

Linux System Administration & Automation for DevOps

Summary:

This project focuses on hands-on Linux system administration and automation skills essential for DevOps roles. It covers managing the Linux file system, users, groups, permissions, processes, networking, and firewall configurations. The project includes writing and scheduling shell scripts for backups, cleanup automation, log rotation, system resource monitoring, and bulk user management. Advanced automation tasks involve monitoring CPU, memory, and disk usage with alert notifications and implementing cron jobs for routine maintenance. Overall, the project demonstrates practical expertise in Linux administration, scripting, and DevOps-oriented automation workflows.

Task 1: Basic Linux Commands

1. Create and Navigate Directories:

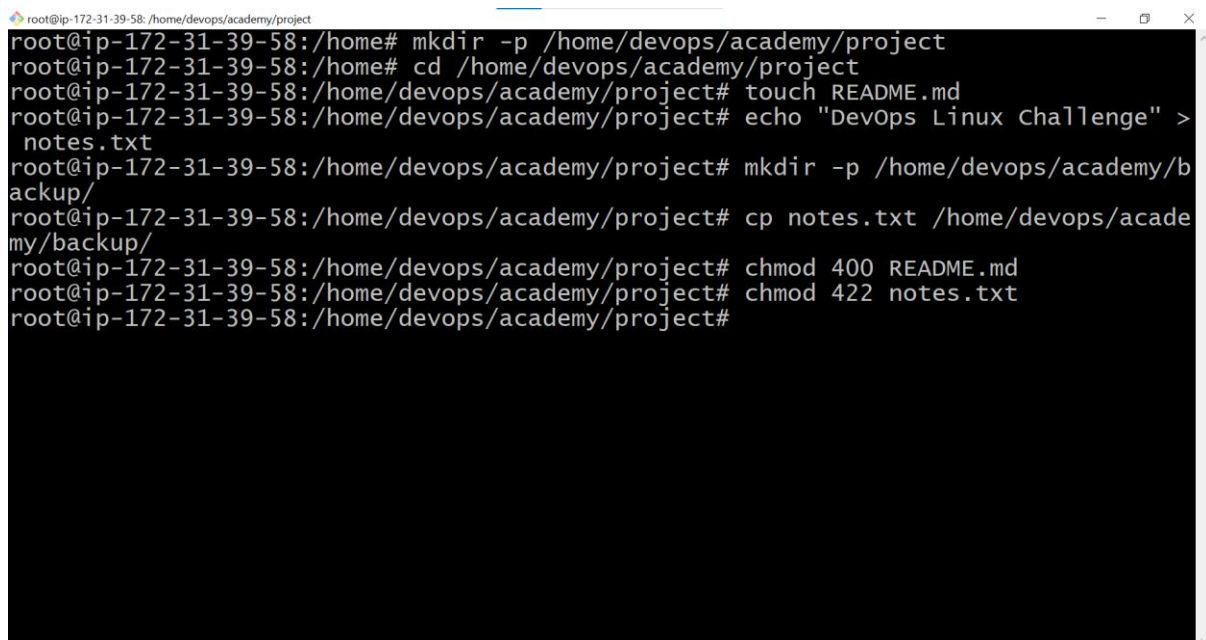
- Create a directory structure as follows: `/home/devops/academy/project`.
- Navigate into the `project` directory.

2. File Management:

- Create an empty file named `README.md` inside the `project` directory.
- Create another file named `notes.txt` and add the text "DevOps Linux Challenge" into it.
- Copy `notes.txt` to `/home/devops/academy/backup/`.

3. Permissions:

- Change the permissions of `README.md` to be readable and writable only by the owner.
- Make `notes.txt` readable by everyone, but writable only by the owner.

