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Network Operating System

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## Introduction

Looking back to history of Unix system it dates back to 1960s and early 70's, at AT&T Bell Labs with involvement of Massachusetts Institute of Technology (MIT) and General Electric developing time-sharing system to allow multiple users accessing the system. Dennis Ritchie, Ken Thompson and their team introduced innovation through Unix system using concepts like Multics earlier and changed the project module to introducing other concept to make efficient operating system like File system and others. Starting Unix platforms like Linux, Minix, SunSolaris, MacOS, etc are highly inspired by the core design principles. (IBM corporation, 2015)

Core of Unix is using command-line interface (CLI) to interfere with that system, a tool enables users to perform file management and other tasks with precision, speed, and control. Unlike graphical user interfaces (GUIs), which prioritize user-friendliness with visual navigational control, the Unix system's CLI focuses on efficiency and flexibility of commands to perform the same task. Commands prompts like ls, cat, and chmod are used as powerful prompts with capabilities for managing files, navigating directories, and controlling system access. Using command line requires user to maintain knowledge and memories the prompts.

Unix is still on system where stability, scalability and robustness are kept on priority. Machines like powerful server computers, supercomputers, workstation, mobile devices, embedded systems, critical system, high available system, desktop system, complex server environment, Airspace, etc are using these system. Remote access to server is widely used feature of the system providing users direct system access remotely. Most of the time, a user interacts with an HPC cluster using a Command Line Interface (CLI), also known as a terminal. (West Virginia University, 2023)

## Objective

The main focus of this workshop is to familiarize students with the use of commands in Unix system. Primarily commands like mkdir, mkdir -p, cat, grep, grep -i, grep -c, alias, history and other commands are used in this workshop.:

- Understand hierarchical file structure and navigate within directory.
- Manipulate text files using the command cat.
- Search for keyword inside text file content using command grep.
- Create and manage command aliases.
- Utilize the history command to re-execute past commands effectively.
- Explore the use of custom aliases for system information retrieval.

## Required Tools and Concepts

### Hardware Requirments:

- Intel Pentium 4 class
- 512MB memory
- 50GB hard drive space
- \*Minimum hardware specs to run as native system\*
- Or, PC capable of ruuning Unix system in virtual enviroment  
(Unix Client System Requirment, n.d.)

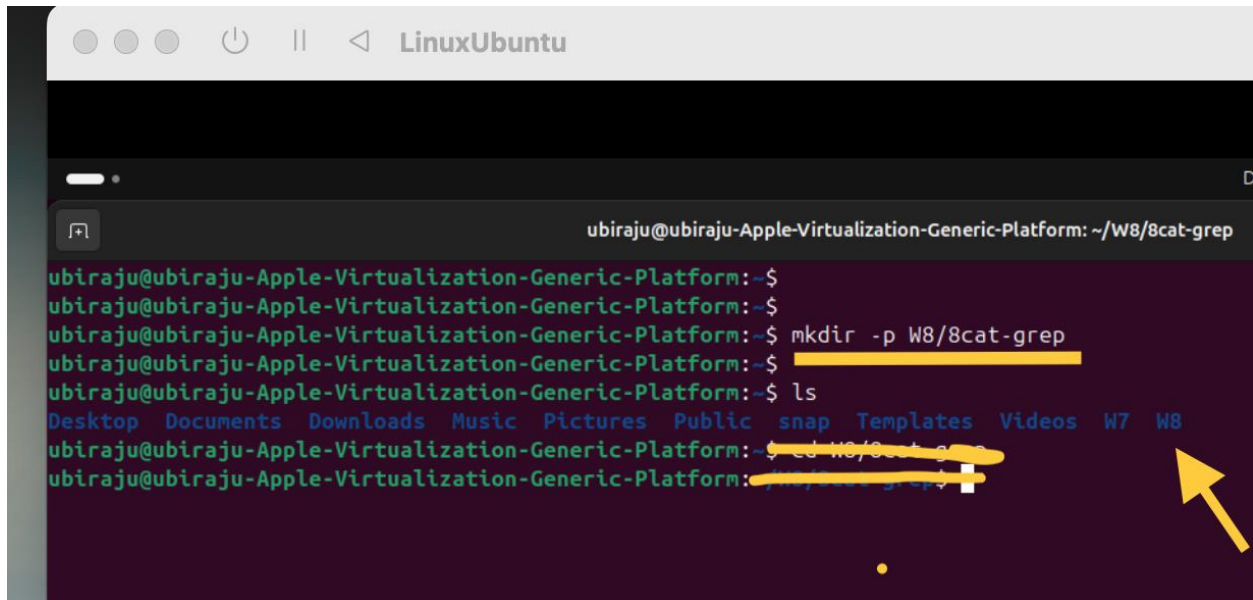
### Software Requirements:

