

# Linux System Administration on Red Hat

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## 1 Course overview

This class is for people who are familiar with Linux or Unix systems as a user (i.e., they know file manipulation, an editor, and common Unix/Linux tools). The class covers information they will need to be a successful system administrator of a Red Hat Linux system. This class stresses troubleshooting problems an administrator is likely to encounter.

## 2 Course objectives

Students attending this class will learn:

- how to install the operating system
- the parts of a user account and the files where these data are stored
- how to verify, install, update, and remove software packages
- the structure of data on disks, including partitions and filesystems and how to work with them
- system administration tools such as *rsync* and *lsof*
- shell programming
- how to execute jobs at regular intervals
- logging, how to control it, how log files are rotated
- the information in the */proc* filesystem and how to work with it
- how the system boots and how to customize it
- how to configure the network to use static or dynamic IP addresses
- configuring and working with network services such as name lookups, NIS (optional), NFS, the automounter, and *ssh*.
- the Linux tools commonly used for backups
- tools for network monitoring and testing
- network performance tuning
- performance monitoring

## 3 Student background

If you are attending this class, then we assume that

- You are comfortable with basic Linux commands such as *cp*, *mv*, *rm*, *mkdir*, *rmdir*, *chmod*, *cat*, *more* or *less*, *passwd*, *date*, and *ls*.
- You know what absolute and relative paths are and the difference between them.
- You know what *.* and *..* mean and when you would use them.
- You know what the permissions on directories mean (they are different from files).
- You are comfortable working at the command line.
- You can read manual pages and other system documentation.
- You know an editor.
- Knowing a programming language will make shell programming much easier.

## 4 Logistics

The class lasts four days. Fedora core 4 or Centos 4 The class uses the following software:

- A CD DVD or USB memory to mount; the installation CDs/DVD work fine for this
- All backup software we use is on the OS distribution CDs
- Gnome for a desktop environment (on distribution CDs)
- Kernel source (from Internet or source CDs or DVDs; **not** on the normal distribution media)
- OS distribution CD 1 or Knoppix CD
- OS installation media
- The test partition created at install time
- *gkrellm* (on class web site)
- *iptraf* (if covered in this class)
- *nmap* (on distribution media)
- *ttcp* (on class web site)
- *xosview* (on class web site)
- a DHCP and DNS server for the class
- a package to install and upgrade (the instructor needs to be prepared for this)
- an NIS server on the instructor machine with an account the students will log into (if this class covers NIS)
- *bonnie* or *bonnie++* (on class web site)
- class network configuration information
- either Internet access or a local CentOS repository (the instructor needs to be prepared for this)
- static IP addresses (these do not need to be routable)
- un-allocated space left at install time.

No class network information specified.

The class needs a web server for the class web site. The instructor's laptop may be this web server; otherwise the machine provided in the classroom for the instructor is a good choice. This machine obviously will need web server software installed.

## 5 Class outline

1. Introduction (Lecture: 15; Lab: 0)
  - (a) Class Introductions
  - (b) Class Logistics
    - i. Class schedule
    - ii. Breaks
    - iii. Question policy
    - iv. Break room and restroom locations
    - v. Assumptions about your background
  - (c) Typographic conventions
2. Red Hat OS Installation (Lecture: 25; Lab: 75)
  - (a) Hardware requirements
  - (b) Installer options
  - (c) Disk partitioning
  - (d) Network configuration
  - (e) GNU/Linux as a guest OS
  - (f) Kickstart
    - i. Summary of CentOS 5 Installation
  - (g) Lab
3. Finding the answer (Lecture: 15; Lab: 40)
  - (a) General hints
  - (b) The help system
  - (c) The manual pages
  - (d) GNU info
    - i. Some *info* commands
  - (e) Summary
  - (f) Lab
4. Basic bash programming, part I (Lecture: 30; Lab: 40)
  - (a) Variables
    - i. Environment Variables
    - ii. Pre-defined Variables
  - (b) Comments and spaces
  - (c) Shell Scripts

