Summary Sheet for Linux Course

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Mathematics

We begin with Maxwell...

$$\nabla \cdot \mathrm{D} = \rho_f$$
$$\nabla \cdot \mathrm{B} = 0$$
$$\nabla \times \mathrm{D} = -\frac{\partial \mathrm{B}}{\partial t}$$
$$\nabla \times \mathrm{H} = \mathrm{J}_f + \frac{\partial \mathrm{D}}{t}$$

And now...

Square of sums

$$(a_1 + a_2)^2 = a_1^2 + 2a_1a_2 + a_2^2$$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Standard Deviation

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

De Morgan's laws

$$\neg(P \land Q) \iff (\neg P) \lor (\neg Q)$$

Log Change of Base

$$\log_b(x) = \frac{\log_a(x)}{\log_a(b)}$$

Cosine addition

$$\cos(\theta + \varphi) = \cos(\theta)\cos(\varphi) - \sin(\theta)\sin(\varphi)$$

Limit e^k

$$\lim_{x \to \infty} \left(1 + \frac{k}{x}\right)^x = e^k$$

Calculus

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi)\, e^{2\pi i \xi x}\, \mathrm{d}\xi$$

Stirling Numbers of the Second Kind

$$\left\{ {n \atop k} \right\} = \frac{1}{k!}\sum_{j=0}^{k}(-1)^{k-j}\binom{k}{j}(k-j)^n$$

Gaussian Integral

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$

Arithmetic mean, geometric mean inequality

$$\frac{1}{n}\sum_{i=1}^{n} x_i \geq \sqrt[n]{\prod_{i=1}^{n} x_i}$$

Cauchy-Schwarz inequality

$$\left(\sum_{k=1}^{n} a_k b_k\right)^2 \leq \left(\sum_{k=1}^{n} a_k^2\right)\left(\sum_{k=1}^{n} b_k^2\right)$$

Cauchy integral formula

$$f^{(n)}(z_0) = \frac{n!}{2\pi i}\oint_\gamma \frac{f(z)}{(z-z_0)^{n+1}}dz$$

Schroedinger's Equation

$$i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{x},t) = -\frac{\hbar}{2m}\nabla^2\Psi(\mathbf{x},t) + V(\mathbf{x})\Psi(\mathbf{x},t)$$

Lorentz Equations

$$\dot{x} = \sigma(y-x)$$
$$\dot{y} = \rho x - y - xz$$
$$\dot{z} = -\beta z + xy"$$

Cross product

$$\vec{V}_1 \times \vec{V}_2 = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ \frac{\partial X}{\partial u} & \frac{\partial Y}{\partial u} & 0 \\ \frac{\partial X}{\partial v} & \frac{\partial Y}{\partial v} & 0 \end{vmatrix}$$

Matrix multiplication

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} \alpha & \beta \\ \gamma & \delta \end{pmatrix} = \begin{pmatrix} a\alpha + b\gamma & a\beta + b\delta \\ c\alpha + d\gamma & c\beta + d\delta \end{pmatrix}$$

Cases

$$f(x) = \begin{cases} \frac{e^x}{2} & x \geq 0 \\ 1 & x < 0 \end{cases}$$

Splitting long equations

$$\mathfrak{Q}(\lambda, \hat{\lambda}) = -\tfrac{1}{2}\mathbb{P}(O \mid \lambda) \sum_s \sum_m \sum_t \gamma_m^{(s)}(t) + \left(\log(2\pi) + \log \left| \mathcal{C}_{\Updownarrow}^{(f)} \right| + \left(o_t - \hat{\mu}_m^{(s)} \right)^T \mathcal{C}_{\Updownarrow}^{(f)-\infty} \right)$$

Week 1

Linux is Open-Source. Which means its source code is available to anyone for editing and re-distributing. It is also free, but free as in *'libre'* and not free as in *'gratuit'*.

Origin

Back then computers occupied full rooms. Different computers used different Operating Systems and software running on one computer would run on others. User needed different types of training to use different computers because each one had their own way of working.
Soon an idea of having all computers run the same software was brought forward, and this would also permit using the same software on all computers. UNIX was born.
Unfortunately, UNIX wasn't free, and Linus Torvalds worked on his idea of a non-paid Operating System to facilitate educational research. People bought into his idea and a growing community started to contribute little by little the code for his master project, Linux.

