Ubuntu
and basic Linux command part 1

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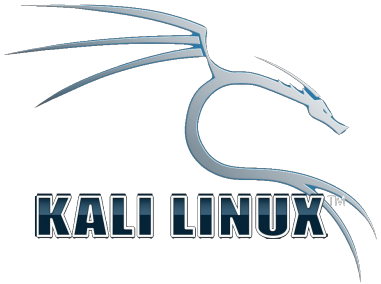
1. Introduction

Some popular Operating Systems

Distributions of linux (OS)

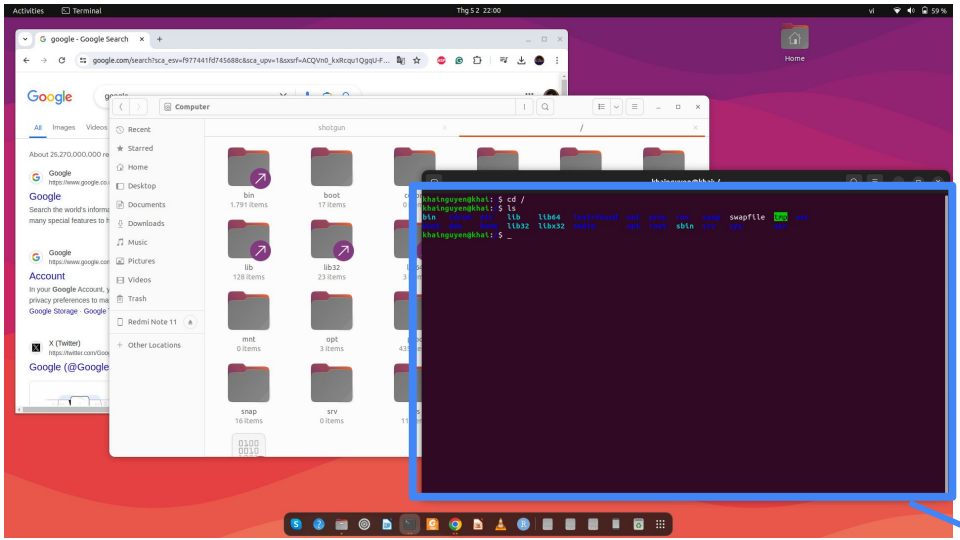
Ubuntu OS has the most users

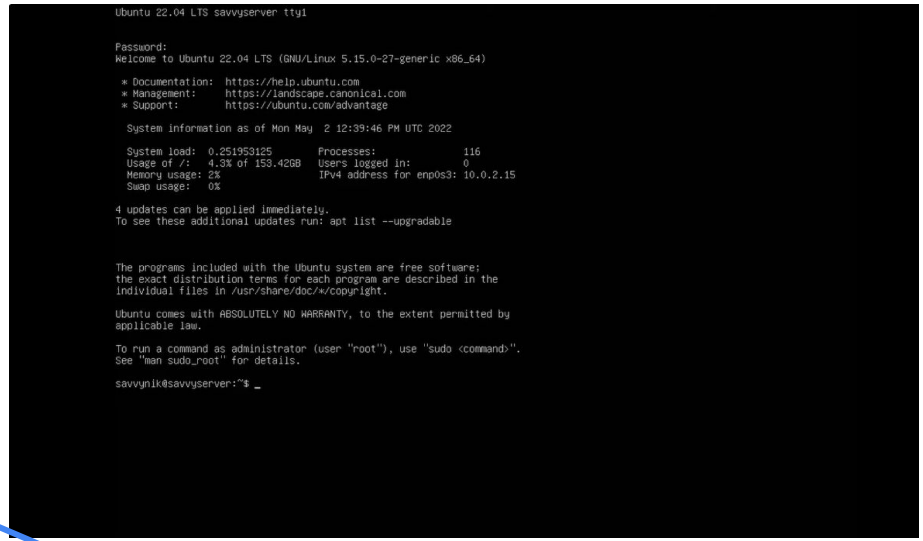


Why linux in bioinformatics?

1. Linux is an open-source operating system.
   - Allows users to customize their systems according to their specific needs.
   - It is free.
2. Linux is the most commonly used operating system in High-Performance Computing (HPC). HPC unlocks primary challenges in bioinformatics:
   - Data processing limits.
   - Slow analysis times.
   - Impact on research progress.
3. Most bioinformatics tools and applications are designed to be run on Linux-based operating systems.

interact with the software/package





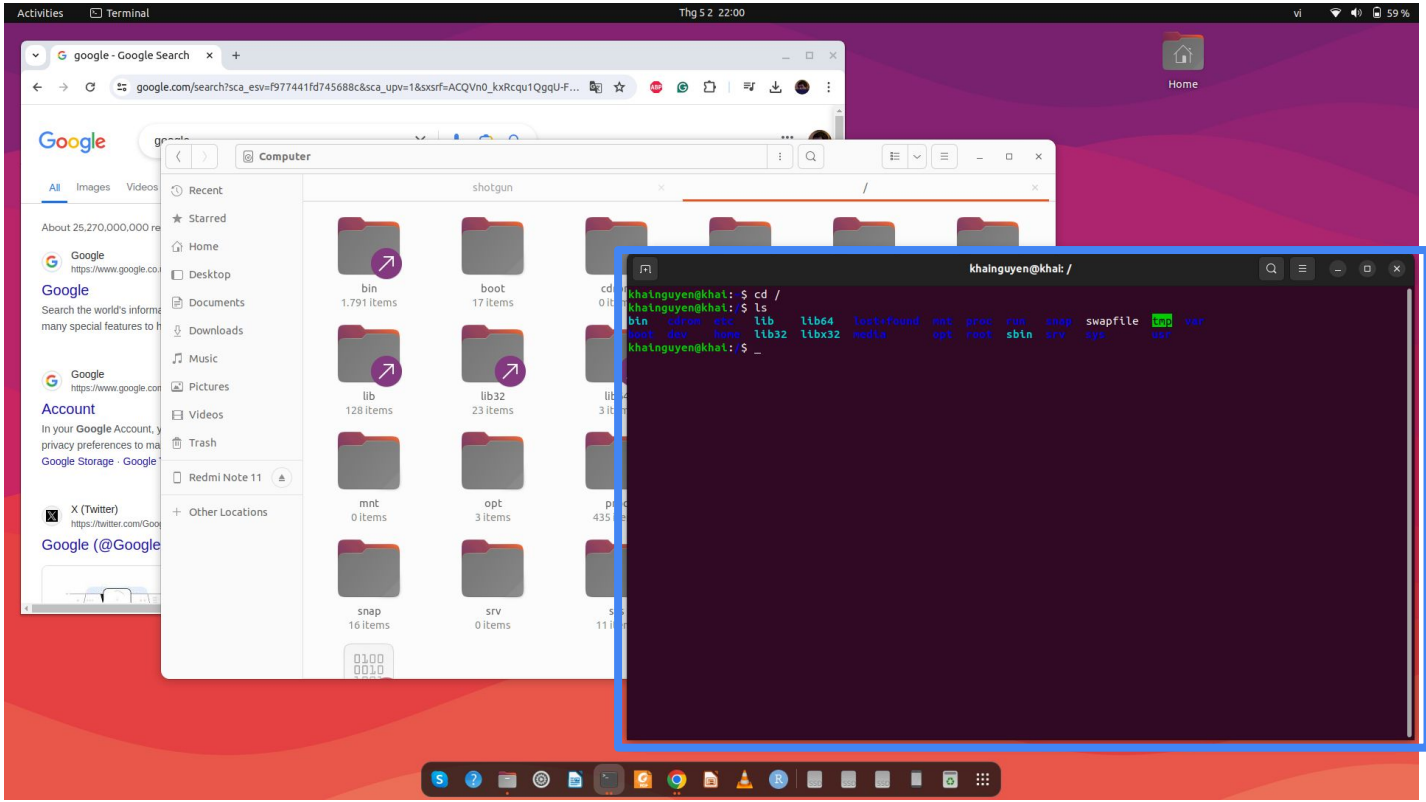
graphic user interface - GUI
(mouse + keyboard)

also called

command line interface - CLI
(keyboard)

Ubuntu desktop: GUI + CLI
Ubuntu server: only CLI

Terminal



Terminal window

is where you
type commands

Open:
Ctrl + Alt + T keys
on the keyboard

Ubuntu desktop

What is Shell?

