Linux

LPI 101

Exam
Preparation
Version - 2

91- LPI-101 -V2 -Exam Preparation

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About this document:

This document is been produced to help candidates to pass the LPI 101 exam. I have created it essentially as a reference document and not as a tutorial. That's why in general, this document doesn't have many explanations for the subjects treated. I usually use it in my courses designed as preparation to this exam. Although it covers, to my knowledge, the most important aspects of the topics asked in the exam, its layout and its content organization is not perfect. Helped by this document, most of my students, if they practiced enough, passed the exam. In some topic I have added more information than needed for the LPI 101 exam. When in doubt, just read again the description of the requirements located at the beginning of each topic.

I offer this document free. You may distribute, modify, improve, use personnaly or commercially as you whish. I don't take any responsibility of any kind for the accuracy of the information in this document as well as for the success or failure of the participants in passing the exam.
I would only appreciate that, if you make modifications to this document, that you send me a copy of it.
My first language being French, the english phrase constructions and vocabulary may suffer a bit in this document.

I do invite you to let me know of any errors or recommendations related to the accuracy of the information in this doicument, that would help me to improve it. Any feedback of any kind is also welcome. If anybody wants to contribute to this document, you're very welcome, please let me know.
My email: michel@linuxint.com

I hope it will help you preparing for the LPI 101 exam and remember that, practice, practice, and more practice is the key.

LPI 101 Introduction:

This is a required exam for LPI certification Level 1. It covers basic system administration skills that are common across all distributions of linux.
Each objective is assigned a weighting value. The weights range roughly from 1 to 10, and indicate the relative importance of each objective.
Objectives with higher weights will be covered in the exam with more questions.

Special exam questions attentions:

- Most questions that require that you fill-in the blank, don't require any options. eg. `cat` or `ls` or `cp` (without options)
- Use your experience and common sense in deciding what is important and what is not when studying. When in doubt, just read again the description of the requirements located at the beginning of each topic.
- It is recommended to create a checklist of topics for yourself and to review it once in a while to keep an overview. This can help avoiding spending too much time in one subject at the expense of other important subjects.

- Pay attention to the weight of each topic and spend the equivalent time on them.

- When doing the exam, it is recommended to answer first the questions that you are sure of and then go back to the other ones afterwards.

- Read the questions thoroughly and make sure you understand them well. Then read ALL the answers carefully before answering. I almost got cought a few times, answering someting I was sure it can't be anything else but when I read the other answers I saw which one was really the correct answer.

- The exam is difficult and needs concentration and a good memory. It is not recommended to eat a heavy meal before the exam.

- No need to rush through the exam and risk overviewing something. There is more than enough time to answer all the questions. When you're finished and there is still time, take the time to review your answers once.

LPI-101 Detailed LPI Topics

1.101 - Hardware & Architecture

- General hardware
  - Processor, BIOS, RAM , Address Bus system, Data Bus system
- Address and IRQ conflicts
  - IRQ Table
    - Used by system: 1,2,6,8,14,15
    - Mostly Free: 5,9,10,11,13
    - May be Freeable: 3,4,7,12
- IRQ Sharing: PCI Mostly OK, ISA – Not sharable
- DMA:
  - 8 DMA Channels.
  - DMA-4 is always busy.
  - Normal use: DMA 1,2 or 3.
  - Watch for conflicts DMA!!
- Setting Hardware ADDR,IRQ,DMA
  - Peripherals Integrated in Motherboard: via BIOS
  - Old ISA expansion boards: Jumpers and DIP Switches on boards
  - Newer ISA expansions boards: Jumpers(ADDR)and software (IRQ)
  - ISA Plug-And-Play expansion boards: BIOS or OS PNP feature
  - PCI expansion cards: Via BIOS and OS using PCI bus
  - Memory Base of certain PCI cards for RAM or BIOS direct on the cards
- **Setting and reading the hardware and system time**

```
date                  Show current system time and date
date -s "15:34"       Set the System time

hwclock               Show the hardware clock time setting
hwclock --localtime   Keep hardware clock to local time mode
hwclock --utc         Keep hardware clock to utc time mode

hwclock --set --date="9/22/2002 16:45:05"
hwclock --hctosys     Sets the system time to current hardware clock
```

- Setting the Hardware and System clock in one command:
  `setclock 09/18/2003 21:13:00`
  (Thu Sep 18 21:13:00 EDT 2003)
- Time Variables in `/etc/sysconfig`
  `HWCLOCK="--localtime"` for `localtime` mode `-u` for `utc` time mode
  When SuSE boots-up it set the time from the script `/etc/init.d/boot`
- Files that have some relation to time are:
  `/usr/lib/zoneinfo/localtime` --> `/etc/localtime` (binary)
  `/etc/adjtime` Temporary file used to adjust the time regularly

- `ksysctrl-` Is good at displaying the found system devices a-la-Windows.
- `hwinfo` - Shows a lot of automatically found hardware and their info. (SuSE)
- `lsdev` - Shows a list of recognized devices and their I/O Addr, IRQ and DMA
- `procinfo-` Shows a list of recognized devices and their I/O Addr and IRQ
- `MAKEDEV` - Command to create devices
- `losetup` - Set up and control loop devices

- **KERNEL MODULES** (general)

  - To list all the Kernel modules already loaded:
    `lsmod`
    `cat /proc/modules`

  - To get more info about a module
    `modinfo` *`modulename`*

  - To load a kernel module use `modprobe` or `insmod`.
    `modprobe` is recommended because it checks the dependencies of the module.

  - To remove a kernel module:
    `modprobe -r` *`modulename`* (without the `.o`) or
    `rmmod` *`modulename`* (without the `.o`)

  - To list all loadable kernel modules who woudn't load properly because of missing symbols: (missing symbols = dependency not respected):
    `depmod` (see `man depmod` for more info on modules dependency)

  - Configuration files for Hardware modules:

    `/etc/modules.conf` Older configuration used by modprobe to change the way a module is loaded or unloaded. Although this file is an older format it provides a lot of functions.

    `/etc/modprobe.conf` Newer configuration file for modprobe command which is used for the same purpose as `/etc/modules.conf` (older).

    Note: It is still unknown to me which one of the two above configuration files would be used if both would be present in a system.

  - **Listing the modules options of `/etc/modprobe.conf`:**
    `modprobe -c`

- **Getting information on hardware**

- **USB**

`lsusb` - Lists all connected USB devices
`/sbin/hotplug` - Script, handles hot-pluggable PCI & USB devices.
`rchotplug {start|stop}` - Starts/Stops USB and PCI configurator.
`usbmodules --device /proc/bus/usb/`*`NNN/nnn`*
- Lists kernel modules corresponding to USB devices currently plugged into the computer. *eg.*
`usbmodules --device /proc/bus/usb/001/009`

- **PCI**

`lspci` - List all PCI devices
`cat /proc/pci` - "" "" ""
`setpci` - Configure PCI devices
`pcitweak` - Read/write/list PCI config space
`scanpci` - Scan/probe PCI buses
`/sbin/hotplug` - SuSE cript to handle hot-pluggable PCI and USB devices
`rchotplug {start|stop}` - Starts/Stops USB and PCI configurator

- **PCMCIA**

`cardinfo` - X-Program to list and control PCMCIA cards
`cardctl` - ASCII program to control the PCMCIA cards
`dump_cis` - ASCII program to list PCMCIA cards and their parameters
`cardmgr` - Daemon who loads and unloads PCMCIA kernel modules for inserted cards.
`/etc/init.d/pcmcia` - Script to load PCMCIA `cardmgr` as daemon

- **PNP**

`lspnp` - To list Plug and Play BIOS device nodes and resources.
`/etc/isapnp.conf` - File used by `isapnp` see also `man setpnp` for info on controlling `pnp` devices resources.
`isapnp /etc/isapnp.conf` - Sets the PNP devices according to `/etc/isapnp.conf`

- **SCSI**

`sg_map` - Displays mapping between `sg` and other SCSI devices.
`cat /proc/scsi/scsi` - Displays information about all SCSI devices that can be : `hdx`, `srx`, `sgx`, `scdx`
`scsiinfo -l` - List of active SCSI device in system. eg. `/dev/sda /dev/scd0` etc.
`sg_reset` - exercises SCSI *device/bus/host* reset capability
`scsi_info` - SCSI device description tool
`sg_test_rwbuf` - Tests the SCSI host adapter by issueing write and read operations on a device's buffer and calculating checksums.
`lsscsi` - list all SCSI devices (or hosts) currently on system
`mover` - utility to control scsi media changers
`sg_scan` - does a SCSI bus scan and prints the results to STDOUT
`sg_senddiag` - performs a SCSI SEND DIAGNOSTIC command

`sg_logs` - reads SCSI LOG SENSE pages
`scsidev` - populate `/dev/scsi` with device names that are persistent against SCSI configuration changes.
`sg_start` - starts (spins-up) or stops (spins down) SCSI devices
`sg_map` - displays mapping between sg and other SCSI devices
`scsiinfo` - query information from a scsi device
`sg_readcap` - calls a READ CAPACITY command on a SCSI device
`sg_rbuf` - reads data using SCSI READ BUFFER command
`sg_inq` - outputs data retrieved from the SCSI INQUIRY command
`sginfo` - outputs mode sense information for a SCSI generic device the given device
`sg_modes` - reads SCSI MODE SENSE pages
`xmover` - X11 frontend for scsi media changers
`scsi_devfs_scan` - Scan SCSI devices within a devfs tree
`sane-find-scanner` - find SCSI and USB scanners and their device files
`scsiformat` - low level format an scsi disk device

- **SERIAL**
  `cat /proc/tty/drivers` - The serial ports being detected.
- **CDROMS**
  `cat /proc/sys/dev/cdrom/info` - The CD-ROMS devices names and their capabilities. Note: scsi cdroms can be `scdx`
- **I/O ADDRESSES**
  `cat /proc/ioports` - I/O Addresses used by which device.
- **I/O MEMORY**
  `cat /proc/iomem` - Memory Addresses used by the devices.
- **INTERRUPTS**
  `cat /proc/interrupts` - Interrupts used by the devices
- **DMA**
  `cat /proc/dma` - DMA channels in use.
- **CPU**
  `cat /proc/cpuinfo` - CPU hardware information
- **DEVICES**
  `cat /proc/devices` - Character & Block devices used and their IDs.
  `lsdev` - Display recognized devices IRQ,DMA and IO.
- **KERNEL OPTIONS**
  `cat /proc/cmdline` - Kernel options given at boot time
- **FILESYSTEMS**
  `cat /proc/filesystems` - Filesystem types recognized by linux. '`nodev`' = it doesn't have any physical device.
- **SYSTEM MEMORY**
  `cat /proc/meminfo` - System Memory management information

The /proc file system.

- Connection (window) to the kernel's internal workings. Mostly ReadOnly.

- Each process get a directory in `/proc` (named after their PID). Content is:

`cmdline`	What started the process
`cwd`	Symlink to dir where user was when he started the command
`environ`	Environment of process.
`exe`	Symlink to the running program (full path)
`root`	root dir. for the process. (may be changed using command `chroot`)
`fd`	file descriptors (eg. 0,1,2,255. used in `prgm 1>&2` etc.)

- Hardware information/parameters: readable via the program `cat` or `less`:

Hardware Parameters

`interrupts`	IRQ used by peripherals
`ioports`	IO Address used by peripherals
`dma`	DMA used by peripherals
`iomem`	Video RAM/ROM, System RAM/ROM, PCI system memory, VESA Frame buffer, reserved areas.

Other hardware information

`cpuinfo`	Processor type/model, speed, internal cache size, etc.
`partitions`	List of known local PC partitions with major and minor numbers.
`pci`	Scan of peripherals on PCI bus and AGP slot.

Kernel and software information

`cmdline`	Kernel start command and parameters.
`filesystems`	List if file systems know by the Kernel.
`meminfo`	Info about usage of available memory
`modules`	List of loaded modules
`mounts`	List of mounted filesystems. Here are also the mounted filesystems that were mounted with the option `-n` and hidden from `/etc/mtab` and `df` command.
`version`	Present Kernel version.

Extra important directories in `/proc`

`bus`	Info about system busses found in systems
`ide`	Info about IDE controllers and devices
`scsi`	Info about SCSI controllers and devices
`net`	Network info like ARP Info, Routing table etc
`sys`	WRITEABLE system control table.

Plug and Play

- Description PNP cards have an internal list of Addr,IRQ,DMA to which it can set-itself to, if requested.
  Linux is NOT automatic PNP compatible. It must be done manually.
  Two programs are available for this:
  - `pnpdump` Scans the ISA bus for PNP cards and displays the possible settings of each PNP card found.
  - `isapnp` Reads a PNP configuration file and sets the PNP cards accordingly.
- Manual Process: (Using: SuSE package:`isapnp` Debian package: `isapnptools`
  1. Collect possible settings from PNP cards. Scans addresses `0x0273` to `0x03f3`
     `pnpdump > /etc/isapnp.conf`
  2. Edit the file and activate the desired settings of each PNP cards (*)
     `vi /etc/isapnp.conf`
  3. Set the PNP cards as per `/etc/isapnp.conf`. Must be done at every boot.
     `isapnp /etc/isapnp.conf`

  (*)Editing the `/etc/isapnp.conf`
  Find:
  IO ADDRESS:
  - First IO base address possible: `Minimum IO base address 0x0`*`240`*
  - Last IO base address possible: `Maximum IO base address 0x0`*`3e0`*
  - Address block size: `Number of IO addresses required:` *`32`*
  - Take a look at the already used IO addresses in system : `cat /proc/ioports`
  - Make a list of possible IO base addresses for this card.
    (First IO base address possible + Address block size) etc
    eg. `240, 260, 280, 2A0, 2c0, ..., ..., 3e0`
  - Chose a free address, write it in the following line and ucomment the line:
    `(IO 0 (BASE 0x`**`340`**`))`

  IRQ:
  - Proceed the same way as above for IRQs and at the end uncomment the line:
    `(INT 0 (IRQ` *`xx`* `(MODE +E)))` (*xx*=chosen IRQ)
  - Finally activate the card by uncommenting the line: `(ACT Y)`

1.101.1 Configure Fundamental BIOS Settings Weight: 1

Description: Candidates should be able to configure fundamental system hardware by making the correct settings in the system BIOS. This objective includes a proper understanding of BIOS configuration issues such as the use of LBA on IDE hard disks larger than 1024 cylinders, enabling or disabling integrated peripherals, as well as configuring systems with (or without) external peripherals such as keyboards. It also includes the correct setting for IRQ, DMA and I/O addresses for all BIOS administrated ports and settings for error handling.

- **Key files, terms, and utilities:**
  `/proc/ioports`
  `/proc/interrupts`
  `/proc/dma`
  `/proc/pci`

- **Purpose of BIOS:** Middleman program (in ROM) between non-standard hardware architecture (main board) and the operating system.
  Linux deals directly with some hardware (eg. IDE Controller) for reasons of speed and better control.

- **CMOS Set-up program:**
  Triggered at booting by possible key combinations: DEL (Entf), F2, <Ctrl-Alt-ESC> etc.

- **Hard disk Set-up:**
  Although the hard disk controller is accessed directly by Linux, some HD settings in CMOS are still important.
  - HD cylinders have physically less sectors in the inside of the disk as on the outside.
  - LBA (Large Block Architecture) logically diminishes the number of cylinders and raise the number of heads.
  - LBA is important if Number of physical cylinders is more than 1024 even if Linux doesn't use the BIOS to access the HD.
    Reasons: - `fdisk` reads the BIOS for HD Parameters
    - `lilo` and GRUB are loaded from the BIOS.

- **Errors handling:**
  Normal is: `Halt on all errors` (no booting continues if any type of error occur)
  Linux server without keyboard: `Halt on all errors but keyboard`.

- **Peripherals settings:**
  - Turn off any unused device. eg. COM ports, Mouse, IDE channels if SCSI used, etc

- **IRQ Reserving for older ISA cards**
  These parameters are read from the ISA PNP and PCI cards and deletes them from their possible parameters list. When asked for possible set-ups,(eg. by `pnpdump`) the PNP cards will not have these reserved addresses.

1.101.3 Configure Modem and Sound cards

Weight: 1

Description: Ensure devices meet compatibility requirements (particularly that the modem is NOT a win-modem), verify that both the modem and sound card are using unique and correct IRQ's, I/O, and DMA addresses, if the sound card is PnP install and run sndconfig and isapnp, configure modem for outbound dial-up, configure modem for outbound PPP | SLIP | CSLIP connection, set serial port for 115.2 Kbps

Modems

- Check the hardware compatibility list from the distribution used.
- Good source of hardware info is the Hardware-HOWTO
- Normal modems are controlled by AT commands (Hayes compatible)
- Watch for WinModems. They are not real hardware modems. This section is not for them. Winmodems are hardware that don't have this AT commands intelligence and rely on drivers to silmulate it. More about it at `www.linmodems.org`

Sound Cards

- LPI concentrates on OSS sound technique. (Open Sound System)
- Each sound board type needs its own kernel module.
- Program for sound card installation: `sndconfig` (RedHat and others)
  - It scans possible sound cards IO ports and is menu driven.

    Standard I/O port for soundcard is: **********

    It handles the PNP and older ISA sound cards as well.

• 1.101.4 Setup SCSI Devices Weight: 1

Description: Candidates should be able to configure SCSI devices using the SCSI BIOS as well as the necessary Linux tools. They also should be able to differentiate between the various types of SCSI. This objective includes manipulating the SCSI BIOS to detect used and available SCSI IDs and setting the correct ID number for different devices especially the boot device. It also includes managing the settings in the computer's BIOS to determine the desired boot sequence if both SCSI and IDE drives are used.

