# Linux Academy
## Study Guide

# LPIC-1 Exam
# 102

# Contents

# Shells, Scripting and Data Management

- Skills:
  - » Customize shell environments
  - » Modify global and user profiles
  - » Set environmental variables at log-in or shell creation
  - » BASH functions
  - » Maintain skeleton directories
  - » Set command search paths with the appropriate directory
- **`/etc/profile`** • Set shell variables for all users
- **`set`** • Displays options related to bash operation
- **`~/.bash_login`** • File is executed when user logs in to shell
- **`~/.bash_logout`** • File is executed when user logs out of shell
- **`env`** • Run in modified environment; without flags, outputs all environmental variables
  - » **`-u`** • Remove variable from environment
- **`unset`** • Unset a variable
- **Function** • Part of a script containing a certain task
- **`export`** • Sets variable in working environment
- **`~/.bash_profile`** • File used to alter environment of login shells
- **`~/.bashrc`** • File used to alter environment of non-login shells
- **`declare -f`** • Prints all available shell commands
- **`alias`** • Creates a shortcut for a command
- **`$EDITOR`** • Environmental variable for opening files in a text editor
- **`#!/bin/bash`** • Determines interpreter with which to run the script; in that instance, Bash
- **`#!/bin/sh`** • Symlink; also to run script in Bash
- **`bash -r`** • Run Bash in restrictive mode

# Write and Customize Simple Scripts

- Skills:
  - » Use `sh` syntax
  - » Use command substitution
  - » Test return values for success and failure information
  - » Perform conditional mailing
  - » Set the script interpreter
  - » Manage location, ownership, execution and SUID rights
  - » Shift arguments

## Loops

**`for`**

```
for d in file.txt ;
  do
echo $d
  done
```

**`until`**

```
until [ condition ] ;
  do
command
  done
```

**`while`**

```
while [ condition ] ;
  do
command
  done
```

## Commands

- **`read`** • Read user input
- **`test`** • Test two objects against each otherbased on conditions
  - » **`-f`** • Test file name against file
  - » **`-d`** • Test if directory

- **`[ -x filename ]`** • **`Test if filename`** is a file
  - » **`-x`** • Test if file exists and executable
  - » **`+f`** • Test if file exists and is a plain file
- **`seq`** • Print sequence of numbers
  - » **`seq [first] [increment] [last]`** • Count up by increment, starting at the first number until the last number is reached

# SQL Data Management

- Skills:
  - » Query databases
  - » Manipulate data with basic SQL commands
  - » Join tables
  - » Subselects

## Commands

- **`INSERT`** • Insert row into database
  - » **`INSERT INTO tablename (field1,field2) VALUES ("value1","value2")`**
- **`DELETE`** • Delete row from database
  - » **`DELETE FROM table_name`**
  - » **`DELETE FROM table_name WHERE field="field"`**
- **`GROUP BY`** • Group results by field
  - » **`SELECT * FROM products GROUP BY type;`**
- **`UPDATE`** • Update a row where id=1
  - » **`UPDATE table_name SET field='content' WHERE id=1`**
- **`FROM`** • Select field from table
  - » **`SELECT * FROM table_name`**
  - » **`SELECT field1,field2 FROM table_name`**
- **`ORDER BY`** • Order by field description; ascending or descending order
  - » **`SELECT * FROM products ORDER BY price DESC`** • Descending order
  - » **`SELECT * FROM products ORDER BY price ASC`** • Ascending order

- **`SELECT`** • Select rows with given condition from table
  - » **`SELECT * FROM table_name`** • Select any fields and rows from table
  - » **`SELECT field1,field2 FROM table_name`** • Select only *field1* and *field2* from table
- **`WHERE`** • Select rows that match condition
  - » **`SELECT * FROM products WHERE type="toy"`**
- **`JOIN`** • Join multiple tables together
  - » **`SELECT * FROM orders LEFT JOIN customers ON orders.customer_id=customers.id;`**

# User Interfaces and Desktops

## Install and Configure X11

- Skills:
  - » Verify video card and monitor are supported by X server
  - » Awareness of X font server
  - » Understanding of X window configuration file
  - » Understanding of X11 configuration file (*/etc/X11/xorg.conf*)
  - » Understanding of X Windows startup process

### Commands

- **`xwininfo`** • Window information utility; displays parameters of open window
- **`xhost`** • Allow or disallow X forwarding
  - » **`-`** • Disallow host
  - » **`+`** • Allow host
- **`xdpyinfo`** • Display information utility for X
- **`startx`** • Start X server
  - » **`xinit`** • **`xinitrc`** • **`Xclients`** • Scripts and files used in the startup process

