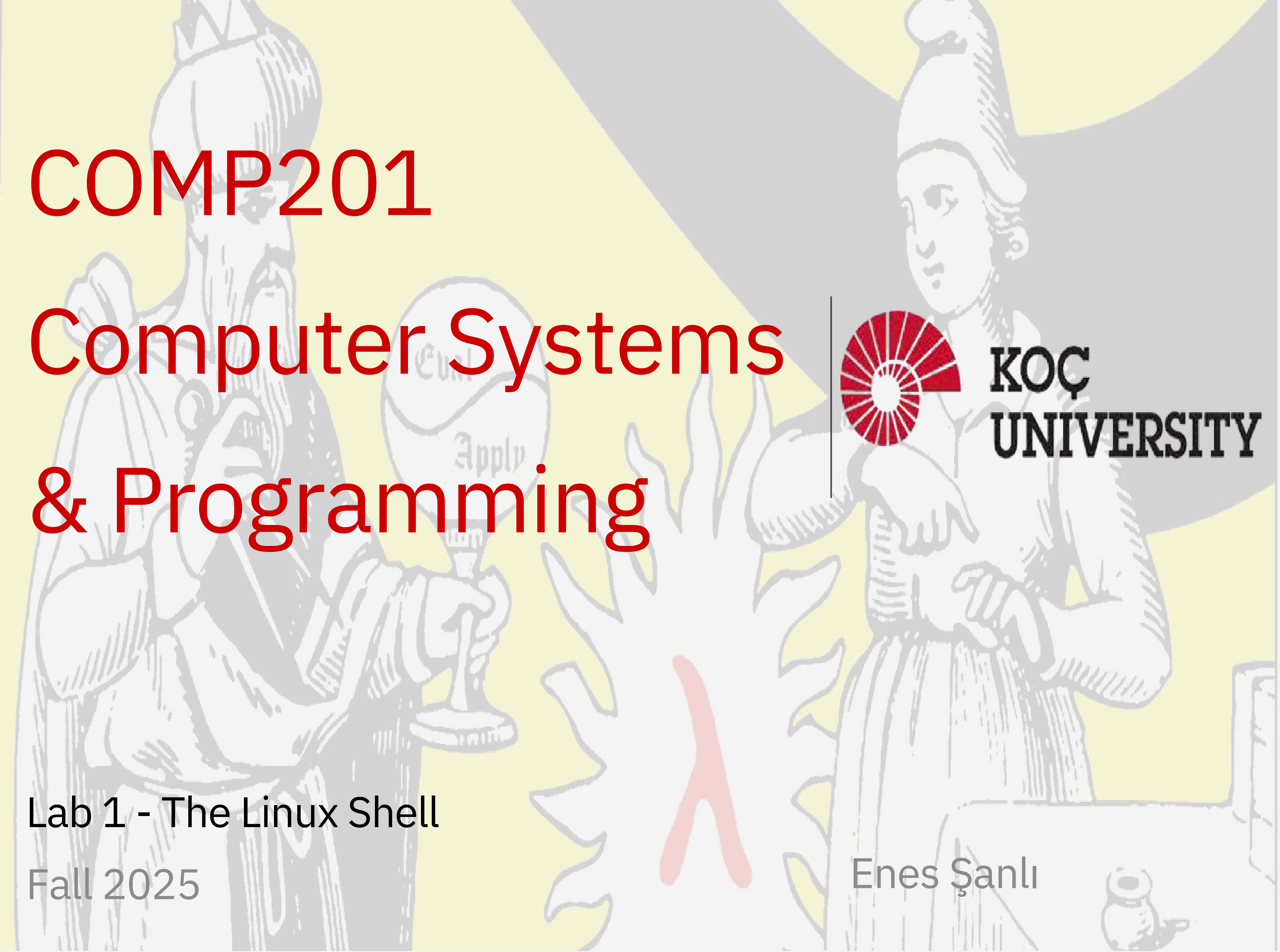


COMP201

Computer Systems & Programming

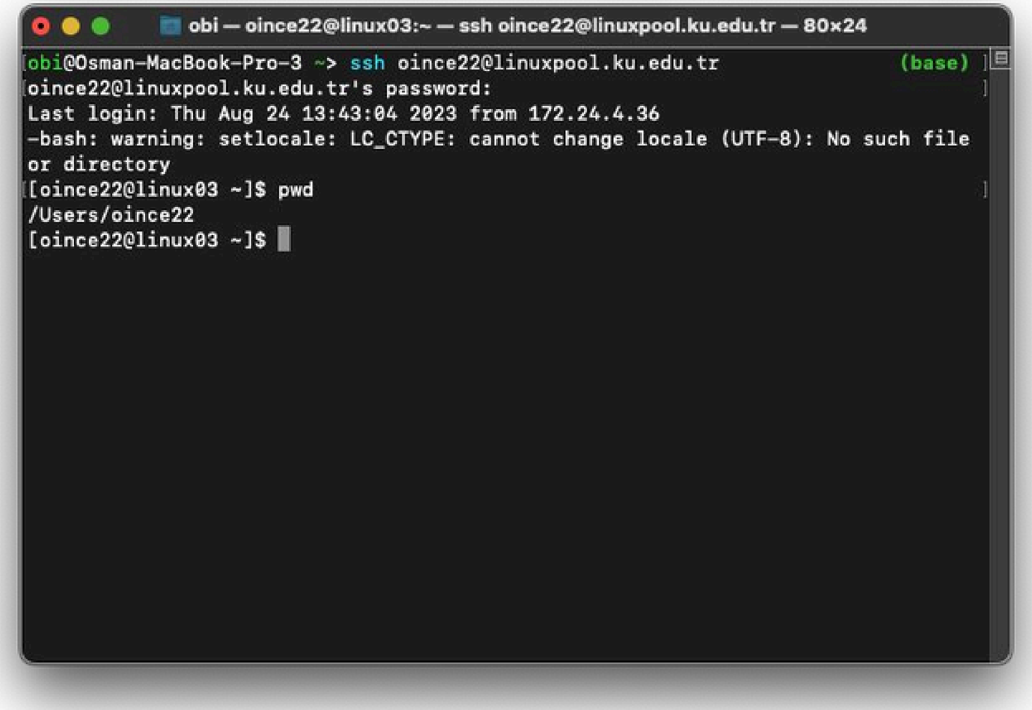
KOÇ UNIVERSITY

Lab 1 - The Linux Shell

Fall 2025

Enes Şanlı

What is shell?


obi — oince22@linux03:~ — ssh oince22@linuxpool.ku.edu.tr — 80×24

```
obi@Osman-MacBook-Pro-3 ~> ssh oince22@linuxpool.ku.edu.tr                (base)
oince22@linuxpool.ku.edu.tr's password:
Last login: Thu Aug 24 13:43:04 2023 from 172.24.4.36
-bash: warning: setlocale: LC_CTYPE: cannot change locale (UTF-8): No such file
or directory
[oince22@linux03 ~]$ pwd
/Users/oince22
[oince22@linux03 ~]$
```

- Linux shell is the interface between you and OS that controls hardware.
- The most commonly used shell is called BASH – Bourne Again Shell
    - The default shell in Linuxpool
- username@hostname:curr_dir$
    - username: oince22
    - hostname: linux03
    - curr_dir: /Users/oince22

How to connect?

