Part 1

Linux

(Fedora Core 2)

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1.0 General

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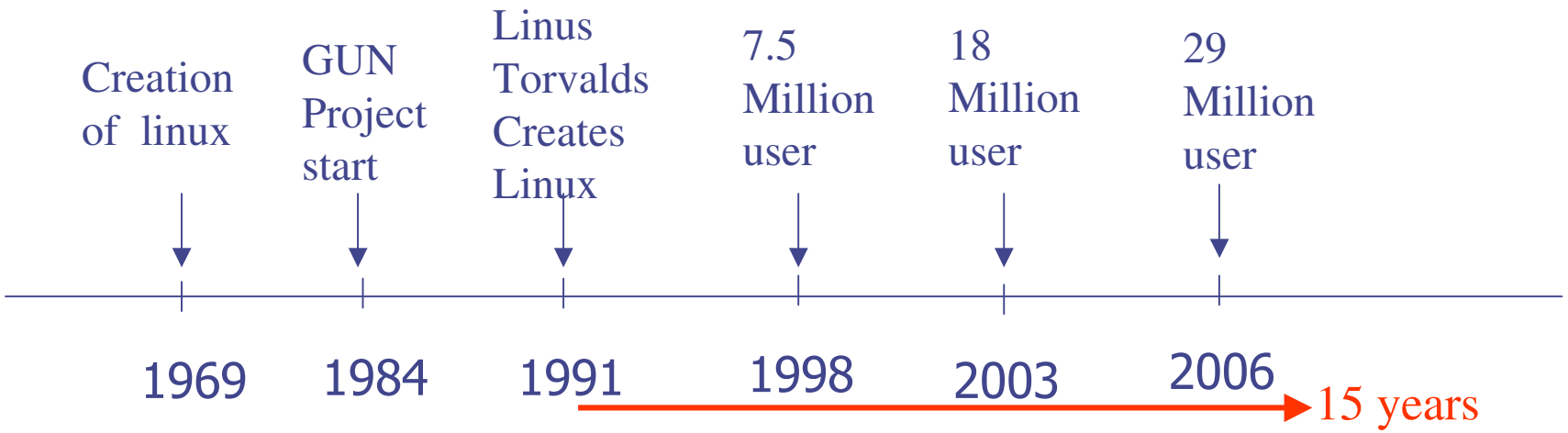
Linux History & Distribution



- Common distribution of Linux
- Redhat (Fedora core , Enterprise)
- Novell SUSE (Europe)
- Ubuntu
- mandrake
- Debian
- knoppix – standalone run direct from CD

a lot more … see **http://en.wikipedia.org/wiki/List_of_Linux_distributions**

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Open Source Software (OSS)

- Source code available to developer
- Allow to modify, improve and redistribute the code
- Free of charge
- Design with betterment in mind

Advantages

- Fast development speed (spread collaboration)
- Shorter Beta test duration
- Bug identification and fix fast

Disadvantage

- No company really responsible , in terms of commercial commitment ,for the software

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Open Source Software (OSS)

Type of software	Free source code	Free application code
Open source	✓	✓
Close source	✗	✗
Freeware	✗	✓
Shareware	✗	Limited free

GUN Public License(GPL)

Developed by Free Software Foundation (FSF) stipulated that the source code of any software published under its license must be freely available.

If some one modifies the source code, that source code must be freely re-distributed and therefore keeping the source code free forever

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Is Linux/Embedded Linux Cost Free ?

- Freedom to use
- Costs in development using Linux :

- expertise to develop/manage/maintain the system -- high
  - need in depth technical knowledge
  - not many expertise available locally
  - takes longer time to familiarize with the language and system – not so user friendly (more powerful in command line)
  - information are not customized
- Hardware (PC) / Linux Software -- low

Choose the hardware that provide free development tool-chain

- Embedded System (hardware + development tool chain)-- moderate
  - price of a specific ready-make hardware board or design cost
  - methods use on one embedded hardware may not be the same on another (expertise needed)
  - development tool-chain (may need to purchase) is hardware board specific

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Software On Computer

Two main types

Operating System software (OS) ⟷ **Application software**

Control the hardware of a computer.
When computer power-up, BIOS loads the OS into computer which centrally controls all the applications
In Linux, it is call Kernel.

program for a specific application.
e.g. Internet Explorer, games … etc

Device Driver

(Some where in between)
software that tell the OS how to use a specific hardware device

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Which Version of Linux to Use ?

- For development system or general application use Fedora core 2 and above. Better GUI ,hardware driver support and more Plug & Play
- Use redhat 9 or 8 if you have no choice for some reasons
- There are some differences in file system and configuration file among Redhat8/9, Fedora, Embedded Linux … and other Linux distribution
- If you use Linux on embedded project, MUST use exactly the version that your SDK (Software Development Kit) required unless you prepare to spend time to make changes
- Kernel version and patch version MUST use exactly what is specified by the SDK
- When view Linux articles & books, must be aware of the kernel version use

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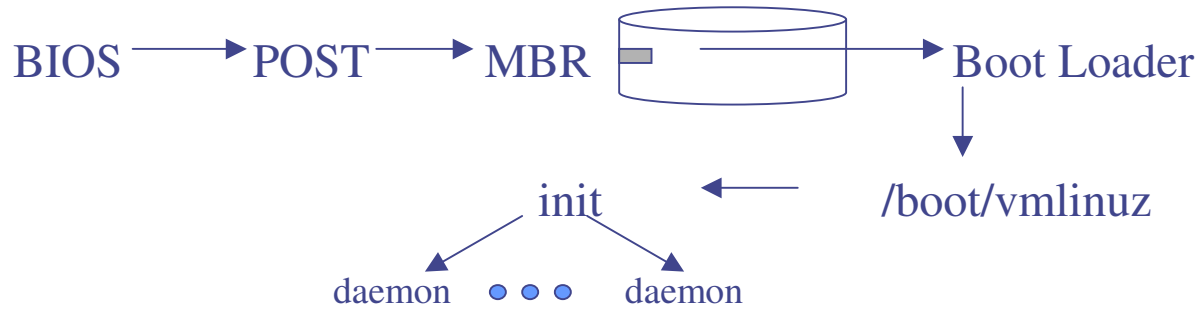
How Linux OS works

- main board BIOS performs a Power On Self Test (POST) .
- Computer first check for operating system on floppy disk and on CD-ROM to ensures installation of an operating system from these devices can occur at boot time.
- After that, the computer usually checks the Master Boot Record (MBR) on the first hard disk inside the computer. The MBR might have (or point to a partition that has) a boot loader on it that can locate and execute the operating kernel .Kernel is now also know as Operating System (OS)
- The kernel initializes the devices and its drivers
- The kernel mount the root filesystem
- Kernel starts the first program (or daemon) called *init*



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How Linux OS works

GRUB boot loader

- Grand Unified Boot loader (GRUB) is more recent than LILO boot loader. The first major part of the GRUB boot loader (called Stage1) typical resides on the MBR.
- Stage1.5 and Stage2 , reside in the /boot/grub directory.
- GRUB stage1 simply points to GRUB Stage1.5 which loads filesystem support and proceeds to load GRUB Stage2.
- GRUB Stage2 performs the actual boot loader functions and displays a graphical boot loader screen.

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How Linux OS works

files that inside /boot folder

```
boot.b              initrd-2.6.5-1.358.img   System.map-2.6.5-1.358
chain.b             lost+found               vmlinuz-2.6.5-1.358
config-2.6.5-1.358                           memtest86+-1.11
grub                os2_d.b
```

files that inside /boot/grub/grub.conf

```
# grub.conf generated by anaconda
#
# Note that you do not have to rerun grub after making changes to this file
# NOTICE:  You have a /boot partition.  This means that
#          all kernel and initrd paths are relative to /boot/, eg.
#          root (hd0,5)
#          kernel /vmlinuz-version ro root=/dev/hdc7
#          initrd /initrd-version.img
#boot=/dev/hdc
default=0
timeout=10
splashimage=(hd0,5)/grub/splash.xpm.gz
title Fedora Core (2.6.5-1.358)
                root (hd0,5)
                kernel /vmlinuz-2.6.5-1.358 ro root=LABEL=/ rhgb quiet
                initrd /initrd-2.6.5-1.358.img
title Win2000 (my modified messasge)
                rootnoverify (hd0,0)
                chainloader +1
```


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Linux kernel Version

- The core components of Linux OS is called Linux kernel which has many versions. Kernel version naming practice is shown below.

For kernel 2.6 or later

For example Kernel version 2.6.5-1.358

VERSION = 2
PATCHLEVEL = 6 (**even number** – production release)
SUBLEVEL = 5
EXTRAVERSION = <put your own info> e.g -1.358 - user tracking information
NAME=Affluent Albatross

/usr/src/linux-2.6.5-1.358/Makefile - gedit

```
VERSION = 2
PATCHLEVEL = 6
SUBLEVEL = 5
EXTRAVERSION = -1.358custom
NAME=Zonked Quokka
```

always use even version !

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Linux kernel Version

kernel 2.4.xx (Redhat 8/9)

major . **minor** . **Revision #** - **Patch #**

Before kernel 2.6
i.e. redhat 8/9

- Odd — Under development
- Even — Production release

2.4.31 – OK to use

2.3.5 – if you are an Linux enthusiast

To see kernel version , use]# **uname -rp**

]# **uname -a**

Revision and processor used

]# uname -rp
2.6.5-1.358 i686
]# uname -a
Linux localhost.localdomain 2.6.5-1.358 #1 Sat May 8 09:04:50 EDT 2004 i686 i686 i386 GNU/Linux
]#

http://www.kernel.org/pub/linux/kernel/

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init and Runlevel

- The init daemon uses its configuration file **/etc/inittab** (init table) to load other daemons on the system that provide system services and ultimately allow user to login and use the system.
- The init daemon is also responsible for **unloading** daemons that are loaded in memory when the system is halt or reboot
- init daemon categorizes the system into runlevels. A runlevel defines the number and type of daemons that are loaded into memory and executed by the kernel on a particular system.
- To see the runlevel,

```
]# runlevel
N 5
] #
```

Current runlevel

Previous runlevel N= nothing

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/etc/inittab

```
# Default runlevel. The runlevels used by RHS are:
#   0 - halt (Do NOT set initdefault to this)
#   1 - Single user mode
#   2 - Multiuser, without NFS (The same as 3, if you do not have networking)
#   3 - Full multiuser mode
#   4 - unused
#   5 - X11
#   6 - reboot (Do NOT set initdefault to this)
#
id:5:initdefault:

# System initialization.
si::sysinit:/etc/rc.d/rc.sysinit

l0:0:wait:/etc/rc.d/rc 0
l1:1:wait:/etc/rc.d/rc 1
l2:2:wait:/etc/rc.d/rc 2
l3:3:wait:/etc/rc.d/rc 3
l4:4:wait:/etc/rc.d/rc 4
l5:5:wait:/etc/rc.d/rc 5
l6:6:wait:/etc/rc.d/rc 6

# Trap CTRL-ALT-DELETE
ca::ctrlaltdel:/sbin/shutdown -t3 -r now

# When our UPS tells us power has failed, assume we have a few minutes
# of power left.  Schedule a shutdown for 2 minutes from now.
# This does, of course, assume you have powerd installed and your
# UPS connected and working correctly.
pf::powerfail:/sbin/shutdown -f -h +2 "Power Failure; System Shutting Down"

# If power was restored before the shutdown kicked in, cancel it.
pr:12345:powerokwait:/sbin/shutdown -c "Power Restored; Shutdown Cancelled"

# Run gettys in standard runlevels
1:2345:respawn:/sbin/mingetty tty1
2:2345:respawn:/sbin/mingetty tty2
3:2345:respawn:/sbin/mingetty tty3
4:2345:respawn:/sbin/mingetty tty4
5:2345:respawn:/sbin/mingetty tty5
6:2345:respawn:/sbin/mingetty tty6

# Run xdm in runlevel 5
x:5:respawn:/etc/X11/prefdm -nodaemon

# added by HKSim 10 Oct 06                    #
# Run COM1 and COM2 gettys in standard runlevels #
#S0:235:respawn:/sbin/agetty -L 115200 ttyS0 vt102
#S1:235:respawn:/sbin/agetty -L 115200 ttyS1 vt102
```

