

# M5 Lab: Ownership and Permissions (Part 1)

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CITA 171: OPERATING SYSTEM USE & ADMIN

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## 3 PREPARATION

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Start the CITA 171 VM and log in. Start a Terminal program.

## 4 USERS

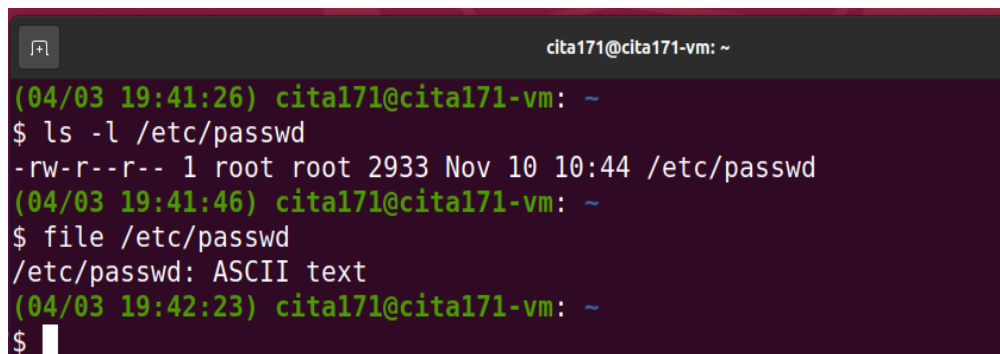
A user is an entity that is authorized to access a computer. The operating system identifies each user by its **user identifier** or **UID**. The **id** command shows the UID. In this example, the UID of the `cita171` user is 1000. See Figure 1.



```
(04/03 19:36:26) cita171@cita171-vm: ~  
$ id  
uid=1000(cita171) gid=1000(cita171) groups=1000(cita171),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare)  
(04/03 19:36:27) cita171@cita171-vm: ~  
$
```

Figure 1. The `id` Command to Display UID

The Linux (and Unix) operating system stores all registered users in a text file located at `/etc/passwd`. See Figure 2.



```
(04/03 19:41:26) cita171@cita171-vm: ~  
$ ls -l /etc/passwd  
-rw-r--r-- 1 root root 2933 Nov 10 10:44 /etc/passwd  
(04/03 19:41:46) cita171@cita171-vm: ~  
$ file /etc/passwd  
/etc/passwd: ASCII text  
(04/03 19:42:23) cita171@cita171-vm: ~  
$
```

Figure 2. The `/etc/passwd` File

The content of `/etc/passwd` is a **flat-file database** (table). See Figure 3. Note that the **head** command with the **-5** option show the first 5 lines of a text file, and the **tail** command with the **-5** options shows the last 5 lines of a text file. The UID of the root user (system administrator) is always 0.

```

(04/03 19:47:12) cita171@cita171-vm: ~
$ head -5 /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
(04/03 19:47:19) cita171@cita171-vm: ~
$ tail -5 /etc/passwd
cita171:x:1000:1000:CITA 171 Student...:/home/cita171:/bin/bash
systemd-coredump:x:999:999:systemd Core Dumper:/:usr/sbin/nologin
vboxadd:x:998:1::/var/run/vboxadd:/bin/false
jetso100:x:1001:1001:George Jetson:/home/jetso100:/bin/sh
fwupd-refresh:x:126:133:fwupd-refresh user,,,:/run/systemd:/usr/sbin/nologin
(04/03 19:47:28) cita171@cita171-vm: ~

```

Figure 3. The Content of /etc/passwd

The structure of the /etc/passwd is shown in Table 1.

Table 1. The Structure of /etc/passwd

Username	Password (Deprecated)	UID	GID	Comment	Path to User's Home Directory	Path to Login Shell
root	x	0	0	root	/root	/bin/bash
daemon	x	1	1	daemon	/usr/sbin	/usr/sbin/nologin
bin	x	2	2	bin	/bin	/usr/sbin/nologin
sys	x	3	3	sys	/dev	/usr/sbin/nologin
sync	x	4	65534	sync	/bin	/bin/sync
games	x	5	60	games	/usr/games	/usr/sbin/nologin
man	x	6	12	man	/var/cache/man	/usr/sbin/nologin
lp	x	7	7	lp	/var/spool/lpd	/usr/sbin/nologin
mail	x	8	8	mail	/var/mail	/usr/sbin/nologin
news	x	9	9	news	/var/spool/news	/usr/sbin/nologin
uucp	x	10	10	uucp	/var/spool/uucp	/usr/sbin/nologin
proxy	x	13	13	proxy	/bin	/usr/sbin/nologin
www-data	x	33	33	www-data	/var/www	/usr/sbin/nologin
backup	x	34	34	backup	/var/backups	/usr/sbin/nologin
list	x	38	38	Mailing List Manager	/var/list	/usr/sbin/nologin
irc	x	39	39	ircd	/var/run/ircd	/usr/sbin/nologin
gnats	x	41	41	Gnats Bug Reporting System (admin)	/var/lib/gnats	/usr/sbin/nologin
nobody	x	65534	65534	nobody	/nonexistent	/usr/sbin/nologin
systemd-network	x	100	102	systemd Network Management,,,	/run/systemd	/usr/sbin/nologin

