KodeKloud

Linux Foundation Certified System
Administrator Exam Details

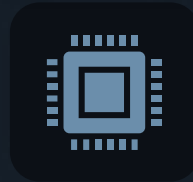Pre-Requisites

none.

LPIC-1 101 Exam Details

90 minutes

200.00 USD

Valid for 5 years

60 Multiple-choice and fill in the blank
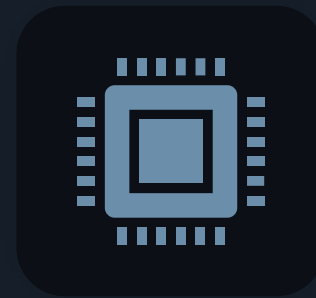
Online proctored and in-person

Determine and Configure
Hardware Settings

BIOS = Basic Input/Output System

UEFI = Unified Extensible Firmware Interface

POST = Power-On Self-Test

- Set the date and time for the hardware clock

- Disable or enable integrated peripherals

- Configure error protection

- Change hardware settings like IRQs and DMA

- Choose the order of boot devices

Inspecting Devices in Linux

```
>_
```

```
$ sudo lspci
00:00.0 Host bridge: Intel Corporation 440FX - 82441FX PMC [Natoma] (rev 02)

00:01.0 ISA bridge: Intel Corporation 82371SB PIIX3 ISA [Natoma/Triton II]

00:01.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)

00:02.0 VGA compatible controller: VMware SVGA II Adapter

00:03.0 Ethernet controller: Intel Corporation 82540EM Gigabit Ethernet Controller (rev 02)

00:04.0 System peripheral: InnoTek Systemberatung GmbH VirtualBox Guest Service

00:07.0 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)

00:0c.0 USB controller: Intel Corporation 7 Series/C210 Series Chipset Family USB xHCI Host Controller

00:0d.0 SATA controller: Intel Corporation 82801HM/HEM (ICH8M/ICH8M-E) SATA Controller [AHCI mode] (rev 02)
```

Inspecting Devices in Linux

```
$ sudo lspci -s 00:03.0 -v
00:03.0 Ethernet controller: Intel Corporation 82540EM Gigabit Ethernet Controller (rev 02)
        Subsystem: Intel Corporation PRO/1000 MT Desktop Adapter

        Flags: bus master, 66MHz, medium devsel, latency 64, IRQ 19

        Memory at f0200000 (32-bit, non-prefetchable) [size=128K]

        I/O ports at d020 [size=8]

        Capabilities: [dc] Power Management version 2

        Capabilities: [e4] PCI-X non-bridge device

        Kernel driver in use: e1000

        Kernel modules: e1000
```

Inspecting Devices in Linux

```
>_
```

```
$ sudo lspci -s 00:03.0 -k
00:03.0 Ethernet controller: Intel Corporation 82540EM Gigabit Ethernet Controller (rev 02)

        Subsystem: Intel Corporation PRO/1000 MT Desktop Adapter

        Kernel driver in use: e1000

        Kernel modules: e1000
```

Inspecting Devices in Linux

```
>_

$ sudo lsusb
Bus 001 Device 029: ID 1781:0c9f Multiple Vendors USBtiny
Bus 001 Device 028: ID 093a:2521 Pixart Imaging, Inc. Optical Mouse
Bus 001 Device 020: ID 1131:1001 Integrated System Solution Corp. KY-BT100
Bluetooth Adapter
Bus 001 Device 011: ID 04f2:0402 Chicony Electronics Co., Ltd Genius LuxeMate i200
Keyboard
Bus 001 Device 007: ID 0424:7800 Standard Microsystems Corp.
Bus 001 Device 003: ID 0424:2514 Standard Microsystems Corp. USB 2.0 Hub
Bus 001 Device 002: ID 0424:2514 Standard Microsystems Corp. USB 2.0 Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

Inspecting Devices in Linux

```
>_
```

```
$ sudo lsusb -v -d 1781:0c9f
Bus 001 Device 029: ID 1781:0c9f Multiple Vendors USBtiny
Device Descriptor:
  bLength 18
  bDescriptorType 1
  bcdUSB 1.01
  bDeviceClass 255 Vendor Specific Class
  bDeviceSubClass 0
  bDeviceProtocol 0
  bMaxPacketSize0 8
  idVendor 0x1781 Multiple Vendors
  idProduct 0x0c9f USBtiny
  bcdDevice 1.04
  iManufacturer 0
  iProduct 2 USBtiny
  iSerial 0
  bNumConfigurations 1
```

Inspecting Devices in Linux

```
$ sudo lsusb -t
/: Bus 01.Port 1: Dev 1, Class=root_hub, Driver=dwc_otg/1p, 480M
    |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/4p, 480M
        |__ Port 1: Dev 3, If 0, Class=Hub, Driver=hub/3p, 480M
            |__ Port 2: Dev 11, If 1, Class=Human Interface Device, Driver=usbhid, 1.5M
            |__ Port 2: Dev 11, If 0, Class=Human Interface Device, Driver=usbhid, 1.5M
                |__ Port 3: Dev 20, If 0, Class=Wireless, Driver=btusb, 12M
                |__ Port 3: Dev 20, If 1, Class=Wireless, Driver=btusb, 12M
                |__ Port 3: Dev 20, If 2, Class=Application Specific Interface,Driver=, 12M
                |__ Port 1: Dev 7, If 0, Class=Vendor Specific Class, Driver=lan78xx, 480M
            |__ Port 2: Dev 28, If 0, Class=Human Interface Device, Driver=usbhid, 1.5M
            |__ Port 3: Dev 29, If 0, Class=Vendor Specific Class, Driver=, 1.5M
```

```
$ sudo lsusb -s 01:20
Bus 001 Device 020: ID 1131:1001 Integrated System Solution Corp. KY-BT100
Bluetooth Adapter
```

Kernel Modules

```
>_

$ sudo lsmod
Module                 Size  Used by

tls                  110592  0

uinput                20480  0

nls_utf8              16384  1

isofs                 49152  1

snd_seq_dummy         16384  0

snd_hrtimer           16384  1

snd_seq               86016  7 snd_seq_dummy

snd_timer             49152  2 snd_seq,snd_hrtimer

snd_seq_device        16384  1 snd_seq

snd                  114688  5 snd_seq,snd_seq_device,snd_timer
```

Kernel Modules

```
>_
```

```
$ sudo lsmod | fgrep -i snd

snd_seq_dummy          16384  0

snd_hrtimer            16384  1

snd_seq                86016  7 snd_seq_dummy

snd_timer              49152  2 snd_seq,snd_hrtimer

snd_seq_device         16384  1 snd_seq

snd                   114688  5 snd_seq,snd_seq_device,snd_timer

soundcore              16384  1 snd
```

```
>_
```

```
$ sudo modprobe -r snd-hda-intel
```

```
$ sudo modinfo snd
filename:       /lib/modules/5.14.0-70.26.1.el9_0.x86_64/kernel/sound/core/snd.ko.xz

alias:          char-major-116-*

license:        GPL

description:    Advanced Linux Sound Architecture driver for soundcards.

author:         Jaroslav Kysela <perex@perex.cz>
```

```
>_
```

```
$ sudo modinfo -p snd
max_user_ctl_alloc_size:Max allocation size for user controls (int)

slots:Module names assigned to the slots. (array of charp)

major:Major # for sound driver. (int)

cards_limit:Count of auto-loadable soundcards. (int)
```

/etc/modprobe.conf

/etc/modprobe.d/snd.conf

/etc/modprobe.d/blacklist.conf

blacklilst snd

/proc

/sys

Special directories that exist in RAM

Used by the kernel to store information on running processes

Boot the System

KODEKLOUD

Boot the System

```
┌─────────────┐
│    BIOS     │
│     or      │
│    UEFI     │
└─────────────┘
       ┆
       ▼
┌─────────────┐
│             │
│ Bootloader  │
│             │
└─────────────┘
       ┆
       ▼
┌─────────────┐
│             │
│   Kernel    │
│             │
└─────────────┘
       ┆
       ▼
┌─────────────┐
│             │
│    Init     │
│             │
└─────────────┘
```
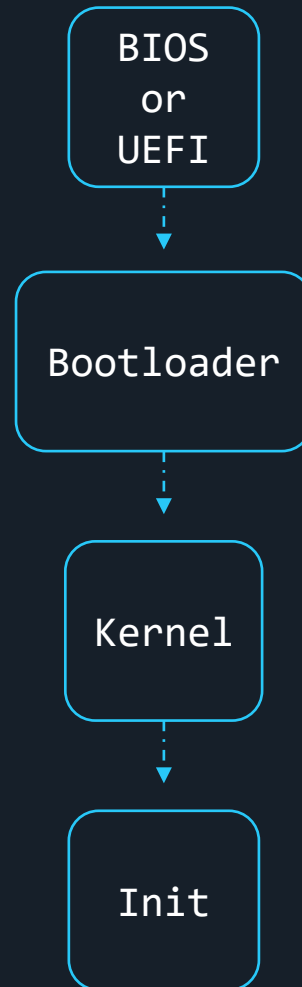
BIOS

440 bytes
1st device
Bootstrap

512 bytes
MBR
DOS partition
Partition table

POST = Identifies simple hardware failures

- Activates basic components like video output, the keyboard, and storage

- Loads the bootstrap from the MBR

- Loads the second stage of the bootloader and pass options to the kernel

UEFI

NVRAM

EFI applications

FAT filesystems or ISO-9660

EFI System Partition (ESP)

EFI directory

POST **=** Identifies simple hardware failures

- Activates basic components like video output, the keyboard, and storage

- Executes EFI applications stored in the ESP partition, such as the bootloader

- The bootloader loads the kernel

- Also supports Secure Boot

GRUB = <u>Gr</u>and <u>U</u>nified <u>B</u>ootloader

BIOS   SHIFT

UEFI   ESC

Bootloader

```
acpi          =   Enable or disable ACPI support acpi=off disables
init          =   Set system init Example: init=/bin/bash
systemd.unit  =   Set systemd target Example: system.unit=graphical.target
mem           =   Set available system RAM Example: mem=512M
maxcpus       =   Limits processors or cores Example: maxcpus=0 or maxcpus=2
quiet         =   Hides boot messages
vga           =   Selects a video mode Example: vga=ask
root          =   Sets the root partition Example: root=/dev/sda3
rootflags     =   Mount options for the root filesystem
ro            =   Mount root filesystem read-only
rw            =   Mount root filesystem read/write
```

Kernel loaded into RAM

initramfs = initial RAM filesystem

Kernel mounts all filesystems configured in /etc/fstab

Kernel loads init. First program that starts all others.

initramfs is removed from RAM.

Init

SysV standard **=**   Controls daemons using runlevels. Runlevels numbered 0 to 6.

systemd   **=**   Modern service manager with concurrent structure. Common default.

Upstart   **=**   Parallel startup. Formerly used by Ubuntu, replaced by systemd.

```
>_
```

```
$ dmesg
    [ 5.262389] EXT4-fs (sda1): mounted filesystem with ordered data mode.
    Opts:
    (null)
    [ 5.449712] ip_tables: (C) 2000-2006 Netfilter Core Team
    [ 5.460286] systemd[1]: systemd 237 running in system mode.
    [ 5.480138] systemd[1]: Detected architecture x86-64.
    [ 5.481767] systemd[1]: Set hostname to <torre>.
    [ 5.636607] systemd[1]: Reached target User and Group Name Lookups.
    [ 5.636866] systemd[1]: Created slice System Slice.
    [ 5.637000] systemd[1]: Listening on Journal Audit Socket.
    [ 5.637085] systemd[1]: Listening on Journal Socket.
    [ 5.637827] systemd[1]: Mounting POSIX Message Queue File System...
    [ 5.638639] systemd[1]: Started Read required files in advance.
    [ 5.641661] systemd[1]: Starting Load Kernel Modules...
    [ 5.661672] EXT4-fs (sda1): re-mounted. Opts: errors=remount-ro
    [ 5.694322] lp: driver loaded but no devices found
    [ 5.702609] ppdev: user-space parallel port driver
    [ 5.705384] parport_pc 00:02: reported by Plug and Play ACPI
    [ 5.705468] parport0: PC-style at 0x378 (0x778), irq 7, dma 3
    [PCSPP,TRISTATE,COMPAT,EPP,ECP,DMA]
    [ 5.800146] lp0: using parport0 (interrupt-driven).
    [ 5.897421] systemd-journald[352]: Received request to flush runtime
    journal
    from PID 1
```

```
$ journalctl --list-boots
 -4 9e5b3eb4952845208b841ad4dbefa1a6 Thu 2019-10-03 13:39:23 -03—Thu 2019-
10-03
13:40:30 -03
 -3 9e3d79955535430aa43baa17758f40fa Thu 2019-10-03 13:41:15 -03—Thu 2019-
10-03
14:56:19 -03
 -2 17672d8851694e6c9bb102df7355452c Thu 2019-10-03 14:56:57 -03—Thu 2019-
10-03
19:27:16 -03
 -1 55c0d9439bfb4e85a20a62776d0dbb4d Thu 2019-10-03 19:27:53 -03—Fri 2019-
10-04
00:28:47 -03
  0 08fbbebd9f964a74b8a02bb27b200622 Fri 2019-10-04 00:31:01 -03—Fri 2019-
10-04
10:17:01 -03
```

```
>_

$ journalctl -b 0
    oct 04 00:31:01 ubuntu-host kernel: EXT4-fs (sda1): mounted filesystem
    with ordered
    data mode. Opts: (null)
    oct 04 00:31:01 ubuntu-host kernel: ip_tables: (C) 2000-2006 Netfilter
    Core Team
    oct 04 00:31:01 ubuntu-host systemd[1]: systemd 237 running in system
    mode.
    oct 04 00:31:01 ubuntu-host systemd[1]: Detected architecture x86-64.
    oct 04 00:31:01 ubuntu-host systemd[1]: Set hostname to <torre>.
    oct 04 00:31:01 ubuntu-host systemd[1]: Reached target User and Group Name
    Lookups.
    oct 04 00:31:01 ubuntu-host systemd[1]: Created slice System Slice.
    oct 04 00:31:01 ubuntu-host systemd[1]: Listening on Journal Audit Socket.
    oct 04 00:31:01 ubuntu-host systemd[1]: Listening on Journal Socket.
    oct 04 00:31:01 ubuntu-host systemd[1]: Mounting POSIX Message Queue File
    System...
    oct 04 00:31:01 ubuntu-host systemd[1]: Started Read required files in
    advance.
    oct 04 00:31:01 ubuntu-host systemd[1]: Starting Load Kernel Modules...
    oct 04 00:31:01 ubuntu-host kernel: EXT4-fs (sda1): re-mounted. Opts:
    commit=300,barrier=0,errors=remount-ro
    oct 04 00:31:01 ubuntu-host kernel: lp: driver loaded but no devices found
    oct 04 00:31:01 ubuntu-host kernel: ppdev: user-space parallel port driver
    oct 04 00:31:01 ubuntu-host kernel: parport_pc 00:02: reported by Plug and
    Play
```

```
>_
```

/var/log/= Initialization and system logs.

$ journalctl -D /var/log/other_directory

Change Runlevels
and Boot Targets

PID 1 = The service manager process.

Runlevel = A group of services for a purpose. Numbered 0 to 6.

Runlevel 0 = System shutdown.

Runlevel 1 = Single-user mode, without networking. Maintenance mode.

Runlevel 2,3,4 = Mulit-user mode. Networking available. 2 and 4 often unused.

Runlevel 5 = Multi-user mode with graphical login.

Runlevel 6 = System restart.

/sbin/init = Manages runlevels and services.

/etc/inittab **=** Defines each runlevel.

/etc/init.d/ **=** Contains scrips for each runlevel.

id:runlevels:action:process

boot **=** Executed during system initialization. Ignores runlevels field.

bootwait **=** Executed during system initialization and init waits until finished. Ignores runlevels field.

sysinit **=** Executed after system initialization. Ignores runlevels field.

wait **=** Executed for the given runlevels. Init waits until finished.

respawn **=** Process will be restarted if terminated.

ctrlaltdel **=** Executed when init receives SIGINT, triggered by CTRL+ALT+DEL.

id:x:initdefault **=** Defines default runlevel.

SysVinit

```
>_ ttab
```

```
$ sudo vi /etc/inittab

$ sudo telnit q
```

/etc/inittab

```
# Default runlevel
id:3:initdefault:
# Configuration script executed during boot
si::sysinit:/etc/init.d/rcS
# Action taken on runlevel S (single user)
~:S:wait:/sbin/sulogin
# Configuration for each execution level
l0:0:wait:/etc/init.d/rc 0
l1:1:wait:/etc/init.d/rc 1
l2:2:wait:/etc/init.d/rc 2
l3:3:wait:/etc/init.d/rc 3
l4:4:wait:/etc/init.d/rc 4
l5:5:wait:/etc/init.d/rc 5
l6:6:wait:/etc/init.d/rc 6
# Action taken upon ctrl+alt+del keystroke
ca::ctrlaltdel:/sbin/shutdown -r now
# Enable consoles for runlevels 2 and 3
1:23:respawn:/sbin/getty tty1 VC linux
2:23:respawn:/sbin/getty tty2 VC linux
3:23:respawn:/sbin/getty tty3 VC linux
4:23:respawn:/sbin/getty tty4 VC linux
# For runlevel 3, also enable serial
# terminals ttyS0 and ttyS1 (modem) consoles
S0:3:respawn:/sbin/getty -L 9600 ttyS0 vt320
S1:3:respawn:/sbin/mgetty -x0 -D ttyS1
```

SysVinit

```
>_
```

```
$ ls /etc/init.d/
    rc0.d/
    rc1.d/
    rc2.d/
    rc3.d/
    rc4.d/
    rc5.d/
    rc6.d/


$ runlevel
    N 3


$ sudo telinit 1
```

Files that start with K kill services when they run

Files that start with S start services when they run

systemd

httpd.service (Red Hat) or apache2.service (Debian)

service   = Active system resources. Can be initiated, interrupted, and reloaded.

socket   = Filesystem or network socket.

device   = A hardware device identified by the kernel.

mount   = A mount point defined in /etc/fstab.

automount = A mount point mounted automatically.

target   = A group of units managed as a single unit.

snapshot   = A saved stated of the systemd manager.

systemd

```
>_

$ sudo systemctl start unit.service

$ sudo systemctl stop unit.service

$ sudo systemctl restart unit.service

$ sudo systemctl status unit.service

$ sudo systemctl is-active unit.service

$ sudo systemctl enable unit.service

$ sudo systemctl disable unit.service

$ sudo systemctl is-enabled unit.service
```

```
>_

$ sudo systemctl isolate multi-user.target

$ sudo systemctl set-default multi-user.target

$ sudo systemctl get-default
  graphical.target
```

```
>_
```

$ sudo systemctl list-unit-files

$ sudo systemctl list-unit-files --type=service

$ sudo systemctl list-unit-files --type=target

$ sudo systemctl suspend

$ sudo systemctl hibernate

/lib/systemd/system/ contains unit files for every unit

/etc/systemd/logind.conf defines actions associated with power events

Can also be found in separate files in /etc/systemd/logind.conf/d/ if no other power manager like acpid is running on the system

```
>_
```

```
$ sudo initctl list
    avahi-cups-reload stop/waiting
    avahi-daemon start/running, process 1123
    mountall-net stop/waiting
    mountnfs-bootclean.sh start/running
    nmbd start/running, process 3085
    passwd stop/waiting
    rc stop/waiting
    rsyslog start/running, process 1095
    tty4 start/running, process 1761
    udev start/running, process 1073
    upstart-udev-bridge start/running, process 1066
    console-setup stop/waiting
    irqbalance start/running, process 1842
    plymouth-log stop/waiting
    smbd start/running, process 1457
    tty5 start/running, process 1764
    failsafe stop/waiting
```

/etc/init/ contains initialization scripts for Upstart

Upstart

```
>_

$ sudo start tty6

$ sudo status tty6
  tty6 start/running, process 3282

$ sudo stop tty6
```

```
>_

$ sudo shutdown [option] time [message]

$ sudo shutdown 02:00

$ sudo shutdown +20

$ sudo shutdown now

$ sudo syestemctl reboot

$ sudo syestemctl poweroff

$ sudo wall 'System going into maintenance mode in 5 minutes!'
```

Configure and Manage Swap Space

Create and Manage Swap Space

```
>_

$ swapon --show
NAME        TYPE      SIZE USED PRIO
/dev/dm-1 partition   2G   0B   -2




$ lsblk

NAME         MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda            8:0    0   20G  0 disk
├─vda1         8:1    0    1G  0 part /boot
└─vda2         8:2    0   19G  0 part
  ├─cs-root  253:0    0   17G  0 lvm  /
  └─cs-swap  253:1    0    2G  0 lvm  [SWAP]
vdb           8:16    0   10G  0 disk
├─vdb1        8:17    0    4G  0 part
├─vdb2        8:18    0    4G  0 part
└─vdb3        8:19    0    2G  0 part
```

Create and Manage Swap Space

```
>_
```

```
$ sudo mkswap /dev/vdb3
 Setting up swapspace version 1, size = 2 GiB (2146430976 bytes)
 no label, UUID=6d6f451e-5fa4-4cd5-b627-b0f39c810002


$ sudo swapon --verbose /dev/vdb3
 swapon: /dev/vdb3: found signature [pagesize=4096, signature=swap]
 swapon: /dev/vdb3: pagesize=4096, swapsize=2146435072, devsize=2146435072
 swapon /dev/vdb3



$ swapon --show
 NAME       TYPE      SIZE USED PRIO
 /dev/dm-1 partition  2G   0B   -2
 /dev/vdb3 partition  2G   0B   -3
```

Create and Manage Swap Space

```
>_

$ sudo swapoff /dev/vdb3

$ sudo dd if=/dev/zero of=/swap bs=1M count=128

$ sudo dd if=/dev/zero of=/swap bs=1M count=2048 status=progress
    1436549120 bytes (1.4 GB, 1.3 GiB) copied, 2 s, 717 MB/s
    2048+0 records in
    2048+0 records out
    2147483648 bytes (2.1 GB, 2.0 GiB) copied, 2.71801 s, 790 MB/s

$ sudo chmod 600 /swap
```

Create and Manage Swap Space

```
>_
```

```
$ sudo mkswap /swap
Setting up swapspace version 1, size = 2 GiB (2147479552 bytes)
no label, UUID=cff8e9dc-54fa-4661-a48e-497610b2f07b


$ sudo swapon --verbose /swap
swapon: /swap: found signature [pagesize=4096, signature=swap]
swapon: /swap: pagesize=4096, swapsize=2147483648, devsize=2147483648
swapon /swap



$ swapon --show
NAME        TYPE       SIZE USED PRIO
/dev/dm-1 partition   2G 268K   -2
/swap       file         2G   0B   -3
```

GRUB Legacy

Install GRUB Legacy

```
>_
```

```
$ sudo grub-install /dev/sda
```

```
$ sudo grub-install /dev/sda --boot-directory=/other/directory
```

Install GRUB Legacy

```
>_
grub> root (hd0,0)

grub> find /boot/grub/stage1
(hd0,0)

grub> setup (hd0)
```

C

Configure GRUB Legacy

```
>_
```

```
$ sudo vi /boot/grub/menu.lst
```

```
# This line is a comment
title My Linux Distribution
root (hd0,0)
kernel /vmlinuz root=/dev/hda1
```

```
# This line is a comment
title My Linux Distribution
kernel (hd0,0)/vmlinuz root=/dev/hda1
```

```
# This line is a comment
title My Linux Distribution
root (hd0,0)
kernel /vmlinuz root=/dev/hda1
initrd /initrd.img
module /boot/grub/i386-pc/915resolution.mod
```

```
>_
```

```
$ sudo vi /boot/grub/menu.lst
```

/boot/grub/menu.lst

```
# This line is a comment
title My Linux Distribution
root (hd0,0)
kernel /vmlinuz root=/dev/hda1



# Load Windows
title Windows XP
root (hd0,1)
makeactive
chainload +1
boot
```

Manage Shared Libraries

Libraries

Software libraries **=** collections of code to be used by many different programs

Compiler : turns the source code into machine code stored in object files

Linker : combines object files and links them to libraries to generate an executable file

Linking : either static or dynamic

Library Types

Static libraries   =   Merged with the program at link time.

No runtime dependencies.

Shared libraries   =   Not merged with the program at link time.

Must be available at run time.

Naming Conventions

```
>_

$ ls -l /lib/x86_64-linux-gnu/libc.so.6
    rwxrwxrwx 1 root root 12 feb 6 22:17 /lib/x86_64-linux-gnu/libc.so.6 ->
    libc-2.24.so



                                          0



                                          a
```

soname

Library name (lib prefix)

so (shared object)

Version number

Example: libpthread.so.0

Example: libpthread.a

Common Locations

/lib

/lib32

/lib64

/usr/lib

/usr/local/lib

Configure Shared Library Paths

```
>_

$ cat /etc/ld.so.conf
    include /etc/ld.so.conf.d/*.conf



$ ls /etc/ld.so.conf.d/
    libc.conf x86_64-linux-gnu.conf



$ cat /etc/ld.so.conf.d/x86_64-linux-gnu.conf
    # Multiarch support
    /lib/x86_64-linux-gnu
    /usr/lib/x86_64-linux-gnu
```

```
ld.so or ld-linux.so

/etc/ld.so.conf

/etc/ld.so.conf.d/
```

```
>_
```

```
$ sudo ldconfig -v
    /usr/local/lib:
    /lib/x86_64-linux-gnu:
      libnss_myhostname.so.2 -> libnss_myhostname.so.2
      libfuse.so.2 -> libfuse.so.2.9.7
      libidn.so.11 -> libidn.so.11.6.16
      libnss_mdns4.so.2 -> libnss_mdns4.so.2
      libparted.so.2 -> libparted.so.2.0.1
      (...)
```

ldconfig

```
>_
```

```
$ sudo ldconfig -p
    1094 libs found in the cache `/etc/ld.so.cache'
        libzvbi.so.0 (libc6,x86-64) => /usr/lib/x86_64-linux-gnu/libzvbi.so.0
        libzvbi-chains.so.0 (libc6,x86-64) => /usr/lib/x86_64-linux-gnu/libzvbi-chains.so.0
        libzmq.so.5 (libc6,x86-64) => /usr/lib/x86_64-linux-gnu/libzmq.so.5
        libzeitgeist-2.0.so.0 (libc6,x86-64) => /usr/lib/x86_64-linux-gnu/libzeitgeist-2.0.so.0
        (...)


$ sudo ldconfig -p | grep libfuse
    libfuse.so.2 (libc6,x86-64) => /lib/x86_64-linux-gnu/libfuse.so.2



$ ls -l /lib/x86_64-linux-gnu/libfuse.so.2
    lrwxrwxrwx 1 root root 16 Aug 21 2018 /lib/x86_64-linux-gnu/libfuse.so.2 ->
    libfuse.so.2.9.7
```

ldconfig

```
>_

$ LD_LIBRARY_PATH=/usr/local/mylib

$ echo $LD_LIBRARY_PATH
  /usr/local/mylib



$ export LD_LIBRARY_PATH=/usr/local/mylib



 $ unset LD_LIBRARY_PATH



$ echo export LD_LIBRARY_PATH=/usr/local/mylib >> ~/.bashrc
```

Dependencies

```
>_
```

```
$ ldd /usr/bin/git
    linux-vdso.so.1 => (0x00007ffcbb310000)
      libpcre.so.3 => /lib/x86_64-linux-gnu/libpcre.so.3 (0x00007f18241eb000)
      libz.so.1 => /lib/x86_64-linux-gnu/libz.so.1 (0x00007f1823fd1000)
      libresolv.so.2 => /lib/x86_64-linux-gnu/libresolv.so.2 (0x00007f1823db6000)
      libpthread.so.0 => /lib/x86_64-linux-gnu/libpthread.so.0 (0x00007f1823b99000)
      librt.so.1 => /lib/x86_64-linux-gnu/librt.so.1 (0x00007f1823991000)
      libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f18235c7000)
      /lib64/ld-linux-x86-64.so.2 (0x00007f182445b000)


$ ldd /lib/x86_64-linux-gnu/libc.so.6
    /lib64/ld-linux-x86-64.so.2 (0x00007fbfed578000)
      linux-vdso.so.1 (0x00007fffb7bf5000)



$ ldd -u /usr/bin/git
    Unused direct dependencies:
      /lib/x86_64-linux-gnu/libz.so.1
      /lib/x86_64-linux-gnu/libpthread.so.0
      /lib/x86_64-linux-gnu/librt.so.1
```

Debian Package Management: dpkg

dpkg

- Early software: source code in compressed files like `.tar` and `.gz`

- Users had to unpack and compile software manually

- Increasing complexity led to package managers

- Debian package format uses `.deb` files and the package tool `dpkg`

dpkg

```
>_

$ sudo dpkg -i mypackage.deb
```

```
>_
```

```
$ sudo dpkg -i  openshot-qt_2.4.3+dfsg1-1_all.deb
    (Reading database ... 269630 files and directories currently installed.)
    Preparing to unpack openshot-qt_2.4.3+dfsg1-1_all.deb ...
    Unpacking openshot-qt (2.4.3+dfsg1-1) over (2.4.3+dfsg1-1) ...
    dpkg: dependency problems prevent configuration of openshot-qt:
     openshot-qt depends on fonts-cantarell; however:
      Package fonts-cantarell is not installed.
     openshot-qt depends on python3-openshot; however:
      Package python3-openshot is not installed.
     openshot-qt depends on python3-pyqt5; however:
      Package python3-pyqt5 is not installed.
     openshot-qt depends on python3-pyqt5.qtsvg; however:
      Package python3-pyqt5.qtsvg is not installed.
     openshot-qt depends on python3-pyqt5.qtwebkit; however:
      Package python3-pyqt5.qtwebkit is not installed.
     openshot-qt depends on python3-zmq; however:
      Package python3-zmq is not installed.
    dpkg: error processing package openshot-qt (--install):
     dependency problems - leaving unconfigured
    Processing triggers for mime-support (3.60ubuntu1) ...
    Processing triggers for gnome-menus (3.32.0-1ubuntu1) ...
    Processing triggers for desktop-file-utils (0.23-4ubuntu1) ...
    Processing triggers for hicolor-icon-theme (0.17-2) ...
    Processing triggers for man-db (2.8.5-2) ...
    Errors were encountered while processing:
     openshot-qt
```

fonts-cantarell

python3-openshot

python3-pyqt5

python3-pyqt5.qtsvg

python3-pyqt5.qtwebkit

python3-zmq

>_

```
$ sudo dpkg -r unrar
   (Reading database ... 269630 files and directories currently installed.)
   Removing unrar (1:5.6.6-2) ...
   Processing triggers for man-db (2.8.5-2) ...