- A shell is a special user program that provides an interface for the user to use operating system services.

- Terminal is where we interact with the shell through commands.

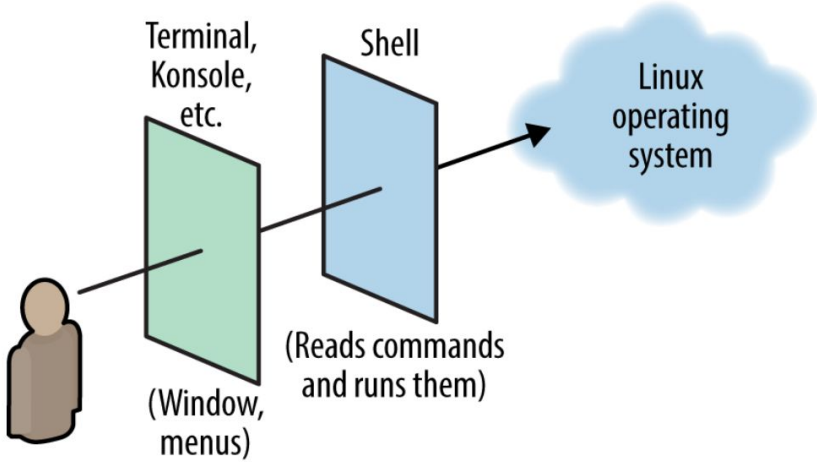
- Several types of Shell:

  +Bourne Shell (sh)

  + C Shell (csh)

  +**Bourne Again Shell (bash): most popular**

  + Z Shell (zsh)

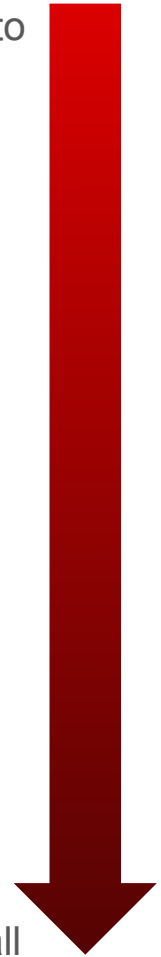


(Daniel J. Barrett, Linux pocket guide)

BASH
THE BOURNE-AGAIN SHELL

Some ways to get the Terminal

easy to install



a bit difficult to install

1.

macOS: How to open Terminal:

https://support.apple.com/en-vn/guide/terminal/apd5265185d-f365-44cb-8b09-71a064a42125/mac

Windows 10/11: Install Ubuntu on Windows Subsystem for Linux (WSL): Recommended for beginners

https://canonical-ubuntu-wsl.readthedocs-hosted.com/en/latest/guides/install-ubuntu-wsl2/

2. Install Ubuntu on virtual machine (VM):

Windows: Install Ubuntu on VirtualBox: https://www.youtube.com/watch?v=ngJQPt-xEeo

macOS: Install Ubuntu on VirtualBox: https://www.youtube.com/watch?v=b_tOialCSXE

3. Install Ubuntu on physical computer: Best for long term use

Delete Windows & install Ubuntu: https://www.youtube.com/watch?v=oZcvqfWf_ps&t=100s

If you don't want to delete windows:

or a) Dual boot: Ubuntu and Windows on the same hard drive:

https://www.youtube.com/watch?v=GXxTxBPKecQ&t=229s

or b) Dual boot: Ubuntu and Windows on the separate hard drive:

(Ubuntu on hard drive 1, Windows on hard drive 2)

https://www.youtube.com/watch?v=KX85vZ3ANVk

Recommended method b) if you want dual-boot.

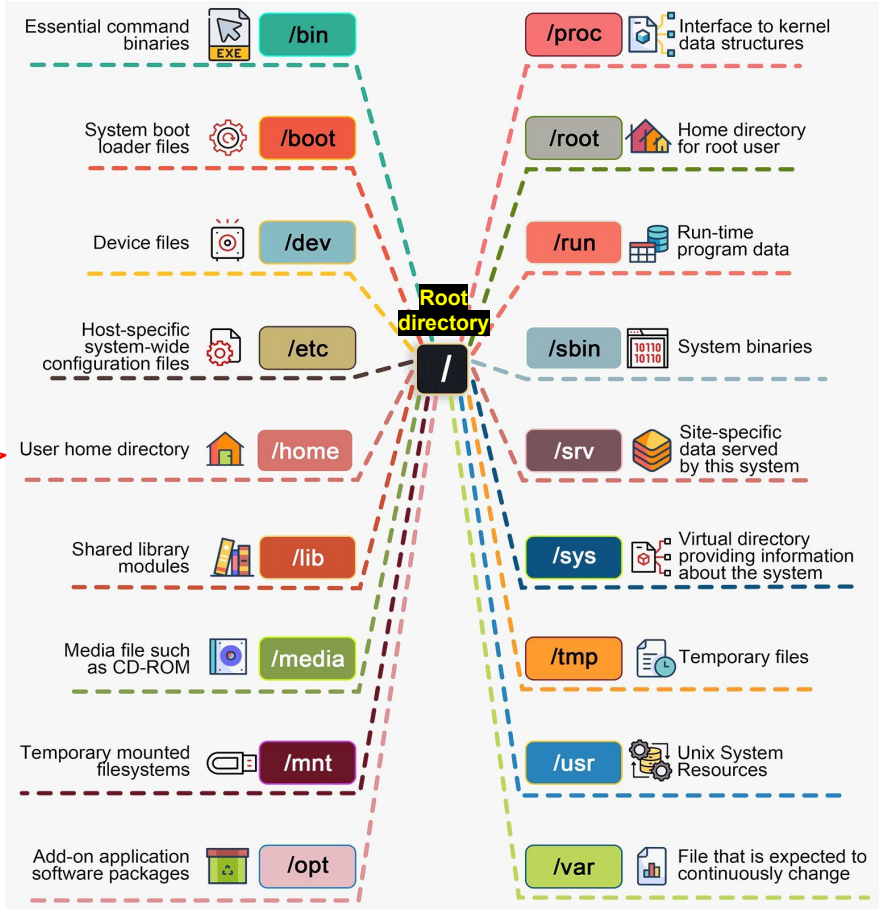
Warning: backup your data before install!!

