Slurm Deployment & Administration Training

Duration: 40 Hours
Schedule: 5 Days x 8 Hours
Method: Theory + Hands-on Labs + Exercises + Troubleshooting
Audience: HPC Admins, Lab Engineers, Technical Architects

Day 1: HPC & Slurm Foundations, Lab Preparation

1 Introduction to HPC

- HPC concepts, architecture
- Workload management role in HPC

2 Slurm Overview

- What is Slurm?
- Key components: slurmctld, slurmd, slurmdbd
- Features and advantages
- Comparison with PBS, LSF

3 Slurm Architecture Deep Dive

- Controllers, compute nodes, partitions
- Node states, jobs, queues
- Munge authentication

4 Environment Preparation Lab

- OS Installation
- Hostname, networking, NTP
- Kernel and performance tuning
- Security and firewall basics

5 Installing Prerequisites

- Munge setup
- Development tools

6 Building/Installing Slurm

- Using EPEL or official repositories

Day 2: Slurm Core Configuration & Initial Testing

1 Slurm Configuration Concepts

- slurm.conf structure
- Node definitions and partitions
- Key parameters

2 Creating slurm.conf

- Using `configurator.html` tool
- Lab: Generate slurm.conf for the cluster

3 Munge Configuration and Testing

4 Starting Slurm Services

- slurmctld and slurmd
- Enabling at boot
- Logs and service status

5 Testing Basic Slurm Commands

- `sinfo`, `squeue`, `scontrol`
- Submitting test jobs using `sbatch`, `srun`

6 Advanced Node Configuration

- Node states, reservations
- Down, drain, resume
- Node health check scripts

Day 3: Advanced Scheduling, Job Management, and Resource Control

1 Understanding Slurm Scheduling

- Backfill scheduling
- Priority parameters
- Fairshare concepts

2 Configuring Partitions and QoS

- Partition properties
- Limits, priorities
- Configuring QoS for users/groups

3 Advanced Job Submission

- `sbatch`, `srun`, `salloc` advanced options
- Array jobs
- Dependencies

4 Managing Jobs

- `scancel`, `scontrol hold/release`
- Monitoring job performance

5 Resource Limits and Cgroups

- Enabling cgroup support
- Memory and CPU constraints

6 Using Accounting Tools

- `sacct`, `sreport`
- Generating usage reports

7 Job Profiling and Performance Monitoring

- Profiling jobs with Slurm tools
- Integration with `htop`, `nmon`, or Ganglia

Day 4: Advanced Features, Security, and Integrations

1 Slurm Advanced Features

- Preemption
- Advanced reservations
- Job requeue

2 Advanced Scheduling Policies

- Configuring advanced fairshare
- Multi-factor priority
- Topology-aware scheduling

3 GPU and Heterogeneous Resources

- Configuring GPUs in Slurm
- Managing heterogenous job requests

4 Security Best Practices

- User management
- SSH and Munge hardening
- Limiting user actions

5 Slurm and Containers

- Using Singularity/Apptainer with Slurm
- Container job submission

6 Monitoring and Logging

- Understanding log files
- Slurm monitoring dashboards (Grafana, Ganglia)

7 Backup and Recovery

- Backing up Slurm configurations
- Upgrading Slurm safely

8 Troubleshooting Advanced Issues

- Debugging failed jobs
- Debugging scheduling problems

Day 5: High Availability, Performance Tuning, Automation, and Capstone Lab

1 High Availability with Slurm

- Configuring Slurmctld failover
- HA storage considerations

2 Performance Tuning Slurm

- Tuning slurm.conf parameters
- Node tuning for HPC workloads

3 Automation with Scripts and Ansible

- Using Ansible to deploy Slurm clusters
- Common automation tasks

4 Advanced Resource Management

- Dynamic node management
- Power saving features
- Elastic computing with Slurm

5 Scaling Slurm Clusters

- Adding/removing nodes
- Multi-cluster federation overview

6 Capstone Lab: Deploy a Slurm Cluster End-to-End

- Clean deployment from OS prep to job submission
- Advanced configurations and testing
- Performance validation