- Unix based OS iso file
- Vmware, Parrallel Desktop, or others for virtualization
- Native Operating system to run virtualization

### Key Concepts:

- Shell, terminal to run the commands
- Command Line Interface (CLI)
- Directory navigation relative and absolute path
- Command for directory management and permission management
- Mkdir, ls, chmod, cat, echo, and others

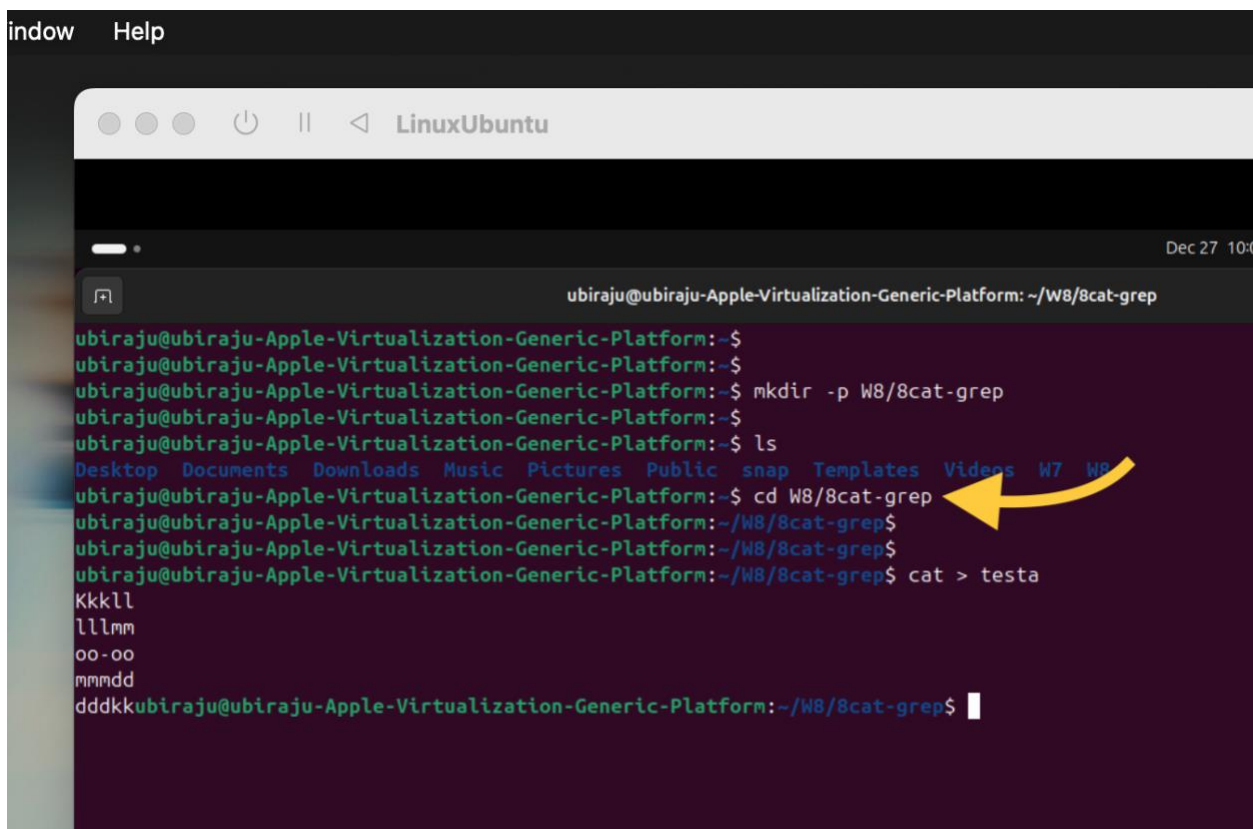
## Steps to Replicate



A terminal window titled "LinuxUbuntu" showing a series of commands. The user is in the directory ~/W8/8cat-grep. The commands executed are: mkdir -p W8/8cat-grep, followed by ls. The ls output shows a list of directories: Desktop, Documents, Downloads, Music, Pictures, Public, snap, Templates, Videos, W7, and W8. The W8 directory is highlighted with a yellow arrow. The terminal prompt is ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep.

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ mkdir -p W8/8cat-grep  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ ls  
Desktop Documents Downloads Music Pictures Public snap Templates Videos W7 W8  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ cd W8/8cat-grep  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep$
```

Figure 1: making directory W8 and subdirectory 8cat-grep



A terminal window titled "LinuxUbuntu" showing a series of commands. The user is in the directory ~/W8/8cat-grep. The commands executed are: mkdir -p W8/8cat-grep, followed by ls. The ls output shows a list of directories: Desktop, Documents, Downloads, Music, Pictures, Public, snap, Templates, Videos, W7, and W8. The W8 directory is highlighted with a yellow arrow. The terminal prompt is ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep. The user then enters the directory W8/8cat-grep using the cd command. The terminal prompt changes to ~/W8/8cat-grep\$. The user then creates a file named test.txt using the cat command. The terminal prompt changes to ~/W8/8cat-grep\$ cat > test.txt. The user then enters the text "Kkkll", "lllmm", "oo-oo", "mmd", and "dddkk" into the file. The terminal prompt changes to ~/W8/8cat-grep\$.

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ mkdir -p W8/8cat-grep  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ ls  
Desktop Documents Downloads Music Pictures Public snap Templates Videos W7 W8  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/$ cd W8/8cat-grep  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep$ cat > test.txt  