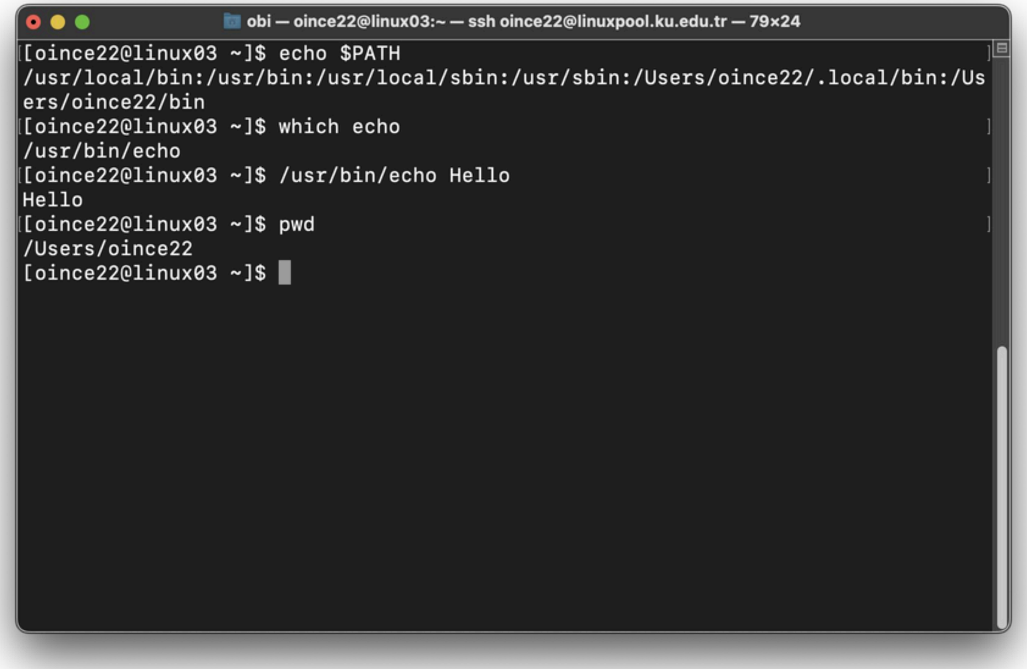
```
ssh USERNAME@linuxpool.ku.edu.tr
```

1. Type your password when prompted.
2. If you see a warning about SSH host keys, click or enter “yes.”

Executing system programs

- Execute programs
- date
  - This program prints current date and time
- echo
  - This program prints the input argument
  - Put quotation marks around the string if the string has more than one word

Path and $PATH

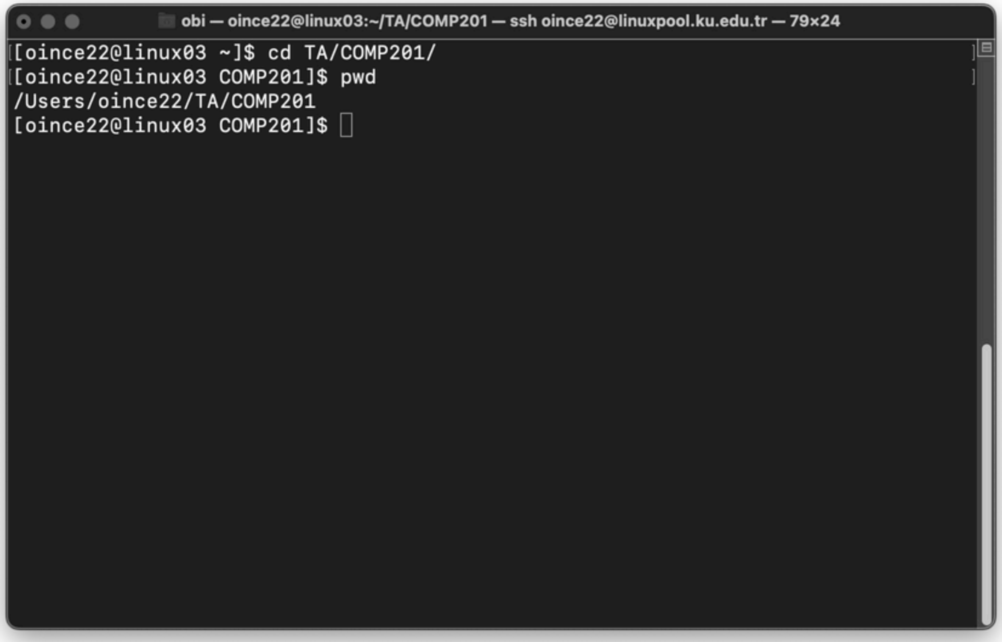


obi — oince22@linux03:~ — ssh oince22@linuxpool.ku.edu.tr — 79×24

```
[oince22@linux03 ~]$ echo $PATH
/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/Users/oince22/.local/bin:/Us
ers/oince22/bin
[oince22@linux03 ~]$ which echo
/usr/bin/echo
[oince22@linux03 ~]$ /usr/bin/echo Hello
Hello
[oince22@linux03 ~]$ pwd
/Users/oince22
[oince22@linux03 ~]$ 
```

- $PATH
    - Avariable 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”