Kernel The Kernel is a 'translator' that converts what we input through the Keyboard or the Mouse into a language that is intelligible to the Operating System. It is itself part of the Operating System Note: You can therefore tune your Kernel so your Operating System communicates more effectively to your hardware–"translates the communication better"

Week 2

Commands

ls ***(trans.)*** lists file in a directory
- -a: lists '.'-starting files
- -l: long listing
- -h: human-readable format
- -R: list recursively
- -r: reverse order
- -t: sort by newest
- -i: display for each file the index number generated with the creation of the file

man ***(trans.)*** format and display on-line manual pages

cd ***(trans.)/(intrans. brings you to '~')*** change directory

mkdir ***(trans.)*** create directory

rmdir ***(trans.)*** delete directory (provided it's empty)

rm ***(*****trans.)*** delete FILE

pwd (intrans.) displays the present working directory

passwd [**USER**] opens password-changing dialog for USER

file ***(trans.)*** displays filetype of FILE

echo ***(trans.:text input in quotes)*** displays text that's input

cat ***(trans.)*** displays content of FILE

more ***(trans.)*** displays content of FILE

less ***(trans.)*** sophisticated version of *more*

info ***(trans.)*** read Info documents

whatis ***(trans.)*** search the whatis database for complete words

apropos ***(trans.)*** search he whatis database for strings

Week 3

Commands

cp ***(doubly-trans.)*** copy [FROM] [TO]
-i: prompt before overwrite
-p: copy with permissions

diff ***(doubly-trans.)*** displays the difference 'bit'-by-'bit' between [FILE] and [FILE2]

mv ***(doubly-trans.)*** move [TO DIRECTORY] [FILE] or rename [FILE] to [FILE2]

Softwares

KDE file browser

dolphin file browser

Week 4: Student Week

No Work.

Week 5

Arborescence

It is a upside-down tree-like structure of files showing the parent–daughter relationships between files.

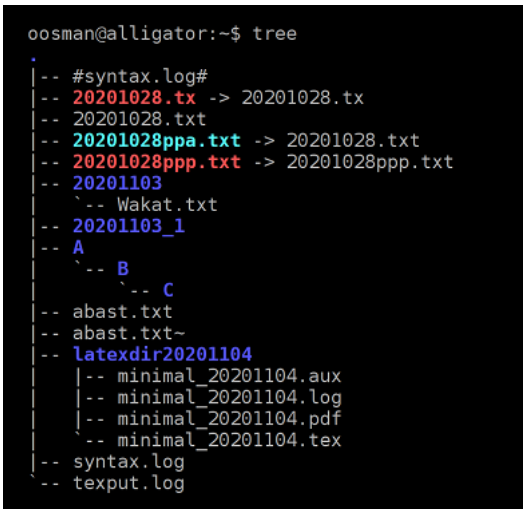


Figure 1: An Arborescence using Command 'tree'

Links

Links are synonymous to *Shortcuts* in Windows.

File Name Prefixes for *ls -l* Command

The first field to the output of ls -l is in the form "-rw-r- -r- -". The first character of which represents the *filetype*. Different filetypes are as follows:

-	normal file
d	directory
l	link
c	special file
s	socket
b	block device
p	named pipe

Partition Types

Main Partition
This is where the entire operating system is stored.
Swap Partition
This partition is used for when the system run out of RAM and therefore decides to shut down. Memory instead is taken from the Swap Partition to act as RAM. Pseudo-RAM.

Zombie Task

An example of a zombie task is a writing to a file during which you delete the file. The writing continues.