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init and Runlevel

- init and telinit (tell init) are almost the same

] # telinit <new runlevel (0 to 6) > *switch to runlevel 3, also know as 's',*

e.g]# telinit 3 *login as root usr*

] # runlevel
5 3
]#

Note : For embedded application, this is the way to do a software reset, **init 6** or a software stop , **init 0**

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init and Runlevel

Run level	Name	
0	Halt	No daemon active in memory, ready to power off
1,s,S,single	Single user mode	Enough daemon to allow one user to login
2	Multi-user mode	Has most daemon started and allow multiple user to login & use system service
3	Extended multi-user mode	Same abilities as multi-user mode, with extra networking services started (e,g,SNMP, NFS)
4	Not use	
5	Graphical mode	Same abilities as extended multi-user mode, yet with a graphical login program called GNOME
6	Reboot	Reboot the system

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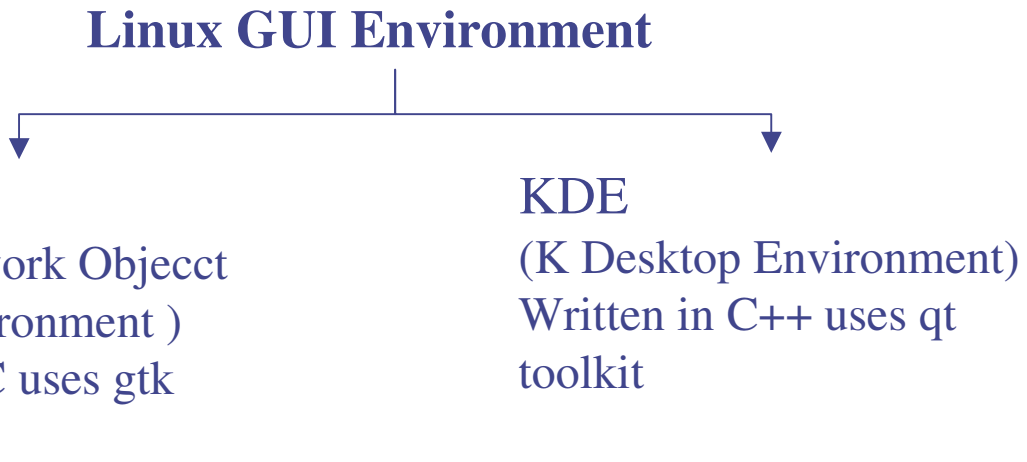
Linux User Interface

- Graphical User Interface (GUI)
  - window – very famous
  - Fedora Linux (catching up)
- Command Line prompt

  Linux / Unix - way of life !

  Window DOS – Not commonly use



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2.0 Basic Commands

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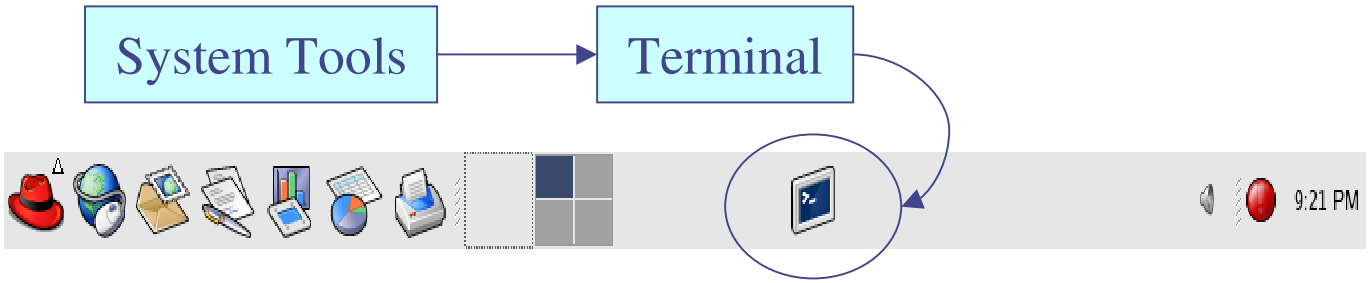
GUI / Command Line

- In GUI , want to access to command line , click the following selection:



- **Switch between Full GUI and Full Command Line**

  from Full GUI to Full command line

  CTRL + ALT + F1

  from Full command line to Full GUI

  CTRL + ALT + F7

  Note : Login to fedora will put you in GUI mode. You can use]# init 3 to initialize to terminal mode

- **Basic Shell command format**

  ]# <command> < -option > <argument>

  e.g. ls -a /etc/http

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date / echo

- View Date

  ]# **date**

- Display what your have enter

  ]# **echo** Hello

- System variables

  any thing that proceed with a $ sign is know as system variable

  e.g $SHELL , $PATH (note : upper case letters)

  ]# **echo** my Linux path is $PATH

  ```
  ]# echo my path is $PATH
  my path is
  /usr/kerberos/sbin:/usr/kerberos/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/s
  bin:/usr/bin:/usr/X11R6/bin:/root/bin
  ]#
  ```

  ]# **echo** my shell is $SHELL

  ```
  ]# echo my shell is $SHELL
  my shell is /bin/bash
  ]#
  ```


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BASH shell Meta Characters

BASH shell meta characters (special characters)

$ - shell variable

~ - home directory variable

& - back ground command execution

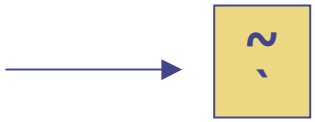
<, <<, >>, > - Input / Output redirect

| - pipe

* , ?, [] - shell wild cads

‘ \ - meta character quote

`` - command substitution



( ) , { } – command group

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BASH shell Meta Characters

Enclose a string by a single quote to prevent Shell from interpreted as command

]# echo 'This is my $SHELL'

This is my $SHELL

]# echo This is my \$SHELL

This is my $SHELL

]# echo This is my $SHELL

This is my /bin/bash

` ` (back quote characters) is use to substitute a command. Anything between back quotes is treated as another command by Shell

]# echo today's date is `date`

Command for date display

]# echo "today is --->" `date`
today is ---> Thu Mar 1 00:56:06 EST 2007
]#

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Help command

3 help commands : man, info, help

- man command

  ]# man whoami

  … *display* …

  to exit man menu, enter ‘q’ at the ‘:’ sign

  Find all commands that have the word “usb” in their name or description

  ]# man –k usb

- info command

  returns an easy to read description

  ]# info whoami

- Help command

  ]# help echo

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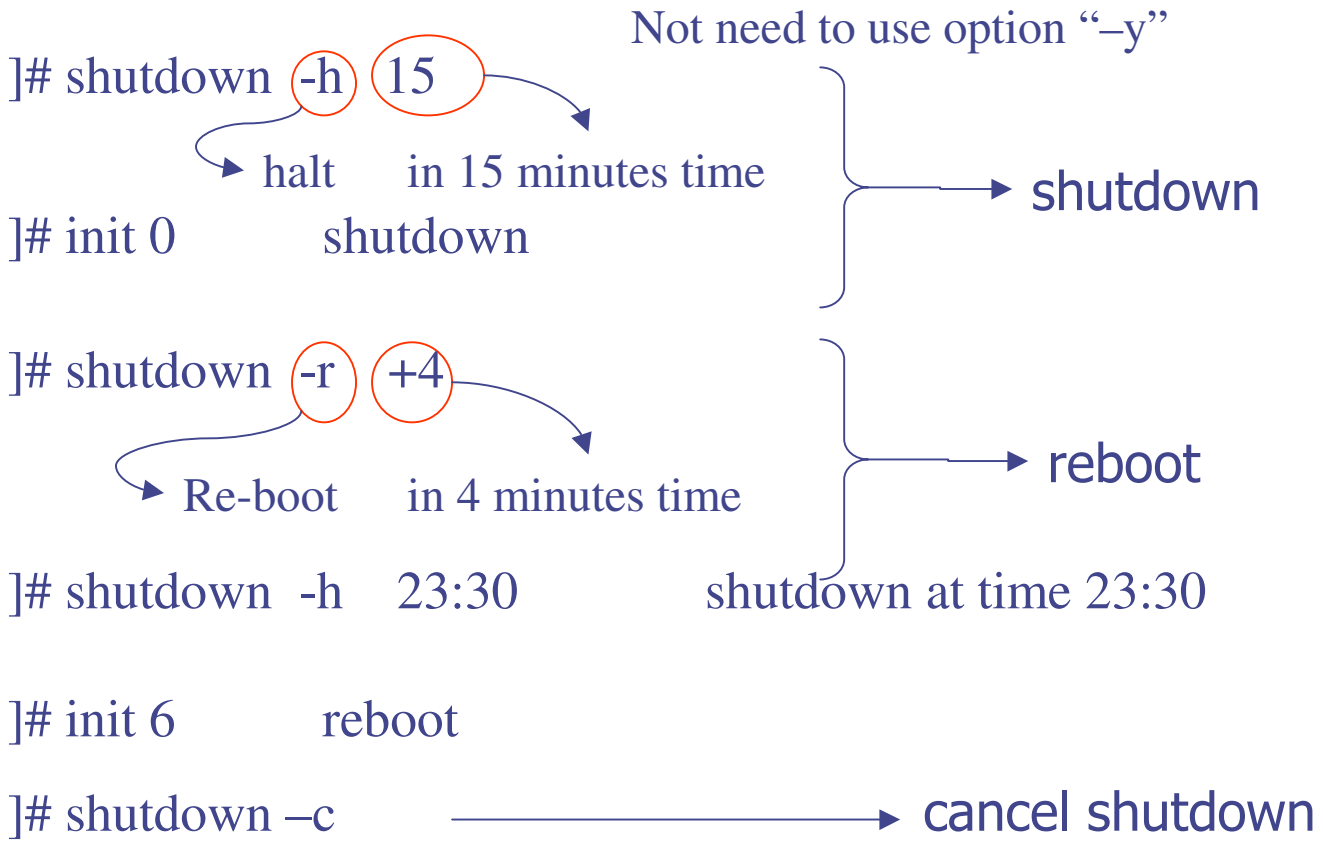
Shut down Linux



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Write Shell Script

- A shell script is program (text file) with a collection of shell commands that are executed when the program is run

myscript.sh

Remove the quote ' '
and
see what happen

```
#!/bin/bash
# this is a comment statment
echo '************************'
echo '*   How are you ?      *'
echo '************************'
echo Date Display
date
echo Who Display
who
echo List files
ls -F /
```

- Use text editor to create the script called myscript
- To run the script :

  ]# bash myscript or

  ]# chmod 755 myscript

  ]# ./myscript

- A full shell script programming has a lot more capabilities include decision making … etc. See more detail on "Shell Script Programming"

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3.0 Directory & File

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Directory (or Folder) in Linux

- Linux OS has NO drive letter
- Directory is also called folder. Use interchangeably.
- Linux directory system start with '/' (root or base folder)
- Absolute path – reference to the root folder e.g /etc/rc.d/init
- Relative path - do not start with a '/ '

  assume now in folder /etc

  cd rc.d/init.d → move to the absolute folder /etc/rc.d/init

  (or cd rc.d , cd init.d)

```
]# cd /
]# ls
bin   dev  home   lib         misc  opt   root  selinux  tftpboot  udev  var
boot  etc  initrd  lost+found  mnt   proc  sbin  sys      tmp       usr
/]#
```


