

# EN4720: Security in Cyber-Physical Systems

## Exercise — Authorization

Name: Thalagala B. P.

Index No: 180631J

May 19, 2023

**This is an individual exercise!**  
**Due Date: 19 May 2023 by 11.59 PM**

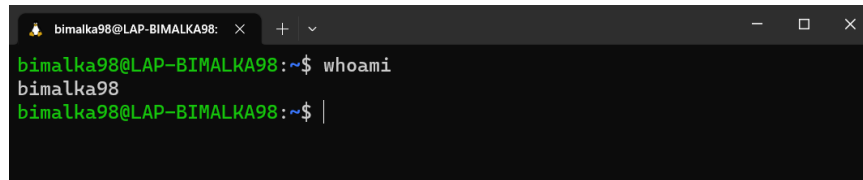
This exercise has to be carried out using a Linux-based PC/virtual machine. Read all the instructions and questions before attempting the exercise. Add answers under each question in the Questions section and submit the resulting PDF.

### Instructions

1. Understand how linux users and groups work.
2. Understand how linux file ownership and permissions work.
3. Answer the questions given below.

## Questions

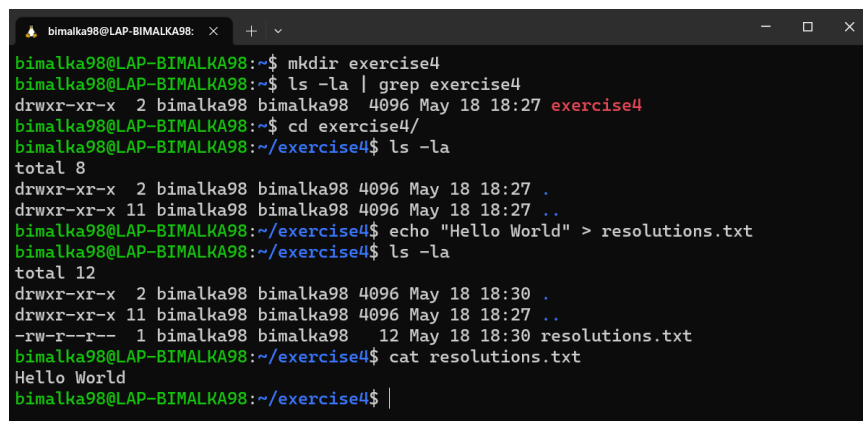
1. View the currently logged in user.



```
bimalka98@LAP-BIMALKA98: ~$ whoami
bimalka98
bimalka98@LAP-BIMALKA98: ~$ |
```

Figure 1: Currently logged in user

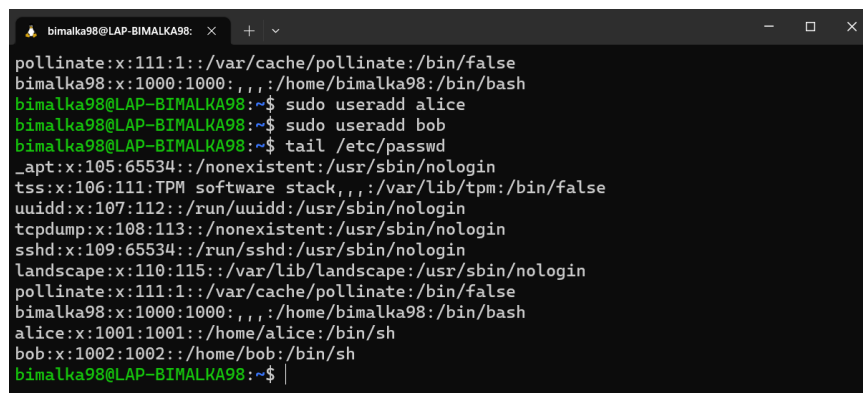
2. Create a sub directory as exercise4. Create a text file resolutions.txt with “Hello World” text in the file and store the file in the newly created directory as exercise4/resolutions.txt. Dump the file to the terminal using the cat command.



```
bimalka98@LAP-BIMALKA98: ~$ mkdir exercise4
bimalka98@LAP-BIMALKA98: ~$ ls -la | grep exercise4
drwxr-xr-x  2 bimalka98 bimalka98 4096 May 18 18:27 exercise4
bimalka98@LAP-BIMALKA98: ~$ cd exercise4/
bimalka98@LAP-BIMALKA98: ~/exercise4$ ls -la
total 8
drwxr-xr-x  2 bimalka98 bimalka98 4096 May 18 18:27 .
drwxr-xr-x 11 bimalka98 bimalka98 4096 May 18 18:27 ..
bimalka98@LAP-BIMALKA98: ~/exercise4$ echo "Hello World" > resolutions.txt
bimalka98@LAP-BIMALKA98: ~/exercise4$ ls -la
total 12
drwxr-xr-x  2 bimalka98 bimalka98 4096 May 18 18:30 .
drwxr-xr-x 11 bimalka98 bimalka98 4096 May 18 18:27 ..
-rw-r--r--  1 bimalka98 bimalka98  12 May 18 18:30 resolutions.txt
bimalka98@LAP-BIMALKA98: ~/exercise4$ cat resolutions.txt
Hello World
bimalka98@LAP-BIMALKA98: ~/exercise4$ |
```

