



Department of Computer Science

Subject:

OPERATING SYSTEM

Submitted by:

ABDUL REHMAN SUDAIS

Reg number:

23-NTU-CS-1123

Lab :

2

Semester:

5TH

Operating Systems – COC 3071L

SE 5th A – Fall 2025

Lab 2: Linux Basics and Introduction

Part 1: Linux Environment Orientation

1.1 Understanding the Linux Environment

- **Concepts to Cover:**
 - What is Linux? Brief history and distributions
 - Linux vs Windows: Key differences
 - Understanding the shell (bash)
 - WSL2 as a Linux environment
- **Hands-on Activity:**

```
# Students open WSL2 terminal and explore
whoami      # Check current user
pwd         # Print working directory
uname -a    # System information
date        # Current date and time
```



The screenshot shows a Windows Terminal window with a dark background. The title bar indicates the user is 'sudais' on a machine named 'DESKTOP-7V1NPFI'. The terminal shows the following commands and their outputs:

```
sudais@DESKTOP-7V1NPFI: ~  
sudais@DESKTOP-7V1NPFI:~$ whoami  
sudais  
sudais@DESKTOP-7V1NPFI:~$ pwd  
/home/sudais  
sudais@DESKTOP-7V1NPFI:~$ uname -a  
Linux DESKTOP-7V1NPFI 6.6.87.2-microsoft-standard-WSL2 #1 SMP PREEMPT_DYNAMIC Thu Jun 5 18:30:46 UTC 2025 x86_64 x86_64  
x86_64 GNU/Linux  
sudais@DESKTOP-7V1NPFI:~$ date  
Fri Sep 26 15:12:48 PKT 2025
```

1.2 Getting Help in Linux

- **Commands to demonstrate:**

```
man ls      # Manual pages  
ls --help   # Built-in help  
which ls    # Location of commands  
type ls     # Command type information
```

```
sudais@DESKTOP-7V1NPFI: ~  
sudais@DESKTOP-7V1NPFI:~$ man ls  
sudais@DESKTOP-7V1NPFI:~$ ls --help  
Usage: ls [OPTION]... [FILE]...  
List information about the FILES (the current directory by default).  
Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.  
  
Mandatory arguments to long options are mandatory for short options too.  
-a, --all do not ignore entries starting with .  
-A, --almost-all do not list implied . and ..  
--author with -l, print the author of each file  
-b, --escape print C-style escapes for nongraphic characters  
--block-size=SIZE with -l, scale sizes by SIZE when printing them;  
e.g., '--block-size=M'; see SIZE format below  
  
-B, --ignore-backups do not list implied entries ending with ~  
-c with -lt: sort by, and show, ctime (time of last  
change of file status information);  
with -l: show ctime and sort by name;  
otherwise: sort by ctime, newest first  
  
-C list entries by columns  
--color[=WHEN] color the output WHEN; more info below  
-d, --directory list directories themselves, not their contents  
-D, --dired generate output designed for Emacs' dired mode  
-f list all entries in directory order  
-F, --classify[=WHEN] append indicator (one of */=>@|) to entries WHEN  
--file-type likewise, except do not append '*'  
--format=WORD across -x, commas -m, horizontal -x, long -l,  
single-column -l, verbose -l, vertical -C  
  
--full-time like -l --time-style=full-iso  
-g like -l, but do not list owner  
--group-directories-first group directories before files;  
can be augmented with a --sort option, but any  
use of --sort=none (-u) disables grouping  
  
-G, --no-group in a long listing, don't print group names  
-h, --human-readable with -l and -s, print sizes like 1K 234M 2G etc.  
--si likewise, but use powers of 1000 not 1024  
-H, --dereference-command-line
```

```
-U do not sort; list entries in directory order  
-v natural sort of (version) numbers within text  
-w, --width=COLS set output width to COLS. 0 means no limit  
-X list entries by lines instead of by columns  
-x sort alphabetically by entry extension  
-Z, --context print any security context of each file  
--zero end each output line with NUL, not newline  
-1 list one file per line  
--help display this help and exit  
--version output version information and exit  
  
The SIZE argument is an integer and optional unit (example: 10K is 10*1024).  
Units are K,M,G,T,P,E,Z,Y,R,Q (powers of 1024) or KB,MB,... (powers of 1000).  
Binary prefixes can be used, too: KiB=K, MiB=M, and so on.  
  
The TIME_STYLE argument can be full-iso, long-iso, iso, locale, or +FORMAT.  
FORMAT is interpreted like in date(1). If FORMAT is FORMAT1<newline>FORMAT2,  
then FORMAT1 applies to non-recent files and FORMAT2 to recent files.  
TIME_STYLE prefixed with 'posix-' takes effect only outside the POSIX locale.  
Also the TIME_STYLE environment variable sets the default style to use.  
  
The WHEN argument defaults to 'always' and can also be 'auto' or 'never'.  
  
Using color to distinguish file types is disabled both by default and  
with --color=never. With --color=auto, ls emits color codes only when  
standard output is connected to a terminal. The LS_COLORS environment  
variable can change the settings. Use the dircolors(1) command to set it.  
  
Exit status:  
0 if OK,  
1 if minor problems (e.g., cannot access subdirectory),  
2 if serious trouble (e.g., cannot access command-line argument).  
  
GNU coreutils online help: <https://www.gnu.org/software/coreutils/>  
Report any translation bugs to <https://translationproject.org/team/>  
Full documentation <https://www.gnu.org/software/coreutils/ls>  
or available locally via: info '(coreutils) ls invocation'  
sudais@DESKTOP-7V1NPFI:~$ which ls  
/usr/bin/ls  
sudais@DESKTOP-7V1NPFI:~$ type ls  
ls is aliased to 'ls --color=auto'
```

Part 2: File System Navigation

2.1 Understanding Linux Directory Structure

- Concepts to Cover:
 - Root directory (/)
 - Important directories: /home, /usr, /etc, /var, /tmp

- Absolute vs relative paths
- Hidden files and directories

- Demonstration:

```
ls /          # Root directory contents
ls -la        # Long listing with hidden files
cd /home      # Change directory
cd ~          # Home directory shortcut
cd -          # Previous directory
```