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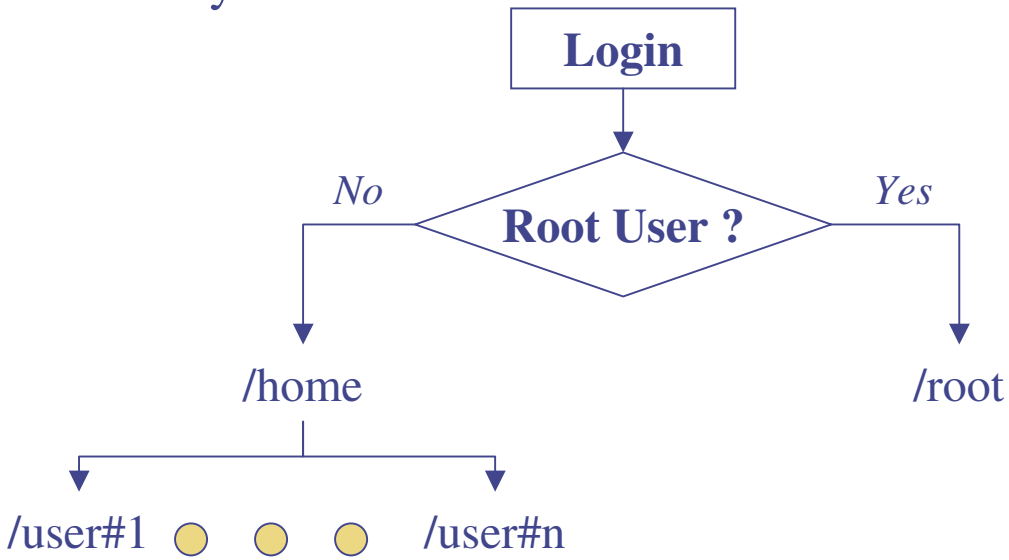
Login Folder

- Normal user login to a Linux system will be put in home directory /home/<your login name>
- Root user (who has administration right) login to a Linux system will be in root directory /root



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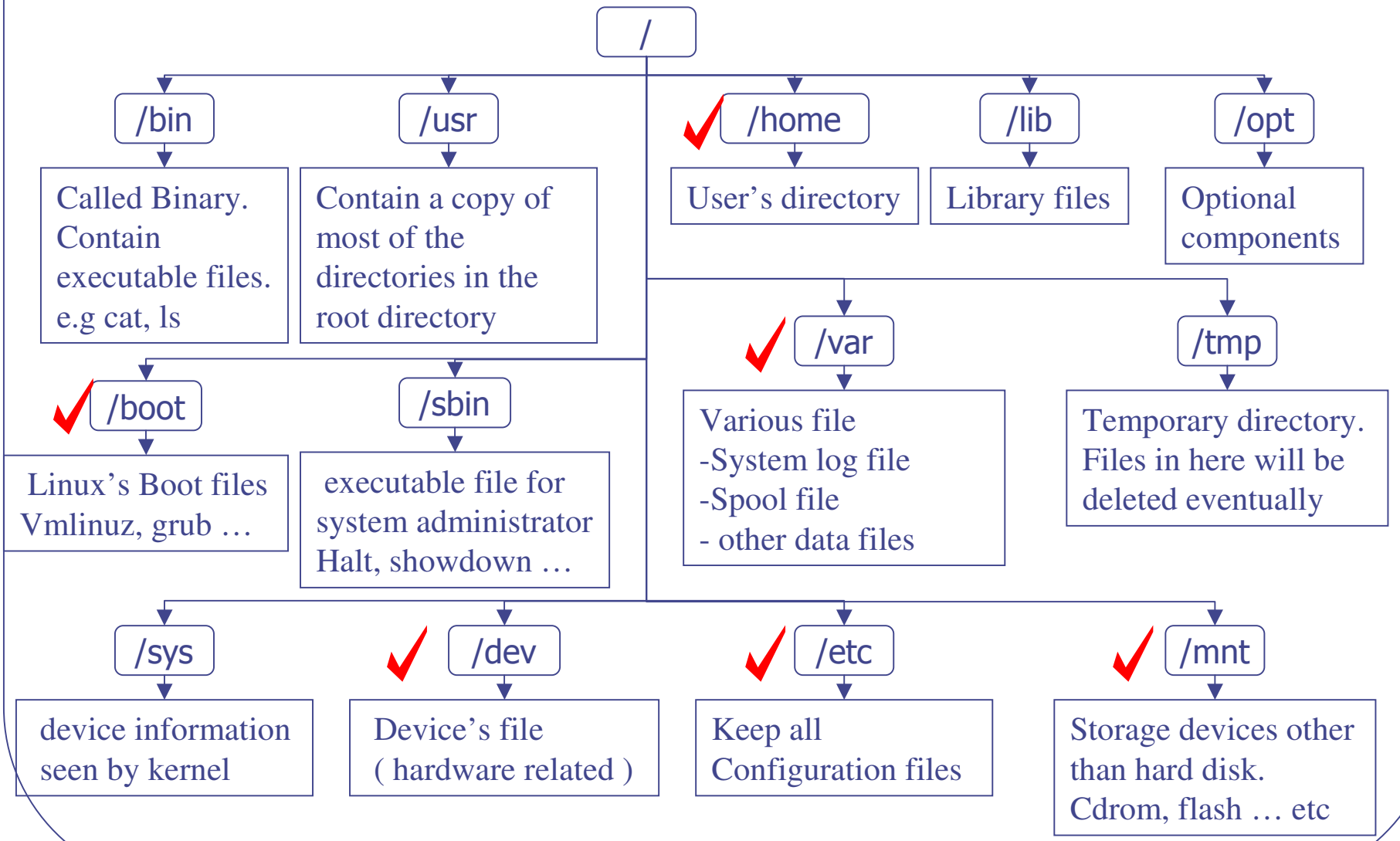
Key Linux Folders



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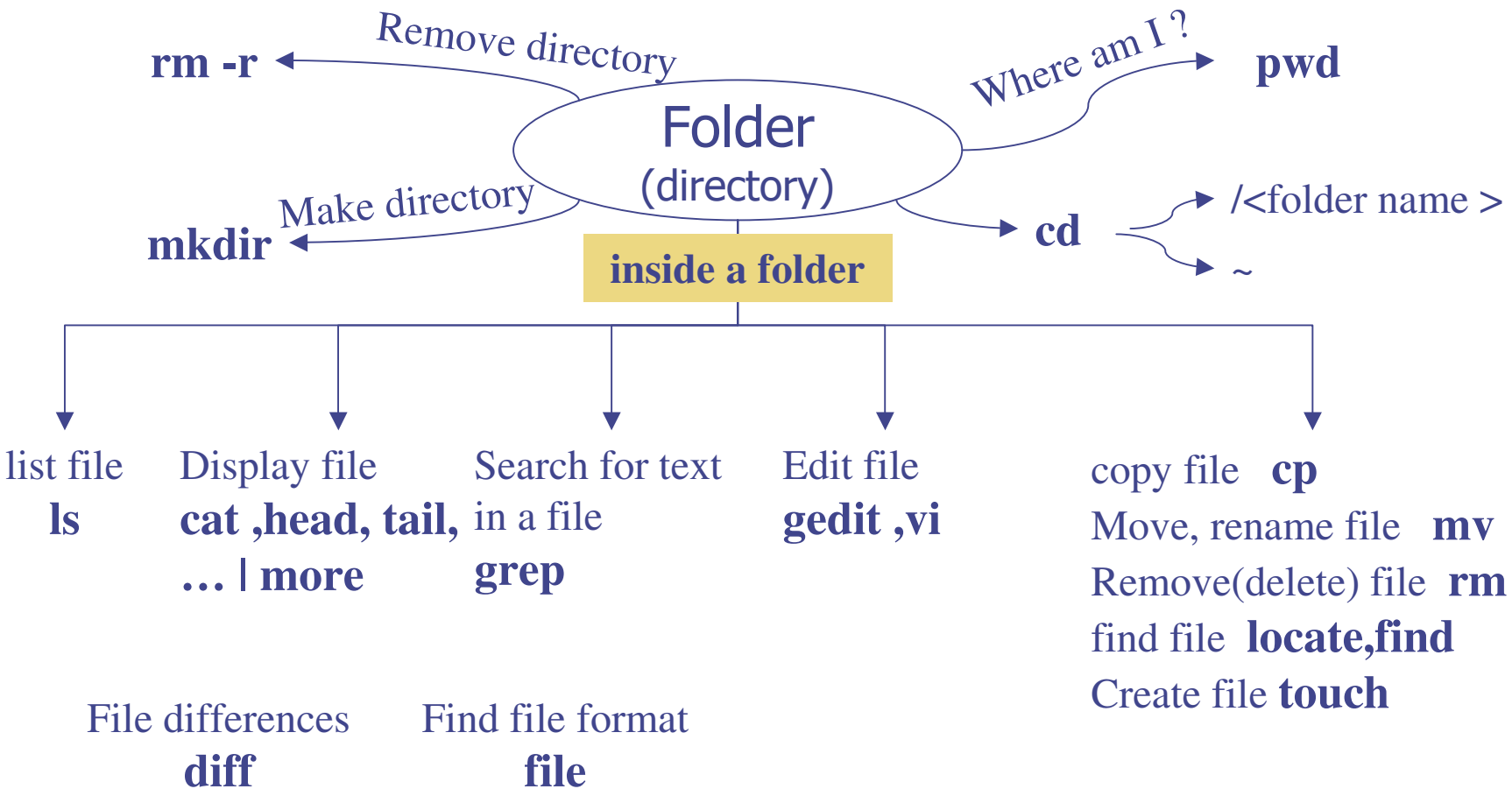
Directory / File Commands Overview



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Change Directory -cd

Where are you ?

]# pwd (Print/Present Working Directory)

cd (Change Directory) allow you to move from one directory to another

]# cd /home/peter go to folder /home/peter

]# cd / go to base directory

]# cd .. go to next higher directory

]# cd ../.. move two directory up

]# cd /dir1/dir2/dir3 go straight down to dir3

Linux metachar '~' means go to your home directory

]# cd ~

]# cd ~peter

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Change Directory - cd

Examples

move 1 level up

```
]# pwd
  /root/testfolder/manyfiles
]# cd ../    or cd ..
]# pwd
  /root/testfolder
]#
```

move 2 level up

```
]# pwd
  /root/testfolder/manyfiles
]# cd ../..
]# pwd
  /root
]#
```

meta character cd

```
]# pwd
/root
]# cd ~john
]# pwd
/home/john
]#
```


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Make/Remove Directory – mkdir/rm -r

Create a new folder / directory

]# mkdir dir1 create new directory

]# mkdir –p 1/2/3/4 create 4 layer of directory /1/2/3/4

Remove a folder / directory

]# rm –r dir1 remove files in the directory with prompt

]# rm –rf dir1 remove files in the directory without prompt

note : once the folder is empty , do one more rm –r or –rf to remove the empty directory

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Make/Remove Directory – mkdir/rm -r

Examples

remove directory rm -r

```
]# ls
  dir1  file1  file2  file3  file4
]# rm -r dir1
 rm: descend into directory `dir1'? y
 rm: remove regular empty file `dir1/file2'? y
 rm: remove regular empty file `dir1/file3'? y
 rm: remove regular empty file `dir1/file1'? y
 rm: remove regular empty file `dir1/file4'? y
 rm: remove directory `dir1'? ls
]#
```


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List File - ls

List the content of a folder

]# ls

]# ls -a list all files include hidden file

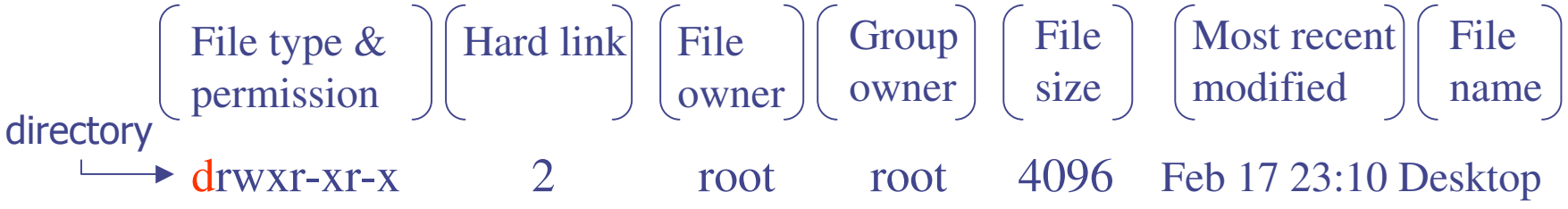
]# ls –F list files with type character append to the end

xxx@ - link file **xxx*** - executable file

xxx/ - subdirectory xxx= - socket

xxx| - pipe **xxx - text, binary or special device file**

]# ls –l long list (more information)



