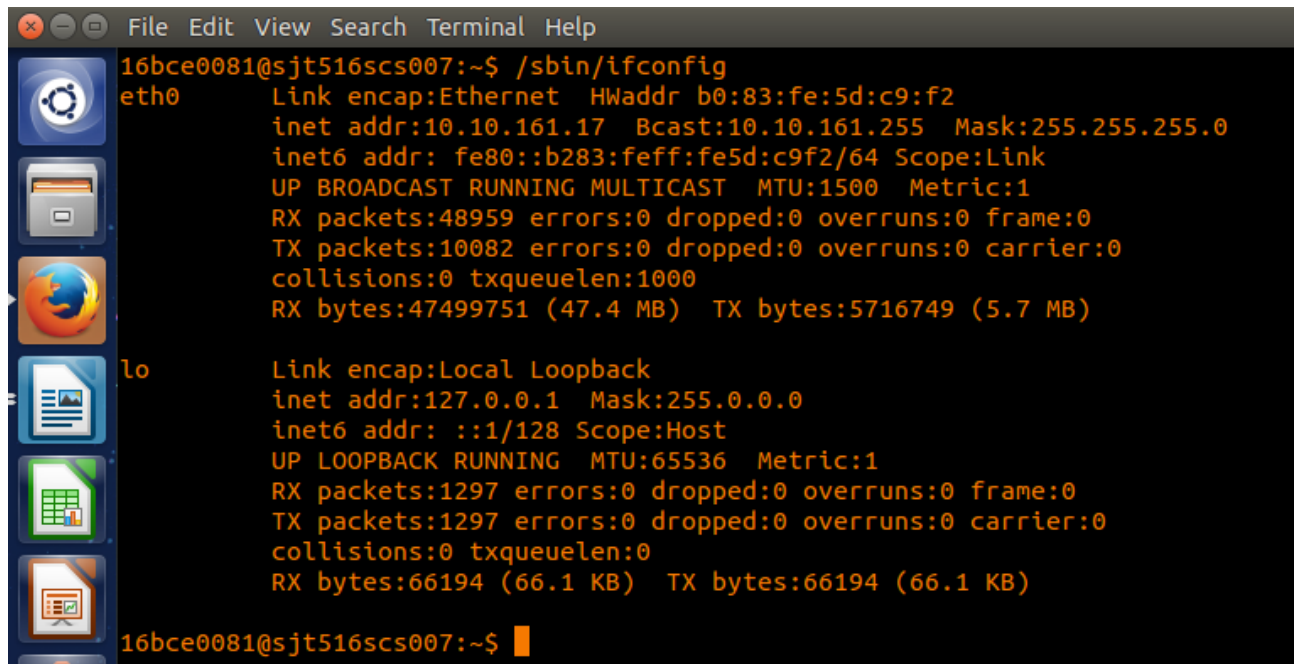
7. ifconfig

Description: This command is used to configure network interfaces, or to display their current configuration.

Command name: ifconfig

Command Syntax: ifconfig

Output:

A terminal window with a dark background and orange text. The window has a title bar with 'File Edit View Search Terminal Help' and standard window controls. On the left, there is a vertical dock with icons for a gear, a folder, Firefox, a document, a spreadsheet, and a presentation. The terminal text shows the command `/sbin/ifconfig` being run, followed by the configuration details for the `eth0` and `lo` interfaces. The `eth0` interface is an Ethernet card with IP `10.10.161.17`. The `lo` interface is a local loopback with IP `127.0.0.1`.

```
16bce0081@sjt516scs007:~$ /sbin/ifconfig
eth0      Link encap:Ethernet  HWaddr b0:83:fe:5d:c9:f2
          inet addr:10.10.161.17  Bcast:10.10.161.255  Mask:255.255.255.0
          inet6 addr: fe80::b283:feff:fe5d:c9f2/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:48959 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10082 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:47499751 (47.4 MB)  TX bytes:5716749 (5.7 MB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:1297 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1297 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:66194 (66.1 KB)  TX bytes:66194 (66.1 KB)

16bce0081@sjt516scs007:~$
```