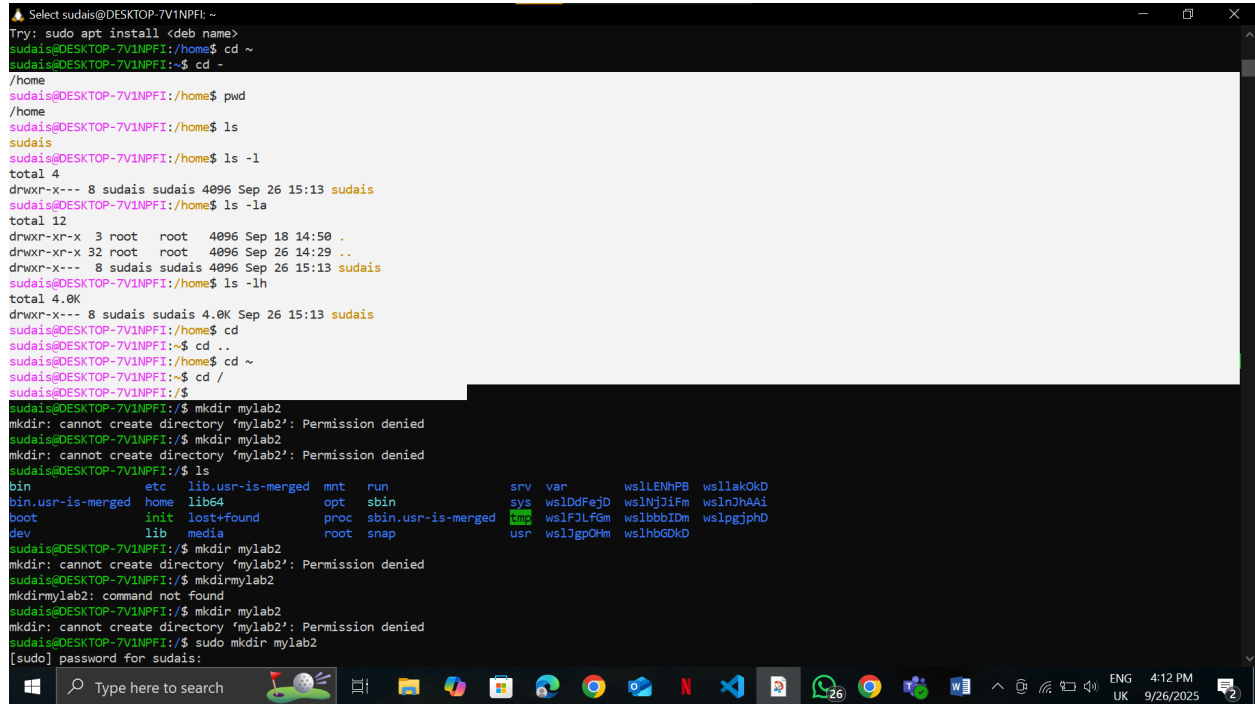
```
sudais@DESKTOP-7V1NPF1: ~
sudais@DESKTOP-7V1NPF1:~$ type ls
ls is aliased to `ls --color=auto'
sudais@DESKTOP-7V1NPF1:~$ ls /
bin      etc      lib.usr-is-merged  mnt      run      srv      var      wslLENhPB  wsl1akOKD
bin.usr-is-merged  home    lib64             opt      sbin     sys      wslDdFeJD  wslNjjiFm  wslnJHAAi
boot      init    lost+found        proc     sbin.usr-is-merged  tmp      wslFJLfGm  wslbbbIDm  wslpgjphD
dev      lib     media             root     snap     usr      wslJgpOHm  wslhbGDkD

sudais@DESKTOP-7V1NPF1:~$ ls -la
total 60
drwxr-xr-x  8 sudais sudais 4096 Sep 26 15:13 .
drwxr-xr-x  3 root   root   4096 Sep 18 14:50 ..
-rw-r--r--  1 sudais sudais 1339 Sep 26 13:12 .bash_history
-rw-r--r--  1 sudais sudais 220  Sep 18 14:50 .bash_logout
-rw-r--r--  1 sudais sudais 3771 Sep 18 14:50 .bashrc
drwxr-xr-x  3 sudais sudais 4096 Sep 19 14:45 .cache
-rw-r--r--  1 sudais sudais 60   Sep 26 09:45 .gitconfig
-rw-r--r--  1 sudais sudais 20   Sep 26 15:13 .lesshst
drwxr-xr-x  3 sudais sudais 4096 Sep 26 13:05 .local
-rw-rw-r--  1 sudais sudais 0    Sep 26 09:32 .motd_shown
-rw-r--r--  1 sudais sudais 807  Sep 18 14:50 .profile
drwxr-xr-x  2 sudais sudais 4096 Sep 26 10:00 .ssh
-rw-r--r--  1 sudais sudais 0    Sep 18 14:52 .sudo_as_admin_successful
drwxr-xr-x  3 sudais sudais 4096 Sep 19 14:45 .vscode-remote-containers
drwxr-xr-x  5 sudais sudais 4096 Sep 19 14:45 .vscode-server
-rw-r--r--  1 sudais sudais 0    Sep 26 14:30 file.txt
drwxr-xr-x  3 sudais sudais 4096 Sep 26 14:37 folder
-rw-r--r--  1 sudais sudais 6    Sep 26 14:33 hello.txt
sudais@DESKTOP-7V1NPF1:~$ cd /home
sudais@DESKTOP-7V1NPF1:/home$ cd~
Command 'cd~' not found, did you mean:
  command 'cdp' from deb irpas (0.10-9)
  command 'cdi' from deb cdo (2.3.0-1)
  command 'cdo' from deb cdo (2.3.0-1)
  command 'cdw' from deb cdw (0.8.1-3)
  command 'cdb' from deb tinycdb (0.81-1)
  command 'cde' from deb cde (0.1+git9-g551e54d-1.2)
  command 'cds' from deb cd5 (0.1-4)
Try: sudo apt install <deb name>
sudais@DESKTOP-7V1NPF1:/home$ cd ~
sudais@DESKTOP-7V1NPF1:~$ cd -
/home
```

