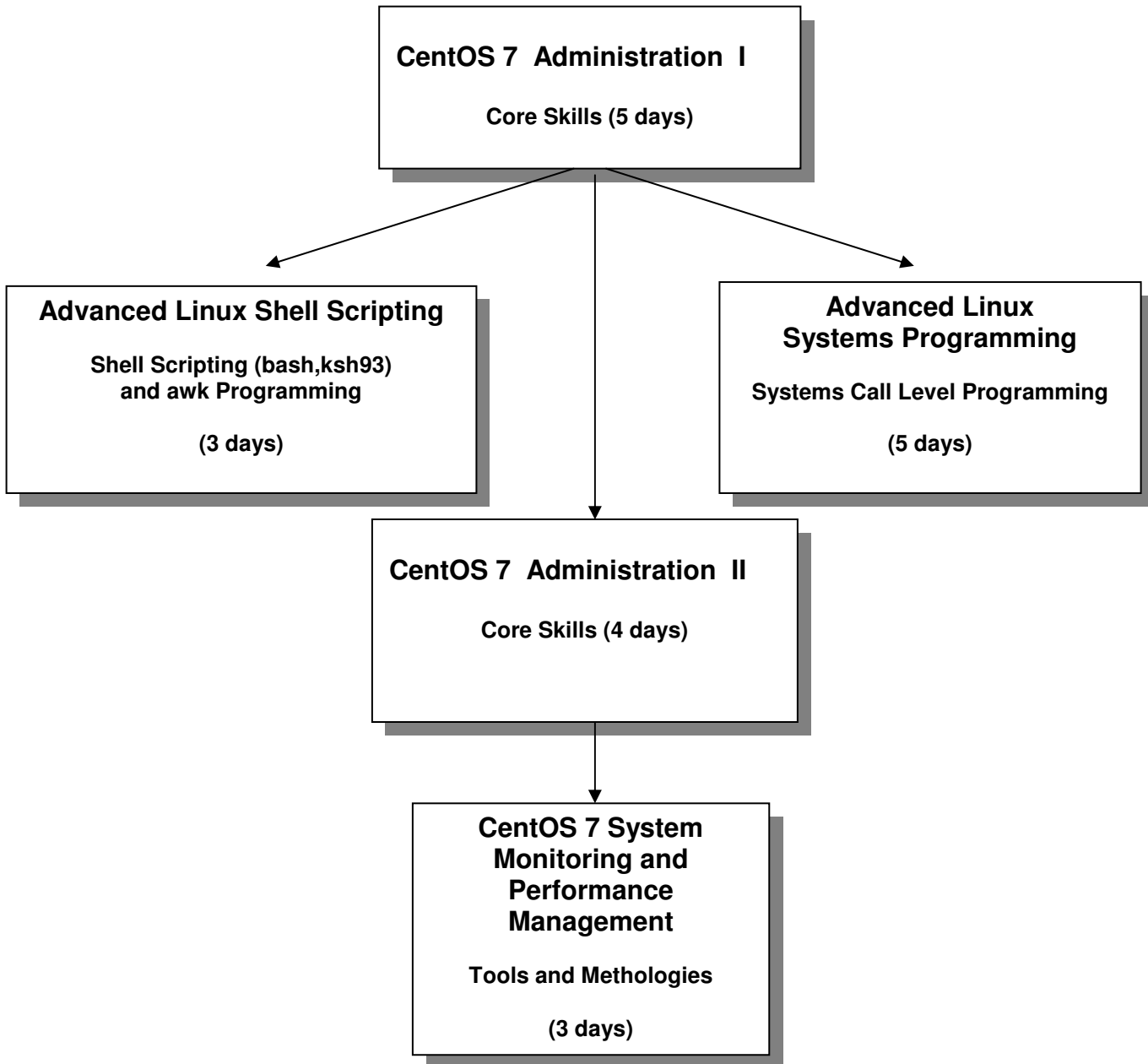


# Community Enterprise Operating System (CentOS 7) Courses



- participants use their own virtualized CentOS 7 system for hands-on and lab exercises

# CentOS 7 Administration I

## COURSE DESCRIPTION

This course presents the basic working environment of a **Linux** system. It introduces commonly required operations that can be performed by entering commands interactively in a command terminal, along with functions available in the **GNOME** Desktop Environment . This course will concentrate on **Community Enterprise Operating System (CentOS), version 7 (all update levels)**.

## COURSE OBJECTIVES

Each participant will be able to use **CentOS 7 Bash Shell** techniques and commands to maintain collections of files, create files using interactive editor utilities, create and execute basic command procedures, communicate with other users, and tailor the interactive environment to meet their needs. Basic administrative features to setup a functioning **CentOS 7** system will also be shown.