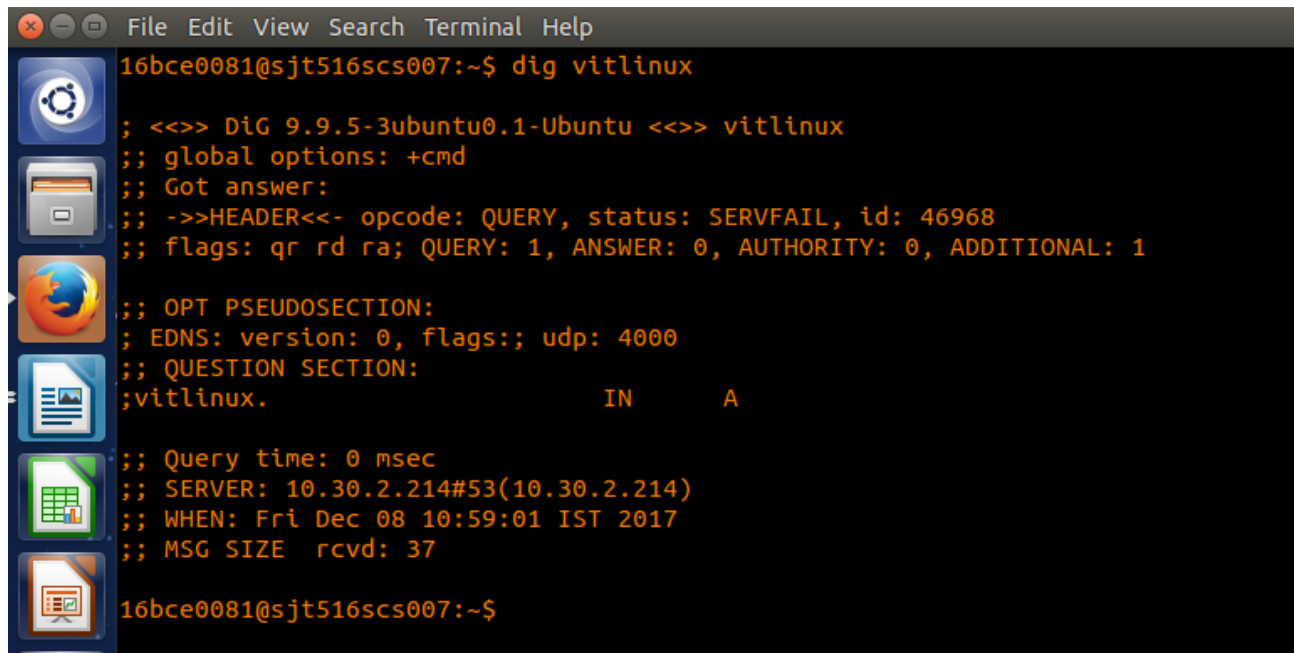
8. dig

Description: The "domain information groper" tool. If a hostname is given as an argument, it outputs information about that host, including it's IP address, hostname and various other information.

Command name: dig

Command Syntax: dig vitlinux

Output:



```
16bce0081@sjt516scs007:~$ dig vitlinux
; <<>> DiG 9.9.5-3ubuntu0.1-Ubuntu <<>> vitlinux
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: SERVFAIL, id: 46968
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1
;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 4000
;; QUESTION SECTION:
;vitlinux.                IN      A
;; Query time: 0 msec
;; SERVER: 10.30.2.214#53(10.30.2.214)
;; WHEN: Fri Dec 08 10:59:01 IST 2017
;; MSG SIZE rcvd: 37
16bce0081@sjt516scs007:~$
```

