Introduction to

Linux Shell

COMP201 Lab1

Spring 2022

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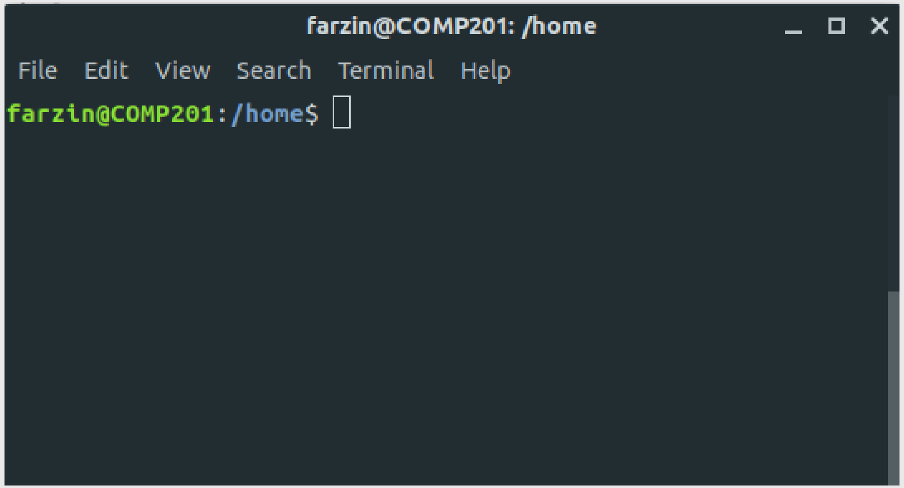
What is shell?



```
farzin@COMP201:/home$ 
```

- The Linux shell is the interface between you and operating system that controls the hardware.
- The most commonly used shell is called BASH – Bourne Again Shell
- username@hostname:curr_dir$
  - username: farzin
  - hostname: COMP201
  - curr_dir: /home

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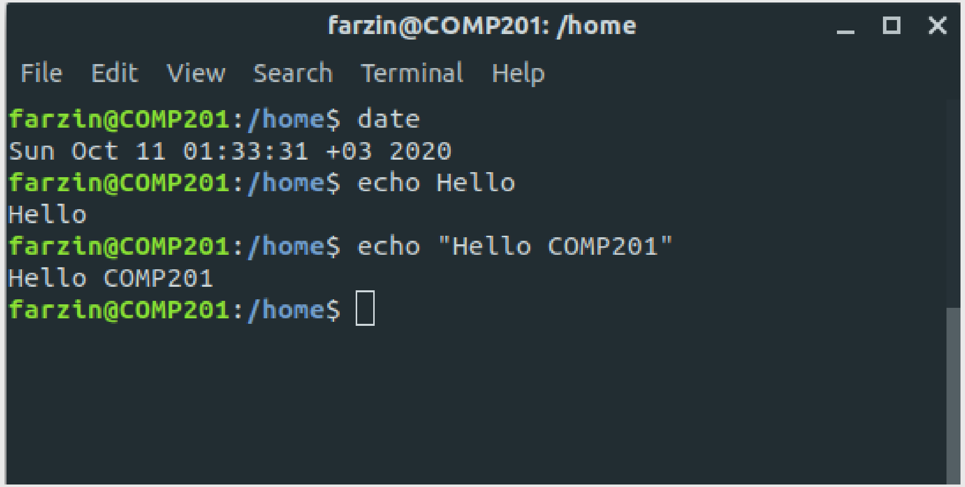
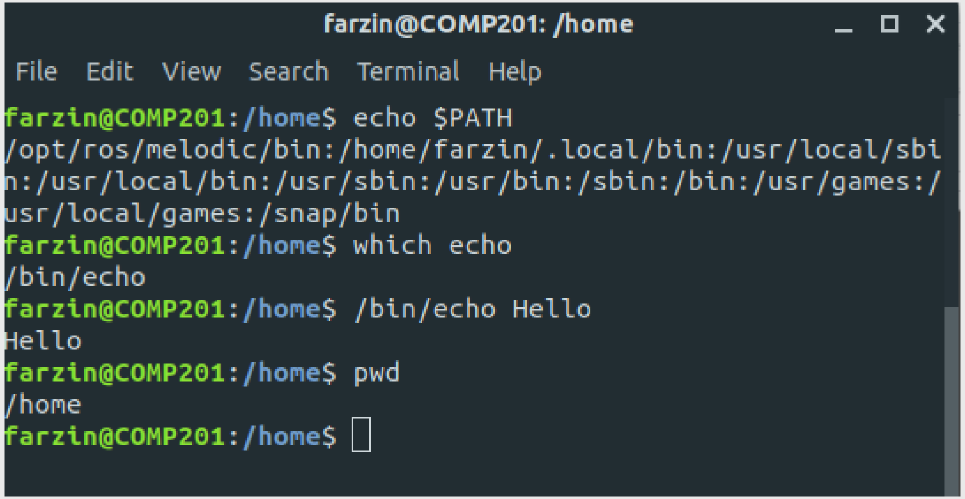
Executing system programs



```
farzin@COMP201:/home$ date
Sun Oct 11 01:33:31 +03 2020
farzin@COMP201:/home$ echo Hello
Hello
farzin@COMP201:/home$ echo "Hello COMP201"
Hello COMP201
farzin@COMP201:/home$
```