2.2 Basic Navigation Commands (15 minutes)

• Commands to practice:

```
pwd          # Present working directory
ls           # List directory contents
ls -l        # Long format
ls -la       # Include hidden files
ls -lh       # Human readable sizes
cd           # Change directory
cd ..        # Parent directory
cd ~         # Home directory
cd /         # Root directory
```



```
Select suda@sDESKTOP-7V1NPF1: ~
Try: sudo apt install <deb name>
suda@sDESKTOP-7V1NPF1:/home$ cd ~
suda@sDESKTOP-7V1NPF1:~$ cd -
/home
suda@sDESKTOP-7V1NPF1:/home$ pwd
/home
suda@sDESKTOP-7V1NPF1:/home$ ls
suda@sDESKTOP-7V1NPF1:/home$ ls -l
total 4
drwxr-x--- 8 suda@s suda@s 4096 Sep 26 15:13 suda@s
suda@sDESKTOP-7V1NPF1:/home$ ls -la
total 12
drwxr-xr-x  3 root  root  4096 Sep 18 14:50 .
drwxr-xr-x 32 root  root  4096 Sep 26 14:29 ..
drwxr-x---  8 suda@s suda@s 4096 Sep 26 15:13 suda@s
suda@sDESKTOP-7V1NPF1:/home$ ls -lh
total 4.0K
drwxr-x---  8 suda@s suda@s 4.0K Sep 26 15:13 suda@s
suda@sDESKTOP-7V1NPF1:/home$ cd
suda@sDESKTOP-7V1NPF1:~$ cd ..
suda@sDESKTOP-7V1NPF1:/home$ cd ~
suda@sDESKTOP-7V1NPF1:~$ cd /
suda@sDESKTOP-7V1NPF1:/ $
suda@sDESKTOP-7V1NPF1:/ $ mkdir mylab2
mkdir: cannot create directory 'mylab2': Permission denied
suda@sDESKTOP-7V1NPF1:/ $ mkdir mylab2
mkdir: cannot create directory 'mylab2': Permission denied
suda@sDESKTOP-7V1NPF1:/ $ ls
bin          etc          lib.usr-is-merged  mnt  run          srv  var          wsllenHbPB  wsllakOKD
bin.usr-is-merged  home  lib64          opt  sbin         sys  wslddFejD  wslnJjiFm  wslnJhAAi
boot         init  lost+found     proc sbin.usr-is-merged  usr  ws1F7LfGm  ws1bbbIDm  ws1pgjphD
dev          lib   media         root snap      usr  ws1JgpOHm  ws1hbGDkD
suda@sDESKTOP-7V1NPF1:/ $ mkdir mylab2
mkdir: cannot create directory 'mylab2': Permission denied
suda@sDESKTOP-7V1NPF1:/ $ mkdirmylab2
mkdirmylab2: command not found
suda@sDESKTOP-7V1NPF1:/ $ mkdir mylab2
mkdir: cannot create directory 'mylab2': Permission denied
suda@sDESKTOP-7V1NPF1:/ $ sudo mkdir mylab2
[sudo] password for suda@s:
suda@sDESKTOP-7V1NPF1:/ $
```

Part 3: File and Directory Operations

**3.1 Creating and Managing Files/Directories

- Commands to demonstrate:

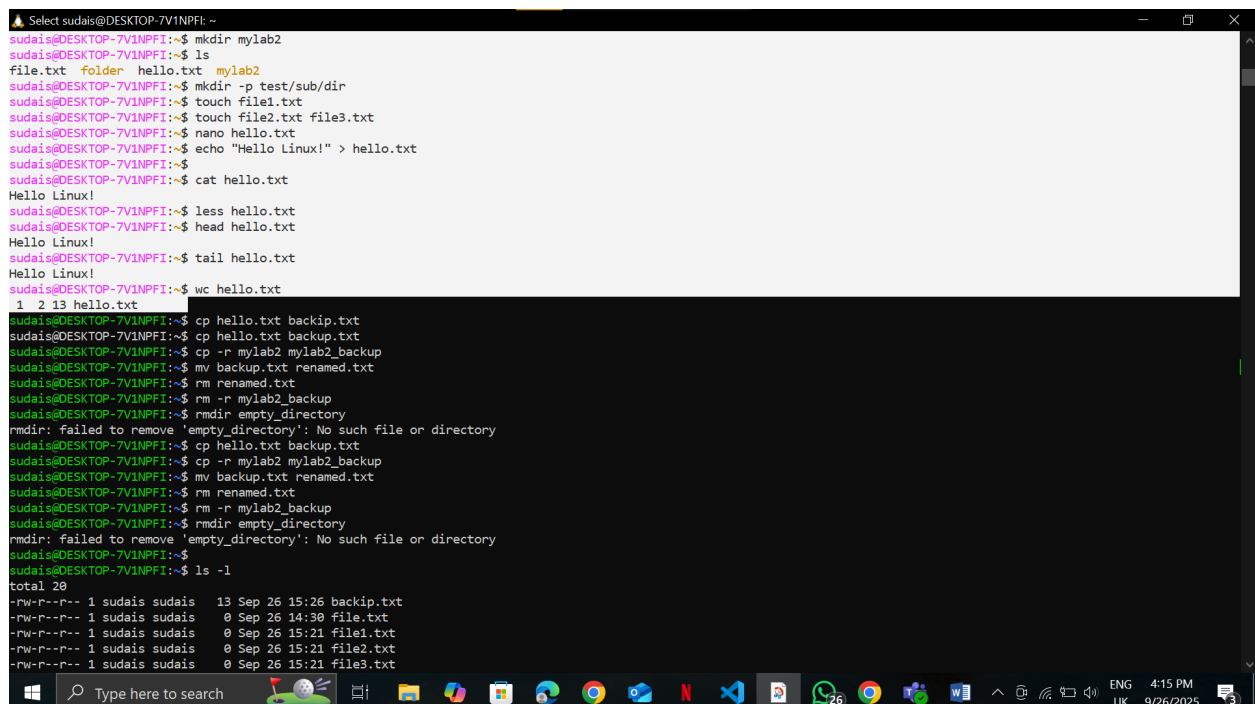
```
mkdir mylab2          # Create directory
mkdir -p test/sub/dir  # Create nested directories
touch file1.txt        # Create empty file
touch file2.txt file3.txt # Multiple files

# Text editors introduction
nano hello.txt         # Simple text editor
# OR
echo "Hello Linux!" > hello.txt # Redirect output to file
```