A terminal window with a black background and white text. The window title is 'root@ip-172-31-39-58: /home/devops/academy/project'. The commands and their outputs are as follows:

```
root@ip-172-31-39-58:/home# mkdir -p /home/devops/academy/project
root@ip-172-31-39-58:/home# cd /home/devops/academy/project
root@ip-172-31-39-58:/home/devops/academy/project# touch README.md
root@ip-172-31-39-58:/home/devops/academy/project# echo "DevOps Linux Challenge" > notes.txt
root@ip-172-31-39-58:/home/devops/academy/project# mkdir -p /home/devops/academy/backup/
root@ip-172-31-39-58:/home/devops/academy/project# cp notes.txt /home/devops/academy/backup/
root@ip-172-31-39-58:/home/devops/academy/project# chmod 400 README.md
root@ip-172-31-39-58:/home/devops/academy/project# chmod 422 notes.txt
root@ip-172-31-39-58:/home/devops/academy/project#
```

Task 2: User and Group Management

1. Create Users:

- Create a new user named `student1`.
- Set a password for `student1`.

2. Groups:

- Create a new group named `devops`.
- Add `student1` to the `devops` group.

3. User Permissions:

- Ensure that the `project` directory is accessible to members of the `devops` group.

4. Disk Usage:

- Display disk usage in human-readable format for `/home` directory and save the output to a file named `disk_usage.txt`.

```
root@ip-172-31-39-58: /home/devops/academy/project
root@ip-172-31-39-58:/home/devops/academy/project# useradd student1
root@ip-172-31-39-58:/home/devops/academy/project# passwd student1
New password:
Retype new password:
passwd: password updated successfully
root@ip-172-31-39-58:/home/devops/academy/project# groupadd devops
root@ip-172-31-39-58:/home/devops/academy/project# usermod -aG devops student1
root@ip-172-31-39-58:/home/devops/academy/project# chown :devops /home/devops/academy/project
root@ip-172-31-39-58:/home/devops/academy/project# du -h /home > disk_usage.txt
root@ip-172-31-39-58:/home/devops/academy/project#
```

Intermediate Level

Task 3: Process Management

1. List Processes:

- Display all running processes and redirect the output to a file named `process_list.txt`.

2. Background Process:

- Start a simple background process that writes the current date and time to a file named `timestamp.txt` every minute using a `while` loop and `sleep`.

3. Kill Process:

- Find the process ID (PID) of the background process started in the previous step and terminate it.

4. CPU and Memory Usage:

- Display the current CPU and memory usage using `top` or `htop`, save a snapshot of this information to a file named `cpu_mem_usage.txt`.

```
root@ip-172-31-39-58: /home/devops/academy/project
root@ip-172-31-39-58:/home/devops/academy/project# ps aux > process_list.txt
root@ip-172-31-39-58:/home/devops/academy/project# vi date.sh
root@ip-172-31-39-58:/home/devops/academy/project#

root@ip-172-31-39-58: /home/devops/academy/project
#!/bin/bash
#
#
while true
do
    echo $(date)
    sleep 60s
done
```

```
root@ip-172-31-39-58: /home/devops/academy/project# ps aux > process_list.txt
root@ip-172-31-39-58: /home/devops/academy/project# vi date.sh
root@ip-172-31-39-58: /home/devops/academy/project# chmod +x date.sh
root@ip-172-31-39-58: /home/devops/academy/project# nohup ./date.sh > timestamp.txt 2>&1 &
[1] 9444
root@ip-172-31-39-58: /home/devops/academy/project# kill 9444
root@ip-172-31-39-58: /home/devops/academy/project# htop -n1 > cpu_mem_usage.txt
[1]+ Terminated nohup ./date.sh > timestamp.txt 2>&1
root@ip-172-31-39-58: /home/devops/academy/project# cat cpu_mem_usage.txt

CPU[|||||] 100.0% Tasks: 34, 34 thr, 72 kthr; 1 running
Mem[|||||] 185M/957M Load average: 0.00 0.00 0.00
Swp[|||||] 0K/0K Uptime: 01:29:26

Main I/O
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
9451 root 20 0 8636 4352 3456 R 100.0 0.4 0:00.01 htop -n1
1 root 20 0 22588 13824 9728 S 0.0 1.4 0:02.07 /usr/lib/systemd/systemd --system --deserial
184 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.05 /sbin/multipathd -d -s
188 root 20 0 26472 8224 5024 S 0.0 0.8 0:00.24 /usr/lib/systemd/systemd-udevd
193 root 20 0 282M 27136 8704 S 0.0 2.8 0:00.00 /sbin/multipathd -d -s
194 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.00 /sbin/multipathd -d -s
195 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.00 /sbin/multipathd -d -s
196 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.00 /sbin/multipathd -d -s
197 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.29 /sbin/multipathd -d -s
198 root RT 0 282M 27136 8704 S 0.0 2.8 0:00.00 /sbin/multipathd -d -s
511 root 20 0 2720 1920 1792 S 0.0 0.2 0:00.00 /usr/sbin/acpid
516 messagebus 20 0 9944 5632 4608 S 0.0 0.6 0:00.20 @dbus-daemon --system --address=systemd: --n
523 root 20 0 32412 20736 10496 S 0.0 2.1 0:00.09 /usr/bin/python3 /usr/bin/networkd-dispatche
524 polkitd 20 0 374M 9752 7424 S 0.0 1.0 0:00.07 /usr/lib/polkit-1/polkitd --no-debug
526 root 20 0 1645M 19012 10880 S 0.0 1.9 0:00.53 /snap/amazon-ssm-agent/9881/amazon-ssm-agent
530 root 20 0 1732M 35884 24320 S 0.0 3.7 0:00.79 /usr/lib/snapd/snapd
```