Figure 2: Creating a sub-directory, creating a file with the required text and dump its content to the terminal

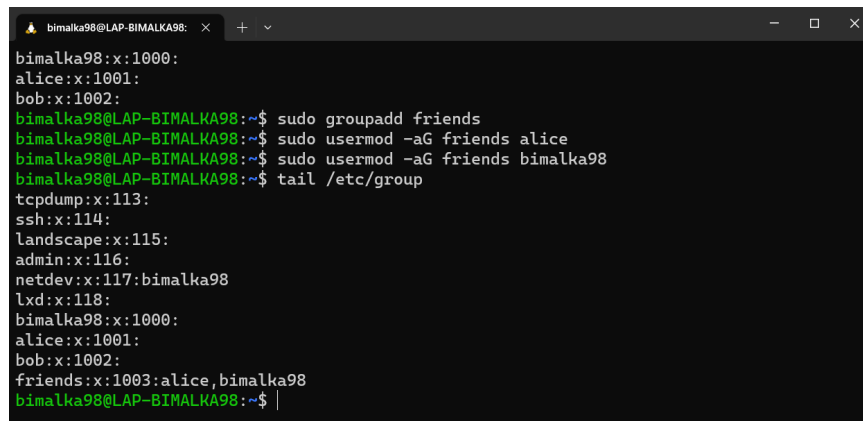
3. Create two new user accounts as **alice** and **bob**.



```
bimalka98@LAP-BIMALKA98: ~$ sudo useradd alice
bimalka98@LAP-BIMALKA98: ~$ sudo useradd bob
bimalka98@LAP-BIMALKA98: ~$ tail /etc/passwd
pollinate:x:111:1::/var/cache/pollinate:/bin/false
bimalka98:x:1000:1000:,,,:/home/bimalka98:/bin/bash
alice:x:1001:1001:,,,:/home/alice:/bin/sh
bob:x:1002:1002:,,,:/home/bob:/bin/sh
bimalka98@LAP-BIMALKA98: ~$ |
```

Figure 3: Creating two new user accounts

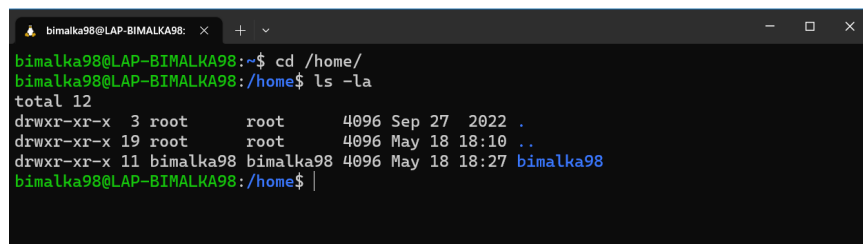
4. Create a group as **friends** and add **alice** and yourself (currently logged in user) to the group **friends**



```
bimalka98@LAP-BIMALKA98: ~$ sudo groupadd friends
bimalka98@LAP-BIMALKA98: ~$ sudo usermod -aG friends alice
bimalka98@LAP-BIMALKA98: ~$ sudo usermod -aG friends bimalka98
bimalka98@LAP-BIMALKA98: ~$ tail /etc/group
tcpdump:x:113:
ssh:x:114:
landscape:x:115:
admin:x:116:
netdev:x:117:bimalka98
lxd:x:118:
bimalka98:x:1000:
alice:x:1001:
bob:x:1002:
friends:x:1003:alice,bimalka98
bimalka98@LAP-BIMALKA98: ~$
```