- File viewing commands:

```
cat hello.txt          # Display file contents
less hello.txt         # Page through file
head hello.txt         # First 10 lines
```

```
tail hello.txt         # Last 10 lines
wc hello.txt           # Word count
```



```
Select suda@sDESKTOP-7V1NPF1: ~
suda@sDESKTOP-7V1NPF1:~$ mkdir mylab2
suda@sDESKTOP-7V1NPF1:~$ ls
file.txt folder hello.txt mylab2
suda@sDESKTOP-7V1NPF1:~$ mkdir -p test/sub/dir
suda@sDESKTOP-7V1NPF1:~$ touch file1.txt
suda@sDESKTOP-7V1NPF1:~$ touch file2.txt file3.txt
suda@sDESKTOP-7V1NPF1:~$ nano hello.txt
suda@sDESKTOP-7V1NPF1:~$ echo "Hello Linux!" > hello.txt
suda@sDESKTOP-7V1NPF1:~$ cat hello.txt
Hello Linux!
suda@sDESKTOP-7V1NPF1:~$ less hello.txt
suda@sDESKTOP-7V1NPF1:~$ head hello.txt
Hello Linux!
suda@sDESKTOP-7V1NPF1:~$ tail hello.txt
Hello Linux!
suda@sDESKTOP-7V1NPF1:~$ wc hello.txt
 1  2 13 hello.txt
suda@sDESKTOP-7V1NPF1:~$ cp hello.txt backup.txt
suda@sDESKTOP-7V1NPF1:~$ cp hello.txt backup.txt
suda@sDESKTOP-7V1NPF1:~$ cp -r mylab2 mylab2_backup
suda@sDESKTOP-7V1NPF1:~$ mv backup.txt renamed.txt
suda@sDESKTOP-7V1NPF1:~$ rm renamed.txt
suda@sDESKTOP-7V1NPF1:~$ rm -r mylab2_backup
suda@sDESKTOP-7V1NPF1:~$ rmdir empty_directory
rmdir: failed to remove 'empty_directory': No such file or directory
suda@sDESKTOP-7V1NPF1:~$ cp hello.txt backup.txt
suda@sDESKTOP-7V1NPF1:~$ cp -r mylab2 mylab2_backup
suda@sDESKTOP-7V1NPF1:~$ mv backup.txt renamed.txt
suda@sDESKTOP-7V1NPF1:~$ rm renamed.txt
suda@sDESKTOP-7V1NPF1:~$ rm -r mylab2_backup
suda@sDESKTOP-7V1NPF1:~$ rmdir empty_directory
rmdir: failed to remove 'empty_directory': No such file or directory
suda@sDESKTOP-7V1NPF1:~$
suda@sDESKTOP-7V1NPF1:~$ ls -l
total 20
-rw-r--r-- 1 suda:suda 13 Sep 26 15:26 backup.txt
-rw-r--r-- 1 suda:suda  0 Sep 26 14:30 file.txt
-rw-r--r-- 1 suda:suda  0 Sep 26 15:21 file1.txt
-rw-r--r-- 1 suda:suda  0 Sep 26 15:21 file2.txt
-rw-r--r-- 1 suda:suda  0 Sep 26 15:21 file3.txt
```

3.2 Copying, Moving, and Deleting

- **Commands to practice:**

```
cp hello.txt backup.txt      # Copy file
cp -r mylab2 mylab2_backup   # Copy directory recursively
mv backup.txt renamed.txt    # Move/rename file
rm renamed.txt               # Remove file
rm -r mylab2_backup          # Remove directory
rmdir empty_directory        # Remove empty directory
```

Hands-on Exercise: Students create a directory structure, add files, and practice file operations.

```
Select suda@sDESKTOP-7V1NPF1: ~
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\Bablu> wsl
suda@sDESKTOP-7V1NPF1: /mnt/c/Users/Bablu$ cd ~
suda@sDESKTOP-7V1NPF1: $ cp hello.txt backup.txt
suda@sDESKTOP-7V1NPF1: $ cp -r mylab2 mylab2_backup
suda@sDESKTOP-7V1NPF1: $ mv backup.txt renamed.txt
suda@sDESKTOP-7V1NPF1: $ rm renamed.txt
suda@sDESKTOP-7V1NPF1: $ rm -r mylab2_backup
suda@sDESKTOP-7V1NPF1: $ rmdir empty_directory
rmdir: failed to remove 'empty_directory': No such file or directory
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $
suda@sDESKTOP-7V1NPF1: $ ls -l
total 20
-rw-r--r-- 1 suda:s suda:s 13 Sep 26 15:26 backup.txt
-rwxr-xr-x 1 suda:s suda:s 0 Sep 26 14:30 file.txt
-rw-r--r-- 1 suda:s suda:s 0 Sep 26 15:21 file1.txt
-rw-r--r-- 1 suda:s suda:s 0 Sep 26 15:21 file2.txt
-rw-r--r-- 1 suda:s suda:s 0 Sep 26 15:21 file3.txt
drwxr-xr-x 3 suda:s suda:s 4096 Sep 26 14:37 folder
-rw-r--r-- 1 suda:s suda:s 13 Sep 26 15:23 hello.txt
drwxr-xr-x 2 suda:s suda:s 4096 Sep 26 15:20 mylab2
drwxr-xr-x 3 suda:s suda:s 4096 Sep 26 15:20 test
suda@sDESKTOP-7V1NPF1: $ chmod 755 file.txt
suda@sDESKTOP-7V1NPF1: $ chmod u+x file.txt
suda@sDESKTOP-7V1NPF1: $ chmod g-w file.txt
suda@sDESKTOP-7V1NPF1: $ chown user:group file.txt
chown: invalid user: 'user:group'
suda@sDESKTOP-7V1NPF1: $ chown user:suda:s group file.txt
chown: invalid user: 'user:suda:s'
suda@sDESKTOP-7V1NPF1: $ chown suda:s:group file.txt
chown: invalid group: 'suda:s:group'
suda@sDESKTOP-7V1NPF1: $ chmod 755 file.txt # Change permissions (numeric)
chmod u+x file.txt # Add execute permission for user
chmod g-w file.txt # Remove write permission for group
```