$ sudo dpkg -r p7zip
   # dpkg -r p7zip
   dpkg: dependency problems prevent removal of p7zip:
    winetricks depends on p7zip; however:
     Package p7zip is to be removed.
   p7zip-full depends on p7zip (= 16.02+dfsg-6).
   dpkg: error processing package p7zip (--remove):
    dependency problems - not removing
   Errors were encountered while processing:
    p7zip
```

```
>_

$ sudo dpkg -r unrar p7zip



$ sudo dpkg -P unrar p7zip



$ sudo dpkg -i --force openshot-qt_2.4.3+dfsg1-1_all.deb
```

dpkg

```
> _
```

```
$ sudo dpkg -I google-chrome-stable_current_amd64.deb
```
new Debian package, version 2.0.
 size 59477810 bytes: control archive=10394 bytes.
  1222 bytes, 13 lines control
  16906 bytes, 457 lines * postinst #!/bin/sh
  12983 bytes, 344 lines * postrm #!/bin/sh
  1385 bytes, 42 lines * prerm #!/bin/sh
 Package: google-chrome-stable
 Version: 76.0.3809.100-1
 Architecture: amd64
 Maintainer: Chrome Linux Team <chromium-dev@chromium.org>
 Installed-Size: 205436
 Pre-Depends: dpkg (>= 1.14.0)
 Depends: ca-certificates, fonts-liberation, libappindicator3-1, libasound2 (>=
1.0.16), libatk-bridge2.0-0 (>= 2.5.3), libatk1.0-0 (>= 2.2.0), libatspi2.0-0 (>=
2.9.90), libc6 (>= 2.16), libcairo2 (>= 1.6.0), libcups2 (>= 1.4.0), libdbus-1-3
(>= 1.5.12), libexpat1 (>= 2.0.1), libgcc1 (>= 1:3.0), libgdk-pixbuf2.0-0 (>=
2.22.0), libglib2.0-0 (>= 2.31.8), libgtk-3-0 (>= 3.9.10), libnspr4 (>= 2:4.9-2~),
libnss3 (>= 2:3.22), libpango-1.0-0 (>= 1.14.0), libpangocairo-1.0-0 (>= 1.14.0),
libuuid1 (>= 2.16), libx11-6 (>= 2:1.4.99.1), libx11-xcb1, libxcb1 (>= 1.6),
libxcomposite1 (>= 1:0.3-1), libxcursor1 (>> 1.1.2), libxdamage1 (>= 1:1.1),
libxext6, libxfixes3, libxi6 (>= 2:1.2.99.4), libxrandr2 (>= 2:1.2.99.3),
libxrender1, libxss1, libxtst6, lsb-release, wget, xdg-utils (>= 1.0.2)
 Recommends: libu2f-udev
 Provides: www-browser
 Section: web
 Priority: optional
 Description: The web browser from Google
  Google Chrome is a browser that combines a minimal design with sophisticated
technology to make the web faster, safer, and easier.

```
>_
```

```
$ sudo dpkg --get-selections
```

```
$ sudo dpkg -L unrar
.
/usr
/usr/bin
/usr/bin/unrar-nonfree
/usr/share
/usr/share/doc
/usr/share/doc/unrar
/usr/share/doc/unrar/changelog.Debian.gz
/usr/share/doc/unrar/copyright
/usr/share/man
/usr/share/man/man1
/usr/share/man/man1/unrar-nonfree.1.gz
```

```
$ sudo dpkg-query -S /usr/bin/unrar-nonfree
unrar: /usr/bin/unrar-nonfree
```

```
>_

$ sudo dpkg-recongifure tzdata
```

Debian Package Management: apt

APT: Advanced Package Tool

Features:

- Advanced search and automatic dependency resolution
- Not a substitute for dpkg (Think of this as a front end)
- Works with software repositories
- Repositories may be local, a remote server, or a CD-ROM
- Distributions like Debian and Ubuntu maintain their own repositories
- Other repositories are maintained by users or groups to provide software not available in the main distribution repositories

```
>_
```

$ sudo apt-get

Download, install, upgrade, and remove

$ sudo apt-cache

Searches in the package index

$ sudo apt-file

Searches for files inside of packages

$ sudo apt

Combines features of apt-get and apt-cache

```
>_
```

```
$ sudo apt-get update
    apt-get update
    Ign:1 http://dl.google.com/linux/chrome/deb stable InRelease
    Hit:2 https://repo.skype.com/deb stable InRelease
    Hit:3 http://us.archive.ubuntu.com/ubuntu disco InRelease
    Hit:4 http://repository.spotify.com stable InRelease
    Hit:5 http://dl.google.com/linux/chrome/deb stable Release
    Hit:6 http://apt.pop-os.org/proprietary disco InRelease
    Hit:7 http://ppa.launchpad.net/system76/pop/ubuntu disco InRelease
    Hit:8 http://us.archive.ubuntu.com/ubuntu disco-security InRelease
    Hit:9 http://us.archive.ubuntu.com/ubuntu disco-updates InRelease
    Hit:10 http://us.archive.ubuntu.com/ubuntu disco-backports InRelease
    Reading package lists... Done
```

```
$ sudo apt-get install xournal
    Reading package lists... Done
    Building dependency tree
    Reading state information... Done
    The following NEW packages will be installed:
      xournal
    0 upgraded, 1 newly installed, 0 to remove and 75 not upgraded.
    Need to get 285 kB of archives.
    After this operation, 1041 kB of additional disk space will be used.
```

```
$ sudo apt-get remove xournal
    Reading package lists... Done
    Building dependency tree
    Reading state information... Done
    The following packages will be REMOVED:
      xournal
    0 upgraded, 0 newly installed, 1 to remove and 75 not upgraded.
    After this operation, 1041 kB disk space will be freed.
    Do you want to continue? [Y/n]
```

```
>_
```

```
$ sudo apt-get remove p7zip
    Reading package lists... Done
    Building dependency tree
    The following packages will be REMOVED:
      android-libbacktrace android-libunwind android-libutils
      android-libziparchive android-sdk-platform-tools fastboot p7zip p7zip-full
    0 upgraded, 0 newly installed, 8 to remove and 75 not upgraded.
    After this operation, 6545 kB disk space will be freed.
    Do you want to continue? [Y/n]
```

```
$ sudo apt-get purge p7zip
```

```
$ sudo apt-get remove --purge p7zip
```

APT

```
>_
```

```
$ sudo dpkg -i  --force openshot-qt_2.4.3+dfsg1-1_all.deb
    (Reading database ... 269630 files and directories currently installed.)
    Preparing to unpack openshot-qt_2.4.3+dfsg1-1_all.deb ...
    Unpacking openshot-qt (2.4.3+dfsg1-1) over (2.4.3+dfsg1-1) ...
    dpkg: dependency problems prevent configuration of openshot-qt:
     openshot-qt depends on fonts-cantarell; however:
      Package fonts-cantarell is not installed.
     openshot-qt depends on python3-openshot; however:
      Package python3-openshot is not installed.
     openshot-qt depends on python3-pyqt5; however:
      Package python3-pyqt5 is not installed.
     openshot-qt depends on python3-pyqt5.qtsvg; however:
      Package python3-pyqt5.qtsvg is not installed.
     openshot-qt depends on python3-pyqt5.qtwebkit; however:
      Package python3-pyqt5.qtwebkit is not installed.
     openshot-qt depends on python3-zmq; however:
      Package python3-zmq is not installed.



$ sudo apt-get install -f
```

```
>_
```

```
$ sudo apt-get update
    Hit:1 http://us.archive.ubuntu.com/ubuntu disco InRelease
    Hit:2 http://us.archive.ubuntu.com/ubuntu disco-security InRelease
    Hit:3 http://us.archive.ubuntu.com/ubuntu disco-updates InRelease
    Hit:4 http://us.archive.ubuntu.com/ubuntu disco-backports InRelease
    Reading package lists... Done


$ sudo apt-get upgrade
    # apt-get upgrade
    Reading package lists... Done
    Building dependency tree
    Reading state information... Done
    Calculating upgrade... Done
    The following packages have been kept back:
      gnome-control-center
    The following packages will be upgraded:
      cups cups-bsd cups-client cups-common cups-core-drivers cups-daemon
      cups-ipp-utils cups-ppdc cups-server-common firefox-locale-ar (...)
    74 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
    Need to get 243 MB of archives.
    After this operation, 30.7 kB of additional disk space will be used.
    Do you want to continue? [Y/n]
```

```
>_
```

```
$ sudo apt-get upgrade unrar
```

```
>_
```

```
$ sudo apt-get clean
```

/var/cache/apt/archives

/var/cache/apt/archives/partial

> _

```
$ sudo apt-cache search p7zip
liblzma-dev - XZ-format compression library - development files
liblzma5 - XZ-format compression library
forensics-extra - Forensics Environment - extra console components
(metapackage)
p7zip - 7zr file archiver with high compression ratio
p7zip-full - 7z and 7za file archivers with high compression ratio
p7zip-rar - non-free rar module for p7zip
```

```
> _
```

```
$ sudo apt-cache show liblzma5

# apt-cache show liblzma5
Package: liblzma5
Architecture: amd64
Version: 5.2.4-1
Multi-Arch: same
Priority: required
Section: libs
Source: xz-utils
Origin: Ubuntu
Maintainer: Ubuntu Developers <ubuntu-devel-discuss@lists.ubuntu.com>
Original-Maintainer: Jonathan Nieder <jrnieder@gmail.com>
Bugs: https://bugs.launchpad.net/ubuntu/+filebug
Installed-Size: 259
Depends: libc6 (>= 2.17)
Breaks: liblzma2 (<< 5.1.1alpha+20110809-3~)
Filename: pool/main/x/xz-utils/liblzma5_5.2.4-1_amd64.deb
Size: 92352
MD5sum: 223533a347dc76a8cc9445cfc6146ec3
SHA1: 8ed14092fb1caecfebc556fda0745e1e74ba5a67
SHA256: 01020b5a0515dbc9a7c00b464a65450f788b0258c3fbb733ecad0438f5124800
Homepage: https://tukaani.org/xz/
Description-en: XZ-format compression library
 XZ is the successor to the Lempel-Ziv/Markov-chain Algorithm
 compression format, which provides memory-hungry but powerful
 compression (often better than bzip2) and fast, easy decompression.
 .
 The native format of liblzma is XZ; it also supports raw (headerless)
 streams and the older LZMA format used by lzma. (For 7-Zip's related
 format, use the p7zip package instead.)
```
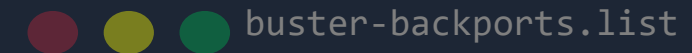
APT

```
                    /etc/apt/sources.list
deb  http://us.archive.ubuntu.com/ubuntu/ disco main restricted universe multiverse
```

main:	officially supported open-source packages
restricted:	officially supported closed-source software, like device drivers
universe:	community maintained open-source software
multiverse:	unsupported closed-source or patented software
main:	complies with Debian Free Software Guidelines (DFSG)
contrib:	DFSG-compliant packages with dependencies not in main
non-free:	not compliant with DFSG
security:	security updates
backports:	more recent than main

APT

```
>_

$ sudo vi /etc/apt/sources.list.d/buster-backports.list
```

buster-backports.list

deb http://deb.debian.org/debian buster-backports
main contrib non-free
deb-src http://deb.debian.org/debian buster-backports
main contrib non-free

```
>_

$ sudo apt-get install apt-file


$ sudo apt-file update



$ sudo apt-file list unrar
    unrar: /usr/bin/unrar-nonfree
    unrar: /usr/share/doc/unrar/changelog.Debian.gz
    unrar: /usr/share/doc/unrar/copyright
    unrar: /usr/share/man/man1/unrar-nonfree.1.gz



$ sudo apt-file search libSDL2.so
    libsdl2-dev: /usr/lib/x86_64-linux-gnu/libSDL2.so
```

Package Management Using zypper

zypper

```
>_
```

$ sudo zypper refresh $ sudo zypper se -u httpd

$ sudo zypper se gnumeric
Loading repository data...
Reading installed packages...
S | Name | Summary | Type
--+---------------+------------------------------+--------
  | gnumeric | Spreadsheet Application | package
  | gnumeric-devel | Spreadsheet Application | package
  | gnumeric-doc | Documentation files for Gnumeric | package
  | gnumeric-lang | Translations for package gnumeric | packag

$ sudo zypper se -i

$ sudo zypper se -i firefox
Loading repository data...
Reading installed packages...
S | Name | Summary | Type
--+----------------------------+--------------------------+--------
i | MozillaFirefox | Mozilla Firefox Web B-> | package
i | MozillaFirefox-branding-openSUSE | openSUSE branding of -> | package
i | MozillaFirefox-translations-common | Common translations f-> | package
```

zypper

```
>_
```

```
$ sudo zypper in unrar

zypper in unrar
Loading repository data...
Reading installed packages...
Resolving package dependencies...
The following NEW package is going to be installed:
  unrar
1 new package to install.
Overall download size: 141.2 KiB. Already cached: 0 B. After the operation,
additional 301.6 KiB will be used.
Continue? [y/n/v/...? shows all options] (y): y
Retrieving package unrar-5.7.5-lp151.1.1.x86_64
  (1/1), 141.2 KiB (301.6 KiB unpacked)
Retrieving: unrar-5.7.5-lp151.1.1.x86_64.rpm .....................[done]
Checking for file conflicts: ....................................[done]
(1/1) Installing: unrar-5.7.5-lp151.1.1.x86_64 ..................[done]


$ sudo zypper in /home/aaron/nomachine.rpm
```

```
>_

$ sudo zypper rm unrar
Loading repository data...
Reading installed packages...
Resolving package dependencies...
The following package is going to be REMOVED:
  unrar
1 package to remove.
After the operation, 301.6 KiB will be freed.
Continue? [y/n/v/...? shows all options] (y): y
(1/1) Removing unrar-5.7.5-lp151.1.1.x86_64 ........................[done]
```

zypper

```
$ sudo zypper rm libgimp-2_0-0
Loading repository data...
Warning: No repositories defined. Operating only with the installed resolvables.
Nothing can be installed.
Reading installed packages...
Resolving package dependencies...
The following 6 packages are going to be REMOVED:
  gimp gimp-help gimp-lang gimp-plugins-python libgimp-2_0-0
  libgimpui-2_0-0
6 packages to remove.
After the operation, 98.0 MiB will be freed.
Continue? [y/n/v/...? shows all options] (y):
```

zypper

```
>_
```

```
$ sudo zypper repos
Repository priorities are without effect. All enabled repositories share the same
priority.
# | Alias | Name | Enabled | GPG Check | Refresh
---+--------------------------+------------------------------------+---------+
----------+--------
 1 | openSUSE-Leap-15.1-1 | openSUSE-Leap-15.1-1 | No |
---- | ----
 2 | repo-debug | Debug Repository | No |
---- | ----
 3 | repo-debug-non-oss | Debug Repository (Non-OSS) | No |
---- | ----
 4 | repo-debug-update | Update Repository (Debug) | No |
---- | ----
 5 | repo-debug-update-non-oss | Update Repository (Debug, Non-OSS) | No |
---- | ----
 6 | repo-non-oss | Non-OSS Repository | Yes | (r) Yes | Yes
 7 | repo-oss | Main Repository | Yes | (r) Yes | Yes
 8 | repo-source | Source Repository | No |
---- | ----
```

```
>_
```

```
$ sudo zypper modifyrepo -d repo-non-oss
Repository 'repo-non-oss' has been successfully disabled.


$ sudo zypper modifyrepo -e repo-non-oss
Repository 'repo-non-oss' has been successfully enabled.


$ sudo zypper modifyrepo -f repo-non-oss
Autorefresh has been enabled for repository 'repo-non-oss'.


$ sudo zypper modifyrepo -F repo-non-oss
Autorefresh has been disabled for repository 'repo-non-oss'.
```

```
>_
```

```
$ sudo zypper addrepo http://packman.inode.at/suse/openSUSE-Leap_15.1/packman
Adding repository 'packman' ...................................[done]
Repository 'packman' successfully added
URI : http://packman.inode.at/suse/openSUSE_Leap_15.1/
Enabled : Yes
GPG Check : Yes
Autorefresh : No
Priority : 99 (default priority)
Repository priorities are without effect. All enabled repositories share the same
priority.


$ sudo zypper removerepo packman
Removing repository 'packman' ...................................[done]
Repository 'packman' has been removed.
```

Linux as a Virtualization Guest: Tools and Images

Virtualization

Virtualization: Allows a hypervisor to run processes that contain a fully emulated computer system

Hypervisor: Manages the physical hardware's resources used by individual virtual machines

- Separates access to the host's hardware resources, allowing multiple operating systems on a single host

Virtual machines: Are known as guests of the hypervisor

- Have many aspects of a physical computer emulated in software

- Often use hard disk images stored as individual files and access RAM and CPU through the hypervisor

Xen:

open-source Type-1 hypervisor

- Bare-metal hypervisor

- Computer can boot directly into the Xen hypervisor

KVM

Kernel Virtual Machine:

Linux kernel module for virtualization

- Both Type-1 and Type-2 hypervisor

- Needs a generic Linux operating system to work

- Can integrate with a running Linux installation

- Virtual machines use the libvirt daemon

VirtualBox

VirtualBox: Popular desktop application to create and manage
                      virtual machines

                      • Cross-platform: works on Linux, macOS, and Microsoft Windows

                      • Type-2 hypervisor

Migrations

Some hypervisors allow dynamic relocation of virtual machines

Migration: moving a virtual machine from one hypervisor installation to another

- Some migrations require the guest to be completely shut down

Live migration: can be performed while the guest is running

- Useful for maintenance on hypervisors and system resiliency

Types of Virtual Machines

Paravirtualized
Guest

Fully
Virtualized
Guest

Hybrid
Guest

Fully Virtualized Guests

> All guest instructions must be able to run within a fully virtualized operating system installation

> No additional software drivers installed within the guest to translate instructions

> The guest is unaware that it is running as a virtual machine

> Requires Intel VT-x or AMD-V CPU extensions on x86 platforms

Paravirtualized Guests

PVM:

The guest operating system is aware that it is running in a virtual machine instance

- Uses a modified kernel and special drivers to help the guest utilize software and hardware resources

- Performance is often better than a fully virtualized guest due to these drivers

Hybrid Guests

> Combines paravirtualization and full virtualization

> Unmoidified operating systems receive near-native I/O performance using paravirtualized drivers

> Paravirtualized drivers contain storage and networking device drivers to enhance performance

> KVM uses the Virtio project

> VirtualBox uses Guest Extentions

Virtual Machines in the Cloud

**IaaS
(infrastructure
as a service):**

providers run hypervisor systems to deploy virtual
guests

- Provide tools to build, deploy, and configure custom virtual machines

- May provide systems for deployment and migration of virtual
  machines from a customer's organization

Computing Instances:

Many providers charge usage rates based on computing instances

how much CPU time your cloud-based infrastructure will use

- Careful planning is required to keep cloud costs manageable

- Computing instances may refer to the number of virtual machines provisioned in a cloud environment

- Higher usage means higher cost

Block Storage

Block Storage: May be meant for web-based traffic or external storage
used to host files

- Costs vary based on the amount of storage used and storage speed

- Faster storage access typically costs more

- Archival storage is often very inexpensive

Networking:

Web-based utilities for designing and implementing network routes, subnetting, and firewall control

- May provide DNS solutions for publicly accessible fully qualified domain names

- Hybrid solutions can connect existing on-premise network infrastructure to the cloud through VPN

Preconfiguring Cloud Systems

```
>_ fig
```

```
$ vi cloud-config
```

cloud-config

```
#cloud-config
timezone: Africa/Dar_es_Salaam
hostname: test-system
# Update the system when it first boots up
apt_update: true
apt_upgrade: true
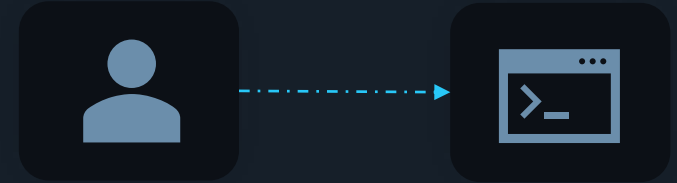# Install the Nginx web server
packages:
 - nginx
```

Login Methods

Local text-mode console

Remote text-mode login

Local graphical-mode console

Remote graphical-mode login

KODEKLOUD

```
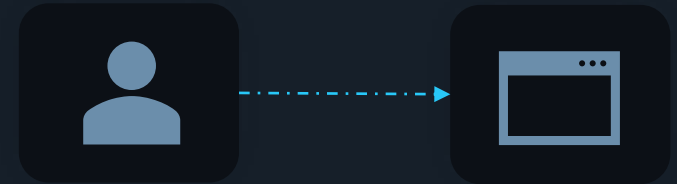[ OK ] Mounted Mount unit for snapd, revision 13270.
[ OK ] Mounted Mount unit for core18, revision 2128.
[ OK ] Mounted Mount unit for lxd, revision 21029.
[ OK ] Mounted Mount unit for lxd, revision 21545.
[ OK ] Mounted Mount unit for snapd, revision 12704.
[ OK ] Reached target Local File Systems.
       Starting Load AppArmor profiles...
       Starting Set console font and keymap...
       Starting Create final runtime dir for shutdown pivot root...
       Starting Tell Plymouth To Write Out Runtime Data...
       Starting Create Volatile Files and Directories...
[ OK ] Finished Set console font and keymap.
[ OK ] Finished Create final runtime dir for shutdown pivot root.
[ OK ] Finished Tell Plymouth To Write Out Runtime Data.
[ OK ] Finished Create Volatile Files and Directories.
       Starting Network Time Synchronization...
       Starting Update UTMP about System Boot/Shutdown...
[ OK ] Finished Update UTMP about System Boot/Shutdown.
[ OK ] Finished Load AppArmor profiles.
       Starting Load AppArmor profiles managed internally by snapd...
       Starting Initial cloud-init job (pre-networking)...
[ OK ] Finished Load AppArmor profiles managed internally by snapd.
[ OK ] Started Network Time Synchronization.
[ OK ] Reached target System Time Set.
[ OK ] Reached target System Time Synchronized.
[    7.050050] cloud-init[655]: Cloud-init v. 21.2-3-g899bfaa9-0ubuntu2~20.04.1 running 'init-local'
       at Wed, 20 Oct 2021 00:20:32 +0000. Up 6.99 seconds.
[ OK ] Finished Initial cloud-init job (pre-networking).
[ OK ] Reached target Network (Pre).
       Starting Network Service...
[ OK ] Started Network Service.
       Starting Wait for Network to be Configured...
[ OK ] Started Network Name Resolution.
[ OK ] Reached target Network.
[ OK ] Reached target Host and Network Name Lookups.
```

```
CentOS Linux 8
Kernel 4.18.0-305.19.1.el8_4.x86_64 on an x86_64

Activate the web console with: systemctl enable --now cockpit.socket

centos-vm login: _
```

```
aaron@LFCS-CentOS:~                          x
File  Edit  View  Search  Terminal  Help
[aaron@LFCS-CentOS ~]$ ls -a
.                    .bash_profile   Desktop        .ICEauthority  Pictures   Templates
..                   .bashrc         Documents      .local         .pki       Videos
.bash_history        .cache          Downloads      .mozilla       Public
.bash_logout         .config                        .esd_auth      Music      .ssh
[aaron@LFCS-CentOS ~]$
```

Console   Virtual Terminal   Terminal Emulator

```
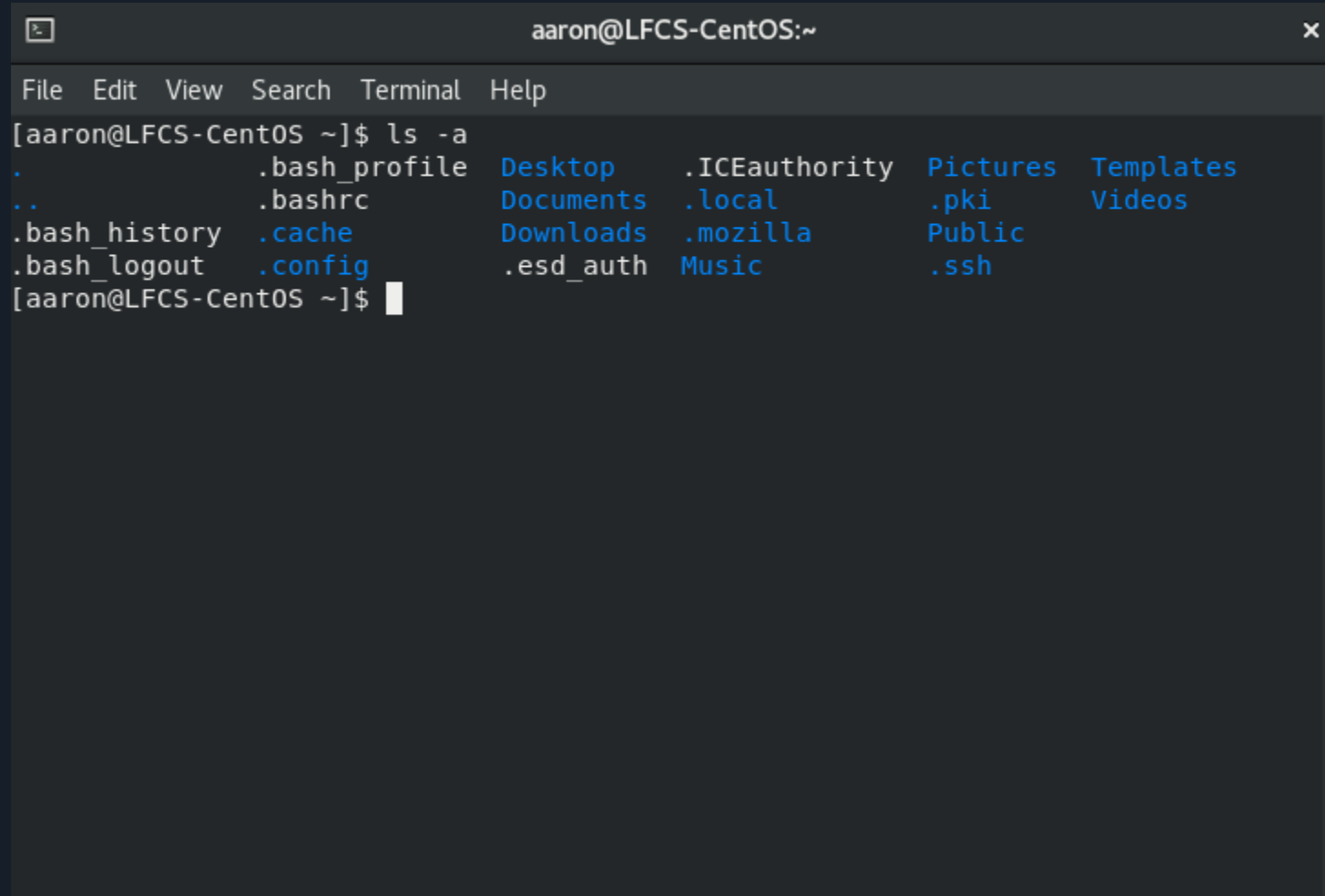[  OK  ] Mounted Mount unit for snapd, revision 13270.
[  OK  ] Mounted Mount unit for core18, revision 2128.
[  OK  ] Mounted Mount unit for lxd, revision 21029.
[  OK  ] Mounted Mount unit for lxd, revision 21545.
[  OK  ] Mounted Mount unit for snapd, revision 12704.
[  OK  ] Reached target Local File Systems.
         Starting Load AppArmor profiles...
         Starting Set console font and keymap...
         Starting Create final runtime dir for shutdown pivot root...
         Starting Tell Plymouth To Write Out Runtime Data...
         Starting Create Volatile Files and Directories...
[  OK  ] Finished Set console font and keymap.
[  OK  ] Finished Create final runtime dir for shutdown pivot root.
[  OK  ] Finished Tell Plymouth To Write Out Runtime Data.
[  OK  ] Finished Create Volatile Files and Directories.
         Starting Network Time Synchronization...
         Starting Update UTMP about System Boot/Shutdown...
[  OK  ] Finished Update UTMP about System Boot/Shutdown.
[  OK  ] Finished Load AppArmor profiles.
         Starting Load AppArmor profiles managed internally by snapd...
         Starting Initial cloud-init job (pre-networking)...
[  OK  ] Finished Load AppArmor profiles managed internally by snapd.
[  OK  ] Started Network Time Synchronization.
[  OK  ] Reached target System Time Set.
[  OK  ] Reached target System Time Synchronized.
[    7.050553] cloud-init[655]: Cloud-init v. 21.2-3-g899bfaa9-0ubuntu2~20.04.1 running 'init-local'
at Wed, 20 Oct 2021 00:20:32 +0000. Up 6.99 seconds.
[  OK  ] Finished Initial cloud-init job (pre-networking).
[  OK  ] Reached target Network (Pre).
         Starting Network Service...
[  OK  ] Started Network Service.
         Starting Wait for Network to be Configured...
         Starting Network Name Resolution...
[  OK  ] Started Network Name Resolution.
[  OK  ] Reached target Network.
[  OK  ] Reached target Host and Network Name Lookups.
```

Virtual Terminals

CTRL + ALT + F2

```
CentOS Linux 8
Kernel 4.18.0-305.19.1.el8_4.x86_64 on an x86_64

Activate the web console with: systemctl enable --now cockpit.socket
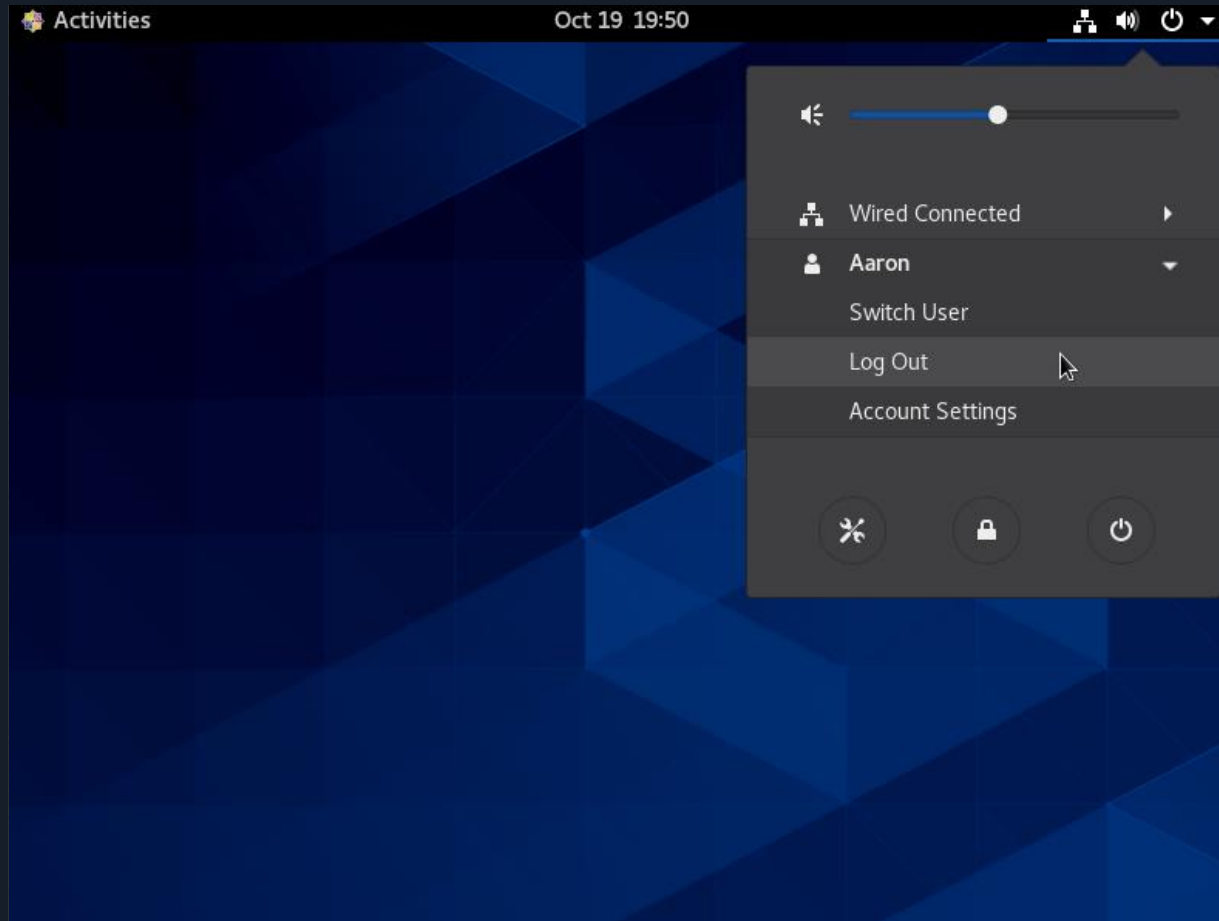
centos-vm login: _
```