Path

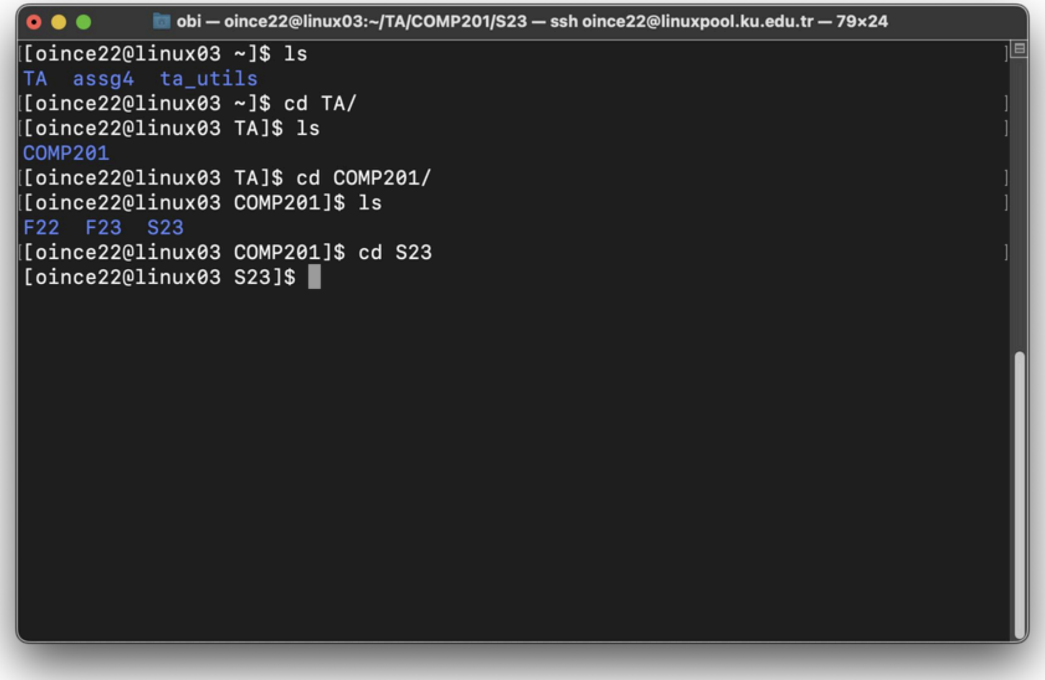

obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 79×24

```
[oince22@linux03 ~]$ cd TA/COMP201/
[oince22@linux03 COMP201]$ pwd
/Users/oince22/TA/COMP201
[oince22@linux03 COMP201]$ 
```

- cd
  - Changes the working directory
  - .. is the parent directory
  - . is the current directory
  - Tilda (~) is the /Users/<username> directory
    - This is true in Linuxpool
    - May be different in another machine

- Absolute vs relative path
  - Relative: TA/COMP201from ~ (home)
  - Absolute: /Users/oince22/TA/COMP201

Listing files and directories



obi — oince22@linux03:~/TA/COMP201/S23 — ssh oince22@linuxpool.ku.edu.tr — 79×24

```
[oince22@linux03 ~]$ ls
TA  assg4  ta_utils
[oince22@linux03 ~]$ cd TA/
[oince22@linux03 TA]$ ls
COMP201
[oince22@linux03 TA]$ cd COMP201/
[oince22@linux03 COMP201]$ ls
F22  F23  S23
[oince22@linux03 COMP201]$ cd S23
[oince22@linux03 S23]$ 
```

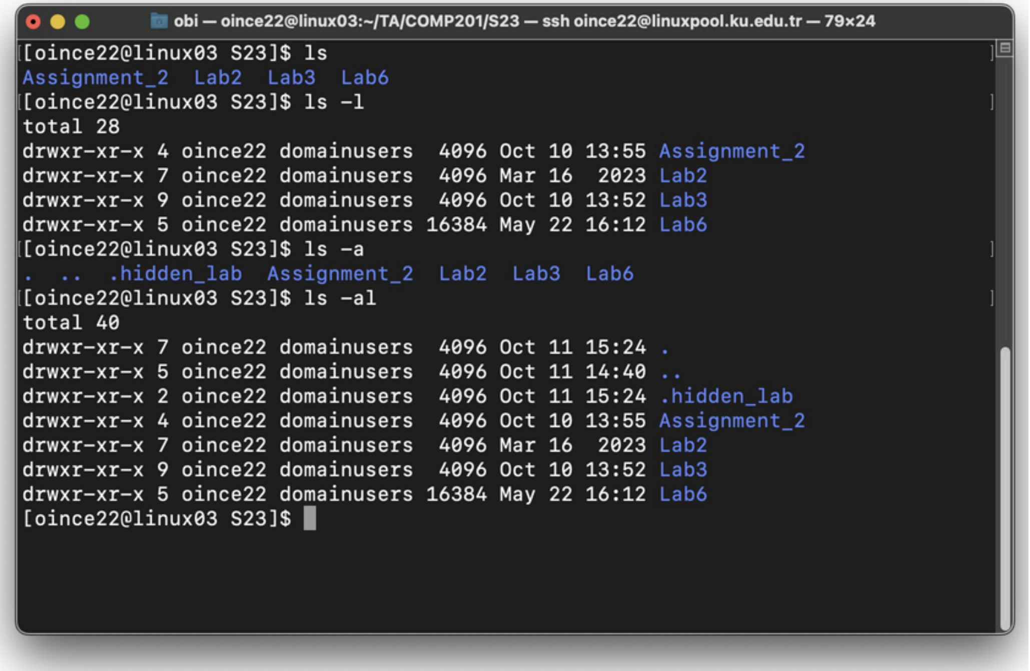
- ls
  - Prints files and directories under current working directory

Flags with Commands in Linux

- Many Linux commands have flags that can be used to modify their behavior.
- Flags are usually preceded by one or two dashes, followed by a letter or a word.
- Flags can be used to:
  - Control the outputofacommand
  - Specify a file or directory to work with
  - Modify the command's behavior in other ways

Flags with Commands in Linux

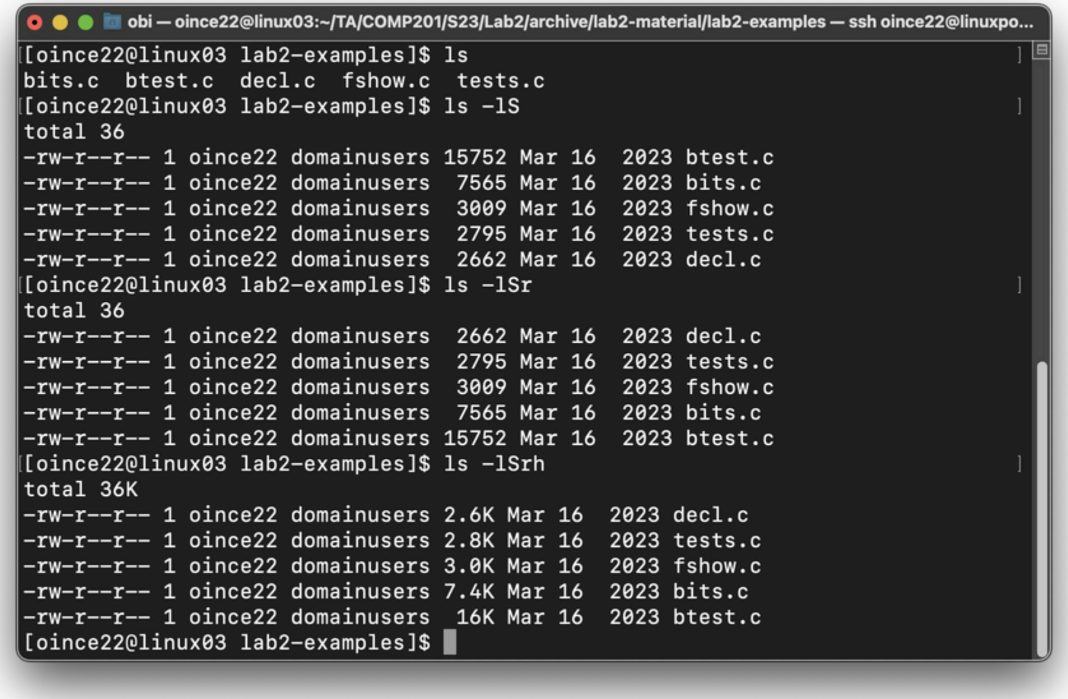
- Let's look at an example: ls command.
- By default, it lists contents of the current folder.
- But we can use flags to modify its behavior.
- For example,
  - -l flag to list the contents of the directory line-by-line, long-format including additional info about file permissions, owner, and size.
  - -a flag to display all files, including hidden files (usually not displayed by default).
- To use both flags together, type ls -la
  - Combine as many as you want!