- **Key files, terms, and utilities:**
  `SCSI ID`
  `/proc/scsi/`
  `scsi_info`
- **Notes:**
  - SCSI=**S**mall **C**omputer **S**ystem **I**nterface
  - Purpose: Learning to set-up the SCSI devices in respect to BIOS, SCSI-ID, booting
  - Use o SCSI: Still in server industry, offers reliability, endurance, Hot-Plug features.
  - Tools: SCSI-ID, `/proc/scsi, scsi_info`
    (`scsi_info` is from Packages: SuSE: `pcmcia`, Debian: `pcmcia-cs`)

- **Architecture of SCSI:**
  - Number of devices with SCSI, including the SCSI controller itself:
    Standard: 8
    Wide: 16

  - Properties and rules of SCSI
    - Cable joining the devices is 50 wires wide
    - No 'T' branching in the cable
    - Each end of the cable must be terminated 330 Ohms to GND and 220 Ohms to +5
    - Minimum 10cm of cable between SCSI devices
    - Maximum length of 50strands cable: 3 Meters (>4 devices Max:1.5 Meters)
    - End of the cable must have a device attached to it.

  - Types of SCSI:
    - Standard(SCSI-1): 8 Devices 10 Mhz Maximum
    - SCSI-2, FAST-SCSI-2, Wide-SCSI-2(68 strand cable, 16 bit bus):
      Faster, command set is better
    - SCSI-3 even faster but still in development (no meaning for LPI)

  - SCSI speed table:

Bus width	Cable Width	Standard	Fast	Ultra	Devices
8-Bit	50 Strands	5 MB/sec	10 MB/sec	20 MB/sec	7+Ctrlr
Wide-16-Bit	68 Strands	10 MB/sec	20 MB/sec	40 MB/sec	15+Ctrlr

Possible names alike Ultra-Wide- or Fast-Wide, etc are possible

- Addressing SCSI devices:
  - SCSI-ID = 0 to 7 or 0 to 15
  - The SCSI Controller on the highest priority = highest ID: 7 or 15
  - If booting is from SCS then boot HD must be on ID 0
  - Each SCSI-ID can contain LUNs(Logical Unit Number)
  - Each CSCI cable(Bus) receives also a number (0,1,2 etc)
  - Each SCSI device can then be identified as follows:
    BusNumber, SCSI-ID, LUN
    Normally `0,x,0` eg. `/dev/sda` is on `0,0,0`

- SCSI Onboard BIOS
  - Separate and unknown from system BIOS
  - Used to boot SCSI drives and changing controller parametrers
  - Cheap Controllers don't usually have On-Board BIOS. More expensive ones do.
  - Newer Controllers even allows via software to assign SCSI-IDs to devices.
  - Role of the Controller:
    - Assignment of SCSI-IDs to devices
    - Selecting the data transfer rate of devices
    - Section of boot drive

- Booting from SCSI drive.
  - Controller must have an onboard BIOS
  - In SCSI onboard BIOS: Set the boot drive
  - In System BIOS: Set boot drive sequence to 'SCSI'

- SCSI in Linux
  - `/proc/scsi` directory contains all SCSI devices as a sub-directory
  - Each sub-directory contains files named by SCSI-BUS number (0,1,2)
  - Theses files contain the list of devices attached to this bus.
  - The file `/proc/scsi/scsi` contains the list of all found SCSI devices.

- Naming of SCSI devices
  - Hard disks are named from sda,sdb ... as per sequence they are found
  - Removable ZIP and USB Chip readers are also in the hard disk class
  - SCSI CD-ROMS are named 2 names at the same time: `sr`*x* & `scd`*x* (*x*=0,1,2,3,..)
  - Each device is also identified by *SCSI-BUS*, *SCSI-ID*, *LUN*
  - Program `scsi_info` shows info on individual device:
    eg. `scsi_info /dev/scd0`

1.101.5 Setup different PC expansion cards

Weight: 3

Description: Candidates should be able to configure various cards for the various expansion slots. They should know the differences between ISA and PCI cards with respect to configuration issues. This objective includes the correct settings of IRQs, DMAs and I/O Ports of the cards, especially to avoid conflicts between devices. It also includes using isapnp if the card is an ISA PnP device.

- **Key files, terms, and utilities:**
  `/proc/dma`
  `/proc/interrupts`
  `/proc/ioports`
  `/proc/pci`
  `pnpdump(8)`
  `isapnp(8)`
  `lspci(8)`

  - Tools used:
    - Info files: `/proc/dma, /proc/interrupts, /proc/ioports, /proc/pci`
    - Programs: `pnpdump(8), isapnp(8), lspci(8)`
  - Important for LPI is: - Hardware parameters (IO Port, IRQ,DMA)
    - `/proc` directory
    - ISA Plug and Play in Linux
    - Setting and reading the time
  - PCI devices are identified by an unique ID just like MAC address in network cards. Linux saves these PCI IDs in the file:
    - `/usr/share/pci.ids` (SuSE)
    - `/usr/share/hwdata/pci.ids` (RedHat & Debian)
    - `/usr/share/mics/pci.ids` (Debian older than above....)

    `update-pciids` command updates the list from internet into:
    `/usr/share/mics/pci.ids.new` or equivalent as per distribution.
  - Linux support PCI(Bus ID=`00`) devices fully without needing manual settings.
  - AGP Is a separate PCI bus(Bus ID=01) reserved for Graphic Cards, having only one slot, made for undisturbed data transfer between the Graphic chips and the PC.
  - PCI Bus system is addressed the same way as SCSI:
    `BusNr``:`*`SlotNr`*`:`*`FunctionNr`*`(Device Nr.)`
  - `lspci` is used to list the PCI devices in system.
    `lspci` finds the manufacturers etc from the file `/usr/share/pci.ids`.
    `lspci -n` forces the NOT-reading of the `pci.ids` file, giving Mfg info in Numbers.
  - Newer kernels as `2.1.82` has more info about devices on PCI-Bus in the `/proc/pci`.
  - Serial ports known as `COM1`,`COM2` etc are in Linux: `ttyS0`,`ttyS1` etc.
    Parallel Printer ports known as `lpt1 lpt2`, are in llnux: `lp0, lp1` etc

1.101.6 Configure Communication Devices Weight: 1

Description: Candidates should be able to install and configure different internal and external communication devices like modems, ISDN adapters, and DSL switches. This objective includes verification of compatibility requirements (especially important if that modem is a `winmodem`), necessary hardware settings for internal devices (IRQs, DMAs, I/O ports), and loading and configuring suitable device drivers. It also includes communication device and interface configuration requirements, such as the right serial port for 115.2 Kbps, and correct modem settings for outbound PPP connection(s).

- **Key files, terms, and utilities:**
  `/proc/dma`
  `/proc/interrupts`
  `/proc/ioports`
  `setserial(8)`

  - Tools: `/proc/dma`, `/proc/ioports`, `/proc/interrupts`, `setserial(8)` (`setserial` is from package `setserial` for SuSE,RedHat & Debian) `minicom` is one of the modem terminal programs for linux.

  - `setserial /dev/ttyS`*`x`* Shows the settings of the serial port.
    or `/dev/cua`*`x`* *x*=0,1,2,3...eg. `ttyS0=COM1, ttyS1=COM2`

  - `setserial /dev/ttyS`*`x`* *`parameter`*
    Sets the serial port to the parameters.

    Parameters are:

`port` *`PortNr`*	IO Port number
`irq` *`IRQ`*	IRQ number
`uart` *`UART_Type`*	UART(Universal Assynchroneous Receiver Transmitter) Possible values are: none, 8250, 16450, 16550, 16550, 16550A, 16650V2, 16654, 16750, 16850, 16950, 16954. none=Turn device OFF

    Most older application know only up to 38400 Baud. To allow for faster speeds even though the application asks for 38400 Baud, extra parameters to `setserial` set flags in hardware that translates requests from applications of 38.4Kb to higher speeds in UART.

Parameter	Speed requested by Aplication	Real UART speed
`spd_normal`	38.4Kb	38.4Kb
`spd_hi`	38.4Kb	57.6Kb
`spd_vhi` **(Important for LPI)**	38.4Kb	115Kb
`spd_shi`	38.4Kb	230Kb
`spd_warp`	38.4Kb	460Kb

- Modem AT Commands

  Hayes compatible commands that controls most modems.

AT	Sets the baud rate between Modem and PC
ATD Nr.	Dial the Number (Nr.)
ATH0	HangUp
ATH1	Pic-up phone line (Opposite of HangUp)
ATX0	Dial blind, CONNECT when connection OK
ATX1	Dial blind, CONNECT *speed* when connection OK
ATX2	Wait for DIALTONE and CONNECT *speed* when connection OK
ATX3	Dial blind, CONNECT *speed* when connection OK or BUZY
ATX4	Wait for DIALTONE and CONNECT *speed* when connection OK
ATX5	Dial blind, CONNECT *speed* when connection OK, BUSY, VOICE
ATX6	Wait for DIALTONE and CONNECT *speed* when connection OK, BUZY, VOICE
ATZ	Reset the modem.
AT&F	Reset the internal modem configuration to factory settings.

1.101.7 Configure USB devices

Weight: 1

Description: Candidates should be able to activate USB support, use and configure different USB devices. This objective includes the correct selection of the USB chipset and the corresponding module. It also includes the knowledge of the basic architecture of the layer model of USB as well as the different modules used in the different layers.

- **Key files, terms, and utilities:**
  `lspci(8)`
  `usb-uhci.o`
  `usb-ohci.o`
  `/etc/usbmgr/`
  `usbmodules`
  `/etc/hotplug`
- Main USB module is usbcore (although often already integrated in kernel)
- There are 2 types of USB controllers:
  OHCI Open Host Controller Interface (Compaq)
  UHCI Universal Host Controller Interface (Intel)
- All USB devices are compatible to both OHCI and UHCI.
- Main boards manufactures using:

OHCI	**UHCI**	**EHCI**(USB 2.0)
Compaq	Intel	Intel
Ali	VIA	VIA
NEC		NEC
Opti Chipset		Phillips

- `lspci` or `less /proc/pci` To recognize the USB controller type:
  IO address format: `0xHHHH=UHCI`, `0xHH000000=OHCI`
- The possible modules are: `ohci.o` , `uhci.o` or `ehci-hcd.o`
- Autoloading at booting: in `/etc/modules.conf`---->entry: `alias usb uhci`
  To also autoload (post-install) other submodules:
  eg.(in `/etc/modules.conf`):

```
alias usb uhci
post-install uhci modprobe printer
post-install printer modprobe joydev
post-install joydev modprobe hid
```

USBDevFS Filesystem:
This dynamic filesystem (like `/proc`) is normally mounted on `/proc/bus/usb`.
Its `/etc/fstab` entry looks like:

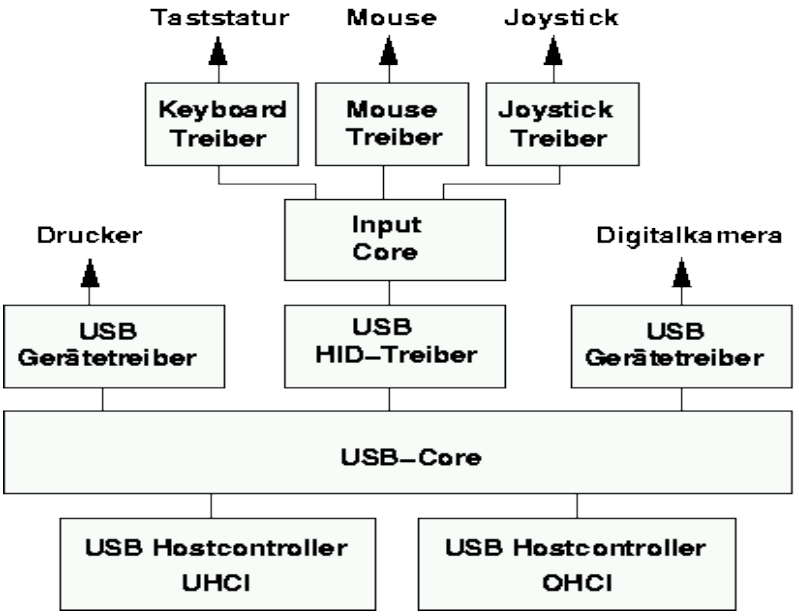
```
none  /proc/bus/usb  usbdevfs  defaults  0 0
```

After the mounting, the content(2 files) of `/proc/bus/usb` looks like this:

```
-r--r--r--  1 root root 0 2003-10-18 00:02 devices
-r--r--r--  1 root root 0 2003-10-18 00:02 drivers
```

After loading the driver(`usb-ohci` or `usb-uhci`) then content of this directory grows to include 1 numbered(001,002 etc) directory for each USB device.
The files in these numbered directories are in binary format.

- **Architecture of USB Modules:**



HID = Human Interface Device.(hid.o) and Input Core (input.o) are only for a USB keyboard(`usbkbd.o`), Mouse(`usbmouse.o`) or Joystick otherwies not needed.
Other USB modules:

printers	`printer.o`
storage	`usb-storage.o`

USB devices can be listed via the command: `lsusb`

For printers,when `printer.o` is loaded it creates devices `/dev/usb/lp0 ..lp1.`

List of current usb modules:

Commmand: `find /lib/modules/ -name "usb*" -exec basename {} \;`

```
usb-ohci.o          usbserial.o
usb-uhci.o          usb-storage.o
usbcore.o           usb-midi.o
                    usbkbd.o
                    usblcd.o
                    usbmouse.o
                    usbnet.o
                    usbvideo.o
                    usbvnet5.o
                    usbvnet5_2958.o
                    usbvnetr.o
```

Dynamic loading of USB Modules
For dynamically load the proper USB module when a USB device is inserted, 2 dynamic systems are available:

`hotplug`	Oversees the Hotplugged devices: USB, PCMCIA, FireWire(ieee1394)
`usbmgr`	USB manager that oversees only the USB devices.

- **hotplug**
  - At boot time the hotplug daemon is started via the script `/etc/init.d/hotplug`.
  - When a new device is inserted, the kernel senses it , it then passes an agent name as parameter to the daemon listed in the file: `/proc/sys/kernel/hotplug` (normally `/sbin/hotplug`).
  - The kernel then fills in the Environment Variables DEVICES with the info about the device and ACTION about if the device was pluged or unplugged.
  - The hotplug daemon starts the proper agent script.
  - The agent script reads the content of the DEVICES and ACTION variables as well as possibly other variables provided by the kernel. It uses also the program `usbmodules` to find-out all about the device inserted.

  The specific 'agents' scripts are.

The USB system uses	`/etc/hotplug/usb.agent`
The PCMCIA uses	`/etc/hotplug/pci.agent` (via a bridge)
The Firewire(ieee1394) uses	`/etc/hotplug/ieee1394.agent`
The Network system uses	`/etc/hotplug/net.agent`

- **Files involved:**

`/lib/modules/*/modules.*map`	depmod output
`/proc/sys/kernel/hotplug`	specifies hotplug program path
`/sbin/hotplug`	hotplug program (default path name)
`/etc/hotplug/*`	hotplug files
`/etc/hotplug/`*`NAME`*`.agent`	hotplug subsystem-specific agents
`/etc/hotplug/`*`NAME`*`*`	subsystem-specific files, for agents
`/etc/hotplug/`*`NAME/DRIVER`*	driver setup scripts, invoked by agents
`/etc/hotplug/usb/`*`DRIVER`*`.usermap`	depmod data for user-mode drivers
`/etc/init.d/hotplug`	hotplug system service script used also to load and configure already plugged hot-plug devices at boot time.

USB Manager (`usbmgr`)

Is a daemon that will load the proper module according to 2 parameters given by the kernel: USB-Vendor-ID and USB-Device-ID

It uses the following configuration files:

`/etc/usbmgr/usbmgr.conf`	List of Vendor-ID/Device-ID and module names
`/etc/usbmgr/preload.conf`	List of modules to load when usbmgr starts.
`/etc/usbmgr/host`	List of module names od the USB controller: either `usb-ohci` or `usb-uhci`.

- The `usbmgr` needs the folowing conditions:
  - The kernel must be USB capable (`usbcore`)
  - The USBDEVFS mus be supported
  - The needed modules must be available.

- ## 1.102 - Linux Installation & Package Management.

The content of this section includes: Weight

1.102.1 Design hard disk layout	5
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- ## 1.102.1 Design hard disk layout Weight: 5

Description: Candidates should be able to design a disk partitioning scheme for a Linux system. This objective includes allocating filesystems or swap space to separate partitions or disks, and tailoring the design to the intended use of the system. It also includes placing /boot on a partition that conforms with the BIOS' requirements for booting.

- **Key files, terms, and utilities:**

```
/ (root) filesystem
/var filesystem
/home filesystem
swap space
mount points
partitions
cylinder 1024
```

  - **File Hierarchy Standard** (FHS)
  - **Why multiple partitions in Linux**:
    - Multiple hard disks can be used
    - Easyer to make backups
    - Quotas are active per partitions
    - Mount partitions in Read-only for protection
    - Possible limit of Boot Manager (<1024 cylinders)

  - **File tree structure**:

    Absolutely Needed: `/bin, /dev/, /etc, /lib, /sbin`

    Note: `/root` is recommended in case the admin must do a rescue

    `/usr` ReadOnly in Extra partition.

    `/home` Recommended as separate partition.
    Reason: quotas, non-interference and fast system recovery

    `/tmp` Recommended as separate partition.
    Reason: quotas, non-interference

    `/var` Highly recommended: When full, doesn't interfere with system.