## Set Up a Display Manager

- Skills:

  - » Enable/disable display manager
  - » Change display manager greeting
  - » Change default color depth
  - » Configure display managers used by X
- **`DISPLAYMANAGER`** • Display manager variable
- **`/etc/issue`** • Display the user seeds *before* logging in
- **`VertRefresh Value`** • This and the resolution determine the monitor's refresh rate
- **`/etc/X11/gdm`** • **`/etc/gdm/custom.conf`** • GDM configuration files
- **`/etc/gdm/custom.conf`** • Location of GNOME display greeting
- **`/etc/X11/xdm/Xresources`** • Configuration file for XDM greeting
- **`/etc/X11/xdm/xdm-config`** • XDM configuration file
- **`/etc/X11/kdm`** • **`/etc/kde/kdm`** • KDM configuration files

# Accessibility

- Keyboard accessibility:
  - » Repeat rate
  - » **Sticky keys** • Causes Ctrl, Alt, Shift key(s) to behave as if they were being pushed until the next key is pressed; same effect as holding Ctrl + C
  - » **Slow keys** • Requires key to be pressed longer for it to register
  - » **Bounce/debounce keys** • Reduces error rate of hitting same key multiple times
  - » **Simulated mouse clicks** • Define action to simulate a mouse click
  - » Settings for keyboard accessibility in X configuration file
- High contrast desktop themes
- Braille display
- Mouse gestures
- Emacspeak • Assists users with visual impairments
- Large print desktop screens
- **Kmag** • Screen magnifier
- **Orca** • Screen reader

- **GOK** • On-screen keyboard for X

# Administrative Tasks

## Manage User and Group Accounts, Related System Files

- **`/etc/passwd`** • Contains list of users on system
  - » **`username:password:UID:primaryGID:comment:homedir:defaultShell`**
  - » User IDs under 100 are reserves for system users
  - » User accounts have IDs between 500 and 1000
  - » The file can be directly edited to add, remove, or modify users
  - » Setting the default shell to */bin/false* prevents a user from logging in
  - » Readable by all
- **`/etc/shadow`** • Password file; readable only by superusers
  - » **`username:password:daysUntilChangeAllowed:daysUntilChangeRequired: daysofWarning:daysBetweenExperiationActivation: experiationDate:specialFlag`**
- **`pwck`** • Verified integrity of *passwd* and *shadow* files; ensure entries are in proper format
- **`/etc/skel`** • Skeleton file for new users
- **`useradd`** • **`adduser`** • Create a user
  - » **`-c`** • Comment
  - » **`-d`** • Set home directory
  - » **`-e`** • Account expire date; YYYY-MM-DD
  - » **`-p`** • Set encrypted password
  - » **`-M`** • Do not create home directory
  - » **`-m`** • **`Create home directory, based on /etc/skel`**
  - » **`-G`** • Add groups (not primary group)
  - » **`-g`** • Set default group
  - » **`-f`** • Number of days after password expiration until an account is permanently disabled
  - » **`-k`** • Define while skeleton file to use

- **`chage`** • Manage user expiry information
  - » **`-E`** • Expire date
  - » **`-I`** • Days of inactivity after password expiration to lock account
  - » **`-m`** • Set minimum days between password changes
  - » **`-M`** • Set maximum days that a password is valid
- **`groupdel`** • Delete group; if group is a user's default group, cannot be deleted
- **`groupmod`** • Modify group name or ID
  - » **`-g`** • Set group ID
  - » **`-o`** • Allows two groups to share the same ID
  - » **`-n`** • New group name
- **`userdel`** • Delete user account and files
  - » **`-f`** • Force deletion of logged-in user, removes home directory and mail
  - » **`-r`** • Remove home directory and mail; does not remove user-owned files in other directories
- **`usermod`** • Modify user account
  - » **`-d`** • Set new home directory
  - » **`-e`** • Set date account with expire; YYYY-MM-DD
  - » **`-f`** • Number of days after password expiration to disable account
  - » **`-g`** • Set default group
  - » **`-G`** • Add additional groups
  - » **`-l`** • Change login name
  - » **`-L`** • Lock account
- **`/etc/group`** • List of groups and group members
  - » **`groupName:password:GUID:userlist`**
- **`groupadd`** • Create a group
  - » **`-g`** • Specify group ID
  - » **`-r`** • System picks group ID
  - » **`-f`** • Force group creation
- **`passwd`** • Set user's password