obi — oince22@linux03:~/TA/COMP201/S23 — ssh oince22@linuxpool.ku.edu.tr — 79×24

```
[oince22@linux03 S23]$ ls
Assignment_2  Lab2  Lab3  Lab6
[oince22@linux03 S23]$ ls -l
total 28
drwxr-xr-x 4 oince22 domainusers  4096 Oct 10 13:55 Assignment_2
drwxr-xr-x 7 oince22 domainusers  4096 Mar 16  2023 Lab2
drwxr-xr-x 9 oince22 domainusers  4096 Oct 10 13:52 Lab3
drwxr-xr-x 5 oince22 domainusers 16384 May 22 16:12 Lab6
[oince22@linux03 S23]$ ls -a
.  ..  .hidden_lab  Assignment_2  Lab2  Lab3  Lab6
[oince22@linux03 S23]$ ls -al
total 40
drwxr-xr-x 7 oince22 domainusers  4096 Oct 11 15:24 .
drwxr-xr-x 5 oince22 domainusers  4096 Oct 11 14:40 ..
drwxr-xr-x 2 oince22 domainusers  4096 Oct 11 15:24 .hidden_lab
drwxr-xr-x 4 oince22 domainusers  4096 Oct 10 13:55 Assignment_2
drwxr-xr-x 7 oince22 domainusers  4096 Mar 16  2023 Lab2
drwxr-xr-x 9 oince22 domainusers  4096 Oct 10 13:52 Lab3
drwxr-xr-x 5 oince22 domainusers 16384 May 22 16:12 Lab6
[oince22@linux03 S23]$ 
```

To learn more about the flags available for a command, type man command
To learn details about the ls command and its flags → man ls

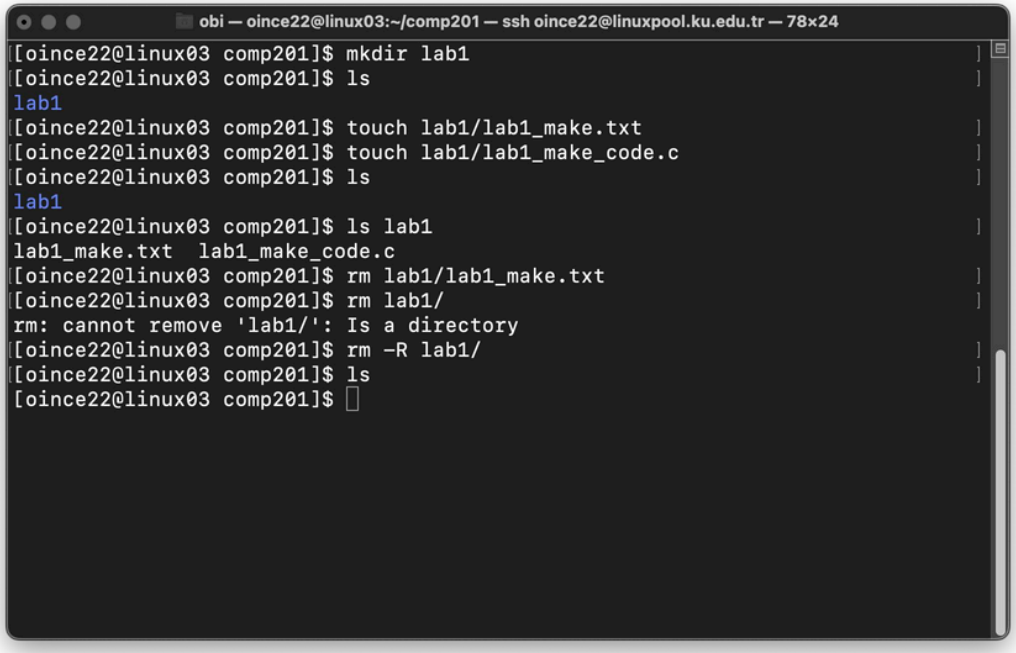
Listing files and directories


obi — oince22@linux03:~/TA/COMP201/S23/Lab2/archive/lab2-material/lab2-examples — ssh oince22@linuxpo...

```
[oince22@linux03 lab2-examples]$ ls
bits.c  btest.c  decl.c  fshow.c  tests.c
[oince22@linux03 lab2-examples]$ ls -lS
total 36
-rw-r--r-- 1 oince22 domainusers 15752 Mar 16  2023 btest.c
-rw-r--r-- 1 oince22 domainusers  7565 Mar 16  2023 bits.c
-rw-r--r-- 1 oince22 domainusers  3009 Mar 16  2023 fshow.c
-rw-r--r-- 1 oince22 domainusers  2795 Mar 16  2023 tests.c
-rw-r--r-- 1 oince22 domainusers  2662 Mar 16  2023 decl.c
[oince22@linux03 lab2-examples]$ ls -lSr
total 36
-rw-r--r-- 1 oince22 domainusers  2662 Mar 16  2023 decl.c
-rw-r--r-- 1 oince22 domainusers  2795 Mar 16  2023 tests.c
-rw-r--r-- 1 oince22 domainusers  3009 Mar 16  2023 fshow.c
-rw-r--r-- 1 oince22 domainusers  7565 Mar 16  2023 bits.c
-rw-r--r-- 1 oince22 domainusers 15752 Mar 16  2023 btest.c
[oince22@linux03 lab2-examples]$ ls -lSrh
total 36K
-rw-r--r-- 1 oince22 domainusers 2.6K Mar 16  2023 decl.c
-rw-r--r-- 1 oince22 domainusers 2.8K Mar 16  2023 tests.c
-rw-r--r-- 1 oince22 domainusers 3.0K Mar 16  2023 fshow.c
-rw-r--r-- 1 oince22 domainusers 7.4K Mar 16  2023 bits.c
-rw-r--r-- 1 oince22 domainusers  16K Mar 16  2023 btest.c
[oince22@linux03 lab2-examples]$ 
```

- You can use -S flag to display files sorted by their sizes, and -r option for reverse sorting.
- You can use -h flag to display file sizes in a human-readable format.