`/var/lib`	- Modifyable settings
`/var/lock`	- Lock files for programs and Daemons
`/var/log`	- Log files of system, daemons and programs
`/var/run`	- PIDs of Daemons and programs (if needed)
`/var/spool`	- Queues for Printing, mail etc.
`/var/tmp`	- Programs temporary place. Writable by anybody

- **Swap Partitions**
  - Created and managed by: `fdisk, mkswap, swapon, /etc/fstab`

  - Normal size: 64 to 128 MB

  Creating a swap file (64MB):

```
dd if=/dev/zero of=/path/of/swapfile bs=1024 count=64000
mkswap /path/of/swapfile 64000
swapon [-p 42] /path/of/swapfile
```

  Entry in `/etc/fstab`

```
/path/of/swapfile   none   swap
```

  `[cat /proc/swaps]` to see all the swap files

1.102.2 Install a boot manager

Weight: 1

Description: Candidate should be able to select, install, and configure a boot manager. This objective includes providing alternative boot locations and backup boot options (for example, using a boot floppy).

- **Key files, terms, and utilities:**

```
/etc/lilo.conf
/boot/grub/grub.conf
lilo
grub-install
MBR
superblock
first stage boot loader
```

- - MBR(<512 bytes), Partition table and Boot sectors
  - Stage 1 Program in MBR or Booosector loads the bootmanager menu from the hard disk. (performs direct disk access)
  - Stage 2 Presents menu and waits
  - Stage 3 Starts the selected operating system

  - **LILO:**

`/etc/lilo.conf`	Main and only config file.
`/boot/boot.b`	Boot Menu file
`/boot/boot-menu.b`	Other possible menu elements
`/boot/message, /boot/boot-bmp.b`	
`/boot/map`	Physical Address and size of kernel files.
`/sbin/lilo`	Program that: - Reads config file and writes the part 1 in MBR - Uses BIOS functions and creates `/boot/map`

Note: After any change of `/etc/lilo.conf` or any location or zize of any file in /boot directory the program lilo MUST be rerun.

`lilo -u`	- Rewrites the previous boot manager in MBR (eg. windows MBR)
Nothing	The partition booted is not Boot-activated or no bootmanager.
L*ErrorNr*	Second part of LILO cannot be loaded and error number is the reason.
LI	Second part of lilo is loaded but is probably invalid. Reason: Lilo was probably not run after changes in /boot or config file.
LIL	Second part of LILO is loaded but the content of `/boot/map` is wrong. Reason: Media error or wrong media geometry.
LIL?	Second part of LILO is loaded but it is garbage. Reason: file `/boot/boot.b` has moved or changed.
LIL-	Second part of LILO is loaded but the `/boot/map` is garbage. Reason: file `/boot/map` has moved or changed.
LILO	All OK. LILO has loaded properly.

- **/etc/lilo.conf**

`append="reboot=warm"`	NO RAM check when rebooting.
`boot=/dev/hda`	Where the LILO part1 should be written `hda`=MBR, `hda1`=Boot sector of `hda1` etc.
`lba32`	HD has physically more than 1024 cylinders. and LILO should be using the LBA mode. Only valid if BIOS supports LBA32
`message=/boot/message`	Message loaded in MBR with part1 of LILO.conf
`prompt`	LiLO will wait for user selection.
`timeout=300`	Boot default system when timeout occurs. 300 = 30 seconds

Individual Systems sections

`image = /boot/bzlinuz`	Location of the kernel to load.
`root = /dev/hda2`	Partiton to use as root directory `'/'`
`initrd = /boot/initrd`	Location of ramdrive file: temporary file system.
`label = linux`	Name of menu item.
`other = /dev/hda3`	Location of a jump-to OS. Together with `label` gives the order to LILO to jump th the bootsector of the partition. Normally used with Windose.

- **GRUB** (GRan Unified Bootloader)

- Hard disks are recognized as `(hd0)` is the first HD found in system, `(hd0,0)` is the the first partition of the first hard drive; normally `/dev/hda1`.

- NO static binary menu (`/boot/boot.b`). Instead it's `/boot/grub/menu.lst`

- `/boot/grub/grub.conf` can also be used as menu/config file.

- Entries in GRUB menu/config file:

`default=0`	First menu item starts if no selection done before timeout.
`timeout=10`	Timeout of 10 Sec. will occur if no selection is done by user.
`splashimage=(hd0,0)/boot/grub/splash.xpm.gz`	The menu image will be taken from `/dev/hda1` in this path.

Individual Systems sections

`title linux`	Menu item text
`root (hd0,0)`	First partition of first found Hard Drive is used for the dir. `'/'`
`kernel /boot/bzlinuz ro root=/dev/hda1`	The kernel is `/boot/bzlinuz` and some parameters like `ro` and `root=/dev/hda1` is given to the kernel when started.
`initrd`	Ramdrive for booting (if used by kernel)
`map (hd0,1) (hd0,0)` `map (hd0,0) (hd0,1)`	Ued to swap the assignment of physical partitions. Useful to let windows 98 boot from a partiton which is not the first one (picky fellow!!) and make it think that it is.

`rootnoverify (hd0,1)`
Set GRUB's root device without mounting.

`chainloader +1`
Jump to the Boot Sector of the root partition and hope a boot loader is there waiting....

`makeactive` Make the partition active.

To boot from a CD/Floppy/HD and use the root directory of another linux as it own root dir (`/`) then use the kernel parameter:
eg. `root=/dev/hda4`

How does GRUB works:
`stage1` file is written in the MBR.
It contains the physical address of the *`fssys`*`_stage1_5`.(*`fssys`*=filesystem)
GRUB Booting sequence:

- MBR (`stage1`) is loaded
- `stage1` loads *`fssys`*`_stage1_5` (filesystem converter)
- *`fssys`*`_stage1_5` loads `stage2` file
- `stage2` loads the `menu.lst`
- After boot menu item selection is done,
  `stage2` loads the kernel(`vmlinuz`) and possibly the `initrd`

See document `20_LILO-GRUB.sxw` for more info on Grub.

• 1.102.3 Make and install programs from source Weight: 5

Description: Candidates should be able to build and install an executable program from source. This objective includes being able to unpack a file of sources. Candidates should be able to make simple customizations to the Makefile, for example changing paths or adding extra include directories.

- **Key files, terms, and utilities:**

```
gunzip
gzip
bzip2
tar
configure
make
```

- **Tools and files used:**
  - `gzip, gunzip, bzip2, tar, configure, Makefile, make`

- **Difference between script and binary(compiled) programs.**

- **Verifying the validity of the package's content**(checksum)
  - Get the MD5 checksum file from the location where you downloaded the file.
  - Put the tar file and the checksum file in the current directory

  `md5sum --check` *`checksumfilename`*

- **Standard file extentions for packages:**

  Tarred files: `*.tar`
  Compressed tarred files: `*.tar.gz` or `*.tar.bz2` or `*.tgz`
  Zipped files: `*.gz`
  Bzipped files: `*.bz2`

- **Unpacking packages:**

  Compressed tar files: (a new directory will be created in destination directory.)

  `cd` *`DestinationDirectory`*
  `tar fvxz` *`tarfile`*`.tar.gz` or `zcat tarfile.tar.gz|tar xvf -`
  `tar fvxj` *`tarfile`*`.tar.bz2` or `bzcat` *`tarfile`*`.tar.bz2|tar xvf -`

  Un-compressed tar files:

  `tar fcx` *`tarfile`*`.tar`

  Compressed files:

  `gunzip` *`File`*`.gz ----> File` (original `File.gz` is deleted!!)
  `bunzip2` *`File`*`.bz2 ----> File "" File.bz2 ""`
  `bzip2 -d` *`File`*`.bz2 ----> File "" "" ""`

- **Packing files:**

  Uncompressed tar files

  `tar fvc newfile.tar` */dir/to/pack*

  Compressed tar files

  `tar fvcz` *`newfile`*`.tar.gz` */dir/to/pack*
  `tar fvcj` *`newfile`*`.tar.bz2` */dir/to/pack*

  Compressed files

  `gzip` *`filename`* `----> filename.gz` (original is deleted!!!)
  `bzip2` *`filename`* `----> filename.bz2` ("" "" "")

- **Compliling process:** (Absolutely needed commands are in **`Bold`**)

  `cd` *`SourceBaseDirrectory`*

  `./configure` This script studies system environment and creates `Makefile`

  `make` or `make all` Reads `Makefile` and start the compiling of the source files.

  `make install` Installs the compiled files and possibly others in the system. Normally only possible to run as root.

  `make clean` Deletes all the already compiled binary files.

  Note: `make` works with timestamps which tells whether the binary file should be recompiled if the source is younger than the binary file.

- Modifying `Makefile` manually
  Changes to the Makefile would normally be done to adjust the installation paths. These changeable parameters are normally at the beginning of the Makefile. They are in the normal bash variable assignment format: `var=value`

• 1.102.4 Manage shared libraries Weight: 3

Description: Candidates should be able to determine the shared libraries that executable programs depend on and install them when necessary. Candidates should be able to state where system libraries are kept.

- **Key files, terms, and utilities:**

```
ldd
ldconfig
/etc/ld.so.conf
LD_LIBRARY_PATH
```

Libraries are SHARED between running programs within the RAM. So only one copy of a shared library is needed to be loadad in RAM for all programs using it.

- **Sequence of events**:

- `bash` tells the kernel to start a program
- The kernel starts the Dynamic Library Linker `ld.so`
- `ld.so` searches to load all libraries needed for the program in the following order:
  - Looks in the (':' separated) paths listed in shell Env. variable `LD_LIBRARY_PATH`
  - Looks in the paths listed in the library cache `/etc/ld.so.cache`
  - Looks in `/lib` and `/usr/lib`
- `ld.so` loads itself
- `ld.so` loads the program in memory and pass-on control to the program.

- **Tools and files used:**

`LD_LIBRARY_PATH`	Bash Environment Variable containing List of paths of Libraries to search.
`ldd` *`/path/to/program`*	Lists all the libraries a program needs.

`/lib`
`/usr/lib`
`/usr/local/lib`
	Standard dir. where are most libraries installed.

`ldconfig`	Program that keeps track of all libraries in system. When a library is installed in a directory other than above standard library locations then we need to: - Enter new library path in `/etc/ld.so.conf` - Run `ldconfig`. This updates the libraries paths cache: `/etc/ld.so.cache` .
`/etc/ld.so.conf`	Configuration file of `ldconfig`
`/etc/ld.so.cache`	Libraries paths cache.

- **1.102.5 Use Debian package management** Weight: 8

Description: Candidates should be able to perform package management skills using the Debian package manager. This objective includes being able to use command-line and interactive tools to install, upgrade, or uninstall packages, as well as find packages containing specific files or software (such packages might or might not be installed). This objective also includes being able to obtain package information like version, content, dependencies, package integrity and installation status (whether or not the package is installed).

- **Key files, terms, and utilities:**

```
unpack
configure
/etc/dpkg/dpkg.cfg
/var/lib/dpkg/*
/etc/apt/apt.conf
/etc/apt/sources.list
dpkg
dselect
dpkg-reconfigure
apt-get
alien
```

• 1.102.6 Use Red Hat Package Manager (RPM) Weight: 8

Description: Candidates should be able to perform package management under Linux distributions that use RPMs for package distribution. This objective includes being able to install, re-install, upgrade, and remove packages, as well as obtain status and version information on packages. This objective also includes obtaining package information such as version, status, dependencies, integrity, and signatures. Candidates should be able to determine what files a package provides, as well as find which package a specific file comes from.

- **Key files, terms, and utilities:**
  `/etc/rpmrc`
  `/usr/lib/rpm/*`
  `rpm`
  `grep`

- **Filename format of RPM pacakges:**
  PackageName-VersionNumber.Architechture.rpm

- **Content of RPM packages:**
  - Information about the package
  - List of files to install
  - List of Dependencies
  - 4 Scripts: - Before Installation - Before De-Installation
    - After Installation - After De-Installation
  - Files to install

- **Where are the RPM databases:**
  - Directory of RPM Database of installed packages(in binary format):
    `/var/lib/rpm/*`
  - Directory of RPM tools needed to manage RPM packages:
    `/usr/lib/rpm/*`
  - To rebuild the RPM Database: `rpm --rebuilddb`

- **Syntax:**
  `rpm` *`Action`* `[`*`Options`*`]` *`Packagename`*`[.rpm]`

  - **Action:**

Short Format	Long Format	Description
Installation/Upgrade/Unstallation		
`-i`	`--install`	Install the package. Works only when no older package was alreay installed.
`-U`	`--upgrade`	Upgrade the package. Works like Install. but will also erase an older version of it.
`-F`	`--freshen`	Upgrade the package. Works only when an older version of it is already installed.
`-e`	`--erase`	Uninstall the package.

Installation Options

`--nodeps`	Installs and does not check dependencies.
`--noscripts`	No Pre/Post-Install scripts will be run.
`--test`	Do not install, just simulate installation.
`--excludedocs`	Install but without the documentation.
`--replacepkgs`	Install all even if some pacakges are already installed.
`--replacefiles`	Overwrite already installed files if existing.
`--oldpackage`	Allow Downgrading a package version.
`--force`	Install all no matter what. It can be seen as the same as: `--replacepkgs --replacefiles --oldpackage`

De-Installation Options

`--nodeps`	De-Installs and does not check dependencies.
`--noscripts`	No Pre/Post-de-Install scripts will be run.
`--test`	Do not de-install, just simulate de-installation.
`--allmatches`	De-Install all packages names that matches patern. In this case the patern no errors would be produced if the patern matched 2 or more packages.

Package queries

- If a query is made on installed packages the package name needs to be naked without the version or revision number or `.rpm`
- If a query is made for an RPM file, then the actual file name including the `.rpm` must be given as the package name.

`-q[options]`	`--query`	Queries info on the package. (no `.rpm`)
`i`	`--info`	Information header of package.
`l`	`--list`	List of all files
`c`	`--configfiles`	List of Configuration files.
`d`	`--docfiles`	List of Documantation files.
	`--provides`	Programs/Libs provided by the package.
`R`	`--requires`	List of files on which this package depends.
	`--changelog`	Display log of package changes.
	`--scripts`	Displays all 4 Install/Uninstall scripts**.**
	`--dump`	List of all files and their attributes.
	`--filesbypkg`	Same as `--list` + package name per line
	`--last`	Date of last installations of the package.
	`--state`	`--LIST` + Files Installation status: `normal`, `not installed` or `replaced`
	`--qf %{`*`QUERYTAG`*`}` or `--queryformat %{`*`QUERYTAG`*`}`	Extracts specific items from info header. eg. `rpm -q --qf %{DESCRIPTION} apache` Displays only description part of the info. eg. `rpm -qa --qf "%{NAME}\n"|sort|less` Lists only names of all installed packages.
	`--querytags`	Lists the *`QUERYTAGs`* usable in `--queryformat`.

Query Package selection:(combined with `-q` option)

`a`	`--all`	Query all installed Packages
`f`	`--file` *`filename`*	Query installed Package owning file (incl. path)
`p`	`--package`	Query Specific Uninstalled packages (`.rpm`)

- `--whatrequires`
  Query all installed packages that depend on this one.
  Note: `rpm -q --whatrequires --qf "%{NAME}\n" apache|less`
  Displays all names of packages that depends on `apache` package.

- `--whatprovides` *`program_or_libname`*(incl. path)
  Query all installed packages that provides this program or library.
  Note: `rpm -q --whatprovides --qf \`
  `"%{NAME}\-%{VERSION}\-%{RELEASE}\n" /bin/sed`
  Displays names of packages that provides `/bin/sed`.
  Same output as `rpm -qf /bin/sed`

- `g` *`group`* or `--group` *`group`* All installed packages belonging to group
  Note: `rpm -qa --qf "%{GROUP}\n" | sort -u | less`
  Lists group names of which some packages are installed.