Terminal Emulators


```
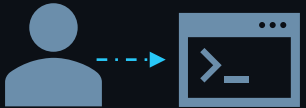aaron@LFCS-CentOS:~

File   Edit   View   Search   Terminal   Help

[aaron@LFCS-CentOS ~]$ ls -a
.                .bash_profile   Desktop      .ICEauthority   Pictures    Templates
..               .bashrc         Documents    .local          .pki        Videos
.bash_history    .cache          Downloads    .mozilla        Public
.bash_logout     .config         .esd_auth    Music           .ssh
[aaron@LFCS-CentOS ~]$
```

Local GUI

Activities | Oct 19 19:50

Wired Connected

Aaron

Switch User

Log Out

Account Settings

Local text console


```
CentOS Stream 8
Kernel 4.18.0-338.el8.x86_64 on an x86_64

Activate the web console with: systemctl enable --now cockpit.socket

LFCS-CentOS login: aaron
Password:
Last login: Tue Oct 19 20:00:22 on tty2
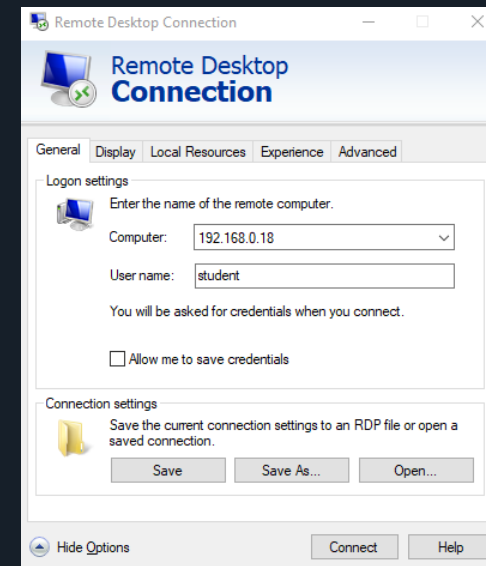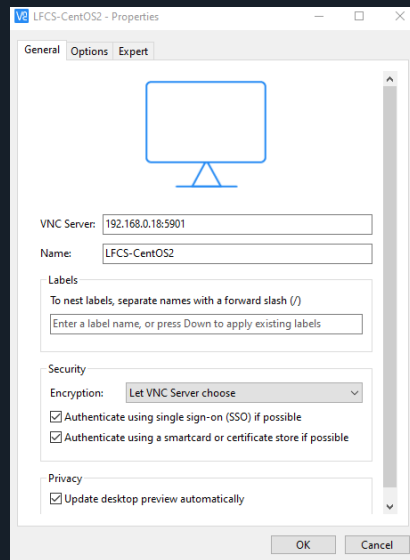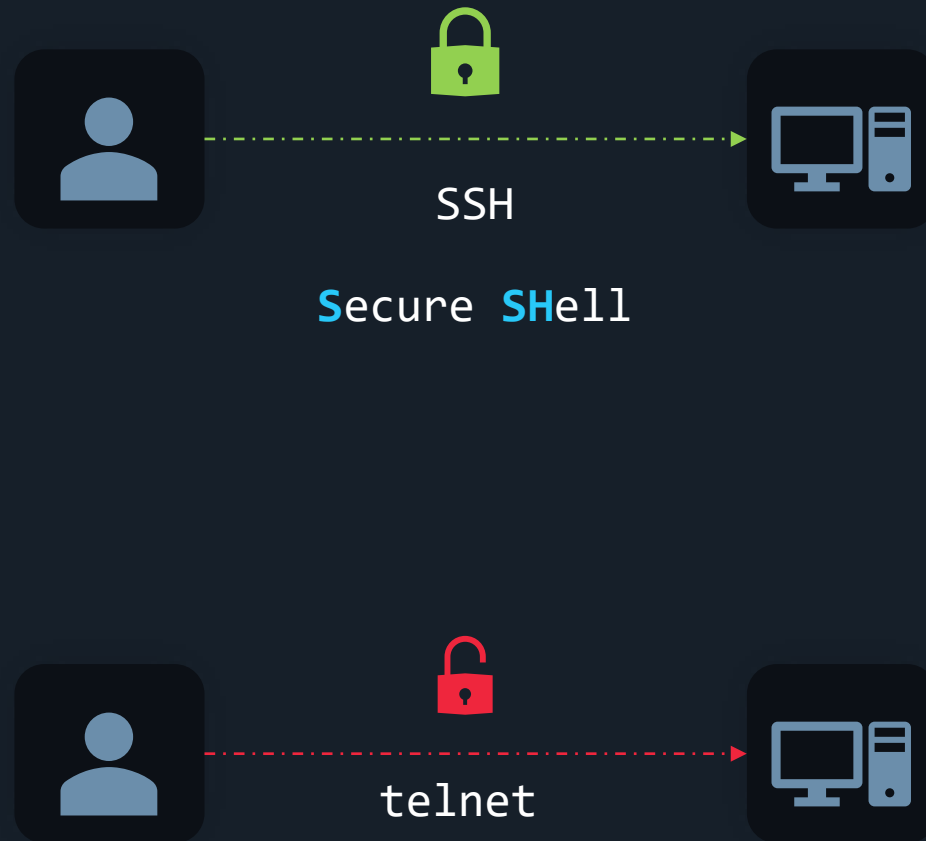[aaron@LFCS-CentOS ~]$ exit
```

Remote GUI

VNC

RDP

Remote text-mode login

SSH login

```
$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group
default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state
UP group default qlen 1000
    link/ether 08:00:27:6b:d7:87 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.17/24 brd 192.168.0.255 scope global dynamic
noprefixroute enp0s3
       valid_lft 1966sec preferred_lft 1966sec
    inet6 fe80::a00:27ff:fe6b:d787/64 scope link noprefixroute
```

Server

⚙ SSH daemon

SSH client

Computer

MacOS & Linux


```
Processes: 210 total, 2 running, 9 stuck, 199 sleeping, 901 threads    23:30:03
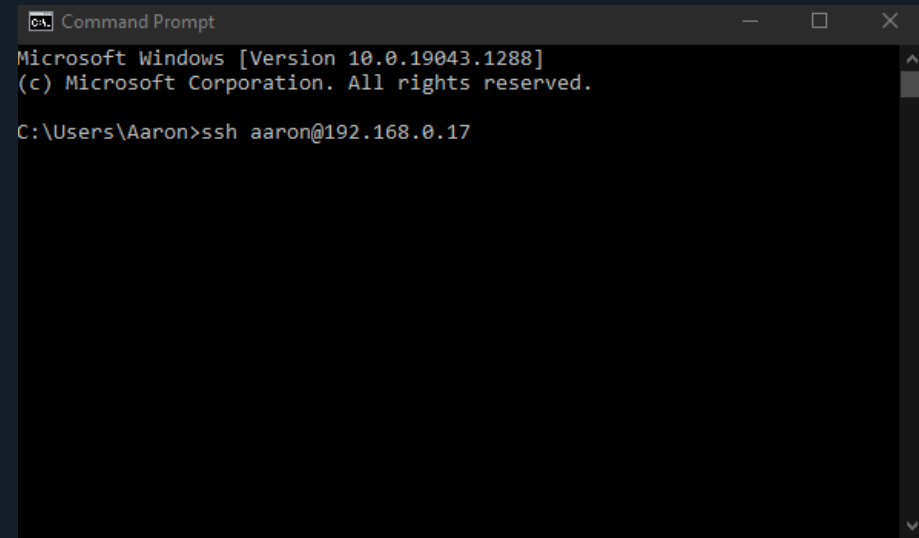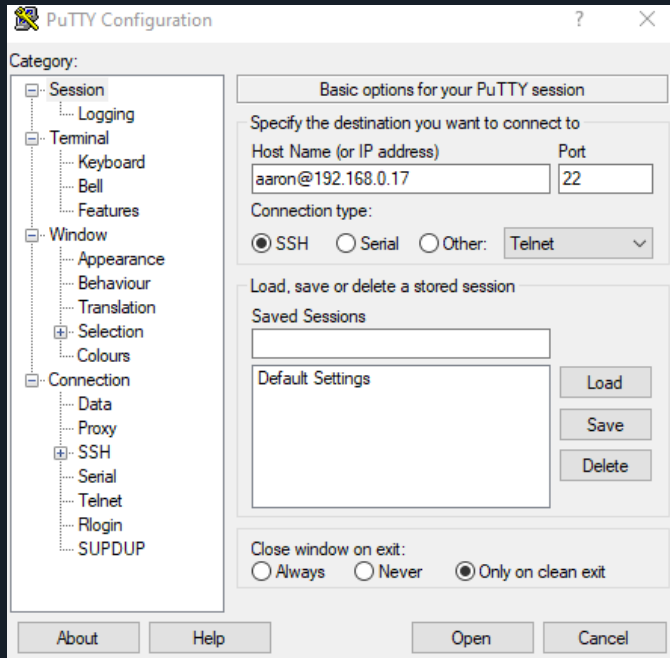Load Avg: 1.40, 1.75, 1.00  CPU usage: 4.15% user, 4.40% sys, 91.44% idle
SharedLibs: 1648K resident, 0B data, 0B linkedit.
MemRegions: 31278 total, 1892M resident, 117M private, 564M shared.
PhysMem: 5893M used (1191M wired), 10G unused.
VM: 523G vsize, 1026M framework vsize, 0(0) swapins, 0(0) swapouts.
Networks: packets: 12105/8925K in, 11907/1964K out.
Disks: 80156/2205M read, 21235/425M written.
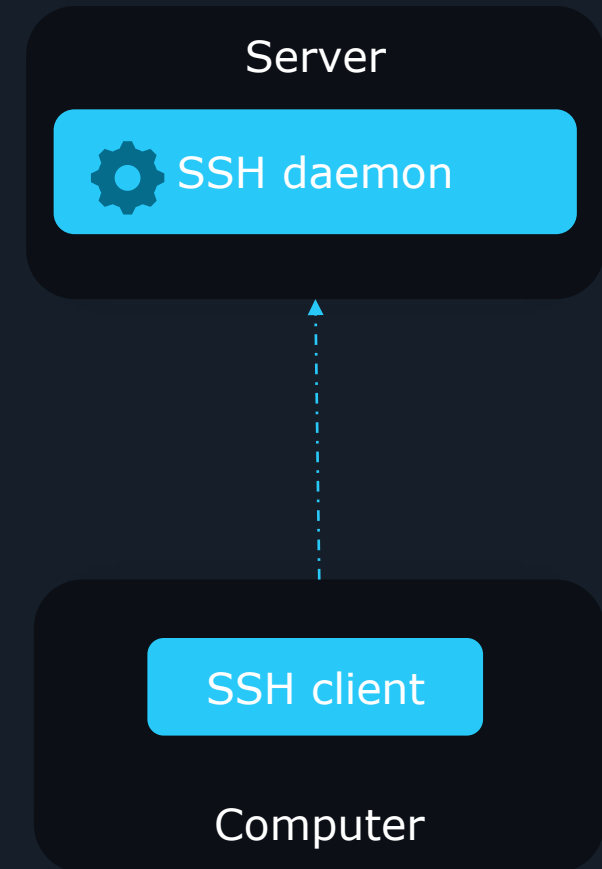
PID   COMMAND      %CPU TIME      #TH  #WQ  #PORT MEM    PURG   CMPR PGRP PPID
592   screencaptur 0.0  00:00.02  7    5    55+   1952K+ 20K+   0B   262  262
590   mdworker     0.0  00:00.01  3    0    44    2032K  0B     0B   590  1
589   mdworker     0.0  00:00.01  3    0    44    1572K  0B     0B   589  1
588   top          1.7  00:00.51  1/1  0    22+   2860K  0B     0B   588  584
584   bash         0.0  00:00.00  1    0    15    588K   0B     0B   584  583
583   login        0.0  00:00.01  3    1    28    1228K  0B     0B   583  482
574   auditd       0.0  00:00.00  2    0    25    560K   0B     0B   574  1
567   System Prefe 0.0  00:03.23  3    0    270   39M    8364K  0B   567  1
561   systemstatsd 0.0  00:00.01  2    1    19    1040K  0B     0B   561  1
560   com.apple.We 0.0  00:01.42  9    0    229   25M    0B     0B   560  1
558   com.apple.We 0.0  00:05.07  15   3    224   151M   1716K  0B   558  1
555   bash         0.0  00:00.00  1    0    15    604K   0B     0B   555  554
554   login        0.0  00:00.01  3    1    28    1176K  0B     0B   554  482
550   bash         0.0  00:00.00  1    0    15    608K   0B     0B   550  549
```

aaron@LFCS-CentOS:~

File   Edit   View   Search   Terminal   Help

```
[aaron@LFCS-CentOS ~]$ ls -a
.                  .bash_profile  Desktop    .ICEauthority  Pictures   Templates
..                 .bashrc        Documents  .local         .pki       Videos
.bash_history      .cache         Downloads  .mozilla       Public
.bash_logout       .config        .esd_auth  Music          .ssh
[aaron@LFCS-CentOS ~]$
```

SSH

```
>_

$ ssh aaron@192.168.0.17
aaron@192.168.0.17's password:
Activate the web console with: systemctl enable --now cockpit.socket

Last login: Tue Oct 19 20:27:15 2021 from 192.168.0.3
[aaron@LFCS-CentOS ~]$
```

Use and Edit Bash Command History

```
>_
```

$ history
```
1  history

   2  ls

   3  ls -la

   4  test

   5  clear

   6  cd

   7  pwd

   8  clear

   9  sudo systemctl reboot

  10  ls -la

  11  clear
```

Bash History

```
>_
```

```
$ history | grep sudo

9  sudo systemctl reboot

   12  sudo yum update

   14  sudo -i

   17  history | grep sudo
```

```
>_

$ ls -la /home/aaron
drwx------. 14 aaron aaron 4096 Dec  5 13:52 .
drwxr-xr-x.  3 root  root    19 Dec  5 13:43 ..
-rw-------.  1 aaron aaron  112 Dec  5 13:51 .bash_history
-rw-r--r--.  1 aaron aaron   18 Nov 24 08:20 .bash_logout
-rw-r--r--.  1 aaron aaron  141 Nov 24 08:20 .bash_profile
-rw-r--r--.  1 aaron aaron  492 Nov 24 08:20 .bashrc
drwx------.  7 aaron aaron  181 Dec  5 13:45 .cache
drwx------.  9 aaron aaron 4096 Dec  5 13:46 .config
drwxr-xr-x.  2 aaron aaron    6 Dec  5 13:45 Desktop
drwxr-xr-x.  2 aaron aaron    6 Dec  5 13:45 Documents
drwxr-xr-x.  2 aaron aaron    6 Dec  5 13:45 Downloads
```

```
>_
```

```
$ cat .bash_history
history

ls

ls -la

test

clear

cd

pwd

clear

sudo systemctl reboot

ls -la

clear
```

UP   DOWN   ENTER

Working With Files
and Directories

KODEKLOUD

Listing Files and Directories

>_

```
$ ls
Pictures              Desktop
Documents             Videos
Downloads             Music
```

ls list

```
$ ls -a
.
..
.ssh
.bash_logout
.bash_profile
.bashrc
Pictures
Desktop               Documents              Videos
Downloads             Music
```

-a all

Listing Files and Directories

```
>_
```

```
$ ls -l /var/log/
total 4064
drwxr-xr-x. 2 root    root      4096 Oct 18 22:52 anaconda
drwx------. 2 root    root        23 Oct 18 22:53 audit
-rw-------. 1 root    root     19524 Nov  1 17:56 boot.log
-rw-rw----. 1 root    utmp         0 Nov  1 14:08 btmp
-rw-rw----. 1 root    utmp         0 Oct 18 22:38 btmp-20211101
drwxr-x---. 2 chrony  chrony       6 Jun 24 09:21 chrony
-rw-------. 1 root    root      9794 Nov  1 18:01 cron
-rw-------. 1 root    root     10682 Oct 26 14:01 cron-20211026
drwxr-xr-x. 2 lp      sys        135 Oct 26 14:13 cups
-rw-r--r--. 1 root    root     35681 Nov  1 18:13 dnf.rpm.log
-rw-r-----. 1 root    root      4650 Nov  1 17:56 firewalld
drwx--x--x. 2 root    gdm          6 Oct 19 00:07 gdm
drwxr-xr-x. 2 root    root         6 Aug 31 12:07 glusterfs
```

Listing Files and Directories

```
$ ls -a -l  ➡  $ ls -al
total 76
drwx------.  16 aaron aaron 4096 Nov  1 17:57 .
drwxr-xr-x.   7 root  root    70 Oct 26 16:54 ..
-rw-------.   1 aaron aaron 5085 Nov  1 17:56 .bash_history
-rw-r--r--.   1 aaron aaron   18 Jul 27 09:21 .bash_logout
-rw-r--r--.   1 aaron aaron  141 Jul 27 09:21 .bash_profile
-rw-r--r--.   1 aaron aaron  376 Jul 27 09:21 .bashrc
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Desktop
drwxr-xr-x.   3 aaron aaron   25 Oct 23 18:15 Documents
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Downloads
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Music
drwxr-xr-x.   2 aaron aaron   28 Oct 26 13:37 Pictures
-rw-rw-r--.   1 aaron aaron   36 Oct 28 20:06 testfile
```

Listing Files and Directories

```
>_
```

```
$ ls -alh
total 76K
drwx------.  16 aaron aaron 4.0K Nov  1 17:57 .
drwxr-xr-x.   7 root  root    70 Oct 26 16:54 ..
-rw-------.   1 aaron aaron 5.0K Nov  1 17:56 .bash_history
-rw-r--r--.   1 aaron aaron   18 Jul 27 09:21 .bash_logout
-rw-r--r--.   1 aaron aaron  141 Jul 27 09:21 .bash_profile
-rw-r--r--.   1 aaron aaron  376 Jul 27 09:21 .bashrc
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Desktop
drwxr-xr-x.   3 aaron aaron   25 Oct 23 18:15 Documents
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Downloads
drwxr-xr-x.   2 aaron aaron    6 Oct 19 00:11 Music
drwxr-xr-x.   2 aaron aaron   28 Oct 26 13:37 Pictures
-rw-rw-r--.   1 aaron aaron   36 Oct 28 20:06 testfile
```

-h human readable format

Filesystem Tree

Filesystem Tree

/

home   var

aaron   jane   log

directory path   Documents

file path   Invoice.pdf

Absolute Path

/home/aaron/Documents/Invoice.pdf

/

home

var

aaron

jane

log

Documents

Invoice.pdf

Current / Working Directory

```
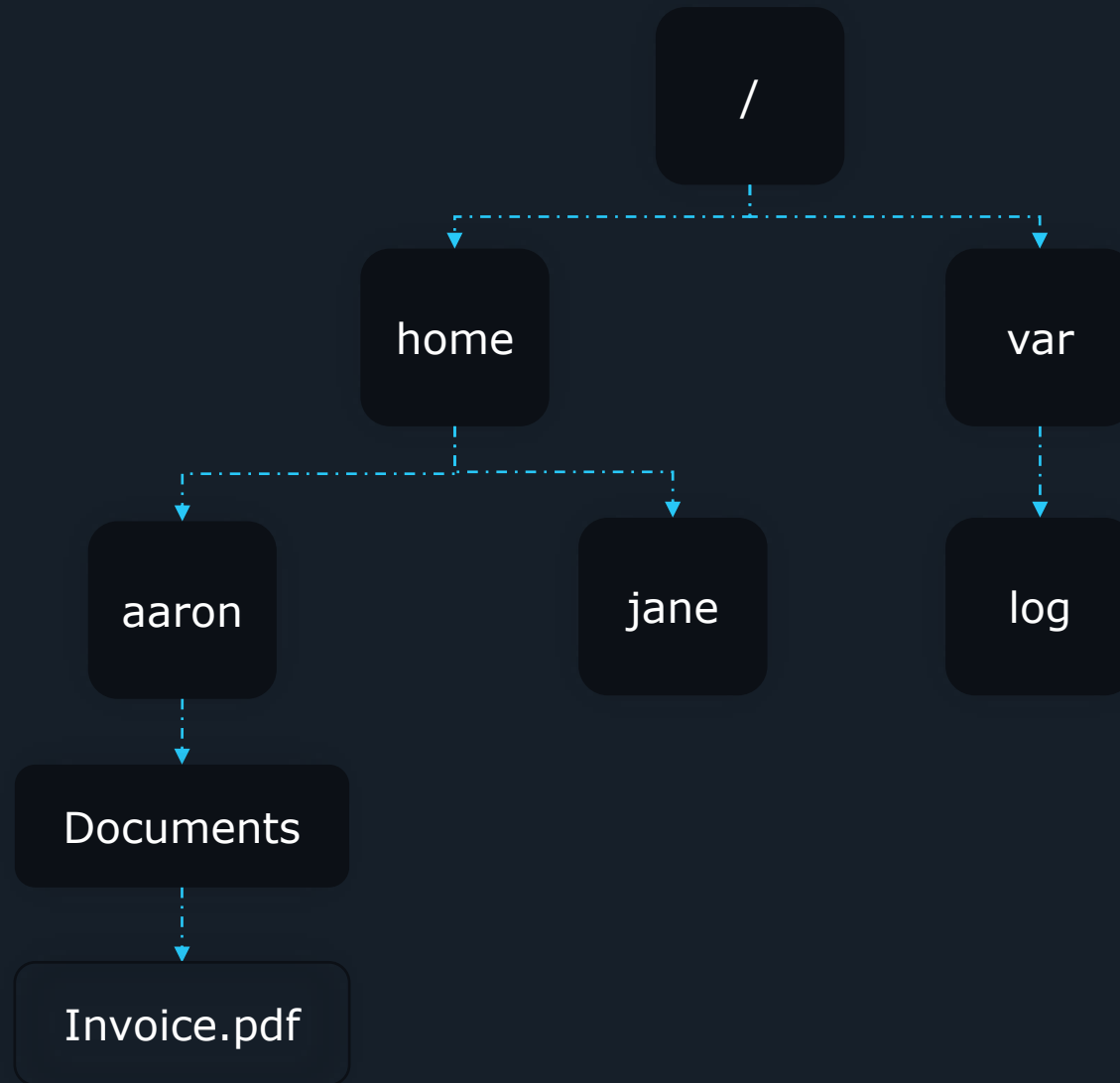>_
```

```
$ pwd          print working directory
  /root
```

Current / Working Directory

```
>_
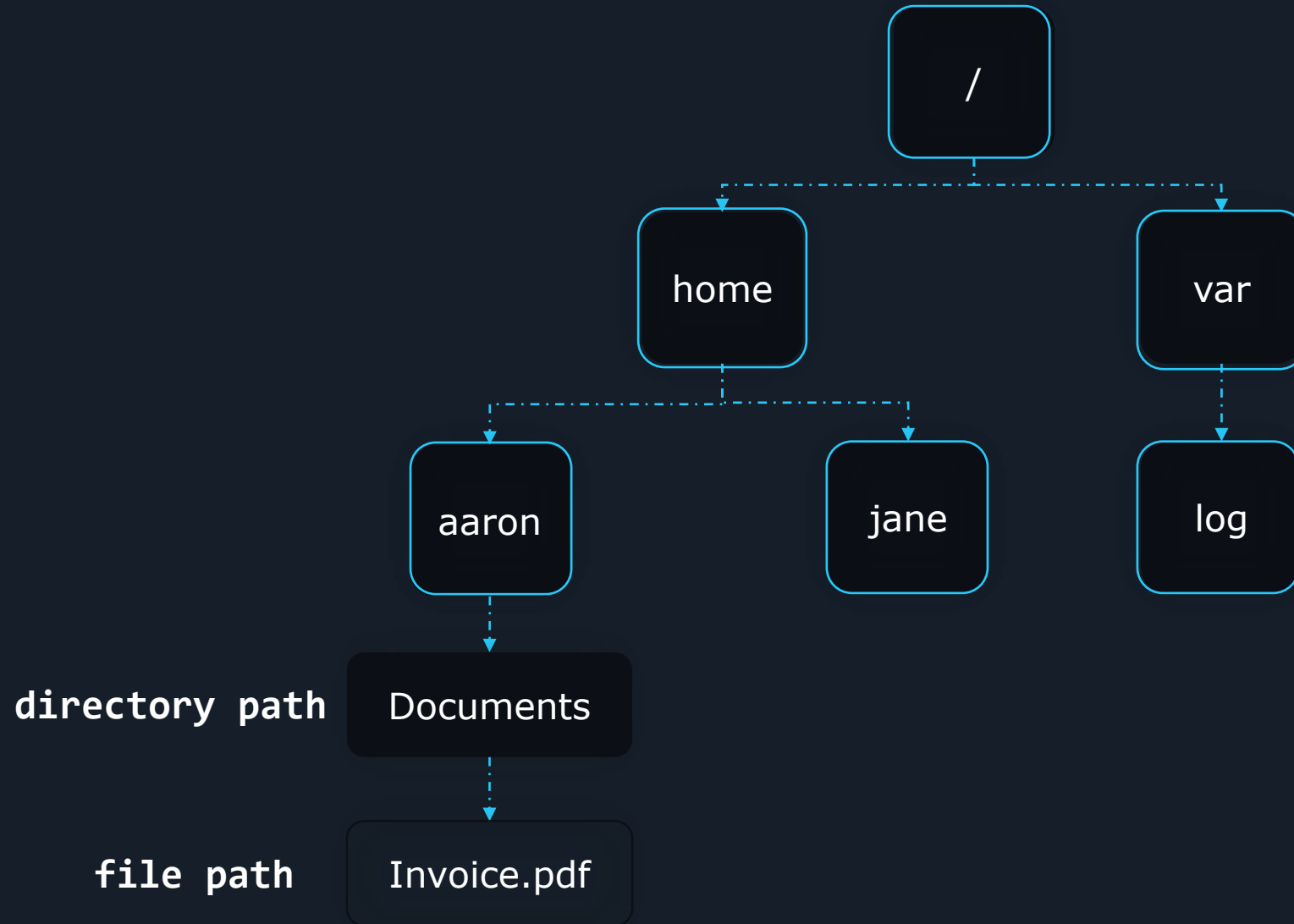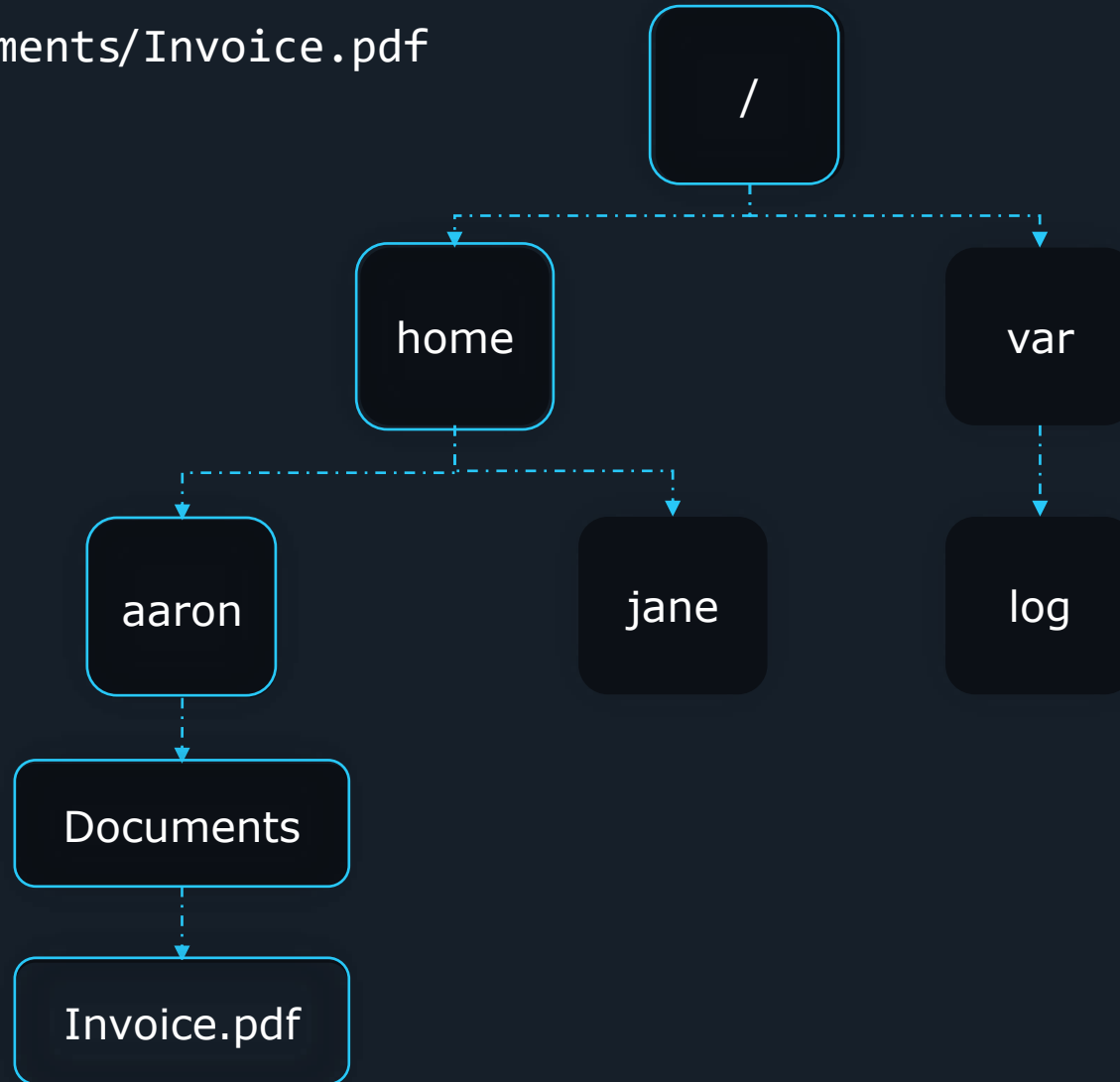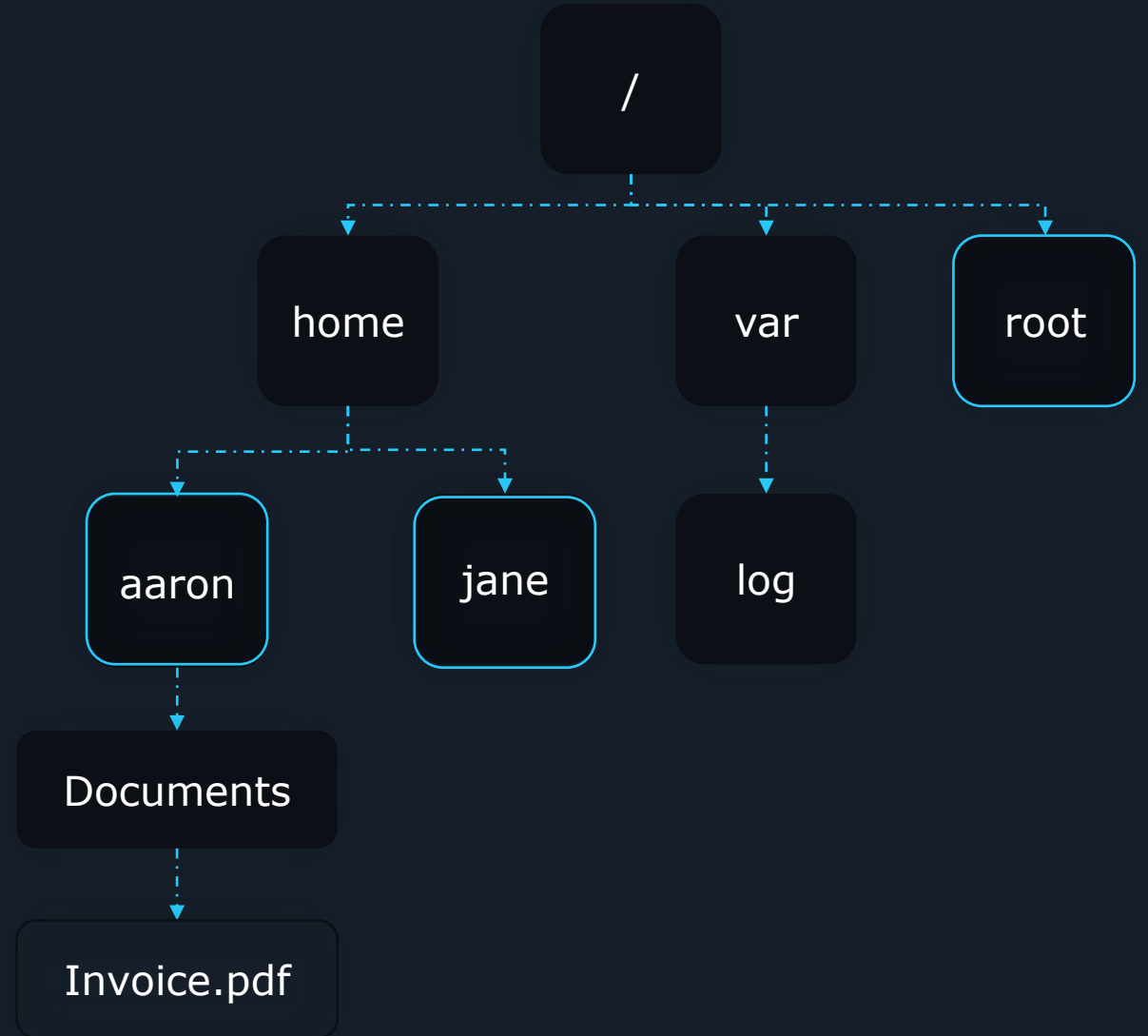
$ cd /var/log          change directory

$ cd /home/aaron

$ cd ..                .. = parent directory
```