More reference: https://www.youtube.com/watch?v=oZcvqfWf_ps&t=100s

Linux file systems

user_name directory (or folder):

/home/khainguyen/
/home/vanA/
/home/vanB/



The root directory is a special directory that contains all of the other files and directories on the computer. The root directory is specified as a / at the beginning of a path

https://x.com/bytebytego/status/1764911444993495121

When opening the terminal, default:

tell you the computer is ready to accept a command

$ means non-root user

command prompt

user_name

host name

The tilde (~) represents the home directory of the currently logged in 'user_name'

cursor

This case, user_name is khainguyen, so the path is: /home/khainguyen

ENTER

To print the current path, type the command: pwd → stands for 'print working directory'
,then hitting the ENTER key on keyboard to run the command

A basic command, could be:

Example: ls command

The command line will be read **from left to right** by the shell once press ENTER

command
(must have)

a space

option/flag
(optional)
hyphen-prefixed characters

a space

parameter
(optional)

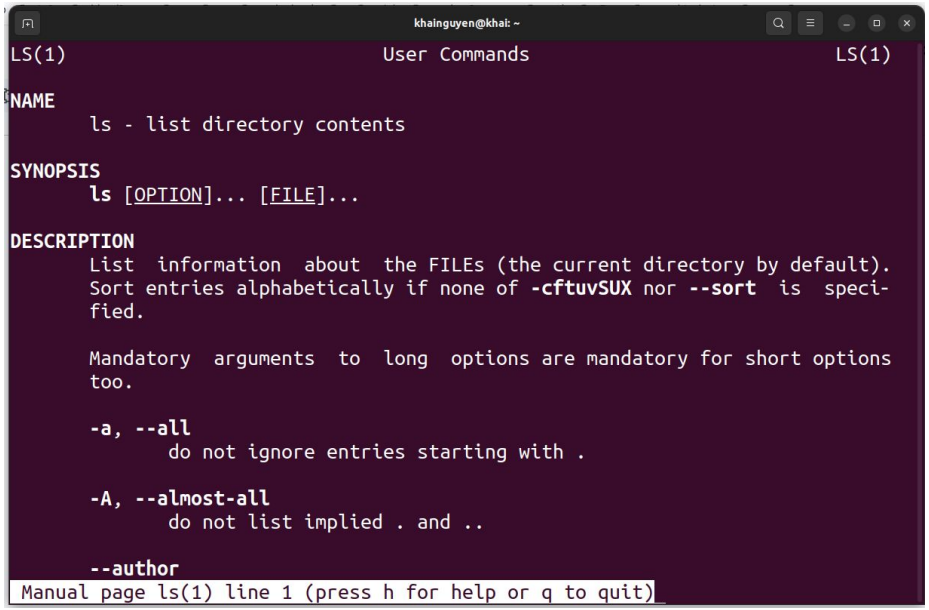
How do I know what options a command has?

man command_name

command_name --help

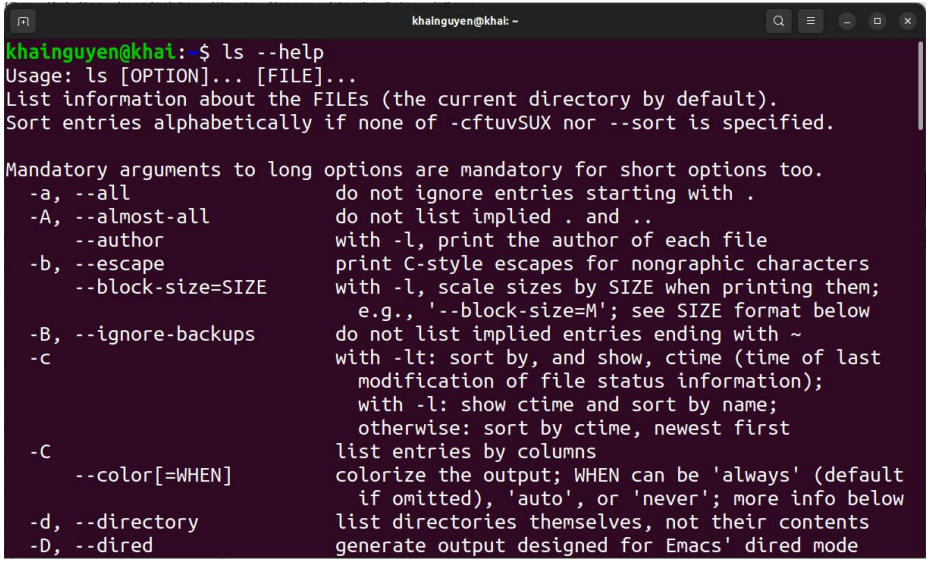
Example: ls command

```
khainguyen@khai:~$ man ls
```