Part 4: File Permissions and Ownership

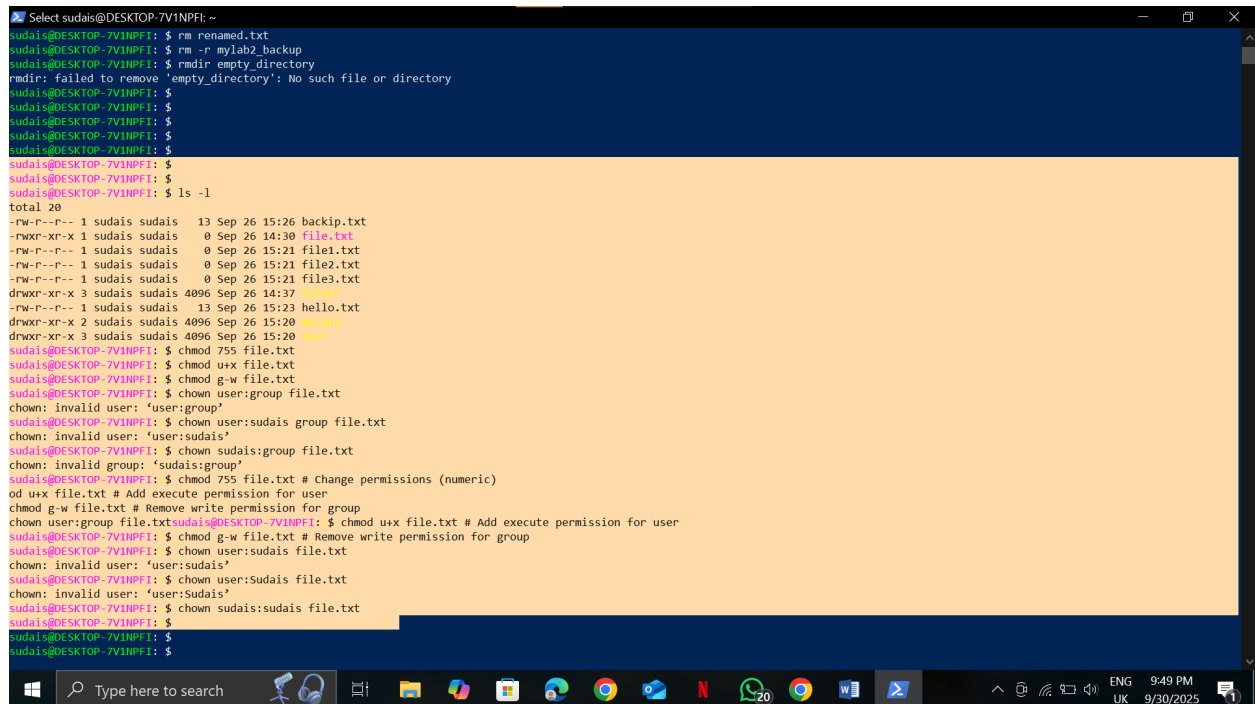
4.1 Understanding File Permissions

- **Concepts to Cover:**

- Permission types: read (r), write (w), execute (x)
- Permission groups: user (u), group (g), others (o)
- Numeric notation: 755, 644, etc.

- **Commands to demonstrate:**

```
ls -l          # View permissions
chmod 755 file.txt # Change permissions (numeric)
chmod u+x file.txt # Add execute permission for user
chmod g-w file.txt # Remove write permission for group
chown user:group file.txt # Change ownership (if applicable)
```



```
Select sudais@DESKTOP-7VINPFI: ~
sudais@DESKTOP-7VINPFI: $ rm renamed.txt
sudais@DESKTOP-7VINPFI: $ rm -r mylab2_backup
sudais@DESKTOP-7VINPFI: $ rmdir empty_directory
rmdir: failed to remove 'empty_directory': No such file or directory
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $ ls -l
total 20
-rw-r--r-- 1 sudais sudais 13 Sep 26 15:26 backup.txt
-rwxr-xr-x 1 sudais sudais 0 Sep 26 14:30 file.txt
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file1.txt
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file2.txt
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file3.txt
drwxr-xr-x 3 sudais sudais 4096 Sep 26 14:37 folder
-rw-r--r-- 1 sudais sudais 13 Sep 26 15:23 hello.txt
drwxr-xr-x 2 sudais sudais 4096 Sep 26 15:20 mylab2
drwxr-xr-x 3 sudais sudais 4096 Sep 26 15:20 test
sudais@DESKTOP-7VINPFI: $ chmod 755 file.txt
sudais@DESKTOP-7VINPFI: $ chmod u+x file.txt
sudais@DESKTOP-7VINPFI: $ chmod g-w file.txt
sudais@DESKTOP-7VINPFI: $ chown user:group file.txt
chown: invalid user: 'user:group'
sudais@DESKTOP-7VINPFI: $ chown user:sudais group file.txt
chown: invalid user: 'user:sudais'
sudais@DESKTOP-7VINPFI: $ chown sudais:group file.txt
chown: invalid group: 'sudais:group'
sudais@DESKTOP-7VINPFI: $ chmod 755 file.txt # Change permissions (numeric)
od u+x file.txt # Add execute permission for user
chmod g-w file.txt # Remove write permission for group
chown user:group file.txt sudais@DESKTOP-7VINPFI: $ chmod u+x file.txt # Add execute permission for user
sudais@DESKTOP-7VINPFI: $ chmod g-w file.txt # Remove write permission for group
sudais@DESKTOP-7VINPFI: $ chown user:sudais file.txt
chown: invalid user: 'user:sudais'
sudais@DESKTOP-7VINPFI: $ chown user:Sudais file.txt
chown: invalid user: 'user:Sudais'
sudais@DESKTOP-7VINPFI: $ chown sudais:sudais file.txt
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
```