Relative Path

```
>_
```

```
$ Documents/Invoice.pdf
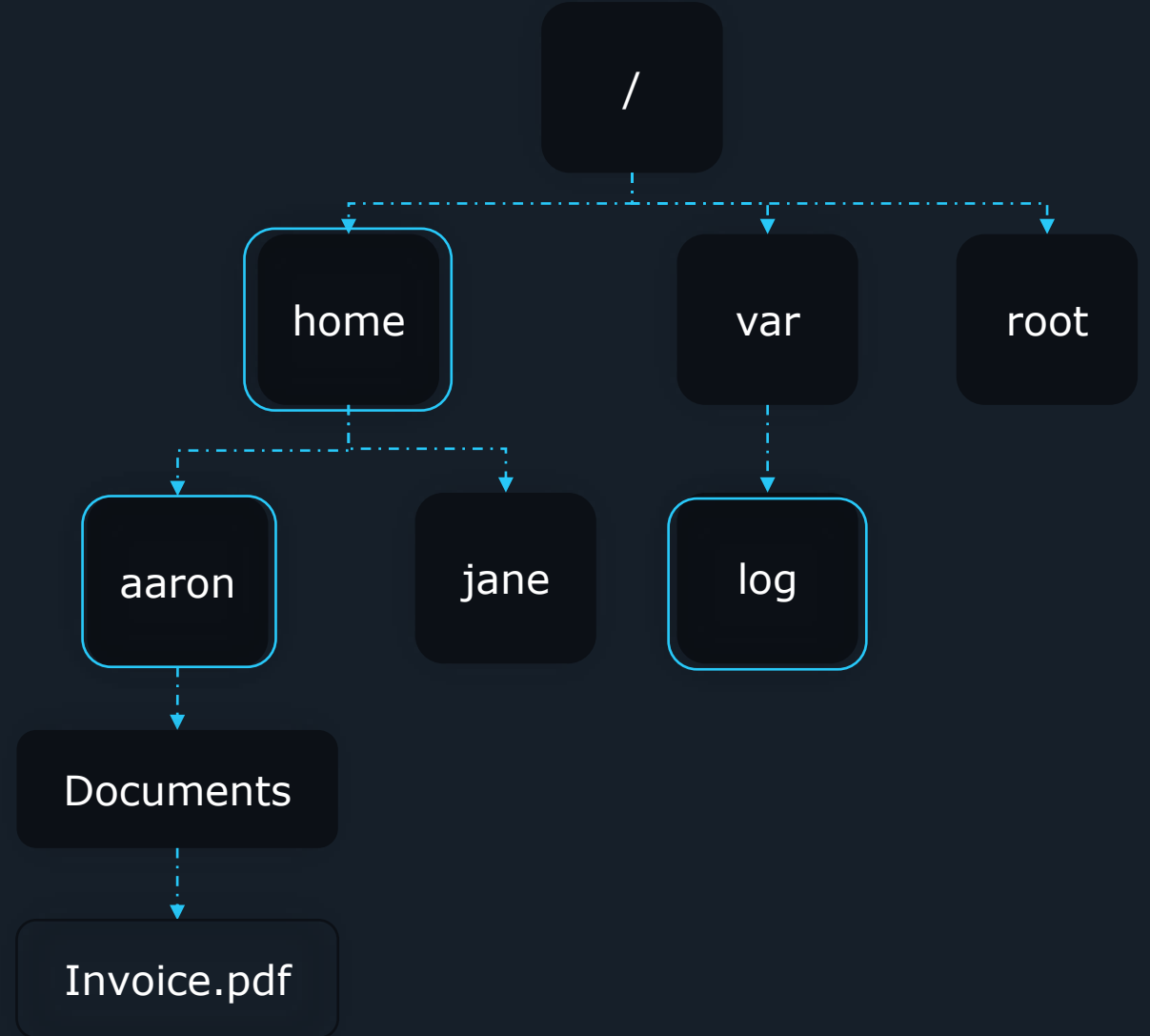
$ Invoice.pdf

$ ../Invoice.pdf
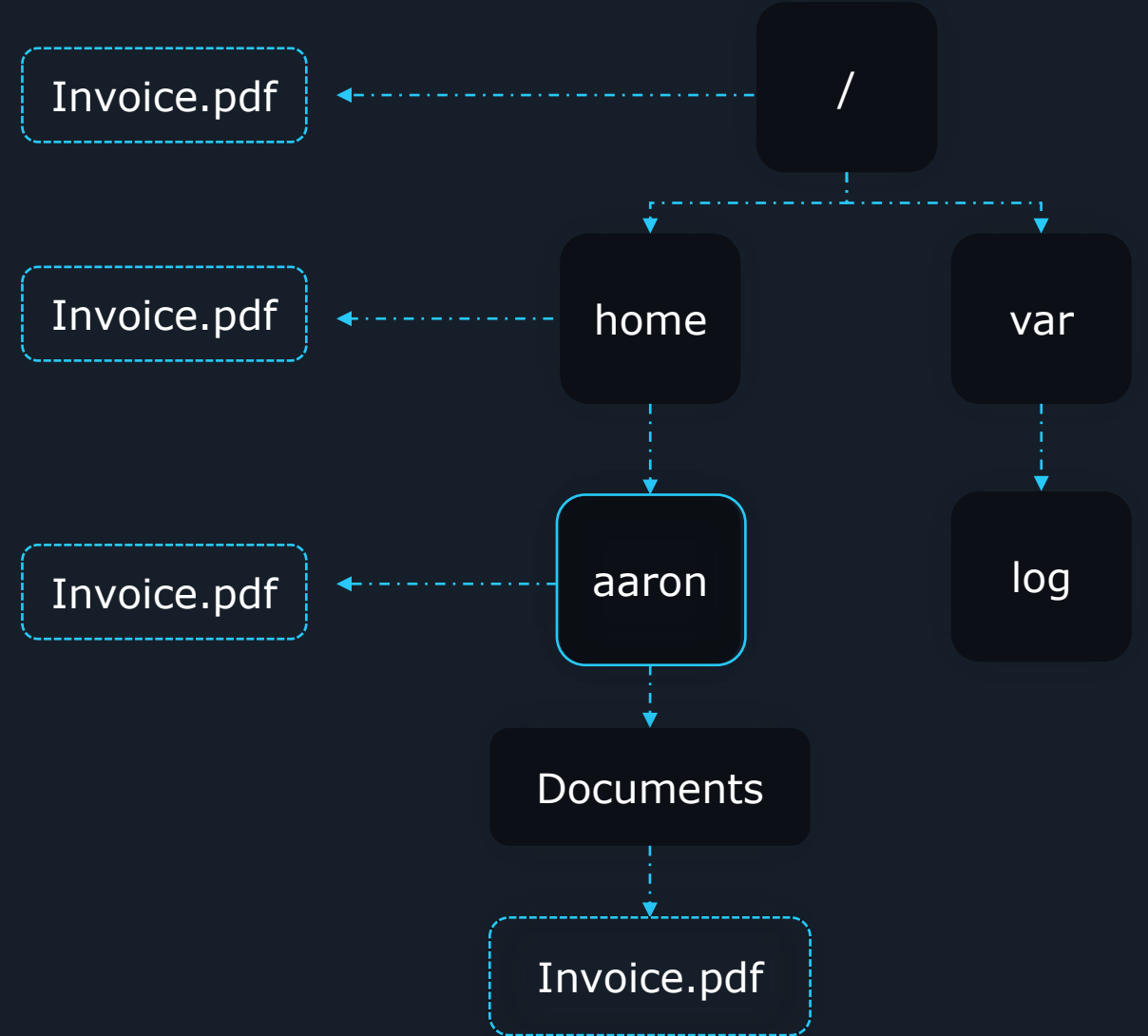
$ ../../Invoice.pdf
```

Invoice.pdf ← /

Invoice.pdf ← home

Invoice.pdf ← aaron

/ → home, var

home → aaron

var → log

aaron → Documents

Documents → Invoice.pdf

Current / Working Directory

```
>_

$ cd /          # Go to root directory

$ cd -          # Go to previous directory

$ cd            # Go to home directory
```

Creating Files

```
>_
```

```
$ touch Receipt.pdf
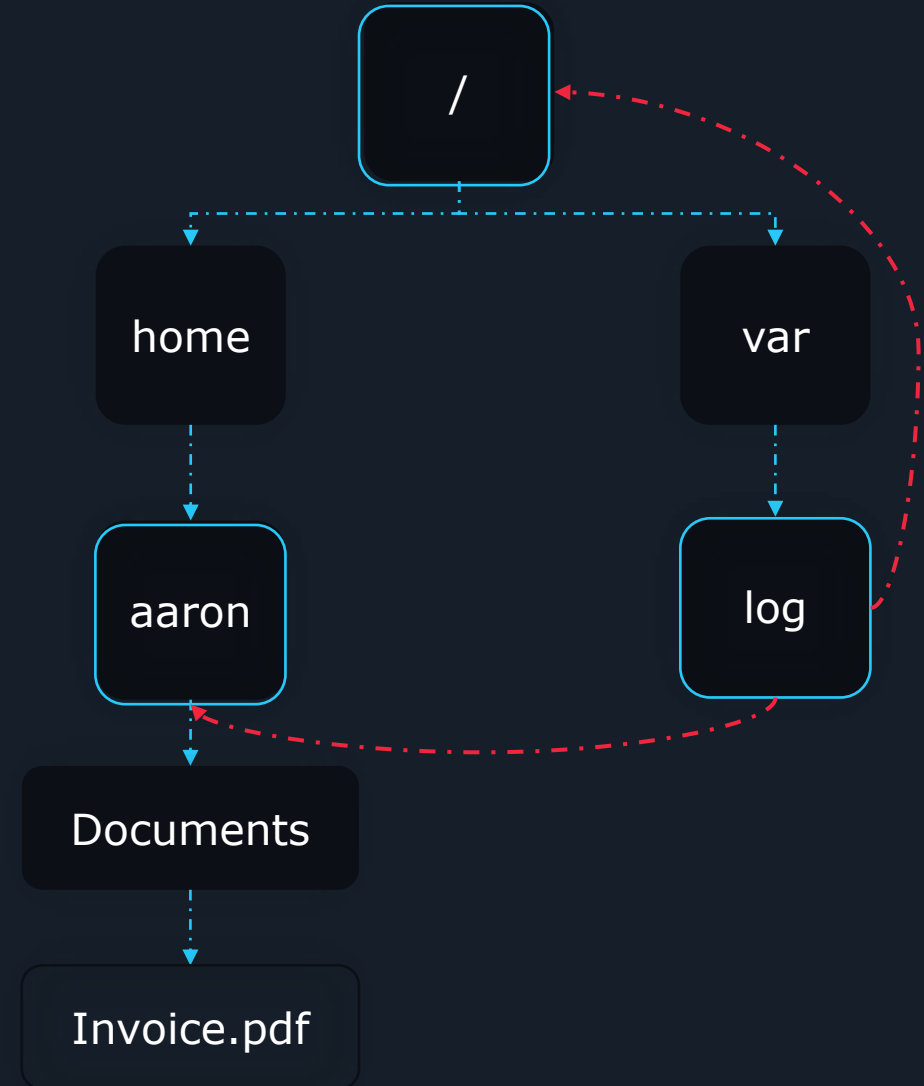
$ touch /home/jane/Receipt.pdf

$ touch ../jane/Receipt.pdf
```

/

home

aaron   jane

Receipt.pdf   Receipt.pdf

Creating Directories

```
>_
```

```
$ mkdir Receipts
```

make directory

```
/
 └── home
      ├── aaron
      │    ├── Receipts
      │    └── Receipt.pdf
      └── jane
           └── Receipt.pdf
```

Copying Files

```
>_
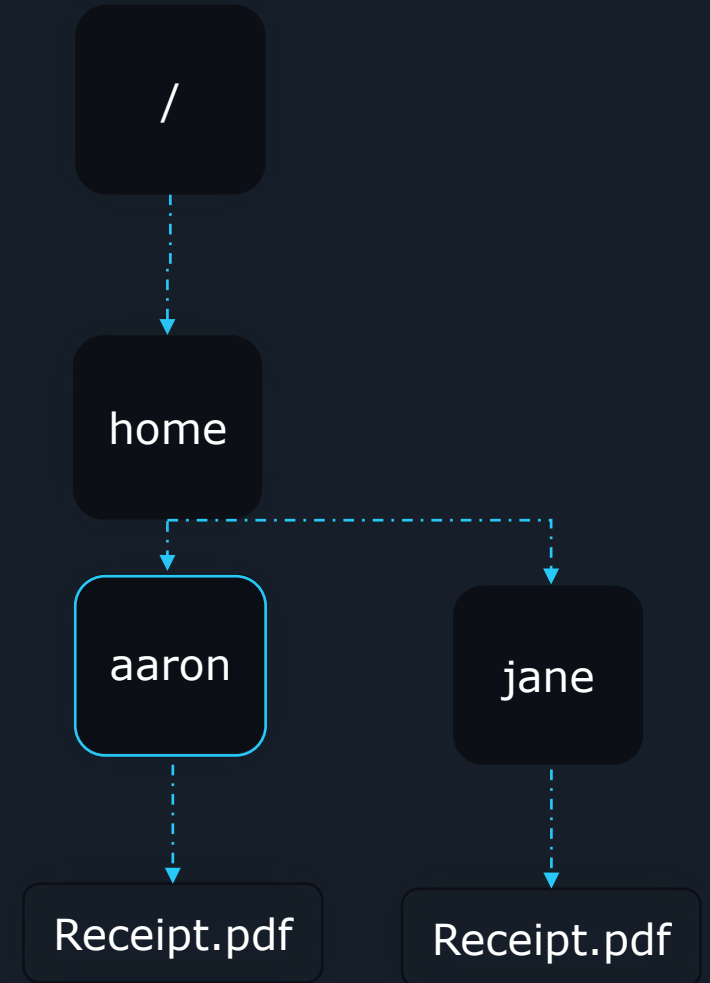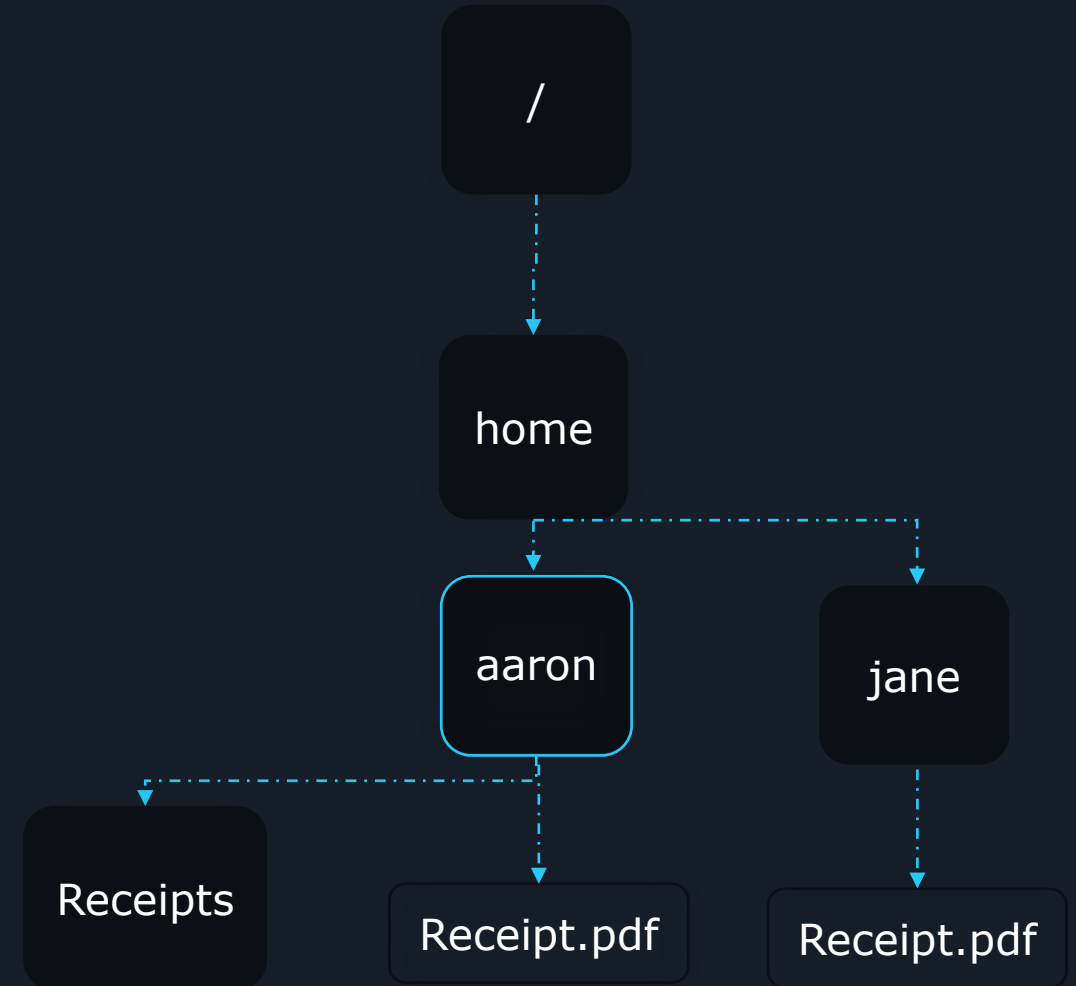
# cp [source] [destination]          copy

$ cp Receipt.pdf Receipts/

$ cp Receipt.pdf Receipts

$ cp Receipt.pdf Receipts/ ReceiptCopy.pdf
```

/

home

aaron

Receipts

Receipt.pdf

Receipt.pdf

ReceiptCopy.pdf

Copying Directories

```
>_
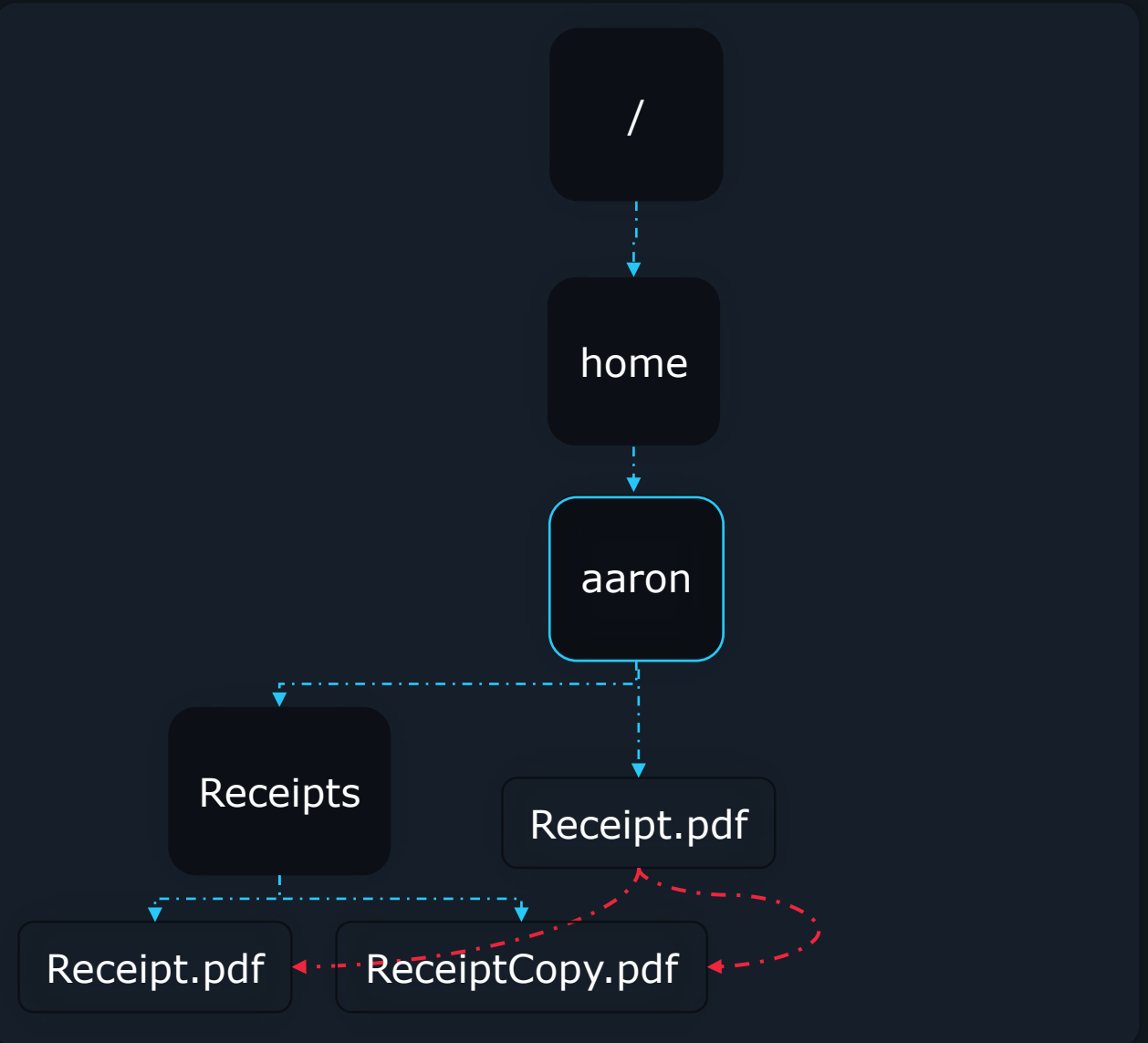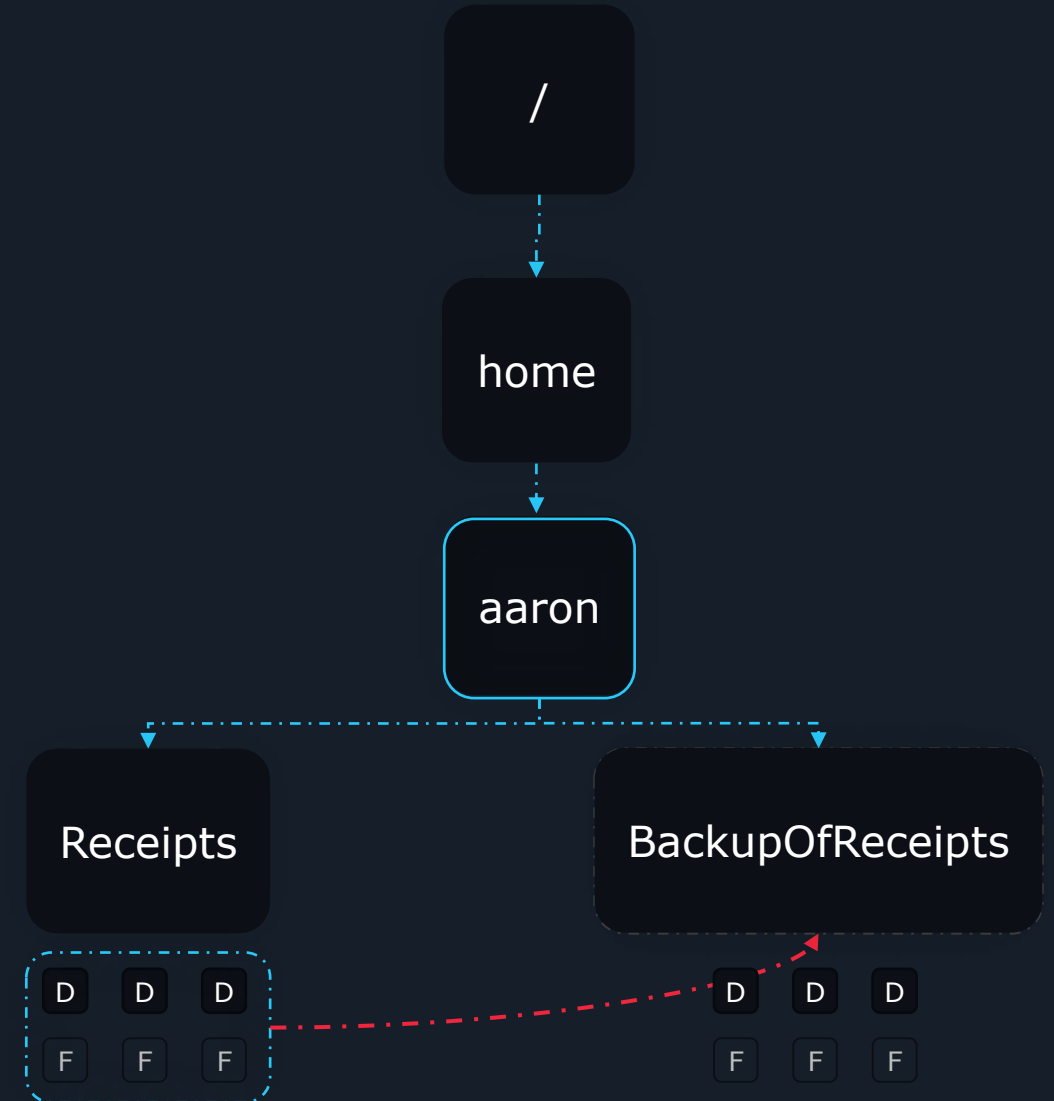
# cp  -r  [source] [dest]   recursive


$ cp -r Receipts/ BackupOfReceipts/
```

/

home

aaron

Receipts

BackupOfReceipts

D	D	D
F	F	F

D	D	D
F	F	F

Copying Directories

```
>_

# cp  -r   [source] [dest]   recursive

$ cp -r Receipts/ BackupOfReceipts/
```