Figure 4: Creating a group and add members

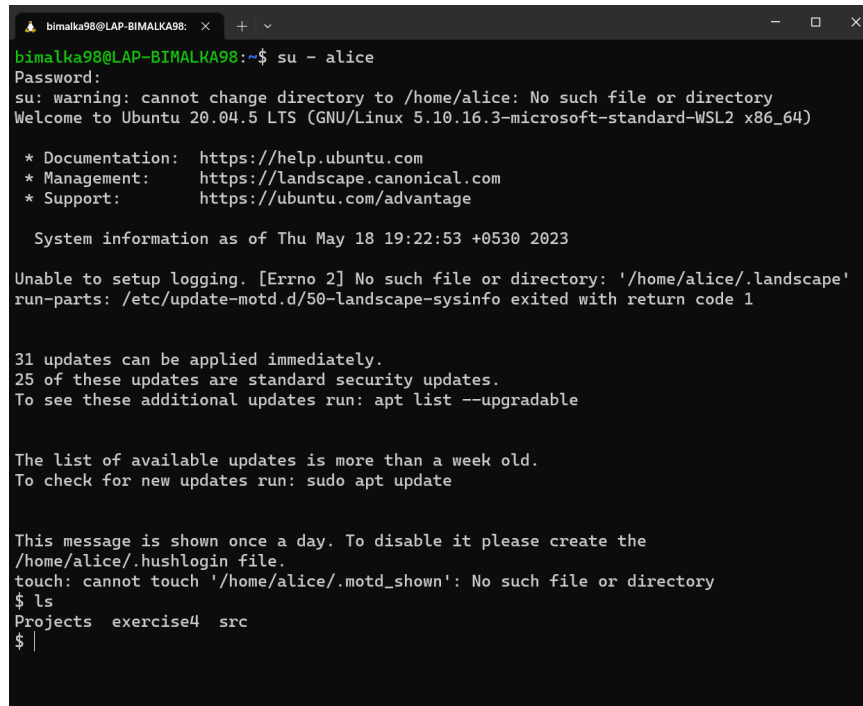
5. Make sure your (currently logged in user's) home directory has execute permissions for all the users.



```
bimalka98@LAP-BIMALKA98: ~$ cd /home/
bimalka98@LAP-BIMALKA98: /home$ ls -la
total 12
drwxr-xr-x  3 root    root      4096 Sep 27  2022 .
drwxr-xr-x 19 root    root      4096 May 18 18:10 ..
drwxr-xr-x 11 bimalka98 bimalka98 4096 May 18 18:27 bimalka98
bimalka98@LAP-BIMALKA98: /home$
```

Figure 5: Execution permission to the current user's home directory

6. Become (log in as) one of your new user accounts (**alice** or **bob**). You can simply `su -` to the alternate user.



```
bimalka98@LAP-BIMALKA98:~$ su - alice
Password:
su: warning: cannot change directory to /home/alice: No such file or directory
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.10.16.3-microsoft-standard-WSL2 x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Thu May 18 19:22:53 +0530 2023

Unable to setup logging. [Errno 2] No such file or directory: '/home/alice/.landscape'
run-parts: /etc/update-motd.d/50-landscape-sysinfo exited with return code 1

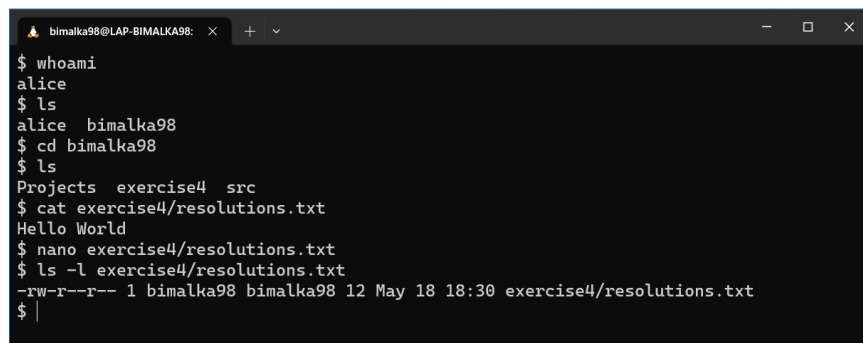
31 updates can be applied immediately.
25 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

This message is shown once a day. To disable it please create the
/home/alice/.hushlogin file.
touch: cannot touch '/home/alice/.motd_shown': No such file or directory
$ ls
Projects  exercise4  src
$ |
```