]# ls *i* list with wild card

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List File - ls

Examples

```
]# ls
anaconda-ks.cfg  Desktop   install.log  install.log.syslog  testfolder
]#
]# ls -F
anaconda-ks.cfg  Desktop/   install.log  install.log.syslog  testfolder/
]#
]# ls -a
.                .default_contexts  .gstreamer-0.8      .recently-used
..               Desktop            .gtkrc              .rhn-applet
anaconda-ks.cfg  .dmrc              .gtkrc-1.2-gnome2   .rhn-applet.conf
.bash_history    .fonts.cache-1                         .tcshrc
.bash_logout     .gconf             .ICEauthority       testfolder
.bash_profile    .gconfd            install.log         .Xauthority
.bashrc          .gnome             install.log.syslog  .Xresources
.config          .gnome2            .metacity
.cshrc           .gnome2_private    .nautilus
]#
```

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List File - ls

Examples

```
[root@localhost bin]#
[root@localhost bin]# ls -F
arch*           dmesg*          ipcalc*         pgawk*      sync*
ash*            dnsdomainname@  kbd_mode*       ping*       tar*
ash.static*     doexec*         kill*           ping6*      tcsh*
aumix-minimal*  domainname@     ksh*            ps*         touch*
awk@            dumpkeys*       link*           pwd*        tracepath*
basename*       echo*           ln*             red@        tracepath6*
bash*           ed*             loadkeys*       rm*         traceroute*
bash2@          egrep@          login*          rmdir*      traceroute6*
bsh@            env*            ls*             rpm*        true*
```

```
[root@localhost bin]# ls -al
total 5840
drwxr-xr-x   2 root root    4096 Mar  6 19:46 .
drwxr-xr-x  24 root root    4096 Mar  6 19:08 ..
-rwxr-xr-x   1 root root    4580 May  4  2004 arch
-rwxr-xr-x   1 root root   98388 Feb 16  2004 ash
-rwxr-xr-x   1 root root  489552 Feb 16  2004 ash.static
-rwxr-xr-x   1 root root   12784 Mar 29  2004 aumix-minimal
lrwxrwxrwx   1 root root       4 Mar  6 16:43 awk -> gawk
-rwxr-xr-x   1 root root   14756 May  4  2004 basename
-rwxr-xr-x   1 root root  593304 Mar 11  2004 bash
lrwxrwxrwx   1 root root       4 Mar  6 16:43 bash2 -> bash
lrwxrwxrwx   1 root root       3 Mar  6 16:43 bsh -> ash
-rwxr-xr-x   1 root root   18372 May  4  2004 cat
-rwxr-xr-x   1 root root   33744 May  4  2004 chgrp
-rwxr-xr-x   1 root root   33344 May  4  2004 chmod
-rwxr-xr-x   1 root root   36028 May  4  2004 chown
```


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List File - ls

Examples

```
]# ls -l
total 92
-rw-r--r--    1  root  root    988   Feb 17   23:04  anaconda-ks.cfg
drwxr-xr-x  2  root  root   4096  Feb 17   23:10  Desktop
drwxr-xr-x  2  root  root   4096  Feb 19   15:44  hksim
-rw-r--r--    1  root  root   61164 Feb 17   23:04  install.log
-rw-r--r--    1  root  root   8557 Feb 17    23:04 install.log.syslog
drwxr-xr-x  3  root  root   4096 Feb 19    15:35 testfolder
]#
```

ls with wild card

```
]# ls
file1  file2  file3
]# ls *i*
file1  file2  file3
]#
```


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Copy File - cp

]# cp file* dir1	copy wild card to directory named dir1
]# cp -f file1 file4	over written of file4 without prompt ?
]# cp –r dir1 dir2	directory copy: dir1 to dir2 with prompt if dir2 exist
]# cp file1 file2 dir2	long list (more information)

normal copy file with question

]# **cp file1 file4**

cp: overwrite `file4'? y

]#

force copy file without questions

]# **cp -f file1 file4**

]#

copy directory must use -r

]# **cp -r dir1 dir2**

]# ls

dir1 dir2 file1 file2 file3 file4

]#

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Move/Rename File - mv

Rename file1 to file2

]# mv file1 file2

Move files

]# mv file1 file2 dir1 move file1 and file2 to directory dir1

]# mv –f file1 file2 if file2 exist, no question ask.

```
]# ls
dir1  file1  file2  file3  file4
]# mv file1 file4
mv: overwrite `file4'? y
]# ls
dir1  file2  file3  file4
]# mv -f file2 file4
]# ls
dir1  file3  file4
]#
```


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Make/Remove File – touch / rm

Create a new file

]# touch file1 create new file called file1

]# touch file1 file2 create two files at time

Remove a file

]# rm file1 delete file1

Get File Format - file

]# file myfile

```
]# file file_number
file_number: ASCII text
]#
```


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Find File Location - find

find

Find a file in a particular tree

]# find / -name myfile.c find file myfile.c in the whole Linux system

]# find /root –name tempinfo find file named tempinfo in /root folder

]# find / -size +5000k 2>/dev/null & find file szie > 1Mbytes at background

Take long time

]# **find / -name** file_number

/root/testfolder/manyfiles/dir2/file_number

]# find / -name file_number &

Run at background mood

Much faster

]# **find /root -name** file_number

/root/testfolder/manyfiles/dir2/file_number

]#

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Find File Location - locate

Locate a file or folder

Search a database for a particular file's location. If the file is just created, it may not yet updated in the database. Can force an update.

]# updatedb &	force update file name database at background mode
]# locate tempinfo	locate the file called tempinfo
]# locate rpm	
]# locate howto	

```
]# locate tempinfo
/root/folder2/tempinfo
/root/folder2/tempinfo~
]#
```


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Find File Location - which

which

Search a specific file in directories that are specified in the PATH variable

]# which grep

/bin/grep

]# which myfile

Note :
]# echo my path is $PATH
my path is
/usr/kerberos/sbin:/usr/kerberos/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/s
bin:/usr/bin:/usr/X11R6/bin:/root/bin
]#

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Link File/Directories - ln

link

ln -s <file/folder to be linked> <link file/folder> Link files or directories

-s means soft link

]# ln -s /mnt /my_link

```
]# ln /mnt /root/my_link
  ln: `/mnt': hard link not allowed for directory

]# ln -s /mnt  /root/my_link
]# ls
anaconda-ks.cfg   hksim         install.log.syslog   testfolder
Desktop           install.log   my_link
]# ls my_link
mnt
]#
```


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Display File's Content - cat

cat

]# cat /<folder path>/myfile display the text file , myfile

]# cat /etc/passwd | more display large text file in control manner

```
dir2]# cat /etc/passwd | more
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:/sbin/nologin
daemon:x:2:2:daemon:/sbin:/sbin/nologin
...
--More--
```


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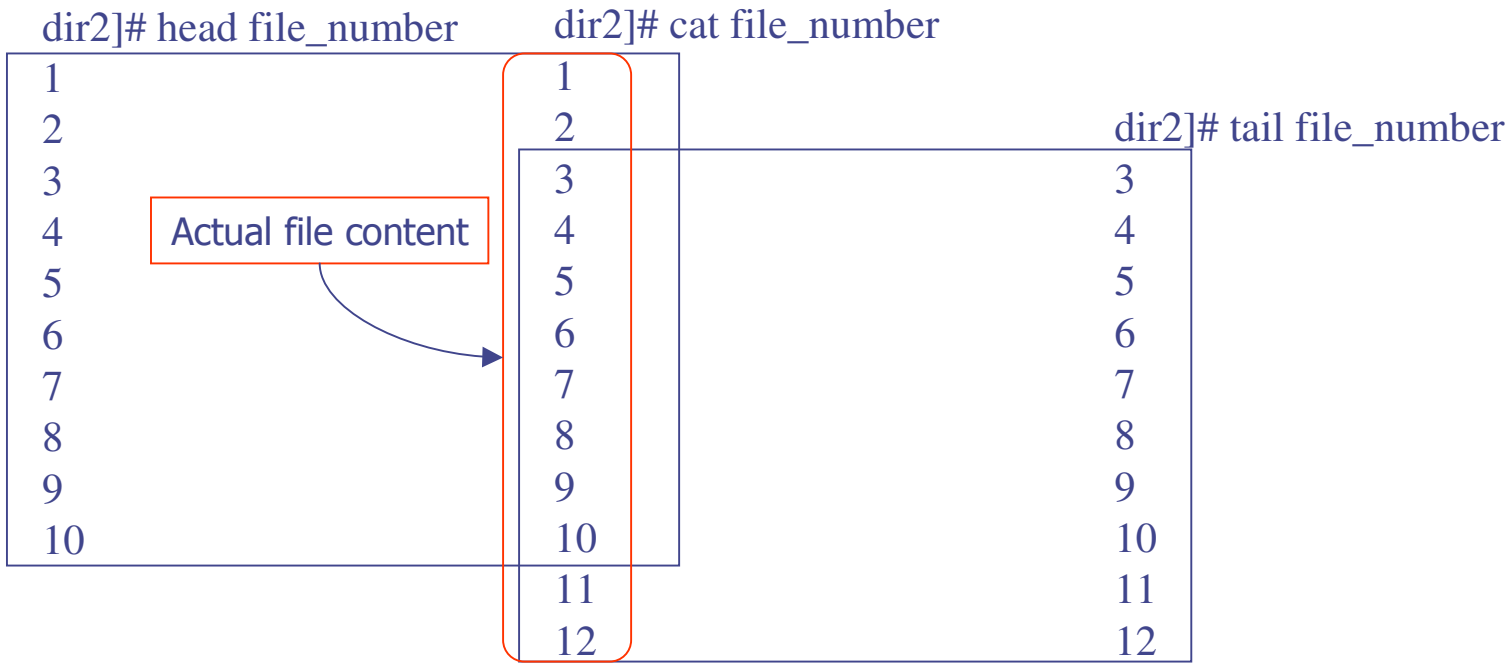
Display File's Content – head / tail

head

]# head myfile	display top 10 lines of the file (default)
]# head –n15 myfile	display top 15 lines of the file

tail

]# tail myfile	display last 10 lines of the file
]# tail –n20 myfile	display last 20 lines of the file



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String Search in File - grep

grep

print the line from a file or input stream that match the expression

grep “<string to search>” <filename>

]# grep “number games” file_number

]# grep –5 “number games” file_number

Display +/- 5 line of
the item found

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Linux file & Extension

- File type

  Text , Binary, Executable

  Directory file, Linked file, Special device file

  Name pipes and socket

- File name

  start with alpha numeric character, underscore (_), dish (-) and period (.)

  maximum 255 character

  file starts with a period (.) is a hidden file

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Linux file & Extension

- configuration file (text file)

  .conf, .cfg - configuration

- Archive / Compress file

  .tar – archive file

  .gz, .bzz, .z – compressed file

  .tar.gz , tgz , .tar.bzz, .tar.z – compressed archive file

- Shell Script file (Batch file)

  .sh – shell script

- Web Programming file

  .html, htm - Hyper Text Markup Language

  .pl - PEAL (Practical Extraction and Report Language)

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Linux file & Extension

- Programming files

  .c - c program

  .cc, .cpp – c++ file

  .so – share Object (programming library file)

  .o – compiled object file

- Text file

  .txt – text file

- Others

  .jpg, .jpeg, .png, tiff, .xpm , .gif – image binary file

  .tcl – TCL (Tool Command Language) program

  .ps – file formatted for printer with post script

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File Ownership - chmod

- When a file is created by an user, the user name and primary group automatically becomes the owner and group of the file
- View user name , enter]# whoami
- View group membership name , enter]# groups
- Every file and directory on a Linux file system contain information regarding 3 permissions : read, write , execute

  each of the 3 categories : user (owner), group (group owner) and others (every one) can be of different permission to a file or directory
- File ownership is important when you have a program to be executed freely or a data file to collect/append data

```
mnt]# whoami
root
mnt]# groups
root bin daemon sys adm disk wheel
mnt]#
```