/

home

aaron

Receipts   BackupOfReceipts

D   D   D   Receipts

F   F   F   D   D   D

F   F   F

```
>_
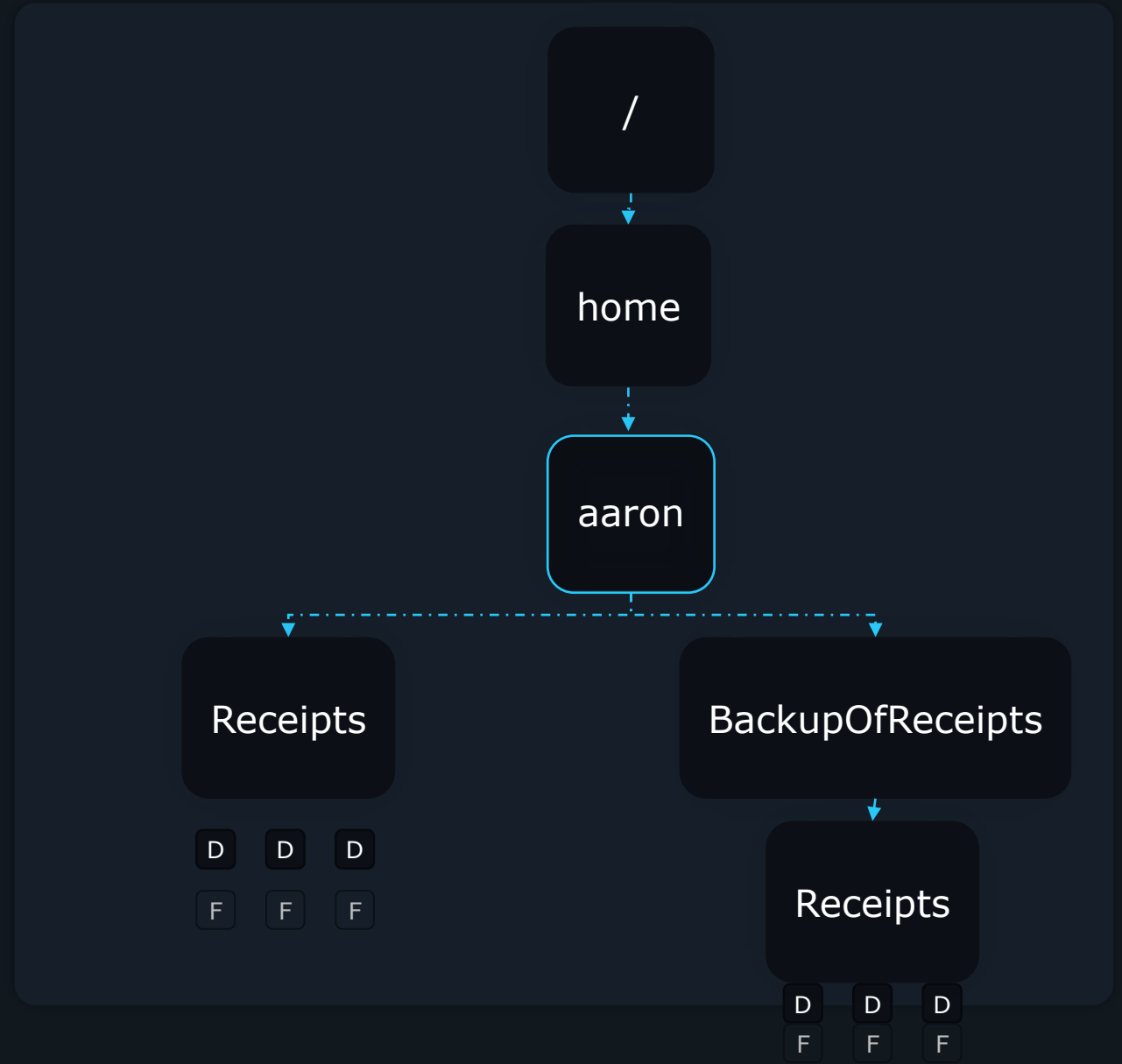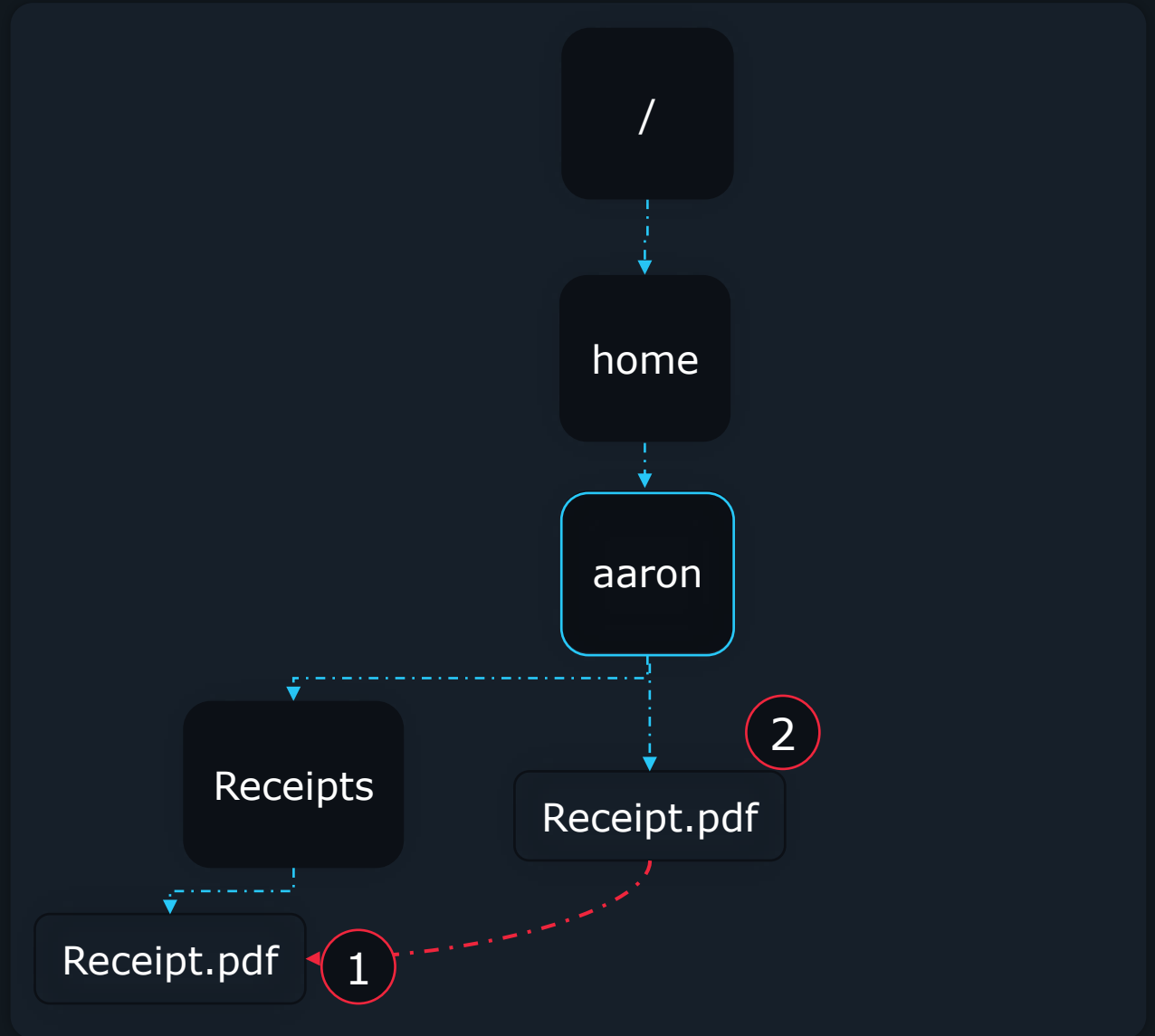
$ cp Receipt.pdf Receipts/
```

/

home

aaron

Receipts

Receipt.pdf

2

Receipt.pdf

1

```
>_
```

mv   [source] [dest]   move

$ mv Receipt.pdf Receipts/

$ mv Receipt.pdf OldReceipt.pdf

$ mv Receipts/ OldReceipts/

/

home

aaron

OldReceipts

Receipt.pdf

(1)

OldReceipt.pdf

Deleting Files and Directories

```
>_
```

```
# rm
```

remove

```
$ rm Invoice.pdf
```

```
$ rm -r Invoices/
```

/

home

aaron

Invoices

Invoice.pdf

Manage System-wide
Environment Profiles

Manage System-wide Environment Profiles

```
>_
```

```
$ printenv ══ $ env
```
```
    PATH=/home/aaron/.local/bin:/home/aaron/bin:/usr/local/bin:/usr/local/sbin
    :/usr/bin:/usr/sbin
    HISTSIZE=1000
    GJS_DEBUG_TOPICS=JS ERROR;JS LOG
    SESSION_MANAGER=local/unix:@/tmp/.ICE-unix/2260,unix/unix:/tmp/.ICE-
    unix/2260
```

```
$ HISTSIZE=2000
```

```
$ history
```
```
    1  sudo nano -w /etc/hosts
       2  ssh student@192.168.0.18
       3  ssh student@LFCS-CentOS2
       4  ls
       5  ls -laF
       6  cd .ssh
       7  ls
       8  nano -w known_hosts
       9  exit
      10  rm .ssh/known_hosts
```

```
>_
```

```
$ printenv
    PWD=/home/aaron
    SSH_ASKPASS=/usr/libexec/openssh/gnome-ssh-askpass
    HOME=/home/aaron
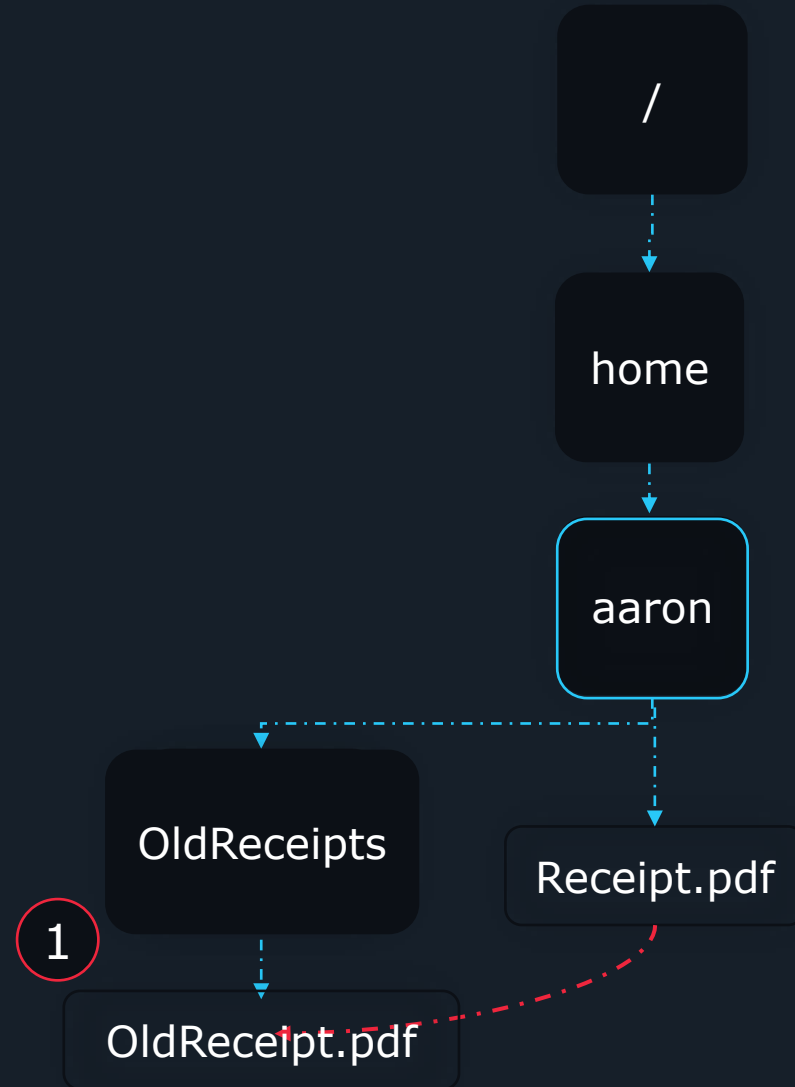

$ echo $HOME
    /home/aaron


$ touch $HOME/saved_file ══ $ touch /home/aaron/saved_file
```

Manage System-wide Environment Profiles

```
$ cat .bashrc
    # .bashrc

    # Source global definitions
    if [ -f /etc/bashrc ]; then
            . /etc/bashrc
    fi

    # User specific environment
    if ! [[ "$PATH" =~ "$HOME/.local/bin:$HOME/bin:" ]]
    then
        PATH="$HOME/.local/bin:$HOME/bin:$PATH"
    fi
    export PATH


$ sudo vim /etc/environment

$ logout

$ echo $KODEKLOUD
    https://kodekloud.com
```

```
● ● ●    environment

    KODEKLOUD=https://kodekloud.com
```

Manage System-wide Environment Profiles

```
$ sudo vim /etc/profile.d/lastlogin.sh


$ logout


$ ls
    lastlogin


$ cat lastlogin
    Your last login was at: Thursday DEC 16 11:19:27 CDT 2021
```

environment

```
echo "Your last login was at: " >
$HOME/lastlogin

date >> $HOME/lastlogin
```

Manage Template
User Environment

Manage Template User Environment

```
>_
```

```
$ sudo vim /etc/skel/README
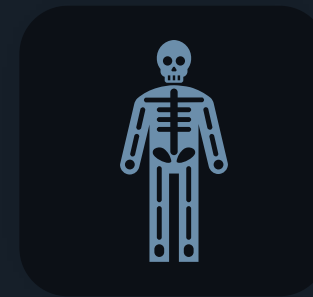

$ sudo useradd trinity


$ sudo ls -a /home/trinity
    .  ..  .bash_logout  .bash_profile  .bashrc  README


$ cat README
    Please don't run CPU-intensive processes between 8AM and 10PM.
```

README

Please don't run CPU-intensive processes between 8AM and 10PM.

Manage Template User Environment

```
>_
```

```
$ sudo vim /home/trinity/.bashrc


$ echo $PATH
  /home/trinity/.local/bin:/home/trinity/bin:/usr/local/bin:/usr/bin:/usr
  /local/sbin:/usr/sbin


$ specialtool == $ /opt/specialtool


$ sudo vim /etc/skel/.bashrc
```

.bashrc

```
PATH="$HOME/.local/bin:$HOME/bi
n:$PATH"
```

```
PATH="$HOME/.local/bin:$HOME/bin
:/opt/bin:$PATH"
```

Basic File Management: Wildcard Specifications in Commands

Types of Wildcards

* (asterisk): Represents zero, one, or more occurrences of any character

? (question mark): Represents a single occurrence of any character

[ ] (bracketed characters): Represents an occurrence of the character(s) enclosed in the square brackets

[0-9] matches all digits

```
>_
```

```
$ find /home -name *.png
```
photo.png
cat.png
frank.png

```
$ ls lpic-*.txt
```
lpic-1.txt lpic-2.txt

```
$ cp -r  animal/* forest
```

```
$ rm *ate*
```

Question Mark

```
>_
```

```
$ ls
last.txt lest.txt list.txt third.txt past.txt


$ ls l?st.txt

last.txt lest.txt list.txt


$ ls ??st.txt

last.txt lest.txt list.txt past.txt
```

```
>_
```

```
$ ls l[aef]st.txt
last.txt lest.txt

$ ls l[a-z]st.txt
last.txt lest.txt list.txt

$ ls
student-1A.txt student-2A.txt student-3.txt

$ ls student-[0-9][A-Z].txt
student-1A.txt student-2A.txt
```

```
>_

$ ls
last.txt lest.txt list.txt third.txt past.txt


$ ls [plf]?st*
last.txt lest.txt list.txt past.txt




$ ls
file1.txt file.txt file23.txt fom23.txt


$ ls f*[0-9].txt
file1.txt file23.txt fom23.txt
```

Analyze Text With
Regular Expressions

203.102.3.5

5.23

x is an integer

x is greater than 3 (x > 3)

x is less than 8 (x < 8)

x = 4, 5, or 6

Regex Operators

```
^
$
.
*
+
{}
?
|
[]
()
[^]
```

^ "The line begins with"

```
>_
```

```
$ less /etc/login.defs

    #
    # Please note that the parameters in this configuration file control the
    # behavior of the tools from the shadow-utils component. None of these
    # tools uses the PAM mechanism, and the utilities that use PAM (such as the
    # passwd command) should therefore be configured elsewhere. Refer to
    # /etc/pam.d/system-auth for more information.
    #

    # *REQUIRED*
    #   Directory where mailboxes reside, _or_ name of file, relative to the
    #   home directory.  If you _do_ define both, MAIL_DIR takes precedence.
    #   QMAIL_DIR is for Qmail
    #
    #QMAIL_DIR       Maildir
    MAIL_DIR        /var/spool/mail
    #MAIL_FILE       .mail


$ grep '^#' /etc/login.defs
```

```
$ grep -v '^#' /etc/login.defs

    MAIL_DIR    /var/spool/mail

    UMASK                  022

    HOME_MODE  0700

    PASS_MAX_DAYS          99999
    PASS_MIN_DAYS          0
    PASS_MIN_LEN           5
    PASS_WARN_AGE          7

    UID_MIN                 1000
    UID_MAX                60000
    SYS_UID_MIN              201
    SYS_UID_MAX              999

    GID_MIN                 1000
    GID_MAX                60000
    SYS_GID_MIN              201
    SYS_GID_MAX              999


    CREATE_HOME            yes
```

^ "The line begins with"

```
$ grep '^PASS' /etc/login.defs
PASS_MAX_DAYS        99999
PASS_MIN_DAYS        0
PASS_MIN_LEN         5
PASS_WARN_AGE        7
```

$ "The line ends with"

```
> _
```

$ grep '7' /etc/login.defs

```
  # 022 is the default value, but 027, or even 077, could be considered
  HOME_MODE  0700
  PASS_WARN_AGE          7
```

$ grep '7$' /etc/login.defs

```
  PASS_WARN_AGE          7
```

$ grep 'mail$' /etc/login.defs

```
  MAIL_DIR   /var/spool/mail
  #MAIL_FILE .mail
```

^PASS

mail$

. "Match any ONE character"

```
>_
```

```
$ grep -r 'c.t' /etc/
    /etc/man_db.conf:# manpath. If no catpath string is used, the catpath will default to the
    /etc/man_db.conf:# the database cache for any manpaths not mentioned below unless explicitly
    /etc/man_db.conf:# location of catpaths and the creation of database caches; it has no effect
    /etc/man_db.conf:#DEFINE          cat          cat
    /etc/man_db.conf:# directives may be given for clarity, and will be concatenated together in
    /etc/man_db.conf:# is that you only need to explicitly list extensions if you want to force a
    /etc/man_db.conf:# Range of terminal widths permitted when displaying cat pages. If the
    /etc/man_db.conf:# terminal falls outside this range, cat pages will not be created (if
    /etc/man_db.conf:# If CATWIDTH is set to a non-zero number, cat pages will always be
    /etc/man_db.conf:# NOCACHE keeps man from creating cat pages.
    /etc/nanorc:## Use cut-from-cursor-to-end-of-line by default.
    /etc/nanorc:# set cutfromcursor
    /etc/nanorc:## (The old form, 'cut', is deprecated.)
    /etc/nanorc:## double click), and execute shortcuts.  The mouse will work in the X


$ grep -wr 'c.t' /etc/
```

. "Match any ONE character"

```
>_
```

```
$ grep -wr 'c.t' /etc/
/etc/brltty/Input/mn/all.txt:Left: append to existing cut buffer from selected character
/etc/brltty/Input/mn/all.txt:Up: start new cut buffer at selected character
/etc/brltty/Input/mn/all.txt:Down: rectangular cut to selected character
/etc/brltty/Input/mn/all.txt:Right: linear cut to selected character
grep: /etc/libvirt: Permission denied
grep: /etc/wpa_supplicant/wpa_supplicant.conf: Permission denied
/etc/mime.types:application/vnd.commonspace                              csp cst
/etc/mime.types:# wav: audio/x-wav, cpt: application/mac-compactpro
/etc/mime.types:application/mac-compactpro                                   cpt
grep: /etc/sudo-ldap.conf: Permission denied
grep: /etc/sudo.conf: Permission denied
grep: /etc/sudoers: Permission denied
grep: /etc/sudoers.d: Permission denied
grep: /etc/iscsi/iscsid.conf: Permission denied
grep: /etc/firewalld: Permission denied
/etc/mcelog/triggers/cache-error-trigger:  if [ "$(cat $F)" != "0" ] ; then
/etc/smartmontools/smartd_warning.sh:  cat <<EOF
```

```
>_
```

```
$ grep '.' /etc/login.defs
```

```
SYS_UID_MIN                 201
SYS_UID_MAX                 999
#
# Min/max values for automatic gid selection in groupadd
#
GID_MIN                    1000
GID_MAX                   60000
# System accounts
SYS_GID_MIN                 201
SYS_GID_MAX                 999
#
# If defined, this command is run when removing a user.
# It should remove any at/cron/print jobs etc. owned by
# the user to be removed (passed as the first argument).
#
#USERDEL_CMD        /usr/sbin/userdel_local
#
# If useradd should create home directories for users by default
# On RH systems, we do. This option is overridden with the -m flag on
# useradd command line.
#
CREATE_HOME              yes
# This enables userdel to remove user groups if no members exist.
```

```
>_
```

```
$ grep '\.' /etc/login.defs

    # behavior of the tools from the shadow-utils component. None of these
    # passwd command) should therefore be configured elsewhere. Refer to
    # /etc/pam.d/system-auth for more information.
    #   home directory.  If you _do_ define both, MAIL_DIR takes precedence.
    #MAIL_FILE .mail
    # Default initial "umask" value used by login(1) on non-PAM enabled
    systems.
    # Default "umask" value for pam_umask(8) on PAM enabled systems.
    # home directories if HOME_MODE is not set.
    # for increased privacy. There is no One True Answer here: each sysadmin
    # must make up their mind.
    # home directories.
    # If HOME_MODE is not set, the value of UMASK is used to create the mode.
    #           PASS_MAX_DAYS        Maximum number of days a password may be
    used.
    #           PASS_MIN_DAYS        Minimum number of days allowed between
    password changes.
    #           PASS_MIN_LEN         Minimum acceptable password length.
    #           PASS_WARN_AGE        Number of days warning given before a
    password expires.
```

*: Match The Previous Element 0 Or More Times

>_

let* ➡ lettt

```
$ grep -r 'let*' /etc/
    /etc/pnm2ppa.conf:# configuration  file (/etc/pnm2ppa.conf), and not from
    configuration files
    /etc/pnm2ppa.conf:#silent 1
    /etc/pnm2ppa.conf:# (Older versions of pnm2ppa required larger left and
    right margins to avoid
    /etc/pnm2ppa.conf:# printer failure with  "flashing lights", but this
    problem is believed to
    /etc/pnm2ppa.conf:#leftmargin     10
    /etc/pnm2ppa.conf:# and color ink print cartridges.   This changes a
    little  whenever  you
    /etc/pnm2ppa.conf:# if there is a horizontal offset between right-to-left
    and left-to-right
    /etc/pnm2ppa.conf:# density of black ink used: 1 (least ink), 2 (default),
    4 (most).
    /etc/pnm2ppa.conf:# a calibration file /etc/pnm2ppa.gamma, in which case
    these
    /etc/pnm2ppa.conf:# gEnh(i) = (int) ( pow ( (double) i / 256, Gamma ) *
    256 )
    /etc/pnm2ppa.conf:# Valid choices are: a4, letter, legal:
    /etc/pnm2ppa.conf:#papersize letter    # this is the default
    /etc/pnm2ppa.conf:#papersize legal
```

*: Match The Previous Element 0 Or More Times

> _

```
$ grep -r '/.*/' /etc/   Begins with /; has 0 or more characters between; ends with a /
```

/etc/man_db.conf:# before /usr/man.
/etc/man_db.conf:MANDB_MAP   /usr/man
          /var/cache/man/fsstnd
/etc/man_db.conf:MANDB_MAP   /usr/share/man
          /var/cache/man
/etc/man_db.conf:MANDB_MAP   /usr/local/man
          /var/cache/man/oldlocal
/etc/man_db.conf:MANDB_MAP   /usr/local/share/man
          /var/cache/man/local
/etc/man_db.conf:MANDB_MAP   /usr/X11R6/man
          /var/cache/man/X11R6
/etc/man_db.conf:MANDB_MAP   /opt/man   /var/cache/man/opt
/etc/nanorc:# set quotestr "^([ ]*([#:>|}]|//))+"
/etc/nanorc:## include "/path/to/syntax_file.nanorc"
/etc/nanorc:include "/usr/share/nano/*.nanorc"
/etc/pbm2ppa.conf:# Sample configuration file for the HP720/HP820/HP1000
PPA Printers
/etc/pbm2ppa.conf:# /etc/pbm2ppa.conf
/etc/pnm2ppa.conf:# /etc/pnm2ppa.conf
/etc/pnm2ppa.conf:# configuration file (/etc/pnm2ppa.conf), and not from
configuration files
/etc/pnm2ppa.conf:# a calibration file /etc/pnm2ppa.gamma, in which case
these
/etc/mailcap:audio/*; /usr/bin/xdg-open %s

+: Match The Previous Element 1 Or More Times

> _

$ grep -r '0*' /etc/

/etc/pnm2ppa.conf:
/etc/pnm2ppa.conf:#black_ink 1
/etc/pnm2ppa.conf:#color_ink 1
/etc/pnm2ppa.conf:#cyan_ink 1
/etc/pnm2ppa.conf:#magenta_ink 1
/etc/pnm2ppa.conf:#yellow_ink 1
/etc/mailcap:###
/etc/mailcap:### Begin Red Hat Mailcap
/etc/mailcap:###
/etc/mailcap:
/etc/mailcap:audio/*; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:image/*; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:application/msword; /usr/bin/xdg-open %s
/etc/mailcap:application/pdf; /usr/bin/xdg-open %s
/etc/mailcap:application/postscript ; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:text/html; /usr/bin/xdg-open %s ; copiousoutput
/etc/subuid-:aaron:100000:65536
/etc/subuid-:bob:165536:65536
/etc/subuid-:charles:231072:65536
/etc/subuid-:david:296608:65536

+: Match The Previous Element 1 Or More Times

```
>_
```

```
$ grep -r '0*' /etc/                              0+

/etc/pnm2ppa.conf:
/etc/pnm2ppa.conf:#black_ink 1
/etc/pnm2ppa.conf:#color_ink 1
/etc/pnm2ppa.conf:#cyan_ink 1
/etc/pnm2ppa.conf:#magenta_ink 1
/etc/pnm2ppa.conf:#yellow_ink 1
/etc/mailcap:###
/etc/mailcap:### Begin Red Hat Mailcap
/etc/mailcap:###
/etc/mailcap:
/etc/mailcap:audio/*; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:image/*; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:application/msword; /usr/bin/xdg-open %s
/etc/mailcap:application/pdf; /usr/bin/xdg-open %s
/etc/mailcap:application/postscript ; /usr/bin/xdg-open %s
/etc/mailcap:
/etc/mailcap:text/html; /usr/bin/xdg-open %s ; copiousoutput
/etc/subuid-:aaron:100000:65536
/etc/subuid-:bob:165536:65536
/etc/subuid-:charles:231072:65536
```

+: Match The Previous Element 1 Or More Times

```
>_
```

0+ ➡ 000

```
$ grep -r '0+' /etc/
```

```
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP2 MENU_NEXT_ITEM
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP7 MENU_FIRST_ITEM
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP1 MENU_LAST_ITEM
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP9 MENU_PREV_SETTING
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP3 MENU_NEXT_SETTING
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KP5 MENU_PREV_LEVEL
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KPEnter PREFMENU
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KPPlus PREFSAVE
/etc/brltty/Keyboard/keypad.ktb:bind KP0+!KPMinus PREFLOAD
grep: /etc/libvirt: Permission denied
grep: /etc/wpa_supplicant/wpa_supplicant.conf: Permission denied
/etc/mime.types:application/vnd.d2l.coursepackage1p0+zip
grep: /etc/sudo-ldap.conf: Permission denied
grep: /etc/sudo.conf: Permission denied
grep: /etc/sudoers: Permission denied
grep: /etc/sudoers.d: Permission denied
grep: /etc/iscsi/iscsid.conf: Permission denied
/etc/sane.d/mustek_pp.conf:#               - cis1200+  (for Mustek 1200CP+
& OEM versions),
/etc/sane.d/mustek_pp.conf:# scanner Mustek-1200CP+ 0x378 cis1200+
/etc/sane.d/mustek_pp.conf:# scanner mustek-cis1200+ * cis1200+
/etc/sane.d/teco1.conf:scsi "RELISYS" "VM3530+" Scanner * * * 0
```

```
$ man grep
```

```
In basic regular expressions the meta-characters
?, +, {, |, (, and ) lose their special meaning;
instead use the backslashed versions \?, \+, \{,
\|, \(, and \).
```

+: Match The Previous Element 1 Or More Times

```
>_
```

```
$ grep -r '0\+' /etc/
    /etc/pnm2ppa.conf:# The setting is correct when alignments "0" are
    correct.
    /etc/pnm2ppa.conf:#colorshear     0
    /etc/pnm2ppa.conf:#blackshear     0
    /etc/pnm2ppa.conf:# 0 = no black ink.   This affects black ink bordered by
    whitespace
    /etc/pnm2ppa.conf:# (i.e., 256 times ( i*(1.0/256)) to the power Gamma ),
    /etc/pnm2ppa.conf:# where (int) i is the ppm color intensity, in the range
    0 - 255.
    /etc/pnm2ppa.conf:# the corresponding color.   Gamma = 1.0 corresponds to
    no
    /etc/pnm2ppa.conf:#GammaR 1.0      # red enhancement
    /etc/pnm2ppa.conf:#GammaG 1.0      # green enhancement
    /etc/pnm2ppa.conf:#GammaB 1.0      # blue enhancement
    /etc/pnm2ppa.conf:# which gives Gamma = 1.0 - 0.033 * GammaIdx :
    /etc/pnm2ppa.conf:#RedGammaIdx   0
    /etc/pnm2ppa.conf:#GreenGammaIdx 0
    /etc/pnm2ppa.conf:#BlueGammaIdx 0
    /etc/pnm2ppa.conf:# by default the printing sweeps are now bidirectional
    (unimode 0);
    /etc/pnm2ppa.conf:# set their values to 0 to switch off the corresponding
    ink type:
    /etc/subuid-:aaron:100000:65536
    /etc/subuid-:charles:231072:65536
```

```
$ grep -Er '0+' /etc/  ➡️  $ egrep r '0+' /etc/
    /etc/pnm2ppa.conf:# The setting is correct when alignments "0" are
    correct.
    /etc/pnm2ppa.conf:#colorshear     0
    /etc/pnm2ppa.conf:#blackshear     0
    /etc/pnm2ppa.conf:# 0 = no black ink.    This affects black ink bordered by
    whitespace
    /etc/pnm2ppa.conf:# (i.e., 256 times ( i*(1.0/256)) to the power Gamma ),
    /etc/pnm2ppa.conf:# where (int) i is the ppm color intensity, in the range
    0 - 255.
    /etc/pnm2ppa.conf:# the corresponding color.    Gamma = 1.0 corresponds to
    no
    /etc/pnm2ppa.conf:#GammaR 1.0      # red enhancement
    /etc/pnm2ppa.conf:#GammaG 1.0      # green enhancement
    /etc/pnm2ppa.conf:#GammaB 1.0      # blue enhancement
    /etc/pnm2ppa.conf:# which gives Gamma = 1.0 - 0.033 * GammaIdx :
    /etc/pnm2ppa.conf:#RedGammaIdx    0
    /etc/pnm2ppa.conf:#GreenGammaIdx 0
    /etc/pnm2ppa.conf:#BlueGammaIdx  0
    /etc/pnm2ppa.conf:# by default the printing sweeps are now bidirectional
    (unimode 0);
    /etc/pnm2ppa.conf:# set their values to 0 to switch off the corresponding
    ink type:
    /etc/subuid-:aaron:100000:65536
    /etc/subuid-:charles:231072:65536
```

{}: Previous Element Can Exist "this many" Times

> _

```
$ egrep -r '0{3,}' /etc/
```

000/09/xmldsig#
/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd: [2]
http://www.w3.org/Consortium/Legal/IPR-FAQ-20000620.html#DTD
/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd:<schema
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
targetNamespace="http://www.w3.org/2000/09/xmldsig#" version="0.1"
elementFormDefault="qualified">
grep: /etc/firewalld: Permission denied
/etc/smartmontools/smartd.conf:# Monitor 4 ATA disks connected to a 3ware
6/7/8000 controller which uses
/etc/smartmontools/smartd.conf:# Monitor 2 ATA disks connected to a 3ware
9000 controller which
/etc/smartmontools/smartd.conf:# Monitor 2 SATA (not SAS) disks connected
to a 3ware 9000 controller which
/etc/nanorc:## of tabs and spaces. 187 in ISO 8859-1 (0000BB in Unicode)
and 183 in
/etc/nanorc:## ISO-8859-1 (0000B7 in Unicode) seem to be good values for
these.
/etc/pbm2ppa.conf:# Sample configuration file for the HP720/HP820/HP1000
PPA Printers
/etc/pbm2ppa.conf:# 1000:   HP DeskJet 1000Cse,
1000Cxi