Task 4: Networking

1. Network Configuration:

- Display the current network configuration using `ifconfig` or `ip addr`.

2. Ping Test: ○ Ping `google.com` and save the output to a file named `ping_results.txt`.

```
root@ip-172-31-39-58: /home/devops/academy/project# ls
README.md cpu_mem_usage.txt date.sh disk_usage.txt notes.txt ping.txt process_list.txt timestamp.txt
root@ip-172-31-39-58: /home/devops/academy/project# rm ping.txt
root@ip-172-31-39-58: /home/devops/academy/project# ifconfig
enx0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 9001
    inet 172.31.39.58 netmask 255.255.240.0 broadcast 172.31.47.255
    inet6 fe80::c98:18ff:feff:278f prefixlen 64 scopeid 0x20<link>
    ether 0e:98:18:ff:27:8f txqueuelen 1000 (Ethernet)
    RX packets 140638 bytes 104278977 (104.2 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 67045 bytes 6671108 (6.6 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 166 bytes 17783 (17.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 166 bytes 17783 (17.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@ip-172-31-39-58: /home/devops/academy/project# ping -c 5 google.com > ping_results.txt
root@ip-172-31-39-58: /home/devops/academy/project# cat ping_results.txt
PING google.com (142.250.207.110) 56(84) bytes of data:
64 bytes from kix06s11-in-f14.1e100.net (142.250.207.110): icmp_seq=1 ttl=112 time=1.27 ms
64 bytes from kix06s11-in-f14.1e100.net (142.250.207.110): icmp_seq=2 ttl=112 time=1.03 ms
64 bytes from kix06s11-in-f14.1e100.net (142.250.207.110): icmp_seq=3 ttl=112 time=1.01 ms
64 bytes from kix06s11-in-f14.1e100.net (142.250.207.110): icmp_seq=4 ttl=112 time=1.01 ms
64 bytes from kix06s11-in-f14.1e100.net (142.250.207.110): icmp_seq=5 ttl=112 time=1.00 ms

--- google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.002/1.065/1.271/0.103 ms
root@ip-172-31-39-58: /home/devops/academy/project# |
```