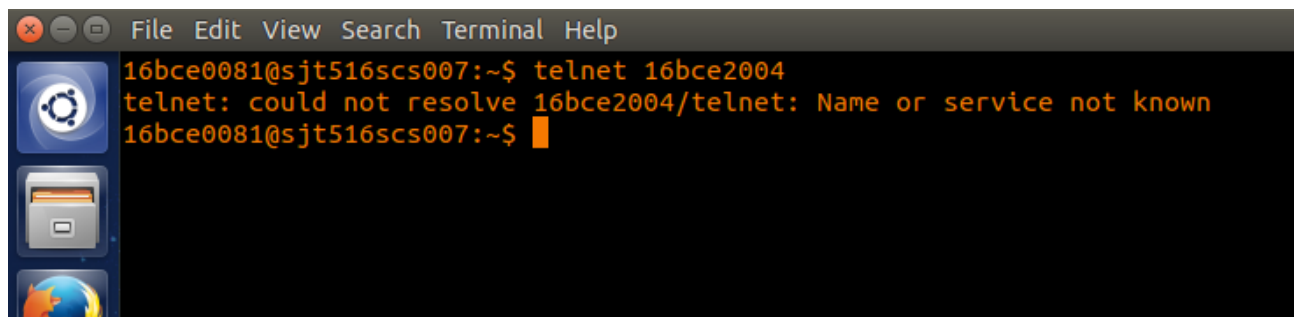
9. telnet

Description: telnet allows you to log in to a computer, just as if you were sitting at the terminal. Once your username and password are verified, you are given a shell prompt. From here, you can do anything requiring a text console.

Command name: telnet

Command Syntax: telnet 16bce2004

Output:



```
16bce0081@sjt516scs007:~$ telnet 16bce2004
telnet: could not resolve 16bce2004/telnet: Name or service not known
16bce0081@sjt516scs007:~$
```

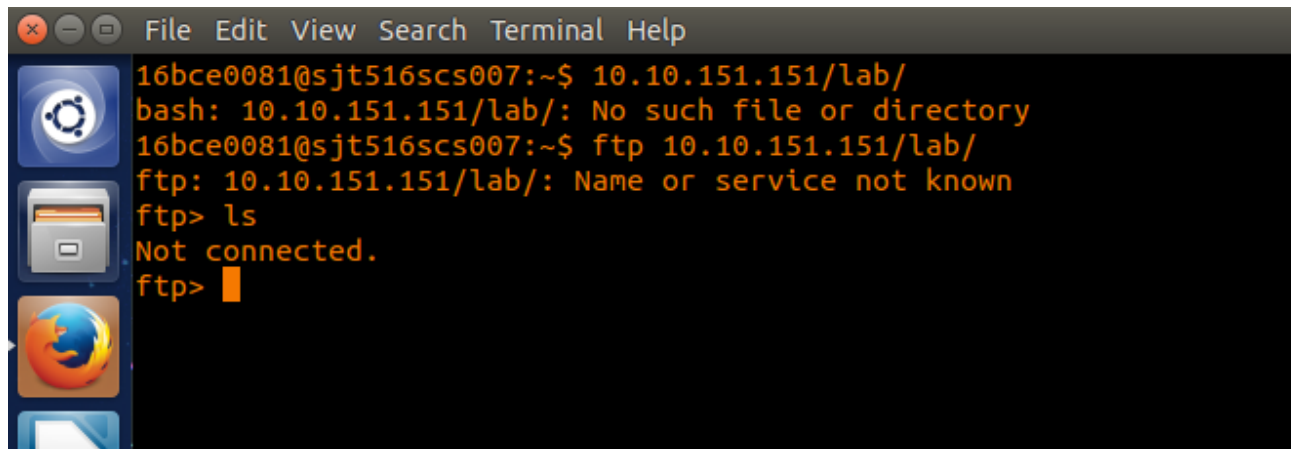
10. ftp

Description: To connect to an FTP server.

Command name: ftp

Command Syntax: ftp 10.10.151.151/lab/

Output:

A terminal window with a dark background and orange text. The window has a title bar with 'File Edit View Search Terminal Help' and a sidebar with icons for a gear, a folder, a globe, and a document. The terminal shows the following commands and output:

```
16bce0081@sjt516scs007:~$ 10.10.151.151/lab/
bash: 10.10.151.151/lab/: No such file or directory
16bce0081@sjt516scs007:~$ ftp 10.10.151.151/lab/
ftp: 10.10.151.151/lab/: Name or service not known
ftp> ls
Not connected.
ftp> █
```