Press q key on keyboard to exit

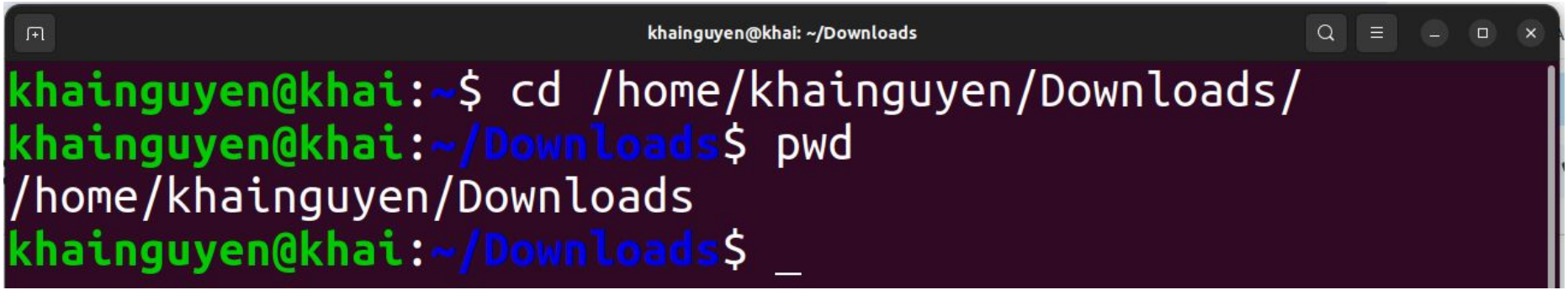
```
khainguyen@khai:~$ ls --help
```



2. Some basic Linux commands work with files and directories

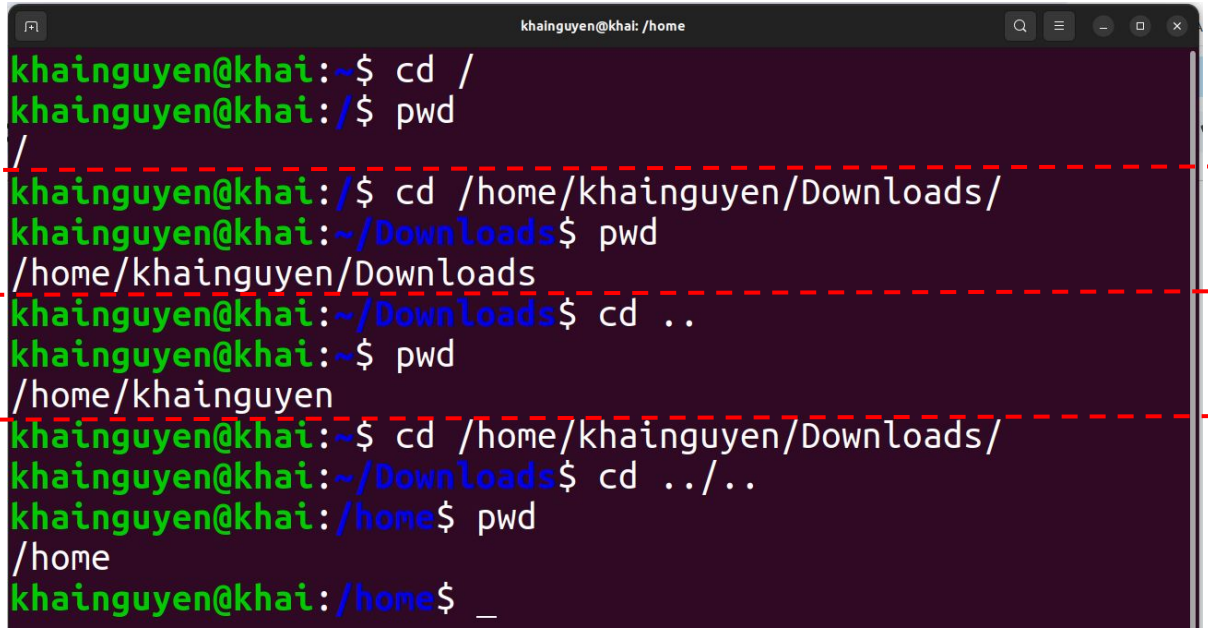
change working directory

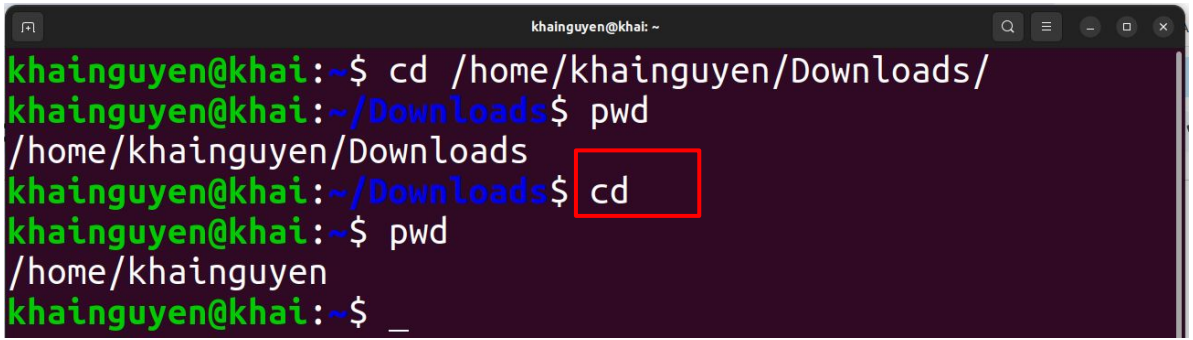
`cd` command, an abbreviation for ‘change directory’.



Path shortcuts

~	the home directory of the currently logged in ‘user_name’
/	the root directory
.	the current directory (or the working directory)
..	the parent directory of the working directory
../..	the parent directory of the parent directory of the working directory

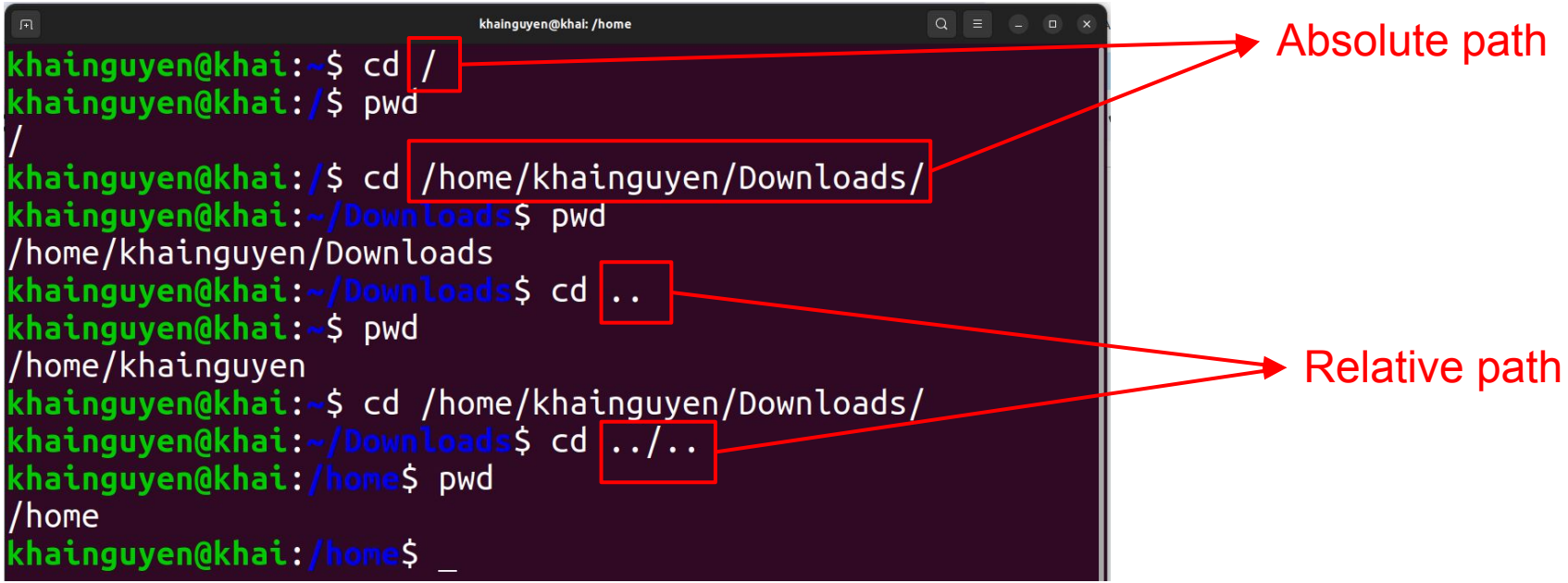




just cd to change to ~

Absolute path: from the root directory to the interest directory/file.

Relative path: from the working directory to the interest directory/file.



Clean up all the command lines and results above, with command: clear

or using: Ctrl-L

Listing content (files and subdirectories) of a directory

with command: ls (“ls" stands for “list”)

list files and directories in current directory (in short format): `ls`

```
khainguyen@khai:~$ ls
230Sam      ENTER                                opt                                          r_mgs2amr
bin         Exercise_1                           Pictures                                     shotgun
card        localDB                              Public                                       snap
Desktop     mgs2amr                              qiime2-amplicon-2024.2-py38-linux-conda.yml  Templates
Documents   Miniconda3-py312_24.1.2-0-Linux-x86_64.sh  qiime2-inport                        Videos
Downloads   Music                                R
khainguyen@khai:~$ _
```

list all files and directories in current directory (in short format): `ls -a` or `ls --all`

```
khainguyen@khai:~$ ls -a
.                .gnome                               Public
..               .gnupg                               .python_history
230Sam           .hplip                               qiime2-amplicon-2024.2-py38-linux-conda.yml
.anthy           .ibus                                qiime2-inport
.bash_history    .java                                R
.bash_logout     .lesshst                             .Rhistory
.bashrc          .local                               r_mgs2amr
bin              localDB                              shotgun
.cache           mgs2amr                              snap
card             Miniconda3-py312_24.1.2-0-Linux-x86_64.sh  .sudo_as_admin_successful
.conda           .mozilla                             Templates
.condarc         Music                                .thunderbird
.config          .nebi                                .vim_d
.cups            .nv                                  .var
Desktop          opt                                  Videos
Documents        .pam_environment                     .viminfo
Downloads        Pictures                             .vscode
ENTER            .pki                                 .wget-hsts
Exercise_1       .profile                             .xinputrc
khainguyen@khai:~$ _
```