- Execute programs
- **$date**
  - This program prints current date and time
- **$echo**
  - This program prints the input argument

Path and $PATH



```
farzin@COMP201:/home$ echo $PATH
/opt/ros/melodic/bin:/home/farzin/.local/bin:/usr/local/sbi
n:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/
usr/local/games:/snap/bin
farzin@COMP201:/home$ which echo
/bin/echo
farzin@COMP201:/home$ /bin/echo Hello
Hello
farzin@COMP201:/home$ pwd
/home
farzin@COMP201:/home$
```

- **$PATH**
  - A variable that contains addresses where system look for programs to execute
- **$which**
  - Prints which file is being executed given an input program name
- **$pwd**
  - This program prints current working directory
  - Stands for “print working directory”

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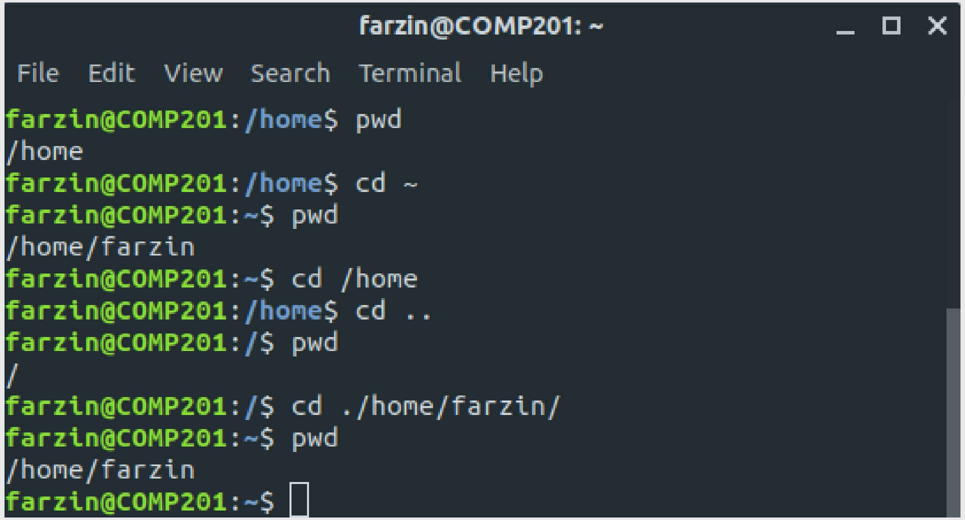
Path

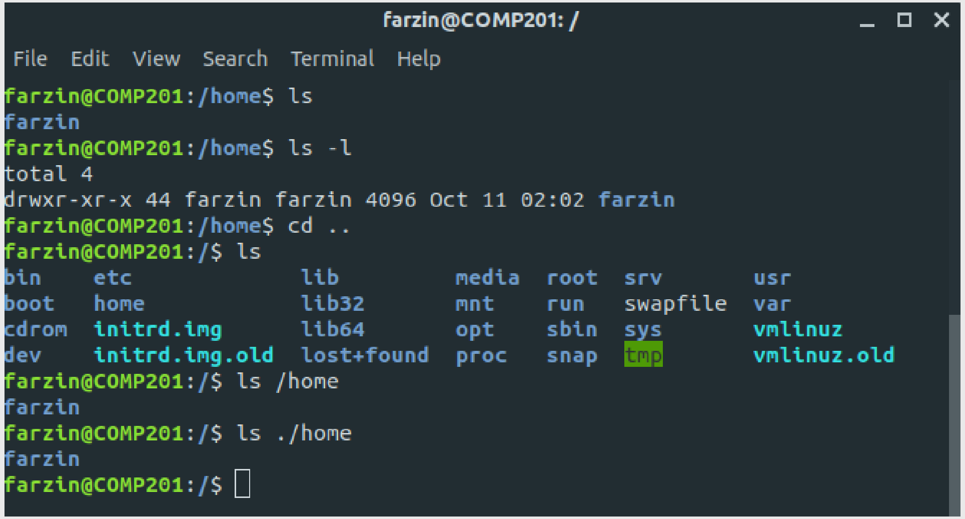


```
farzin@COMP201:/home$ pwd
/home
farzin@COMP201:/home$ cd ~
farzin@COMP201:~$ pwd
/home/farzin
farzin@COMP201:~$ cd /home
farzin@COMP201:/home$ cd ..
farzin@COMP201:/$ pwd
/
farzin@COMP201:/$ cd ./home/farzin/
farzin@COMP201:~$ pwd
/home/farzin
farzin@COMP201:~$ 
```