Examples:

`rpm -qil` *`PackageName`*	Information and install file list of package.
`rpm -qa | sort | less`	Display all installed packages(all `.rpm` files)
`rpm -qai | grep -2 "^Release" | less`	Same as above but more complete info.
`rpm -hiv` *`PackageName`*`.rpm`	Install with progress bar (hash #)
`rpm -hiv --replacefiles` *`PackageName`*`.rpm`	Install on top of existing package with progress bar (hash #)
`rpm -hUv` *`PackageName`*`.rpm`	Upgrade with progress bar (hash #)
`rpm -hUv --force` *`PackageName`*`.rpm`	Upgrades and overwrite existing package even if conflict or lack of dependencies exists.
`rpm -qf` *`filename`*(incl PATH)	Tells which packet this file belongs to
`rpm -qdf` *`filename`*(incl PATH)	Tells which help documents came with this file

Queries for not installed `rpm` packages

`rpm -qpi` *`PackageName`*`.rpm`	header information of this package.
`rpm -qpl` *`PackageName`*`.rpm`	List of files where this package installs

Advanced Examples:

- To display a list of all already installed packages and their summary description:

```
rpm -qa --qf "%{NAME} : %{SUMMARY}\n" | sort | less
```

- To search for an already installed PackageName by pattern:

```
rpm -qai | awk -F: ' /^Name|^Version/ {print $1,$2} /^Version/ \
   {print ""}' | cut -b-30 | grep -1 $1
```

- To search through non installed RPM files for a filename:

```
rpm -qp --filesbypkg *.rpm | grep filename
```

- Verifying integrity of packages

`rpm -V` *`PackageName`*	Verify integrity of the installed packages
`rpm -Va`	Verify integrity of all installed packages

The result of both of these above commands will be shown as follows:
- One line per file is displayed.
- Each line contains a status field(8 chars.) File type (1 char) Filename.
eg. `S.5....T c /etc/samba/smbpasswd`

Meaning of Status field:

`S`	Size of file has changed	`U`	File Owner has changed
`M`	Access rights has changed	`G`	Group of file has changed
`5`	MD5 Checksum doesn't match	`T`	Timestamp has changed
`L`	ReadLink system call failed	`.`	OK
`D`	Major/Minor numbers of device has changed		

Meaning of filetype:

'c'	Configuration file.	' '	Normal File
'?'	Couldn't check (maybe because of read access failed)		

- **PGP and GPG Signature test**

Syntax:
`rpm --checksig` *`Packagefilename.rpm`*

result should be:
`Packagefilename.rpm` `md5 gpg OK`
`----------`

- **Extract from RPM Man page:**

QUERYING AND VERIFYING PACKAGES:

```
rpm  {-q|--query} [select-options] [query-options]
rpm  {-K|--checksig} [--nogpg] [--nopgp] [--nomd5] PACKAGE_FILE ...
rpm  {-V|--verify} [select-options] [--nodeps] [--nofiles] \
     [--nomd5] [--noscripts]
```

INSTALLING, UPGRADING, AND REMOVING PACKAGES:

```
rpm  {-i|--install} [install-options] PACKAGE_FILE ...
rpm  {-U|--upgrade} [install-options] PACKAGE_FILE ...
rpm  {-F|--freshen} [install-options] PACKAGE_FILE ...
rpm  {-e|--erase}   [--allmatches]    [--nodeps] [--noscripts] \
     [--notriggers] [--repackage]     [--test]   PACKAGE_NAME ...
```

MISCELLANEOUS:

```
rpm  {--initdb|--rebuilddb}
rpm  {--querytags|--showrc}
rpm  {--addsign|--resign}    PACKAGE_FILE ...
rpm  {--setperms|--setugids} PACKAGE_NAME ...
```

SELECT-OPTIONS

```
[PACKAGE_NAME] [-a,--all] [-f,--file FILE] [-g,--group GROUP]
[-p,--package PACK-AGE_FILE] [--querybynumber NUMBER]
[--triggeredby PACKAGE_NAME] [--whatprovides  CAPABILITY]
[--whatrequires CAPABILITY]
```

QUERY-OPTIONS

```
[--changelog]  [-c,--configfiles] [-d,--docfiles] [--dump]
[--filesbypkg] [-i,--info]        [--last]        [-l,--list]
[--provides]   [--qf,--queryformat QUERYFMT]      [-R,--requires]
[--scripts]    [-s,--state]       [--triggers,--triggerscripts]
```

INSTALL-OPTIONS

```
[--allfiles]  [--badreloc] [--excludepath OLDPATH] [--excludedocs]
[--force]     [-h,--hash]     [--ignoresize]       [--ignorearch]
[--ignoreos]  [--includedocs] [--justdb]           [--nodeps]
[--noorder]   [--noscripts]   [--notriggers]       [--oldpackage]
[--percent]   [--prefix  NEWPATH]  [--relocate OLDPATH=NEWPATH]
[--repackage] [--replacefiles][--replacepkgs]      [--test]
```

Note: Options for Building packages are left out here. See man page for further info.

- **Other source of info are at** `http://www.rpm.org`
  The program `kpackage`, `KpackViewer` and `kpm`

• 1.103 - GNU & Unix Commands

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1.103.1 - Work on the command line Weight **5**

Description: Candidates should be able to Interact with shells and commands using the command line. This includes typing valid commands and command sequences, defining, referencing and exporting environment variables, using command history and editing facilities, invoking commands in the path and outside the path, using command substitution, applying commands recursively through a directory tree and using man to find out about commands.

- **Key files, terms, and utilities:**

```
.
bash            man
echo            pwd
env             set
exec            unset
export
~/.bash_history
~/.profile
```

- Command format (command, options and parameters)
  - short (-) and long (--) form options.
  - short form options combinations
- Entering commands
  - Which are in PATH
  - Which are not in the PATH
  - '.' as part of PATH and *./command*
  - Where am I?: pwd
- Prompt ($PS1) and Incomplete command syntax ($PS2)
- Entering command sequences
  - With ';' '&'
- Shell(local) and Environment(exported) variables:
  - Exported variables (Environment variables)
    - env Lists all environment variables
    - printenv Same as env
    - export Lists all exported (environment) variables
    - declare -x *variable*[=*value*] Sets the env. variable
    - export *variable*[=*value*] "" "" ""

- Setting and unsetting variables:
  - `set` Lists all local and environment variables incl. functions
  - Setting: `set variable=value`
  - UnSetting: `unset variable`

- Read-Only Variables (variable cannot be changed or unset)
  - `readonly` Lists all read-only variables
  - `readonly variable` Sets the variable to read-only

- `$TERM` (present terminal type)
  - `screen` Console in 'screen' mode
  - `dumb` From Cron
  - `linux` From tty1-tty6
  - `xterm` Xserver terminal
  - Terminal info Database
    - -Old: `/etc/termcap` Still in SuSE
    - -New: `/etc/terminfo/*` Debian uses it

- Command substitution: old `` `command` `` and new `$(command)`

  eg.
```
echo "My present directory is `pwd`"
ls -la /lib/modules/$(uname -r)/*
```

- Command history and editing

  Command history navigation:

  `set +o history` Turns history recording OFF
  `set -o history` Turns history recording ON
  `$HISTFILE` Variable containing the history file name. Normally `~/.bash_history`
  `$HISTFILESIZE` Variable containing the maximum number of commands the history file can contain. Default=`500`
  `$HISTSIZE` Variable containing the maximum number of commands in history. Default=`500`

  `history` Displays the whole history
  `history 10` Displays the last 10 lines of history
  `fc -l -10` Displays the last 10 lines of history
  `fc -l Pattern` Search the history for `Pattern` & display the result
  `<Ctrl>-r` Reverse search in history
  `history -c` Clears the whole history

  `!!` Most recent command
  `!n` Command *n* in the history
  `!-n` Backwards command *n* in history
  `! string` Last recent command starting with `string`
  `!? string` Last recent command containing with `string`
  `^string1^string2` Quick substitution `string1` to `string2`
  `<Ctrl>-p` Previous Line in history (also up-arrow)
  `<Ctrl>-n` Next Line in history (also down arrow)
  `<Alt>-<` Go to beginning of History
  `<Alt>->` Go to end of History

Cmd Line Editing commands

(E-macs editing cmds -readline library)

<Ctrl>-l	Clear screen
<Ctrl>-b	Back one character (also left arrow)
<Ctrl>-f	Foreward one character (also right arrow)
<Ctrl>-a	Go to beginning of line (also Pos1 key)
<Ctrl>-e	Go to end of line (also Ende key)
<Ctrl>-k	Delete text from cursor to end of line
<Ctrl>-d	Dlete a character on the right (or under cursor)
<Alt>-d	Delete from crursor to end of current word
<Ctrl>-y	Paste text previously cut (deleted)

- Applying commands recursively (-r, -R, --recursive)

Command	Short format	Long format
ls	-R	--recursive
chown	-R	--recursive
chmod	-R	--recursive
chgrp	-R	--recursive
grep	-r	--recursive
cp	-r and -R	--recursive
rm	-r and -R	--recursive

- Help of commands using man and info.

man [*n*] *command* Syntax to call a man page for a command
n Represents the man page type (1-9)

1	Executable programs or shell commands
2	System calls (functions provided by the kernel)
3	Library calls (functions within program libraries)
4	Special files (usually found in /dev)
5	File formats and conventions eg. /etc/passwd
6	Games
7	Miscellaneous (including macro packages and conventions), e.g. man(7), groff(7)
8	System administration commands (usually only for root)
9	Kernel routines [Non standard]

1.103.2 - Process text streams using filters Weight 6

Description: Candidates should should be able to apply filters to text streams. Tasks include sending text files and output streams through text utility filters to modify the output, and using standard UNIX commands found in the GNU textutils package.

- **Key files, terms, and utilities:**

```
cat                     sed
cut                     sort
expand                  split
fmt                     tac
head                    tail
join                    tr
nl                      unexpand
od                      uniq
paste                   wc
pr
```

Commands list

- ❒ - `cut` Extracts columns from file:
- ❒ - `expand` Expands TABs to SPACES in text files
- ❒ - `fmt` Formatting of text files
- ❒ - `head` Display first x lines of text file
- ❒ - `join` Joins lines of a data file on common fields
- ❒ - `nl` Number the lines of a text file
- ❒ - `od` Display file content in Octal,Hex or Decim.
- ❒ - `paste` Pastes corresponding lines of 2 text files
- ❒ - `pr` Convert text files ready for printing
- ❒ - `split` Splits files into multi files
- ❒ - `cat` Cancatenate files / Display files content
- ❒ - `tac` Displays content of text file bottom to top
- ❒ - `tail` Display last x lines of text file
- ❒ - `tr` Translate or delete characters of file
- ❒ - `wc` Counts number of chars,words,lines of files
- ❒ - `xargs` Extends the argument list of a command
- ❒ - `sed` Stream file editor
- ❒ - `sort` Sorting content of files
- ❒ - `grep` Filtering/extracting text from files
- ❒ - `more` Display content of files- Page Foreward
- ❒ - `less` Display content of files- Lines Foreward/Backward

Command Examples:

cut -d*x* **-f***y* - Extracts columns from file: field(*y*) separator(*x*)
`eg. cut -d: -f1,6 /etc/passwd` (Extract field 1 and 6)

expand - Expands(converts) TABs to SPACEs in text files.
`eg. expand /etc/init.d/at > ~/atnew`

unexpand - Opposite to `expand`: Converts SPACEs to TABs in text files.
`eg. unexpand -a /etc/services > ~/serv ; vi ~/serv`

fmt - Formatting of text files: Before printing. (for continuous text only)
Note. Each line must have at least one space within it.
`eg. fmt -w50 /usr/share/doc/packages/apache/ABOUT_APACHE`

head [-|+][n]*x* - Display first x lines of text file (default 10)
`eg. head -40 /etc/services`
Displays the first 40 lines of the file

join - Joins lines of a data file on common fields
`eg. join -t: -11 -21 /etc/passwd /etc/shadow`

nl - Number the lines of a text file.
`nl -ba filename` Numbers empty lines as well
Default options: `-v1 -i1 -l1 -sTAB -w6 -nrn -hn -bt -fn`
`eg.1 nl -s" - " /etc/services`
Number the lines, adding `" - "` after line number
`eg.2 nl -bp"^#" file1` Numbers only the lines starting with '#'

od -bih -t *x* - Display file content in Octal(`-b`) Decimal(`-i`) Hexadec.(`-h`)
`eg. od -h /bin/ping`
x = Format type

`-a`	`same as -t a,`	select named characters
`-b`	`same as -t oC,`	select octal bytes
`-c`	`same as -t c,`	select ASCII characters or '\' escapes
`-d`	`same as -t u2,`	select unsigned decimal shorts
`-f`	`same as -t fF,`	select floats
`-h`	`same as -t x2,`	select hexadecimal shorts
`-i`	`same as -t d2,`	select decimal shorts
`-l`	`same as -t d4,`	select decimal longs
`-o`	`same as -t o2,`	select octal shorts
`-x`	`same as -t x2,`	select hexadecimal shorts

Note: `-x` is not the same as `-tx`

paste - Pastes corresponding lines of 2 text files

```
eg.1 paste /etc/passwd /etc/shadow
eg.2 cut -d: -f1 /etc/passwd > file1
     cut -d: -f3 /etc/passwd > file2
     paste -d: file1 file2 > file3
```

pr - Convert text files for printing
`eg. pr /etc/services | less`

split -l*x* -by[b|k|m]
- Splits files into multi files containing (*x*)lines or (y) bytes,kilobytes or megabytes. Syntax: `split [options] filename prefix`
eg1. `split -l100 /etc/services serv`
creates `servaa servbb` etc. To get the original back
`cat serv?? > servicesnew`

eg2. `split -b1440k /bin/rpm rpms` (for backups on diskettes)
creates `rpms`**`aa`** `rpms`**`ab`** etc. To get the original back
`cat rpms?? > rpmnew`

cat - Displays content of text file top to bottomand exits
eg.1 `cat -n /etc/hosts`
Show all lines of file with line numbers(`-n`)
eg.2 `cat -b /etc/hosts` Numbers only the non-empty lines

tac - Displays content of text file bottom to top and exits (reverse of `cat`)
eg. `tac /etc/passwd`
List starts with the lasts users created in system

tail [-|+][n]*x* - Display last *x* lines of text file (default 10)
eg1. `tail -30 /etc/services` (Display last 30 lines)
eg2. `tail +100 /etc/services`
Bypass first 100 lines and display the rest till end of file
eg3. `tail -fs5 --retry /var/log/httpd/error_log`
Read the last 10 lines of the file every 5 sec. and keep retrying even if the file is not available

tr -d - Translate or delete characters of file
eg1. `tr "a-z" "A-Z" < /etc/motd` (translates a-z to A-Z)
eg2. `tr -d "#" < /etc/services | less` (deletes all #)
eg3. `tr -d '\r' < windowsfile.txt > unixfile.txt`
Converts DOS format text file in Unix fromat file

wc -l|-c|-w - Counts number of `--lines`(`-l`), `--words`(`-w`) or `--chars`(`-c`) of text file. Without options it counts all lines, words and chars.
eg. `wc /etc/motd`

xargs - Reads text from pipe and provides it as parameter(s) for specified command up to max 64kb per command launch.
eg. `find /etc -name *.conf | xargs cat > /root/confs`
Finds all `.conf` files in `/etc` and accumulates their contents all in one file called `/root/confs`.

sed - Stream file editor (see `45_Editing_Text-sed.sxw`)
eg.1 `sed 's/#/;-/g' /etc/services`
eg.2 `sed '12,$s/Versions/Revisions/g'`
Start global(g) substitution at line 12 till end of file ($)

sort -k*y*[n] -t*x*
- Sort text file by field(*y*) with field separator(*x*)default sep.:<space>
eg.1 `ls -la | sort -k5n` (sorted by file size: field 5)
eg.2 `ls -la | sort -n +0.32`
Same result as above: excludes characters 0 to 32 in sorting

`grep [-virns]` - Extract all lines of text where pattern is [not] found

eg1. `grep -ins "^f.p.*SSL$" /etc/services`
Display all lines of file where pattern(ignoring case (`-i`) is found with its line numbers(`-n`) and no error messages (`-s`)

eg2. `ps -ax | grep httpd | grep -v grep`
Display all instances of processes where `httpd` is found excluding(`-v`) the `grep httpd` command itself

`more` - Forward only display of text file content

eg. `more -30 /etc/services`
Scrolls display next 30 lines when pressing space bar, press enter to scroll to the next line

`less` - Scrollable display of text file/pipe content. Press `v` to edit the file

eg1. `less -X +G /etc/services`
Go to the end of the file (`+G`) and leave the display as is(`-X`) when leaving `less`.

eg2. `less -phttps /etc/services`
Load file and go to first occurence of search pattern `https`

`uniq` - Filters consecutive line repetitions of a file.

eg.
```
rpm -qa --qf "%{LICENSE}\n" | sort | uniq | less
```
or
```
rpm -qa --qf "%{LICENSE}\n" | sort -u | less
```
Display all the licences types used by installed packages.

`awk -F`*`x`* - Programmable text formatter fields delimited (*x*)

```
eg.  awk -F: '{ print $1,"\t- ", $3 }' /etc/passwd
```

1.103.3 Perform basic file management Weight: 3

Description: Candidates should be able to use the basic UNIX commands to copy, move, and remove files and directories. Tasks include advanced file management operations such as copying multiple files recursively, removing directories recursively, and moving files that meet a wildcard pattern. This includes using simple and advanced wildcard specifications to refer to files, as well as using find to locate and act on files based on type, size, or time.

- **Key files, terms, and utilities:**

```
cp              ls
find            rm
mkdir           rmdir
mv              touch
file globbing
```

Directories, files and Inodes

File/directory commands

cd /newdir or cd newdir — Absolute/relative change directory
eg. cd ~foo — Changes to the home directory of user foo

ls [dir|file] — List content of directory or file information.
eg. ls -lai /etc — Long format lists of files inc. inode numbers

cp *source destination* — Copy files or directories
eg. cp source1 source2 ... . — Copy all files in the current directory
cp /dev/null newemptyfile — Create a new empty file

mv *source destination* — Move or rename file or directories
eg. mv -f (default) file1 file2 — Allows overwriting of file2 if exists
mv -i file1 file2 — Request confirmation for overwriting

mkdir Create directories.
Options: -p|--parents — Creates full paths, existing or not
-m 755 — To set the access rights mode

rmdir Deletes Directories. -p|--parents for non empty directories
Non-Empty directories must be without files in them.

touch Change file modification time of a file.
Can also be used to create an empty file:
touch file1 or >file1 or echo >file1

File naming wildcards * ? [...] [...-...] [!...]

Finding files with find:
See document 42_Finding_Files-find.pdf for info on find.

1.103.4 Use streams, pipes, and redirects Weight: 5

Description: Candidates should be able to redirect streams and connect them in order to efficiently process textual data. Tasks include redirecting standard input, standard output, and standard error, piping the output of one command to the input of another command, using the output of one command as arguments to another command and sending output to both stdout and a file.

- **Key files, terms, and utilities:**

```
tee
xargs
<    <<
>    >>
|    ` `
```

Standard I/O (`STDIN(0)` and `STDOUT(1)` and `STDERR(2)`)

pipes '**|**'. Note: '|' redirects only the `STDOUT` and NOT the `STDERR`
`prg1` **`2>&1 |`** `prg2` Redirects `STDOUT` and `STDERR`

`|xargs` Uses output of a program as list of arguments for another one.
eg. `prgm1 | xargs prgm2` is same as `prgm2 $(prgm1)`
The diference is that `xargs` will deliver the arguments per chuncks of 64kBytes to `prgm2` and run the `prgm2` multiple times until all arguments (output of `prgm1`) are used up.