systemd-resolve	x	101	103	systemd Resolver,,,	/run/systemd	/usr/sbin/nologin
systemd-timesync	x	102	104	Systemd Time Synchronization,,,	/run/systemd	/usr/sbin/nologin
messagebus	x	103	106		/nonexistent	/usr/sbin/nologin
syslog	x	104	110		/home/syslog	/usr/sbin/nologin
_apt	x	105	65534		/nonexistent	/usr/sbin/nologin
tss	x	106	111	TPM software stack,,,	/var/lib/tpm	/bin/false
uuid	x	107	114		/run/uuid	/usr/sbin/nologin
tcpdump	x	108	115		/nonexistent	/usr/sbin/nologin
avahi-autopid	x	109	116	Avahi autoip daemon,,,	/var/lib/avahi-autoipd	/usr/sbin/nologin
usbmux	x	110	46	usbmux daemon,,,	/var/lib/usbmux	/usr/sbin/nologin
rtkit	x	111	117	RealtimeKit,,,	/proc	/usr/sbin/nologin
dnsmasq	x	112	65534	dnsmasq,,,	/var/lib/misc	/usr/sbin/nologin
cups-pk-helper	x	113	120	user for cups-pk-helper service,,,	/home/cups-pk-helper	/usr/sbin/nologin
speech-dispatcher	x	113	29	Speech Dispatcher,,,	/run/speech-dispatcher	/bin/false
avahi	x	115	121	Avahi mDNS daemon,,,	/var/run/avahi-daemon	/usr/sbin/nologin
kernoops	x	116	65534	Kernel Oops Tracking Daemon,,,	/	/usr/sbin/nologin
saned	x	117	123		/var/lib/saned	/usr/sbin/nologin
nm-openvpn	x	118	124	NetworkManager OpenVPN,,,	/var/lib/openvpn/chroot	/usr/sbin/nologin
hplip	x	119	7	HPLIP system user,,,	/run/hplip	/bin/false
whoopsie	x	120	125		/nonexistent	/bin/false
colord	x	121	126	colord colour management daemon,,,	/var/lib/colord	/usr/sbin/nologin
geoclue	x	122	127		/var/lib/geoclue	/usr/sbin/nologin
pulse	x	123	128	PulseAudio daemon,,,	/var/run/pulse	/usr/sbin/nologin
Gnome-initial-setup	x	124	65534		/run/gnome-initial-setup/	/bin/false
gdm	x	125	130	Gnome Display Manager	/var/lib/gdm3	/bin/false
systemd-coredump	x	999	999	systemd Core Dumper	/	/usr/sbin/nologin
vboxadd	x	998	1		/var/run/vboxadd	/bin/false

Jetso100	x	1001	1001	George Jetson	/home/jetso100	/bin/bash
sshd	x	126	65534		/run/ssh	/usr/sbin/nologin
Cita171	x	1000	1000	CITA 171 Student	/home/cita171	/bin/bash

## 5 GROUPS

A group is a mechanism to manage one or more users collectively. The operating system identifies each group by its **group identifier** of **GID**. A user's default group (and GID) is called the user's **primary group**. If the primary group's name is the same as the username, it is also called the user's **private group**. The user can be a member of other groups called **secondary groups**. Every user must belong to at least one group (the primary group). The **id** command shows the user's GIDs. In this example, the GID of the primary groups of the `cita171` user is 1000. See Figure 4.

```

(04/03 19:36:26) cita171@cita171-vm: ~
$ id
uid=1000(cita171) gid=1000(cita171) groups=1000(cita171),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare)
(04/03 19:36:27) cita171@cita171-vm: ~
$