Commands

tree ***(trans.)/(intrans.)*** displays an arborescence of the present working directory *(intrans.)* or of [DIRECTORY] *(trans.)*

ln ***(doubly-trans.)*** creates a link for [FILE] with name [NAME OF LINK]
-s: create a soft/symbolic link instead of a hard link

cfdisk ***(trans.)/(intrans.)*** create or manipulate disk-partition table for the default partition */dev/sda (intrans.)* or for [PARTITION] *(trans.)*

top ***(intrans.)*** display Linux processes *While in 'top':*
s: changes refresh rate
r: input dialog for renice change (prompting for PID first)
u: filter users

vmstat ***(intrans.)*** virtual memory statistics

netstat ***(intrans.)*** info on what is happening in the network of the system

iostat ***(intrans.)*** input/output statistics

sleep [**TIME**s] pauses terminal for [TIME] seconds

Week 6

Commands

locate ***(trans.)*** displays path of [FILE] instantly wherever found in Linux

pdflatex ***(trans.)*** compiles [LaTeX-Script FILE] into a PDF

Softwares

xpdf PDF-reader

Week 7

Purpose of all Directories in the Root Directory

/bin the programs used by the normal user, root user and the system itself

/boot the startup files and the kernel

/dev contains references to all the CPU peripheral hardware, which are represented as files with special properties

/lib if you write programs you use libraries

/media mount point of file systems

/opt 3^{rd}-party (optional) softwares

/proc virtual file system with information

/sbin programs used by the system and the Root user

/srv for servers

/usr user-related material

/var storage for variable files

/root the home of the Root user

/sys information on the bus/the kerner which we are using

Notable Files in */etc*

fstab contains descriptive information about the filesystems the system can mount

mtab lists currently-mounted filesystems

crontab and cron.* contains configuration of tasks that need to be executed periodically - backups, updates of the system databases, cleaning of the system, rotating logs etc

inittab describes which processes are started at the bootup and during normal operation

passwd contains user-account information

shadow contains encrypted user-acount information

Notable Files in */proc*

meminfo reports the amount of free and used memory (both physical and swap) on the system as well as the shared memory and buffers used by the kernel

swaps measures swap space and its utilization

Notable Files in */dev*

sda1 acronym for SATA Drive A - 1^{st} partition
Note: We have sdb1 and so forth–all are acronyms bearing the same format as sda1

Softwares

okular PDF-reader

Week 8

Absolute Paths v/s Relative Paths

An Absolute Path has to be stated *with respect to the '/' directory.* A Relative Path refers to a path that is inside the Present Working Directory (pwd).

Commands

which *(trans.)* displays where the script of [COMMAND] is located

echo $PATH lists directories that will be searched when the user types a command

echo $SHELL displays the name of the shell being used

cd .. "cd 'dot' 'dot' ": climb up one directory

Softwares

konsole interface for loading shells

Week 9

Default File Name Suffixes for *ls* Command

nothing	normal file
/	directory
*	executable file
@	link
=	socket
l	named pipe

Commands

time; [COMMAND] displays the time taken to run [COMMAND]

updatedb ***(intrans.)*** updates the slocate database

compress ***(trans.)*** compresses [FILE]

uncompress ***(trans.)*** uncompresses [FILE]

find ***(doubly-trans.)*** searches in [PATH] for [FILE]
-size [+5000K]: filter by size; display that of more than 5MB
Note: *Options* come at the end of the query

ls - -color runs *ls* command with the displayed coloured blue - directory
red - compressed archive
white - text file
pink - images

Softwares

cal calendar with today's date highlighted

gzip lossless file compressor #1
gzip [FILE] - compresses file
gzip -d [FILE] - decompresses file
gunzip [FILE] - decompresses file

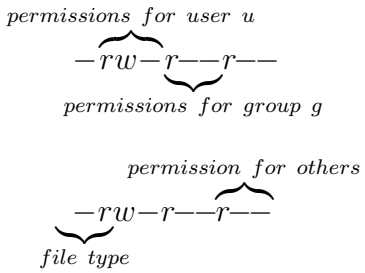
bzip2 file compressor #2
bzip2 [FILE] - compresses file
bzip2 -d [FILE] - decompresses file

xz file compressor #3

Week 10

File Permissions

ls -al gives File Permissions in the format '-rw-r--r--' in the first field. This means:



Commands

chmod [OPTIONS [FILE]] changes permissions for [FILE] based on [OPTIONS]
Note: *[OPTIONS]* have form *abc*
a = *u* (user) or *g* (group)
b = - or + (*remove* permissions or *add* permissions)
c = *r* (read permission) or *w* (write permission) or *x* (execute permission)
Note II: The variants of *abc* all have numbers associated to them. It is an alternative to use a desired number instead of *abc* for *[OPTIONS]*

chown *(*doubly-trans.) change ownership to [OWNER], for that of [FILE]

chgrp *(*doubly-trans.) change filegroup to [GROUP], for that of [FILE]

umask *(*doubly-trans.) set file node creation mask

id *(*intrans.) displays all groups available

grep *(trans.)* display lines matching [TEXT]

head *(trans.)* display the first *n* lines in [FILE]
-5: display the first 5 lines in [FILE]

tail *(trans.)* display the last *n* lines in [FILE]
-6: display the last 6 lines in [FILE]

wc *(trans.)* displays the word count in [FILE] in the form of *x y z*
x = no. of lines
y = no. of words
z = no. of characters

Week 11

Interactive v/s Automatic Processes

Interactive Process One you can run from the Terminal

Automatic Process One that is not associated with the Terminal

Processes Running in the Foreground v/s in the Background

Running a program in the foreground is running it in *Series* with the Terminal. Terminal freezes until the program ends running.
Running a program in the background is running it in *Parallel* with the Terminal. Means you can run both Terminal and the program at the same time.

Daemons

Bon, Daemons are server processes that start at boot and are meant to run continuously until their services are needed. Have no idea what is a server.

Key Terms for Command *ps -eLf*

PID = Process ID
PPID = Parent Process ID
NI = Nice Number
Note: The Nice Number of a process gives a measure of how much it is willing to share resources from the computer. The range is 1–20

Init

Init is the first process that runs at boot$^{(?)}$, duplicates itself in case of failure then boots the Opertaing System. Kill this process and the computer shuts down.

Init Tables and Run Levels

In */etc/inittab* is the table for *init*. Which you can edit with a text editor. The table has Run Levels, fancy phrase for 'ways Linux can boot'. Basically what Linux does right after booting:

Run Level	Mode
0	Halt
1	Single-User Mode
2	Multi-User Mode
3	Multi-User Mode with Networking
4	Undefined
5	X11
6	Reboot

Run Level	Action
0	Shuts down system
1	Does not configure network interfaces, starts daemons, or allow non-root logins
2	Does not configure network interfaces or starts daemons
3	Starts the system normally
4	Not used/user-definable
5	As runlevel 3 + display manager(X)
6	Reboots the system

Commands

Note: *Ctrl+Z* suspends a program whereas *Ctrl+C* quits it.

bg reactivates a suspended program in the background

fg puts the job back in the foreground

kill [**PROCESS ID**] ends [PROCESS]

[**COMMAND** &] starts [COMMAND] in the background

ps ***(intrans.)***) displays a snapshot of the current processes -aux: displays every process in the system using the BSD syntax -eLf: displays info about *threads* axjf: displays a process tree

pstree displays a tree of processes

jobs lists the current running processes

Softwares

xload graphical representation of 'top'/'ps'

Week 12

Input/Output Redirection

> means 'overwrite file with'.
For example, `> abast.txt` overwrites *abast.txt* with nothing. Equal to deleting a file's content. Normally, to overwrite with text we use 'echo'. `echo "Bla blah" > abast.txt`.

< means 'feed following input to (command)'.
For example, `ispell < abast.txt` inputs the content of *abast.txt* into command *ispell*.

>> means 'append to file'.
Contrast to 'overwrite file' above.

Piping Commands

Piping means 'to feed the result of a command into another'. You can pipe as man commands as you like into other commands.

Command 1 | Command 2 | Command 3 ...

For example:

`ls -al | grep pdf`

This command outputs all results of *'ls -al'* containing 'pdf'.

Commands

ispell (file) gives wrongspelling proposed corrections

sort (file) sorts content of *file* into order. *Numbers* first, then *Capitals*, then *Lowercases*

Variant **sort -nk 5** sorts n*umerically*, then according to *Size* (k 5). In fact, 'k 5' means field #5, which is *Size* in the output of ls -al

play (file) plays audio *file*

Softwares

vim space-efficient alternative to *emacs*

mplayer general media player

kplayer alternaive to *mplayer*

xine graphical media player

seamonkey HTML-code generator from WYSYWIG input