- **$cd**
  - Changes the working directory
  - .. is the parent directory
  - . is the current directory
  - Tilda (~) is the /home/usr directory

- **Absolute vs Relative path**
  - Relative: ./home/farzin
  - Absolute: /home/farzin

Listing files and directories



```
farzin@COMP201:/home$ ls
farzin
farzin@COMP201:/home$ ls -l
total 4
drwxr-xr-x 44 farzin farzin 4096 Oct 11 02:02 farzin
farzin@COMP201:/home$ cd ..
farzin@COMP201:/$ ls
bin    etc             lib         media  root  srv       usr
boot   home            lib32       mnt    run   swapfile  var
cdrom  initrd.img      lib64       opt    sbin  sys       vmlinuz
dev    initrd.img.old  lost+found  proc   snap  tmp       vmlinuz.old
farzin@COMP201:/$ ls /home
farzin
farzin@COMP201:/$ ls ./home
farzin
farzin@COMP201:/$ 
```

- $ **ls**
  - Prints files and directories under current working directory
  - You can use options with commands like “-l” which shows a long list containing more details of files and folders
  - You can also pass absolute or relative path to $ls command
  - Use --help for more info about arguments
  - Check -a and -F options
  - Try: ls –alt

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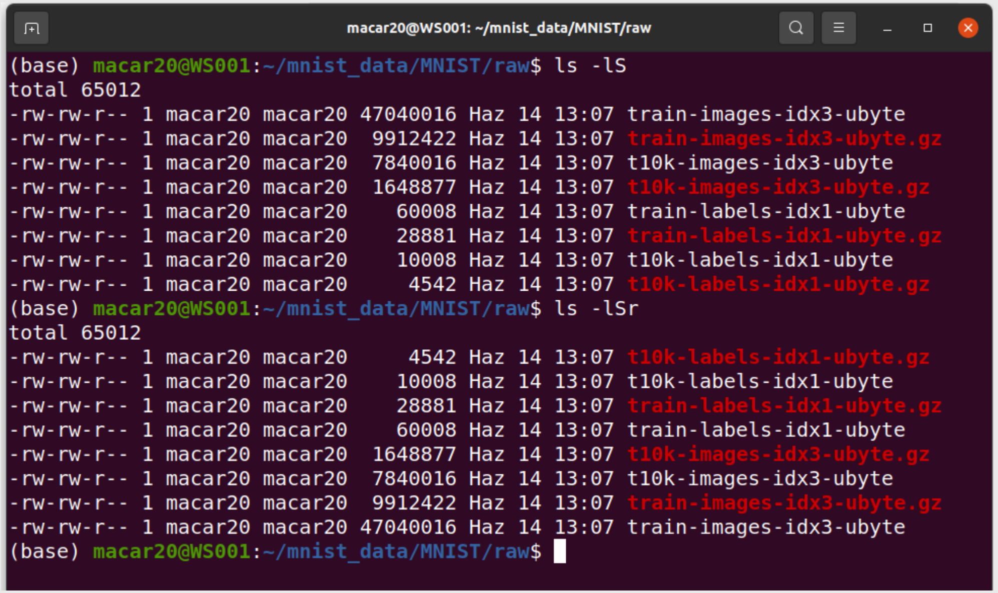
Listing files and directories



```
(base) macar20@WS001:~/mnist_data/MNIST/raw$ ls -lS
total 65012
-rw-rw-r-- 1 macar20 macar20 47040016 Haz 14 13:07 train-images-idx3-ubyte
-rw-rw-r-- 1 macar20 macar20  9912422 Haz 14 13:07 train-images-idx3-ubyte.gz
-rw-rw-r-- 1 macar20 macar20  7840016 Haz 14 13:07 t10k-images-idx3-ubyte
-rw-rw-r-- 1 macar20 macar20  1648877 Haz 14 13:07 t10k-images-idx3-ubyte.gz
-rw-rw-r-- 1 macar20 macar20    60008 Haz 14 13:07 train-labels-idx1-ubyte
-rw-rw-r-- 1 macar20 macar20    28881 Haz 14 13:07 train-labels-idx1-ubyte.gz
-rw-rw-r-- 1 macar20 macar20    10008 Haz 14 13:07 t10k-labels-idx1-ubyte
-rw-rw-r-- 1 macar20 macar20     4542 Haz 14 13:07 t10k-labels-idx1-ubyte.gz
(base) macar20@WS001:~/mnist_data/MNIST/raw$ ls -lSr
total 65012
-rw-rw-r-- 1 macar20 macar20     4542 Haz 14 13:07 t10k-labels-idx1-ubyte.gz
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-rw-rw-r-- 1 macar20 macar20 47040016 Haz 14 13:07 train-images-idx3-ubyte
(base) macar20@WS001:~/mnist_data/MNIST/raw$ 
```

- You can use “-S” option to display files sorted by their sizes, and “-r” option for reverse sorting.