Kkkll  
lllmm  
oo-oo  
mmd  
dddkk  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~/W8/8cat-grep$
```

Figure 2: entering into directory 8cat-grep

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ cd W8/8cat-grep
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ cat > testa
Kkkll
lllmm
oo-oo
mmdd
dddkkubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ cat > testb
KKKKK
LLLLL
MMMMM
DDDDD
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 4: creating file 'testa' and 'testb' with text contents

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ cat > testa
Kkkll
lllmm
oo-oo
mmdd
dddkkubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ cat > testb
KKKKK
LLLLL
MMMMM
DDDDD
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ ls
testa testb
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 3: checking for file existence of testa and testb using command ls

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ ls
testa  testb
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep ll testa
Kkkll
lllmm
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 7: searches for 'll' in file 'testa'

```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep ll testa
Kkkll
lllmm
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -v ll testa
oo-oo
mmdd
dddkk
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 6: display the text in file testa excluding 'll'

```
oo-oo
mmdd
dddkk
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -n ll testa
1:Kkkll
2:lllmm
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 5: displays line in text with 'll' in file testa



```

ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -i ll *
testa:Kkkll
testa:lllmm
testb:LLLLL
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -i LL *
testa:Kkkll
testa:lllmm
testb:LLLLL
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$

```

Figure 10: performs search without case sensitive

```

testb:LLLLL
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -c ll *
testa:2
testb:0
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$

```

Figure 9: displays count of content 'll'

```

ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -c ll
testa:2
testb:0
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep '^K' testa testb
testa:Kkkll
testb:KKKKK
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$