## COURSE TOPICS

### **Understanding the User Environment**

- CentOS 7** system overview
- process concepts
- the graphical environment (**GNOME**)

### **Getting Started with the Command Language**

- logging into an **CentOS 7** system
- Bash** shell syntax rules
- documentation via **man**, **info** and **pinfo**
- command line editing and history control
- shortcut control keys

# CentOS 7 Administration I

## COURSE TOPICS

### **Configure Secure Communications with OpenSSH**

utilities that support a trusted environment

**rsh, rlogin, rcp**

required packages and services

**.rhosts** file

defining **ssh** keys

setup on client and server systems

### **Managing Files**

file specification syntax

device specifications

directory specifications

regular expressions and special characters

**CentOS 7** commands to manipulate files

file permission mechanisms

### **Creating and Editing Text Files**

command line utilities to control file (content)

**vim** editor

key operations

importance of **.vimrc**

### **Improving the User Interface**

controlling the history mechanism

creating command aliases

redirection of input and output

using hard and symbolic links

process control commands

### **Monitor and Manage Linux Processes**

obtaining system information

show process information and attributes

control process execution

background

daemon

signals (**kill**)

# CentOS 7 Administration I

## COURSE TOPICS

### **User Level Archival Operations**

**tar** utility syntax

**tar** commands for product access

using compression/uncompression commands

**gzip / gunzip**

### **System Installation and Updating**

installation types and methods

installing the **CentOS 7** operating system

maintaining the system via patches

managing system software

package information (**rpm, yum**)

installing packages (**rpm, yum**)

removing packages (**rpm, yum**)

creating and using (**yum**) repositories

### **Startup and Shutdown**

components involved in the **Linux** boot

**GRUB** loader stages and configuration

default bootstrap

boot to single-user mode

**CentOS 7** startup methods, tools, and procedures

understanding **systemd** (daemons, files)

comparing **systemd targets** to **run levels**

**systemctl** and **journal** commands

adding services to the startup mechanisms

shutdown methods and control

### **Managing of System Users**

**UID** and **GID** concepts

creation of a user account

security through **password aging**

controlling access by groups

# CentOS 7 Administration I

## COURSE TOPICS

### **Analyzing Logging Information**

collection mechanism  
configuring **rsyslogd**  
**rsyslog.conf**

### **Monitoring System Activity**

informational utilities  
**vmstat**  
**iostat**  
**mpstat**  
**pidstat**  
**top**  
contents of the **/proc** hierarchy files

### **Network Setup and Configuration**

available tools  
**Network Manager**  
**nmcli**  
**nmtui, nmtui-edit**  
host names and related files  
configuring network devices

### **Virtualization**

available tools  
**virt-install**  
**virt-manager**  
**virsh**  
creating a **kvm**  
controlling a **kvm**

# CentOS 7 Administration I

## COURSE DURATION

This course normally requires **five** (5) days, approximately 50% lecture and 50% lab time.

## COURSE PREREQUISITES

This course is considered to be the basic **CentOS** course. Experience with any interactive system is helpful.

# Advanced Linux Shell Scripting

## COURSE DESCRIPTION

This course presents to the **Linux / Unix** computer professional (user, systems administrator, application/system programmer) the techniques needed to develop advanced shell and reporting type procedures. The techniques shown are applicable to all **Linux** system variants.

## COURSE OBJECTIVES

Each participant will be able to use **bash** shell, **Korn** shell, and **awk** capabilities to maintain collections of files, manipulate data, implement process communication, synchronization, and data sharing. Brief comparisons in techniques and performance considerations with **Perl** will also be shown.

## COURSE TOPICS

### **Review of (Core) Shell Scripting Features**

- Importance of signatures
- Methods of script execution
- Debugging shell scripts
- Variable types
- Looping statement constructs
- Decision statements

### **Advanced Techniques in Shell Scripts**

- Alternative script execution methods
- Defining a **trap** step debugger
- Here Document** data
- Defining and using functions
- Using string pattern expressions
- Indexed array creation and access
- Option processing with **getopts**

# Advanced Linux Shell Scripting

## COURSE TOPICS

### **Advanced Techniques in Korn Shell Scripts**

- Availability of variable data
- Defining and using **nameref** variables
- Active variables (and tied functions)
- Features of **Associative arrays**
- Direct control of file **I/O** (**exec, read, print**)
  - User-defined file descriptors
- Interprocess communication/synchronization
  - Co-processes
  - Reassignment of file descriptor paths
- TCP** and **UDP** port access
  - Attaching to network listener processes

### **awk Scripting Features**

- Importance of signatures
- Methods of script execution
- Patterns and actions
- Output formatting
- Defining and using associative arrays
- the **getline( )** function
- awk** supplied function features
  - string handling
  - information
  - callouts for system features
  - arithmetic operations
- Defining and using functions
  - Passing arguments to functions

### **Introduction to Perl Scripting**

- History, versions, ports
- Perl** capabilities
- Comparison with shell scripts



# Advanced Linux Shell Scripting

## COURSE DURATION

This course normally requires **three** (3) days, approximately 50 % lecture, and 50 % lab time.