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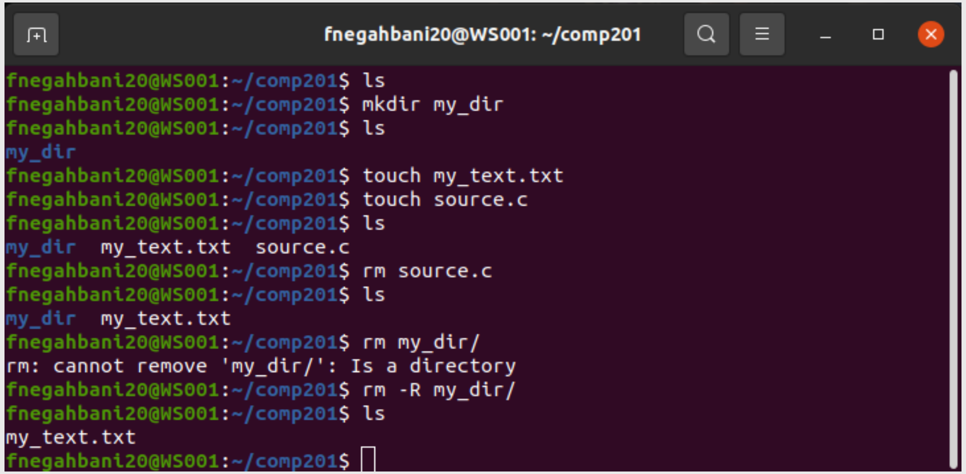
Making directories, files, and removing them



```
fnegahbani20@WS001:~/comp201$ ls
fnegahbani20@WS001:~/comp201$ mkdir my_dir
fnegahbani20@WS001:~/comp201$ ls
my_dir
fnegahbani20@WS001:~/comp201$ touch my_text.txt
fnegahbani20@WS001:~/comp201$ touch source.c
fnegahbani20@WS001:~/comp201$ ls
my_dir  my_text.txt  source.c
fnegahbani20@WS001:~/comp201$ rm source.c
fnegahbani20@WS001:~/comp201$ ls
my_dir  my_text.txt
fnegahbani20@WS001:~/comp201$ rm my_dir/
rm: cannot remove 'my_dir/': Is a directory
fnegahbani20@WS001:~/comp201$ rm -R my_dir/
fnegahbani20@WS001:~/comp201$ ls
my_text.txt
fnegahbani20@WS001:~/comp201$ 
```

- $ **mkdir <folder_name>**
  - Makes a new directory in the given working directory with the given “folder_name”.
- $ **touch**
  - Creates a file with desired extension and name
- $ **rm**
  - Removes a file or folder.
  - For removing folders you need to use -R option

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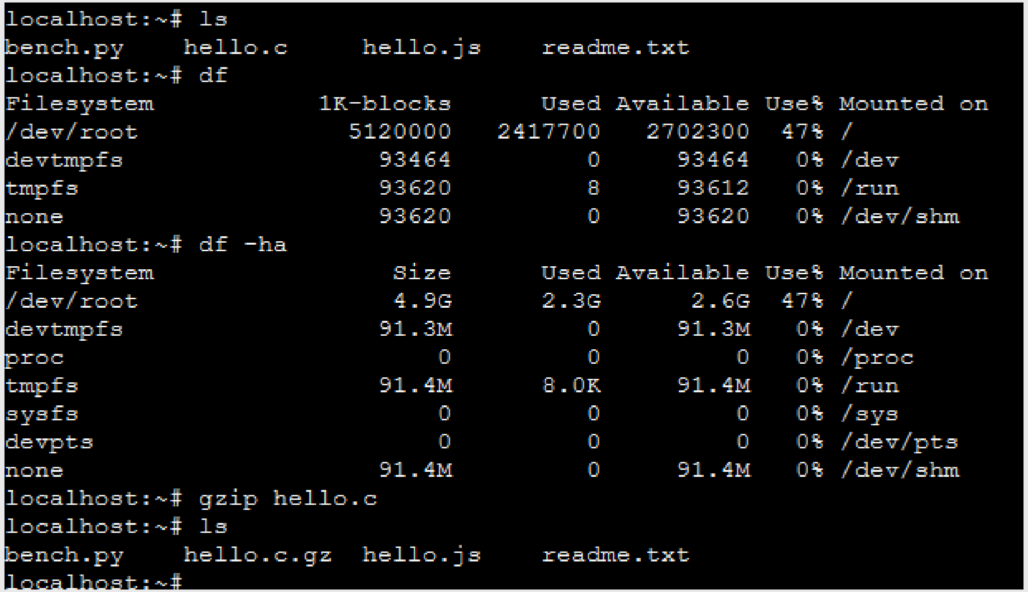
df and gzip



```
localhost:~# ls
bench.py    hello.c     hello.js    readme.txt
localhost:~# df
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/root              5120000   2417700   2702300  47% /
devtmpfs                 93464         0     93464   0% /dev
tmpfs                    93620         8     93612   0% /run
none                     93620         0     93620   0% /dev/shm
localhost:~# df -ha
Filesystem                Size      Used Available Use% Mounted on
/dev/root                 4.9G      2.3G      2.6G  47% /
devtmpfs                 91.3M         0     91.3M   0% /dev
proc                         0         0         0   0% /proc
tmpfs                    91.4M      8.0K     91.4M   0% /run
sysfs                        0         0         0   0% /sys
devpts                       0         0         0   0% /dev/pts
none                     91.4M         0     91.4M   0% /dev/shm
localhost:~# gzip hello.c
localhost:~# ls
bench.py    hello.c.gz  hello.js    readme.txt
localhost:~#
```