3. Open Ports:

- List all open ports on the system using `netstat` or `ss` command.

```
root@ip-172-31-39-58: /home/devops/academy/project# netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp6      0      0 ip-172-31-39-58.ap-:ssh 183.82.110.104.ac:50327 ESTABLISHED

Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags               Type       State         I-Node  Path
unix    2      0 [ ]               DGRAM      CONNECTED    8752     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    6906     /run/systemd/journal/stdout
unix    3      0 [ ]               STREAM     CONNECTED    8725     /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    6739     /run/systemd/journal/stdout
unix    3      0 [ ]               STREAM     CONNECTED    17706    /run/dbus/system_bus_socket
unix    3      0 [ ]               DGRAM      CONNECTED    1704     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    6663     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    17881    /run/systemd/journal/stdout
unix    2      0 [ ]               DGRAM      CONNECTED    8289     /run/user/1000/systemd/notify
unix    2      0 [ ]               DGRAM      CONNECTED    6636     /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    17832    /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    17601    /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    17894    /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    6958     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    17880    /run/systemd/journal/stdout
unix    3      0 [ ]               STREAM     CONNECTED    7325     /run/dbus/system_bus_socket
unix    3      0 [ ]               DGRAM      CONNECTED    17907    /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    7393     /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    17716    /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    8585     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    6952     /run/dbus/system_bus_socket
unix    3      0 [ ]               SEQPACKET  CONNECTED    6793     /run/dbus/system_bus_socket
unix    3      0 [ ]               STREAM     CONNECTED    17793    /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    7310     /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    17991    /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    6959     /run/dbus/system_bus_socket
unix    2      0 [ ]               DGRAM      CONNECTED    19917    /run/dbus/system_bus_socket
unix    3      0 [ ]               DGRAM      CONNECTED    1702     /run/systemd/notify
unix    3      0 [ ]               STREAM     CONNECTED    8294     /run/dbus/system_bus_socket
```

4. Firewall Configuration:

- Check if the `ufw` (Uncomplicated Firewall) is installed and running. If not, install and enable it.
- Allow incoming connections on port 80 (HTTP) and 443 (HTTPS).

```
root@ip-172-31-39-58: /home/devops/academy/project# which ufw
/usr/sbin/ufw
root@ip-172-31-39-58: /home/devops/academy/project# ufw status
Status: inactive
root@ip-172-31-39-58: /home/devops/academy/project# ufw enable
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
root@ip-172-31-39-58: /home/devops/academy/project# ufw allow http
Rule added
Rule added (v6)
root@ip-172-31-39-58: /home/devops/academy/project# ufw allow https
Rule added
Rule added (v6)
root@ip-172-31-39-58: /home/devops/academy/project#
```

Task 5: Shell Scripting

1. Backup Script:

- Write a shell script named `backup.sh` that compresses the `project` directory into a `tar.gz` file and saves it in the `/home/devops/academy/backup` directory. The script should include error handling to ensure the backup only proceeds if the `project` directory exists.

```
#!/bin/bash
#
#
backupDir="/home/devops/academy/backup"
projectDir="/home/devops/academy/project"

if [ -d "$projectDir" ]; then
    echo "project dir exists"
    tar -cf "$backupDir/project.tar.gz" "$projectDir"
else
    echo "project dir not exists"
fi
~
```

2. Automation Script:

- Create a script named `cleanup.sh` that deletes all files in the `/home/devops/academy/backup` directory that are older than 7 days. Schedule this script to run daily using `cron`.

Crontab -e

```

root@ip-172-31-3-177: /home/devops/academy
#!/bin/bash
#
#
backupDir="/home/devops/academy/backup"
home="/home"

if [ -d $backupDir ]; then
    echo "backup dir exists"
    for file in $(find "$backupDir" -type f -mtime +7); do
        echo "i got file $file"
        rm -rf $file
        echo "deleted file $file"
    done
else
    echo "backup dir does not exists"
fi
fi

~
root@ip-172-31-3-177:/home/devops/academy# crontab -l
# Edit this file to introduce tasks to be run by cron.
#
# Each task to run has to be defined through a single line
# indicating with different fields when the task will be run
# and what command to run for the task
#
# To define the time you can provide concrete values for
# minute (m), hour (h), day of month (dom), month (mon),
# and day of week (dow) or use '*' in these fields (for 'any').
#
# Notice that tasks will be started based on the cron's system
# daemon's notion of time and timezones.
#
# Output of the crontab jobs (including errors) is sent through
# email to the user the crontab file belongs to (unless redirected).
#
# For example, you can run a backup of all your user accounts
# at 5 a.m every week with:
# 0 5 * * 1 tar -zcf /var/backups/home.tgz /home/
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h dom mon dow   command
0 2 * * * /home/devops/academy/cleanup.sh >> /home/devops/academy/cleanup.log
root@ip-172-31-3-177:/home/devops/academy#