Figure 6: Log-in as the user `alice`

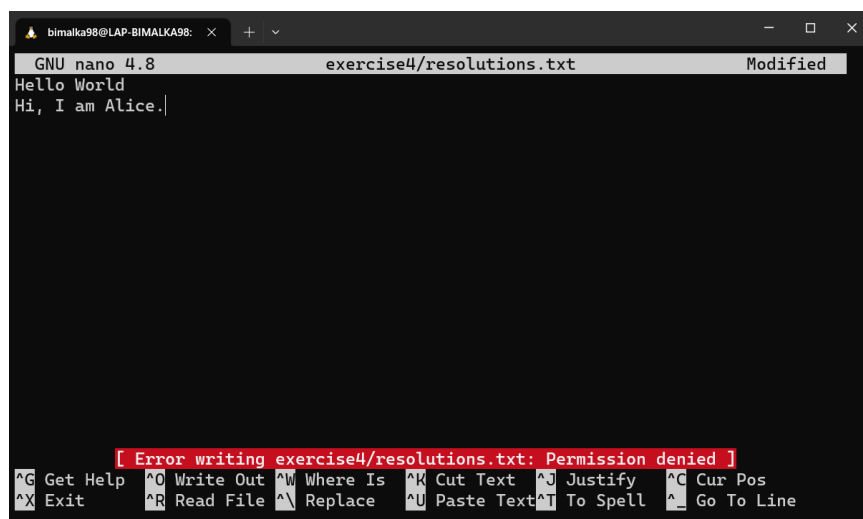
7. As the new user, confirm that you can view the file by dumping the content to the terminal. Try adding a new item to the `resolutions.txt` file. Why can't you modify the file as the new user?



```
$ whoami
alice
$ ls
alice  bimalka98
$ cd bimalka98
$ ls
Projects  exercise4  src
$ cat exercise4/resolutions.txt
Hello World
$ nano exercise4/resolutions.txt
$ ls -l exercise4/resolutions.txt
-rw-r--r-- 1 bimalka98 bimalka98 12 May 18 18:30 exercise4/resolutions.txt
$ |
```

Figure 7: Viewing the content of the `resolutions.txt` file

*As the Figure 8 illustrates, altering the content of the `resolutions.txt` file, is denied. Because, the other users in the Linux host machine has only the read permission for that file, and no write permission is given to them. This fact is verified by the output of the last command in the Figure 7, which inspects various permissions to the `resolutions.txt` file. The line segment `-rw-r--r--` indicates that the User `bimalka98` has Read and Write permissions (`rw-`), the Group `bimalka98` has Read permission (`r-`), and Others have Read permission (`r-`).*

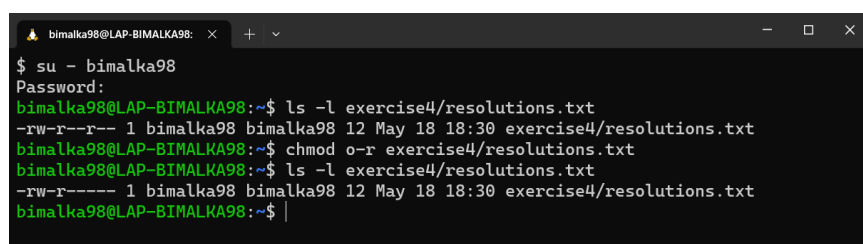


```
bimalka98@LAP-BIMALKA98: x + v
GNU nano 4.8 exercise4/resolutions.txt Modified
Hello World
Hi, I am Alice.

[ Error writing exercise4/resolutions.txt: Permission denied ]
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell ^_ Go To Line
```

Figure 8: Trying to alter the content of the `resolutions.txt` file: Permission Denied.

