Advanced Linux Programming and Administration

Course Duration: 32 Hours **Course code: ALPA**

1. Course Overview

This advanced course is designed for Linux professionals who want to master system-level programming, administration, and performance optimization. It covers advanced shell scripting, Linux internals, process management, memory handling, file systems, system calls, kernel modules, and security. Learners will gain practical experience in tuning, troubleshooting, and automating Linux environments, along with writing C programs that interface with Linux system APIs.

2. What you'll learn?

By the end of this course, participants will be able to:

- Master Linux system calls and library functions for programming.
- Develop advanced shell scripts for automation.
- Manage Linux kernel modules, processes, and memory.
- Optimize system performance, networking, and storage.
- Implement Linux security policies and access controls.
- Debug and troubleshoot Linux-based applications.
- Understand and apply Linux administration best practices.

3. Target Audience

- Linux system administrators
- DevOps engineers
- C programmers working with Linux system APIs
- IT professionals managing enterprise Linux environments

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4. Pre-Requisites

Familiarity with:

- Linux command line & basic administration
- Shell scripting
- C programming fundamentals
- Basic networking concepts

5. Course content

Module 1: Course Introduction

- Course Objectives
- Tools and References
- Linux Programming & Administration Scope

Module 2: Advanced Linux System Programming

- Linux Architecture and System Programming Basics
- System Calls and Library Functions
- File I/O, File Descriptors, and File Locking
- Process Creation, Signals, and Daemons

Module 3: Memory Management in Linux

- Virtual Memory and Paging
- Shared Memory and IPC Mechanisms
- Memory Mapping and Allocation Strategies
- Debugging Memory Issues

Module 4: Advanced Shell Scripting and Automation

- Writing Robust Bash Scripts
- Automating System Administration Tasks
- Error Handling and Logging
- Using Cron and systemd timers

Module 5: Kernel and Module Programming

- Linux Kernel Overview
- Writing and Loading Kernel Modules
- Kernel Debugging Tools
- Device Drivers Introduction

Module 6: Linux Security and Access Control

- User and Group Management
- File Permissions and ACLs
- SELinux and AppArmor
- Securing Network Services

Module 7: Networking in Linux

- Advanced Networking Commands
- Network Socket Programming in C
- Network Performance Tuning
- Firewall and iptables/nftables Configuration

Module 8: Performance Monitoring and Optimization

- System Resource Monitoring (top, htop, vmstat, iostat)
- Debugging with strace and gdb
- Performance Tuning of CPU, Memory, and Disk
- Benchmarking Tools

Module 9: Storage and File Systems

- Ext4, XFS, and Btrfs Features
- LVM and RAID Configuration
- File System Maintenance and Recovery
- NFS and SMB Administration

Module 10: Troubleshooting and Debugging Linux Systems

- Analyzing System Logs
- Crash Debugging and Core Dumps
- Troubleshooting Boot Issues
- Best Practices in Problem Diagnosis

Module 11: Real-World Projects and Labs

- Automating System Backup and Restore
- Writing a Multi-Process Application in C
- Building a Custom Kernel Module
- Implementing Security Policies

Module 12: Course Wrap-Up

- Review of Key Concepts
- Best Practices for Linux Admins and Developers
- References and Further Learning Paths