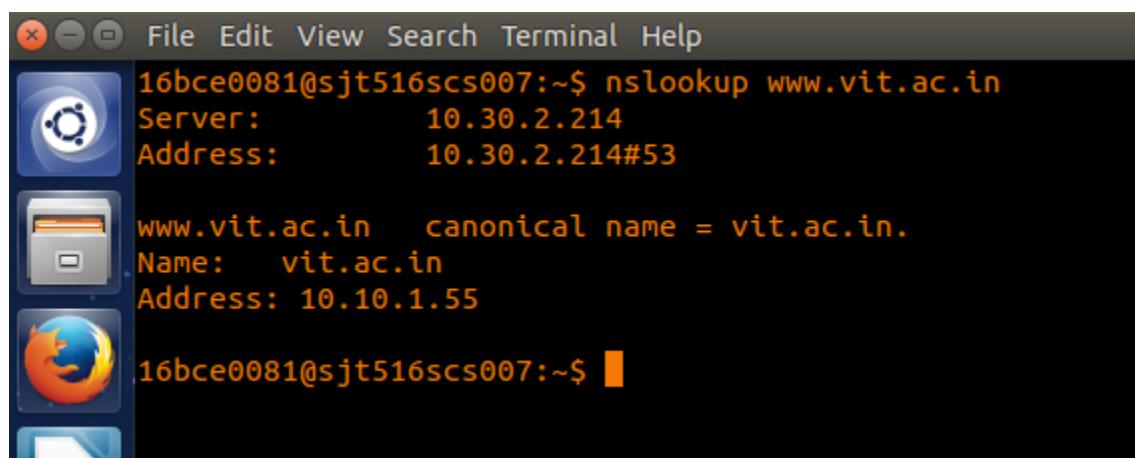
11. nslookup

Description: returns the ipaddress of the given hostname and vice versa.

Command name: nslookup

Command Syntax: nslookup www.vit.ac.in

Output:

A terminal window with a dark background and orange text. The window has a title bar with 'File Edit View Search Terminal Help' and a sidebar with icons for a gear, a folder, a globe, and a document. The terminal shows the following commands and output:

```
16bce0081@sjt516scs007:~$ nslookup www.vit.ac.in
Server:          10.30.2.214
Address:         10.30.2.214#53

www.vit.ac.in   canonical name = vit.ac.in.
Name:   vit.ac.in
Address: 10.10.1.55

16bce0081@sjt516scs007:~$ █
```

Switch

A network switch (also called switching hub, bridging hub, officially MAC bridge) is a computer networking device that connects devices together on a computer network by using packet switching to receive, process, and forward data to the destination device.

Eg.

- (i) Cisco small business SG300-28 28-port Gigabit Ethernet rackmount switch
- (ii) D-Link 24-Port 10/100 Mbps Unmanaged Fast Ethernet Switch DES-1024A Network Switch
- (iii) TP-LINK TL-SG1024D 24-Port Gigabit Desktop Switch
- (iv) Cisco Catalyst WS-C3650-24TS-L Ethernet Switch

Bridge

A network bridge is a computer networking device that creates a single aggregate network from multiple communication networks or network segments.

Eg.:

- (i) Quadro M32X
- (ii) AXIS C8033 Network Audio Bridge
- (iii) Cisco 1410 Series Bridge
- (iv) G.Shdsl 4 Wire Router Bridge

Hub

A hub is a component of a network with a high-degree node. Hubs have a significantly larger number of links in comparison with other nodes in the network.

Eg.:

- (i) SIGARAM 4 Port Usb Hub 2.0 Ultra
- (ii) TECH SHOP 4 Port Ultra High Speed USB Hub 480 Mbps
- (iii) eErlik 4 Port Ultra High Speed USB Hub 480 Mbps
- (iv) Quantum 4 Port USB Hub

Router

A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. A data packet is typically forwarded from one router to another router through the networks that constitute an internetwork until it reaches its destination node.

Eg.:

- (i) TP-LINK TL-WR740N Router
- (ii) iball WRA300N3GT 300 Mbps Wireless 3G Router
- (iii) TP-LINK TD-W8960N 300Mbps Wireless N ADSL2+ Modem Router

- (iv) Alcatel MW40CJ 4G Wi-Fi Router

Gateways

A gateway is a node (router) in a computer network, a key *stopping point* for data on its way to or from other networks.