Making/Removing folders and files


obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 78×24

```
[oince22@linux03 comp201]$ mkdir lab1
[oince22@linux03 comp201]$ ls
lab1
[oince22@linux03 comp201]$ touch lab1/lab1_make.txt
[oince22@linux03 comp201]$ touch lab1/lab1_make_code.c
[oince22@linux03 comp201]$ ls
lab1
[oince22@linux03 comp201]$ ls lab1
lab1_make.txt  lab1_make_code.c
[oince22@linux03 comp201]$ rm lab1/lab1_make.txt
[oince22@linux03 comp201]$ rm lab1/
rm: cannot remove 'lab1/': Is a directory
[oince22@linux03 comp201]$ rm -R lab1/
[oince22@linux03 comp201]$ ls
[oince22@linux03 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

Chmod

- Chmod (short for "change mode") is a command in Linux that allows users to change the read, write, and execute permissions of files and directories.
- The syntax for chmod is as follows:
  - chmod [options] MODE FILENAME
- The mode is a combination of the letters "r" (read), "w" (write), and "x" (execute).
- Permissions can be granted to three different user groups:
  - The fileowner
  - The group owner
  - All users

File Permission in Linux

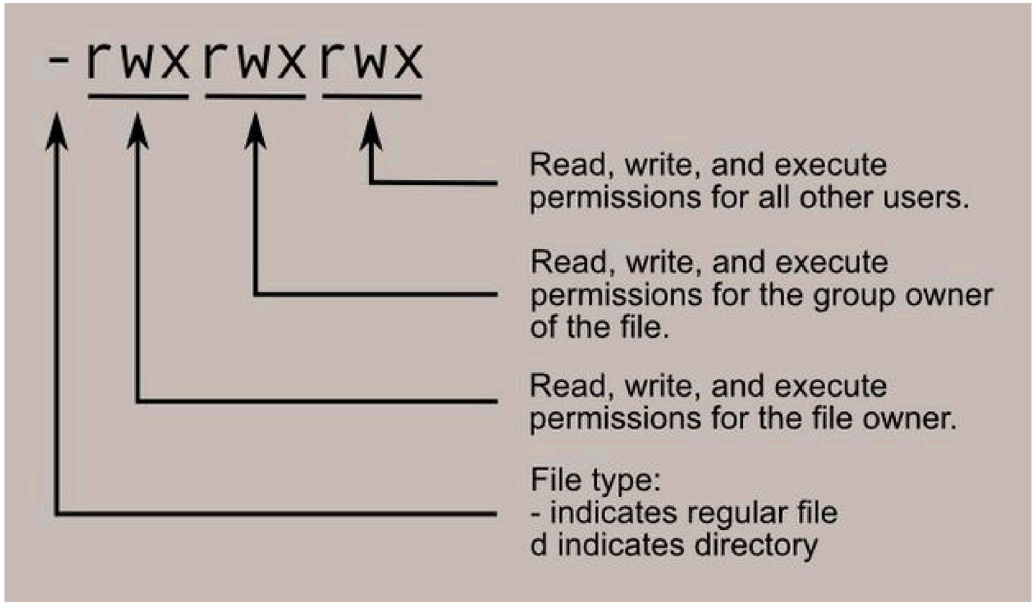
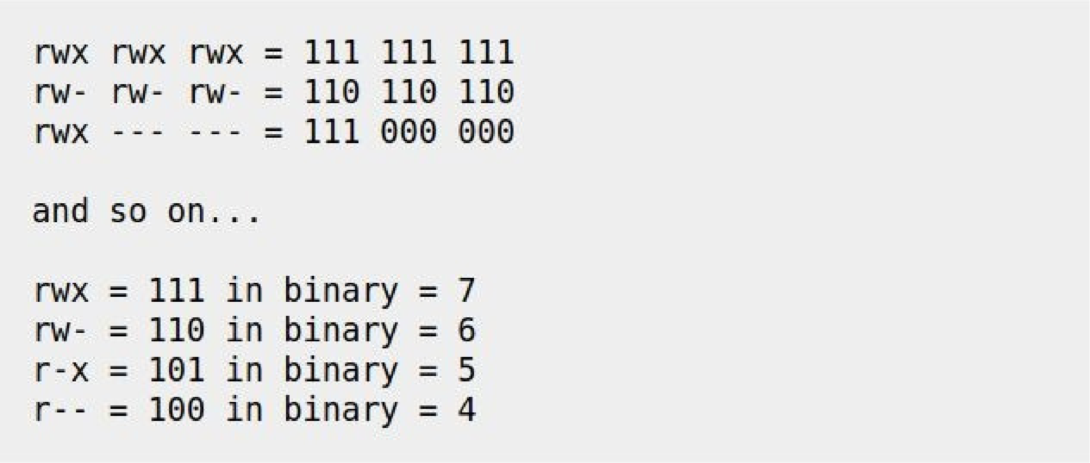

-rwxrwxrwx
Read, write, and execute permissions for all other users.
Read, write, and execute permissions for the group owner of the file.
Read, write, and execute permissions for the file owner.
File type:
- indicates regular file
d indicates directory

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

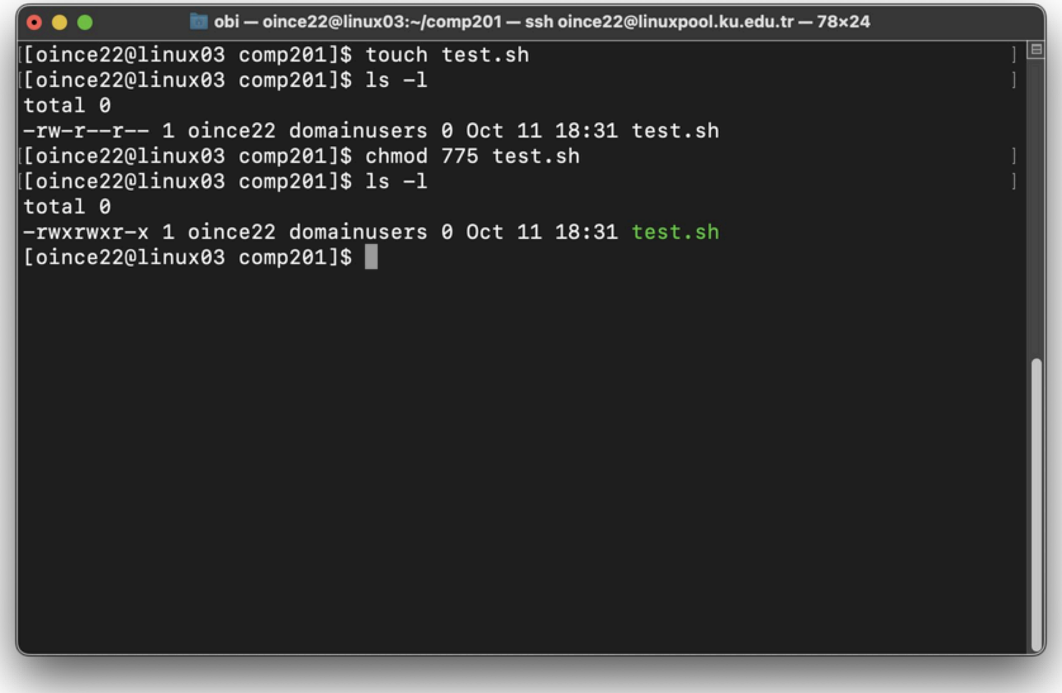
File Permission in Linux