  - » **`-x`** • Number of days before password expiration
  - » **`-n`** • Minimum amount of days between password changes
  - » **`-i`** • Make count inactive after a certain number of days past password expiration
- **`echo $$`** • Display current shell process
  - » **`$?`** • Display exit value
  - » **`$!`** • PID of last job to run in background
  - » **`$*`** • Expand all parameters passed
  - » **`$@`** • Each parameter passed expands into word
  - » **`$0`** • Show name of shell or script
  - » **`$_`** • Set at shell start; contains absolute file name of shell/script

# Automate System Administration Tasks by Scheduling Jobs

- **`/etc/crontab`** • System cron jobs; files must end in new line
- **`/var/spool/cron/*`** • Location of crontabs for users
- **`atq`** • List users' pending AT jobs; if user not a superuser, displays only user's jobs
- **`/etc/at.deny`** • Users in file are denied AT access
- **`/etc/cron.allow`** • Users lists have cron access
- **`crontab`** • Maintains crontab files for individual users
- **`atrm`** • Removes job for pending AT task
- **`/etc/at.allow`** • Users listed have AT access
- **`/etc/cron.deny`** • Users listed are denied cron access
- **`at`** • Command or script to be executed "at" a later time
  - » **`at now + 1 minute`**
  - » **`at> echo "hello"`**
  - » **`CTRL+D`**
  - » Accepts following time formats:
    - hh:mm
    - midnight

    - noon
    - teatime
  - » Can specify AM or PM
  - » Can specify full dates; **`now + 1 day`**
- Cron examples:
  - » **`* * * * * /command`**
  - » **`15 1,5 * * */command`** • Run command at 1:15 and 5:15 every day
  - » **`/2 * * * * /command`** • Run command every two minutes
  - » **`21 0-23/2 * * * /command`** • Run command at the 21 minute mark of every hour, every two days
  - » **`00 18-07 * * 1-5 /command`** • Run command every house between 18 and 07, on days 1 to 5

# Localization and Internationalization

- **Locale settings** • How Linux specifies the language, and associated country information
- Add to *.bash_profile* to change language to Portuguese:
  - » **`export LANG="pt"`**
  - » **`export LC_MESSAGES="pt"`**
- **Timezone settings** • Are not part of locale settings
- **`/etc/timezone`** • **Location of timezone file; to change timezone symlink to the correct `/usr/share/localtime`** file
  - » **`tzconfig`**
- **UTF** • 8-bit Unicode Transformation Format extended by supporting variable-byte extensions
- **Unicode** • Character set designed to support as many languages as possible
- **ASCII** • American Standard Code for Information Interchange; oldest encoding method
- **`iconv`** • Converts between character sets

# Essential System Services

## Maintain System Time

- Skills:
  - » Set hardware clock to UTC
  - » Configure correct timezone
  - » Basic NTP knowledge
  - » pool.ntp.org
- **`/usr/share/zoneinfo`** • Location of timezone files
- **`/etc/ntp.conf`** • NTP configuration and list of NTP servers
- **`ntpd`** • Daemon for NTP server
- **`date`** • Print or set the system date and time
- **`ntpdate`** • Set or view the date and time via NTP
- **`hwclock`** • View or set the hardware clock
  - » **`-w`** • Set to current system time
  - » **`-s`** • Set to current hardware time
- **`pool.ntp.org`** • Virtual cluster of timeservers for easy NTP

## System Logging

- **`syslog.conf`** • Logging configuration
  - » Set priority with: **`facility.priority action`**
  - » **`debug`** • Logs most detailed information
  - » **`emerg`** • Logs most important information
    - **`crit`**
  - » **`err`** • Logs regular errors
  - » **`alert`** • Logs messages classified as alert
    - **`!`** • Reverse order of match
  - » **`none`** • Exclude all logging

- **`logger`** • Manually log data; good for scripting
  - » **`-i`** • Return process ID
  - » **`-s`** • Output standard error
  - » **`-f`** • Send contents to log file
  - » **`-p`** • Specify priority
  - » **`-t`** • Change name of tag shown in file
- **`syslogd`** • User space log daemon
- **`klogd • Kernel logging; standalone or as part of syslogd`**
- **`/etc/logrorate.conf`** • Configuration file to set the logrotate function
- **`/var/log/wtmp • If exists, last`** command displays recently logged-in users and current users