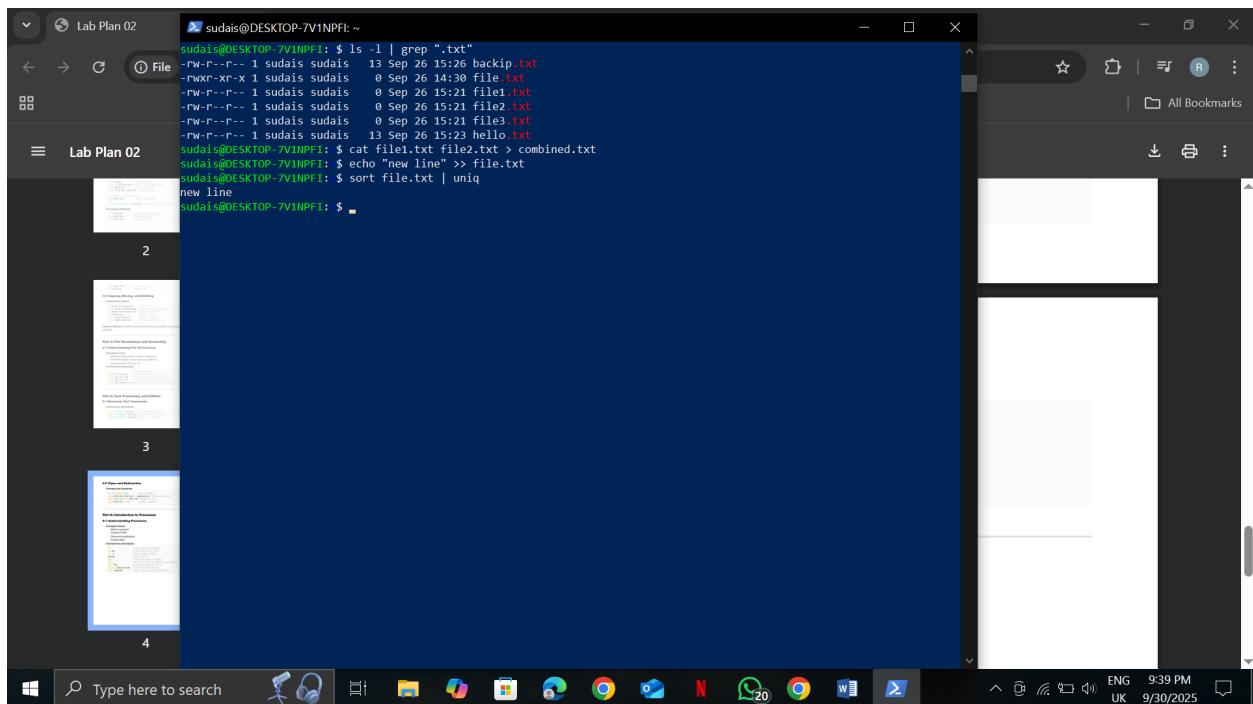


```
Select sudais@DESKTOP-7V1NPF1: ~  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $ grep "pattern" file.txt # Search for patterns  
"pattern" file.txt # Case-insensitive search  
grep -n "pattern" file.txt sudais@DESKTOP-7V1NPF1: $ grep -i "pattern" file.txt # Case-insensitive search  
sudais@DESKTOP-7V1NPF1: $ grep -n "pattern" file.txt  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $ grep "pattern" file.txt  
sudais@DESKTOP-7V1NPF1: $ grep -i "pattern" file.txt  
sudais@DESKTOP-7V1NPF1: $ grep -n "pattern" file.txt  
sudais@DESKTOP-7V1NPF1: $ grep -n "pattern" file.txt  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $  
sudais@DESKTOP-7V1NPF1: $ ls -l | grep ".txt"  
-rw-r--r-- 1 sudais sudais 13 Sep 26 15:26 backup.txt  
-rwxr-xr-x 1 sudais sudais 0 Sep 26 14:30 file.txt  
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file1.txt  
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file2.txt  
-rw-r--r-- 1 sudais sudais 0 Sep 26 15:21 file3.txt  
-rw-r--r-- 1 sudais sudais 13 Sep 26 15:23 hello.txt  
sudais@DESKTOP-7V1NPF1: $ cat file1.txt file2.txt > combined.txt  
sudais@DESKTOP-7V1NPF1: $ echo "new line" >> file.txt  
sudais@DESKTOP-7V1NPF1: $ sort file.txt | uniq
```

5.2 Pipes and Redirection

- Concepts and commands:

```
ls -l | grep ".txt"          # Pipe output
cat file1.txt file2.txt > combined.txt # Redirect output
echo "new line" >> file.txt # Append to file
sort file.txt | uniq         # Chain commands
```