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File Ownership - chmod

Structure of a file permission

rwx	rwx	rwx
user	group	others
421	421	421

Binary Weighting factor

1 = has the permission
0 = no permission

r- read , w – write , x - execute

110 – has read, has write and no execute permission
101 – has read, no write and has execute permission

755(decimal) - user rwx, group r_x, other r_x

777(decimal) – user/group/other all has rwx permission

To change the permission , use

-]# chmod 755 myfile chmod – change mode

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4.0 Process

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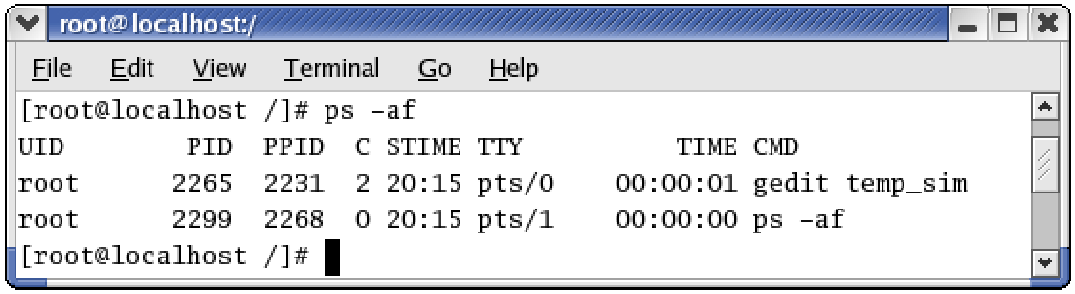
Process & PID

- Multi-tasking OS , like Linux, allow many programs run at once. Each instance of a running program constitutes a process
- A running process consists of program code, variables, file operation and an environment. System share code, libraries among processes
- Each process is allocated a unique number called process identifier or PID.
- A process has its own stack space for local variables in functions and for controlling function call and return. A process must maintain its own program counter, which keep track of program execution.

]# ps –af to see what user process is running



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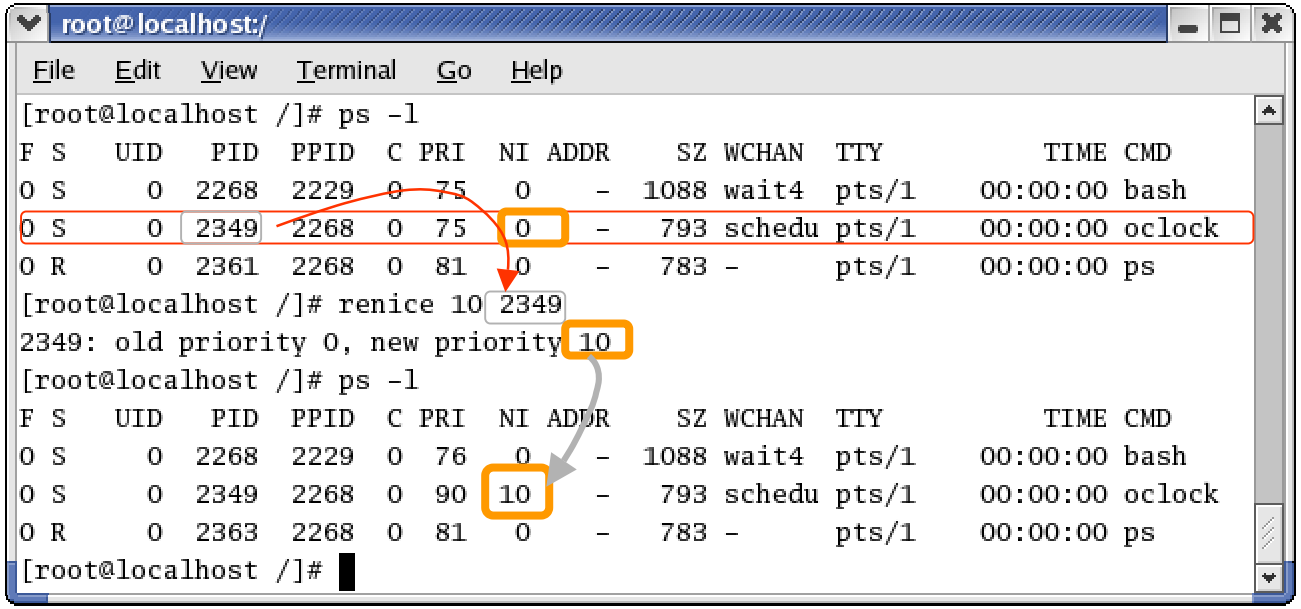
Parent Process & Priority

- To get the system process :
  $ ps –ax try it out
- Each process is started by another process called parent process. The process so started is known as a child process
- Linux uses a process scheduler to decide which process will receive the next time slice. It does this using the process priority. Processes with a high priority get to run more often.



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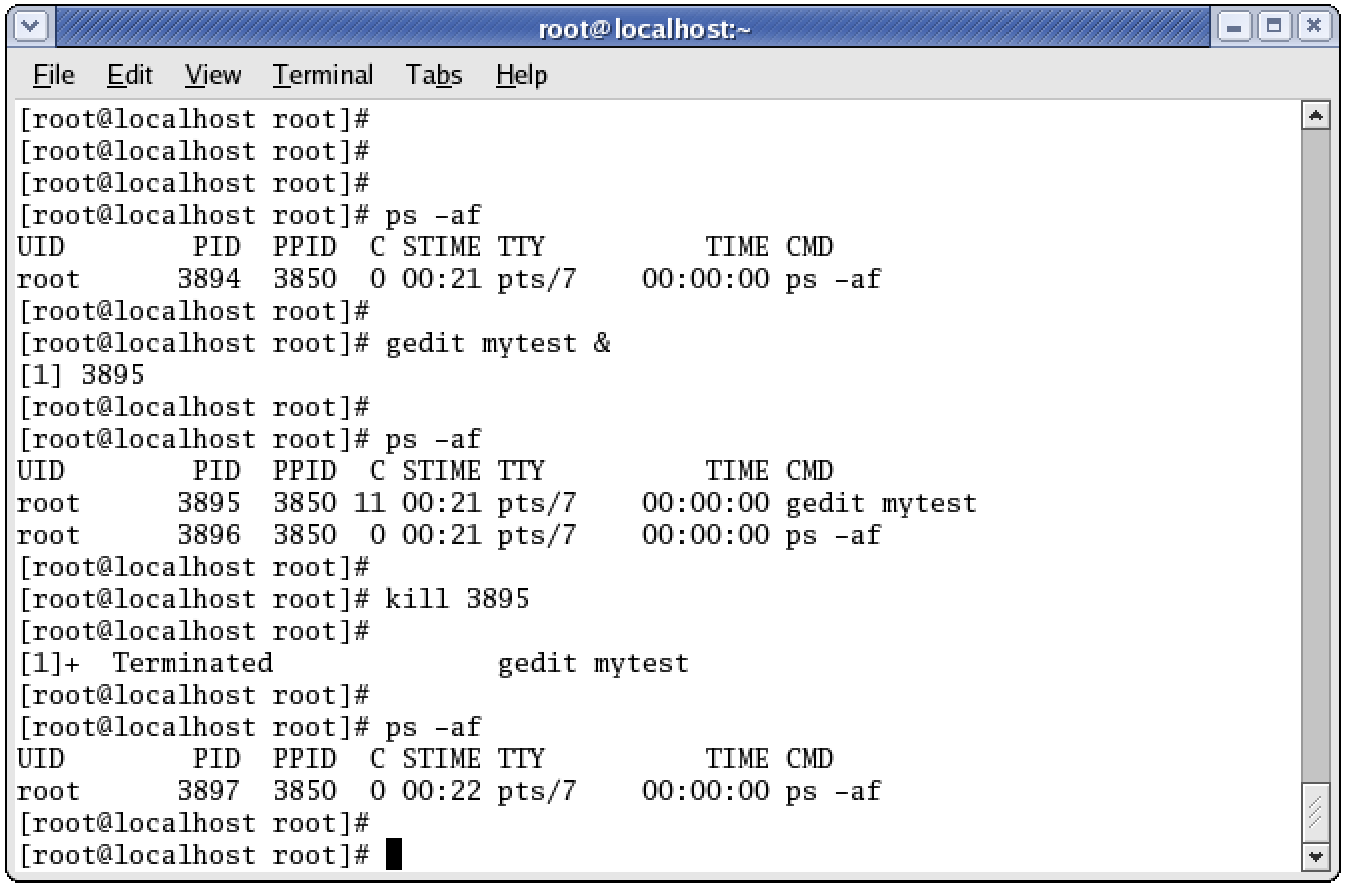
Kill a Process

- To stop a process use]# kill <process ID>



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Important Experience

- If you are developing a program that may cause hang on your Linux operating system, it is good to run the program at the background. This is because if your program go into an unexpected looping, you can still execute "kill' command to stop the program.
  This is important when your program is set to auto-execute mode when the embedded hardware device is powered up

  ]# ./myprogram &

  ….. Hang ….

  ]# ps –af to see the PID of "myprogram"

  ]# kill <myprogram's PID>

Note : If you forget to run your program at background mode and your program hang-up your embedded system and no way to stop , you have to load the factory default and reload all your previous program

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5.0 Hardware Devices

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Linux Devices

- Devices such as disk, terminal and serial port … etc on a Linux are represented by a file called Device file
- Device file are found in folder **/dev**
- Each device file specifies how data should be transferred to and from the device
- Two data transfer methods

  Character device

  information is transferred character by character to and from the device

  e.g. serial port

  Block device

  information is transferred one block at a time by using physical memory to buffer the transfer. Block devices are : floppy drive, CRDOM , hard disk …etc

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Linux Devices

Command device files

- Floppy

  /dev/fd0 /dev/fd1

- IDE Hard disk

  /dev/hda1 - 1st partition on 1st IDE (preliminary master)
  /dev/hdb1 - 1st partition on 2nd IDE (preliminary slave)
  /dev/hdc1 - 1st partition on 3rd IDE (secondary master)
  /dev/hdd1 - 1st partition on 4th IDE (secondary slave)

- SCSI Hard disk

  /dev/sda1 - 1st primary partition on 1st SCSI hard drive
  /dev/sdb1 - 1st primary partition on 2nd SCSI hard drive

- USB memory stick

  /dev/sda1 - treated as SCSI drive

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Linux Devices

- Local terminals
  /dev/tty1 /dev/tty2
- Serial port
  /dev/ttyS0 /dev/ttyS1
- Line printer
  /dev/lp0 /dev/lp1
- Nothing
  /dev/null data send to this device will be discarded
- SCSI tape drive
  /dev/st0
- USB devices
  /dev/usb/*

I/O address :

com1	3f8 – 3ff
com2	2f8 – 2ff
com3	3e8 - 3ef
com4	2e8 – 2ef
LPT1	378 – 37f
LPT2	278 – 2ef

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Linux Devices

❖ Linux device listing


```
]#  ls -l /dev/hda1 /dev/hda2 /dev/hdc1 /dev/hdd1
brw-rw----   1 root disk   3,   1 Feb 23   2004 /dev/hda1
brw-rw----   1 root disk   3,   2 Feb 23   2004 /dev/hda2
brw-rw----   1 root disk  22,   1 Feb 23   2004 /dev/hdc1
brw-rw----   1 root disk  22,  65 Feb 23   2004 /dev/hdd1
```

Major number

Point to the device driver for the device in the Linux kernel. Different device with the same type can share the same major number

Minor number

Indicates the particular device itself.
e.g 1st floppy drive will have different minor number than the 2nd floppy drive