```
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

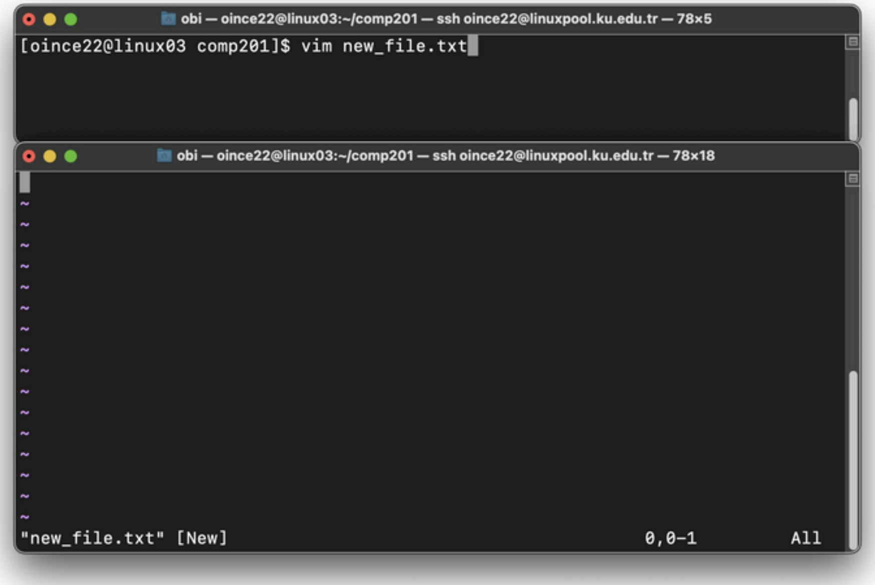
File Permission in Linux


obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 78×24

```
[oince22@linux03 comp201]$ touch test.sh
[oince22@linux03 comp201]$ ls -l
total 0
-rw-r--r-- 1 oince22 domainusers 0 Oct 11 18:31 test.sh
[oince22@linux03 comp201]$ chmod 775 test.sh
[oince22@linux03 comp201]$ ls -l
total 0
-rwxrwxr-x 1 oince22 domainusers 0 Oct 11 18:31 test.sh
[oince22@linux03 comp201]$ 
```

Initially, test.sh cannot be executed, to grant -rwx rwx r-x permission to test.sh file execute chmod 775 test.sh command.

What is Vim?

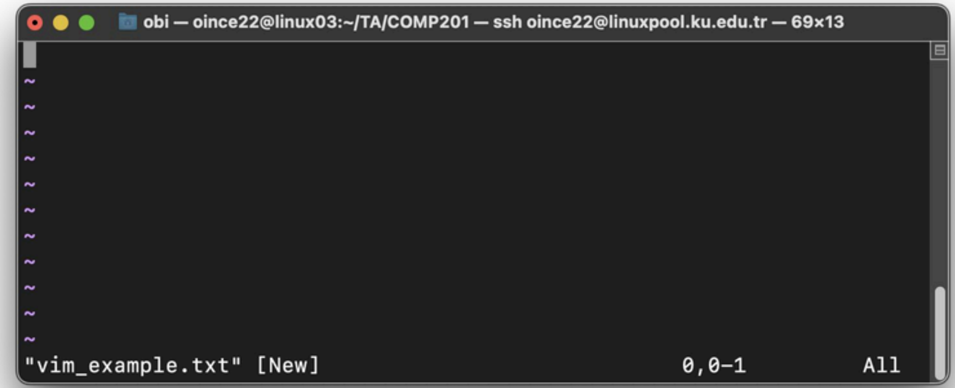

obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 78×5
obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 78×18

```
[oince22@linux03 comp201]$ vim new_file.txt
```

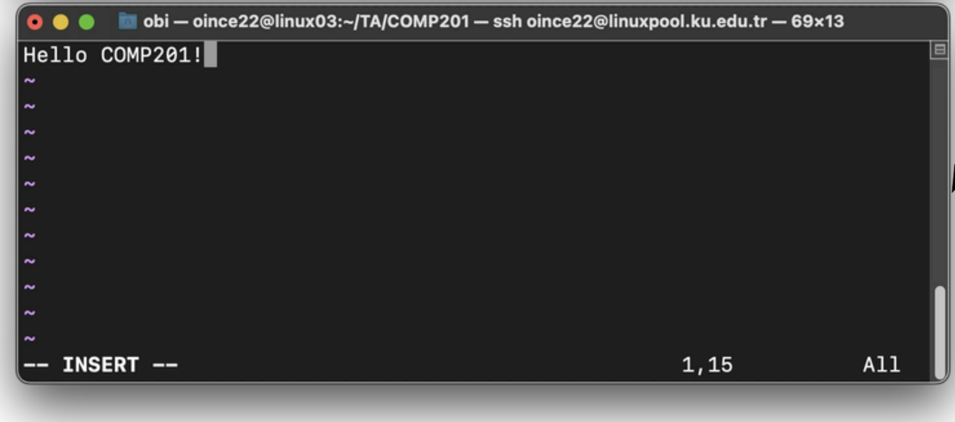
```

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
"new_file.txt" [New]                                          0,0-1         All
```

- Vim is the default text editor in the UNIX operating system.
- Using vim, we can create a new file, read, and edit an existing file.
- To open vim, type vim or vim FNAME.
  If the file FNAME doesn’t exist, it will be created when you save it.