- **$ df**
  - (disk free) is a standard Unix command used to display the amount of available disk space
- **$ gzip**
  - Used for file compression and decompression
  - Compressing Single file:
    $ gzip filename
  - Compressing Multiple file:
    $ gzip file1 file2 file3
  - -d: Decompressing Files
  - With --help try to find -k and -v usage.

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File Permission in Linux

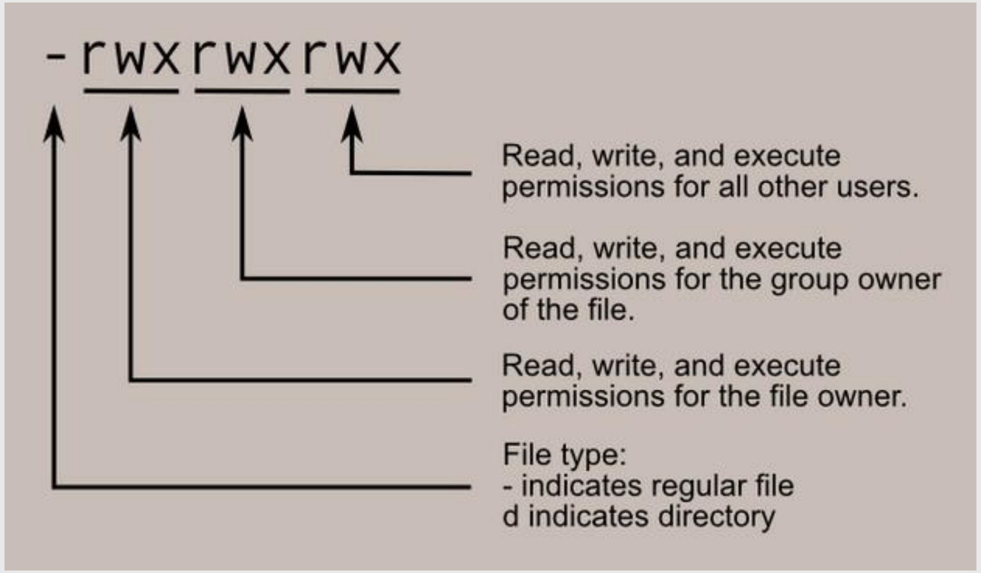
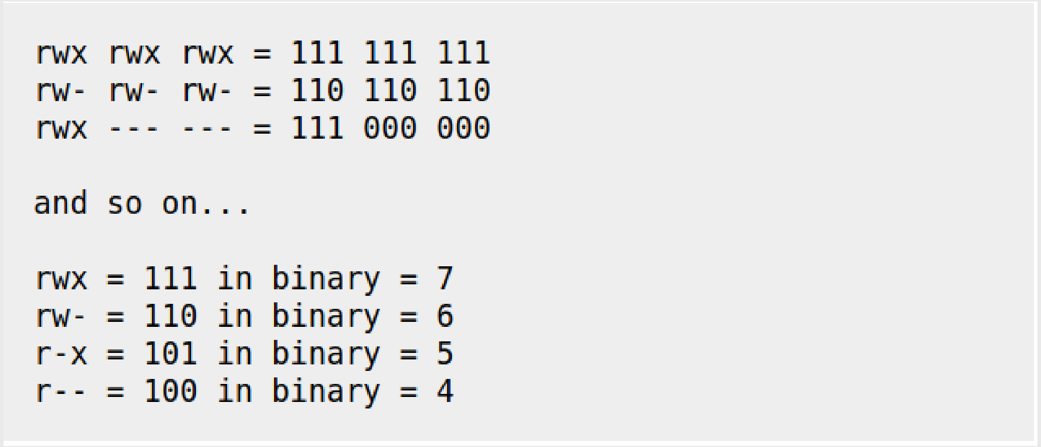

-rwxrwxrwx
Read, write, and execute permissions for all other users.
Read, write, and execute permissions for the group owner of the file.
Read, write, and execute permissions for the file owner.
File type:
- indicates regular file
d indicates directory

Image source: http://linuxcommand.org/lc3_lts0090.php

File Permission in Linux



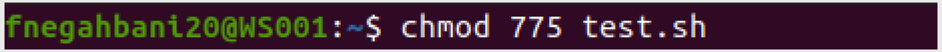
```
rwx rwx rwx = 111 111 111
rw- rw- rw- = 110 110 110
rwx --- --- = 111 000 000

and so on...

rwx = 111 in binary = 7
rw- = 110 in binary = 6
r-x = 101 in binary = 5
r-- = 100 in binary = 4
```