# Mail Transfer Agent Basics

- Skills:
  - » Create email aliases
  - » Configure email forwarding
  - » Send mail from command line
  - » Read mail from command line
- Mail transfer agents:
  - » Sendmail
  - » Exim
  - » Postfix
  - » Qmail
- **`!~/.forward`** • Input server, username, or email address of the email you would like mail to be forwarded to
- **`mail`** • Command line utility for sending mail; best used in scripts
  - » **`-s`** • Subject
  - » **`-c`** • CC
  - » **`-b`** • BCC

  - » **`-f`** • Name of mail spool file (for reading mail)
  - » **`-u`** • Username (for reading mail)
  - » When done entering message, hit Ctrl + d
  - » Press **d** to delete read message
  - » Press **r** to reply to read message
- **`mailq`** • Shows all messages waiting to be sent
- **`/var/spool/mqueue`** • Undelivered remote mail
- **`/var/spool/mail`** • Delivered mail for users
- **`newaliases`** • Use after updating */etc/aliases*

# Printers and Printing

- Skills:
  - » Manage print queues
  - » Troubleshoot general printing problems
  - » Add and remove print jobs from queue
- **`/etc/cups/`** • Configuration file for printers
- **`lpadmin`** • Configure CUPS
- **`lpd`** • Legacy print interface
- **`lpr`** • Legacy; sends files to print queue
  - » **`-r`** • Delete file after print
  - » **`-l`** • Verbose
- **`cat /etc/services | lpr - #2`** • Print services file on second printer
- **`lpq`** • Show queue status
- **`/etc/printcap`** • Print queue definitions
- **`lprm`** • Remove job from queue
  - » **`-a`** • Remove all
  - » **`-p`** • Queue name
- **`cupsdisposal`** • Pause print jobs

  - **`-c`** • Cancel all jobs
  - **`-r`** • Reason
  - **`-m`** • Message
- **GhostScript** • Printer filter; concerts PostScript data for non-PostScript printers
- **`/etc/spool/lpd`** • LPD queue directory

# Networking Fundamentals

- Skills:
  - Understand network masks
  - Set default routes
  - Understand private and public dotted quad IP addresses
  - Understand different between IPv4 and IPv6
- Common TCP and UDP ports:
  - **20** • FTP, unencrypted, incoming
  - **21** • FTP, outgoing
  - **22** • SFTP and SSH; encrypted
  - **23** • Telnet
  - **25** • Simple Mail Transfer Protocol
  - **53** • DNS
  - **80** • HTTP
  - **110** • POP3
  - **119** • NTTP
  - **139** • Samba file sharing
  - **143** • IMAP
  - **161** • SNMP
  - **443** • HTTP over SSL
  - **465** • SMTP over SSL
  - **993** • IMAP over SSL

  - » **995** • POP3 over SSL
  - » **65535** • Highest numbered port
- **`/etc/services`** • ASCII file providing mapping between names and port numbers
- **`ping`** • Sends ICMP packets to network hosts; tests connection
- **UDP** • User Datagram Protocol
  - » Does not correct out-of-order packets
  - » Packet delivery not gaurenteed
  - » Faster
  - » Used up system and network file systems
- **TCP** • Transmission Control Protocol
  - » Full with error checking
  - » Slower
- **ICMP** • Internet Control Message Protocol
  - » Simple data transmission
  - » Error checking, connection testing
  - » **`ping`** can use ICMP
- **`tcpdchk • Check syntax of /etc/inetd.conf`**

# Basic Network Configuration

- **`ifdown`** • Deactivate network interface
- **`/etc/hosts`** • Maps from IP addresses to hostnames
- **`route`** • Manages IP routing table
  - » **`add`** • Add route
  - » **`gw`** • Gateway
  - » **`del`** • Delete route
- **`ifconfig`** • Configures network interfaces

# Basic Network Troubleshooting

- Skills:

  - » Manually and automatically configure network interfaces
  - » Change, view, configure network routing tables
- **`dig`** • Complex DNS lookups
- **`host`** • Returns DNS and IP information for designated host
- **`hostname`** • The "name" of the server used in routing; associated with an IP address

## Client Side DNS

- **`/etc/nsswitch.conf`** • Informs Linux how to handle DNS and hosts; can alter the order DNS is read

# Security

## Perform Security Administration Tasks

- Skills:
  - » Audit a system using the SUID and SGID bit sets
  - » Set and change user passwords and password expiration requirements
  - » Use **`nmap and netstat`** to find open ports
- **`/var/run/utmp`** • Allow or deny commands for users