## COURSE PREREQUISITES

This is an advanced **Linux / Unix** course. It is assumed that participants either have attended a **Linux or Unix Essentials** course, or have equivalent command line experience with the **bash** and/or **Korn** shells.

# Advanced Linux Systems Programming

## Course Description

This course introduces the participants to system level programming in the **C language** in a **Linux** environment. The course focuses on **Linux** system calls and library functions, how to use them, and their underlying mechanisms. The course deals with many facets of the **Linux** operating system, including: introduction to **Linux** kernel structure, I/O, Signals, Signal handlers, Timers, Processes, Multi-Tasking, Inter-Process Communication (**IPC**) Pipes, Shared memory, Message Queues, Semaphores, Networking, Sockets, using **TCP/IP** and **UDP/IP**. Throughout the course the information presented is related to the participant through: the execution of common **Linux** user/administrator commands, and writing, compiling, and executing example **C language** programs which demonstrate the use of system routines and accessing system data structures on a live **Linux** system.

## Course Objectives

Upon completion of this course the participant will be able to:

- Explain the programmable mechanisms in a **Linux** environment
- Write applications using standard **Linux** system calls and library functions

## Course Topics

### **System Programming Environment of Linux**

Environment of a **C** language program

System level programming requirements:

**C** compiler issues

Header files and libraries

Special data types used

Useful functions

Error handling (basic)

Documentation

Security Issues

# Advanced Linux Systems Programming

## Course Topics

### **File Systems**

- Types of file I/O
- File I/O structures
- File I/O access types
- Dealing with **STDIN, STDOUT, STDERR**
- Creating and using temporary files
- Directory file access and manipulation
- Permissions

### **Process Creation and Control**

- Attributes (username, UID, PID, Groups)
- Creation methods
- Multi-tasking
- Shells
- Synchronization
- An introduction to **POSIX** threads

### **Synchronization and System Information**

- Time issues
  - how time is maintained
  - timers
- General synchronization
  - semaphores
  - mutexes
  - spinlocks and barriers
  - signals (generation and handling)
- System information
  - uname
  - hostname
  - load averages

### **Interprocess Data Communication Facilities**

- Overview of **Linux** IPC Facilities
- Memory Mapped files
- Pipes and Named Pipes
- Messages Queues
- Creating and Using Shared Memory structures

# Advanced Linux Systems Programming

## Course Topics

### **Sharing Code Between Processes**

- Building shared object (libraries)
- Static Linking
- Dynamic Linking

### **Networking**

- Concepts and basic requirements
- Socket creation and usage
- TCP/IP level connections
- UDP/IP level connections

## Course Duration

This course normally requires **five** (5) days, 60% lecture, 40% hands on lab exercises.

## Course Prerequisites

It is assumed that the participant has a solid background in basic **Linux** utilities and editors (such as **vim**), and a working knowledge of the **C** (or **C++**) programming language(s).

# CentOS 7 Administration II

## COURSE DESCRIPTION

This course will present the commands and methods needed to setup and manage a **CentOS 7** system. The course will also use a problem solving approach in the lab exercises to teach system administrators advanced topics, for long-term management of the system.

Systems: **Community Enterprise Operating System Version 7 (all update levels)**

## COURSE OBJECTIVES

On completion of this course, a systems administrator should be able to install, update, and boot the **CentOS 7** operating system; set up user accounts and directories; prepare queues for use; perform backups for integrity and performance reasons; monitor the system for performance and do basic setup of network software and capabilities.

## COURSE TOPICS

### **Creating and Editing Text Files**

- vim** editor

  - key operations

  - contents of **.vimrc**

- vim** editor variants (**vimdiff**, **gvim**)

- alternative editors (**gedit**, **nano**)

### **Scheduling Tasks and Operations**

- batch job scheduling with **at**

- batch job scheduling with **crontab**

- operation scheduling with **systemd** timers

- logging

# CentOS 7 Administration II

## COURSE TOPICS

### **Regular Expressions**

definition

usage with **grep** and **sed**

### **Controlling Processes**

running priority (**nice** values)

processor affinity (**taskset**)