- (d) Quoting
  - (e) Lab
5. Basic bash programming, part II (Lecture: 30; Lab: 50)
- (a) Exit status and **\$?**
  - (b) Expressions
    - i. Expressions (using *test*)
    - ii. String expressions (*bash* and *ksh*)
    - iii. File expressions
    - iv. Arithmetic expressions (*bash* and *ksh*)
  - (c) if
    - i. Examples
  - (d) case
  - (e) Lab
6. Basic bash programming, part III (Lecture: 20; Lab: 45)
- (a) for
  - (b) while
  - (c) Functions
    - i. Function arguments
    - ii. Example
    - iii. Output from running the example
    - iv. Local variables
  - (d) Debugging Shell Scripts
  - (e) Lab
7. User Information (Lecture: 40; Lab: 50)
- (a) User and group information files
    - i. ***/etc/passwd***
    - ii. ***/etc/shadow***
    - iii. ***/etc/group***
  - (b) Adding and deleting users
    - i. GUI
    - ii. *vipw*
  - (c) Password aging
    - i. *chage* command-line arguments
  - (d) ***login.defs***
  - (e) PAM
    - i. Example
  - (f) ***nsswitch.conf***
  - (g) *su* and the root account

- (h) *sudo*
    - i. *sudo* configuration
  - (i) Troubleshooting hints
  - (j) Summary
  - (k) Lab
8. RPM Packages (Lecture: 40; Lab: 50)
- (a) RPM overview
    - i. Names, labels, and file names
  - (b) Working with *rpm*
    - i. Querying packages
    - ii. Verifying package signatures
    - iii. Verifying installed packages
    - iv. Installing packages
    - v. Upgrading packages
    - vi. Removing packages
    - vii. Other RPM information
  - (c) *yum*
    - i. Yum repositories
    - ii. Repository configuration
    - iii. Installing software with *yum*
    - iv. Searching for software
    - v. Updating
    - vi. Removing software
    - vii. *yum* and proxies
  - (d) Keeping your system patched
  - (e) Summary
  - (f) Lab
9. Partitions and filesystems (Lecture: 40; Lab: 55)
- (a) Special files (devices)
    - i. Disk special files
  - (b) Partitions
    - i. Extended partitions
    - ii. *fdisk*
  - (c) Filesystem labels
  - (d) Mounting filesystems
    - i. *mount* and *umount*
    - ii. Boot time filesystem mounting
  - (e) Inodes
  - (f) The structure of a directory

- (g) Adding a disk
  - (h) *fsck*
  - (i) Dealing with filesystem problems
  - (j) Summary
  - (k) Lab
10. Filesystem tools (Lecture: 20; Lab: 30)
- (a) *df*
  - (b) *du*
  - (c) *locate* and *slocate*
  - (d) *find*
  - (e) Summary
  - (f) Lab
11. Useful sysadmin tools (Lecture: 40; Lab: 65)
- (a) *lsuf* and *fuser*
  - (b) *rsync*
    - i. Some *rsync* options
  - (c) *cron*
    - i. The **crontab** file
  - (d) Logging and log files
    - i. The syntax of **syslog.conf**
  - (e) Log file rotation
    - i. *logrotate* directives
  - (f) The **/proc** filesystem
  - (g) *sysctl*
  - (h) Summary
  - (i) Lab
12. Booting (Lecture: 45; Lab: 60)
- (a) The hardware boot process
    - i. How Linux on an Intel x86 architecture machine boots
  - (b) *grub*
    - i. Overview
    - ii. File specification to *grub*
    - iii. Commands
    - iv. Example
  - (c) Initial ramdisks
  - (d) Booting single user
  - (e) *init* and startup scripts
    - i. Run levels
    - ii. Interactive boot

- iii. *chkconfig*
    - iv. *service*
  - (f) Boot floppies/CDs
    - i. Booting rescue mode
  - (g) Shutting down the system
  - (h) Troubleshooting
  - (i) Summary
  - (j) Lab
- 13. Network Configuration (Lecture: 30; Lab: 45)
  - (a) Network configuration
    - i. DHCP client configuration
    - ii. Static network configuration
  - (b) DNS lookups
    - i. ***/etc/resolv.conf***
    - ii. *host*
  - (c) Virtual network interfaces
  - (d) *mii-tool* and *ethtool*
    - i. Examples
  - (e) *system-config-network*
  - (f) Troubleshooting
  - (g) Summary
  - (h) Lab
- 14. Network services (Lecture: 30; Lab: 45)
  - (a) *xinetd*
  - (b) *ssh*
    - i. Public key authentication
    - ii. Tunneling
  - (c) NFS
    - i. Client
    - ii. Server
  - (d) Automounter
  - (e) Troubleshooting
  - (f) Summary
  - (g) Lab
- 15. Network monitoring, testing, and tuning (Lecture: 45; Lab: 80)
  - (a) Network monitoring and testing tools
    - i. *tcpdump*
    - ii. *wireshark*