Operation Modes in Vim


obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 69×13

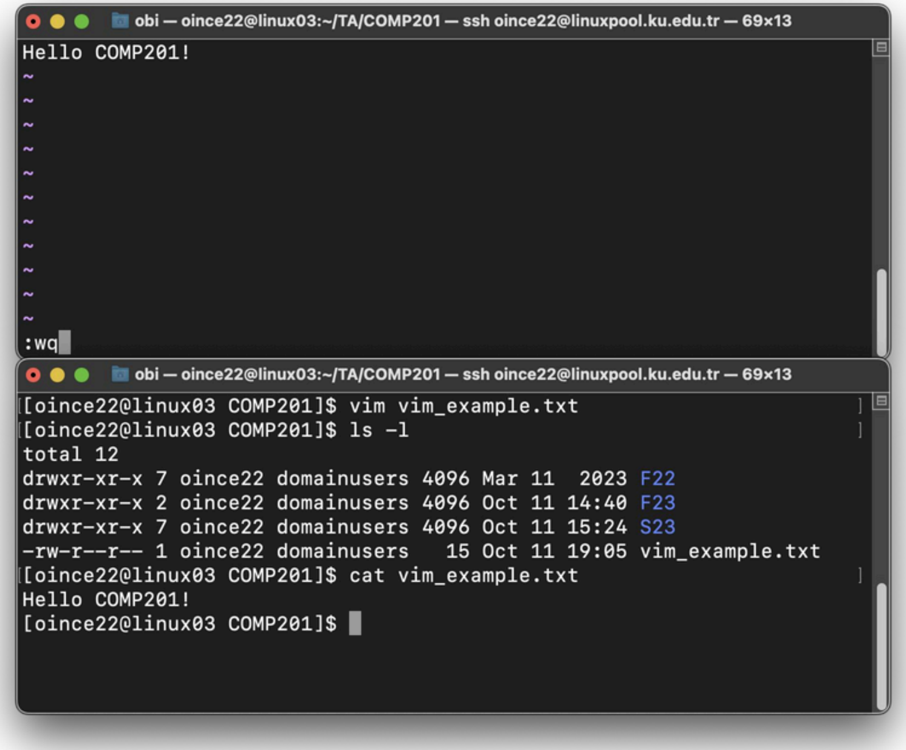
```

~
~
~
~
~
~
~
~
~
~
~
"vim_example.txt" [New]                           0,0-1        All
```


obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 69×13

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

- Normal mode
  - ○ Thedefaultmode in vim.
  - ○ Every character you type is interpreted as a command.
- Insert mode
  - ○ 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>

Operation Modes in Vim


obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 69×13

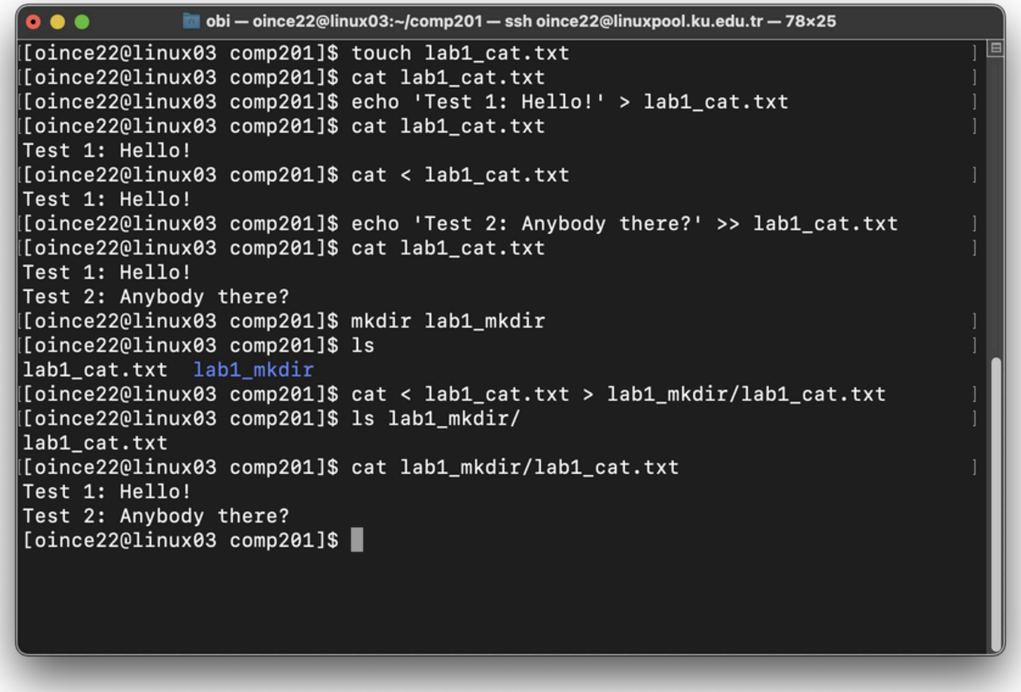
```
Hello COMP201!
~
~
~
~
~
~
~
~
~
~
~
:wq
```

obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 69×13

```
[oince22@linux03 COMP201]$ vim vim_example.txt
[oince22@linux03 COMP201]$ ls -l
total 12
drwxr-xr-x 7 oince22 domainusers 4096 Mar 11  2023 F22
drwxr-xr-x 2 oince22 domainusers 4096 Oct 11 14:40 F23
drwxr-xr-x 7 oince22 domainusers 4096 Oct 11 15:24 S23
-rw-r--r-- 1 oince22 domainusers   15 Oct 11 19:05 vim_example.txt
[oince22@linux03 COMP201]$ cat vim_example.txt
Hello COMP201!
[oince22@linux03 COMP201]$ 
```

- Exit with saving
  - Tosave andexit a file, go to the Normal mode by pressing <Esc> then type :wq
- Exit without saving
  - To exit from afile without saving it, go to the Normal mode by pressing <Esc> then type :q!
- After typing :wq or :q!, press <Enter>