```

Figure 4. The `id` Command to Display GIDs

Alternatively, the **groups** command can also show the user's groups, but the GIDs are not displayed. See Figure 5.

```

(04/03 20:48:59) cita171@cita171-vm: ~
$ groups
cita171 adm cdrom sudo dip plugdev lpadmin lxd sambashare
(04/03 20:49:02) cita171@cita171-vm: ~
$

```

Figure 5. The `groups` Command

The Linux (and Unix) operating system stores all registered users in a text file located at **/etc/group**. See Figure 6.

```

cita171@cita171-vm: ~
(04/03 20:51:31) cita171@cita171-vm: ~
$ ls -l /etc/group
-rw-r--r-- 1 root root 1133 Nov 10 10:44 /etc/group
(04/03 20:51:43) cita171@cita171-vm: ~
$ file /etc/group
/etc/group: ASCII text
(04/03 20:51:52) cita171@cita171-vm: ~
$

```

Figure 6. The /etc/group File

The content of the /etc/group file is a **flat-file database** (table). See Figure 7. The GID of the root user (system administrator) is always 0.

```

cita171@cita171-vm: ~
(04/03 20:53:56) cita171@cita171-vm: ~
$ head -5 /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog,cita171
(04/03 20:54:03) cita171@cita171-vm: ~
$ tail -5 /etc/group
systemd-coredump:x:999:
vboxsf:x:998:
jetso100:x:1001:
A-Team:x:1002:
fwupd-refresh:x:133:
(04/03 20:54:12) cita171@cita171-vm: ~
$

```

Figure 7. The Content of /etc/group

The structure of the /etc/passwd is shown in .

Table 2. The Structure of /etc/groupd

Group Name	Password (Deprecated)	GID	Members
root	x	0	
daemon	x	1	
bin	x	2	
sys	x	3	
adm	x	4	Syslog.cita171

tty	x	5	syslog
disk	x	6	
lp	x	7	
mail	x	8	
news	x	9	
uucp	x	10	
man	x	12	
proxy	x	13	
kmem	x	15	
dialout	x	20	
fax	x	21	
voice	x	22	
cdrom	x	24	cita171
floppy	x	25	
tape	x	26	
sudo	x	27	cita171
audio	x	29	pulse
dip	x	30	cita171
www-data	x	33	
backup	x	34	
operator	x	37	
list	x	38	
irc	x	39	
src	x	40	
gnats	x	41	
shadow	x	42	
utmp	x	43	
video	x	44	
sasl	x	45	
plugdev	x	46	cita171
staff	x	50	
games	x	60	
users	x	100	
nogroup	x	65534	
systemd-journal	x	101	
systemd-network	x	102	
systemd-resolve	x	103	
systemd-timesync	x	104	
crontab	x	105	
messagebus	x	106	
input	x	107	
kvm	x	108	
render	x	109	
syslog	x	110	
tss	x	111	

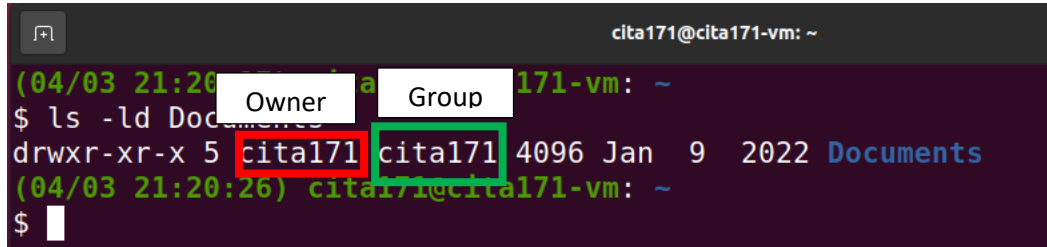


bluetooth	x	112	
ssl-cert	x	113	
uuid	x	114	
tcpdump	x	115	
avahi-autoip	x	116	
rtkit	x	117	
ssh	x	118	
netdev	x	119	
lpadmin	x	120	cita171
avahi	x	121	
scanner	x	122	saned
saned	x	123	
nm-openvpn	x	124	
whoopsie	x	125	
colord	x	126	
geoclue	x	127	
pulse	x	128	
pulse-access	x	129	
gdm	x	130	
lxd	x	131	cita171
sambashare	x	132	cita171
systemd-coredump	x	999	
vboxsf	x	998	
students	x	1001	
A-Team	x	1102	
cita171	x	1000	

## 6 FILE/DIRECTORY OWNERSHIP AND GROUP MEMBERSHIP

Each file and directory must have an **owner** and belongs to a group (**group membership**). The owner is a registered user responsible for setting proper access permissions to the file or the directory. The group membership shows to which group the file or the directory belongs. The owner may or may not be the user who created the file or the directory because the ownership can be transferred to another user.