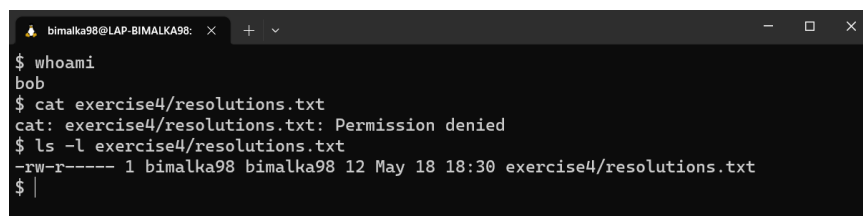
- Note that the permissions on a newly created file allow all users on the system to read the file. Assume that you want to keep `resolutions.txt` file private. Modify the file's permissions, such that read access for others is removed.



```
bimalka98@LAP-BIMALKA98: x + v
$ su - bimalka98
Password:
bimalka98@LAP-BIMALKA98:~$ ls -l exercise4/resolutions.txt
-rw-r--r-- 1 bimalka98 bimalka98 12 May 18 18:30 exercise4/resolutions.txt
bimalka98@LAP-BIMALKA98:~$ chmod o-r exercise4/resolutions.txt
bimalka98@LAP-BIMALKA98:~$ ls -l exercise4/resolutions.txt
-rw-r----- 1 bimalka98 bimalka98 12 May 18 18:30 exercise4/resolutions.txt
bimalka98@LAP-BIMALKA98:~$
```

Figure 9: Removing the read access for `other` users

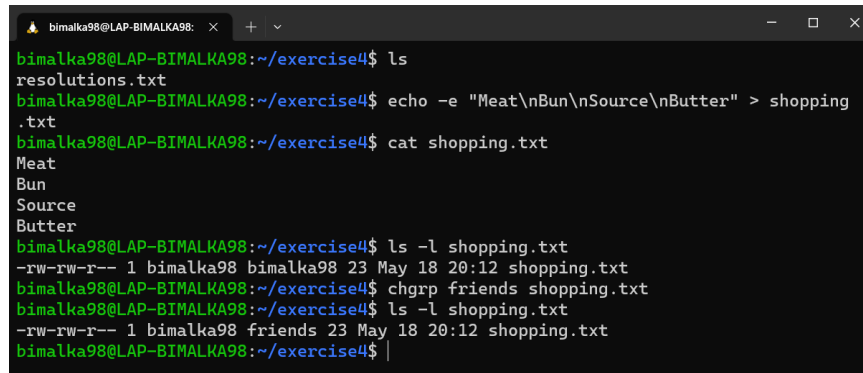
- Using the other new account (if you used `alice` before, now use `bob`), confirm that other users on the system are not able to read your `resolutions.txt` file by trying to dump the file to the terminal.



```
bimalka98@LAP-BIMALKA98: x + v
$ whoami
bob
$ cat exercise4/resolutions.txt
cat: exercise4/resolutions.txt: Permission denied
$ ls -l exercise4/resolutions.txt
-rw-r----- 1 bimalka98 bimalka98 12 May 18 18:30 exercise4/resolutions.txt
$
```

Figure 10: Confirming that other users on the system are not able to read your `resolutions.txt` file, by trying to viewing its content from `bob`'s account