```

3. Log Rotation:

- Write a script named `rotate_logs.sh` to rotate the `timestamp.txt` file if it exceeds 1MB in size and save old logs with a timestamp in the filename. ○

```

root@ip-172-31-3-177: /home/devops/academy
#!/bin/bash
#
#
logDir="/home/devops/academy/logs"
logFile="timestamp.txt"
timestamp=$(date +%Y%m%d_%H%M)
mb1=$(( 1024 * 1024 ))
fileSize=$(stat -c %s "$logDir/$logFile")

if [ $fileSize -ge $mb1 ]; then
    echo "file is greater than 1mb"
    echo "moving file to archive directory"
    mv $logDir/$logFile $logDir/archive/"timestamp_$timestamp.txt"
    touch $logDir/$logFile
else
    echo "file is less than 1mb"
fi
fi

```

Advanced Level:

• Advanced Shell Scripting:

- Write a script named `resource_monitor.sh` that:
 - Monitors CPU, memory, and disk usage.
 - Logs usage data every 5 minutes to a file named `resource_usage.log`.
 - Sends an alert email if CPU usage exceeds 80% or available disk space falls below 20%.


```

root@ip-172-31-3-177: /home/devops/academy
#!/bin/bash
#
logfile="/home/devops/academy/project/resource_usage.log"

echo "logging data --*--*--*-- $(date)"

cpuUsage=$(vmstat 1 2 | tail -1 | awk '{print 100 - $15}')
echo "----- cpu usage -----"
echo $(vmstat | awk 'NR==1 {print $6}')
echo $(vmstat | awk 'NR==2 {print $13} " " $14 " " $15 " " $16 " " $17 " " $18}')
echo $(vmstat | awk 'NR==3 {print $13} " " $14 " " $15 " " $16 " " $17 " " $18}')
echo ""

diskUsage=$(df / | awk 'NR==2 {print $5}' | tr -d '%')
echo "----- disk usage -----"
echo $(df / | awk 'NR==1')
echo $(df / | awk 'NR==2')
echo ""

echo "----- memory usage -----"
echo $(free -m | awk 'NR==1')
echo $(free -m | awk 'NR==2')
echo ""

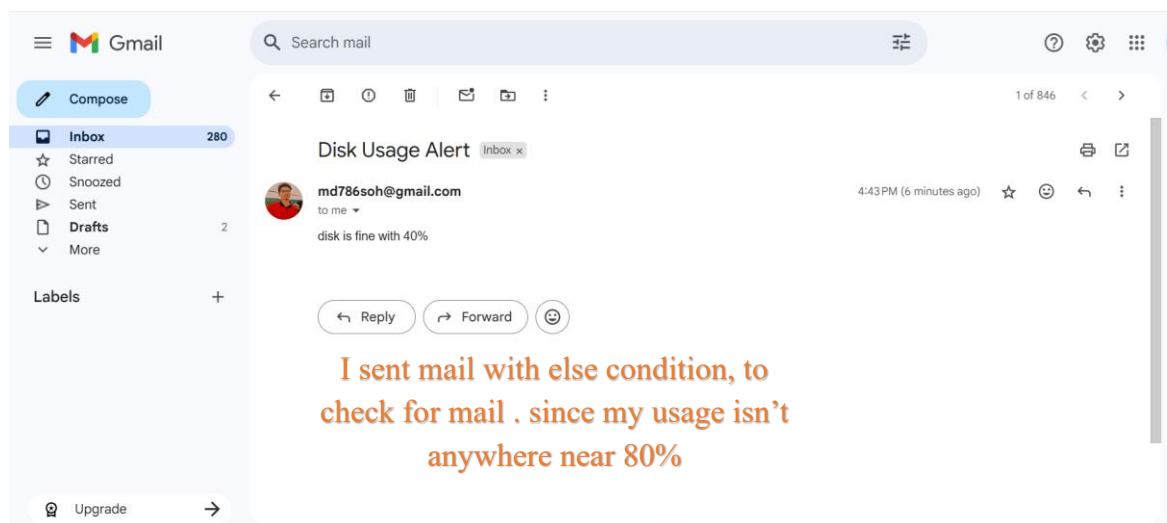
echo "cpu usage is $cpuUsage || disk usage is $diskUsage"

if [ $cpuUsage -ge 80 ]; then
    echo "cpu usage exceeded 80%" | mail -s "cpu usage Alert" sohail.bfl@gmail.com
else
    echo "cpu is fine with $cpuUsage %"
fi

if [ $diskUsage -ge 80 ]; then
    echo "disk usage exceeded 80%" | mail -s "Disk Usage Alert" sohail.bfl@gmail.com
else
    echo "disk is fine with $diskUsage%"
fi

echo "----- logging completed waiting for 5-minutes -----"
sleep 300s