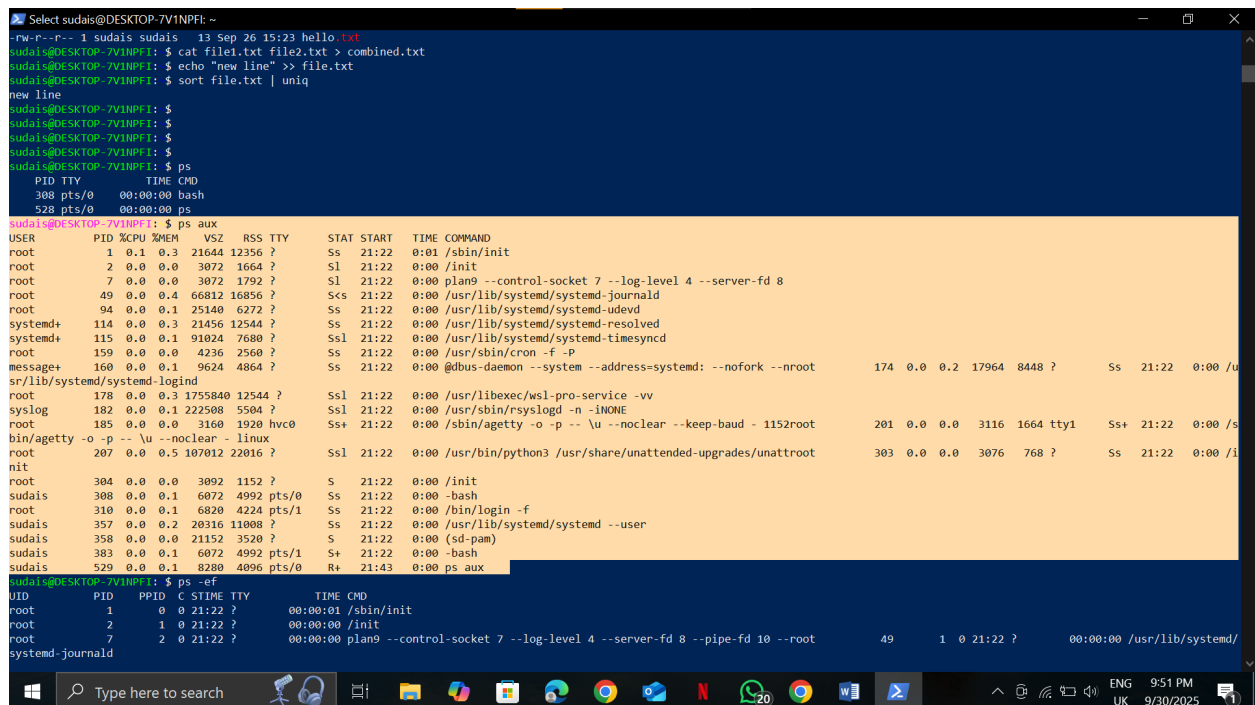


Part 6: Introduction to Processes

6.1 Understanding Processes

- **Concepts to Cover:**
 - What is a process?
 - Process ID (PID)
 - Parent-child relationships
 - Process states
- **Commands to demonstrate:**

```
ps                # Show current processes
ps aux            # Detailed process list
ps -ef           # Full format listing
pstree            # Process tree
top               # Real-time process viewer
htop              # Enhanced process viewer (if available)
kill PID          # Terminate process by PID
killall process_name # Kill processes by name
pkill pattern     # Kill processes matching pattern
```