```

Figure 8: searches for line starting with 'K' in file testa and testb



```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ grep -n '^' testa  
1:Kkkll  
2:lllmm  
3:oo-oo  
4:mmmdd  
5:dddkk  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 11: displays all line in file testa with line numbering

```
4:mmmdd  
5:dddkk  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ alias lsal='ls -al'  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ lsal  
total 16  
drwxrwxr-x 2 ubiraju ubiraju 4096 Dec 27 10:09 .  
drwxrwxr-x 3 ubiraju ubiraju 4096 Dec 27 10:06 ..  
-rw-rw-r-- 1 ubiraju ubiraju 29 Dec 27 10:08 testa  
-rw-rw-r-- 1 ubiraju ubiraju 23 Dec 27 10:09 testb  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$
```

Figure 13: creating alias for command "ls -al" and using the alias as "lsal"

```
-rw-rw-r-- 1 ubiraju ubiraju 23 Dec 27 10:09 testb  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~/W8/8cat-grep$ cd ../../..  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$ lsal  
total 12  
drwxr-xr-x 3 root root 4096 Dec 9 13:52 .  
drwxr-xr-x 20 root root 4096 Dec 9 13:49 ..  
drwxr-x-- 18 ubiraju ubiraju 4096 Dec 27 10:06 ubiraju  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
```

Figure 12: getting into home directory and listing permissions

```
drwxr-xr-x 20 root root 4096 Dec 9 13:49 ..
drwxr-x-- 18 ubiraju ubiraju 4096 Dec 27 10:06 ubiraju
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$ alias
alias alert='notify-send --urgency=low -i "${[ $? = 0 ]} && echo terminal || echo error)" "$(history|tail -n1|sed -e '\''s/^\s*[0-9]\+\s*//;s/[\;\&]\s*alert$//'\`)"'
alias egrep='egrep --color=auto'
alias fgrep='fgrep --color=auto'
alias grep='grep --color=auto'
alias l='ls -CF'
alias la='ls -A'
alias ll='ls -alF'
alias ls='ls --color=auto'
alias lsal='ls -al'
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
```

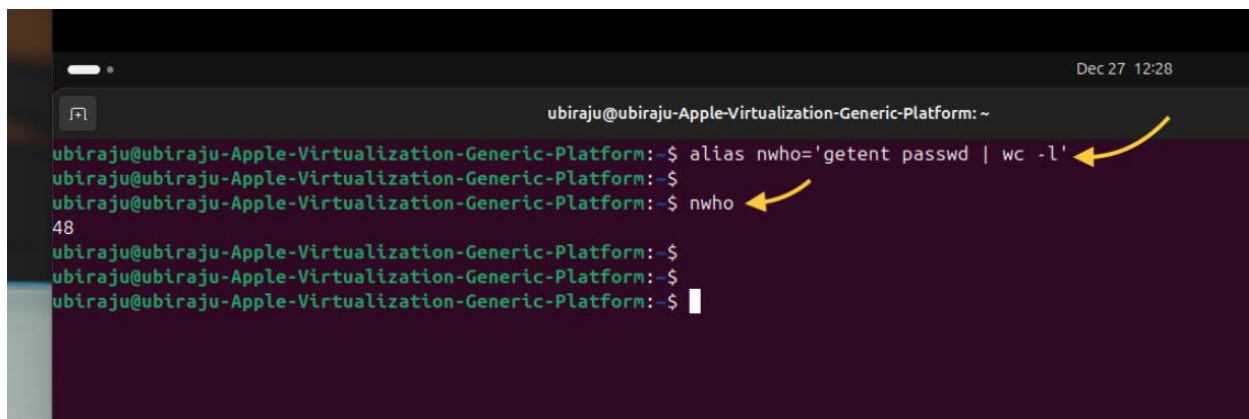
Figure 16: display all alias stored

```
alias ll='ls -alF'
alias ls='ls --color=auto'
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$ lsal
Command 'lsal' not found, did you mean:
  command 'lsar' from debunar (1.10.8+ds1-6)
Try: sudo apt install <deb name>
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
```

Figure 15: alias unstored session expired