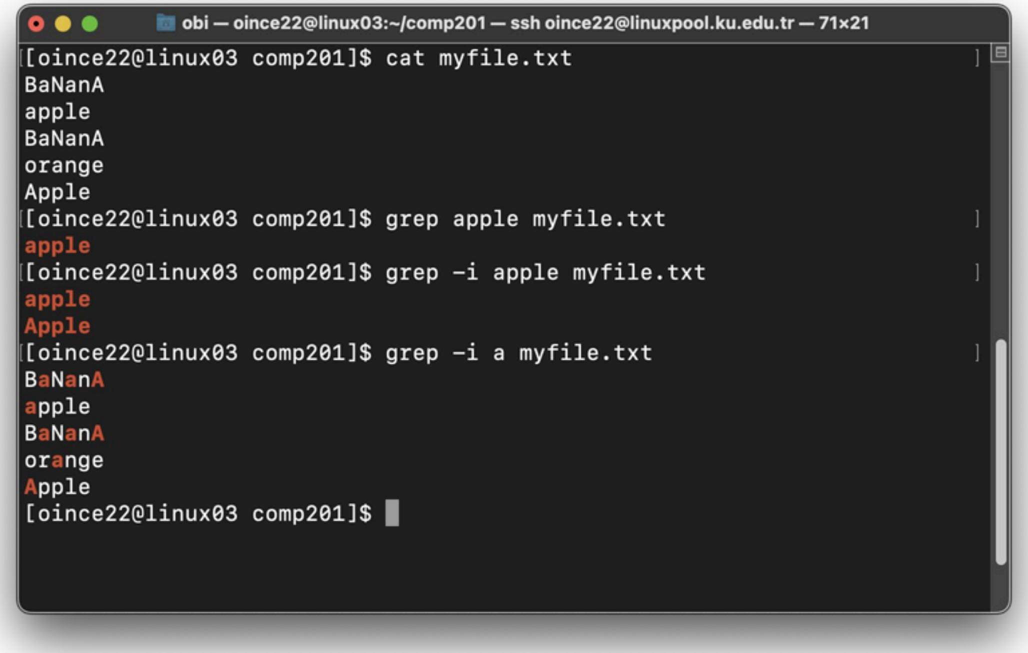
Redirection


obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 78×25

```
[oince22@linux03 comp201]$ touch lab1_cat.txt
[oince22@linux03 comp201]$ cat lab1_cat.txt
[oince22@linux03 comp201]$ echo 'Test 1: Hello!' > lab1_cat.txt
[oince22@linux03 comp201]$ cat lab1_cat.txt
Test 1: Hello!
[oince22@linux03 comp201]$ cat < lab1_cat.txt
Test 1: Hello!
[oince22@linux03 comp201]$ echo 'Test 2: Anybody there?' >> lab1_cat.txt
[oince22@linux03 comp201]$ cat lab1_cat.txt
Test 1: Hello!
Test 2: Anybody there?
[oince22@linux03 comp201]$ mkdir lab1_mkdir
[oince22@linux03 comp201]$ ls
lab1_cat.txt  lab1_mkdir
[oince22@linux03 comp201]$ cat < lab1_cat.txt > lab1_mkdir/lab1_cat.txt
[oince22@linux03 comp201]$ ls lab1_mkdir/
lab1_cat.txt
[oince22@linux03 comp201]$ cat lab1_mkdir/lab1_cat.txt
Test 1: Hello!
Test 2: Anybody there?
[oince22@linux03 comp201]$ 
```

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

Piping



obi — oince22@linux03:~/comp201 — ssh oince22@linuxpool.ku.edu.tr — 71×21

```
[oince22@linux03 comp201]$ cat myfile.txt
BaNanA
apple
BaNanA
orange
Apple
[oince22@linux03 comp201]$ grep apple myfile.txt
apple
[oince22@linux03 comp201]$ grep -i apple myfile.txt
apple
Apple
[oince22@linux03 comp201]$ grep -i a myfile.txt
BaNanA
apple
BaNanA
orange
Apple
[oince22@linux03 comp201]$ 
```

- Pipe character is |
  - Connectsoutput ofa 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

SCP

- SCP is a tool in Linux used to transfer files between hosts over a network.
- The syntax for SCP is as follows:
  - scp [OPTIONS] SOURCE DESTINATION
- -r flag is used to copy directories, stands for recursive

SCP

- From local machine to Linuxpool:
  - ○ (on local machine):

    ```
    scp -r FILENAME USERNAME@linuxpool.ku.edu.tr:
    ```

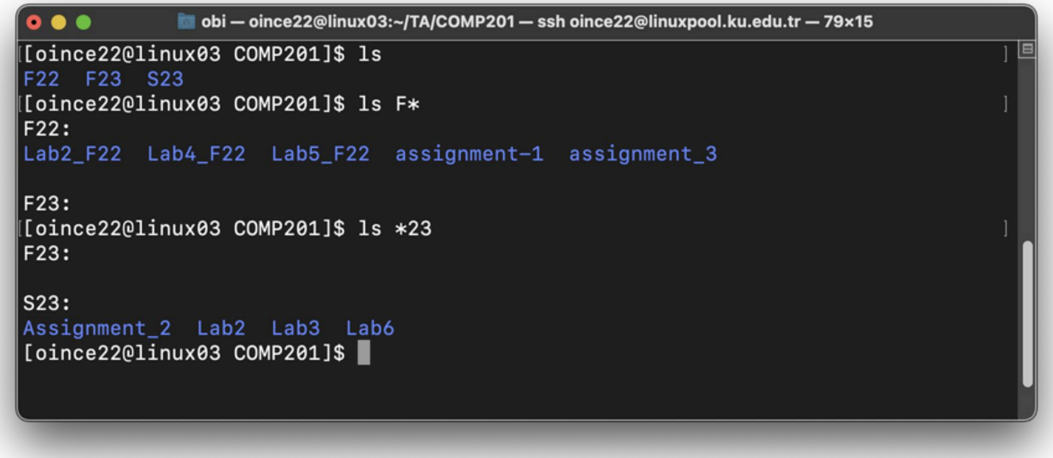
- From Linuxpool to local machine:
  - ○ (on local machine):

    ```
    scp -r USERNAME@linuxpool.ku.edu.tr:PATH/TO/FILE      .
    ```

Do not forget the colon!!

Useful Commands

- clear: Clearing the contents of the terminal screen
- history: Searching for previously executed commands
- Tab key: auto-completion
- * (asterisk): Used as a wildcard to represent any combination of characters in a command or filename



obi — oince22@linux03:~/TA/COMP201 — ssh oince22@linuxpool.ku.edu.tr — 79×15

```
[oince22@linux03 COMP201]$ ls
F22  F23  S23
[oince22@linux03 COMP201]$ ls F*
F22:
Lab2_F22  Lab4_F22  Lab5_F22  assignment-1  assignment_3

F23:
[oince22@linux03 COMP201]$ ls *23
F23:

S23:
Assignment_2  Lab2  Lab3  Lab6
[oince22@linux03 COMP201]$
```

Other Resources

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

Contributors:

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