Permissions

Joseph Hallett

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University of BRISTOL

In the beginning there was `root`...

And it was good.
The `root` user is all powerful.

- The *super user*
- The *system administor*
- UID 0

And so root beget `init` which beget `login`...

And so other users came to pass

- Each less powerful than the original root

For inside the password file...

In the bowels of the computer's configuration directory `/etc/`:

```
$ grep -Ev '^_' /etc/passwd | column -ts :
```

Username	Password	UID	GID	GECOS	Home Directory	Shell
root	*	0	0	Charlie &	/root	/bin/ksh
daemon	*	1	1	The devil himself	/root	/sbin/nologin
operator	*	2	5	System &	/operator	/sbin/nologin
bin	*	3	7	Binaries Commands and Source	/	/sbin/nologin
build	*	21	21	base and xenocara build	/var/empty	/bin/ksh
sshd	*	27	27	sshd privsep	/var/empty	/sbin/nologin
www	*	67	67	HTTP Server	/var/www	/sbin/nologin
nobody	*	32767	32767	Unprivileged user	/nonexistent	/sbin/nologin
joseph	*	1000	1000	Joseph Hallett,,,	/home/joseph	/usr/local/bin/bash

See `man 5 passwd` or your OS's manual pages.

(Can anyone spot what OS I use?)

grep：用于在文件中搜索指定模式的行。
-E：表示使用扩展的正则表达式。
-v：表示反向匹配，即只输出不匹配模式的行。
'^_'：表示以 _ 开头的行。
/etc/passwd：表示要搜索的文件路径。
这个部分的作用是从 /etc/passwd 文件中过滤掉以 _ 开头的行。

column -ts：
column：用于在输出中创建列格式。
-t：表示将输入的文本进行表格化（格式化为多列），即自动将每行文本按列对齐。
-s：用于指定列分隔符。但是在这个命令中，-s 后面没有给出分隔符，因此它会使用默认的空格作为分隔符。
这个部分的作用是对前一个命令的输出进行列格式化，使得输出更易读。

And inside the group file....

```
$ grep -Ev '^_' /etc/group | column -ts :
```

```
Groupname   Password     GID   Members
wheel       *              0   root,joseph
daemon      *              1   daemon
kmem        *              2   root
sys         *              3   root
tty         *              4   root
operator    *              5   root
bin         *              7
wsrc        *              9   joseph
users       *             10
auth        *             11
games       *             13
staff       *             20   root,joseph
wobj        *             21   joseph
sshd        *             27
guest       *             31   root
utmp        *             45
crontab     *             66
www         *             67
network     *             69
authpf      *             72
dialer      *            117
nogroup     *          32766
nobody      *          32767
joseph      *           1000
```

Something very similar

- Each group can have *multiple* members
- No passwords ever actually listed
  - (They're in `/etc/shadow`)

For all files were owned by a user and a group...

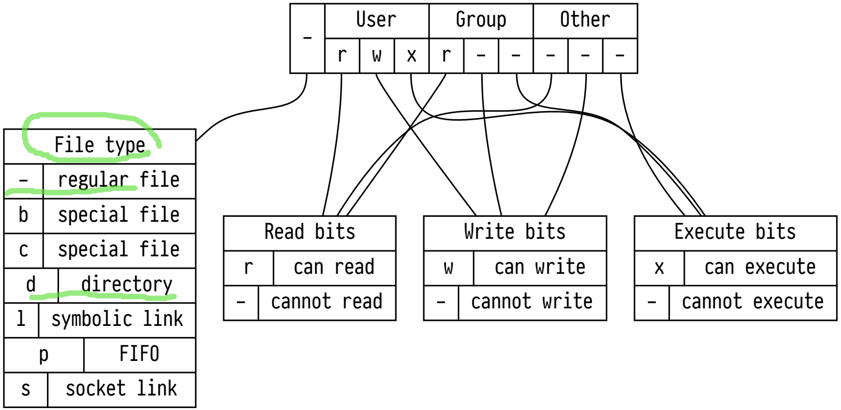
```
ls -loh /etc/
```

```
Permissions         UID     GID     File flags    Size     Filename
drwxr-xr-x     5    root    wheel   -             512B     May 20 2022     ConsoleKit
drwxr-xr-x     2    root    wheel   -             512B     Nov 25 13:25    ImageMagick
drwxr-xr-x     7    root    wheel   -             512B     Nov 16 20:19    X11
-rw-r--r--     1    root    wheel   -             20.5K    Nov 6 12:41     abcde.conf
drwx------     2    root    wheel   -             512B     Nov 16 19:39    acme
-rw-r--r--     1    root    wheel   -             1.7K     Sep 22 19:03    adduser.conf
drwxr-xr-x     2    root    wheel   -             512B     Nov 16 19:39    amd
-rw-r--r--     1    root    wheel   -             271B     Oct 30 19:14    anthy-conf
drwxr-xr-x     3    root    wheel   -             512B     Nov 25 13:27    apache2
-rw-r--r--     1    root    wheel   -             1.8K     Nov 14 10:34    authentication_milter.json
```