```
Try: sudo apt install <deb name>
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$ echo "alias lsal='ls -al'" >> ~/.bashrc
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$ source ~/.bashrc
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:/home$
```


Figure 14: creating alias and storing into bash system



```
Dec 27 12:28
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ alias nwho='getent passwd | wc -l'
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ nwho
48
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
```

A terminal window with a dark purple background. The title bar shows 'Dec 27 12:28'. The prompt is 'ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~'. The user enters the command 'alias nwho='getent passwd | wc -l'', which is highlighted with a yellow arrow. The next prompt shows the user has entered 'nwho', which is also highlighted with a yellow arrow. The output of the command is '48'. The prompt then returns to '~\$'.

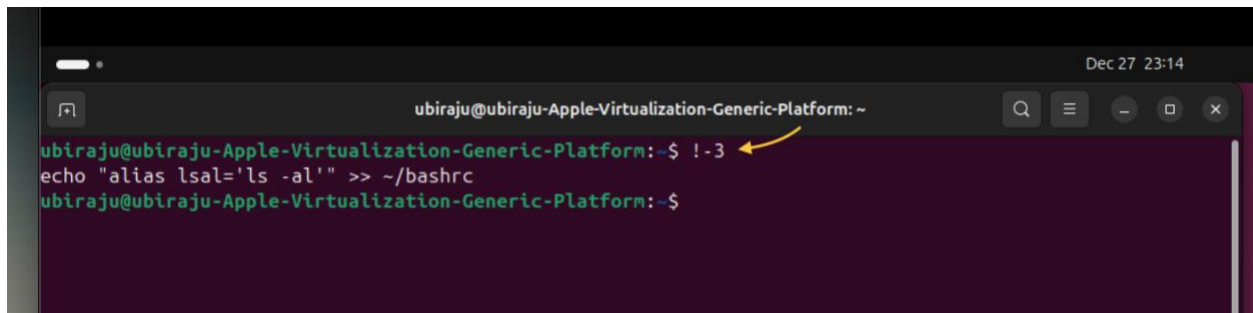
Figure 18: Counts the number of user accounts in the system by combining `getent passwd` and `wc -l`.



```
399 grep -n '^' testa
400 alias lsal='ls -al'
401 lsal
402 cd ../../../../
403 lsal
404 alias
405 unalias lsal
406 alias
407 lsal
408 echo "alias lsal='ls -al'" >> ~/.bashrc
409 source ~/.bashrc
410 alias nwho='getent passwd|wc-l
411 alias nwho='getent passwd | wc -l'
412 nwho
413 history
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
```

A terminal window with a dark purple background. The prompt is 'ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~\$'. The user enters a series of commands: 'alias lsal='ls -al'', 'lsal', 'cd ../../../../', 'lsal', 'alias', 'unalias lsal', 'alias', 'lsal', 'echo "alias lsal='ls -al'" >> ~/.bashrc', 'source ~/.bashrc', 'alias nwho='getent passwd|wc-l', 'alias nwho='getent passwd | wc -l'', 'nwho', and 'history'. The 'history' command is highlighted with a yellow arrow. The prompt then returns to '~\$'.

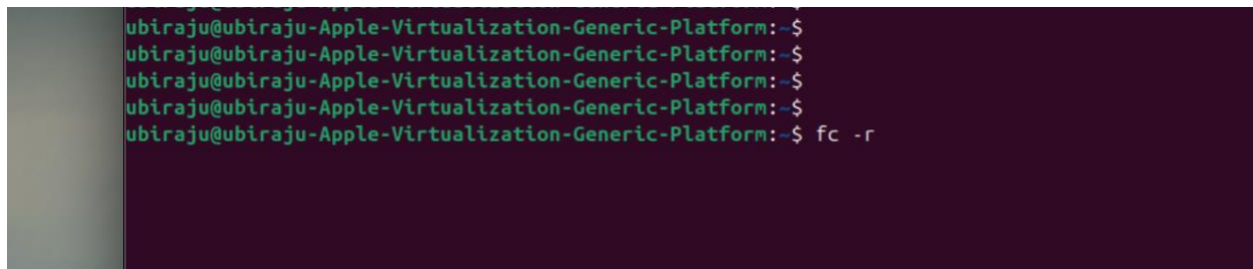
Figure 17: command `'history'` displays series of commands previously used