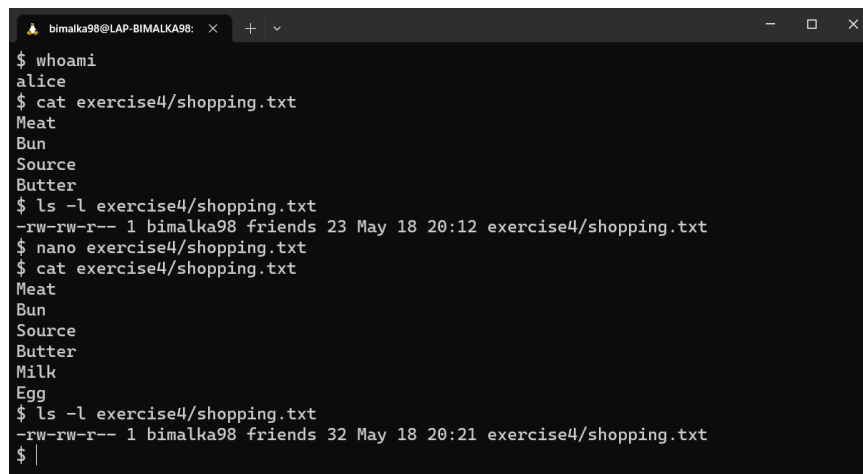
10. Compose a short shopping list in your preferred text editor, or using the command line. Store the file as exercise4/shopping.txt. Change the group owner of the file to **friends**.



```
bimalka98@LAP-BIMALKA98: ~/exercise4$ ls
resolutions.txt
bimalka98@LAP-BIMALKA98:~/exercise4$ echo -e "Meat\nBun\nSource\nButter" > shopping
.txt
bimalka98@LAP-BIMALKA98:~/exercise4$ cat shopping.txt
Meat
Bun
Source
Butter
bimalka98@LAP-BIMALKA98:~/exercise4$ ls -l shopping.txt
-rw-rw-r-- 1 bimalka98 bimalka98 23 May 18 20:12 shopping.txt
bimalka98@LAP-BIMALKA98:~/exercise4$ chgrp friends shopping.txt
bimalka98@LAP-BIMALKA98:~/exercise4$ ls -l shopping.txt
-rw-rw-r-- 1 bimalka98 friends 23 May 18 20:12 shopping.txt
bimalka98@LAP-BIMALKA98:~/exercise4$ |
```

Figure 11: Creating the `shopping.txt` file and change its group owner

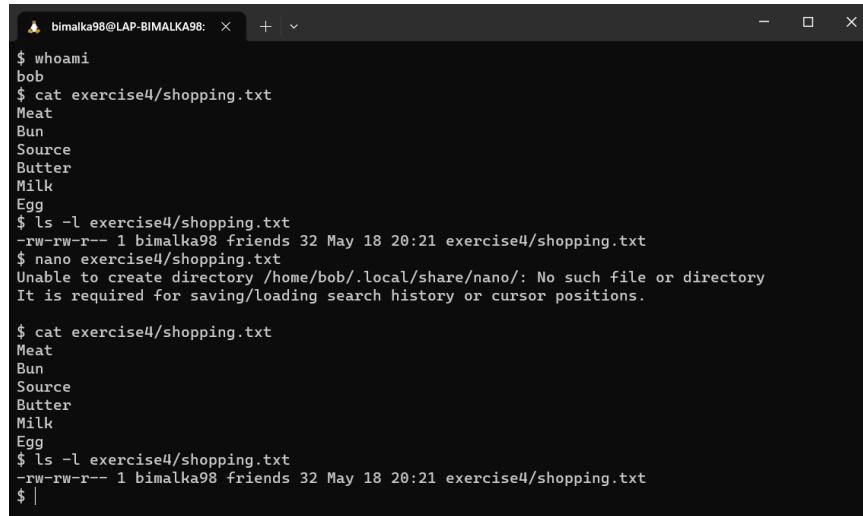
11. As the alternate user **alice**, confirm that you can view the file. Also, note that you can modify the file, by adding an additional item to the shopping list. Dump the file content to the terminal to show that the new item is added.



```
$ whoami
alice
$ cat exercise4/shopping.txt
Meat
Bun
Source
Butter
$ ls -l exercise4/shopping.txt
-rw-rw-r-- 1 bimalka98 friends 23 May 18 20:12 exercise4/shopping.txt
$ nano exercise4/shopping.txt
$ cat exercise4/shopping.txt
Meat
Bun
Source
Butter
Milk
Egg
$ ls -l exercise4/shopping.txt
-rw-rw-r-- 1 bimalka98 friends 32 May 18 20:21 exercise4/shopping.txt
$ |
```

