MERCURY

Cluster Computing

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Introduction:

The Cluster Computing course provides participants with a comprehensive understanding of cluster computing systems and their applications in modern computing environments. Participants will explore the concepts, principles, and practical aspects of cluster computing, including the design, configuration, and management of cluster systems. Through hands-on exercises and real-world examples, participants will gain the skills necessary to harness the power of clustered computing resources for high-performance and distributed computing tasks.

Targeted Groups:

- IT professionals and system administrators
- Software developers and programmers
- Data scientists and researchers
- High-performance computing HPC specialists
- Cloud computing engineers
- Technical managers and decision-makers involved in cluster computing projects

Targeted Competencies:

- Understand the fundamentals of cluster computing and its applications in various domains.
- Configure and manage cluster systems, including hardware, software, and network components.
- Implement parallel and distributed computing algorithms on cluster platforms.
- Optimize performance and scalability of cluster applications.
- Utilize job scheduling and workload management techniques in cluster environments.
- Design fault-tolerant and resilient cluster systems.
- Apply cluster computing to solve real-world computational problems.
- Stay updated with emerging trends and advancements in cluster computing.

Course Objectives:
Upon completion of the Cluster Computing course, participants will be able to:

- Understand the fundamentals of cluster computing and its role in high-performance computing.
- Gain knowledge of cluster architecture, components, and deployment models.
- Configure and manage cluster systems for efficient resource utilization.
- Implement parallel and distributed computing algorithms on cluster platforms.
- Optimize performance and scalability of cluster applications.
- Utilize job scheduling and workload management techniques in cluster environments.
- Design fault-tolerant and resilient cluster systems.
- Apply cluster computing to solve real-world computational problems.

Course Outline:

Unit 1: Introduction to Cluster Computing

- Overview of cluster computing and its advantages.
- Evolution of cluster systems and their applications.
- Key components and characteristics of cluster architectures.

Unit 2: Cluster Architecture and Design

- Cluster hardware and network configurations.
- Cluster interconnect technologies and topologies.
- Scalability considerations in cluster design.

Unit 3: Cluster Configuration and Management

- Cluster provisioning and setup procedures.
- Operating system and software stack configuration.
- Cluster management tools and utilities.

Unit 4: Parallel and Distributed Computing on Clusters

- Parallel programming models and frameworks.
- Task decomposition and load balancing techniques.
- Message passing and synchronization in distributed computing.

Unit 5: Performance Optimization in Cluster Computing

- Performance analysis and profiling of cluster applications.
- Techniques for parallelization and optimization.
- Memory management and data locality in clusters.

Unit 6: Job Scheduling and Workload Management

- Cluster job scheduling algorithms and policies.
- Resource allocation and task assignment strategies.
- Queue management and job prioritization.

Unit 7: Fault Tolerance and Resilience in Clusters

- Fault detection and recovery mechanisms in clusters.
- High availability and data replication techniques.
- Cluster monitoring and failure prediction.

Unit 8: Applications of Cluster Computing

- Scientific simulations and data-intensive computing.
- Big data analytics and distributed processing.
- Cluster computing in cloud and HPC environments.