`ls --help`

```
-a, --all                  do not ignore entries starting with .
```

list files and directories in current directory (in long format): ls -l

```
khainguyen@khai:~$ ls -l
total 140772
drwxrwxr-x  4 khainguyen khainguyen      4096 Thg 3   7 19:26 2305am
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 bin
drwxrwxr-x  6 khainguyen khainguyen      4096 Thg 4  21 17:50 card
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Desktop
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 11 25 22:16 Documents
drwxr-xr-x  4 khainguyen khainguyen      4096 Thg 5   4 00:05 Downloads
drwxrwxr-x 19 khainguyen khainguyen      4096 Thg 3  25 19:50 ENTER
drwxrwxr-x  5 khainguyen khainguyen      4096 Thg 3   6 15:28 Exercise_1
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 4  21 10:35 localDB
drwxrwxr-x  9 khainguyen khainguyen      4096 Thg 4  18 13:33 mgs2amr
-rw-rw-r--  1 khainguyen khainguyen 144041912 Thg 3  25 17:29 Miniconda3-py312_24.1.2-0-Linux-x86_64.sh
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Music
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 10  8  2023 opt
drwxr-xr-x  3 khainguyen khainguyen      4096 Thg 10  8  2023 Pictures
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Public
-rw-rw-r--  1 khainguyen khainguyen     13837 Thg 3  25 20:09 qiime2-amplicon-2024.2-py38-linux-conda.yml
drwxrwxr-x 14 khainguyen khainguyen      4096 Thg 3  29 18:11 qiime2-import
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 4  16 20:03 R
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 4  18 13:25 r_mgs2amr
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 5   2 20:11 shotgun
drwx------  7 khainguyen khainguyen      4096 Thg 10 24  2023 snap
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Templates
drwxr-xr-x  3 khainguyen khainguyen      4096 Thg 10 27  2023 Videos
khainguyen@khai:~$ _
```

ls --help

```
-l                         use a long listing format
```

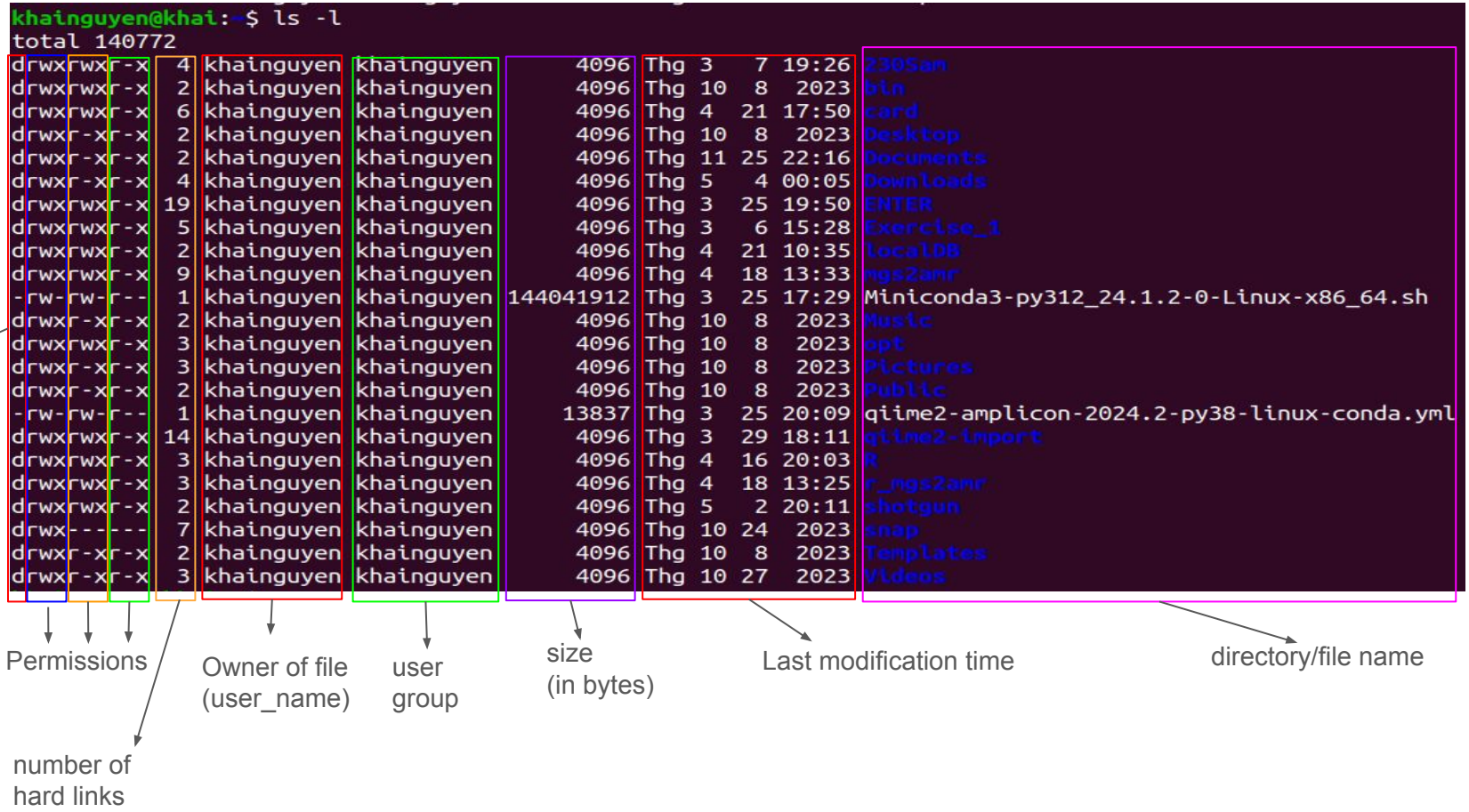
list all files and directories in current directory (in long format): ls -al

```
khainguyen@khai:~$ ls -al
total 140964
drwxr-x--- 42 khainguyen khainguyen      4096 Thg 5   4 15:33 .
drwxr-xr-x  3 root       root            4096 Thg 10  8  2023 ..
drwxrwxr-x  4 khainguyen khainguyen      4096 Thg 3   7 19:26 230Sam
drwx------  2 khainguyen khainguyen      4096 Thg 11 21 23:18 .anthy
-rw-------  1 khainguyen khainguyen     56345 Thg 5   4 15:28 .bash_history
-rw-r--r--  1 khainguyen khainguyen       220 Thg 10  8  2023 .bash_logout
-rw-r--r--  1 khainguyen khainguyen      4619 Thg 5   2 23:57 .bashrc
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 bin
drwx------ 36 khainguyen khainguyen      4096 Thg 4   21 16:24 .cache
drwxrwxr-x  6 khainguyen khainguyen      4096 Thg 4   21 17:50 card
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 10 11  2023 .conda
-rw-rw-r--  1 khainguyen khainguyen        26 Thg 3   25 22:13 .condarc
drwx------ 34 khainguyen khainguyen      4096 Thg 4   30 23:24 .config
drwx------  2 khainguyen khainguyen      4096 Thg 3   6 17:33 .cups
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Desktop
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 11 25 22:16 Documents
drwxr-xr-x  4 khainguyen khainguyen      4096 Thg 5   4 00:05 Downloads
drwxrwxr-x 19 khainguyen khainguyen      4096 Thg 3   25 19:50 ENTER
drwxrwxr-x  5 khainguyen khainguyen      4096 Thg 3   6 15:28 Exercise_1
drwx------  3 khainguyen khainguyen      4096 Thg 10  8  2023 .gnome
drwx------  2 khainguyen khainguyen      4096 Thg 4   30 23:24 .gnupg
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 3   6 17:21 .hplip
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 10  8  2023 .ibus
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 12 13 16:41 .java
-rw-------  1 khainguyen khainguyen        20 Thg 4   16 18:10 .lesshst
drwx------  3 khainguyen khainguyen      4096 Thg 10  8  2023 .local
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 4   21 10:35 localDB
drwxrwxr-x  9 khainguyen khainguyen      4096 Thg 4   18 13:33 mgs2amr
-rw-rw-r--  1 khainguyen khainguyen 144041912 Thg 3   25 17:29 Miniconda3-py312_24.1.2-0-Linux-x86_64.sh
drwx------  3 khainguyen khainguyen      4096 Thg 11 25 20:56 .mozilla
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Music
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 11  9 20:23 .ncbi
drwx------  3 khainguyen khainguyen      4096 Thg 10 12  2023 .nv
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 10  8  2023 opt
-rw-r--r--  1 khainguyen khainguyen       303 Thg 10  9  2023 .pam_environment
```

```
-rw-r--r--  1 khainguyen khainguyen       303 Thg 10  9  2023 .pam_environment
drwxr-xr-x  3 khainguyen khainguyen      4096 Thg 10  8  2023 Pictures
drwx------  3 khainguyen khainguyen      4096 Thg 10  8  2023 .pki
-rw-r--r--  1 khainguyen khainguyen       851 Thg 4   18 00:30 .profile
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Public
-rw-------  1 khainguyen khainguyen       858 Thg 3    3 16:25 .python_history
-rw-rw-r--  1 khainguyen khainguyen     13837 Thg 3   25 20:09 qiime2-amplicon-2024.2-py38-linux-conda.yml
drwxrwxr-x 14 khainguyen khainguyen      4096 Thg 3   29 18:11 qiime2-import
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 4   16 20:03 R
-rw-rw-r--  1 khainguyen khainguyen        88 Thg 4   21 21:00 .Rhistory
drwxrwxr-x  3 khainguyen khainguyen      4096 Thg 4   18 13:25 r_mgs2amr
drwxrwxr-x  2 khainguyen khainguyen      4096 Thg 5    2 20:11 shotgun
drwx------  7 khainguyen khainguyen      4096 Thg 10 24  2023 snap
-rw-r--r--  1 khainguyen khainguyen         0 Thg 10  8  2023 .sudo_as_admin_successful
drwxr-xr-x  2 khainguyen khainguyen      4096 Thg 10  8  2023 Templates
drwx------  6 khainguyen khainguyen      4096 Thg 11 25 20:56 .thunderbird
drwx------  3 khainguyen khainguyen      4096 Thg 10  8  2023 .vim.d
drwxr-xr-x  3 khainguyen khainguyen      4096 Thg 10 18  2023 .var
drwxr-xr-x  3 khainguyen khainguyen      4096 Thg 10 27  2023 Videos
-rw-------  1 khainguyen khainguyen      7478 Thg 4   21 10:47 .viminfo
drwxrwxr-x  4 khainguyen khainguyen      4096 Thg 4   30 23:24 .vscode
-rw-rw-r--  1 khainguyen khainguyen       530 Thg 4   18 12:31 .wget-hsts
-rw-rw-r--  1 khainguyen khainguyen       131 Thg 10  8  2023 .xinputrc
khainguyen@khai:~$ _
```