```



- **User Management Automation:**
- Write a script named `bulk_user_add.sh` that:
 - Reads a list of usernames from a file named `user_list.txt`.
 - Creates each user and sets a default password.
 - Adds each user to a specific group (e.g., `students`). ◦ Ensures each user has a home directory created.

```

root@ip-172-31-3-177: /home
#!/bin/bash
#
usersFile="/home/users.txt"

password="12345678"
groupadd admins
groupadd students
groupadd teachers
for user in $(cat $usersFile); do
    useradd -m $user

    echo "user created $user"
    echo "$user:$password" | sudo chpasswd

    if [[ $user == student* ]]; then
        usermod -aG students $user
        echo "user added in the group students"
    elif [[ $user == admin* ]]; then
        usermod -aG admins $user
        echo "user added in the group admins"
    elif [[ $user == teacher* ]]; then
        usermod -aG teachers $user
        echo "user added in the group teachers"
    fi
done

tail -10 /etc/passwd
tail -13 /etc/group

```

```
root@ip-172-31-3-177:/home# ./users.sh
user created student01
user added in the group students
user created student02
user added in the group students
user created student03
user added in the group students
user created teacher01
user added in the group teachers
user created teacher02
user added in the group teachers
user created teacher03
user added in the group teachers
user created admin01
user added in the group admins
user created admin02
user added in the group admins
user created admin03
user added in the group admins
msmtp:x:112:116::/var/lib/msmtp:/usr/sbin/nologin
student01:x:1002:1006::/home/student01:/bin/sh
student02:x:1003:1007::/home/student02:/bin/sh
student03:x:1004:1008::/home/student03:/bin/sh
teacher01:x:1005:1009::/home/teacher01:/bin/sh
teacher02:x:1006:1010::/home/teacher02:/bin/sh
teacher03:x:1007:1011::/home/teacher03:/bin/sh
admin01:x:1008:1012::/home/admin01:/bin/sh
admin02:x:1009:1013::/home/admin02:/bin/sh
admin03:x:1010:1014::/home/admin03:/bin/sh
msmtp:x:116:
admins:x:1003:admin01,admin02,admin03
students:x:1004:student01,student02,student03
teachers:x:1005:teacher01,teacher02,teacher03
student01:x:1006:
student02:x:1007:
student03:x:1008:
teacher01:x:1009:
teacher02:x:1010:
teacher03:x:1011:
admin01:x:1012:
admin02:x:1013:
admin03:x:1014:
root@ip-172-31-3-177:/home# ls
admin01 admin03 student01 student02 teacher01 teacher03 userdel.sh users.txt
admin02 devops student02 student1 teacher02 ubuntu users.sh
root@ip-172-31-3-177:/home#
```