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Linux Devices

```
dev]# ls -l fd0 ttyS0  tty1  lp0  sda1  usb
brw-rw----   1 root floppy 2,   0 Feb 23   2004 fd0
crw-rw----   1 root lp     6,   0 Feb 23   2004 lp0
brw-------   1 root root   8,   1 Feb 23   2004 sda1
crw-------   1 root root   4,   1 Feb 20 15:57 tty1
crw-rw----   1 root uucp   4,  64 Feb 23   2004 ttyS0

usb:
total 0
...
crw-------   1 root root 180,  48 Feb 23   2004 scanner0
crw-------   1 root root 180,  49 Feb 23   2004 scanner1
...
crw-------   1 root root 188,   0 Feb 23   2004 ttyUSB0
crw-------   1 root root 188,   1 Feb 23   2004 ttyUSB1
...
dev]#
```


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Linux Devices

MAKEDEV

Use to re-create the device

]# /dev/MAKEDEV fd0

mknod

Use to re-create the device if you know the type, major and minor number

]# mknod /dev/fd0 b 2 0

```
root]# rm -f /dev/fd0
root]# ls -l /dev/fd0
ls: /dev/fd0: No such file or directory
root]# /dev/MAKEDEV fd0
root]# ls -l /dev/fd0
brw-rw----  1 root floppy 2, 0 Feb 20 21:22 /dev/fd0
root]#
```


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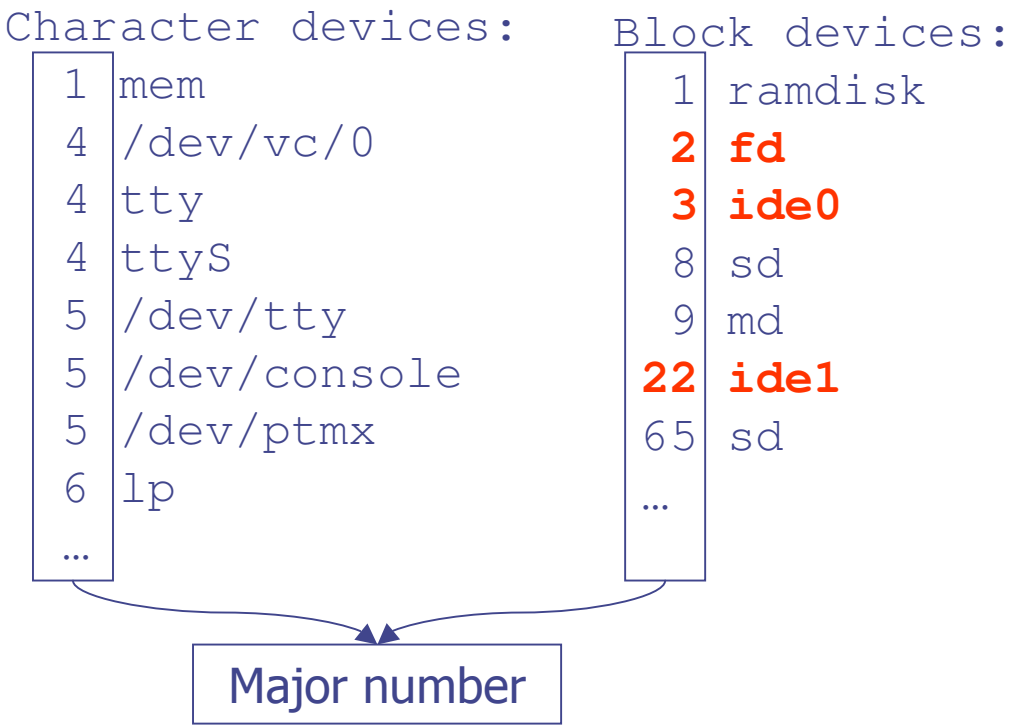
Linux Devices

- To see a list of devices that are currently used on the system and their major number, use

  ]# **cat /proc/devices**



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Linux SWAP & File Format

SWAP memory (virtual memory)

- Temporary storage space to store information that normally reside in the physical memory (RAM)
- At least the size of the physical RAM

File format in Linux

- iso9600 – CDROM file system
- ext2 – traditional filesystem still used on linux computer
- Vfat (Virtual File Allocation Table)- compatible with the FAT filesystem. Recognized by both window OS and Linux OS
- ext3 (or REISER) filesystem
  - much more robust then ext2 & vfat
  - support Journaling

REISER is the default filesystem for SUSE, Lindows, FTOSX,Libranet … etc

Journaling - Keep track of information written to the hard drive in a journal such that the system can retrace the steps the system took place prior to any disruption of a file transfer process , for example

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Mounting of Devices

- Mounting

  when a device is attached to a certain directory on the directory tree, this directory is called a mount point. The process of mounting a device to a directory tree is called mounting. Any existing directory can be a mounting point

- Mounting process can be automatic (auto-detect) or done manually using “mount” command

  in fedora, mounting of standard devices are carry out automatically and are shown in the /mnt directory :

  /mnt/floppy - floppy drice

  /mnt/cdrom - CD-ROM

  /mnt/flash - USB memory stick

  default

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Mounting of Devices

- The following methods are used to view current mounted device :

  ]# cat /etc/fstab - file system table

  ]# cat /etc/mtab - mount table

- Before a device is mounted, it must be formatted to a file system using command mkfs (make file system)

  ]# mkfs –t ext2 /dev/fd0 format floppy to type ext2

  or]# mkfs /dev/fd0 default – ext2

  ]# mkfs –t vfat /dev/fd0 format floppy to vfat file system

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Mounting of Devices

- Display current mounted command

  ]# mount - same as cat /etc/mtab

  …

  /dev/hda1 on / type ext3 (rw)

  → Root file directory

  …

- At boot time, the /etc/fstab is used to mount all the available devices.

  to mount all the file system in the /etc/fstab file that intended at boot time, use]# mount -a

- Format for mount command

  mount –t <type> <device> <mount point >

  fuser –u < mount point > - see who are the users using the device

  umount < mount point > or umount <device>

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Mounting of USB Memory Stick

- Mount an USB memory stick to a customer folder called /root/myusb

  ]# mount –t vfat /dev/sda1 /root/myusb

  ]# ls /root/myusb

- To un-mount the USB stick use :

  ]# umount /root/myusb

  some times the system will not allow you to un-mount. It will reply that device is busy

- To see who is using the device :

  ]# fuser –u /root/myusb

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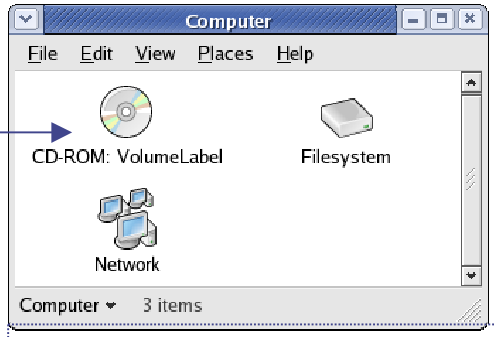
Mounting of CDROM

Insert CD to cdrom drive

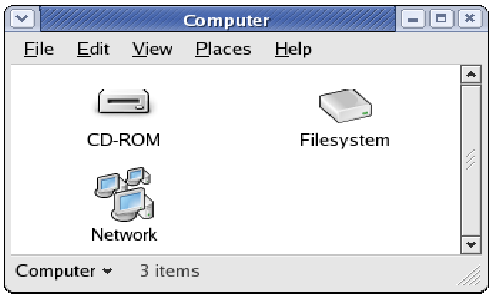
Auto-detect



View the current file system table /etc/fstab

```
[root@localhost root]# cat /etc/fstab
  ...
/dev/hda3               swap                    swap
defaults        0 0
/dev/cdrom      /mnt/cdrom      df,iso9660
noauto,owner,kudzu,ro 0 0
```

At command prompt,
]# umount /dev/cdrom



To eject the CD,
]# eject /dev/cdrom

At command prompt,
]# **mount -t iso9660 /dev/cdrom /mnt/cdrom**
mount: block device /dev/cdrom is write-protected, mounting read-only

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File System Monitoring

- Monitor file system

  ]# df -h

  -h : Human readable format

```
]# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/hdc2              37G  9.5G   25G  28% /
/dev/hdc1              97M  6.0M   86M   7% /boot
none                  110M     0  110M   0% /dev/shm
/dev/sda1             244M  239M  5.1M  98% /mnt/flash
]#
```

- View directory with size

  ]# du -sh /root

  s – size
  h – human readable

```
]# du -sh /root
3.1G    /root
]#
```


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File System Monitoring

- Print out latest kernel message to see some of the devices

  ]# dmesg

  or

  ]# dmesg | grep eth0

Display kernel message . Pipe the output through grep command that display the kernel message with string “eth0”

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6.0 FAQ (Engineering)

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Network - FAQ

- How to check which NIC(Network Interface Card) is ready ? ifconfig –a
- How to temporary change NIC's parameters ?
- How to configure NIC permanently ?
- How to re-initialized NIC ?
- How to know NIC capability : ethtool <eth0/1>

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Network - FAQ

How to Check which NIC is ready

]# ifconfig -a

```
eth0    Link encap:Ethernet  HWaddr 00:14:85:3A:A6:3D
        inet addr:10.20.100.89  Bcast:10.20.100.255  Mask:255.255.255.0
        inet6 addr: fe80::214:85ff:fe3a:a63d/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:76 errors:0 dropped:0 overruns:0 frame:0
        TX packets:39 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:9015 (8.8 Kb)  TX bytes:3408 (3.3 Kb)
        Interrupt:10 Base address:0xa400

eth1    Link encap:Ethernet  HWaddr 00:10:4B:37:8C:BB
        BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:4 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 b)  TX bytes:308 (308.0 b)
        Interrupt:11 Base address:0x7000
```

eth0 is present and working- has IP address

eth1 is present but NOT working- no IP address.

Note : eth1 is disconnected from the Ethernet Switch

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Network - FAQ

How to temporary change NIC's parameters ?

- NIC's parameters can by temporary change by using ifconfig

  ifconfig eth0 10.20.100.88 netmask 255.255.255.0 up

  Activate the interface for new setting

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Network - FAQ

How to configure NIC permanently ?

Note : in A-LimEmb is /etc/conf.d/net.eth0 or net.eth1

❖ In fedora core 2, to setup NIC permanently, go to

/etc/sysconfig/network-scripts/ifcfg-eth0 for 1st LAN port on Linux PC
/etc/sysconfig/network-scripts/ifcfg-eth1 for 2nd LAN port on Linux PC

/etc/sysconfig/network-scripts/ifcfg-eth0

```
#Realtek|RTL-8139/8139C/8139C+
DEVICE=eth0
BOOTPROTO=static
HWADDR=00:14:85:3A:A6:3D
ONBOOT=yes
TYPE=Ethernet
NETMASK=255.255.255.0
IPADDR=10.20.100.89
USERCTL=no
PEERDNS=yes
IPV6INIT=no
GATEWAY=10.20.100.10
```

/etc/sysconfig/network-scripts/ifcfg-eth1

```
# VIA Technologies|VT6105 [Rhine-III]
DEVICE=eth1
ONBOOT=yes
BOOTPROTO=dhcp
HWADDR=00:10:4B:37:8C:BB
NETMASK=255.255.255.0
IPADDR=10.20.100.90
USERCTL=no
PEERDNS=no
TYPE=Ethernet
IPV6INIT=no
GATEWAY=10.20.100.10
```


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Network - FAQ

How to re-initialize NIC

- NIC can be re-initialize any time using ifstop <NIC name>, and ifup <NIC name >

```
]# ifstop eth1
]# ifup eth1
   Determining IP information for eth1...SIOCADDRT: File exists
   done.
]#
]# ifconfig -a
...
eth1      Link encap:Ethernet  HWaddr 00:10:4B:37:8C:BB
          inet addr:10.20.100.54  Bcast:10.20.100.255  Mask:255.255.255.0
          inet6 addr: fe80::210:4bff:fe37:8cbb/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:3 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:893 (893.0 b)  TX bytes:1028 (1.0 Kb)
          Interrupt:11 Base address:0x7000
```

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Network - FAQ

How to know NIC capability : ethtool <eth0/1>

]# ethtool eth0 ***- Linked***

```
Settings for eth0:
        Supported ports: [ TP MII ]
        Supported link modes:   10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
        Supports auto-negotiation: Yes
        Advertised link modes:  10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
        Advertised auto-negotiation: Yes
        Speed: 100Mb/s
        Duplex: Full
        Port: MII
        PHYAD: 32
        Transceiver: internal
        Auto-negotiation: on
        Supports Wake-on: pumbg
        Wake-on: d
        Current message level: 0x00000007 (7)
        Link detected: yes
]#
```