```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform: ~  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ !-3  
echo "alias lsal='ls -al'" >> ~/.bashrc  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
```

A terminal window with a dark background. The title bar shows the user 'ubiraju' and the host 'ubiraju-Apple-Virtualization-Generic-Platform'. The prompt is '~'. The user enters '!-3', which is highlighted with a yellow arrow. The terminal then shows the output of the command: 'echo "alias lsal='ls -al'" >> ~/.bashrc'. The prompt returns to '~\$'.

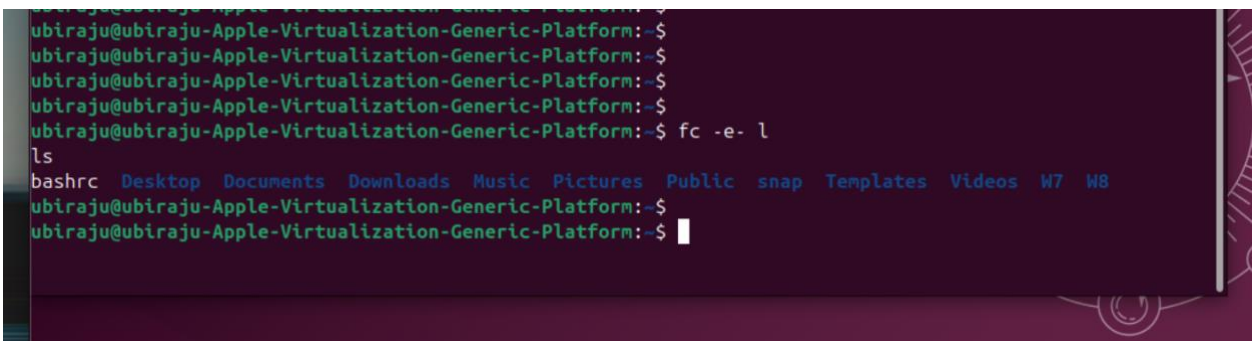
Figure 19: performs last third command



```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ fc -r
```

A terminal window showing five consecutive prompts '~\$'. The user enters 'fc -r' at the end of the sequence.

Figure 21: fc -r reexecute command in reverse order



```
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$ fc -e- l  
ls  
bashrc Desktop Documents Downloads Music Pictures Public snap Templates Videos W7 W8  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$  
ubiraju@ubiraju-Apple-Virtualization-Generic-Platform:~$
```

A terminal window showing five consecutive prompts '~\$'. The user enters 'fc -e- l'. The terminal then shows the output of the command: 'ls'. Below the output, there is a list of files and directories: 'bashrc Desktop Documents Downloads Music Pictures Public snap Templates Videos W7 W8'. The prompt returns to '~\$'.

Figure 20: reexecute the command starting with 'L'

## Conclusion

This session of workshop made a clearer understanding of key comand concept while using Unix based system. Use of commands for file handling and manipulation and directory management, text searching, and efficient use of command by creating alias and history of commands used. By completing this log exerices , my understanding of Unix system has significantly enhanced.

## References

- West Virginia University. (2023). *WU - Research Computing*. From <https://docs.hpc.wvu.edu/text/23.CommandLine.html#:~:text=Most%20of%20the%20time%2C%20a,by%20a%20program%20called%20shell>.
- IBM corporation. (2015). From IBM.com: <https://www.ibm.com/docs/en/zos/2.4.0?topic=reference-summary-zos-unix-shell-commands>
- Unix Programmers Manual <https://dspinellis.github.io/unix-v4man/v4man.pdf>