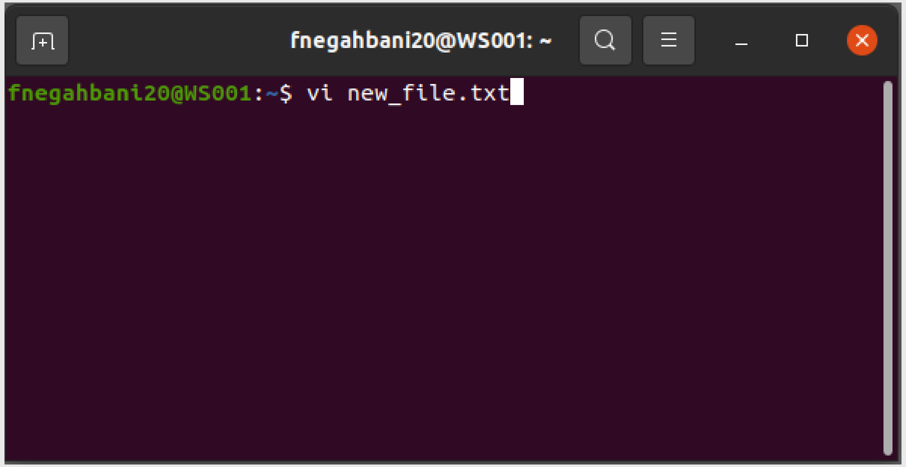
Image source: http://linuxcommand.org/lc3_lts0090.php

Initially, test.sh cannot be executed, to grant -rwx rwx r-x permission to test.sh file:



```
fnegahbani20@WS001:~$ chmod 775 test.sh
```

What is Vi/Vim?



```
fnegahbani20@WS001:~$ vi new_file.txt
```

- Vi/Vim is the default text editor in the UNIX operating system.
- Using vi/vim, we can create a new file, read, and edit an existing file.
- Vim is short for Vi Improved. The two editors are very similar to each other. However, Vim offers some additional functionalities over the Vi editor

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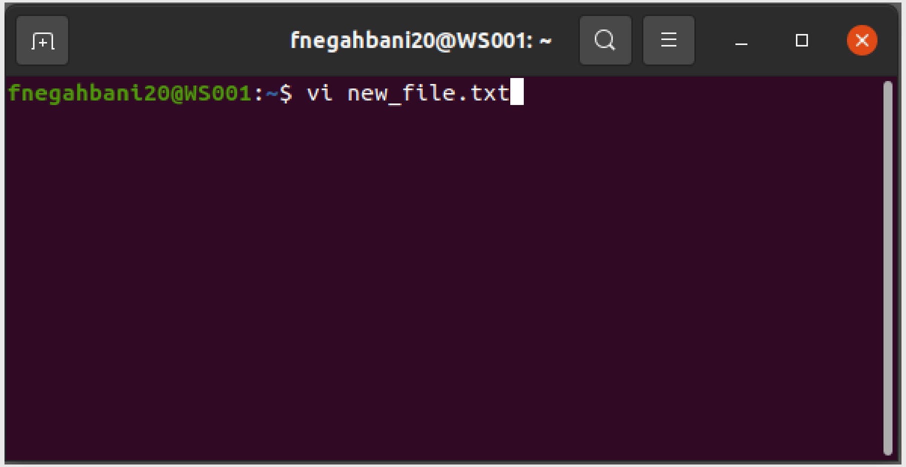
What is Vi/Vim?



```
fnegahbani20@WS001:~$ vi new_file.txt
```

- To open vi, type “vi” or “vi filename”. If the file “filename” doesn’t exist, it will be created when you save it.

- To open vim, type “vim” or “vim filename”. If the file “filename” doesn’t exist, it will be created when you save it.

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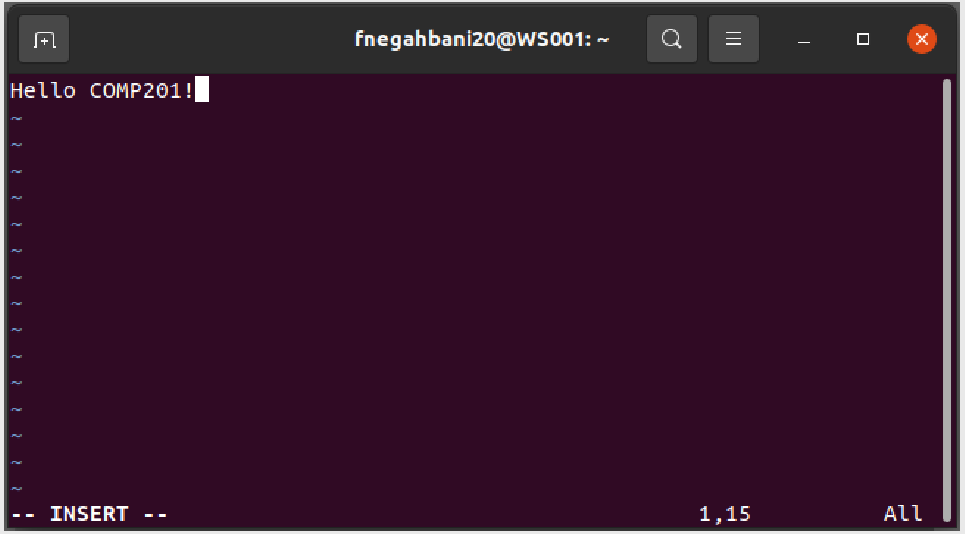
Operation Modes in vi or vim



```
Hello COMP201!
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
-- INSERT --                                    1,15          All
```