list files and directories in another directory (in long format): ls -l path_to_directory

```
khainguyen@khai:~$ ls -l /var/
total 48
drwxr-xr-x  2 root root     4096 Thg 5   1 00:00 backups
drwxr-xr-x 18 root root     4096 Thg 10 11  2023 cache
drwxrwsrwt  2 root whoopsie 4096 Thg 5   5 13:28 crash
drwxr-xr-x 74 root root     4096 Thg 3   6 16:40 lib
drwxrwsr-x  2 root staff    4096 Thg 4  18  2022 local
lrwxrwxrwx  1 root root        9 Thg 10  8  2023 lock -> /run/lock
drwxrwxr-x 14 root syslog   4096 Thg 5   6 00:00 log
drwxrwsr-x  2 root mail     4096 Thg 8   8  2023 mail
drwxrwsrwt  2 root whoopsie 4096 Thg 8   8  2023 metrics
drwxr-xr-x  2 root root     4096 Thg 8   8  2023 opt
lrwxrwxrwx  1 root root        4 Thg 10  8  2023 run -> /run
drwxr-xr-x 16 root root     4096 Thg 10 24  2023 snap
drwxr-xr-x  7 root root     4096 Thg 8   8  2023 spool
drwxrwxrwt 13 root root     4096 Thg 5   6 15:55 tmp
khainguyen@khai:~$ _
```