{}: Previous Element Can Exist "this many" Times

```
$ egrep -r '10{,3}' /etc/
   /etc/pnm2ppa.conf:#xoffset    160
   /etc/pnm2ppa.conf:# sweeps of the print head, adjust these in units of
   1"/600 (1 dot).
   /etc/pnm2ppa.conf:# valid blackness choices are 1 2 3 4; controls the
   /etc/pnm2ppa.conf:# density of black ink used: 1 (least ink), 2 (default),
   4 (most).
   /etc/pnm2ppa.conf:# (i.e., 256 times ( i*(1.0/256)) to the power Gamma ),
   /etc/pnm2ppa.conf:# the corresponding color.   Gamma = 1.0 corresponds to
   no
   /etc/pnm2ppa.conf:#GammaR 1.0      # red enhancement
   /etc/pnm2ppa.conf:#GammaG 1.0      # green enhancement
   /etc/pnm2ppa.conf:#GammaB 1.0      # blue enhancement
   /etc/pnm2ppa.conf:# which gives Gamma = 1.0 - 0.033 * GammaIdx :
   /etc/pnm2ppa.conf:# (unimode 1) uncomment the next line .  (The command
   line options --uni
   /etc/pnm2ppa.conf:#unimode 1
   /etc/pnm2ppa.conf:#black_ink 1
   /etc/pnm2ppa.conf:#color_ink 1
   /etc/pnm2ppa.conf:#cyan_ink 1
   /etc/pnm2ppa.conf:#magenta_ink 1
   /etc/pnm2ppa.conf:#yellow_ink 1
   /etc/subuid-:aaron:100000:65536
   /etc/subuid-:bob:165536:65536
   /etc/subuid-:charles:231072:65536
```

{}: Previous Element Can Exist "this many" Times

```
>_
```

```
$ egrep -r '0{3}' /etc/
```

/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd: [2]
http://www.w3.org/Consortium/Legal/IPR-FAQ-20000620.html#DTD
/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd:<schema
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
targetNamespace="http://www.w3.org/2000/09/xmldsig#" version="0.1"
elementFormDefault="qualified">
grep: /etc/firewalld: Permission denied
/etc/smartmontools/smartd.conf:# Monitor 4 ATA disks connected to a 3ware
6/7/8000 controller which uses
/etc/smartmontools/smartd.conf:# Monitor 2 ATA disks connected to a 3ware
9000 controller which
/etc/smartmontools/smartd.conf:# Monitor 2 SATA (not SAS) disks connected
to a 3ware 9000 controller which
/etc/nanorc:## of tabs and spaces. 187 in ISO 8859-1 (0000BB in Unicode)
and 183 in
/etc/nanorc:## ISO-8859-1 (0000B7 in Unicode) seem to be good values for
these.
/etc/pbm2ppa.conf:# Sample configuration file for the HP720/HP820/HP1000
PPA Printers
/etc/pbm2ppa.conf:# 1000:   HP DeskJet 1000Cse,
1000Cxi
/etc/pbm2ppa.conf:#version 1000
/etc/pnm2ppa.conf:#version 1000
/etc/subuid-:aaron:100000:65536

?: Make The Previous Element Optional

```
>_
```

```
$ egrep -r 'disabled?' /etc/
    t to 0 to disable polling.
    /etc/vmware-tools/tools.conf.example:# Set to true to disable the
    deviceHelper plugin.
    /etc/vmware-tools/tools.conf.example:#disabled=false
    /etc/containers/storage.conf:# Value 0% disables
    /etc/dleyna-server-service.conf:# 0 = disabled
    /etc/dleyna-server-service.conf:# You can't enable levels disabled at
    compile time
    /etc/dleyna-server-service.conf:# If netf is enabled but the list is
    empty, it behaves as disabled.
    /etc/tuned/tuned-main.conf:# Dynamicaly tune devices, if disabled only
    static tuning will be used.
    /etc/tuned/tuned-main.conf:# Recommend functionality, if disabled
    "recommend" command will be not
    /etc/enscript.cfg:# Enable / disable page prefeed.
    grep: /etc/firewalld: Permission denied
    /etc/mcelog/mcelog.conf:# An upstream bug prevents this from being
    disabled
    /etc/smartmontools/smartd.conf:#   -o VAL  Enable/disable automatic
    offline tests (on/off)
    /etc/smartmontools/smartd.conf:#   -S VAL  Enable/disable attribute
    autosave (on/off)
    /etc/smartmontools/smartd_warning.sh:# Plugin directory (disabled if
    empty)
```

{}: Previous Element Can Exist "this many" Times

```
>_
```

```
$ egrep -r '0{3,5}' /etc/ O{min,max}

000/09/xmldsig#
/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd:    [2]
http://www.w3.org/Consortium/Legal/IPR-FAQ-20000620.html#DTD
/etc/vmware-tools/vgauth/schemas/xmldsig-core-schema.xsd:<schema
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
targetNamespace="http://www.w3.org/2000/09/xmldsig#" version="0.1"
elementFormDefault="qualified">
grep: /etc/firewalld: Permission denied
/etc/smartmontools/smartd.conf:# Monitor 4 ATA disks connected to a 3ware
6/7/8000 controller which uses
/etc/smartmontools/smartd.conf:# Monitor 2 ATA disks connected to a 3ware
9000 controller which
/etc/smartmontools/smartd.conf:# Monitor 2 SATA (not SAS) disks connected
to a 3ware 9000 controller which
/etc/nanorc:## of tabs and spaces.  187 in ISO 8859-1 (0000BB in Unicode)
and 183 in
/etc/nanorc:## ISO-8859-1 (0000B7 in Unicode) seem to be good values for
these.
/etc/pbm2ppa.conf:# Sample configuration file for the HP720/HP820/HP1000
PPA Printers
/etc/pbm2ppa.conf:# 1000:                            HP DeskJet 1000Cse,
1000Cxi
```

|: Match One Thing Or The Other

>_

```
$ egrep -r 'enabled|disabled' /etc/
```

/etc/vmware-tools/tools.conf.example:#   disabled.
/etc/vmware-tools/tools.conf.example:#disabled=false
/etc/dleyna-server-service.conf:# 0 = disabled
/etc/dleyna-server-service.conf:# You can't enable levels disabled at
compile time
/etc/dleyna-server-service.conf:netf-enabled=false
/etc/dleyna-server-service.conf:# If netf is enabled but the list is
empty, it behaves as disabled.
/etc/tuned/tuned-main.conf:# Dynamicaly tune devices, if disabled only
static tuning will be used.
/etc/tuned/tuned-main.conf:# Recommend functionality, if disabled
"recommend" command will be not
/etc/tuned/tuned-main.conf:# /etc/sysctl.conf. If enabled, these sysctls
will be re-appliead
grep: /etc/firewalld: Permission denied
/etc/mcelog/mcelog.conf:# An upstream bug prevents this from being
disabled
/etc/mcelog/mcelog.conf:dimm-tracking-enabled = yes
/etc/mcelog/mcelog.conf:socket-tracing-enabled = yes
/etc/smartmontools/smartd_warning.sh:# Plugin directory (disabled if
empty)
/etc/nanorc:## To make sure an option is disabled, use "unset <option>".

|: Match One Thing Or The Other

```
$ egrep -ir 'enabled?|disabled?' /etc/
```

grep: /etc/firewalld: Permission denied
/etc/mcelog/mcelog.conf:# An upstream bug prevents this from being
disabled
/etc/mcelog/mcelog.conf:# Enable DIMM-tracking
/etc/mcelog/mcelog.conf:dimm-tracking-enabled = yes
/etc/mcelog/mcelog.conf:# Disable DIMM DMI pre-population unless supported
on your system
/etc/mcelog/mcelog.conf:socket-tracing-enabled = yes
/etc/smartmontools/smartd.conf:# First ATA/SATA or SCSI/SAS disk. Monitor
all attributes, enable
/etc/smartmontools/smartd.conf:#   -o VAL Enable/disable automatic
offline tests (on/off)
/etc/smartmontools/smartd.conf:#   -S VAL Enable/disable attribute
autosave (on/off)
/etc/smartmontools/smartd_warning.sh:# Plugin directory (disabled if
empty)
/etc/nanorc:## Please note that you must have configured nano with --
enable-nanorc
/etc/nanorc:## To make sure an option is disabled, use "unset <option>".
/etc/nanorc:## When soft line wrapping is enabled, make it wrap lines at
blanks
/etc/nanorc:## Enable vim-style lock-files. This is just to let a vim
user know you

[]: Ranges Or Sets

>_

```
$ egrep -r 'c[au]t' /etc/                    [a-z]  [0-9] [abz954]

    /etc/man_db.conf:# Range of terminal widths permitted when displaying cat
    pages. If the
    /etc/man_db.conf:# terminal falls outside this range, cat pages will not
    be created (if
    /etc/man_db.conf:# If CATWIDTH is set to a non-zero number, cat pages will
    always be
    /etc/man_db.conf:# NOCACHE keeps man from creating cat pages.
    /etc/nanorc:## Use cut-from-cursor-to-end-of-line by default.
    /etc/nanorc:# set cutfromcursor
    /etc/nanorc:## (The old form, 'cut', is deprecated.)
    /etc/nanorc:## double click), and execute shortcuts.  The mouse will work
    in the X
    /etc/nanorc:## Don't display the helpful shortcut lists at the bottom of
    the screen.
    /etc/nanorc:## (The old form, 'justifytrim', is deprecated.)
    /etc/nanorc:## Disallow file modification.  Why would you want this in an
    rcfile? ;)
    /etc/nanorc:# bind M-B cutwordleft main
    /etc/nanorc:# bind M-N cutwordright main
    /etc/mailcap:application/msword; /usr/bin/xdg-open %s
    /etc/mailcap:application/pdf; /usr/bin/xdg-open %s
    /etc/mailcap:application/postscript ; /usr/bin/xdg-open %s
```

```
$ egrep -r '/dev/.*' /etc/
/etc/smartmontools/smartd.conf:#/dev/twa0 -d 3ware,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:# On FreeBSD /dev/tws0 should be used
instead
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:#/dev/hdc,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/hdc,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/1 -a -s L/../../7/01
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/2 -a -s L/../../7/02
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/3 -a -s L/../../7/03
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/1 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/2 -a -s L/../../2/03
/etc/smartmontools/smartd_warning.sh:  hostname=`eval $cmd 2>/dev/null` ||
continue
/etc/smartmontools/smartd_warning.sh:    dnsdomain=`eval $cmd 2>/dev/null`
|| continue
/etc/smartmontools/smartd_warning.sh:  nisdomain=`eval $cmd 2>/dev/null`
|| continue
/etc/smartmontools/smartd_warning.sh:                echo "$cmd </dev/null"
/etc/smartmontools/smartd_warning.sh:                "$cmd" </dev/null
/etc/smartmontools/smartd_warning.sh:                echo "$cmd </dev/null"
/etc/smartmontools/smartd_warning.sh:                "$cmd" </dev/null
/etc/smartmontools/smartd_warning.sh:    echo "exec '$SMARTD_MAILER'
</dev/null"
```

[]: Ranges Or Sets

```
>_

$ egrep -r '/dev/[a-z]*' /etc/

/etc/smartmontools/smartd.conf:#/dev/twa0 -d 3ware,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:# On FreeBSD /dev/tws0 should be used instead
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:#/dev/hdc,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/hdc,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/1 -a -s L/../../7/01
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/2 -a -s L/../../7/02
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/3 -a -s L/../../7/03
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/1 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/2 -a -s L/../../2/03
/etc/smartmontools/smartd_warning.sh:  hostname=`eval $cmd 2>/dev/null` || continue
/etc/smartmontools/smartd_warning.sh:    dnsdomain=`eval $cmd 2>/dev/null` || continue
/etc/smartmontools/smartd_warning.sh:  nisdomain=`eval $cmd 2>/dev/null` || continue
/etc/smartmontools/smartd_warning.sh:              echo "$cmd </dev/null"
/etc/smartmontools/smartd_warning.sh:              "$cmd" </dev/null
/etc/smartmontools/smartd_warning.sh:              echo "$cmd </dev/null"
/etc/smartmontools/smartd_warning.sh:              "$cmd" </dev/null
/etc/smartmontools/smartd_warning.sh:    echo "exec '$SMARTD_MAILER' </dev/null"
```

```
$ egrep -r '/dev/[a-z]*[0-9]' /etc/
/etc/sane.d/umax_pp.conf:# /dev/ppi1, ...
/etc/sane.d/fujitsu.conf:#scsi /dev/sg1
/etc/sane.d/v4l.conf:/dev/bttv0
/etc/sane.d/v4l.conf:/dev/video0
/etc/sane.d/v4l.conf:/dev/video1
/etc/sane.d/v4l.conf:/dev/video2
/etc/sane.d/v4l.conf:/dev/video3
/etc/sane.d/gphoto2.conf:port=serial:/dev/ttyd1
/etc/sane.d/kodak.conf:#scsi /dev/sg1
/etc/sane.d/ma1509.conf:#/dev/uscanner0
/etc/sane.d/mustek_usb.conf:#/dev/usbscanner0
/etc/sane.d/snapscan.conf:# For SCSI scanners specify the generic device, e.g. /dev/sg0 on Linux.
/etc/sane.d/snapscan.conf:# /dev/sg0
grep: /etc/firewalld: Permission denied
/etc/smartmontools/smartd.conf:# For example /dev/twe0, /dev/twe1, and so on.
/etc/smartmontools/smartd.conf:#/dev/twa0 -d 3ware,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/twa0 -d 3ware,1 -a -s L/../../2/03
/etc/smartmontools/smartd.conf:# On FreeBSD /dev/tws0 should be used instead
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,0 -a -s L/../../2/01
/etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,1 -a -s L/../../2/03
```

```
>_
```

```
$ egrep -r '/dev/[a-z]*[0-9]?' /etc/
    /etc/smartmontools/smartd.conf:#/dev/twa0 -d 3ware,1 -a -s L/../../2/03
    /etc/smartmontools/smartd.conf:# On FreeBSD /dev/tws0 should be used instead
    /etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,0 -a -s L/../../2/01
    /etc/smartmontools/smartd.conf:#/dev/twl0 -d 3ware,1 -a -s L/../../2/03
    /etc/smartmontools/smartd.conf:#/dev/hdc,0 -a -s L/../../2/01
    /etc/smartmontools/smartd.conf:#/dev/hdc,1 -a -s L/../../2/03
    /etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/1 -a -s L/../../7/01
    /etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/2 -a -s L/../../7/02
    /etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/3 -a -s L/../../7/03
    /etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/1 -a -s L/../../2/01
    /etc/smartmontools/smartd.conf:#/dev/sdd -d hpt,1/4/2 -a -s L/../../2/03
    /etc/smartmontools/smartd_warning.sh:  hostname=`eval $cmd 2>/dev/null` || continue
    /etc/smartmontools/smartd_warning.sh:    dnsdomain=`eval $cmd 2>/dev/null` || continue
    /etc/smartmontools/smartd_warning.sh:  nisdomain=`eval $cmd 2>/dev/null` || continue
    /etc/smartmontools/smartd_warning.sh:                echo "$cmd </dev/null"
    /etc/smartmontools/smartd_warning.sh:                "$cmd" </dev/null
    /etc/smartmontools/smartd_warning.sh:                echo "$cmd </dev/null"
    /etc/smartmontools/smartd_warning.sh:                "$cmd" </dev/null
    /etc/smartmontools/smartd_warning.sh:   echo "exec '$SMARTD_MAILER' </dev/null"
```

(): Subexpressions

```
>_

$ egrep -r '/dev/[a-z]*[0-9]?' /etc/

/etc/sane.d/dc25.conf:#port=/dev/tty0p0
/etc/sane.d/dc25.conf:#port=/dev/tty01
/etc/sane.d/u12.conf:# device /dev/usbscanner
/etc/sane.d/u12.conf:# device /dev/usbscanner
/etc/sane.d/dmc.conf:/dev/camera
/etc/sane.d/umax.conf:/dev/scanner
/etc/sane.d/umax.conf:/dev/usbscanner
/etc/sane.d/epjitsu.conf:#usb /dev/usb/scanner0
/etc/sane.d/epjitsu.conf:#                    if echo "$nal" | grep -q
'\.nal$' - 2>/dev/null; then
/etc/sane.d/epson.conf:#usb /dev/usbscanner0
/etc/sane.d/epson.conf:#usb /dev/usb/scanner0
/etc/sane.d/umax1220u.conf:#/dev/scanner
/etc/sane.d/umax1220u.conf:#/dev/usb/scanner0
/etc/sane.d/umax_pp.conf:# device : /dev/parport0, /dev/parport1, ......
/etc/sane.d/umax_pp.conf:# on *BSD, you may provide the device name of the
ppi device: /dev/ppi0,
/etc/sane.d/umax_pp.conf:# /dev/ppi1, ...
/etc/sane.d/fujitsu.conf:#scsi /dev/sg1
/etc/sane.d/fujitsu.conf:#usb /dev/usb/scanner0
/etc/sane.d/v4l.conf:/dev/bttv0
/etc/sane.d/v4l.conf:/dev/video0
/etc/sane.d/v4l.conf:/dev/video1
/etc/sane.d/v4l.conf:/dev/video2
```

1+2*3

1+6 = 7

(1+2)*3

3*3 = 9

(): Subexpressions

```
$ egrep -r '/dev/([a-z]*[0-9]?)*' /etc/
    /etc/sane.d/coolscan3.conf:#scsi:/dev/scanner
    /etc/sane.d/coolscan3.conf:#usb:/dev/usbscanner
    /etc/sane.d/dc210.conf:port=/dev/ttyS0
    /etc/sane.d/dc210.conf:#port=/dev/ttyd1
    /etc/sane.d/dc210.conf:#port=/dev/term/a
    /etc/sane.d/dc210.conf:#port=/dev/tty0p0
    /etc/sane.d/dc210.conf:#port=/dev/tty01
    /etc/sane.d/dc240.conf:port=/dev/ttyS0
    /etc/sane.d/dc240.conf:#port=/dev/ttyd1
    /etc/sane.d/dc240.conf:#port=/dev/term/a
    /etc/sane.d/dc240.conf:#port=/dev/tty0p0
    /etc/sane.d/dc240.conf:#port=/dev/tty01
    /etc/sane.d/dc25.conf:port=/dev/ttyS0
    /etc/sane.d/dc25.conf:#port=/dev/ttyd1
    /etc/sane.d/dc25.conf:#port=/dev/term/a
    /etc/sane.d/dc25.conf:#port=/dev/tty0p0
    /etc/sane.d/dc25.conf:#port=/dev/tty01
    /etc/sane.d/u12.conf:# device /dev/usbscanner
    /etc/sane.d/u12.conf:# device /dev/usbscanner
    /etc/sane.d/dmc.conf:/dev/camera
    /etc/sane.d/umax.conf:/dev/scanner
    /etc/sane.d/umax.conf:/dev/usbscanner
```

[a-z]*[0-9]?

tty0p0

(): Subexpressions

```
>_

$ egrep -r egrep -r '/dev/(([a-z]|[A-Z])*[0-9]?)*' /etc/

/etc/sane.d/coolscan3.conf:#scsi:/dev/scanner
/etc/sane.d/coolscan3.conf:#usb:/dev/usbscanner
/etc/sane.d/dc210.conf:port=/dev/ttyS0
/etc/sane.d/dc210.conf:#port=/dev/ttyd1
/etc/sane.d/dc210.conf:#port=/dev/term/a
/etc/sane.d/dc210.conf:#port=/dev/tty0p0
/etc/sane.d/dc210.conf:#port=/dev/tty01
/etc/sane.d/dc240.conf:port=/dev/ttyS0
/etc/sane.d/dc240.conf:#port=/dev/ttyd1
/etc/sane.d/dc240.conf:#port=/dev/term/a
/etc/sane.d/dc240.conf:#port=/dev/tty0p0
/etc/sane.d/dc240.conf:#port=/dev/tty01
/etc/sane.d/dc25.conf:port=/dev/ttyS0
/etc/sane.d/dc25.conf:#port=/dev/ttyd1
/etc/sane.d/dc25.conf:#port=/dev/term/a
/etc/sane.d/dc25.conf:#port=/dev/tty0p0
/etc/sane.d/dc25.conf:#port=/dev/tty01
/etc/sane.d/u12.conf:# device /dev/usbscanner
/etc/sane.d/u12.conf:# device /dev/usbscanner
/etc/sane.d/dmc.conf:/dev/camera
/etc/sane.d/umax.conf:/dev/scanner
/etc/sane.d/umax.conf:/dev/usbscanner
```

([a-z]|[A-Z]*[0-9]?)*

```
$ egrep -r 'http[^s]' /etc/
    /etc/containers/registries.conf.d/001-rhel-
    shortnames.conf:"openshift4/ose-egress-http-proxy" =
    "registry.redhat.io/openshift4/ose-egress-http-proxy"
    /etc/containers/registries.conf.d/001-rhel-shortnames.conf:"rhel8/httpd-
    24" = "registry.redhat.io/rhel8/httpd-24"
    /etc/containers/registries.conf.d/001-rhel-shortnames.conf:"rhscl/httpd-
    24-rhel7" = "registry.access.redhat.com/rhscl/httpd-24-rhel7"
    /etc/containers/registries.conf.d/001-rhel-shortnames.conf:"ubi8/httpd-24"
    = "registry.redhat.io/ubi8/httpd-24"
    /etc/containers/registries.d/default.yaml:# For reading signatures, schema
    may be http, https, or file.
    /etc/containers/registries.d/default.yaml:#    sigstore:
    http://privateregistry.com/sigstore/
    /etc/wgetrc:# You can set the default proxies for Wget to use for http,
    https, and ftp.
    /etc/wgetrc:#https_proxy = http://proxy.yoyodyne.com:18023/
    /etc/wgetrc:#http_proxy = http://proxy.yoyodyne.com:18023/
    /etc/wgetrc:#ftp_proxy = http://proxy.yoyodyne.com:18023/
    /etc/enscript.cfg:# along with Enscript.  If not, see
    <http://www.gnu.org/licenses/>.
    grep: /etc/firewalld: Permission denied
    /etc/smartmontools/smartd.conf:# Home page is:
    http://www.smartmontools.org
```

[abc123]

[a-z]

http[^s] ➡ http https

```
$ egrep -r '/[^a-z]' /etc/                              https://regexr.com

    /etc/smartmontools/smartd_warning.sh:            cmd="$plugindir/${ad#@}"
    /etc/qemu-ga/fsfreeze-hook:for file in "$FSFREEZE_D"/* ; do
    /etc/man_db.conf:MANPATH_MAP      /usr/X11R6/bin                    /usr/X11R6/man
    /etc/man_db.conf:MANPATH_MAP      /usr/bin/X11                      /usr/X11R6/man
    /etc/man_db.conf:MANDB_MAP        /usr/X11R6/man                    /var/cache/man/X11R6
    /etc/nanorc:## Each user can save his own configuration to ~/.nanorc
    /etc/nanorc:## Don't convert files from DOS/Mac format.
    /etc/nanorc:# set quotestr "^([  ]*([#:>|}]|//))+"
    /etc/nanorc:## Fix Backspace/Delete confusion problem.
    /etc/nanorc:include "/usr/share/nano/*.nanorc"
    /etc/pbm2ppa.conf:# Sample configuration file for the HP720/HP820/HP1000 PPA Printers
    /etc/pbm2ppa.conf:# 1/4 inch margins all around (at 600 DPI)
    /etc/pbm2ppa.conf:# 1/4 inch margins all around (at 600 DPI)
    /etc/pbm2ppa.conf:# 1/4 inch margins all around (at 600 DPI)
    /etc/pnm2ppa.conf:# paper.   Units are dots (1/600 inch).   Add a positive number of dots to
    /etc/pnm2ppa.conf:# sweeps of the print head, adjust these in units of 1"/600 (1 dot).
    /etc/pnm2ppa.conf:# gEnh(i) = (int) ( pow ( (double) i / 256, Gamma ) * 256 )
```

Compress and Decompress Files

Compression And Decompression Utilities

```
>_
```

```
$ gzip file1          $ gunzip file1.gz        gzip --decompress file1.gz
  file1.gz              file1

$ bzip2 file2         $ bunzip file2.bz2       bzip2 --decompress file2.bz2
  file2.bz2            file2

$ xz file3            $ unxz file3.xz          xz --decompress file3.xz
  file3.bz2             file3
```

| 50 MB | file1 |

| 5 MB | file1.gz |

| 5 MB | file1.gz |

| 50 MB | file1 |

Compression And Decompression Utilities

```
>_
```

```
$ gzip --help
   Usage: gzip [OPTION]... [FILE]...
   Compress or uncompress FILEs (by default, compress FILES in-place).
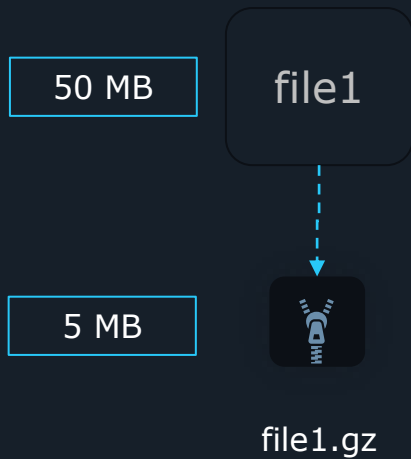
   Mandatory arguments to long options are mandatory for short options too.

      -c, --stdout      write on standard output, keep original files unchanged
      -d, --decompress  decompress
      -f, --force       force overwrite of output file and compress links
      -h, --help        give this help
      -k, --keep        keep (don't delete) input files
      -l, --list        list compressed file contents
      -L, --license     display software license
      -n, --no-name     do not save or restore the original name and timestamp
      -N, --name        save or restore the original name and timestamp
      -q, --quiet       suppress all warnings
      -r, --recursive   operate recursively on directories
          --rsyncable   make rsync-friendly archive
      -S, --suffix=SUF  use suffix SUF on compressed files
          --synchronous synchronous output
      -t, --test        test compressed file integrity
      -v, --verbose     verbose mode
      -V, --version     display version number
```

```
$ gzip --keep file1
   file1        file1.gz


$ bzip2 --keep file2
   file2        file2.bz2


$ xz --keep file3
   file3        file3.xz


$ gzip --list file1
   compressed   uncompressed   ratio name
   71           78             39.7% file1
```

Compression And Decompression Utilities

```
>_
```

```
$ zip archive file1  =  $ zip archive.zip file1
   adding: file1 (deflated 40%)


$ zip -r archive.zip Pictures/                              -r = recursively
   adding: Pictures/ (stored 0%)
   adding: Pictures/family_dog.jpg (stored 0%)


$ unzip archive.zip
   Archive:  archive.zip
   replace file1? [y]es, [n]o, [A]ll, [N]one, [r]ename: N
```

```
>_
```

```
$ tar --create --file archive.tar file1

$ gzip archive.tar
    archive.tar.gz

$ gzip --keep archive.tar
    archive.tar          archive.tar.gz

$ tar --create --gzip --file archive.tar.gz file1   ➡   $ tar czf archive.tar.gz file1

$ tar --create --bzip2 --file archive.tar.bz2 file1   ➡   $ tar cjf archive.tar.bz2 file1

$ tar --create --xz --file archive.tar.xz file1   ➡   $ tar cJf archive.tar.xz file1

$ tar --create --autocompress --file archive.tar.gz file1

$ tar caf archive.xz file1

$ tar --extract --file  archive.tar.gz

$ tar xf archive.tar.gz file1
```

Backup to a Remote System

Syncing Two Directories

```
>_
```

```
$ rsync -a Pictures/ aaron@9.9.9.9:/home/aaron/Pictures/
```

```
$ rsync -a aaron@9.9.9.9:/home/aaron/Pictures/ Pictures/
```

```
$ rsync -a Pictures/ /Backups/Pictures/
```

rsync = remote synchronization

Remote Server
/home/aaron/Pictures

SSH daemon

Local Server
Pictures/

Disk Imaging

```
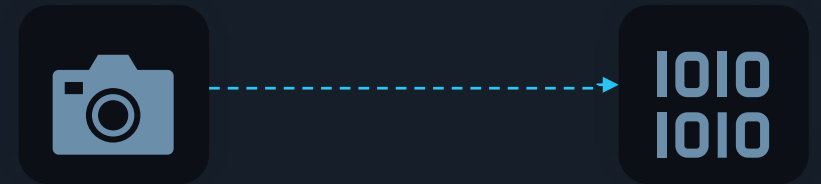>_
```

```
$ sudo dd if=/dev/vda of=diskimage.raw bs=1M status=progress

  1340080128 bytes (1.3GB, 1.2GB) copied, 3s, 432 MB/s


$ sudo dd if=diskimage.raw of=/dev/vda bs=1M status=progress

  1340080128 bytes (1.3GB, 1.2GB) copied, 3s, 432 MB/s
```

Redirecting Input and Output

```
>_
```

```
$ cat file.txt

    6
    5
    1
    3
    4
    2

$ sort file.txt

    1
    2
    3
    4
    5
    6

$ sort file.txt > sortedfile.txt

$ cat sortedfile.txt

    1
    2
    3
    4
    5
    6
```

```
> file_name #Redirect Output
```

Redirecting Output

```
>_

$ date
    Mon Nov  8 18:50:25 CST 2021

$ date > file.txt

$ date > file.txt

$ date > file.txt

$ date > file.txt

$ date > file.txt

$ cat file.txt
    Mon Nov  8 18:50:30 CST 2021
```

> file_name #Redirect & Overwrite

Redirecting Output

```
>_
```

```
$ date >> file.txt

$ date >> file.txt

$ date >> file.txt

$ date >> file.txt

$ date >> file.txt                          >> file_name #Redirect & Append

$ cat file.txt
    Mon Nov  8 18:50:30 CST 2021
    Mon Nov  8 18:50:31 CST 2021
    Mon Nov  8 18:50:32 CST 2021
    Mon Nov  8 18:50:33 CST 2021
    Mon Nov  8 18:50:34 CST 2021
    Mon Nov  8 18:50:35 CST 2021
```

```
>_
```

date > file.txt

date 1> file.txt

stdin, stdout, and stderr

file.txt

stdin
<
standard input

sort

stdout
1>
standard output

terminal

stderr
2>
standard error

errors.txt

<file.txt

2>errors.txt

>file.txt or 1>file.txt

Redirecting Errors

```
>_
```

```
$ grep -r '^The' /etc/
```

grep: /etc/cups/ssl: Permission denied
grep: /etc/cups/subscriptions.conf.O: Permission denied
grep: /etc/cups/subscriptions.conf: Permission denied
grep: /etc/ssh/sshd_config: Permission denied
grep: /etc/chrony.keys: Permission denied
grep: /etc/brlapi.key: Permission denied
/etc/brltty/Input/tn/all.txt:The two keys at the left
rear (2 columns, 1 row):
/etc/brltty/Input/tn/all.txt:The four keys at the left
middle (cross):
/etc/brltty/Input/tn/all.txt:The six keys at the left
front (2 columns, 3 row):
/etc/brltty/Input/tn/all.txt:The one key at the right
rear (1 column, 1 row):
/etc/brltty/Input/tn/all.txt:The two keys at the right
rear (1 column, 2 rows):
/etc/brltty/Input/tn/all.txt:The four keys at the right
rear (1 column, 4 rows):
/etc/brltty/Input/tn/all.txt:The twelve keys of the
numeric pad (3 columns, 4 rows):
grep: /etc/libvirt: Permission denied
grep: /etc/wpa_supplicant/wpa_supplicant.conf:
Permission denied
grep: /etc/sudo-ldap.conf: Permission denied

```
$ grep -r '^The' /etc/ 2>/dev/null
```