Eg.:

- (i) Maretron USB100 Nmea 2000 USB Gateway
- (ii) Actisense NMEA Networks USB Gateway
- (iii) Cisco VG248 - gateway (VG248)
- (iv) LORA LORAWAN INDUSTRIAL GATEWAY 868MHZ

Error Detection

Parity Check

```
#include <stdio.h>
```

```
int getParity(int n)
```

```
{
```

```
    int parity = 0;
```

```
    while (n)
```

```
    {
```

```
        parity = !parity;
```

```
        n = n & (n - 1);
```

```
    }
```

```
    return parity;
```

```
}
```

```
int convert(int dec){
```

```
    if (dec == 0)
```

```
        return 0;
```

```
    else
```

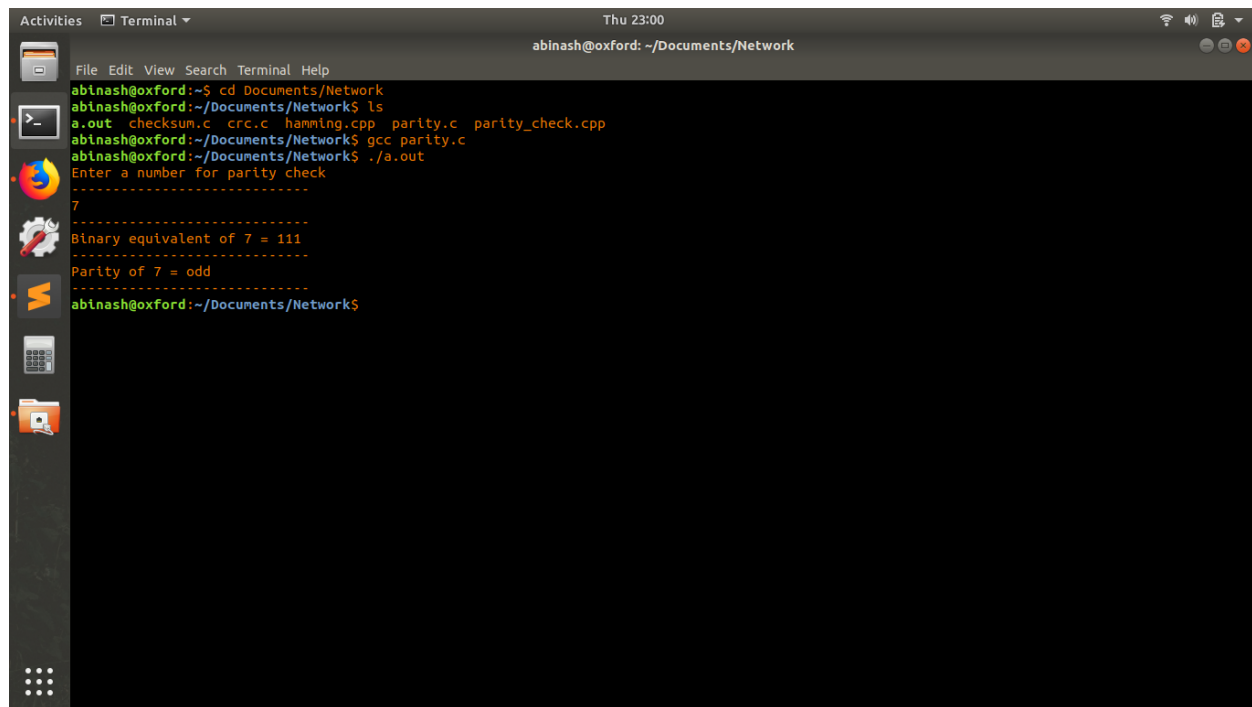
```
        return (dec % 2 + 10 * convert(dec / 2));
```

```
}
```

```
int sender(){  
    int num;  
    printf("Enter a number for parity check\n");  
    printf("-----\n");  
    scanf("%d", &num);  
    return num;  
}
```

```
void receiver(int m){  
    int result = getParity(m);  
    printf("-----\n");  
    printf("Binary equivalent of %d = %d\n", m, convert(m));  
    printf("-----\n");  
    if(result == 1)  
        printf("Parity of %d = odd\n", m);  
    else  
        printf("Parity of %d = even\n", m);  
}
```

```
int main(){  
    int sender_val = sender();  
    receiver(sender_val);  
    printf("-----\n");  
    return 0;  
}
```