## Set Up Host Security

- Skills:
  - » Knowledge of shadow passwords
  - » Turn off unused services
  - » TCP wrappers
- **`/etc/nologin`** • Prevents non-root users from logging in
- **`xinitd`** • Extended super server program; provides TCP security wrappers
  - » **`only_from`** • Define which IP addresses/network can access the server
  - » **`no_access`** • Define with IP addresses/network cannot access the server
  - » **`access_times`** • List times a user can access the server
- **`/etc/xinetd.d/*`** • Individual server configuration files

- **`/etc/inetd.conf`** • Configure servers launched by inetd
- **`/etc/xinetd.conf`** • **Configure xinetd**
  - » **bind** • Specify network address/interface to offer service
  - » **disable** • Disable service
- **`/etc/hosts.allow`** • Allow hosts access to system
- **`/etc/hosts.deny`** • Deny hosts access to system

# Secure Data with Encryption

- Skills:
  - » OpenSSH client configuration
  - » GNUPG configuration
  - » SSH tunnels
- **`ssh`** • Secure remote access service
- **`ssh-add`** • Adds RSA key
- **`~/.ssh/id_rsa`** • Default location for key
- **`~/.ssh/authorized_keys`** • Public keys for accessing the remote server
- **`~/.gnupg/*`** • Location of GPG keys
- **`ssh-keygen`** • Generate new OpenSSH keys
- **`id_dsa.pub`** • Default public key name
- **`/etc/ssh/ssh_host_dsa_key`** • Host key location
- **`/etc/ssh_known_hosts`** • Machines trusted to connect to via SSH
- **`ssh-agent`** • Add configuration keys to the password ring
- **`gpg`** • Digitally sign messages as encrypted
  - » **`gpg --gen-key`** • Generate a GPG key
  - » **`gpg --export keyname > gpg.pub`** • Public key
  - » **`gpg --import keyname.pub`** • Import another user's public key
  - » **`gpg --list-keys`** • List keys in keyring
  - » **`gpg --out encrypted-file --recipient uid --armor`** • Encrypt file

  - » **`gpg --out decrypted-file --decrypted encrypted-file`** • Decrypt file
  - » **`gpg --clearsign original-file`** • Creates a new *.gpg* file, encrypted with your private key
  - » **`gpg --edit-key`** • Brings up interactive menu to manage keys
- **`tcpdchk`** • Checks syntax of */etc/inetd.conf*

# General Reference

## getent

- Displays entries from databases
- **`getent passwd username`** • Shows */etc/passwd* entry
- **`getent hosts`** • Shows all hosts configured
- **`getent hosts localhost`** • Shows configuration for requested host

## anacron

- Executes commands periodically
- **`-f`** • Force all jobs
- **`-u`** • Update timestamps
- **`-n`** • Run job immediately
- **`-t`** • Use defined configuration file
- **`-h`** • Help

## who

- Prints information about users logged into system
- **`-b`** • Time of last system boot
- **`-l`** • Login processes
- **`-q`** • Number of users logged in
- **`-u`** • Logged in users and process IDs
- **`-a`** • All

# fuser

- Display process IDs of processes using specified files
- Display users accessing the processes
- Kick users from process
- **`-k`** • Kill all processes accessing a file
- **`-i`** • Interactive mode
- **`-v`** • Verbose
- **`-u`** • Append username
- **`-a`** • Display all filenames

# last

- Show list of last logged in users
- **`-n`** • Show specific number of users
- **`-R`** • Suppress hostname
- **`-F`** • Print log in and log out times and dates
- **`-x`** • Display system shutdown entries and changes in run level

# journalctl

- Collects and stores logging data
- **`-n`** • Define number of journal events to output
- **`-k`** • Only show kernel messages
- **`-x`** • Augment lines with explanation texts

# IPv6

- Benefits over IPv4:
  - » Larger address pool
  - » Simplified header format
  - » Automatic configuration
  - » More efficient routing

  - » Improved quality of service and security
  - » Compliance with regulatory requirements
  - » Widespread in global markets

# dig

- DNS lookup
- `-x` • Reverse lookup

# host

- Basic DNS lookup
- Supported IPv4 and IPv6

# netcat

- Test network service that is not working
- `-v` • Verbose
- `-z` • Scan for listening daemons
- `-l` • Bind to a specific port to look for incoming connections