The **ls** command with the **-ld** option display the owner and the group membership of a file or a directory. See Figure 8. The ls Command to Display Ownership and Group Membership.

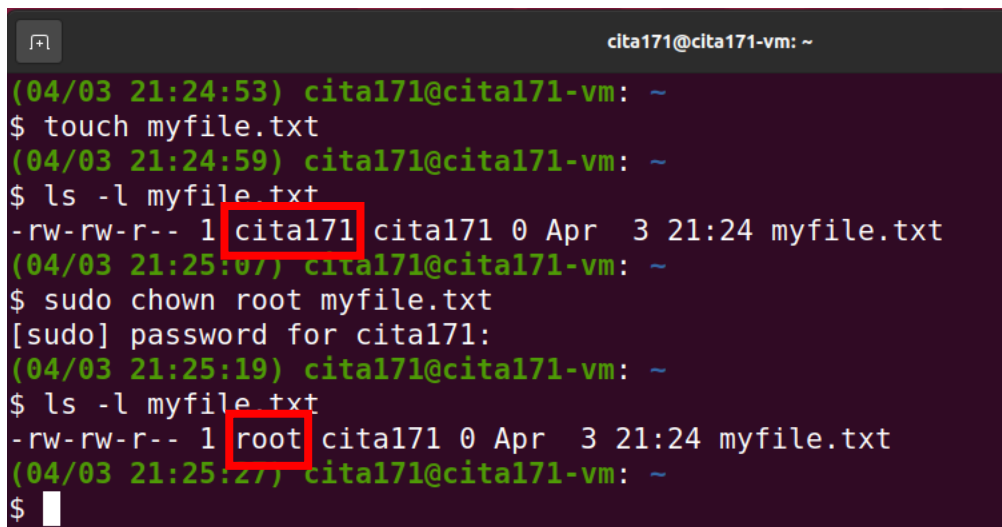


```
 cita171@cita171-vm: ~  
(04/03 21:20:26) cita171@cita171-vm: ~  
$ ls -ld Documents  
drwxr-xr-x 5 cita171 cita171 4096 Jan 9 2022 Documents  
(04/03 21:20:26) cita171@cita171-vm: ~  
$
```

Figure 8. The `ls` Command to Display Ownership and Group Membership

## 7 MANAGING OWNERS

Regular users (non-administrators) cannot change the file or directory ownership. Only system administrators (e.g., the root user) can. Users who are allowed to use the **sudo** command also can. The **chown** command changes the ownership. See Figure 9. The `chown` Command. In this example, a file whose owner is `cita171` is changed to root.

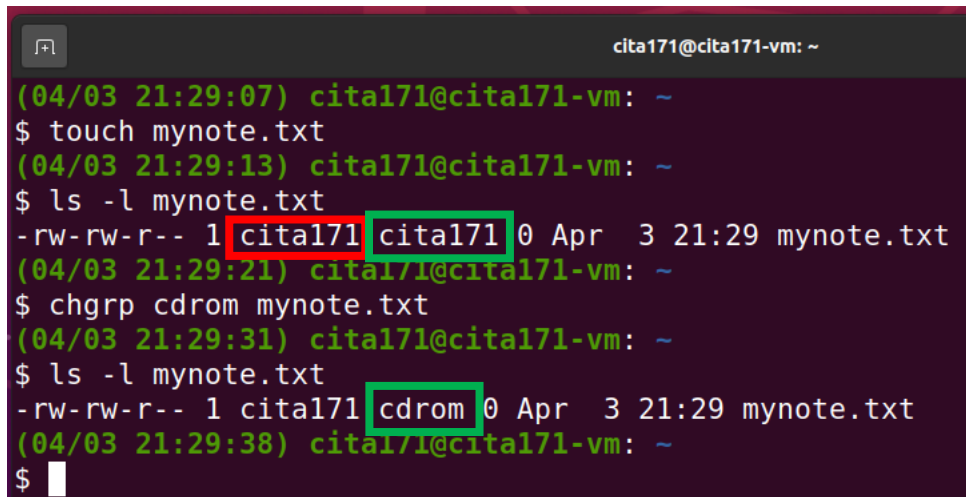


```
 cita171@cita171-vm: ~  
(04/03 21:24:53) cita171@cita171-vm: ~  
$ touch myfile.txt  
(04/03 21:24:59) cita171@cita171-vm: ~  
$ ls -l myfile.txt  
-rw-rw-r-- 1 cita171 cita171 0 Apr 3 21:24 myfile.txt  
(04/03 21:25:07) cita171@cita171-vm: ~  
$ sudo chown root myfile.txt  
[sudo] password for cita171:  
(04/03 21:25:19) cita171@cita171-vm: ~  
$ ls -l myfile.txt  
-rw-rw-r-- 1 root cita171 0 Apr 3 21:24 myfile.txt  
(04/03 21:25:27) cita171@cita171-vm: ~  
$
```