The screenshot shows a terminal window with the following commands and output:

```
Select sudais@DESKTOP-7VINPFI: ~
-rw-r--r-- 1 sudais sudais 13 Sep 26 15:23 hello.txt
sudais@DESKTOP-7VINPFI: $ cat file1.txt file2.txt > combined.txt
sudais@DESKTOP-7VINPFI: $ echo "new line" >> file.txt
sudais@DESKTOP-7VINPFI: $ sort file.txt | uniq
new line
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $
sudais@DESKTOP-7VINPFI: $ ps
  PID TTY          TIME CMD
 308 pts/0    00:00:00 bash
 528 pts/0    00:00:00 ps
sudais@DESKTOP-7VINPFI: $ ps aux
USER        PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1   0.1  0.3   21644 12356 ?        Ss   21:22   0:01 /sbin/init
root         2   0.0  0.0    3072 1664 ?        S1   21:22   0:00 /init
root         7   0.0  0.0    3072 1792 ?        S1   21:22   0:00 plan9 --control-socket 7 --log-level 4 --server-fd 8
root        49   0.0  0.4   66812 16856 ?        S<   21:22   0:00 /usr/lib/systemd/systemd-journald
root        94   0.0  0.1   25140 6272 ?        Ss   21:22   0:00 /usr/lib/systemd/systemd-udevd
systemd+   114   0.0  0.3   21456 12544 ?        Ss   21:22   0:00 /usr/lib/systemd/systemd-resolved
systemd+   115   0.0  0.1   91024 7680 ?        Ss1  21:22   0:00 /usr/lib/systemd/systemd-timesyncd
root       159   0.0  0.0    4236 2560 ?        Ss   21:22   0:00 /usr/sbin/cron -f -p
message+   160   0.0  0.1    9624 4864 ?        Ss   21:22   0:00 @dbus-daemon --system --address=systemd: --nofork --nroot
sr/lib/systemd/systemd-logind
root       178   0.0  0.3  1755840 12544 ?        Ss1  21:22   0:00 /usr/libexec/wsl-pro-service -vv
syslog     182   0.0  0.1   222508 5504 ?        Ss1  21:22   0:00 /usr/sbin/rsyslogd -n -iNONE
root      185   0.0  0.0    3160 1920 hvc0    Ss+  21:22   0:00 /sbin/agetty -o -p -- \u --noclear --keep-baud - 1152root
bin/agetty -o -p -- \u --noclear - linux
root      207   0.0  0.5  107012 22016 ?        Ss1  21:22   0:00 /usr/bin/python3 /usr/share/unattended-upgrades/unattroot
nit
root      304   0.0  0.0    3092 1152 ?        S   21:22   0:00 /init
sudais     308   0.0  0.1    6072 4992 pts/0    Ss   21:22   0:00 -bash
root      310   0.0  0.1    6820 4224 pts/1    Ss   21:22   0:00 /bin/login -f
sudais     357   0.0  0.2   20316 11008 ?        Ss   21:22   0:00 /usr/lib/systemd/systemd --user
sudais     358   0.0  0.0   21152 3520 ?        S   21:22   0:00 (sd-pam)
sudais     383   0.0  0.1    6072 4992 pts/1    S+   21:22   0:00 -bash
sudais     529   0.0  0.1    8280 4096 pts/0    R+   21:43   0:00 ps aux
sudais@DESKTOP-7VINPFI: $ ps -ef
UID        PID     PPID  C  TIME TTY          TIME CMD
root         1       0  0  21:22 ?        00:00:01 /sbin/init
root         2       1  0  21:22 ?        00:00:00 /init
root         7       2  0  21:22 ?        00:00:00 plan9 --control-socket 7 --log-level 4 --server-fd 8 --pipe-fd 10 --root
systemd-journald
```

```
Select sudo@DESKTOP-7V1NPF1: ~
[unattended-upgr] (unattended-upgr)
wsl-pro-service-7*[[wsl-pro-service]]
sudo@DESKTOP-7V1NPF1: $
sudo@DESKTOP-7V1NPF1: $
sudo@DESKTOP-7V1NPF1: $
sudo@DESKTOP-7V1NPF1: $ top
top - 21:44:51 up 22 min, 1 user, load average: 0.01, 0.00, 0.00
Tasks: 23 total, 1 running, 22 sleeping, 0 stopped, 0 zombie
Cpu(s): 0.0 us, 0.1 sy, 0.0 ni, 99.9 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
MiB Mem : 3843.2 total, 3410.8 free, 447.1 used, 106.5 buff/cache
MiB Swap: 1024.0 total, 1024.0 free, 0.0 used, 3396.1 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM     TIME+ COMMAND
    1 root        20   0  21644 12356 9284  S   0.0   0.3   0:01.33 systemd
    2 root        20   0  3072  1664  1664  S   0.0   0.0   0:00.01 init-systemd(Ub
    7 root        20   0  3072  1792  1792  S   0.0   0.0   0:00.00 init
   49 root       -1  -1 66812 16856 15960  S   0.0   0.4   0:00.37 systemd-journal
   94 root        20   0  25140  6272  4992  S   0.0   0.2   0:00.18 systemd-udev
  114 systemd+   20   0  21456 12544 10368  S   0.0   0.3   0:00.20 systemd-resolve
  115 systemd+   20   0  91024  7680  6784  S   0.0   0.2   0:00.13 systemd-timesyn
  159 root        20   0  4236  2560  2432  S   0.0   0.1   0:00.00 cron
  160 message+   20   0  9624  4864  4352  S   0.0   0.1   0:00.10 dbus-daemon
  174 root        20   0  17964  8448  7552  S   0.0   0.2   0:00.13 systemd-logind
  178 root        20   0 1755840 12544 10624  S   0.0   0.3   0:00.18 wsl-pro-service
  182 syslog     20   0  222508  5504  4352  S   0.0   0.1   0:00.11 rsyslogd
  185 root        20   0  3160  1920  1792  S   0.0   0.0   0:00.01 agetty
  201 root        20   0  3116  1664  1664  S   0.0   0.0   0:00.01 agetty
  207 root        20   0 107012 22016 12928  S   0.0   0.6   0:00.22 unattended-upgr
  303 root        20   0  3076   768   768  S   0.0   0.0   0:00.00 SessionLeader
  304 root        20   0  3092  1152  1024  S   0.0   0.0   0:00.06 Relay(308)
  308 sudo@      20   0  6072  4992  3456  S   0.0   0.1   0:00.13 bash
  310 root        20   0  6820  4224  3712  S   0.0   0.1   0:00.01 login
  357 sudo@      20   0 20316 11008  9088  S   0.0   0.3   0:00.21 systemd
  358 sudo@      20   0  21152  3520  1792  S   0.0   0.1   0:00.00 (sd-pam)
  383 sudo@      20   0  6072  4992  3456  S   0.0   0.1   0:00.05 bash
  532 sudo@      20   0  9296  5504  3328  R   0.0   0.1   0:00.04 top
top - 21:45:07 up 22 min, 1 user, load average: 0.00, 0.00, 0.00
Tasks: 23 total, 1 running, 22 sleeping, 0 stopped, 0 zombie
Cpu(s): 0.0/0.2  0%
MiB Mem : 3843.2 total, 3411.0 free, 446.9 used, 106.5 buff/cache
MiB Swap: 1024.0 total, 1024.0 free, 0.0 used, 3396.3 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM     TIME+ COMMAND
    1 root        20   0  21644 12356 9284  S   0.0   0.3   0:01.33 systemd
```

```
Select sudo@DESKTOP-7V1NPF1: ~
sudo@DESKTOP-7V1NPF1: $ ps -ef
sudo@DESKTOP-7V1NPF1: $ ps -ef
  UID    PID  PPID  C  TIME  TTY      TIME CMD
   root      1      0  0 21:22 ?        00:00:01 /sbin/init
   root      2      1  0 21:22 ?        00:00:00 /init
   root      7      2  0 21:22 ?        00:00:00 plan9 --control-socket 7 --log-level 4 --server-fd 8 --pipe-fd 10 --root
systemd-journal
   root     94      1  0 21:22 ?        00:00:00 /usr/lib/systemd/systemd-udev
systemd+   114      1  0 21:22 ?        00:00:00 /usr/lib/systemd/systemd-resolved
systemd+   115      1  0 21:22 ?        00:00:00 /usr/lib/systemd/systemd-timesyncd
   root    159      1  0 21:22 ?        00:00:00 /usr/sbin/cron -f -P
message+  160      1  0 21:22 ?        00:00:00 @dbus-daemon --system --address=systemd: --nofork --nopidfile --sysroot
systemd-logind
   root    178      1  0 21:22 ?        00:00:00 /usr/libexec/wsl-pro-service -vv
syslog    182      1  0 21:22 ?        00:00:00 /usr/sbin/rsyslogd -n -iNONE
   root    185      1  0 21:22 hvco  00:00:00 /sbin/agetty -o -p -- \u --noclear --keep-baud - 115200,38400,9600 vroot
p -- \u --noclear - linux
   root    207      1  0 21:22 ?        00:00:00 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-sroot
   root    303      1  0 21:22 ?        00:00:00 /init
sudo@      308     304  0 21:22 pts/0    00:00:00 -bash
   root    310      2  0 21:22 pts/1    00:00:00 /bin/login -f
sudo@      357      1  0 21:22 ?        00:00:00 /usr/lib/systemd/systemd --user
sudo@      358     357  0 21:22 ?        00:00:00 (sd-pam)
sudo@      383     310  0 21:22 pts/1    00:00:00 -bash
sudo@      530     308  0 21:43 pts/0    00:00:00 ps -ef
sudo@DESKTOP-7V1NPF1: $ pstree
systemd-2*[agetty]
├──cron
├──dbus-daemon
├──init-systemd(Ub
│   ├──SessionLeader──Relay(308)──bash──pstree
│   ├──init--(init)
│   ├──login──bash
│   └──(init-systemd(Ub)
├──rsyslogd--3*[(rsyslogd)]
├──systemd--(sd-pam)
├──systemd-journal
├──systemd-logind
├──systemd-resolve
├──systemd-timesyn--{systemd-timesyn}
├──systemd-udev
└──unattended-upgr--{unattended-upgr}
    └──wsl-pro-service-7*[[wsl-pro-service]]
sudo@DESKTOP-7V1NPF1: $
```

```
Select sudais@DESKTOP-7VINPFI: ~  
  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $ htop  
Command 'htop' not found, but can be installed with:  
sudo snap install htop # version 3.4.1, or  
sudo apt install htop # version 3.2.2-2  
See 'snap info htop' for additional versions.  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $ kill PID  
-bash: kill: PID: arguments must be process or job IDs  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $ killall process_name  
process_name: no process found  
sudais@DESKTOP-7VINPFI: $ killall pstree  
pstree: no process found  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $  
sudais@DESKTOP-7VINPFI: $ pkill pattern  
sudais@DESKTOP-7VINPFI: $
```