]# ethtool eth1 ***- NOT Linked***

```
Settings for eth1:
        Supported ports: [ TP MII ]
        Supported link modes:   10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
        Supports auto-negotiation: Yes
        Advertised link modes:  10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
        Advertised auto-negotiation: Yes
        Speed: 10Mb/s
        Duplex: Half
        Port: MII
        PHYAD: 1
        Transceiver: internal
        Auto-negotiation: on
        Current message level: 0x00000001 (1)
        Link detected: no
]#
```

No link default setting, lowest speed and half duplex

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Serial Port Utility (minicom) - FAQ

- What is serial port utility in Linux (like hyper-terminal in Window) ?
  minicom
- How to set minicom for just serial port application ?]# minicom

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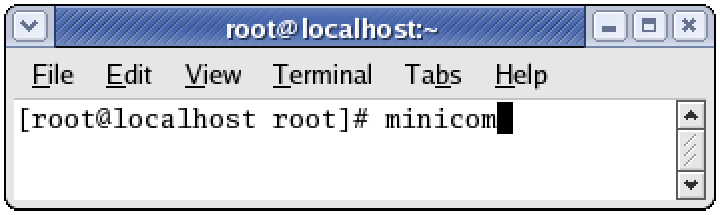
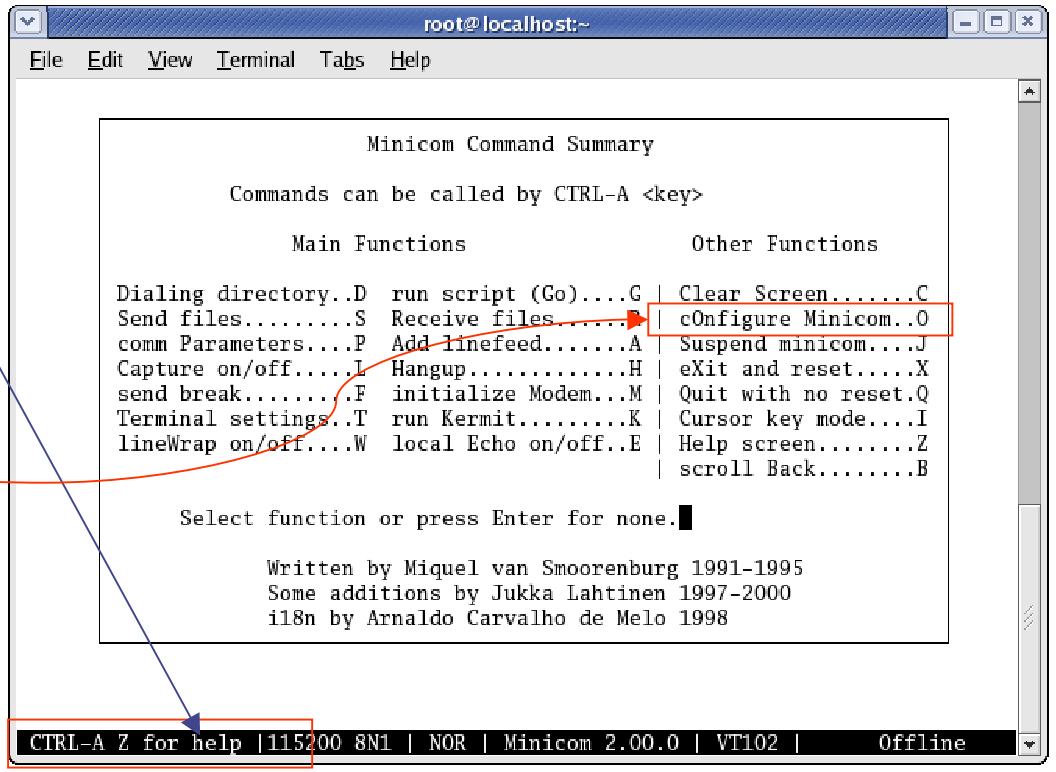
Serial Port Utility (minicom) - FAQ

How to Start minicom

- Start minicom]# minicom



- Use CTRL-A Z to enter into help
- Select 'O' to go into configuration



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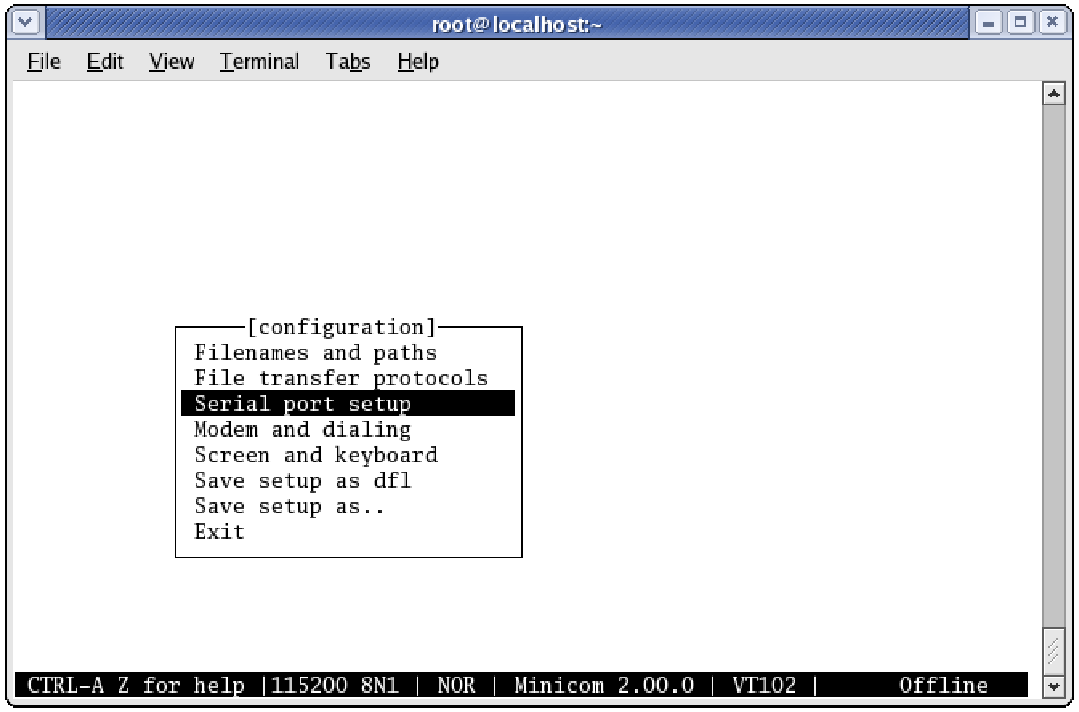
Serial Port Utility (minicom) - FAQ

How to Configure Minicom

- Select “Serial port setup”



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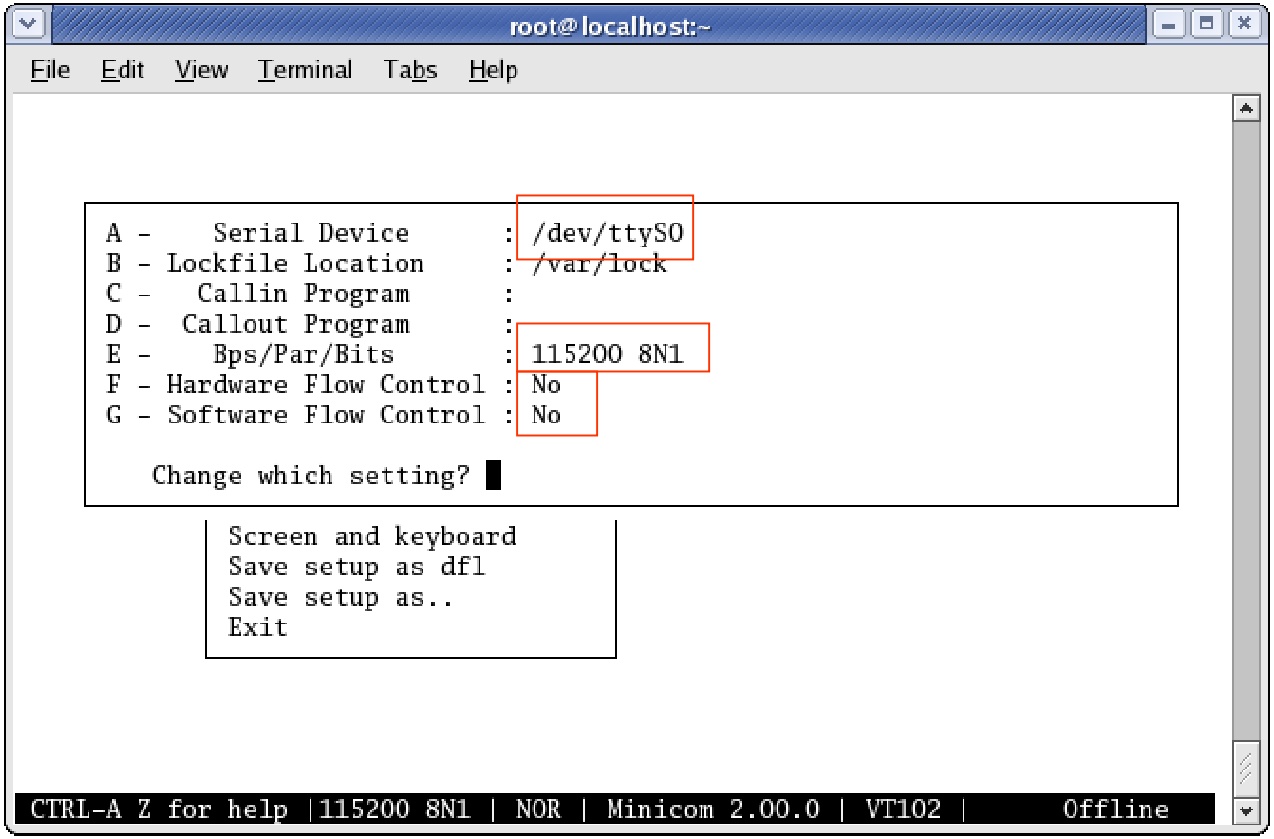
Serial Port Utility (minicom) - FAQ

How to Configure Minicom

- Change to /dev/ttyS0
- Set rate to 115200 8N1 , no hardware & software flow control