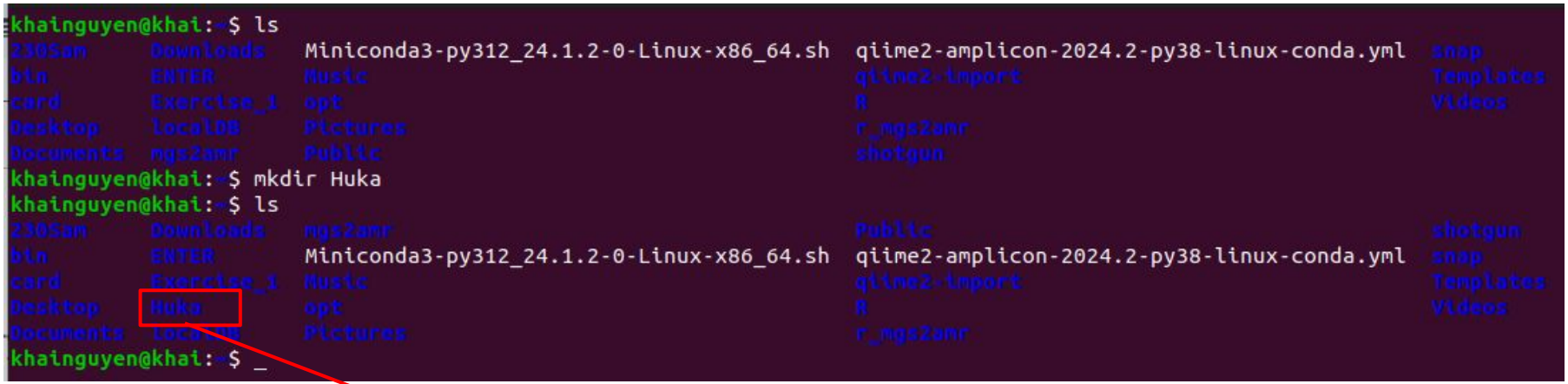

khainguyen@khai:~$ ls -l
total 140772
drwxrwxr-x 4 khainguyen khainguyen 4096 Thg 3 7 19:26 230Sam
drwxrwxr-x 2 khainguyen khainguyen 4096 Thg 10 8 2023 bin
drwxrwxr-x 6 khainguyen khainguyen 4096 Thg 4 21 17:50 card
drwxr-xr-x 2 khainguyen khainguyen 4096 Thg 10 8 2023 Desktop
drwxr-xr-x 2 khainguyen khainguyen 4096 Thg 11 25 22:16 Documents
drwxr-xr-x 4 khainguyen khainguyen 4096 Thg 5 4 00:05 Downloads
drwxrwxr-x 19 khainguyen khainguyen 4096 Thg 3 25 19:50 ENTER
drwxrwxr-x 5 khainguyen khainguyen 4096 Thg 3 6 15:28 Exercise_1
drwxrwxr-x 2 khainguyen khainguyen 4096 Thg 4 21 10:35 localDB
drwxrwxr-x 9 khainguyen khainguyen 4096 Thg 4 18 13:33 mgs2amr
-rw-rw-r-- 1 khainguyen khainguyen 144041912 Thg 3 25 17:29 Miniconda3-py312_24.1.2-0-Linux-x86_64.sh
drwxr-xr-x 2 khainguyen khainguyen 4096 Thg 10 8 2023 Music
drwxrwxr-x 3 khainguyen khainguyen 4096 Thg 10 8 2023 opt
drwxr-xr-x 3 khainguyen khainguyen 4096 Thg 10 8 2023 Pictures
drwxr-xr-x 2 khainguyen khainguyen 4096 Thg 10 8 2023 Public
-rw-rw-r-- 1 khainguyen khainguyen 13837 Thg 3 25 20:09 qiime2-amplicon-2024.2-py38-linux-conda.yml
drwxrwxr-x 14 khainguyen khainguyen 4096 Thg 3 29 18:11 qiime2-import
drwxrwxr-x 3 khainguyen khainguyen 4096 Thg 4 16 20:03 R
drwxrwxr-x 3 khainguyen khainguyen 4096 Thg 4 18 13:25 r_mgs2amr
drwxrwxr-x 2 khainguyen khainguyen 4096 Thg 5 2 20:11 shotgun
drwx------ 7 khainguyen khainguyen 4096 Thg 10 24 2023 snap
drwxr-xr-x 2 khainguyen khainguyen 4096 Thg 10 8 2023 Templates
drwxr-xr-x 3 khainguyen khainguyen 4096 Thg 10 27 2023 Videos
File type: "d" means this is a directory
Permissions
number of hard links
Owner of file (user_name)
user group
size (in bytes)
Last modification time
directory/file name

Create and remove directory

Create a directory named “Huka” in the current directory (~) , with the command: mkdir

`mkdir Huka` or `mkdir ./Huka`

“mkdir” stands for “make directory”



Run “ls" to check

a new directory is created

Create and remove directory

Create three directory named “Huki”, “Huka", “Huke" in the current directory

```
mkdir Huki Huka Huke
```

Delete a empty directory named “Huka” in current directory, with command: rmdir

```
rmdir Huka
```

“rmdir” stands for “remove directory”

Delete a non-empty directory named “Huka” in current directory, with the command “rm”, option -r:

```
rm -r Huka
```

or

```
rm -R Huka
```

or

```
rm --recursive Huka/
```

“rm” stands for “remove”

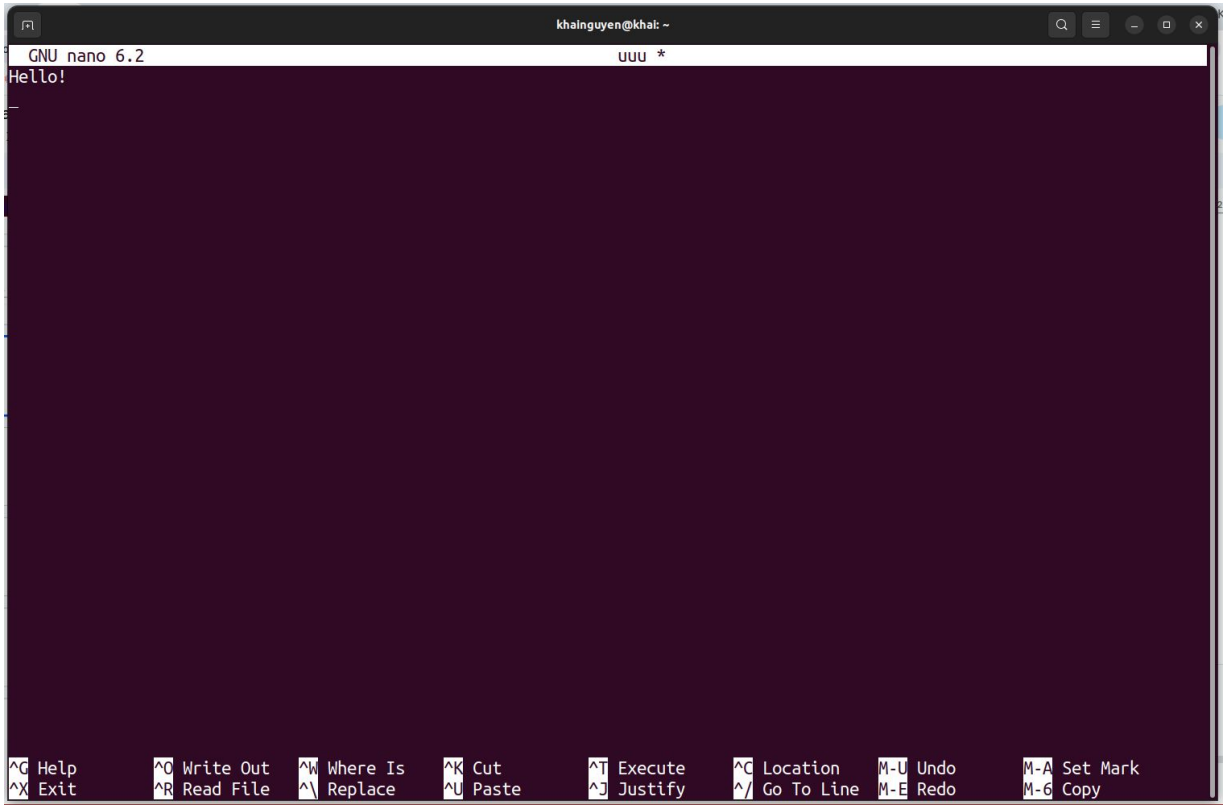
```
rm --help
```

```
  -r, -R, --recursive   remove directories and their contents recursively
```

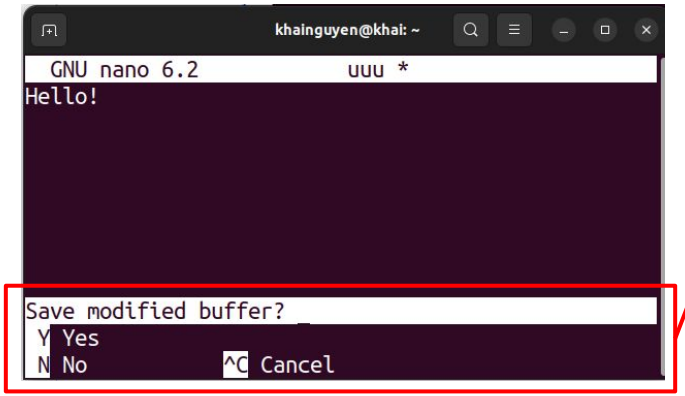
Create and remove file

Create and edit text file with nano, a text editor

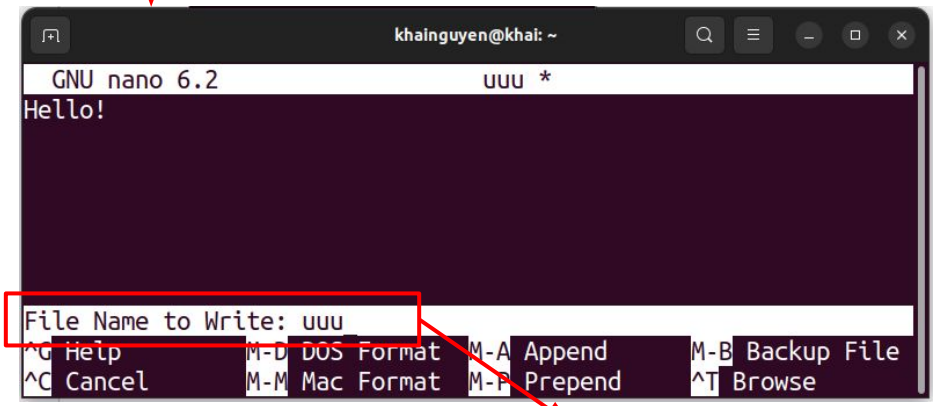
1. Create a text file named “uuu" (“uuu” doesn't exist): `nano` or `nano uuu`