- **Normal mode**
  - The default mode in vi.
  - In some source, like https://www.cs.colostate.edu/helpdocs/vi.html, it is also called command mode.
  - Every character you type is interpreted as a command.

- **Insert mode**
  - The one on the left picture.
  - To switch from normal mode to insert mode, type ‘i’ in the normal mode.
  - Every character you type is put to the file.
  - To switch back to normal mode, press <Esc>

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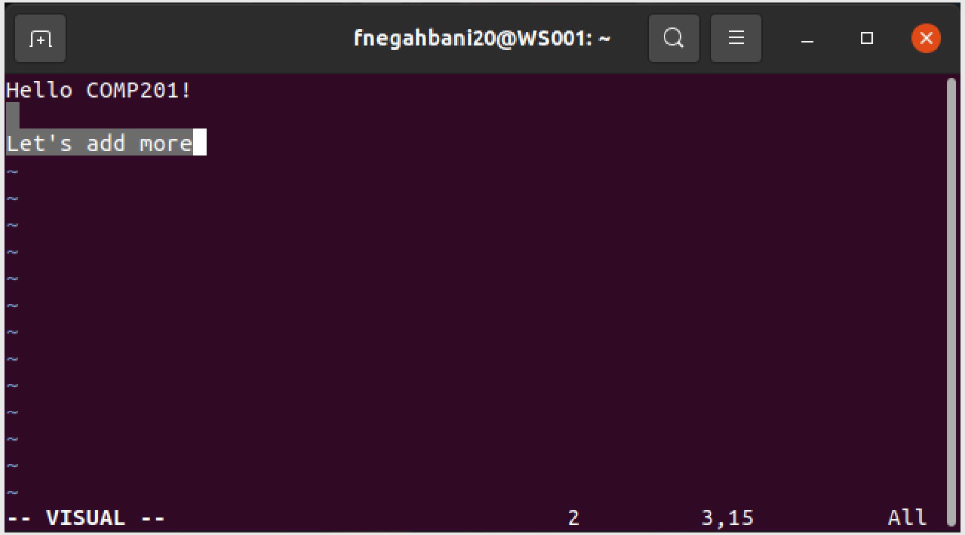
Operation Modes in vi or vim

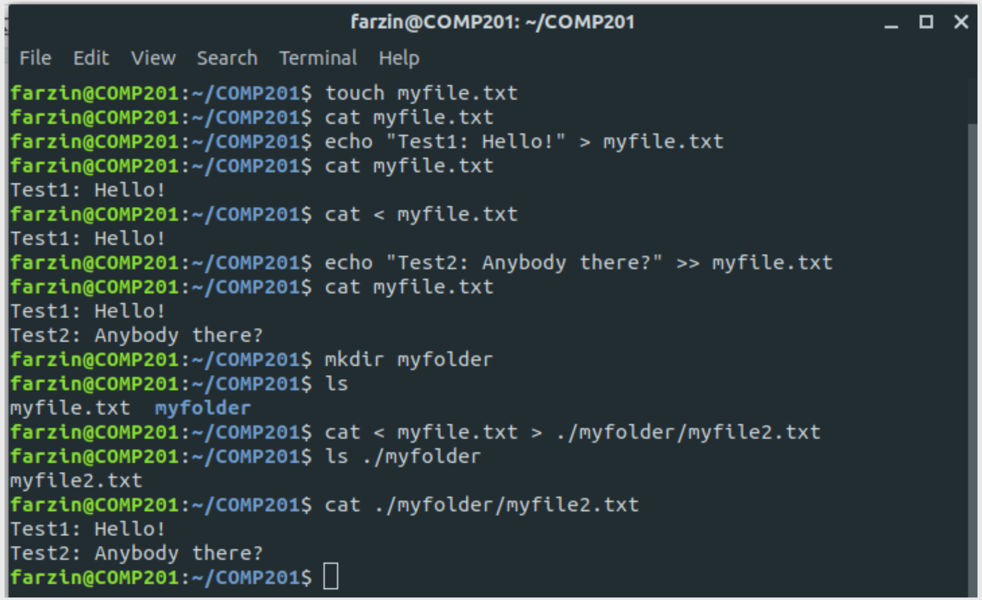


```
Hello COMP201!

Let's add more
~
~
~
~
~
~
~
~
~
~
~
~
~
-- VISUAL --                2          3,15          All
```

- **Visual mode**
  - To switch from normal mode to visual mode, type ‘v’.
  - You can select blocks of text.
  - Type d to delete the block, c to delete the block and switch to insert mode to replace the deleted block with another string.
  - To switch back to normal mode, type <Esc>.
- **Exit without saving**
  - To exit from a file without saving it, go to the Normal mode (command mode) by pressing <Esc> then type :q!