`xargs` example:

```
find /etc -name "issue*" 2>/dev/null | xargs grep -c "SuSE"
```

- Redirection `>` `>>` `<<` `<` `1>` `2>` `&>` `2>&1`

`>` first overwrite/creates new file, processes the comand and then writes the `STDOUT` of command into the file.
Therefore the command: `sed 's/#/;/g' file1 > file1`
Simply overwrites `file1` with an empty one !!!

Note. `>newfile` Is the same as `touch newfile`

`<` Redirects its `STDIN` from a file instead of the keyboard.
`prgm < file1` Reads its input from `file1`.

'**`here-document`**'

```
prgm << EOF Text goes here ....
EOF
```

`prgm` gets its input from text between first `OEF` and last `OEF`

Combining outputs:
`prgm 2>&1 1>file` or `prgm &>file`
Both command combine `STDOUT` and `STDERR` to be sent to `file`

`program | tee filename` (Redirecting to `STDOUT` and file)

eg. `prg1 | tee file1 | prg2|tee file2 | prg3 >file3`
gives the same result a the following detached commands:

```
prg1 > file1
prg2 < file1 > file2
prg3 < file2 > file3
```

1.103.5 Create, monitor, and kill processes Weight: 5

Description: Candidates should be able to manage processes. This includes knowing how to run jobs in the foreground and background, bring a job from the background to the foreground and vice versa, start a process that will run without being connected to a terminal and signal a program to continue running after logout. Tasks also include monitoring active processes, selecting and sorting processes for display, sending signals to processes, killing processes and identifying and killing X applications that did not terminate after the X session closed.

- **Key files, terms, and utilities:**

```
&               kill
bg              nohup
fg              ps
jobs            top
```

-What is `PID`, `PPID` etc

Process Viewing Commands

`ps` Show process table

Examples:

`ps waux` All processes with user in a wide format

`ps caux` All processes with user with true command name
Practical for `killall` command.

`ps -fe` All processes(`-e`) with full listing(`-f`)

`ps -la` All processes(`-a`) excluding session leaders

```
ps -eo "%p &P %n %y %x %c"
```

Formatted output as:

PID	PPID	NICE	TTY	TIME	COMMAND
%p	%P	%n	%y	%x	%c

`pstree` Show process tree

`top` Show most processor 'time hungry' processes

- Signalling active processes

`kill SIG`*`xxx`* Send signals to a process
eg. `kill SIGHUP 1329` same as
`kill HUP 1329` or `kill -1 1329`

`nohup` *`prgm`* Runs *`prgm`* with `HUP` signal immunity.
`STDOUT` and `STDERR` is sent to
`./nohup.out` or `$HOME/nohup.out`

`kill -l` List of signals possible

- Terminating processes

`kill [-9]` Brutal killing of a process
`killall` Killing many processes in one command
`xkill` X Program to kill a process owning a window
`pkill` See `man pkill`
`skill [signal] [option] parameter`
Allows to send signals to multiple processes at the same time.

`skill` Options(optional) & parameters:

`-t terminal`
Affects all processes running off a specific terminal. (`ttyx` or `pts/x`)

`-u username1 [username2....]`
Affects all process belonging to one or more users.

`-p PID1 [PID2 ...]`
Affects all process owning the PID(s).

`-c CommandName`
Affects process having the *CommandName*

examples:

`skill -KILL -v pts/*`
Kill and list(`-v`) all processes on new-style PTY devices

`skill -STOP viro lm davem`
Stop 3 users: `viro` `lm` and `davem`

- Shell job control and '&'

Job Control Commands

bg [%*n*]	Resume current or stopped job *n* in the background
fg [%*n*]	Move current or background job *n* into foreground
jobs [*option*]	Display status of all jobs `-n` Status since last job change `-r` List of running jobs only `-s` List stopped jobs only `-l` display status of all jobs and their process ID's `-p` display process ID's of all jobs
jobs `-x` *command*	Replace job *n* in *command* with corresponding process group id, then execute *command*
kill [**-***signal*] *%n*	Send specified signal to job *n* (default **15**)
stop *%n*	Stop job *n*
stty [**-**]**tostop**	Allow/prevent background jobs from generating output
suspend	Suspend execution of current shell
wait	Wait for all background jobs to complete
wait *%n*	Wait for background job *n* to complete
Ctl-z	Stop current job
disown [*option*] [*%n*]	Disown the last activated(+) background job or job *%n*. Disowned job will not die when shell dies. `-a` Disown all the background jobs `-r` Disown only the running jobs `-h` Disown active job (+)from shell only when shell is closed:

Job Name Format

`%%, %+`	current job
`%`*n*	job *n*
`%-`	previous job
`%`*string*	job whose name begins with *string*
`%?`*string*	job that matches part or all of *string*

1.103.6 Modify process execution priorities Weight: 3

Description: Candidates should should be able to manage process execution priorities. Tasks include running a program with higher or lower priority, determining the priority of a process and changing the priority of a running process.

- **Key files, terms, and utilities:**

```
nice
ps
renice
top
```

Notes:

-Possible Priorities: `19`(min) to `-20`(max)
-Users can only change to a lower priority than the currrent one
-Priority when normally starting a program: `0`

`nice` Start a job with pre-defined priority

```
nice --8 prgm        Start prgm with priority  -8
nice -11 prgm        Start prgm with priority  11
nice -n-12 prgm      Start prgm with priority 12
```

`renice` Change priority of a running process

```
renice -6 1247  Change priority of prgm w/ PID-1247 to -6
renice  8 1247  Change priority of prgm w/ PID-1247 to  8
```

`snice` Change priority of a multiple running processes by category.
syntax: `snice` [*`newpriority`*] [*`options`*] *`category`*
eg.

```
snice +7 seti crack  Slow down seti and crack
snice -17 root bash  Give priority to root's shell.
```

1.103.7 Search text files using regular expressions Weight: 3

Description: Candidates should be able to manipulate files and text data using regular expressions. This objective includes creating simple regular expressions containing several notational elements. It also includes using regular expression tools to perform searches through a filesystem or file content.

- **Key files, terms, and utilities:**

```
grep
regexp
sed
```

`grep` Search for patherns in text. See **43**_Finding_Text-grep.pdf
Syntax: `grep "regexp" filename`
See also: `grep -F, grep -E`

`sed` Edit text using paterns. See **45**_Editing_Text-sed.pdf
Ranges are declared as *start,end*
eg. sed '1,$s/^\#/##/'
Substitute from line 1 till end($) of document

eg. `sed -f sedscr file1` Uses sed commands in `sedsrc`
`sed -e 'cmd1' -e 'cmd2' file1` Multiple commands
`sed 's/pattern/replacement/g'` Global substitution
`sed '/pattern/d'` Delete matching lines or `grep -v "pattern"`
`sed 's/^\(.*\) \(.*\)/\1_\2/'` Using Variables(\1 \2)
Last example inserts '_' between first 2 words in all lines.

Regular expressions(regex) . See. **94**_Regular_Expressions.pdf
List: `. * ^ $ \< \> \b \B [..] \ (..) {..} + ? |`

1.103.8 Perform basic file editing operations using vi

Weight: 1

Description: Candidates should be able to edit text files using vi. This objective includes vi navigation, basic vi nodes, inserting, editing, deleting, copying, and finding text.

- **Key files, terms, and utilities:**

```
vi
/, ?
h,j,k,l
G, H, L
i, c, d, dd, p, o, a
ZZ, :w!, :q!, :e!
:!
```

Search:	*/pattern,?pattern*	Search foreward, backward *pattern*
Repeat Search:	/,?	forward, backward
Goto:	n	foreward next found
	N	Backward next found

Cursor move:	l	forward	h	backward
	k	up	j	down
	w,W	Foreward one word		
	b,B	Backward one word		
	e	End of current word		
	0	Beginning of line		
	$	End of line		

Goto:	0	Beginning of line	$	End of line
	H	Top of screen	L	Bottom of screen
	:1 First line		G Last line	23 Line 23

Editing:	<esc>	Command mode
	i	Insert mode
	:sp	Split screen in 2
	<Ctrl>w w	Change to other spilt window

Delete and put in clipboard:

- x Deletes the char on the right or under the cursor(DEL)
- d Delete current char or line till (incl.) next cursor move.
  - eg. dl Delete next char. on the right same as x
  - dk Delete current line & one line above
  - d0 Delete from cursor till begin of line.
  - d$ Delete from cursor till end of line.
- c Same as d but starts inserting after
  - eg. ch Delete 1 char backward then insert mode.
  - cj Delete current line then insert mode.
- C Delete till end of line and then insert mode.
- dd Delete lines
  - eg. dd-Delete current line

3dd - Delete 3 lines (incl. current line)

Clipboard Copy and Paste:

yy,*n*yy	Copy current line, *n* lines to clipboard
p,P	Paste Clipboard before, after cursor position

Start editing(insert mode):

i,a,A	Insert text before, after cursor, at end of line
o,O	Open new line for text below, above cursor

Undoing actions:

u,<Ctrl>r	Undo last action in command mode.
<Alt>u	Undo last action in insert command mode.

Saving/switching file:

:wq	:x	ZZ	Save file and exit
:w	:w!		Save file, Save file (overwriting files)
:w *file*			Save file under....(no overwrite)
:w! *file*			Save file under....(can overwrite)
:x *file*			Save file under....(no overwrite)
:n	:N		Show the next, previous buffer
:f			Show name of current file

Load/Reload/Quit

:e *file*	Loads a new *file* if current file is saved.
:e! *file*	Loads a new *file* even if current file is not saved.
:r *file*	Insert the content of *file* at cursor position
:! *cmd*	Run shell command(*cmd*) and come back to current file editing.
:e!	Load last saved version of this file
:q!	Quit without saving

Special:

Substitutions:

:1,$s/*pattern*/*replacement*/g (same as sed)

Running a shell command (filter) on a range of text

:*range*! *shellcommand*

Runs the range of text through shell command (filter) and replace the original with the results.

eg. :1,$! grep -v '^\#' Deletes all comments lines.

Topic 104: Devices, Linux Filesystems, Filesystem Hierarchy Standard

I-nodes
- A fixed number of i-nodes are laid when a filesystem is created depending on the size of the hard disk.
- Directories are files (type'd') containing filenames and their respective i-nodes.

Storage elements names in fiesystems:
- msdos : *Clusters*
- Linux filesystems: *Blocks*

- Normal size of Blocks: 1024 Bytes
- Possible sizes: 512,1024 & 2048 Bytes
- Each Linux filesystem partition contains:
  - 1 Boot block
  - 1 SuperBlock
  - I-nodes area
  - Data area

Content of boot Block:
- Boot sector normally used to store a Boot Manager

Content of Super Block(partial) :
- Differing between filesystems, includes:
  - Number of blocks in filesystem
  - Size of Blocks
  - Address of first free Data Block
  - Address of first free I-Node
  - Various status flags

`tune2fs -l /dev/hda2` Full content of SuperBlock of partition.

Content of <u>Normal</u> I-nodes:

Type and access rights
Number of hard links
UID
GID
Filesize in bytes
mtime (last content modified)
ctime(last properties modified)
atime(last time accessed)
Address of Bloc 0
....
Address of Bloc 9
Address of single-indirection block
Address of double-indirection block
Address of triple-indirection block

Block 0 to 9:	Block containing data
Single-indirection block:	Block listing up to 128 Data Blocks
Double-indirection block:	Block listing up to 128 Single-indirection Blocks
Triple-indirection block:	Block listing up to 128 Double-indirection Blocks

EXT2 Filesystem

The main difference between normal filesystems and the EXT2 is the content of the i-nodes which are slightly different to accomodate for future expansion and special features.

Content of EXT2 i-nodes:

permissions	**Nr. of Hard links**	**owner(UID)**	**group(GID)**
size		**properties change time(ctime)**	
modification time(mtime)		**access time(atime)**	
deletion time(dtime)		**blockcount**	
flags(attributes)		**file version (NFS)**	
file ACL		**dir ACL**	
fragment addr.	**fr. size**	**frag. nr**	**reserved**
1. block data		**2. block data**	
3. block data		**4. block data**	
5. block data		**6. block data**	
7. block data		**8. block data**	
9. block data		**10. block data**	
11. block data		**12. block data**	
simple indirect		**double indirect**	
triple indirect		**reserved**	
reserved		**reserved**	

Some differences between EXT2 and normal filesystem:

- Deletion Time entry: Helpful to un-delete files
- Field for 12 attributes(flags): `A,a,c,d,i,S,s,u`.
  Usefull are: Append(`+a`) Allows only to append to it via redirection(>>)
  Immutable(`+i`) Not changeable, no new hardlinks, not deletable
  Safe-delete(`+s`) Fills file with '0s' before deleting it.
  `chattr` *`attribute filename`* Changes the file's attributes. Only root allowed!!
  `chattr +i file` Turns atrribute `i` ON
  `chattr -i file` Turns atrribute `i` OFF
  `lsattr` *`filename`* Lists a file's attributes

- File Version Entry: Can be used by NFS server.
- File ACL and Dir ACL: (Access Control List) for better access control.
- Support for fragmented files
- 12 Direct Block Addresses instead of only 10(standard)
- The Superblock is having multiple backups of itself at the start of some block groups. I found between 6 to 10 copies (backups) in 3 to 10 GB Partitions

- Superblock of EXT2 has extra entries:
  - Valid-Flag Entry: if ON means the filesystem was not unmounted properly. `e2fsck` uses this flag to know if it should do a full check. `e2fsck -f` forces the full check.
  - Max-Mounts before full check and mount-count Entries: Used by e2fsck. If mount-count=Max-Mounts before full check then e2fsck does a full check.
  - Percent of full partition space reserved for root Entry: Normally 5%.
  - tune2fs can manipulate these above superblock entries. Warning: Partition should NOT be mounted as ReadWrite if changing any of these entries.

Journaling Filesystems

EXT3: Is an EXT2 filesystem with a journal file and journalling functions.

Reiserfs: Stores a report of all transactions bigger than 1 block. Experienced as up to 10 times faster than EXT3 in reading.

Xfs: Ported from IRIX system. Meant for handling very large files. max 9,000 Peta Bytes. Info: Kilo, Mega, Giga, Terra, Peta, Exa.

1.104.1 Create partitions and filesystems Weight: 3

Description: Candidates should be able to configure disk partitions and then create filesystems on media such as hard disks. This objective includes using various mkfs commands to set up partitions to various filesystems, including ext2, ext3, reiserfs, vfat, and xfs.

- **Key files, terms, and utilities:**

```
fdisk
mkfs
```

Notes:

Max number of Primary partitions per hard disks: 4
Max number of extended partitions per hard disk: 1
Maximum number of logical partitons per hard disk: 11
Naming of the partitions:

hda----IDE-Ctrl1------hdb		hdc----IDE Ctrl 2-----hdd	
master	slave	master	slave

hda1(pri/ext)
hda2(pri/ext)
hda3(pri/ext)
hda4(pri/ext)
    hda5(logic)
    hda6(logic)
    .....
    hda15(logic)

Partitioning:

`fdisk -l` Display all hard disks and partitions recognized in system.

`fdisk /dev/hda` Partitioning of hda hard disk

```
Command (m for help):m
Command action
   a   toggle a bootable flag
   b   edit bsd disklabel
   c   toggle the dos compatibility flag
   d   delete a partition
   l   list known partition types
   m   print this menu
   n   add a new partition
   o   create a new empty DOS partition table
   p   print the partition table
   q   quit without saving changes
   s   create a new empty Sun disklabel
   t   change a partition's system id
   u   change display/entry units
   v   verify the partition table
   w   write table to disk and exit
   x   extra functionality (experts only)
```

Creating a new partition:

```
     n --> primary-->.....
```

Changing its partiton system id:

```
     t--->l(liste)-->83(linux) or 82(swap)
```

Listing partitions:

```
p Shows the partition table
```

When all finished:(warning: last change to verify and correct if needed)

```
w Writes the partition table on disk!!!
```

Note: Linux does not need the activation of the bootable flag, but Windows does. So if windows is installed and the flag is on its partion, then leave it there.

Creating a filesystem.

`mkfs -t` *`filesystem`* [*`options`*] *`device`* [*`blocks`*]
or `mke2fs` [*`options`*] *`device`* [*`blocks`*] (for `ext2` filesystem)

`filesystems`:
`ext2,ext3,vfat,msdos,reiserfs,xfs,minix,bfs,xiafs`

Note: Possible commands and their synonyms:

```
mke2fs    =  mkfs.ext2        = mkfs -t ext2
mkfs.ext3 =  mkfs.ext2 -j     = mkfs -t ext3
mkdosfs   =  mkfs.msdos  = mkfs.vfat = mkfs -t vfat
mkfs.xfs  =  mkfs -t xfs
mkfs.bfs, mkfs.minix,, mkfs.xiafs
```

`options`:

- `-b` Block size. Valid values: 1024, 2048, 4096
- `-c` Before creating the filesystem, check the device for bad blocks
- `-i` *`n`* Specify the number(*n*) of bytes per inode. Min = Block size
  This helps to calculate the number of inodes to create.
  Number of i-nodes = Dependent on the size of partition.
- `-N` *`n`* Specify the absolute number(*n*) of i-nodes to create.

`device`: `/dev/`*`xxxx`* *`xxxx`*=`hda1`.... `hdc4` etc.

`blocks`: Optional. Size in blocks of the filesystem to create.
If not given the size is auto detected.

`mkreiserfs` *`options device`* For making a reiser filesystem.
or `mkfs -t reiserfs` " " " "
or `mkfs.reiserfs` " " " "

`tune2fs -j device` Converts an `ext2` to `ext3` filesystem.