- iii. *telnet*
    - iv. *netcat*
    - v. *netstat*
  - (b) Tuning
    - i. Prerequisite assumptions
    - ii. Benchmarking
      - A. Example
    - iii. Parameters
      - A. Maximum Transmission Unit
      - B. Example
      - C. Bandwidth-Delay product
      - D. TCP parameters
      - E. IP fragmentation parameters
      - F. Other kernel parameters
  - (c) NFS performance
  - (d) Summary
  - (e) Lab
16. Performance monitoring (Lecture: 25; Lab: 25)
- (a) Introduction
  - (b) *ps* and threads
    - i. Example
  - (c) *sar*
  - (d) *free*
  - (e) *vmstat*
  - (f) *iostat*
  - (g) *top*
  - (h) Graphical tools
  - (i) Troubleshooting
  - (j) Summary
  - (k) Lab
17. Backups (Lecture: 30; Lab: 45)
- (a) Compression
  - (b) Incremental backups
  - (c) *tar*
    - i. Examples
  - (d) *dump* and *restore*
    - i. *dump*
    - ii. Example
    - iii. *restore*
    - iv. Interactive restore

- v. Examples
- (e) *rsync*
  - i. Example
- (f) Summary
- (g) Lab

## Appendices

- A. Basics (Lecture: 20; Lab: 20)
  - (a) Logging in and out
  - (b) Typing and correcting mistakes
    - i. In dialog boxes
    - ii. In a terminal window
  - (c) Changing your password
  - (d) An overview of the Gnome Desktop
    - i. The decoration around windows
    - ii. The panel
    - iii. The Terminal Emulator
  - (e) An introduction to the Gnome file manager
  - (f) Command-line structure
  - (g) Some simple commands
  - (h) Displaying the contents of a file in a terminal
  - (i) Lab
- B. File manipulation (Lecture: 30; Lab: 50)
  - (a) An Overview of the UNIX filesystem
    - i. Pathnames
    - ii. Directories
    - iii. Filenames
  - (b) Listing files
  - (c) Renaming and Copying Files
  - (d) Removing Files
  - (e) The *file* command
  - (f) Creating and removing directories
  - (g) Links
  - (h) Lab
- C. File and directory permissions (Lecture: 15; Lab: 15)
  - (a) Introduction
  - (b) Looking at File Permissions
  - (c) Changing Permissions
  - (d) Lab

- D. The vi editor (Lecture: 20; Lab: 30)
  - (a) Introduction
  - (b) Getting in and out
  - (c) *vi* modes
  - (d) Moving around
  - (e) Adding text
  - (f) Deleting text
  - (g) More
  - (h) Lab
- E. The shell (Lecture: 55; Lab: 55)
  - (a) Introduction
  - (b) Metacharacters
    - i. Examples
  - (c) Redirecting I/O
    - i. Examples
  - (d) Pipes
  - (e) History and command line editing (*ksh* and *bash*)
  - (f) Shell startup and customization (*bash*)
  - (g) Aliases
  - (h) Additional *bash* features
  - (i) Lab
- F. Some useful tools, part I (Lecture: 35; Lab: 60)
  - (a) *grep*
  - (b) Regular expressions
    - i. Example
    - ii. Example
    - iii. Summary of regular expression characters
  - (c) *head* and *tail*
  - (d) *less*
  - (e) Summary
  - (f) Lab
- G. Some useful tools, part II (Lecture: 30; Lab: 30)
  - (a) *cut*
  - (b) *diff*
  - (c) *sort*
    - i. Example
  - (d) *uniq*
  - (e) *cat*
  - (f) *wc*

- (g) *tee*
- (h) *sleep*
- (i) Lab

H. Processes (Lecture: 30; Lab: 25)

- (a) Process information
- (b) Job control
- (c) *nice*
- (d) Looking at processes
  - i. *ps*
- (e) *top*
- (f) Killing processes
- (g) Lab