/etc/brltty/Input/tn/all.txt:The two keys at the left
rear (2 columns, 1 row):
/etc/brltty/Input/tn/all.txt:The four keys at the left
middle (cross):
/etc/brltty/Input/tn/all.txt:The six keys at the left
front (2 columns, 3 row):
/etc/brltty/Input/tn/all.txt:The one key at the right
rear (1 column, 1 row):
/etc/brltty/Input/tn/all.txt:The two keys at the right
rear (1 column, 2 rows):
/etc/brltty/Input/tn/all.txt:The four keys at the right
rear (1 column, 4 rows):
/etc/brltty/Input/tn/all.txt:The twelve keys of the
numeric pad (3 columns, 4 rows):

```
>_
```

```
$ grep -r '^The' /etc/ 1>output.txt 2>errors.txt          overwrite

$ grep -r '^The' /etc/ 1>>output.txt 2>>errors.txt          append
```

>_

```
$ grep -r '^The' /etc/
    grep: /etc/cups/ssl: Permission denied
    grep: /etc/cups/subscriptions.conf.O: Permission denied
    grep: /etc/cups/subscriptions.conf: Permission denied
    grep: /etc/ssh/sshd_config: Permission denied
    grep: /etc/chrony.keys: Permission denied
    grep: /etc/brlapi.key: Permission denied
    /etc/brltty/Input/tn/all.txt:The two keys at the left
    rear (2 columns, 1 row):
    /etc/brltty/Input/tn/all.txt:The four keys at the left
    middle (cross):
    /etc/brltty/Input/tn/all.txt:The six keys at the left
    front (2 columns, 3 row):
    /etc/brltty/Input/tn/all.txt:The one key at the right
    rear (1 column, 1 row):
    /etc/brltty/Input/tn/all.txt:The two keys at the right
    rear (1 column, 2 rows):
    /etc/brltty/Input/tn/all.txt:The four keys at the right
    rear (1 column, 4 rows):
    /etc/brltty/Input/tn/all.txt:The twelve keys of the
    numeric pad (3 columns, 4 rows):
    grep: /etc/libvirt: Permission denied
    grep: /etc/wpa_supplicant/wpa_supplicant.conf:
    Permission denied
    grep: /etc/sudo-ldap.conf: Permission denied
```

```
$ grep -r '^The' /etc/ > all_output.txt 2>&1

$ grep -r '^The' /etc/ 1>all_output.txt 2>&1

$ grep -r '^The' /etc/ 2>&1 1>all_output.txt
    grep: /etc/cups/classes.conf: Permission denied
    grep: /etc/cups/cups-files.conf: Permission denied
    grep: /etc/cups/cups-files.conf.default: Permission denied
    grep: /etc/cups/cupsd.conf: Permission denied
    grep: /etc/cups/cupsd.conf.default: Permission denied
    grep: /etc/cups/printers.conf: Permission denied
    grep: /etc/cups/snmp.conf.default: Permission denied
    grep: /etc/cups/ssl: Permission denied
    grep: /etc/cups/subscriptions.conf.O: Permission denied
    grep: /etc/cups/subscriptions.conf: Permission denied
    grep: /etc/ssh/sshd_config: Permission denied
    grep: /etc/ssh/ssh_host_ecdsa_key: Permission denied
    grep: /etc/ssh/ssh_host_ed25519_key: Permission denied
    grep: /etc/ssh/ssh_host_rsa_key: Permission denied
    grep: /etc/nftables: Permission denied
    grep: /etc/audit: Permission denied
    grep: /etc/gssproxy/99-nfs-client.conf: Permission denied
```

Redirecting Input

```
>_
```

$ sort file.txt   from file

$ sendemail someone@example.com   from keyboard

    Hi Someone,

    How are you today?
    ...
    Talk to you soon

    Bye

$ sendemail someone@example.com < emailcontent.txt $ from file

```
>_
```

```
$ sort <<EOF
    > 6
    > 3
    > 2
    > 5
    > 1
    > 4
    > EOF
    1
    2
    3
    4
    5
    6
```

Here document or heredoc

```
$ bc <<<1+2+3+4
    10
```

Here string

Piping

```
>_
```

```
$ grep -v '^#' /etc/login.defs            $ grep -v '^#' /etc/login.defs | sort

    PASS_MAX_DAYS        99999                CREATE_HOME          yes
    PASS_MIN_DAYS        0                    ENCRYPT_METHOD SHA512
    PASS_MIN_LEN         5                    GID_MAX              60000
    PASS_WARN_AGE        7                    GID_MIN              1000
                                              HOME_MODE  0700
    UID_MIN              1000                  MAIL_DIR   /var/spool/mail
    UID_MAX              60000                 PASS_MAX_DAYS        99999
    SYS_UID_MIN          201                   PASS_MIN_DAYS        0
    SYS_UID_MAX          999                   PASS_MIN_LEN         5
                                              PASS_WARN_AGE        7
    GID_MIN              1000                  SYS_GID_MAX          999
    GID_MAX              60000                 SYS_GID_MIN          201
    SYS_GID_MIN          201                   SYS_UID_MAX          999
    SYS_GID_MAX          999                   SYS_UID_MIN          201
                                              UID_MAX              60000
                                              UID_MIN              1000
    CREATE_HOME          yes                   UMASK                022
                                              USERGROUPS_ENAB yes
    USERGROUPS_ENAB yes

    ENCRYPT_METHOD SHA512
```

```
>_
```

```
$ grep -v '^#' /etc/login.defs | sort    $ grep -v '^#' /etc/login.defs | sort | column -t
    CREATE_HOME          yes                  CREATE_HOME       yes
    ENCRYPT_METHOD SHA512                      ENCRYPT_METHOD    SHA512
    GID_MAX                    60000          GID_MAX           60000
    GID_MIN                     1000          GID_MIN           1000
    HOME_MODE  0700                           HOME_MODE         0700
    MAIL_DIR    /var/spool/mail               MAIL_DIR          /var/spool/mail
    PASS_MAX_DAYS      99999                  PASS_MAX_DAYS     99999
    PASS_MIN_DAYS      0                      PASS_MIN_DAYS     0
    PASS_MIN_LEN       5                      PASS_MIN_LEN      5
    PASS_WARN_AGE      7                      PASS_WARN_AGE     7
    SYS_GID_MAX                999            SYS_GID_MAX       999
    SYS_GID_MIN                201            SYS_GID_MIN       201
    SYS_UID_MAX                999            SYS_UID_MAX       999
    SYS_UID_MIN                201            SYS_UID_MIN       201
    UID_MAX                60000              UID_MAX           60000
    UID_MIN                 1000              UID_MIN           1000
    UMASK              022                    UMASK             022
    USERGROUPS_ENAB yes                       USERGROUPS_ENAB   yes
```

Basic File Management: cpio

cpio

```
> _

$ ls | cpio -o > archive.cpio

$ cpio -id < archive.cpio
```

cpio = Copy In, Copy Out

.cpio or .tar files

Copying files to archives

Extracting files from archives

Command Substitution

```
>_

$ mkdir `date +%Y+%m+%d`

$ ls
2022-12-13

$ rmdir 2022-12-13

$ mkdir $(date +%Y+%m+%d)

$ ls
2022-12-13

$ OS=`uname -o`

$ echo $OS
GNU/Linux
```

Command Substitution **=**

Using the output of one command as an argument to another command.

Backquotes: `` Normally located on the same key as ~ on English keyboards

$()

Command Substitution

```
>_
```

```
$ find /usr/share/icons -name 'debian*' | xargs identify -format "%f: %wx%h\n"
debian-swirl.svg: 48x48
debian-swirl.png: 22x22
debian-swirl.png: 32x32
debian-swirl.png: 256x256
debian-swirl.png: 48x48
debian-swirl.png: 16x16
debian-swirl.png: 24x24
debian-swirl.svg: 48x48
```

```
$ find /usr/share/icons -name 'debian*' | xargs -n 1 identify -format "%f: %wx%h\n"
```

```
$ find /usr/share/icons -name 'debian*' | xargs -L 3 identify -format "%f: %wx%h\n"
```

Command Substitution

```
>_
```

```
$ find . -name '*avi' -print0 -name '*mp4' -print0 -name '*mkv' -print0 | xargs -0 du | sort -n
```

```
$ find . -mindepth 2 -name '*avi' -print0 -o -name '*mp4' -print0 -o -name '*mkv' -print0 | xargs -0 -I PATH mv PATH ./
```

Using GNU Screen

Terminal Multiplexers

> Multiplexers allow multiple inputs connected to a single output.

> Any successful invocation results in at least a session and includes at least a window. Windows contain programs.

> Windows can be split into regions or panes. Increases productivity when using programs simultaneously.

> Ease of control: most commands use a key combination. Consists of a command prefix and letter.

> Sessions can detach from their current terminal.

> Provide features like socket connections and copy mode.

> Highly customizable.

```
> _

$ screen

GNU Screen version 4.05.00 (GNU) 10-Dec-16
Copyright (c) 2010 Juergen Weigert, Sadrul
Habib Chowdhury
Copyright (c) 2008, 2009 Juergen Weigert,
Michael Schroeder, Micah Cowan, Sadrul
Habib Chowdhury
Copyright (c) 1993-2002, 2003, 2005, 2006, 2007
Juergen Weigert, Michael Schroeder
Copyright (c) 1987 Oliver Laumann
(...)



$

0*$ bash
```

SPACE   OR   ENTER

CTRL + a - w

```
>_
```

```
$ ps

  PID TTY TIME CMD
  974 pts/2 00:00:00 bash
  981 pts/2 00:00:00 ps




0-$ bash        1*$ bash




Set window's title to: ps
```

CTRL	+	a	-	c

CTRL	+	a	-	w

CTRL	+	a	-	A

```
>_
$ screen -t yetanotherwindow




Num Name              Flags
0   bash              $
1   ps                $
2   yetanotherwindow
```

CTRL	+	a	-	n
CTRL	+	a	-	p
CTRL	+	a	-	Number
CTRL	+	a	-	"

| UP | DOWN | ENTER |

GNU Screen: Windows

```
>_
 Really kill this window [y/n]
Window 0 (bash) killed.
```

CTRL + a - k

```
>_
1 ps                                                    --
```

```
$ ps                                            $
  PID TTY TIME CMD
 1020 pts/2 00:00:00 bash
 1033 pts/2 00:00:00 ps
$ screen -t yetanotherwindow
 1 ps                                           2
yetanotherwindow
```

CTRL	+	a	-	S

CTRL	+	a	-	|

CTRL	+	a	-	TAB

CTRL	+	a	-	2

GNU Screen: Regions

Move between regions:

CTRL + a - TAB

Terminate all regions except current:

CTRL + a - Q

Terminate current region:

CTRL + a - X

Terminating a region does not terminate its window.

```
>_
```

```
$ screen -ls

  There is a screen on:
    1037.pts-0.debian (08/24/19 13:53:35)
(Attached)
1 Socket in /run/screen/S-carol.


$ screen -S "second session"


$ screen -ls

There are screens on:
    1090.second session (08/24/19 14:38:35)
(Attached)
    1037.pts-0.debian (08/24/19 13:53:36)
(Attached)
2 Sockets in /run/screen/S-carol.
```

GNU Screen: Sessions

```
>_
```

```
$ screen -S 1037 -X quit
```

```
$ screen -ls
```

```
There is a screen on:
    1090.second session (08/24/19 14:38:35)
(Detached)
1 Socket in /run/screen/S-carol.
```

```
>_
```
[detached from 1090.second session]
$

$ screen -r

$ screen -ls

There is a screen on:
    1090.second session (08/24/19 14:38:35)
(Attached)
1 Socket in /run/screen/S-carol.

CTRL + a - d

GNU Screen: Reattaching

```
>_
```

```
$ screen -d -r
```
Reattach. Detach first, if necessary

```
$ screen -d -R
```
Same as -d -r. Create session if necessary.

```
$ screen -d -RR
```
Same as -d -r. Use the first session.

```
$ screen -D -r
```
Reattach. Detach first and logout remotely.

```
$ screen -D -R
```
Reattach if running. Create and notify.

```
$ screen -D -RR
```
Same as -D -R. Stronger.

```
$ screen -d -m
```
Start in detached mode.

```
$ screen -D -m
```
Same as -d -m. Does not fork to new process.

GNU Screen: Scrollback Mode

Enter scrollback mode: CTRL + a - [

Move to the text you want to copy: UP DOWN

Mark the beginning: SPACE

Move to the end: UP DOWN

Mark the end: SPACE

Paste: CTRL + a -]

GNU Screen: Customization

```
>_
$ sudo vi /etc/screnrc

$ vi ~/.screenrc
```

SCREEN SETTINGS

SCREEN KEYBINDINGS

TERMINAL SETTINGS

STARTUP SCREENS

Using tmux

tmux

- Released in 2007.

- Client-server model. Server supplies sessions and sessions supply windows. Multiple clients can share windows.

- Interactive selection of sessions, windows, and clients via menus.

- The same window can be linked to multiple sessions.

- Both vim and Emacs key layouts.

- UTF-8 and 256-color terminal support.

```
>_
```

$ tmux

[0] 0:bash*   "debian" 18:53
27-Aug-19

$ tmux new -s "LPI" -n "Window zero"

[LPI] 0:Window zero*   "debian" 19:01
27-Aug-19

```
>_
```

[LPI] 0:Window zero- 1:bash*   "debian" 19:02
27-Aug-19

(rename-window) Window one

 (0) 0: Window zero- "debian"
 (1) 1: Window one* "debian"

CTRL	+	b	-	c

CTRL	+	b	-	,	ENTER

CTRL	+	b	(-	w	UP/DOWN

CTRL	+	b	-	n

CTRL	+	b	-	p

```
>_
```

kill-window Window one? (y/n)

$ man tmux

CTRL	+	b	-	NUMBER
CTRL	+	b	-	&
CTRL	+	b	-	f
CTRL	+	b	-	.

```
Tasks: 93 total, 1 running, 92 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.0 us, 0.0 sy, 0.0 ni,100.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 4050960 total, 3730920 free, 114880 used, 205160 buff/cache
KiB Swap: 4192252 total, 4192252 free, 0 used. 3716004 avail Mem
  PID USER PR NI VIRT RES SHR S %CPU %MEM TIME+ COMMAND
 1340 carol 20 0 44876 3400 2800 R 0.3 0.1 0:00.24 top
    1 root 20 0 139088 6988 5264 S 0.0 0.2 0:00.50 systemd
    2 root 20 0 0 0 0 S 0.0 0.0 0:00.00 kthreadd
    3 root 20 0 0 0 0 S 0.0 0.0 0:00.04 ksoftirqd/0
    4 root 20 0 0 0 0 S 0.0 0.0 0:01.62 kworker/0:0
    5 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 kworker/0:0H
7 root 20 0 0 0 0 S 0.0 0.0 0:00.06 rcu_sched
    8 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcu_bh
    9 root rt 0 0 0 0 S 0.0 0.0 0:00.00 migration/0
   10 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 lru-add-drain
   11 root rt 0 0 0 0 S 0.0 0.0 0:00.01 watchdog/0
   12 root 20 0 0 0 0 S 0.0 0.0 0:00.00 cpuhp/0
$
_____
_____
_____
$
[LPI] 0:Window zero- 1:Window one* "debian"
19:05 27-Aug-19
```

CTRL + b - "

CTRL + b - %

```
>_
```

```
       1 root 20 0 139088 6988 5264 S 0.0 0.2 0:00.50 systemd

       2 root 20 0 0 0 0 S 0.0 0.0 0:00.00 kthreadd

       3 root 20 0 0 0 0 S 0.0 0.0 0:00.04 ksoftirqd/0
       4 root 20 0 0 0 0 S 0.0 0.0 0:01.62 kworker/0:0
       5 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 kworker/0:0H
       7 root 20 0 0 0 0 S 0.0 0.0 0:00.06 rcu_sched
       8 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcu_bh
       9 root rt 0 0 0 0 S 0.0 0.0 0:00.00 migration/0

      10 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 lru-add-drai
n
      11 root rt 0 0 0 0 S 0.0 0.0 0:00.01 watchdog/0

      12 root 20 0 0 0 0 S 0.0 0.0 0:00.00 cpuhp/0

$
_____
___|___
_____
$
[LPI] 0:Window zero- 1:Window one* "debian"
19:05 27-Aug-19
```

$

tmux: Panes

```
>_

kill-pane 1? (y/n)
```

CTRL + b - x

tmux: Panes

Move between panes: `CTRL` + `b` - `ARROW`

Move to last active pane: `CTRL` + `b` - `;`

Resize pane by one line: `CTRL` + `b` - `CTRL` + `ARROW`

Resize pane b five lines: `CTRL` + `b` - `ALT` + `ARROW`

tmux: Panes

Swap to previous pane:	CTRL	+	b	-	{
Swap to next pane:	CTRL	+	b	-	}
Zoom in/out panel:	CTRL	+	b	-	z
Fancy clock:	CTRL	+	b	-	t
Turn pane into window:	CTRL	+	b	-	!

```
>_
```

(0) + LPI: 2 windows (attached)

`$ tmux ls`

LPI: 2 windows (created Tue Aug 27 19:01:49 2019) [158x39] (attached)

`:new`

[2] 0:bash*   "debian" 19:15
27-Aug-19

CTRL + b - s

CTRL + b ENTER

```
>_
```

(rename-session) Second Session

0) + LPI: 2 windows
(1) + Second Session: 1 windows (attached)

```
$ tmux kill-session -t "Second Session"

[exited]


$
```

CTRL + b - $ ENTER

CTRL + b - s

UP/DOWN   ENTER

```
>_

$ tmux ls

LPI: 2 windows (created Tue Aug 27 19:01:49 2019) [158x39]


$ tmux a




[exited]


$
```

| CTRL | + | b | - | d |

| CTRL | + | b | - | D |

| CTRL | + | b | - | r |

tmux: Scrollback Mode

Enter scrollback mode: CTRL + b — [

Move to the text you want to copy: UP   DOWN

Mark the beginning: CTRL + b — SPACE

Move to the end: UP   DOWN

Mark the end: SPACE

Paste: ALT + W

tmux: Customization

```
$ sudo vi /etc/tmux.conf

$ vi ~/.tmux.conf
```

/etc/tmux.conf

```
# Change the prefix key to C-a
set -g prefix C-a
unbind C-b
bind C-a send-prefix




# Some extra key bindings to select higher
numbered windows
bind F1 selectw -t:10
bind F2 selectw -t:11
bind F3 selectw -t:12
```

Nano and Emacs

Nano

GNU
NANO

undo/redo / syntax coloring

/ interactive search-and-replace

/ auto-indentation / line numbers

/ word completion / file locking

/ backup files / internationalization support

GNU
NANO

/ VI

CTRL

META

Nano

Start a new session: CTRL + 6

Copy selection: META + 6

Cut selection: CTRL + K

Paste: CTRL + U

Nano

Undo: META   +   U

Redo: META   +   E

Replace text: CTRL   +   \

Spell-check: CTRL   +   T

- Text is inserted by typing, as in nano. Navigation is via commands, as in vi.

- Also an IDE, capable of compiling, running, and testing programs.

- Can be configured as an email, news, or RSS client.

Configure the Standard Editor

SysVinit

```
>_

$ export EDITOR=nano

$ vi ~/.bash_profile
```

● ● ● ~/.bash_profile

EDITOR=nano

Demo
List, Create, Delete,
and Modify Physical Storage Partitions

Physical Storage Partitions

```
>_
```

```
$ lsblk

NAME         MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda            8:0    0   20G  0 disk
├─vda1         8:1    0    1G  0 part /boot
└─vda2         8:2    0   19G  0 part
  ├─cs-root  253:0    0   17G  0 lvm  /
  └─cs-swap  253:1    0    2G  0 lvm  [SWAP]
```

block devices

vda
  vda1
  vda2
vdb
  vdb1
  vdb2
  vdb3
vdc
  vdc1

Physical Storage Partitions

```
>_
```

```
$ lsblk

NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda            8:0    0   20G  0 disk
├─vda1         8:1    0    1G  0 part /boot
└─vda2         8:2    0   19G  0 part
  ├─cs-root  253:0    0   17G  0 lvm  /
  └─cs-swap  253:1    0    2G  0 lvm  [SWAP]




$ fdisk


$ cfdisk
```

/dev/

/dev/vda1

Demo
Create and Configure
File Systems

Create and Configure File Systems

```
>_
```

```
$ sudo mkfs.xfs /dev/vdb1                          make filesystem
```

```
$ sudo mkfs.ext4 /dev/vdb1
```

Configure Systems to
Mount Filesystems At or During Boot

```
>_
```

```
$ ls /mnt/

$ sudo mount /dev/vdb1 /mnt/

$ sudo touch /mnt/testfile

$ ls -l /mnt/
  -rw-rw-r--. 1 aaron aaron      30 Jan 31 14:30 testfile

$ lsblk

  NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
  vda           8:0    0   20G  0 disk
  ├─vda1        8:1    0    1G  0 part /boot
  └─vda2        8:2    0   19G  0 part
    ├─cs-root 253:0    0   17G  0 lvm  /
    └─cs-swap 253:1    0    2G  0 lvm  [SWAP]
  vdb          8:16    0   10G  0 disk
  ├─vdb1       8:17    0    4G  0 part
  ├─vdb2       8:18    0    4G  0 part
  └─vdb3       8:19    0    2G  0 part /mnt
```

```
>_
```

```
$ sudo umount /mnt/


$ lsblk

NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda           8:0    0   20G  0 disk
├─vda1        8:1    0    1G  0 part /boot
└─vda2        8:2    0   19G  0 part
  ├─cs-root 253:0    0   17G  0 lvm  /
  └─cs-swap 253:1    0    2G  0 lvm  [SWAP]
vdb          8:16    0   10G  0 disk
├─vdb1       8:17    0    4G  0 part
├─vdb2       8:18    0    4G  0 part
└─vdb3       8:19    0    2G  0 part


$ ls /mnt/
```

Mount Filesystems At or During Boot

```
>_
```

```
$ lsblk

   NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
   vda           8:0    0   20G  0 disk
   ├─vda1        8:1    0    1G  0 part /boot
   └─vda2        8:2    0   19G  0 part
     ├─cs-root 253:0    0   17G  0 lvm  /
     └─cs-swap 253:1    0    2G  0 lvm  [SWAP]
   vdb          8:16    0   10G  0 disk
   ├─vdb1       8:17    0    4G  0 part
   ├─vdb2       8:18    0    4G  0 part
   └─vdb3       8:19    0    2G  0 part

$ sudo mkdir /mybackups/
```

Mount Filesystems At or During Boot

```
$ sudo vim /etc/fstab


$ sudo systemctl daemon-reload
```

/etc/fstab

```
/dev/mapper/cs-root    /                    xfs     defaults    0 0

/dev/vdb1    /mybackups                      xfs     defaults    0 2

/dev/vdb2    /mybackups                      etx4    defaults    0 2


# After editing this file, run 'systemctl daemon-reload' to update systemd
# units generated from this file.
```

```
>_
```

```
$ ls /mybackups/
```

```
$ lsblk

   NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
   vda          8:0     0   20G  0 disk
   ├─vda1       8:1     0    1G  0 part /boot
   └─vda2       8:2     0   19G  0 part
     ├─cs-root 253:0    0   17G  0 lvm  /
     └─cs-swap 253:1    0    2G  0 lvm  [SWAP]
   vdb          8:16    0   10G  0 disk
   ├─vdb1       8:17    0    4G  0 part
   ├─vdb2       8:18    0    4G  0 part
   └─vdb3       8:19    0    2G  0 part
```

Mount Filesystems At or During Boot

```
>_

$ sudo systemctl reboot


$ ls -l /mybackups/

 -rw-rw-r--. 1 aaron aaron       30 Jan 31 14:30 testfile



$ lsblk

    NAME         MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
    vda           8:0    0   20G  0 disk
    ├─vda1        8:1    0    1G  0 part /boot
    └─vda2        8:2    0   19G  0 part
      ├─cs-root 253:0    0   17G  0 lvm  /
      └─cs-swap 253:1    0    2G  0 lvm  [SWAP]
    vdb           8:16   0   10G  0 disk
    ├─vdb1        8:17   0    4G  0 part
    ├─vdb2        8:18   0    4G  0 part /mybackups
    └─vdb3        8:19   0    2G  0 part
```

> _

```
$ man fstab
FSTAB(5)                              File Formats                              FSTAB(5)

NAME
      fstab - static information about the filesystems

SYNOPSIS
      /etc/fstab

DESCRIPTION
      The file fstab contains descriptive information about the filesystems the system can mount.  fstab
      is only read by programs, and not written; it is the duty of the system administrator to  properly
      create  and  maintain  this  file.   The  order  of records in fstab is important because fsck(8),
      mount(8), and umount(8) sequentially iterate through fstab doing their thing.

      Each filesystem is described on a separate line.  Fields on each line are  separated  by  tabs  or
      spaces.  Lines starting with '#' are comments.  Blank lines are ignored.

      The following is a typical example of an fstab entry:

            LABEL=t-home2   /home      ext4    defaults,auto_da_alloc    0  2
```

Mount Filesystems At or During Boot

```
$ sudo vim /etc/fstab


$ swapon --show
  NAME       TYPE      SIZE USED PRIO
  /dev/vdb3 partition   2G   0B   -2
  /dev/dm-1 partition   2G   0B   -3
```

/etc/fstab

```
/dev/mapper/cs-swap   none        swap  defaults   0 0

/dev/vdb3   none              swap  defaults   0 0
```

Mount Filesystems At or During Boot

```
$ sudo vim /etc/fstab


$ sudo blkid /dev/vdb1

  /dev/vdb1: LABEL="FirstFS" UUID="9ab8cfa5-2813-4b70-ada0-7abd0ad9d289"
  BLOCK_SIZE="512" TYPE="xfs" PARTUUID="569a3fcc-f9eb-9147-888d-
  9e3ffe9ccdb0"
```

/etc/fstab

```
UUID=3b93b1ba-e44a-4f75-aa38-c93ed32e34e2 /boot     xfs    defaults    0 0

/dev/vda1    /boot              xfs    defaults    0 0



UUID=9ab8cfa5-2813-4b70-ada0-7abd0ad9d289 /mybackups xfs defaults 0 0
```

Configure Systems to
Mount Filesystems On Demand

On Demand Mounting

/backups/

On Demand Mounting

Mount Filesystems on Demand

```
>_
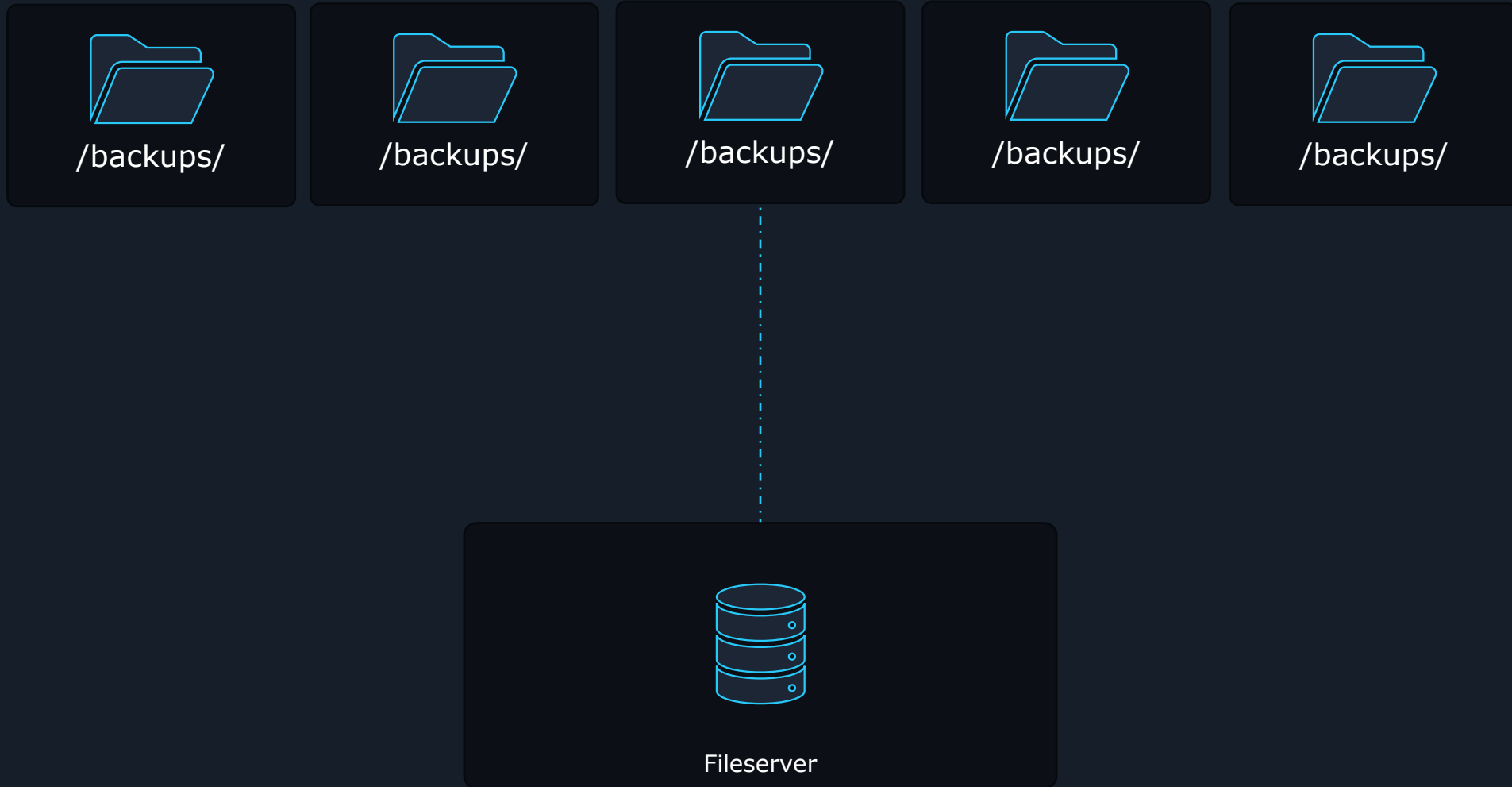
$ sudo dnf install autofs

$ sudo systemctl start autofs.service

$ sudo systemctl enable autofs.service
```

Mount Filesystems on Demand

```
>_

$ sudo dnf install nfs-utils

$ sudo systemctl start nfs-server.service

$ sudo systemctl enable nfs-server.service
```

Mount Filesystems on Demand

```
>_
```

```
$ sudo vim /etc/exports

$ sudo systemctl reload nfs-server.service
```

/etc/exports

```
/etc 127.0.0.1(ro)
```

Mount Filesystems on Demand

```
>_

$ sudo vim /etc/auto.master
```

```
/shares/ /etc/auto.shares --timeout=400
```