### **System Installation and Updating**

installation types and methods (review)

installing the **CentOS 7** operating system via **kickstart**

### **Startup and Shutdown**

controlling kernel operations via boot time arguments

**GRUB** loader manipulation

alternative menu entries

Boot time troubleshooting

shutdown methods

### **Managing of System Users and Files**

special permission codes

access Control Lists (**ACLs**)

files

directory (defaults)

security through **PAM password aging**

group level password controls

connecting to an **LDAP** server

# CentOS 7 Administration II

## COURSE TOPICS

### **Commands to Manipulate Disks/Filesystems**

partitioning disk surfaces with **fdisk** and **parted**  
creating **ext2/ext3/ext4/xfs** file systems (**mkfs**)  
file system structures information (**tune2fs, xfs\_info**)  
verifying file system structures (**fsck, xfs\_repair**)  
making file systems available to software (**mount**)  
configuring swap space(s)

### **Logical Volume Management (LVM)**

physical volumes  
volume groups  
logical volumes  
resizing **LVM** based file systems  
**LVM** based swap space

### **Network Accessible Storage**

#### **NFS**

basic server setup  
basic client setup

#### **Samba/CIFS**

share setup  
accessing shares (**smbclient, mount**)

### **Maintaining System and Network Integrity**

software firewall  
**firewalld**  
**iptables**  
**SELinux** basics  
Log file control (**logrotate**)

# CentOS 7 Administration II

## COURSE DURATION

This course normally requires **four** (4) days, approximately 60% lecture, and 40% lab time.

## COURSE PREREQUISITES

It is assumed that the participant has successfully completed the **CentOS 7 Administration I** course, or has equivalent system administration experience on a **CentOS 7** server.



# CentOS 7 Systems Administration

## System Monitoring and Performance Management

### COURSE DESCRIPTION

The **Community Enterprise Operating System (CentOS) Systems Administration: System Monitoring and Performance Management** course introduces participants to performance management principles, monitoring utilities / tools, and analysis for the **CentOS 7** Operating Environment. The course includes a review of **CentOS 7** subsystems, along with the utilities provided to monitor system efficiency including **sar** and the **\*stat** family of tools. In each area of discussion, emphasis will be placed on writing tools for monitoring and analysis. These tools will include **Korn shell** scripts, **Perl** procedures, and **C language** programs.

Systems: **CentOS Linux Version 7 (all update levels)**

### COURSE OBJECTIVES

On completion of this course, a systems administrator should be able to:

- Describe performance management fundamentals
- Use the **CentOS 7** and third-party tools to analyze performance
- Write tools in various languages
- Use **CentOS 7** performance data extensions
- View and set kernel-based tuning parameters
- Monitor and report on process and thread activity
- Modify **CPU** scheduling and virtual memory operations
- Enable dynamic monitoring via **SystemTap** in all major areas

# CentOS 7 Systems Administration

## System Monitoring and Performance Management

### COURSE TOPICS

#### **Performance Basics**

- Describe the principles of performance analysis
- Describe the performance management process
- Terms used to describe performance aspects
- Factors affecting system performance
- Performance metrics
- Virtual system caching
  - Effects of computer architecture

#### **CentOS 7 Monitoring Capabilities**

- Monitoring tools provided with **CentOS 7**
  - \***stat** family of programs
    - sar / sadc**
  - Third party / freely available tools
    - uptime**
    - ManageEngine**
  - tools from **CentOS**
- Introduction to **SystemTap**
- Kernel tunables (viewing, changing via **sysctl**)

#### **Memory Management**

- Memory layout and distribution
- Memory usage by the kernel
- Process creation
- Process virtual address space
- Buffer Cache (and allocation control)
- Shared Memory / Page Caching
- Paging and Swapping
- Monitoring Tools

# CentOS 7 Systems Administration

## System Monitoring and Performance Management

### COURSE TOPICS

#### **CPU Management**

- Software priorities concepts
- Impact of the **nice** parameter
- Priority boosting
- Adjusting **CPU** scheduling mechanisms
- Tuning (**Java**) threaded applications
- Process states
- Monitoring tools

#### **I/O Management**

- Breakdown of disk I/O
- Measuring Disk and I/O
- ext3/ext4/xfs** performance
  - File system structure concepts
  - File system caching
  - Name Lookup (meta-data) caching
  - Tuning the cache sizes and algorithms
  - (Re-)Defining the **I/O** scheduler
  - File system performance statistics
  - ext3** parameters to improve efficiency
  - write strategies to **ext3/ext4/xfs** buffering
- Monitoring Tools

#### **Network Management**

- TCP/IP** Layers
- Socket controls
- Controlling network services
- Setting network buffer values
- Monitoring tools

#### **Summaries**

- Memory management
- CPU management
- I/O management
- Network management
- User program management

# CentOS 7 Systems Administration

## System Monitoring and Performance Management

### COURSE DURATION

This course normally requires **three** (3) days, approximately 60% lecture, and 40% lab time.

### COURSE PREREQUISITES

It is assumed that the participant has successfully completed the **CentOS 7 System Administration I** and **CentOS 7 System Administration II** ) courses, or has equivalent system time as a user and a working systems administrator.