Redirection


farzin@COMP201: ~/COMP201
File Edit View Search Terminal Help

```
farzin@COMP201:~/COMP201$ touch myfile.txt
farzin@COMP201:~/COMP201$ cat myfile.txt
farzin@COMP201:~/COMP201$ echo "Test1: Hello!" > myfile.txt
farzin@COMP201:~/COMP201$ cat myfile.txt
Test1: Hello!
farzin@COMP201:~/COMP201$ cat < myfile.txt
Test1: Hello!
farzin@COMP201:~/COMP201$ echo "Test2: Anybody there?" >> myfile.txt
farzin@COMP201:~/COMP201$ cat myfile.txt
Test1: Hello!
Test2: Anybody there?
farzin@COMP201:~/COMP201$ mkdir myfolder
farzin@COMP201:~/COMP201$ ls
myfile.txt  myfolder
farzin@COMP201:~/COMP201$ cat < myfile.txt > ./myfolder/myfile2.txt
farzin@COMP201:~/COMP201$ ls ./myfolder
myfile2.txt
farzin@COMP201:~/COMP201$ cat ./myfolder/myfile2.txt
Test1: Hello!
Test2: Anybody there?
farzin@COMP201:~/COMP201$ 
```

- **$cat**
  - Print the content of the given file
- **“< file” and “> file”**
  - You can wire the input and output of a program to a file
  - “>> file” appends to end of file

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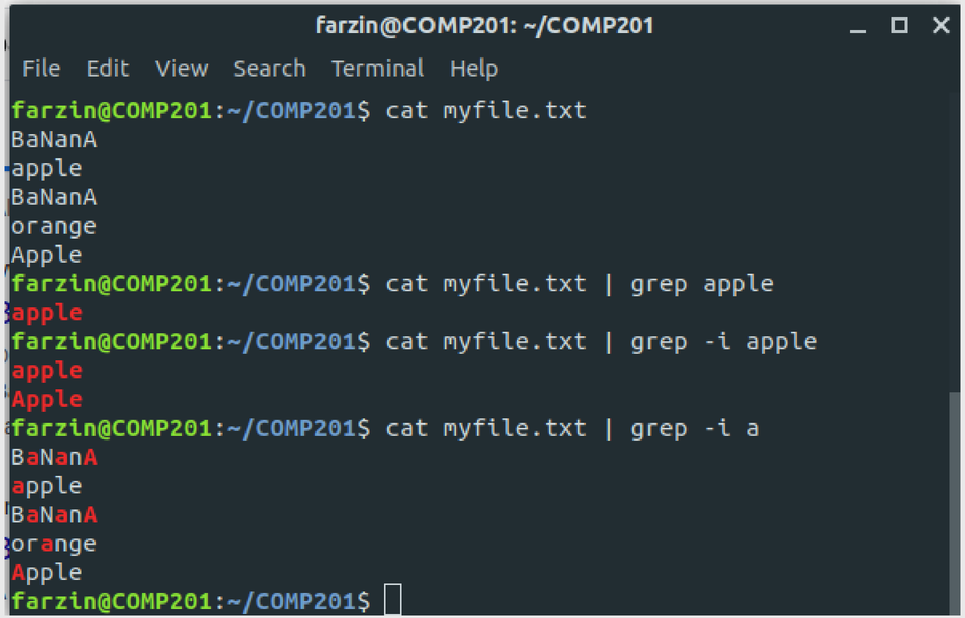
Piping


farzin@COMP201: ~/COMP201
File Edit View Search Terminal Help

```
farzin@COMP201:~/COMP201$ cat myfile.txt
BaNanA
apple
BaNanA
orange
Apple
farzin@COMP201:~/COMP201$ cat myfile.txt | grep apple
apple
farzin@COMP201:~/COMP201$ cat myfile.txt | grep -i apple
apple
Apple
farzin@COMP201:~/COMP201$ cat myfile.txt | grep -i a
BaNanA
apple
BaNanA
orange
Apple
farzin@COMP201:~/COMP201$ 
```

- **Pipe character " | "**
  - Connects output of a program to input of another one
- **$grep**
  - Searches for a particular information
  - By default it is case sensitive
- Try "grep --help" and find what does -i option do

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Other resources:

- UNIX Tutorial for Beginners
- Unix/Linux Command Reference
- MIT MS The Shell
- Stanford CS107 Unix videos 1-15, 24, 25

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