1.104.2 Maintain the integrity of filesystems Weight: 3

Description: Candidates should be able to verify the integrity of filesystems, monitor free space and inodes, and repair simple filesystem problems. This objective includes the commands required to maintain a standard filesystem, as well as the extra data associated with a journaling filesystem.

- **Key files, terms, and utilities:**

```
du,  df
fsck,e2fsck
mke2fs
debugfs
dumpe2fs
tune2fs
```

Disk Usage: du

`du` is recursive as default.

`du -sh /root`	Display amount of space used by `/root` dirrctory
`du -h --max-depth=0 /home`	Amount of space used by /home (non recursive)

Disk Free: df

`df`	List (in kilobytes) free & used space on mounted partitions
`df -h`	Same as above but in human readyble format (`K,M,G`)
`df -i /dev/hda3`	Show amount of free inodes on `hda3`
	Note: `df -i` doesn't show the inodes info for reiserfs or XFS, since they are creating inodes dynamically.

File system check: fsck

Shortcut aliases for fsck:

`e2fsck = fsck.ext2`	For EXT2 and EXT3
`reiserfsck`	For Reiserfs
`fsck.minix`	For minix
`fsck.msdos`	For Ms DOS FAT
`fsck.vfat`	For DOS VFAT
`fsck.xfs`	For XFS

Note: `fsck` should always be run on a non-mounted or read-only mounted filesystem.

Syntax:

```
fsck options filesystem
```

`options`:(mostly for the ext2/ext3 filesystem)

`-A`	Checks all filesystems listed for check in `/etc/fstab`
`-f`	Force checking even if the *Valid-Flag* is not set(filesystem ok)
`-p`	Auto Repair without asking
`-n`	NO-Simulation. No writing of any changes on disk
`-y`	YES- Answer yes to any questions coming up. Dangerous!!!

File system debugging: debugfs

Interactive command driven debugging program.
Created to fully control and manupulate the `ext2` filesystems.
Default is in read-only mode. `-w` option overrrides this.
Command `help` shows all valid commands.

File system info dump: `dumpe2fs`

Displays lots of information about the structure of the ext2 filesystem.
Incl: Superblock content, free inodes categorized per block groups
Location(offsets) of the superblock backups, etc.
Can be useful to be saved in a file and used to recover a damaged system.

File system tuning-up: `tune2fs`

Allows to manipulate some of the parameters of the ext2 filesystem located in the superblock. Heare are few examples:

`tune2fs -l /dev/hda5`	List the content of the superblock
`tune2fs -j /dev/hda3`	Converts the ext2 filesystem to ext3
`tune2fs -c 30 /dev/hda2`	Change the max-mount-count to 30
`tune2fs -C 0 /dev/hda9`	Reset the number of mounts counter to 0.

Extra examples:

```
dumpe2fs /dev/hda7 | grep '[mM]ount count'
   dumpe2fs 1.19, 13-Jul-2000 for EXT2 FS 0.5b, 95/08/09
   Mount count:              7
   Maximum mount count:      20

tune2fs -C 9 /dev/hda6
   tune2fs 1.19, 13-Jul-2000 for EXT2 FS 0.5b, 95/08/09
   Setting current mount count to 9
```

1.104.3 Control mounting and unmounting filesystems Weight: 3

Description: Candidates should be able to configure the mounting of a filesystem. This objective includes the ability to manually mount and unmount filesystems, configure filesystem mounting on bootup, and configure user mountable removeable filesystems such as tape drives, floppies, and CDs.

- **Key files, terms, and utilities:**
  `/etc/fstab`
  `mount`
  `umount`

  - **Systax of Mounting command**
    `mount -t <fstype> <SourceDevice> <MountPoint>`
    eg. `mount /dev/hdc /cdrom`

  - **Mounting all the `fstab` -auto- (boot time only) mount points**
    `mount -a` tries to mount all the devices in fstab as it happens at boot time.

  - **`/etc/fstab` file format**

	Device	Mount point	Files system	Options	Dump	fsck order
e.g.:	/dev/hda1	/boot	ext2	defaults	1	1
	/dev/hdb1	/	ext2	defaults	0	2
	/dev/hdb3	swap	swap	defaults	0	1
	/dev/cdrom	/cdrom	iso9660	ro,noauto,user	0	0
	/dev/floppy	/floppy	auto	noauto,user	0	0
	/dev/hdc1	/windows	vfat	user,umask=000	0	0

  - **Options of 'defaults'**
    `rw,suid,dev,exec,auto,nouser,async,atime`
    (async=buffered)

  - **List of all options**

auto	**noauto**	Mounting at boot time ?
exec	**noexec**	Execute biraries found on device ?
sync	**async**	Buffered data when writing ?
atime	**noatime**	Update inode access time when accessed ?
dev	**nodev**	Accept special character and block devices ?
suid	**nosuid**	Allow suid on mounted file system ?
user	**nouser**	Allow user to mount device ?
rw	**ro**	Read/Write(rw) or Read only(ro) ?
remount		Remount the already mounted device.
umask=		Sets the umask for writing on the partition (good for vfat)

  Notes:
  - The option **`user`** implies: `noexec,nosuid` and `nodev` unless overriden by subsequent contradictory options.
  - Schreibeberechtigung als Benutzer auf einer **vfat Partition**:
    `user,umask=000`
  - The option **`mount -w`** ... is the same as `mount -o rw`
  - Allmost all Options can also be entered using `mount -o`
    z.B.
    `mount -o ro,umask=000 -t vfat /dev/hdd /windows`

- **Display already mounted devices**
  - `mount` Most complete info
  - `cat /etc/mtab` Not always refreshed immediately
  - `cat /proc/mounts` Always current
  - `df -h` Mounted devices and space used/free

1.104.4 Managing disk quota

Weight: 3

Description: Candidates should be able to manage disk quotas for users. This objective includes setting up a disk quota for a filesystem, editing, checking, and generating user quota reports.

- **Key files, terms, and utilities:**
  ```
  quota
  edquota
  repquota
  quotaon
  ```

- **Terms of quota editing and reports:**
  1. The user is allowed to cross the *soft limit* for the length of time limited by the *grace period,* after which he's not any more allowed to write anything on the partition.
  2. The *hard limit* may never be exceeded by the user.
  3. The quota limits may be expressed in number of 1k blocks or in number of i-nodes (files) or both.

- **Procedure for installing quota for users and groups:**(short form)
  - Edit `/etc/fstab` and enter `usrquota,grpquota` in options field for filesystem
    ```
    /dev/hda3  /home     ext2 defaults,usrquota,grpquota    1  1
    ```
  - Remount the filesystem:
    ```
    mount -o remount /dev/hda3
    ```
  - Initialize the quota databases files(`aquota.user,aquota.group`)
    ```
    quotacheck -avugm
    ```
  - Set quota for each user:
    ```
    edquota -u paul or
    edquota paul
    ```
  - Edits grace period for all the users:
    ```
    edquota -tu
    ```
  - Turn quota ON:
    ```
    quotaon -u /dev/hda3
    ```
  - Check quota for user:
    ```
    quota paul
    ```
  - Create a quota report for all users:
    ```
    repquota -u /dev/hda3
    ```
  - Create a quota report for all groups:
    ```
    repquota -g /dev/hda3
    ```
  - Turn quota OFF(when needed)
    ```
    quotaoff -u /dev/hda3
    ```

- **Detailed preparation of quotas.**

- Enter the following options in `/etc/fstab` for the partitions where we want to use quotas.

  eg.

```
/dev/hda2 /srv/www  ext2 defaults,usrquota,grpquota    1  1
/dev/hda3 /home     ext2 defaults,usrquota,grpquota    1  1
```

- Remount the filesystems:

```
mount -o remount /srv/www
mount -o remount /home
```

- Enter the following command to verify the already used space by each user and group:

```
quotacheck -avugm
```

  This command will also update 2 files in the `/home` directory:

  `quota.group`, and `quota.user`

  if version 2 of quotas is used then the 2 files will be:

  `aquota.group`, and `aquota.user`

- Start editing the quota for each user:

  eg. `edquota -u john` or `edquota john`

  Edits the filesystem quota for the user john

  The quota editor(`vi`) will appear and will allow to change the soft and hard quota for user `john`. Note: The value 0 for `soft` or `hard` quota means N O L I M I T.

```
+-------------------------------------------------------------------------+
| Filesystem      blocks     soft     hard     inodes    soft    hard   |
| /dev/hda7        3288      4000     6000      649      2000    3000   |
+-------------------------------------------------------------------------+
```

- This above example means that `john`:

```
Uses already 3288 blocks(kb) of data on /dev/hda7 in 649 inodes (files)
The soft quota is set to 4000 kB and hard to 6000 kB
The soft limit is set to 2000 inodes and hard limit to 3000 inodes
```

- `edquota -tu` Edits grace period for all the users.

  Not possible to set grace period for individual users

  (`month(s),day(s),hour(s),min(utes),sec(onds)`)

  eg.

```
+-------------------------------------------------------------------------+
| Filesystem      Block grace period       Inode grace period            |
| /dev/hda7              7days                    5days                   |
+-------------------------------------------------------------------------+
```

  - To copy the quota for other users with the same limit values, the easy way is:

```
edquota -p john patrick
```

    This command will give the same quota limits of `john` to `patrick.`

  - To verify the status of the quota for the user `john` use the commands:

```
su -
quota john
```

The result:

```
+-------------------------------------------------------------------+
| Disk quotas for user john (uid 5001):                             |
| Filesytem blocks  quota  limit grace  files  quota  limit  grace |
| /dev/hda7 3288     4000   6000          649   2000   3000        |
+-------------------------------------------------------------------+
```

This means that the user `john` is having `649` files using `3288` Kb of hard disk space. His soft limit is `4000` Kb or `2000` Files and hard limit is `6000` kb or `3000` Files(inodes)

Repquota

`Repquota` produces a summarized quota information for a file system.
Here is a sample output `repquota` gives:

```
# repquota -a
     *** Report for user quotas on device /dev/hda7
     Block grace time: 7days; Inode grace time: 5days
                     Block limits                File limits
     User         used    soft    hard  grace    used  soft  hard  grace
     root    -- 175419       0       0          14679    0     0
     john    +-   6000    4000    6000            650 2000  3000
     uucp    --    729       0       0             23    0     0
     user1   --  13046   15360   19200            806 1500  2250
```

`repquota -g /home` Report of groups quota
`repquota -u /home` **same as `repquota /home`** Report of users quota

- **`Quotaon and Quotaoff`**

`quotaon -u /dev/hda2` turns ON quota accouting in kernel for users(`-u`)
`quotaoff -u /dev/hda2` turns it OFF.

Actually both files are similar. They are executed at system startup and shutdown.

Important Files involved in Quota

`quota` (1) Display disk usage and limits `quota` reports the quotas of all the filesystems listed in `/etc/mtab`. For filesystems that are NFS-mounted to a server, a call to the `rpc.rquotad` on the server machine is performed to get the information.
`setquota` (8) Set disk quotas on one commmand wihtout editing like with edquota
`edquota` (8) Edit user quotas
`quotaoff` (8) Turn filesystem quotas off and on [**`quotaon`**]
`quotacheck` (8) Scan a file system for disk usages, create and check the files `aquota.user` and `aquota.group`
`repquota (8)` Summarize quotas for a filesystem

1.104.5 Use file permissions to control access to files Weight: 5

Description: Candidates should be able to control file access through permissions. This objective includes access permissions on regular and special files as well as directories. Also included are access modes such as suid, sgid, and the sticky bit, the use of the group field to grant file access to workgroups, the immutable flag, and the default file creation mode.

- **Key files, terms, and utilities:**
  `chmod`
  `umask`
  `chattr`
- **File types**
  (`-`) Regular files.....(s) is unknow to me till now (eg. `/dev/gpmctl`)
  (**`l`**) Symbolic Links (eg. `/sbin/init.d/rc2.d`.....all files)
  (**d**) Directories and sub-directories
  (**b**) Block Device Files (eg. `/dev/hda1`...)
  (**c**) Character Device Files (eg. `/dev/tty1`....)
  (**p**) FIFO Named pipes (eg. `/dev/log`, `/dev/xconsole`)
  (**s**) ???? (eg. `/var/spool/postfix/private/bounce`...)

  Note. The file names and directory names that starts with a Dot (**.**) are hidden from display by certain programs like `ls` etc.
- **Files and directories access rights**
  Access rights are restrictions applied on the content each file or directory.
  It doesn't restrict deletion of the file or directory. Only their parent directories access rights controls that.
  - **Changing the files access rights**
    `chmod [-R] [ugoa][+=-][rwx stXugo]` or `[0000 to 7777]` *`file`*
    eg. `chmod u+w,g-x,o=wx file1`
    `chmod 750 file2`
    `chmod 4755 program1` (SUID=ON)
    `chmod u+s,g+s,o+t program2` (SUID=ON,SGID=ON,StickyBit=ON)
    `chmod -R u=rwX,g=rX,o=rX dir1` Recursive 755 for directories. and 644 for files.
  - **Directories access rights**
    - The read(`r`) without the search(`x`) access rights for directories makes no sense and the read is ignored.
    - Any file (belonging to the user or not) under a directory set to write access to everybody can be erased by anybody.

Extra access rights			**u**ser			**g**roup			**o**thers		
SUID (s)	**SGID (s)**	**Sticky Bit(t)**	**r**	**w**	**x**	**r**	**w**	**x**	**r**	**w**	**x**
4	**2**	**1**	**4**	**2**	**1**	**4**	**2**	**1**	**4**	**2**	**1**

  - **SUID and SGID for programs** (`-rw`**`s`**`rw`**`s`**`rwx`)(`-rw`**`S`**`rw`**`S`**`rwx`)
    - SUID=ON: Effective user is owner of the program(w/SUID) started
    - SGID=ON: Effective group is the group of the program(w/SGID) started

- **SGID for Directories**
  Forces the subdirectories and files created in it, to have the same group as the directory's group independently of the user's group creating it. Subdirectories created within this directory will enherit of the same SGID.

- **Sticky Bit for Directories :**
  Sets the rights to erase files only to their owner even if the directory is set to write for everybody. The sticky bit on **`/temp`** prevents that users processes erase files belonging to other users.
  Note 1: Normally any file (belonging to the user or not) under a directory set to write access to group or others can be erased by users.
  Note2: The **owner of the directory** can still erase any file even if the sticky bit is set.

- **Sticky Bit for programs:**
  - Allows an already run program to get stored in the ram (buffers) till the system goes down.
    Advantage: Fast load of program.
    Disadvantage: Uses lots of RAM

  - **Command :**
    `chmod o+t` (sets the sticky bit)
    result= (`-rwxrwxrwt`) or (`-rwxrwxrwT`)
    `chmod u+t` (sets the SUID)
    result= (`-rwsrwxrwt`) or (`-rwSrwxrwT`)
    `chmod u+t` (sets the SGID)
    result= (`-rwxrwsrwt`) or (`-rwxrwSrwT`)
    Note: When adding a sticky-bit to a file/dir with an **x** for Others, the sticky-bit is displayed a **t** otherwise as **T** if the x was not present. The same applies to SUID and SGID (`-rw`**`S`**`rw`**`S`**`rw`**`T`**)

- **Attributes(`chattr` & `lsattr`)**

  - Setting a directory or file to `append-only' attribute.
  - Command : **`chattr +a`** *`filename`* or *`directoryname`*
  - User must not necessarily be root
  - A file with this attribute may be appended to, but may not be deleted,and the existing contents of the file may not be overwritten. If a directory has this attribute, any files or directories within it may be modified as normal, but no files may be deleted.

  - Setting a directory or file to `immutable' attribute.
  - Command : **`chattr +i`** *`filename`* or *`directoryname`*
  - User must be ´root´
  - A file or directory with this attribute may not be modified, deleted, renamed, or (hard) linked

  - **Display Attributes of files and directories**
    To list the (special) attributes of files and dirs. use the command **`lsattr`**

- **Attributes list:**

  A Atime record is not modified. Prevents too much disk access for laptops. Still in testing mode

  a Sets it to append mode only (can not erase it)
  Only root can set this attribute

  c The kernel compresses this file before storing
  The kernel decompresses it when reading it.
  NOT Implemented yet by kernel

  d Will not be backed-up by the program "dump"

  i Cannot be modified
  Cannot be erased
  Cannot be renamed
  Cannot be made a link to
  Only root can change this attribute

  s When this file is erased, its used blocks are written with '0' to prevent recovery at a later date.

  S Any change to this file will be immediately written on the disk instead of in the file system buffer.
  (equivalent to '`sync`' mount option)

  u When this file is deleted, its content is saved. It can therefore be undeleted later.
  NOT implemented yet by kernel.

- **`umask` for new files an directories**

  Alows to control which access rights will be given to newly created files or directories:
  New files access rights = `666 !| umask` (`!|`=Logical NOR)
  New directories access rights = `777 !| umask`

  - examples:

	666 access rights 777	
umask	New files	New Directories
022	-rw-r--r--	-rwxr-xr-x
135	-rw-r---w-	-rw-r---w-
216	-r--rw----	-r-xrw---x

1.104.6 Manage file ownership Weight: 1

Description: Candidates should be able to control user and group ownership of files. This objective includes the ability to change the user and group owner of a file as well as the default group owner for new files.

- **Key files, terms, and utilities:**
  `chown`
  `chgrp`
  `chmod`

chown : Change user and group ownership of a file or directory

Syntax: `chown [options] [user][:group] filename`
`chown [options] [user][:group] dirname`

eg.

	`chown`	*`user`*`:`*`group`* *`filename`*	Change user and group	ownership of file
or	"	*`user`* "	Change user	ownership of file
or	"	*`user`*`.` "	Change user and his group	ownership of file
or	"	*`user`*`:` "	" "	"
or	"	`.`*`group`* "	Change group	ownership of file

Important Options:(from man page)

`-R --recursive` Recursive:affect all the files and directories inside directory trees

`--dereference` affect the referent of each symbolic link, rather than the symbolic link itself.