Mount Filesystems on Demand

```
>_
```

```
$ sudo vim /etc/auto.shares
```

/etc/auto.master   /shares /etc/auto.shares

mynetworkshare -fstype=auto 127.0.0.1:/etc

mynetworkshare -fstype=nfs4 127.0.0.1:/etc

mynetworkshare -fstype=auto,ro 127.0.0.1:/etc

mynetworkshare -fstype=auto,ro nfs1.example.com:/etc

myext4files -fstype=auto :/dev/vdb2

Mount Filesystems on Demand

```
>_

$ sudo systemctl reload autofs

$ ls /shares/

$ ls /shares/mynetworkshare/
 mysharedfile1        mysharedfile2
```

Mount Filesystems on Demand

```
>_
```

```
$ sudo vim /etc/auto.master
```

```
/shares/ /etc/auto.shares --timeout=400


/- /etc/auto.shares --timeout=400
```

Mount Filesystems on Demand

```
>_
```

```
$ sudo vim /etc/auto.shares



$ sudo systemctl reload autofs



$ ls /mynetworkshare/
 mysharedfile1        mysharedfile2



$ ls /localfiles/myext4files/
 mysharedfile3        mysharedfile4
```

/etc/auto.shares

```
mynetworkshare -fstype=auto 127.0.0.1:/etc

myext4files -fstype=auto :/dev/vdb2
```

/mynetworkshare -fstype=auto 127.0.0.1:/etc

/localfiles/myext4files -fstype=auto :/dev/vdb2

Create and Manage Hard Links

```
>_
```

```
$ echo "Picture of Milo the dog" > Pictures/family_dog.jpg


$ stat Pictures/family_dog.jpg
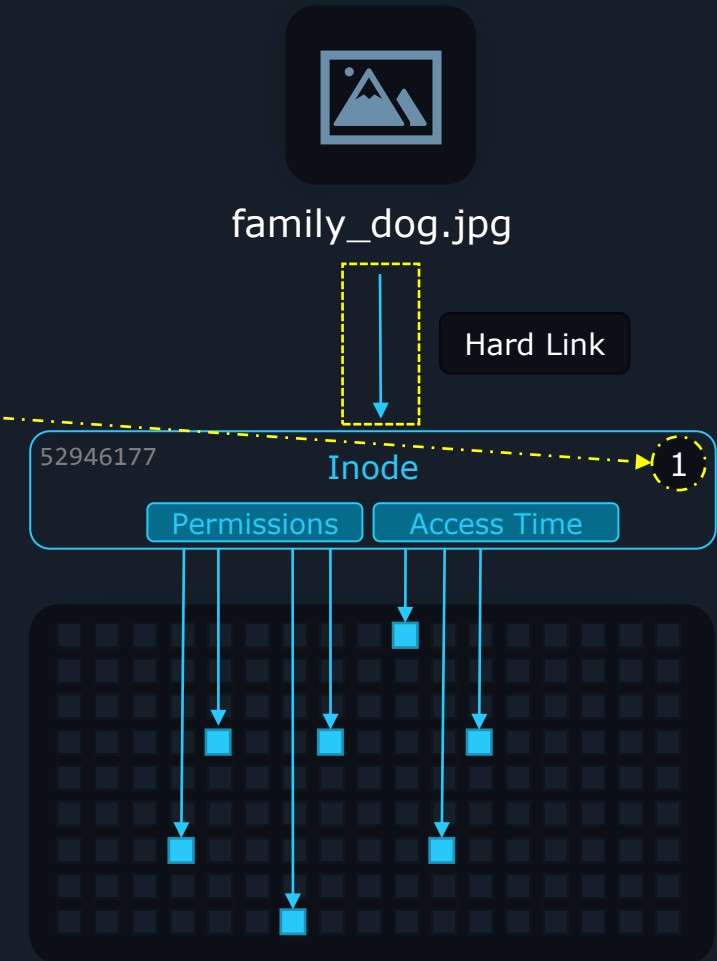
  File: Pictures/family_dog.jpg
    Size: 49          Blocks: 8        IO Block: 4096    regular file
  Device: fd00h/64768d  Inode: 52946177   Links: 1
  Access: (0640/-rw-r-----)  Uid: ( 1000/   aaron)  Gid: ( 1005/  family)
  Context: unconfined_u:object_r:user_home_t:s0
  Access: 2021-10-27 16:33:18.949749912 -0500
  Modify: 2021-10-27 14:41:19.207278881 -0500
  Change: 2021-10-27 16:33:18.851749919 -0500
  Birth: 2021-10-26 13:37:17.980969655 -0500
```

family_dog.jpg

52946177   Inode

Permissions   Access Time

> _

$ echo "Picture of Milo the dog" > Pictures/family_dog.jpg

$ stat Pictures/family_dog.jpg
  File: Pictures/family_dog.jpg
  Size: 49   Blocks: 8   IO Block: 4096   regular file
Device: fd00h/64768d Inode: 52946177   Links: 1
Access: (0640/-rw-r-----) Uid: (1000/   aaron) Gid: (1005/ family)
Context: unconfined_u:object_r:user_home_t:s0
Access: 2021-10-27 16:33:18.949749912 -0500
Modify: 2021-10-27 14:41:19.207278881 -0500
Change: 2021-10-27 16:33:18.851749919 -0500
Birth: 2021-10-26 13:37:17.980969655 -0500

family_dog.jpg

Hard Link

52946177
Inode   1
Permissions   Access Time

Hard Links

```
>_


$ cp -r /home/aaron/Pictures/ /home/jane/Pictures/

# ln   path_to_target_file path_to_link_file

$ ln /home/aaron/Pictures/family_dog.jpg /home/jane/Pictures/family_dog.jpg

$ stat Pictures/family_dog.jpg
  File: Pictures/family_dog.jpg
    Size: 49          Blocks: 8       IO Block: 4096   regular file
  Device: fd00h/64768d  Inode: 52946177    Links: 2
  Access: (0640/-rw-r-----)  Uid: ( 1000/   aaron)   Gid: ( 1005/   family)
  Context: unconfined_u:object_r:user_home_t:s0
  Access: 2021-10-27 16:33:18.949749912 -0500
  Modify: 2021-10-27 14:41:19.207278881 -0500
  Change: 2021-10-27 16:33:18.851749919 -0500
  Birth: 2021-10-26 13:37:17.980969655 -0500



$ rm /home/aaron/Pictures/family_dog.jpg


$ rm /home/jane/Pictures/family_dog.jpg
```

Limitations and Considerations

```
>_
```

```
$ useradd -a -G family aaron
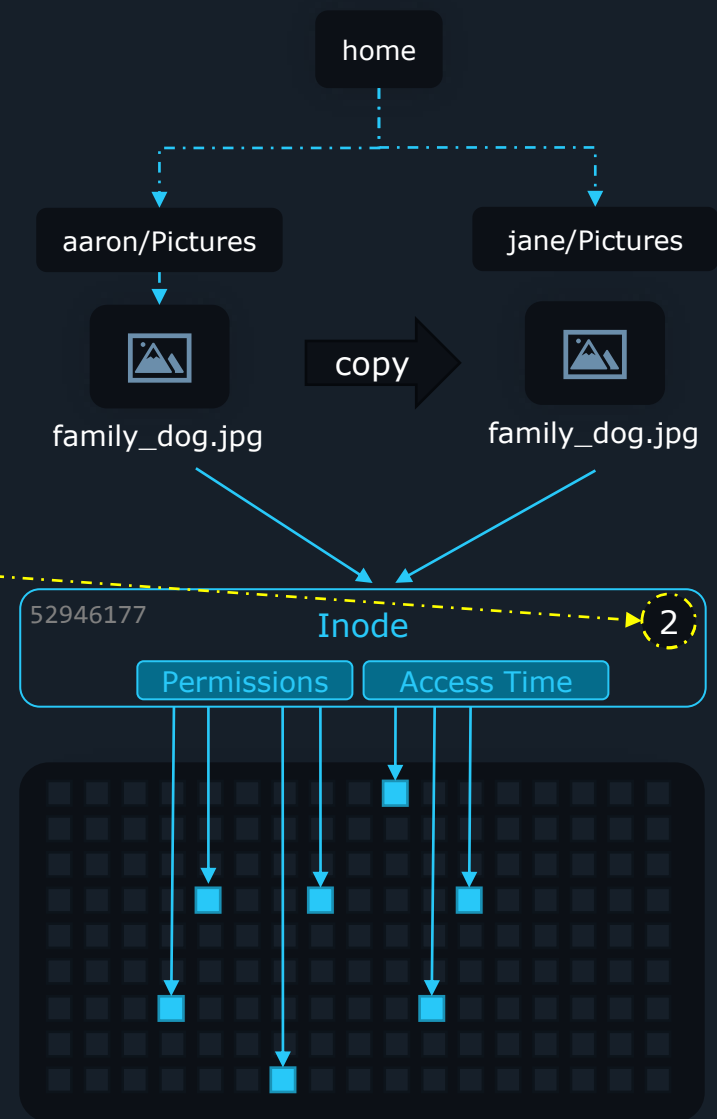
$ useradd -a -G family jane

$ chmod 660 /home/aaron/Pictures/family_dog.jpg
```

Only hardlink to files, not folders

Only hardlink to files on the same filesystem

/home/aaron/file   /mnt/Backups/file

Create and Manage Soft Links

Soft Links

C:\Program Files\MyCoolApp\application.exe

Soft Links

```
>_
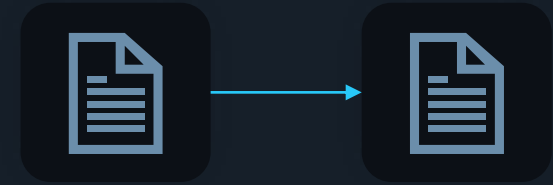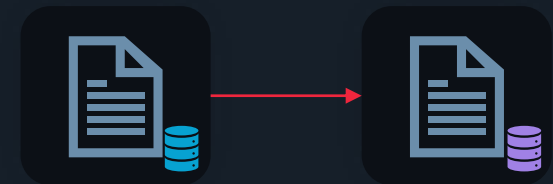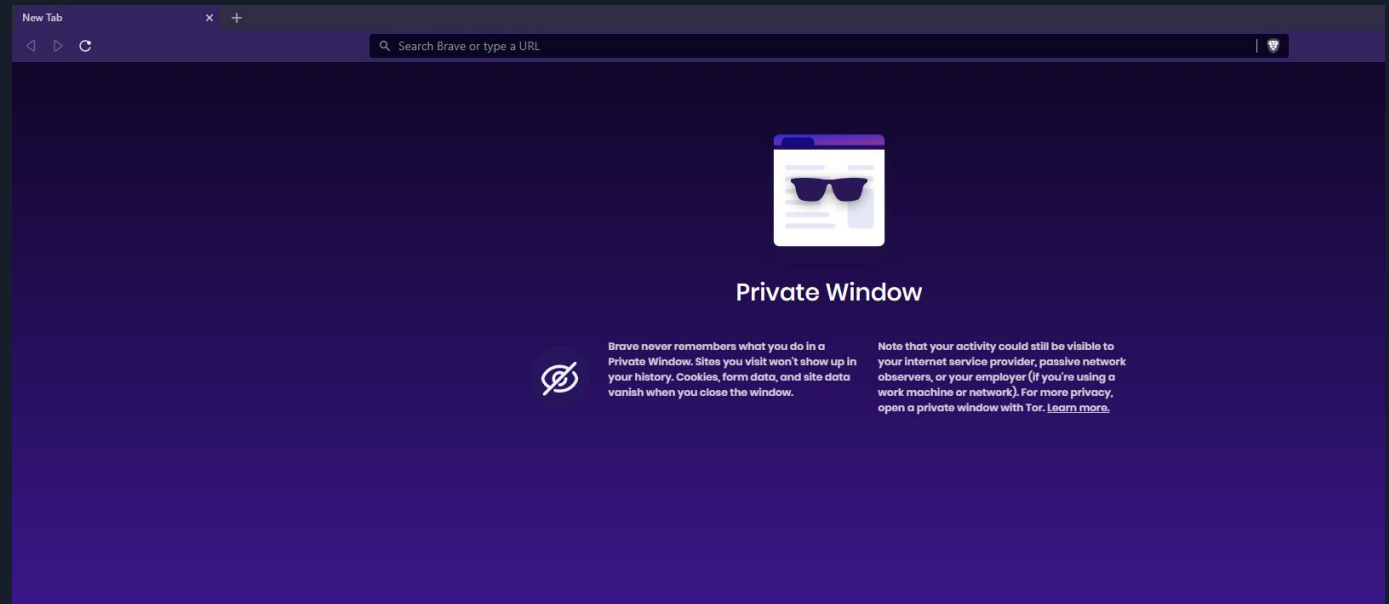
# ln -s path_to_target_file path_to_link_file

$ ln -s /home/aaron/Pictures/family_dog.jpg family_dog_shortcut.jpg

$ ls -l

  lrwxrwxrwx. 1 aaron aaron family_dog_shortcut.jpg -> /home/aaron/Pictures..

$ readlink family_dog_shortcut.jpg

  /home/aaron/Pictures/family_dog.jpg

$ echo "Test" >> fstab_shortcut

  bash: fstab_shortcut: Permission denied

$ ls -l

  lrwxrwxrwx. 1 aaron aaron family_dog_shortcut.jpg -> /home/aaron/Pictures..


[/home/aaron]$ ln -s Pictures/family_dog.jpg relative_picture_shortcut
```

family_dog_shortcut.jpg

Soft Link

family_dog.jpg

Hard Link

52946177 Inode

Soft Links

```
>_
```

Softlink to files and folders

Softlink to files on different filesystem as well

/home/aaron/file   /mnt/Backups/file

List, Set, and
Change File Permissions

```
>_
```

```
$ ls -l
  -rw-r-----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
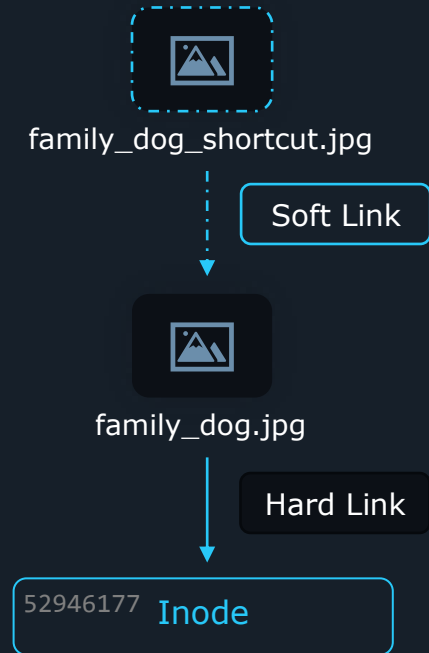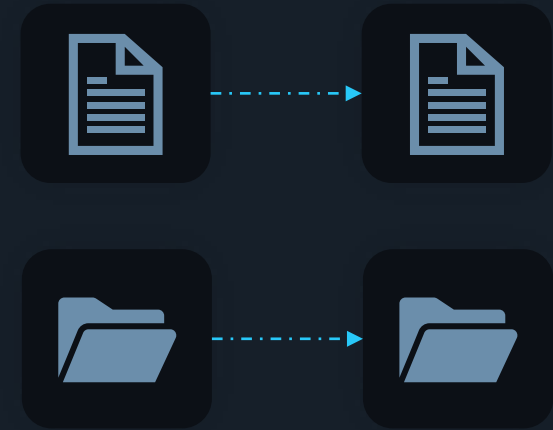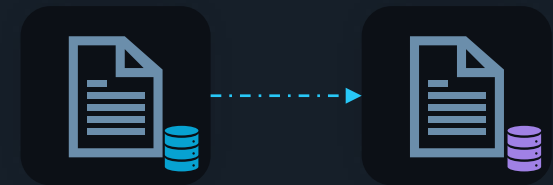
# chgrp group_name file/directory        change group

$ chgrp wheel family_dog.jpg

$ ls -l
  -rw-r-----. 1 aaron wheel 49 Oct 27 14:41 family_dog.jpg
$ groups
aaron wheel family
$ sudo chown jane family_dog.jpg         change owner
$ ls -l
   -rw-r-----. 1 jane family 49 Oct 27 14:41 family_dog.jpg
$ sudo chown aaron:family family_dog.jpg
$ ls -l
  -rw-r-----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
```

aaron jane   family wheel

```
$ ls -l
-rwxrwxrwx. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
```

File Type	Identifier
DIRECTORY	d
REGULAR FILE	-
CHARACTER DEVICE	c
LINK	l
SOCKET FILE	s
PIPE	p
BLOCK DEVICE	b

KODEKLOUD

File and Directory Permissions

r w x r w x r w x

owner	Group	Others
u	g	o

Bit	Purpose
r	Read File
w	Write to File
x	Execute (run)
-	No permission

Directory Permissions

```
>_

$ ls Pictures/

$ mkdir Pictures/Family

$ cd Pictures/
```

Bit	Purpose
r	Read Directory
w	Write to Directory
x	Execute into
-	No permission

Evaluating Permissions

```
(aaron)$ ls -l
        -r--rw----. 1 aaron family 49 family_dog.jpg

(aaron)$ echo "Add this content to file" >> family_dog.jpg
        bash: family_dog.jpg: Permission denied

(aaron)$ su jane

(jane)$ echo "Add this content to file" >> family_dog.jpg

(jane)$ cat family_dog.jpg
        Picture of Milo the dog
```

- r - - r w - - - -

| owner u | Group g | Others o |

Adding Permissions

```
>_
```

chmod permissions file/directory | change mode |

```
$ ls -l
  -r--rw----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
$ chmod u+w family_dog.jpg
$ ls -l
  -rw-rw----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
```

u+[list of permissions]

	Option	Examples
user	u+	u+w / u+rw / u+rwx
group	g+	g+w / g+rw / g+rwx
others	o+	o+w / o+rw / o+rwx

Removing Permissions

```
>_
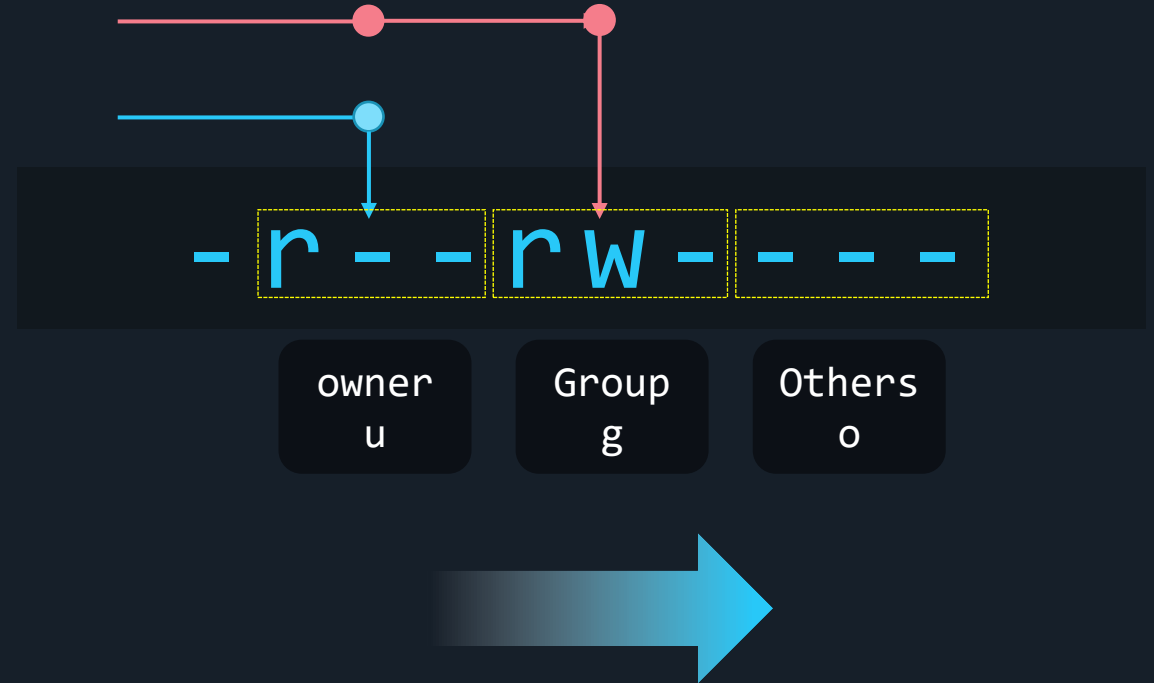
$ ls -l
  -r--rw-r--. 1 aaron family 49 Oct 27 14:41 family_dog.jpg


$ chmod o-r family_dog.jpg
$ ls -l
  -r--rw----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
```

u-[list of permissions]

	Option	Examples
user	u-	u-w / u-rw / u-rwx
group	g-	g-w / g-rw / g-rwx
others	o-	o-w / o-rw / o-rwx

Setting Exact Permissions

```
>_

$ ls -l
  -r--rw----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg

$ chmod g=r family_dog.jpg

$ ls -l
  -r--r-----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg

$ chmod g=rw family_dog.jpg

$ ls -l
  -r--rw----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg

$ chmod g= family_dog.jpg

$ ls -l
  -r--------. 1 aaron family 49 Oct 27 14:41 family_dog.jpg

$ chmod g-rwx family_dog.jpg
```

u=[list of permissions]

	Option	Examples
user	u=	u=w / u=rw / u=rwx
group	g=	g=w / g=rw / g=rwx
others	o=	o=w / o=rw / o=rwx

Chaining Permissions

```
$ ls -l
   -r--------. 1 aaron family 49 Oct 27 14:41 family_dog.jpg


$ chmod u+rw,g=r,o= family_dog.jpg


$ ls -l
   -rw-r-----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg



$ chmod u=rw,g-w family_dog.jpg


$ ls -l
   -rw-r-----. 1 aaron family 49 Oct 27 14:41 family_dog.jpg
```

user: at least read and write

group: only read

others: no permissions

user: only read and write

group: remove write

Octal Permissions

```
>_
```

```
$ stat family_dog.jpg
  File: family_dog.jpg
    Size: 49           Blocks: 8          IO Block: 4096   regular file
  Device: fd00h/64768d  Inode: 52946177    Links: 1
  Access: (0640/-rw-r-----)  Uid: ( 1000/   aaron)   Gid: (   10/   wheel)
```

Octal Permissions

```
r w - | r - - | - - -
1 1 0 | 1 0 0 | 0 0 0
  6       4       0
```

```
r w x r - x r - x
1 1 1 1 0 1 1 0 1
  7       5       5
```

```
r w x r w x r w x
1 1 1 1 1 1 1 1 1
  7       7       7
```

Binary	Decimal
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

Octal Permissions

rw-r-----

4 + 2 + 0 | 4 + 0 + 0 | 0 + 0 + 0
= 6 | = 4 | = 0

rwxr-xr-x

4 2 1 | 4 0 1 | 4 0 1
7 | 5 | 5

rwxrwxrwx

4 2 1 | 4 2 1 | 4 2 1
7 | 7 | 7

Permission	Value
r	4
w	2
x	1

Octal Permissions

```
>_
```

```
$ stat family_dog.jpg

    File: family_dog.jpg
    Size: 49            Blocks: 8         IO Block: 4096   regular file
    Device: fd00h/64768d  Inode: 52946177   Links: 1
    Access: (0640/-rw-r-----)  Uid: ( 1000/   aaron)  Gid: (   10/   wheel)



$ chmod 640 family_dog.jpg
```

Create Partitions and Filesystems: btrfs

B-Tree Filesystem, also known as Butter FS or Better FS

Large amounts of storage and multi-device support

RAID-like features: striping, mirroring, striping+mirroring

Transparent compression

SSD optimizations

Incremental backups and snapshots

Online defragmentation

Offline checks

Supports sub-volumes with quotas

Deduplication

btrfs

Copy-on-write filesystem

Traditional filesystems = New data is written directly over old data

Copy-on-write filesystems = New data is written to free space and the original file's metadata is updated to refer to the new file before removing the old data.

Creating a btrfs Filesystem

```
>_

$ sudo mkfs.btrfs /dev/sdb1


$ sudo mkfs.btrfs /dev/sdb1 -L "New Disk"


$ sudo mkfs.btrfs -d single -m single /dev/sdb /dev/sdc
```

```
raid0
raid1
raid5
raid6
raid10
single
dup
```

```
>_
```

```
$ sudo btrfs subvolume create /mnt/disk/BKP

$ ls -lh /mnt/disk/

total 0
drwxr-xr-x 1 root root 0 jul 13 17:35 BKP
drwxrwxr-x 1 carol carol 988 jul 13 17:30 Images


$ sudo btrfs subvolume show /mnt/disk/BKP/

Name: BKP
  UUID: e90a1afe-69fa-da4f-9764-3384f66fa32e
  Parent UUID: -
  Received UUID: -
  Creation time: 2019-07-13 17:35:40 -0300
  Subvolume ID: 260
  Generation: 23
  Gen at creation: 22
  Parent ID: 5
  Top level ID: 5
  Flags: -
  Snapshot(s):

$ sudo mount -t btrfs -o subvol=BKP /dev/sdb1 /mnt/BKP
```

> _

```
$ sudo btrfs subvolume snapshot /mnt/disk /mnt/disk/snap

$ ls -lh /mnt/disk/

total 2,8M
-rw-rw-r-- 1 carol carol 109K jul 10 16:22 Galaxy_Note_10.png
-rw-rw-r-- 1 carol carol 484K jul 5 15:01 geminoid2.jpg
-rw-rw-r-- 1 carol carol 429K jul 5 14:52 geminoid.jpg
-rw-rw-r-- 1 carol carol 467K jul 2 11:48 LG-G8S-ThinQ-Mirror-White.jpg
-rw-rw-r-- 1 carol carol 654K jul 2 11:39 LG-G8S-ThinQ-Range.jpg
-rw-rw-r-- 1 carol carol 94K jul 2 15:43 Mimoji_Comparativo.jpg
-rw-rw-r-- 1 carol carol 112K jul 10 16:20 Note10Plus.jpg
drwx------ 1 carol carol 366 jul 13 17:56 snap
-rw-rw-r-- 1 carol carol 118K jul 11 16:36 Twitter_Down_20190711.jpg
-rw-rw-r-- 1 carol carol 324K jul 2 15:22 Xiaomi_Mimoji.png
```

```
>_

$ rm LG-G8S-ThinQ-*

$ ls -lh /mnt/disk/

total 1,7M
-rw-rw-r-- 1 carol carol 109K jul 10 16:22 Galaxy_Note_10.png
-rw-rw-r-- 1 carol carol 484K jul 5 15:01 geminoid2.jpg
-rw-rw-r-- 1 carol carol 429K jul 5 14:52 geminoid.jpg
-rw-rw-r-- 1 carol carol 94K jul 2 15:43 Mimoji_Comparativo.jpg
-rw-rw-r-- 1 carol carol 112K jul 10 16:20 Note10Plus.jpg
drwx------ 1 carol carol 366 jul 13 17:56 snap
-rw-rw-r-- 1 carol carol 118K jul 11 16:36 Twitter_Down_20190711.jpg
-rw-rw-r-- 1 carol carol 324K jul 2 15:22 Xiaomi_Mimoji.png


$ ls -lh /mnt/disk/snap

total 2,8M
-rw-rw-r-- 1 carol carol 109K jul 10 16:22 Galaxy_Note_10.png
-rw-rw-r-- 1 carol carol 484K jul 5 15:01 geminoid2.jpg
-rw-rw-r-- 1 carol carol 429K jul 5 14:52 geminoid.jpg
-rw-rw-r-- 1 carol carol 467K jul 2 11:48 LG-G8S-ThinQ-Mirror-White.jpg
-rw-rw-r-- 1 carol carol 654K jul 2 11:39 LG-G8S-ThinQ-Range.jpg
-rw-rw-r-- 1 carol carol 94K jul 2 15:43 Mimoji_Comparativo.jpg
-rw-rw-r-- 1 carol carol 112K jul 10 16:20 Note10Plus.jpg
-rw-rw-r-- 1 carol carol 118K jul 11 16:36 Twitter_Down_20190711.jpg
-rw-rw-r-- 1 carol carol 324K jul 2 15:22 Xiaomi_Mimoji.png
```

```
>_

$ sudo btrfs subvolume snapshot -r /mnt/disk /mnt/disk/snap
```

Compression is transparent

- Enabled with the -o mount option

- Compression is on a per-file basis

Compression

ZLIB: Default compression algorithm

LZO: Faster than ZLIB, but lower compression ratio

ZSTD: Faster than ZLIB, with a similar compression
                 ratio to ZLIB

Control Mounting and Unmounting Filesystems

User Mountable Filesystems

/media/USER/LABEL

/media/john/FlashDrive

user

nouser

group

owner

/dev/sdb1   /mnt/userdrive ext4   defaults,user 0 0

Mounting with Systemd

```
$ sudo vi /etc/systemd/system/mnt-external.mount

$ sudo systemctl daemon-reaload

$ sudo systemctl start mnt-external.mount
```

/etc/systemd/system/mnt-external.mount

```
[Unit]
Description=External data disk
[Mount]
What=/dev/disk/by-uuid/56C11DCC5D2E1334
Where=/mnt/external
Type=ntfs
Options=defaults
[Install]
WantedBy=multi-user.target
```

Mounting with Systemd

```
>_
```

```
$ sudo systemctl status mnt-external.mount

mnt-external.mount - External data disk
  Loaded: loaded (/etc/systemd/system/mnt-external.mount; disabled; vendor
pres
  Active: active (mounted) since Mon 2019-08-19 22:27:02 -03; 14s ago
  Where: /mnt/external
  What: /dev/sdb1
  Tasks: 0 (limit: 4915)
  Memory: 128.0K
  CGroup: /system.slice/mnt-external.mount
ago 19 22:27:02 pop-os systemd[1]: Mounting External data disk...
ago 19 22:27:02 pop-os systemd[1]: Mounted External data disk.
```

```
$ sudo systemctl enable mnt-external.mount
```

Mounting with Systemd

```
$ sudo vi /etc/systemd/system/mnt-external.automount
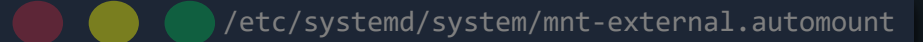
$ sudo systemctl daemon-reaload

$ sudo systemctl start mnt-external.automount
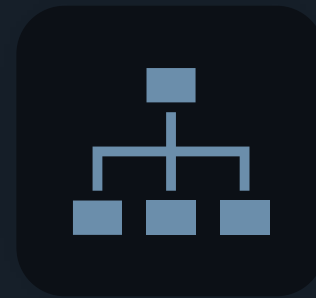
$ sudo systemctl enable mnt-external.automount
```

/etc/systemd/system/mnt-external.automount

```
[Unit]
Description=Automount for the external data disk
[Automount]
Where=/mnt/external
[Install]
WantedBy=multi-user.target
```

Filesystem Hierarchy Standard

Filesystem Hierarchy Standard

```
/                    /root
/bin                 /run
/boot                /sbin
/dev                 /srv
/etc                 /tmp
/home                /usr
/lib                 /proc
/media               /var
/mnt                 /var/tmp
/opt
```

Conclusion

Conclusion