The screenshot shows a terminal window titled 'Terminal' with the user 'abinash@oxford' in the directory '~/Documents/Network'. The terminal output is as follows:

```
abinash@oxford:~$ cd Documents/Network
abinash@oxford:~/Documents/Network$ ls
a.out checksum.c crc.c hamming.cpp parity.c parity_check.cpp
abinash@oxford:~/Documents/Network$ gcc parity.c
abinash@oxford:~/Documents/Network$ ./a.out
Enter a number for parity check
7
-----
Binary equivalent of 7 = 111
-----
Parity of 7 = odd
-----
abinash@oxford:~/Documents/Network$
```

CRC

```
#include<stdio.h>
```

```
#include<string.h>
```

```
#define N strlen(g)
```

```
char t[28],cs[28],g[]="100010000000100001";
```

```
int a,e,c;
```

```
void xor(){
```

```
    for(c=1;c<N;c++)
```

```
        cs[c] = ((cs[c] == g[c])?'0':'1');
```

```
}
```

```
void crc(){
```

```
    for(e=0;e<N;e++)
```

```
        cs[e]=t[e];
```



```

do{
    if(cs[0]=='1')
        xor();
    for(c=0;c<N-1;c++)
        cs[c]=cs[c+1];
    cs[c]=t[e++];
}while(e<=a+N-1);
}

```

```

void sender(){
    printf("\nEnter data (only in binary format): ");
    scanf("%s",t);
    printf("\n-----");
    printf("\nGeneratng polynomial : %s",g);
    a=strlen(t);
    for(e=a;e<a+N-1;e++)
        t[e]='0';
    printf("\n-----");
    printf("\nModified data is : %s",t);
    printf("\n-----");
}

```

```

void testing(){
    printf("\nChecksum is : %s",cs);
    for(e=a;e<a+N-1;e++)
        t[e]=cs[e-a];
    printf("\n-----");
    printf("\nFinal codeword is : %s",t);
}

```

```

printf("\n-----");
printf("\nTest error detection 0(yes) 1(no)? : ");
scanf("%d",&e);
}

void receiver(){
    if(e==0){
        do{
            printf("\nEnter the position where error is to be inserted : ");
            scanf("%d",&e);
        }while(e==0 || e>a+N-1);

        t[e-1]=(t[e-1]=='0')?'1':'0';
        printf("\n-----");
        printf("\nErroneous data : %s\n",t);
    }
}

int main(){
    sender();
    crc();
    testing();
    receiver();
    crc();

    for(e=0;(e<N-1) && (cs[e]!='1');e++);
    if(e<N-1)
        printf("\nError detected\n\n");
}

```

```

else

    printf("\nNo error detected\n\n");

    printf("\n-----\n");

return 0;

}

```

```

ablnash@oxford: ~/Documents/Network$ gcc crc.c
ablnash@oxford:~/Documents/Network$ ./a.out
Enter data (only in binary format): 10110100
-----
Generating polynomial : 10001000000100001
-----
Modified data is : 1011010000000000000000
-----
Checksum is : 1110011101011111
-----
Final codeword is : 10110100111001110101111
-----
Test error detection 0(yes) 1(no)? : 0
Enter the position where error is to be inserted : 3
-----
Erroneous data : 100101001110011101011111
Error detected
-----
ablnash@oxford:~/Documents/Network$