`-h, --no-dereference`
affect symbolic links instead of any referenced file. (available only on systems that can change the ownership of a symlink)

`--from=`*`CURRENT_OWNER`*`:`*`CURRENT_GROUP`*
change the owner and/or group of each file only if its current owner and/or group match those specified here.
Either may be omitted, in which case a match is not required for the omitted attribute.

`-f, --silent, --quiet` suppress most error messages

`-c, --changes` like verbose but report only when a change is made

`--reference=RFILE` use `RFILE`'s owner and group rather than the specified `OWNER:GROUP` values.

`-v, --verbose` output a diagnostic for every file processed

IMPORTANT:
`root` is the only user allowed to change ownership(`chown`) of files or directories.

chgrp : Change group ownership of a file or directrory

`syntax:` `chgrp [`*`options`*`] `*`newgroup filename`*

eg. `chgrp -R ftp /srv/www`
Changes recursively all the files and directories inside the dir. `/srv/www` to be owned by group `ftp`

`chgrp -R --reference=/home/hans /srv/ftp`
Changes recursively the group ownership of all the files and directories contained in `/srv/ftp` to the group owning the directory `/home/hans`

options:

`-R, --recursive`	operate on files and directories recursively
`--dereference`	affect the referent of each symbolic link, rather than the symbolic link itself
`-h, --no-dereference`	affect symbolic links instead of any referenced file (available only on systems that can change the ownership of a symlink)
`-f, --silent, --quiet`	suppress most error messages
`--reference=RFILE`	use `RFILE`'s group rather than the specified `GROUP` value
`-v, --verbose`	output a diagnostic for every file processed
`-c, --changes`	like verbose but report only when a change is made

chmod : Change the access rights of a files or directories
See 1.104.5 Use file persmissions to control access of files

1.104.7 Create and change hard and symbolic links Weight: 1

Description: Candidates should be able to create and manage hard and symbolic links to a file. This objective includes the ability to create and identify links, copy files through links, and use linked files to support system administration tasks.

- **Key files, terms, and utilities:**
  `ln`

Creating a Symbolic link:

Syntax: `ln [options] -s source destination`(newlink)
or `cp -s source destination`(newlink)

eg. `ln -s /bin/cat /home/hans/bin/cat`
Creates a new Symbolic Link called `/home/hans/bin/cat`
pointing to `/bin/cat`

Creating a Hard Link: (files which have the same inode)

Syntax: `ln source destination`(newlink)
or `cp -l source destination`(newlink)
eg. `ln /bin/ping /home/hans/bin/ping`
Creates a new Hard link called `/home/hans/bin/ping`
pointing to `/bin/ping`

Options:

`-f, --force`	remove existing destination files
`-i, --interactive`	prompt whether to remove destinations
`-s, --symbolic`	make symbolic links instead of hard links
`--target-directory=DIRECTORY`	specify the *DIRECTORY* in which to create the links
`-v, --verbose`	print name of each file before linking

Important Notes:

- Although the man page says that it is possible in to make a hard link to a directory, in reality it is not possible...yet.

- Hard links are limited to the same partition as the original

- Symbolic links are NOT limited to the same partition as the original

The command `cp source destination` copies the defered file(the file pointed to) when the *source* is a symbolic link.
eg. `cp linktest3 linktest5` (`linktest3` is a symbolic link---->`linktest`)
Copies the content of `linktest` to `linktest5` as a normal file.

- The field Nr.2 of the command `ls -l filename` shows how many hard links a file has.

eg. `ls -l linktest*`

```
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest2
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest3
```

- The command `stat filename` give also shows also how many hard links a file has.

```
eg.
stat linktest
File: `linktest'
Size: 0     Blocks: 0       IO Block: 4096   regular empty file
Device: 305h/773d       Inode: 876319      Links: 2
Access: (0644/-rw-r--r--) Uid: (  500/ michel)  Gid:( 33/  video)
Access: 2003-11-20 08:45:10.000000000 +0100
Modify: 2003-11-20 08:45:10.000000000 +0100
Change: 2003-11-20 08:45:22.000000000 +0100
```

1.104.8 Find system files and place files in the correct location Weight: 5

Description: Candidates should be thouroughly familiar with the Filesystem Hierarchy Standard, including typical file locations and directory classifications. This objective includes the ability to find files and commands on a Linux system.

- **Key files, terms, and utilities:**

```
find
locate
slocate
updatedb
whereis
which
/etc/updatedb.conf
```

find : Finding file recursively

Syntax:
`find` *`startdirectory`* `[search_criteria_options] [-exec` *`command`* `\;]`

Examples:

```
find . type d -maxdepth 1 | sort
```
Finds all directories located in the current directory and sort them

```
cd /etc/ ; find . -name "*XF*"
```
Finds all files recursively in `/etc` directory of which their names includes the pattern 'XF'

```
find /opt/kde -maxdepth 2 -type f -name "*edit"
```
Searches in /opt/kde and in 2 subdirectories deep, any file of which their name ends-up with the word 'edit'

```
find . -follow -cmin -5
```
(Search the files that of which their properties have been changed less than 5 minutes ago)

`-cmin +5`	Properties of file **c**hanged more than 5 minutes ago
`-amin -6`	Content of file **a**ccessed less than 6 minutes ago
`-mmin +8`	Content of file **m**odified more than 8 minutes ago
`-ctime +5`	Properties of file **c**hanged more than 5 days ago
`-atime -7`	Content of file **a**ccessed less than 7 days ago
`-mtime -3`	Content of file **m**odified less than 3 days ago

```
find /etc -type f -name '*.conf' -exec grep -H "hosts" {} \;
```
Executes the `grep` on each found file. Each found line will be shown accompanied with the name of the file where it was found.

```
find /etc -type f -name '*.conf' -ok grep -H "hosts" {} \;
```
Same actions a as above except that `-ok` option asks `find` to prompt for confirmation(with **y**) of the command to do before executing it.

locate : Locate files in the whole system based using a database of filenames.

Syntax:

`locate` *`filename`* Searched in the locate database for the *`filename`*.
This database is in `/var/lib/locatedb`
It is updated via the command: `updatedb [`*`options`*`]`
The configuration file for updatedb is `/etc/updatedb.conf`

`-d path, --database=path`
Instead of searching the default file name database, search the file name databases in path, which is a colon-separated list of database file names. You can also use the environment variable `LOCATE_PATH` to set the list of database files to search.
The option overrides the environment variable if both are used.

`-e, --existing` Only print out such names that currently exist (instead of such names that existed when the database was created).
Note that this may slow down the program a lot, if there are many matches in the database.

`-i, --ignore-case`
Ignore case distinctions in both the pattern and the file names.

slocate : Secure locate of file in system

Syntax:

`slocate [options] filename`

Secure Locate provides the same features as the `locate` but it will also store file permissions and ownership so that users will not see files they do not have access to.

`slocate` database is not the same as `locate` database. It needs to be built by issuing the `slocate` command with proper options:

Database Build Options:

`-u` Create slocate database starting at path `/`
`-U <dir>` Create slocate database starting at path <dir>
`-e <dir1,dir2,...>`
Exclude directories from `slocate` database .
`-f <fstype1,...>`
Exclude files on specific file systems from the `slocate` database.
`-c` Parse `/etc/updatedb.conf` when updating the slocate database.
`-l <level>` Security level:
`0` Turns security checks off. This will make searchsfaster.
`1` Turns security checks on. This is the default.
`-o <file>` Specifies the database to create.
`--output=<file>`
`-v, --verbose` Verbose mode.
Display files when creating database.

Slocate Search Options:

`-i`	Does a case insensitive search.
`-q`	Quiet mode. Error messages are suppressed.
`-n <num>`	Limit the amount of results shown to `<num>`.
`--regexp=<regexp>`	
`-r <regexp>`	Search the database using a basic POSIX regular expression.
`-d <path>`	Specifies the path of databasesto search in.
`--database=<path>`	

whereis: Search for a program and possibly its man pages from a predefined path.
Syntax:

`whereis` *`filename`*	Searches a predefined (hard coded) list of directories for the filename and man pages. They must be in the path predifined during compilation of `whereis` program.

which : Search for the first occurence of a program through the `PATH`.
Syntax:

`which` *`filename`*	Searches the `PATH` for the first occurence of the filename. The filename can be a list of files.
`type -p` *`filename`*	Same as above `which` *`filename`*

Topic 110: The X Window System

1.110.1 Install & Configure XFree86 Weight: 5

Description: Candidate should be able to configure and install X and an X font server. This objective includes verifying that the video card and monitor are supported by an X server, as well as customizing and tuning X for the videocard and monitor. It also includes installing an X font server, installing fonts, and configuring X to use the font server (may require a manual edit of `/etc/X11/XF86Config` in the "Files" section).

- **Key files, terms, and utilities:**

```
XF86Setup
xf86config
xvidtune
/etc/X11/XF86Config
/etc/.Xresources
~/.Xresources
```

- **X Server**

X-Server offers an empty display where programs the support the X-Protocol will be displayed and controlled via the mouse and keyboard where the display runs.
The X-Server takes control of the local Graphic card,monitor, mouse and keyboard and possibly other devices like joystick, graphic tablet etc.
The X-Server is a network service for local or remote clients(X-Programs).
The X-Server is been develloped for many hardware environments. Most of them are proprietary and one of them is Free: X-Free-86(XF86). It is the one explained below.

`/etc/X11/XF86Config` Main XF86 Configuration file. It is the first looked for. Before FHS it was often at `/etc/XF86Config`
If the user is root and he starts the XF86 manually then the `~/XF86Config` file will be first searched for.

- **Search Path of XF86Config file.**

-When X is started as a normal user:

```
/etc/X11/$XF86CONFIG
/usr/X11R6/etc/X11/$XF86CONFIG
```

Then Common search path

-When X is started as the `root` user.

```
$XF86CONFIG
/etc/X11/$XF86CONFIG
/usr/X11R6/etc/X11/$XF86CONFIG
$HOME/XF86Config
```

Then Common search path

Common search path:

```
/etc/X11/XF86Config-4
/etc/X11/XF86Config
/etc/XF86Config
/usr/X11R6/etc/X11/XF86Config.<hostname>
/usr/X11R6/etc/X11/XF86Config-4
/usr/X11R6/etc/X11/XF86Config
/usr/X11R6/lib/X11/XF86Config.<hostname>
/usr/X11R6/lib/X11/XF86Config-4
/usr/X11R6/lib/X11/XF86Config
```

- **Note:** In the above 2 paths ***/X-Rootdir*** is normally `/usr/X11R6/`
  Depending on distributions the configuration files of X-Server Version 3 and Version 4 are located in different locations. Often used locations and names:

`/etc/XF86Config`	Version 3
`/etc/X11/XF86Config`	Verison 4

  or

`/etc/X11/XF86Config`	Version 3
`/etc/X11/XF86Config-4`	Verison 4

- **XF86 Configuration programs** (Helpers to write the `XF86Config` file)

`xf86config` First text-based configuration program.
Provided and suported by the XF86 development team.
Belongs to standard X-Server packages.

`XF86Setup` Graphic-based (640x480-VGA 16 colors) configuration program.
Also provided and supported by XF86 development team.

`xf86cfg` Graphic-based configuration program. More complex and more for advanced administrators. Provides the possibility of dynamically try some of the settings by pressing on 'Apply' button.
Provides auto-detecting of graphic cards.
Also provided and supported by XF86 development team.

SAX & SAX2 SuSE graphic-based configuration programs.
SAX is for XF86 Version 3 and SAX2 for XF86 Version 4.
Provides auto-detecting of graphic cards.

`Xconfigurator`
RedHat text-based configuration programs. Similar but improved version of the `xf86config`. It does auto-detection of graphic cards. Works in inteactive mode or in automatic-install mode.

`dexconf` Background program run by Debian system installation program.
No user startable program. To reconfigure the X-Server execute:
`dpkg-reconfigure xserver-xfree86`

All of the above configuration programs do 2 things:
- Configuration of the `XF86Config` file.
- Creation of a symbolic link to the configured X-Server

- **Configuration of the `XF86Config` file** :
  Sections of XF86Config file:

`ServerFlags`	Server flags
`Module`	Dynamic module loading
`InputDevice`	Input device description
`Device`	Graphics device description
`VideoAdaptor`	Xv video adapter description
`Monitor`	Monitor description
`Modes`	Video modes descriptions
`Screen`	Screen configuration

`ServerLayout`	Overall layout
`DRI`	DRI-specific configuration
`Vendor`	Vendor-specific configuration

Note: Although the next 2 sections are recognized by version 4 it is recommended to use InputDevice section instead.

`Keyboard`	Keyboard configuration(Version 3)
`Pointer`	Mouse configuration(Version 3)

- **Creation of a symbolic link to the configured X-Server**

  For Version 3

  `/usr/X11R6/bin/X ==> /var/X11R6/bin/X ==> /usr/X11R6/bin/XF86_`*`Servertype`*

  For Version 4

  `/usr/X11R6/bin/X ==> /var/X11R6/bin/XFree86`

- **Starting the Xserver and Windowmanager:**

  `startx` (script)

- **Fine Tuning the monitor settings:**

  - Manual with monitor's buttons
  - Via the `xvidtune` program

- **X11 Fonts and Fonts server:**

  Fonts are listed in XF86Config through the Keyword: `FontPath`
  eg.

```
FontPath "/usr/X11R6/lib/X11/fonts/TrueType"
FontPath "/usr/X11R6/lib/X11/fonts/75dpi:unscaled"
```

  Font servers can also be listed but MUST be listed as first in the list:

```
FontPath "unix/:7100"      Font server on local Unix socket
```

- **`xset`: Temporarily Changing the X-Server's `FontPath` settings as it runs:**

  Example of adding and deleting FontPaths(non permanent).

```
   xset  +fp /usr/X11R6/lib/X11/fonts/TrueType   Adds a FontPath
or xset  fp+/usr/X11R6/lib/X11/fonts/TrueType

   xset  -fp /usr/X11R6/lib/X11/fonts/TrueType   Deletes a FontPath
or xset  fp-/usr/X11R6/lib/X11/fonts/TrueType
```

- **Setting-up a Font server:XFS**

  XFS is the standard Font Server which listens for requests on port `7100`(Standard).

  - Settings of client's `XF86Config` configuration file:

```
FontPath "unix/:7100"                  Local Font server on Unix socket
#FontPath "tcp/myserver.fd.com:7100"  Remote font server
```

  - XFS Configuration file:`/etc/X11/fs/config` or `/etc/X11/xfs.conf`
  - Starting the font server as Daemon:

```
xfs -config /etc/X11/fs/config -daemon
```

- Example of XFS configuration file:

```
no-listen = tcp
port = 7100
client-limit = 10
clone-self = on
use-syslog = on
deferglyphs = 16

catalogue = /usr/X11R6/lib/X11/fonts/misc:unscaled,
            /usr/X11R6/lib/X11/fonts/75dpi:unscaled,
            /usr/X11R6/lib/X11/fonts/100dpi:unscaled,
            /usr/X11R6/lib/X11/fonts/japanese:unscaled,
            /usr/X11R6/lib/X11/fonts/baekmuk:unscaled,
            /usr/X11R6/lib/X11/fonts/Type1,
            /usr/X11R6/lib/X11/fonts/URW,
            /usr/X11R6/lib/X11/fonts/Speedo,
            /usr/X11R6/lib/X11/fonts/CID,
            /usr/X11R6/lib/X11/fonts/PEX,
            /usr/X11R6/lib/X11/fonts/cyrillic,
            /usr/X11R6/lib/X11/fonts/latin2/misc,
            /usr/X11R6/lib/X11/fonts/latin2/75dpi,
            /usr/X11R6/lib/X11/fonts/latin2/100dpi,
            /usr/X11R6/lib/X11/fonts/latin2/Type1,
            /usr/X11R6/lib/X11/fonts/latin7/75dpi,
            /usr/X11R6/lib/X11/fonts/kwintv,
            /usr/X11R6/lib/X11/fonts/truetype,
            /usr/X11R6/lib/X11/fonts/uni,
            /usr/X11R6/lib/X11/fonts/ucs/misc,
            /usr/X11R6/lib/X11/fonts/ucs/75dpi,
            /usr/X11R6/lib/X11/fonts/ucs/100dpi,
            /usr/X11R6/lib/X11/fonts/hellas/misc,
            /usr/X11R6/lib/X11/fonts/hellas/75dpi,
            /usr/X11R6/lib/X11/fonts/hellas/100dpi,
            /usr/X11R6/lib/X11/fonts/hellas/Type1

# in decipoints
default-point-size = 120
default-resolutions = 75,75,100,100
# font cache control, specified in KB
cache-hi-mark = 2048
cache-low-mark = 1433
cache-balance = 70
```

- **Fonts names Format.**

```
Author          Weight   Width      Pixels   XRes    Spacing    ISO-Standard
     |              |       |          |        |       |          |
 -b&h-lucida-medium-r-normal-sans-18-180-75-75-p-106-iso8859-1
       |             |            |        |       |      |         |
   Fontname      Attribute      Style    Points  YRes  Average   Options
               (i or * =Italic)         (1/72 in)       Width
                (r =roman)
```

- **Installing new fonts:**
New fonts needs some preparation before they can be used.
Besides the font files(with extentions `.bdf .snf .pcf`)
located in the font directories, some extra files needs attention:

`fonts.dir` Contains the number of fonts available in this dirctory (on first line) and one line per font description. The Format is:

First line: Number of fonts listed in this file.(eg. 439)
Rest of file: *`FontFilename Font_Description`*

eg.

```
439
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-adobe-standard
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-iso10646-1
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-iso8859-1
............................
```