2. Exit nano: ctrl + x



3. Type “y" to save:



Edit the file name if you don't want the name "uuu"

4. Finish: press ENTER key

We can view the file “uuu" with nano by run (if the file exist in current directory):

```
nano uuu
```

Create a empty file named “uuu", with “touch” command : `touch uuu`

Delete a (empty or non-empty) file named “uuu” in current directory, with the command “rm”: `rm uuu`

View the file with another commands

View the file with command: less

```
khainguyen@khai:~$ less uuu
```

ENTER

press “q" key to quit

View the file with command: cat

```
khainguyen@khai:~$ cat uuu
dgdfg
gdgdf
dfgdfgd
```

Copy and move file/directory

Copy a file named “uuu” in the current directory to ./Download/, with command: cp

```
cp ./uuu ./Download/
```

“cp” stands for “copy”

Copy three the file named “uuu”, “iii", “yyy" in the current directory to./Download/

```
cp ./uuu ./iii ./yyy ./Download/
```

or

```
cp uuu iii yyy ./Download/
```

or

```
cp ./{iii,yyy,uuu} ./Downloads/
```

Create a copy of the file named "uuu" with a different name "ooo" in the current directory

```
cp ./uuu ./ooo
```

Copy a empty directory named “Huka” in the current directory to ./Download/

```
cp ./Huka/ ./Download/
```

note again: **./** means the current directory

Copy and move file/directory

Copy a non-empty directory named “Huka” in the current directory to ./Download/

```
cp -r ./Huka/ ./Download/
```

Move a file named “uuu” in the current directory to /home/khainguyen/Download/, with command: mv

```
mv ./uuu ./Download/
```

“mv” stands for “move”

Move a empty directory named “Huka” in the current directory to /home/khainguyen/Download/

```
mv ./Huka/ ./Downloads/
```

if Huka/ is a non-empty directory, add -r option:

```
mv -r ./Huka/ ./Downloads/
```

Rename a file named “uuu” to “eee":

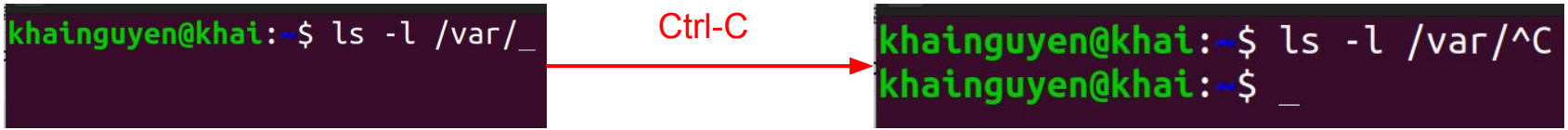
```
mv ./uuu ./eee
```

Rename a directory named “Huka” to “Huko":

```
mv ./Huka/ ./Huko/
```

Shortcuts:

· Ctrl-C stops the current in-progress command and/or



· **Up arrow** key: shows previous commands

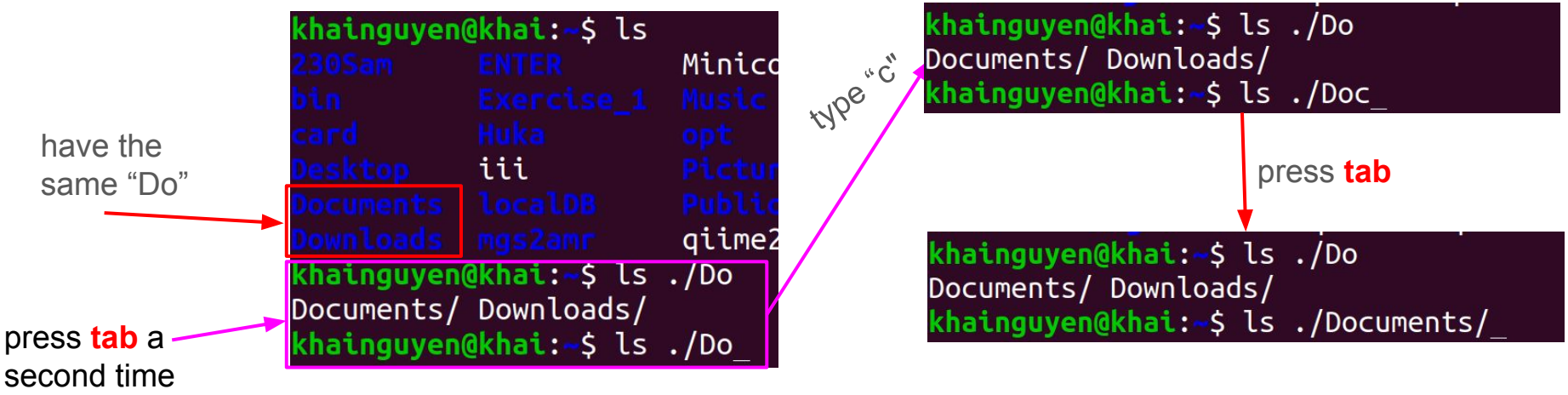
· history command: will show the history of commands you have run.

Shortcuts:

· Ctrl-A moves the cursor to the beginning of the line.

· Ctrl-E moves the cursor to the end of the line.

· Tab key automatically completes commands.



· Ctrl-D exit the terminal.

Summary

pwd	print working directory (or current directory) path
cd	change working directory
ls	Listing content (files and subdirectories) of the directory
clear	clean up all the command lines and results above
mkdir	create the directory
rmdir	delete the empty directory
rm	delete file
rm -r	delete non-empty (or empty) directory, delete file

Summary

nano	a text editor: create, view, edit the text file
touch	create the empty file
less	view text file page by page
cat	Print the content of the text file to the terminal
cp	copy file/directory
mv	move file/directory, rename file/directory
man command_name	Instructions for using the command
command_name --help	

Homework

1. Move to the “Documents” directory in “user_name" directory in home directory. Use: cd

Solve the questions below while still in the “Documents” directory

2. Create 01 directory named “bio1” in “Documents” directory. Use: mkdir
3. Create 01 file named “chr1” in “bio1" directory. Use: touch or nano
4. Create 02 directories named “bio2” and “bio3” in “Documents” directory, with **one command line**. Use: mkdir
5. Create: 2 files named “chr2” and “chr3” in “bio2" directory, 2 files named “chr4” and “chr5” in “bio3" directory, with **one command line**. Use: mkdir
6. Copy “chr2" file into “bio1" directory, with a different name “c2". Use: cp
7. Delete all newly created files and folders above, with **one command line**. Use: rm -r

Answers will be sent on 22/05/2024