```

Checksum

```
#include<stdio.h>
```

```
#include<math.h>
```

```
int sender(int b[10],int k)
```

```
{
```

```
    int checksum,sum=0,i;
```

```
    printf("\n***SENDER***\n");
```

```
    printf("-----\n");
```

```
for(i=0;i<k;i++)
```

```

sum+=b[i];

    printf("SUM IS: %d",sum);

    printf("-----\n");


    checksum=~sum;

    printf("\nSENDER's CHECKSUM IS:%d",checksum);

    printf("-----\n");

    return checksum;
}


int receiver(int c[10],int k,int scheck)
{
int checksum,sum=0,i;

    printf("\n\n****RECEIVER****\n");

    printf("-----\n");

    for(i=0;i<k;i++)

        sum+=c[i];

    printf(" RECEIVER SUM IS: %d",sum);

    printf("-----\n");

    sum=sum+scheck;

    checksum=~sum;

    printf("\nRECEIVER's CHECKSUM IS: %d",checksum);

    printf("-----\n");

    return checksum;

}

int main()

{

    int a[10],i,m,scheck,rcheck;

```

```

printf("\nENTER SIZE OF THE STRING:");
scanf("%d",&m);
printf("\nENTER THE ELEMENTS OF THE ARRAY:");
for(i=0;i<m;i++)
scanf("%d",&a[i]);
scheck=sender(a,m);
rcheck=receiver(a,m,scheck);
if(rcheck==0)
    printf("\n\nNO ERROR IN TRANSMISSION\n\n");
else
    printf("\n\nERROR DETECTED");

return 0;
}

```

```

ablnash@oxford: ~/Documents/Network
ablnash@oxford:~/Documents/Network$ gcc checksum.c
ablnash@oxford:~/Documents/Network$ ./a.out
ENTER SIZE OF THE STRING:4
ENTER THE ELEMENTS OF THE ARRAY:1011
1101
0011
1001
****SENDER****
-----
SUM IS: 3124-----
SENDER'S CHECKSUM IS:-3125-----
****RECEIVER****
-----
RECEIVER SUM IS: 3124-----
RECEIVER'S CHECKSUM IS: 0-----
NO ERROR IN TRANSMISSION
ablnash@oxford:~/Documents/Network$