To create this file the program `mkfontdir` must be run:
Syntax:

`mkfontdir` *`/path/to/font/directory`*

Valid font types: PCF (`.pcf`), SNF (`.snf`) and BDF (`.bdf`)

`fonts.alias`

List entered by hand assigning a non existing font name to an existing one
Format: *`fictive_name existing_name`*
eg.

```
fixed        -misc-fixed-medium-r-semicondensed--13-120-75-75-c-60-iso8859-1
variable     -*-helvetica-bold-r-normal-*-*-120-*-*-*-*-iso8859-1
5x7          -misc-fixed-medium-r-normal--7-70-75-75-c-50-iso8859-1
5x8          -misc-fixed-medium-r-normal--8-80-75-75-c-50-iso8859-1
6x9          -misc-fixed-medium-r-normal--9-90-75-75-c-60-iso8859-1
6x10         -misc-fixed-medium-r-normal--10-100-75-75-c-60-iso8859-1
6x12         -misc-fixed-medium-r-semicondensed--12-110-75-75-c-60-iso8859-1
6x13         -misc-fixed-medium-r-semicondensed--13-120-75-75-c-60-iso8859-1
6x13bold     -misc-fixed-bold-r-semicondensed--13-120-75-75-c-60-iso8859-1
7x13         -misc-fixed-medium-r-normal--13-120-75-75-c-70-iso8859-1
7x13bold     -misc-fixed-bold-r-normal--13-120-75-75-c-70-iso8859-1
7x13euro     -misc-fixed-medium-r-normal--13-120-75-75-c-70-iso8859-15
7x13eurobold -misc-fixed-bold-r-normal--13-120-75-75-c-70-iso8859-15
7x14         -misc-fixed-medium-r-normal--14-130-75-75-c-70-iso8859-1
7x14bold     -misc-fixed-bold-r-normal--14-130-75-75-c-70-iso8859-1
8x13         -misc-fixed-medium-r-normal--13-120-75-75-c-80-iso8859-1
8x13bold     -misc-fixed-bold-r-normal--13-120-75-75-c-80-iso8859-1
8x16         -sony-fixed-medium-r-normal--16-120-100-100-c-80-iso8859-1
9x15         -misc-fixed-medium-r-normal--15-140-75-75-c-90-iso8859-1
9x15bold     -misc-fixed-bold-r-normal--15-140-75-75-c-90-iso8859-1
10x20        -misc-fixed-medium-r-normal--20-200-75-75-c-100-iso8859-1
12x24        -sony-fixed-medium-r-normal--24-170-100-100-c-120-iso8859-1
```

`fonts.scale`

List of fonts that are scalable. The format is:
First line: Number of fonts listed in this file.(eg. 439)
Rest of file: *`FontFilename Font_Description`*
eg.

```
439
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-adobe-standard
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-iso10646-1
putbi.pfa -adobe-Utopia-bold-i-normal--0-0-0-0-p-0-iso8859-1
..................
```

- **Controlling X-Server settings.**
  - Dynamic settings: X-Server can be dynamically(non permanent) controlled via the command `xset`.
    eg. To change immediately the keyboard's delay(250 ms) and repeat rate(30/s):
    `xset r rate 250 30`
  - User controlled settings: X-Server can also be controlled to provide certain configurations when X-Programs are started using the `~/.Xresources` file.
    Note: In SuSE `~/.Xresources` is a symbolic link to `~/.Xdefaults`
  - Sequence of reading resource files: Global config files for each separate X-program are first read from the directory: `/usr/lib/X11/app-defaults/*` and then the `~/.Xresources` file is read. Any user- and machine-specific resources may be specified by setting the `XENVIRONMENT` environment variable to the name of a resource file to be loaded by all applications. If this variable is not defined, a file named: `~/.Xdefaults-`*`hostname`* is looked for instead, where *`hostname`* is the name of the host where the application is executing.

- File Format for resources files ..../`app-defaults/*` and `~/.Xresources`:
  `X-`*`ProgramName`*`*`*`attribute`*`: value`
  eg.(commented lines start with a '`!`')

```
xterm*background:       LightYellow2
xterm.eightBitInput:    true
! xterm*font:   -adobe-courier-bold-r-normal--14-140-75-75-m-90-iso8859-1
```

These parameters can be overriden by starting the X-Program (`xterm`) with arguments.
eg. `xterm -fn 9x15bold -geometry 100x40+30+40 -bg LightYellow2 \`
`-T "Test_Xterm" -sb -rightbar`

1.110.2 Setup a display manager Weight: 3

Description: Candidate should be able setup and customize a Display manager. This objective includes turning the display manager on or off and changing the display manager greeting. This objective includes changing default bitplanes for the display manager. It also includes configuring display managers for use by X-stations. This objective covers the display managers XDM (X Display Manger), GDM (Gnome Display Manager) and KDM (KDE Display Manager).

- **Key files, terms, and utilities:**
  `/etc/inittab`
  `/etc/X11/xdm/*`
  `/etc/X11/kdm/*`
  `/etc/X11/gdm/*`

- **Methods of starting an X session**
  An X session can be started in 2 ways:
  - **Loging from a virtual terminal**(text based) and then run the script `startx`.
    `startx` in turns starts `xinit`.
    `xinit` configuration file:
    `$HOME/.xinitrc` if found otherwise,
    `/var/X11R6/lib/xinit/xinitrc`
  - **Via an X-Display-Manager(XDM):** The user loging in is done graphically.
    The display manager is started at boot time(runlevel 5) in the background as daemon and provides graphical logins to users.
    Note: For this we need to make sure that the `/etc/inittab` has 5 as default runlevel:
    eg. `id:5:initdefault:`

  - **Popular display managers:**

XDM	Config files Directory	Description
`xdm`	`/etc/X11/xdm/`	Provided by XFree86
`kdm`	***`kde_rootdir`***`/share/config/kdm/`	Provided by KDE
`gdm`	***`gnome_rootdir`***`/gdm/`	Provided by Gnome

`kde_rootdir` = Main root directory for kde desktop system
for kde3: `/etc/opt/kde3`

`gnome_rootdir`= Main root directory for Gnome desktop system
for Gnome 2: `/etc/opt/gnome`

- **Properties of the Display Managers:**
  kdm is based on xdm and uses many of its configuration files.
  gdm is totally new developed and is therefore more independent from xdm.

- **xdm configuration:**
  xdm is a typical X11 program and offers only a logo, a background and login fields.
  The parameters to change its behaviour are in :
  /etc/X11/xdm/Xresources

```
eg.
xlogin*greeting:   Welcome at CLIENTHOST  <---(replaced automatically by $HOSTNAME)
xlogin*namePrompt:      \040\040\040\040\040\040\040Login:
xlogin*fail:            Login incorrect
xlogin*login.greetFont: *-FAMILY-bold-SLANT-normal--*-140-*-*-*-*-iso8859-1
xlogin*login.promptFont:    *-FAMILY-bold-r-normal--*-120-*-*-*-*-iso8859-1
xlogin*login.Font:        *-FAMILY-medium-r-normal--*-120-*-*-*-*-iso8859-1
xlogin*logoFilename       /xxxxx.xpm
xlogin*borderWidth
xlogin*useShape:               true
xlogin*greetColor:             CadetBlue
xlogin*failColor:              red
xlogin*borderWidth:            0
xlogin*frameWidth:             5
xlogin*innerFramesWidth:       2
xlogin*Foreground:             black
xlogin*Background:             #c0c0c0
xlogin*shdColor:               #828282
xlogin*hiColor:                #e0e0e0
```

  xdm runs a script called /etc/X11/xdm/Xsetup each time it presents a login window. There we can run programs that change the background etc.
  Some examples of programs: xpmroot , xsetbg etc
  eg. /usr/sbin/xpmroot /etc/X11/xdm/background.xpm

- **kdm configuration**
  kdm works quite similar to xdm and uses a many of its configuration files in:
  /etc/X11/xdm/
  The main kdm configuration file is:
  kde_rootdir/share/config/kdm/**kdmrc**
  kde_rootdir = Main root directory for kde desktop system
  for kde3: /etc/opt/kde3

  The pictures of the users shown in kdm login are(valid formats: .xpm or .png):
  kde_rootdir/share/apps/kdm/pics/users/*username*.png
  The default is default.png

- **gdm configuration**
  gdm has its own configuration files separate from the xdm/kdm.
  - Main configuration file:
  gnome_rootdir/gdm/gdm.conf
  gnome_rootdir= Main root directory for Gnome desktop system
  for Gnome 2: /etc/opt/gnome

  - Method of configuring gdm.conf:
  manual(editor) and (much better) through the config program: gdmconfig

  - Other tool for configuring individual user's pictures in gdm login:
  gdmphotosetup

- **XTerminals using the `xdm/kdm` Display Managers:**

1) Activate the XDMCP (XDM Control Protocol):

- Edit the file `/etc/X11/xdm/xdm-config`

add a '!' at the beginning of the following line (normally the last line):

```
!DisplayManager.requestPort:    0
```

- Edit the file `/etc/opt/kde3/share/config/kdm/kdmrc`:

Enable the Xdmcp and restrict the shutdown to only Root

Important note: The `AllowShutdown=Root` is with a BIG 'R'

```
[Xdmcp]
      Enable=true
[X-*-Core]
      AllowShutdown=Root
```

2)Allow the access through the network:

- Edit the file `/etc/X11/xdm/xaccess`

----> For direct query from a clients:

The client uses a command like: `X -query` *`kdmserver`* `:1`

On server: Enter or activate (remove the '#') the following lines:

```
*                       #Allow any host to remotely login
```

or

```
*.linux.local           #Allow any host from my domain
```

or

```
myhost.linux.local      #allow only myhost to remotely login
```

----> For Broadcast or indirect queries from clients:

The client uses the command:

```
          X -broadcast :2
     or   X -indirect kdmserver :2
```

On server: Enter or activate (remove the '#') the following lines:

```
*               CHOOSER BROADCAST
```

or

```
*.linux.local   CHOOSER BROADCAST
```

or

```
myhost.linux.local CHOOSER BROADCAST
```

----> For Unattended x-login (`xdm/kdm` actively initiates the contact with the client. The client doesn't have to make a request: He only needs to start his X-Server on the right display port is necessary.

The client uses the command:

```
      X :2
```

On server: Edit the file

`kde_rootdir``/share/config/kdm/Xservers`

`kde_rootdir``=/etc/opt/kde3`

enter the follwoing line:

`XTerminalName``:2 foreign`

where *`XTerminalName`*=Client Host name or IPNr.

Note 1: The display port number (`:2` etc) can be chosen at will from the client as long as the same port is not chosen multiple time sin the same client host. This number can also be eg. `:2.0` which means the first graphic card used (`0`). Since it's mostly the case we only use eg. `:2` and it's enough.

Note 2: For these configuration files changes to take effect `kdm`/`xdm` needs to be restarted.

- **`gdm` XDMCP configuration:**
  Use the program gdmconfig ---> Expert sub-menu ---> Activate XDMCP
  or
  - Edit the file ***`gnome_rootdir`***`/gdm/gdm.conf`
    `gnome_rootdir``=` Main root directory for Gnome desktop system
    for Gnome 2: `/etc/opt/gnome/`
  - Enable the Xdmcp:

```
[xdmcp]
  Enable=true
```

1.110.4 Install & Customize a Window Manager Environment Weight: 5

Description: Candidate should be able to customize a system-wide desktop environment and/or window manager, to demonstrate an understanding of customization procedures for window manager menus and/or desktop panel menus. This objective includes selecting and configuring the desired x-terminal (`xterm`, `rxvt`, `aterm` etc.), verifying and resolving library dependency issues for X applications, exporting X-display to a client workstation.

- **Key files, terms, and utilities:**
  `.xinitrc`
  `.Xdefaults`
  `xhost`
  `DISPLAY` environment variable

- **Window manager:**
  The window managers allow the applications to be moved, made bigger or smaller, to iconize, presents a window top bar , some of them also a menu system or allow drag-&-drop between applications.

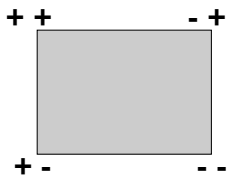
  Window managers names:
  `twm, mwm, olwm, fvwm, kwin, windowmaker` etc:

  Configuration files of window managers:
  Different for each one but they seem almost all to have the `.`*xxxx*`rc` format.
  Thex are normally in the $HOME directory.
  eg. `.mwmrc, .fvwm2rc, .olwmrc` etc.

- **Configuration of X Cilents(X programs):**
  Many X Clients will accept many of the following X11 standard parameters: eg.
  `xterm -T "Title" -fn 9x15 -display :0 -geometry 100x40+30+40`

  - **Positioning and size of window when starting an X Client**: `-geometry`

    Syntax:
    `-geometry <Hsize>x<Vsize><Hpos><Vpos>`
    `<Hsize>` and `<Vsize>` are numbered in characters
    `<Hpos>` `'+'` is down, `'-'` is up (in screen pixels)
    eg. **+10** is down 10 pixels
    `<Vpos>` `'+'` is right, `'-'` is left (in screen pixels)
    eg. **+10** is right 10 pixels

    E**xamples:**
    `-geometry 1x1+0+0`
    1 char Horiz, 1char vert, top left corner
    `-geometry 5x20-10+30`
    5 char Horiz,
    20char vert,
    top right corner
    10 Pixels Horiz.to the left
    30 Pixels vertical down

  Note: The geometry can also be set for x clients by editing the `~/.Xresources`
  eg. `Xterm*geometry: 90x30`

- **Selecting a font for X Clients:** `-fn` *`fontname`*

  List of fixed some short named fonts:

  `7x14 6x10 6x13 8x13 9x15 10x20`

  eg.

  ```
  xterm -fn 10x20
  ```

  or

  ```
  xterm -fn -misc-fixed-medium-r-normal--20-200-75-75-c-100-iso8859-1
  ```

  Note: The fonts can also be set for x clients by editing the `~/.Xresources`
  eg. `Xterm*font: 90x30`

- **`~/.Xresources` or `~/.Xdefaults` file:**

  Note: in SuSE `~/.Xresources` is a symbolic link to `~/.Xdefaults`

  File syntax:

  `ProgramName*Resource`*`: Value`

  Examples of Xterm settings in `~/.Xresources`

  ```
  xterm*background:       LightYellow2
  xterm*Foreground:       Blue
  xterm.eightBitInput:    true
  xterm*multiScroll:      on
  xterm*jumpScroll:       on
  xterm*font:   -adobe-courier-bold-r-normal--14-140-75-75-m-90-iso8859-1
  xterm*ScrollBar: on
  xterm*SaveLines: 2000
  xterm*VisualBell: true
  xterm.eightBitOutput:   true
  Xterm*geometry: 90x30
  ```

  Actualizing changes made in the `~/.Xresources` file
  without restarting the X Server:

  ```
  xrdb -merge .Xresources
  ```

- **Starting an X session with `startx`:**

  Loging from a virtual terminal(text based) and then run the script `startx`.
  `startx` in turns starts `xinit`.
  `xinit` startx the X Server then starts the `xinitrc` script file:
  (`$HOME/.xinitrc` if found otherwise `/var/X11R6/lib/xinit/xinitrc`)

  Content of `xinitrc` script:
  - System wide and configured key definitions are loaded:
    Definitions are in:
    `/etc/X11/Xmodmap` and `~/.Xmodmap`
  - System wide and configured Resources definitions are loaded:
    Definitions are in:
    `/etc/X11/Xresources, ~/.Xresources, & ~/.Xfefaults`
  - Some user's manually entered programs may start here
  - The selected window manager is started.

- **Starting an X session with xdm/kdm/gdm:**
  When a user does login via a display manager, a similar process as with `startx` will occur, the difference is the script that will be run is:
  `/etc/X11/xdm/Xsession` and `~/.Xsession` if it exists.

  Note: Some distributions are running the `~/.xinitrc` from Xsession to keep the same environment consistance.

- **X11 in Network**
  Xclient preparation:
  Since almost all of X Client programs can us the argument `-display :xx`, we can start a client program and send its output to any existing X server that will allow teh connection.
  All X Clients programs need to know where the X Server intended to host the progranm is located. This information is given to the program when we start it either via the above argument (-display :xx.xx) or via the environment variable `DISPLAY`.
  To do so the following command prepares the content of this variable:
  ```
  export DISPLAY=X-ServerHost:xx
  ```
  then run the X client program.

  Xserver preparation:
  X-Servers are by default allowing only the locally started owner's programs to be displayed on it. In order for other users or other hosts to be allowed to display their X-Client programs in it, the X-Server needs to be notified to do so. The notification is done by issuing the command `xhost`.
  Syntax:
  ```
  xhost [+|-] ClientHostName
  ```

eg.	`xhost + localhost`	Allows other users X-clients in the local host to use this X-server.
	`xhost +`	Allows everybody from anywhere to use this X-Server. Hummm dangerous!!!
	`xhost + myfriend`	Allows XClient programs on the host `myfriend` to use this local X-Server.
	`xhost - bugger`	Disables the allwoance of the host bugger to use this X-Server.

  Note 1: Only the owner of the X-Server process is allowed to issue this xhost command.

  Permanent allowance of access:
  There are 2 regular methods to allow a list of hosts the use of the local X-Server permanently:
  1) Edit the file enter the comand xhost for all the hosts allowed in ~/.xinitrc script.
  or
  2) Create a file called `/etc/X`*n*`.hosts` where all the hosts allowed to use the local X-Server are entered. *n*=X-Server display port number.

- **Checking the libraries dependencies for X-Client programs:**
  In the matter of library dependencies, there is no difference between normal and X-Clients programs. The programm `ldd` does the job. See chapter 1.102.4