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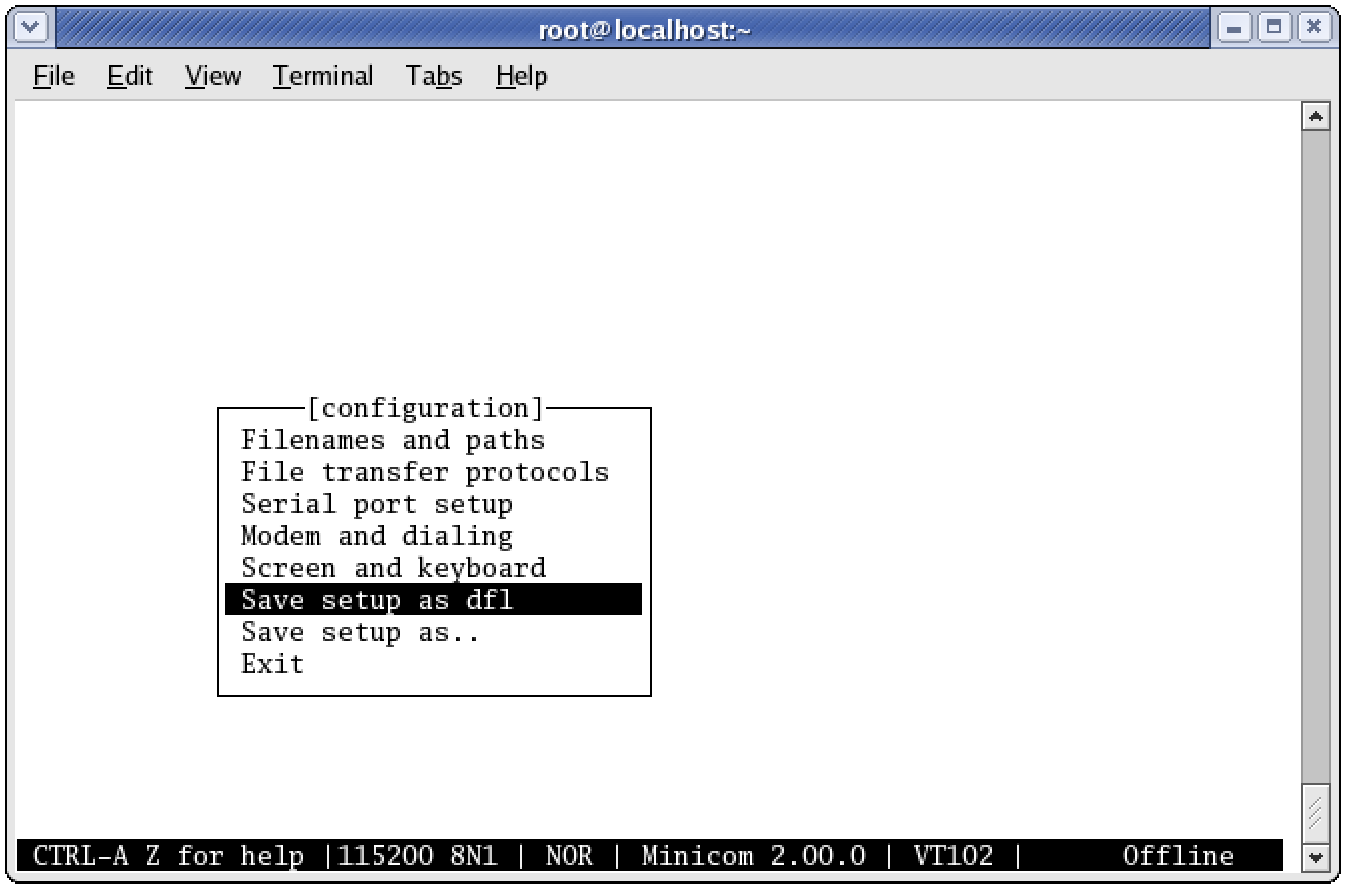
Serial Port Utility (minicom) - FAQ

How to Configure Minicom

- Don't forget to save your setting in default file named "df1"



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WebServer - FAQ

- How to quick setup Apache Web Server ?
- Which folder store HTML file, CGI or User define web page ?
- How to set default web page file name ?
- How to access to individual web folder using internet browser ?
- How to use special port instead of port 80 ?

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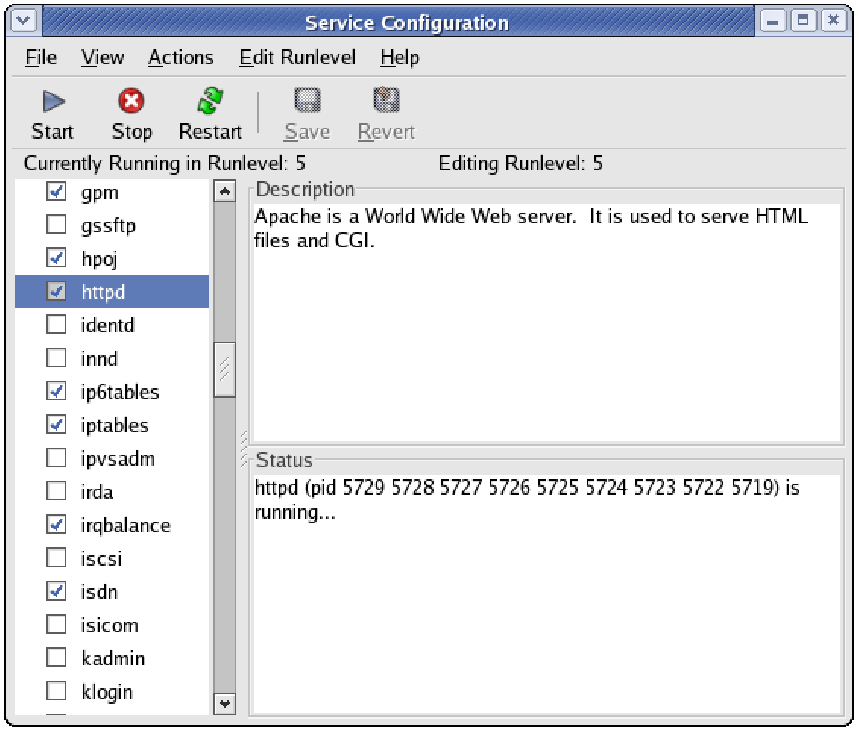
WebServer - FAQ

How to quick setup Apache Web Server ?

- Make sure http service is running : go to GUI,

  system setting -> server setting -> service

  make sure httpd selection is checked



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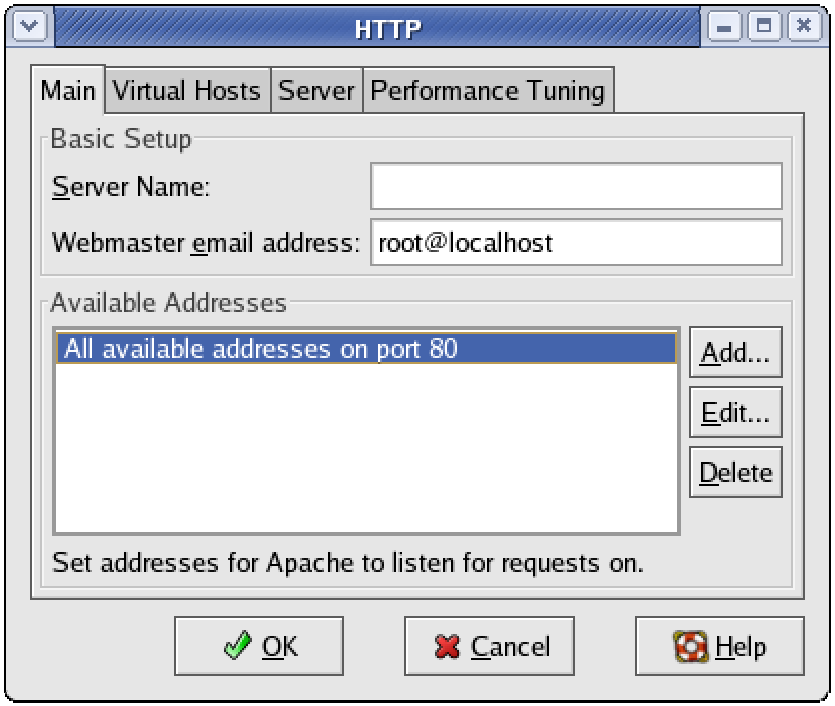
WebServer - FAQ

How to quick setup Apache Web Server ?

- Make sure http service is running : go to GUI,
  system setting -> server setting -> HTTP
  make sure setting is correct



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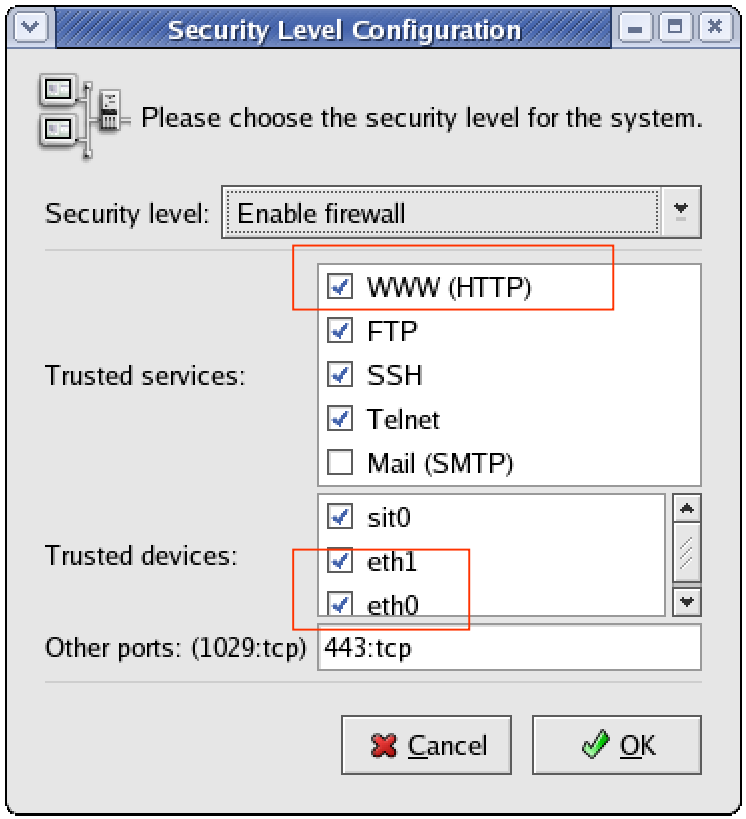
WebServer - FAQ

How to quick setup Apache Web Server ?

- Make sure security level is set correctly :
  go GUI : system setting -> security level
  check trusted service if the service is allow. Also check the necessary trusted devices



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WebServer - FAQ

How to quick setup Apache Web Server ?

- In fedora core 2, the web server configuration file is in folder /etc/httpd/conf/httpd.conf
- Your web server computer must have an IP address (fix - prefer or dynamic)
- To view your IP address, use ifconfig –a on your Linux web server PC
- Key setting in the httpd.conf files :

```
#Listen 12.34.56.78:80
#Listen 80      # any IP on this system
Listen 10.20.100.71:80
…
```

```
DocumentRoot "/var/www/html“
```

```
…
ScriptAlias /cgi-bin/ "/var/www/cgi-bin/"
ScriptAlias /userweb/ "/var/www/userweb/"
```


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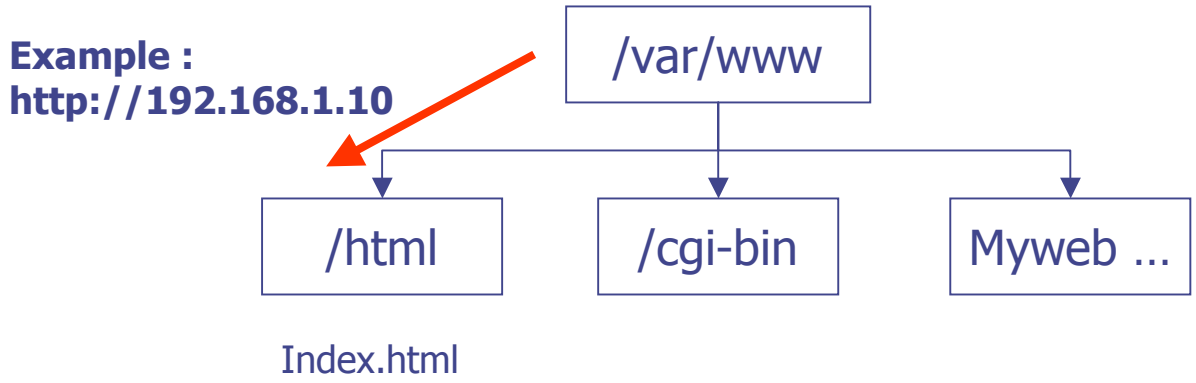
WebServer - FAQ

How to quick setup Apache Web Server ?

- By default, when you http://<web server IP address> you will access to the folder /var/ww/html.
- Put your default web page , index.html, and associate files into this folder



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WebServer - FAQ

Which folder store HTML file, CGI or User define web page ?

- For proper house keeping, all cgi should put in the folder /cgi-bin which is created during installation with some default CGI programs . you can also create a folder called /userweb where it stores all your web pages. Both folder is under path /var/www/ directory. i.e.
  /var/www/html
  /var/www/cgi-bin
  /var/www/userweb

How to access to individual web folder using internet browser ?

- To access the cgi folder , use http://<server IP address>/cgi-bin/mycgi.cgi
- To access the myweb folder, hse http://<server IP adderss>/userweb/

(if your default page name is index.html in the myweb folder)

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