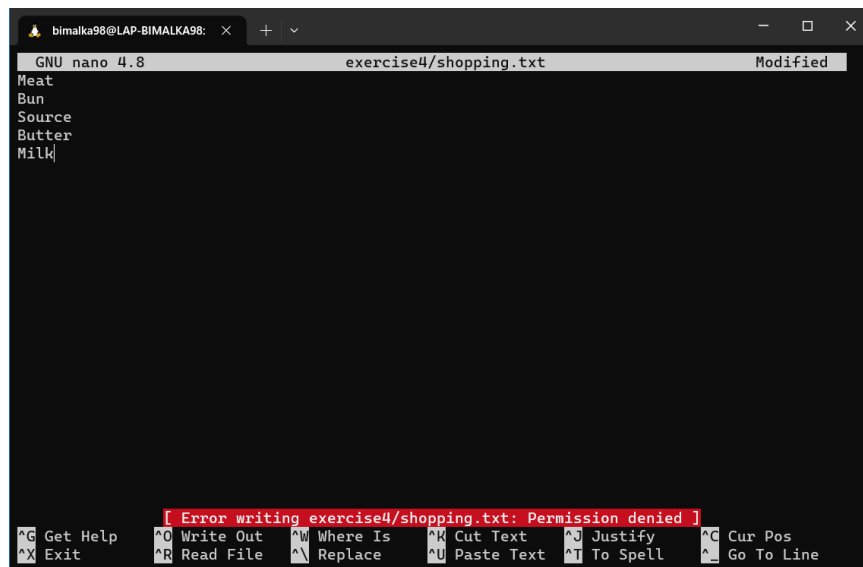
Figure 12: Confirming the read and write permission of the users of the friends group

12. Recall that your other new account (**bob**) is not a member of the group **friends**. Try becoming **bob** and repeat the previous steps. You should be able to view, but not modify, the file.



```
bimalka98@LAP-BIMALKA98: ~  
$ whoami  
bob  
$ cat exercise4/shopping.txt  
Meat  
Bun  
Source  
Butter  
Milk  
Egg  
$ ls -l exercise4/shopping.txt  
-rw-rw-r-- 1 bimalka98 friends 32 May 18 20:21 exercise4/shopping.txt  
$ nano exercise4/shopping.txt  
Unable to create directory /home/bob/.local/share/nano/: No such file or directory.  
It is required for saving/loading search history or cursor positions.  
$ cat exercise4/shopping.txt  
Meat  
Bun  
Source  
Butter  
Milk  
Egg  
$ ls -l exercise4/shopping.txt  
-rw-rw-r-- 1 bimalka98 friends 32 May 18 20:21 exercise4/shopping.txt  
$ |
```

Figure 13: Checking the read and write permission of the user bob



```
GNU nano 4.8 exercise4/shopping.txt Modified  
Meat  
Bun  
Source  
Butter  
Milk|  
  
[ Error writing exercise4/shopping.txt: Permission denied ]  
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos  
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell ^_ Go To Line
```

Figure 14: Verifying the user bob does not have write permission

Provide analytical answers to the questions below. Screenshots are not required.

13. What are the challenges that organizations face during the cyber security authorization process, and how can they be overcome?

*The following answer was adopted from <https://www.accenture.com/us-en/blogs/security/keys-successful-access-authorization>*

*Challenges and ways to overcome them:*

- **Lack of vendor solutions** - Due to inflexibility and performance concerns of the available cyber security authorization processes, most organizations chose to build the authorization systems which best suits for their specific requirement. The growth of the number of vendor specializing in this area is a way to overcome this challenge. So that organization can select the best match for their requirements and adopt the solution accordingly.
- **Complexity of managing policies** - When managing authorization processes, organizations need to maintain/ update rules that determine who is allowed to access certain information and resources. This process involve, analyzing the existing complex code to identify already existing rules and reverse engineer the existing decision making (if/ else) algorithms to understand how those rules are enforced. This whole process is super complex to carry out manually. Tools with Artificial Intelligence capabilities have been built by vendors to dynamically generate and manage policies. In addition to that friendly user interfaces that hides the complexity of extensible access control markup language (XACML) has also become a grate relief.
- **Performance and scale** - Organizations need to make sure that their systems can handle the ever increasing demands of the authorization process. However, this process involves communication between various system components which essentially can slow down the system. Focusing on modernizing applications and systems that take advantage of cloud technologies is a way to address this issue, as they often have better integration with authorization tools.

14. How do different cyber security authorization frameworks differ from one another, and what are the key considerations that organizations should take into account when choosing a framework to follow?

*Your answer here*

15. What are the most common vulnerabilities that may be identified during the cyber security authorization process, and how can organizations address them?

*Your answer here*