Figure 9. The `chown` Command

## 8 MANAGING GROUP MEMBERSHIP

The **chgrp** command is used to change the group membership of a file or a directory. A regular user can change the file or directory's group membership if the user is the owner of the file or directory and already a member of the original and the new groups. See Figure 10. The `chgrp` Command. In this example, because `cita171` is the owner and a member of the `cita 171` and `cdrom` groups, the user can change the group membership from `cita 171` to `cdrom` without using `sudo` command.

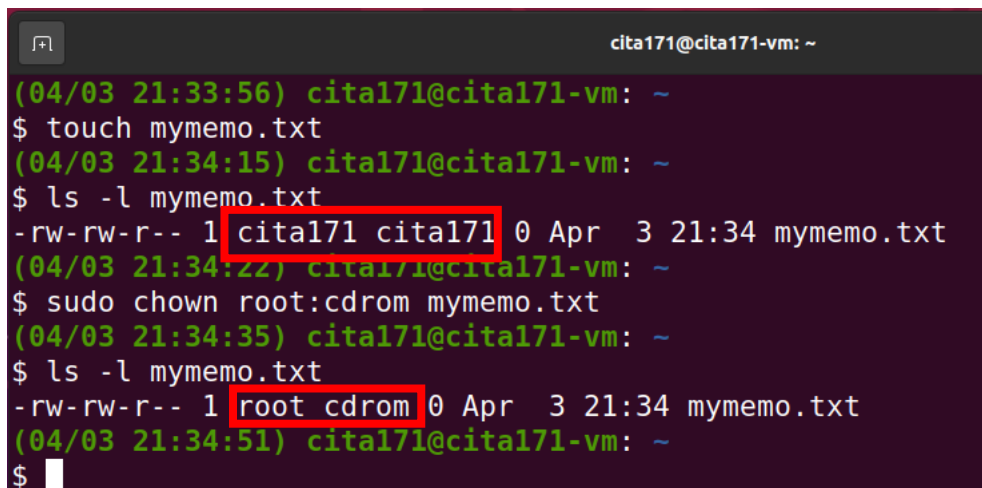


```
cita171@cita171-vm: ~
(04/03 21:29:07) cita171@cita171-vm: ~
$ touch mynote.txt
(04/03 21:29:13) cita171@cita171-vm: ~
$ ls -l mynote.txt
-rw-rw-r-- 1 cita171 cita171 0 Apr  3 21:29 mynote.txt
(04/03 21:29:21) cita171@cita171-vm: ~
$ chgrp cdrom mynote.txt
(04/03 21:29:31) cita171@cita171-vm: ~
$ ls -l mynote.txt
-rw-rw-r-- 1 cita171 cdrom 0 Apr  3 21:29 mynote.txt
(04/03 21:29:38) cita171@cita171-vm: ~
$
```

Figure 10. The chgrp Command

## 9 MANAGING BOTH OWNER AND GROUP MEMBERSHIP

The chown command is used to change the owner and the group membership at the same time. Only system administrators (e.g., the root user) can. See Figure 11. The chown Command to Change Both Ownership and Group Membership. This example changed the owner from cita171 to root and the group membership from cita 171 to cdrom simultaneously.



```
cita171@cita171-vm: ~
(04/03 21:33:56) cita171@cita171-vm: ~
$ touch mymemo.txt
(04/03 21:34:15) cita171@cita171-vm: ~
$ ls -l mymemo.txt
-rw-rw-r-- 1 cita171 cita171 0 Apr  3 21:34 mymemo.txt
(04/03 21:34:22) cita171@cita171-vm: ~
$ sudo chown root:cdrom mymemo.txt
(04/03 21:34:35) cita171@cita171-vm: ~
$ ls -l mymemo.txt
-rw-rw-r-- 1 root cdrom 0 Apr  3 21:34 mymemo.txt
(04/03 21:34:51) cita171@cita171-vm: ~
$
```

Figure 11. The chown Command to Change Both Ownership and Group Membership