```

Error Correction

Hamming Code

```
#include<iostream>
```

```
using namespace std;
```

```
int main() {
```

```
    int data[10];
```

```
    int dataatrec[10],c,c1,c2,c3,i;
```

```
    cout<<"Enter 4 bits of data one by one\n";
```

```
    cin>>data[0];
```

```
    cin>>data[1];
```

```
    cin>>data[2];
```

```
    cin>>data[4];
```

```
    //Calculation of even parity
```

```
    data[6]=data[0]^data[2]^data[4];
```

```
    data[5]=data[0]^data[1]^data[4];
```

```
    data[3]=data[0]^data[1]^data[2];
```

```
    cout<<"\nEncoded data is\n";
```

```
    for(i=0;i<7;i++)
```

```
        cout<<data[i];
```

```
    cout<<"\n\nEnter received data bits one by one\n";
```

```
    for(i=0;i<7;i++)
```

```
        cin>>dataatrec[i];
```

```
    c1=dataatrec[6]^dataatrec[4]^dataatrec[2]^dataatrec[0];
```

```
    c2=dataatrec[5]^dataatrec[4]^dataatrec[1]^dataatrec[0];
```

```

c3=dataatrec[3]^dataatrec[2]^dataatrec[1]^dataatrec[0];
c=c3*4+c2*2+c1 ;

if(c==0) {
    cout<<"\nNo error while transmission of data\n";
}
else {
    cout<<"\nError on position "<<c;

    cout<<"\nData sent : ";
    for(i=0;i<7;i++)
        cout<<data[i];

    cout<<"\nData received : ";
    for(i=0;i<7;i++)
        cout<<dataatrec[i];

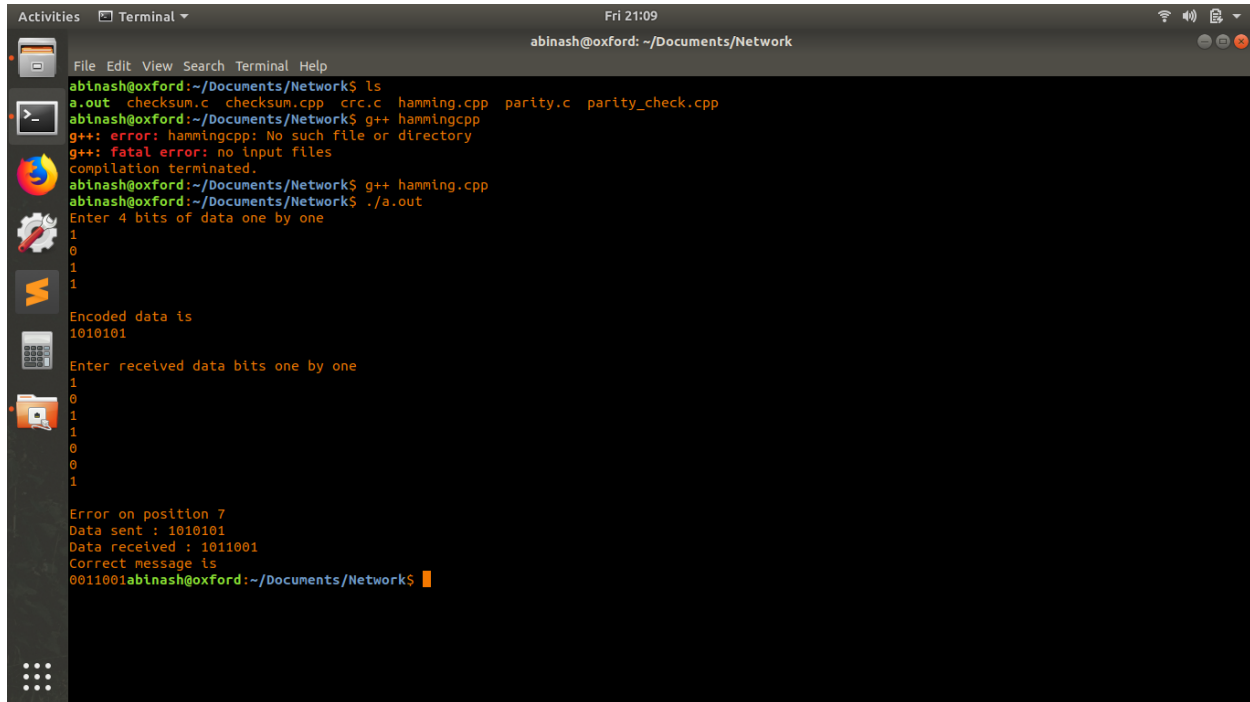
    cout<<"\nCorrect message is\n";

    //if errorneous bit is 0 we complement it else vice versa
    if(dataatrec[7-c]==0)
        dataatrec[7-c]=1;
    else
        dataatrec[7-c]=0;
    for (i=0;i<7;i++) {
        cout<<dataatrec[i];
    }
}

```

```
return 0;
```

```
}
```



The screenshot shows a terminal window titled "abinash@oxford: ~/Documents/Network". The user has listed files in the directory, including a.out, checksum.c, checksum.cpp, crc.c, hamming.cpp, parity.c, and parity_check.cpp. They then attempt to compile hamming.cpp with g++, which fails due to missing input files. After compiling successfully, they run ./a.out. The program prompts for 4 bits of data, which are entered as 1, 0, 1, 1. It then displays the encoded data as 1010101. Next, it prompts for received data bits, which are entered as 1, 0, 1, 1, 0, 0, 1. The program reports an error on position 7, showing the data sent as 1010101 and the data received as 1011001. It concludes that the correct message is 0011001.

```
abinash@oxford:~/Documents/Network$ ls
a.out checksum.c checksum.cpp crc.c hamming.cpp parity.c parity_check.cpp
abinash@oxford:~/Documents/Network$ g++ hamming.cpp
g++: error: hamming.cpp: No such file or directory
g++: fatal error: no input files
compilation terminated.
abinash@oxford:~/Documents/Network$ g++ hamming.cpp
abinash@oxford:~/Documents/Network$ ./a.out
Enter 4 bits of data one by one
1
0
1
1
Encoded data is
1010101
Enter received data bits one by one
1
0
1
1
0
0
1
Error on position 7
Data sent : 1010101
Data received : 1011001
Correct message is
0011001abinash@oxford:~/Documents/Network$
```