…

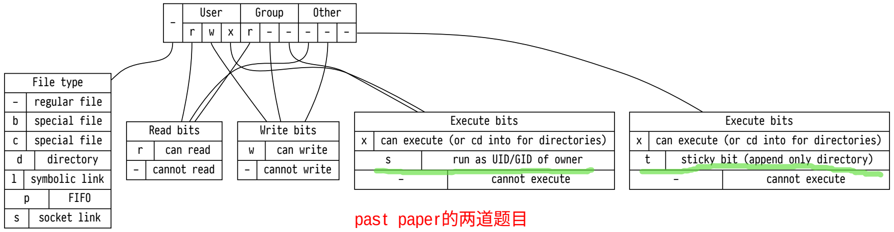
UNIX Discretionary Access Controls

And the owner of each file could set the *permissions* for each file



Actually its a *bit* more complex

And the owner of each file could set the *permissions* for each file



past paper的两道题目

And, honestly, on some systems/filesystems it gets *even more* complex

- But this is 99.99% of everything you'll ever see or use

So what are those weird extra bits for

The *sticky* bit `t` is mostly for log directories and temporary directories

- You should be able to append to log files, but not delete them

The `setuid/setgid` bits are used for privilege separation.

For example how do you update your password?

Passwords are normally stored *securely* bin the shadow file `/etc/shadow`, or equivalent

- But I use OpenBSD...

```
ls -l /etc/spwd.db
```

-rw-r—– 1 root _shadow 40960 Dec 22 15:03 /etc/spwd.db

Changing passwords

The `passwd` program changes your password:

```
ls -l $(command -v passwd)
```

```
-r-sr-xr-x 1 root bin 21208 Jan 12 03:08 /usr/bin/passwd
```

Other useful `setuid` programs

`su`	switch to user (by default root) with *their* password
`sudo`	switch to user *if the sysadmin says you're allowed* to with *your* password
`doas`	modern rewrite of `sudo` with less bugs and Spiderman references

See `man su` or `man sudo` or `man doas`...

- Or *Michael W. Lucas*'s excellent *Sudo Mastery*
- (You can do a lot with `sudo...`)

Generally `setuid` programs are dangerous and you want to use them extremely carefully!

Sysadmining

How do you change who owns a file?

```
ls -l exam
```

```
-rw-r--r-- 1 joseph joseph 0 Jan 12 11:49 exam
```

```
chown joseph:staff exam
# Alternatively...
chown :staff exam
ls -l exam
```

```
-rw-r--r-- 1 joseph staff 0 Jan 12 11:49 exam
```

(See `man 1 chown`)

How do you change a file's permissions

```
chmod go-wx exam
ls -l exam
```

表示移除了所有者组和其他用户的写权限和执行权限，但保留了读权限。

```
-rw-r--r-- 1 joseph staff 0 Jan 12 11:49 exam
```

Footnote

Some people like to use octal (base 8) to express permissions, where r=4, w=2, x=1...
Instead of saying `go-wx` to remove `w` and `x` bits from the group and other permissions they'll say:
`chmod 744 exam`
I suggest you give these people a wide berth.

- (but you should know how to do it)

Recap

Systems have users!

- The UNIX DAC lets you set file permissions!
- `setuid` and `setgid` programs exist! past paper的两条题目
- Root's firstname is *Charlie*!

`chmod` to change permissions

`chown` to change file owners

One more thing...

Traditionally the `root` user can do anything...
In *most* modern operating systems this has been split up a bit more

- For example Linux uses *capabilities* to set what things any user can do
- ...and *namespaces* to allow multiple root users with different capabilities

`man 7 capabilities` if you want to know more

- ...but *most of the time* you won't need to know about them...
- Unless you use Docker...

This is a lie, you really *should* know about them... but unless you're routinely in the habit of writing sysadmin tools or privileged programs you *won't normally* need to touch them. Hey, I'm a security researcher I think this stuff is fascinating but other people don't. Don't get it meself: it isn't *that* complex but hey ho. I tried.