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PostgreSQL Advanced DBA

Enterprise Performance Tuning, High Availability, Security, and Cloud Architecture - 1 day

FA-0350 · 1 day

DevOps, Cloud & Infrastructure · Data & Analytics

Introduction

High-concurrency PostgreSQL environments demand far more than basic cluster management and default configuration parameters. As relational databases take on increasingly complex workloads, database administrators must balance rigorous query optimization, low-latency transaction processing, automated failover, and strict enterprise security controls.

This intensive one-day course delivers a practical deep-dive into advanced PostgreSQL administration, covering engine internals, connection pooling architectures, memory tuning, replication topologies, maintenance strategies, and cloud migration patterns.

The course is led by an instructor with over 30 years of industry experience and focuses exclusively on real-world, industry-demanded practices rather than theoretical fluff. Database professionals will gain practical, battle-tested expertise required to diagnose production performance bottlenecks, maintain bulletproof database reliability, and optimize PostgreSQL across modern enterprise environments.

Learning outcomes

- Understand PostgreSQL engine architecture, including process models, memory allocation, and storage internals
- Configure and fine-tune shared buffers, work memory, WAL parameters, and autovacuum settings for maximum operational efficiency
- Analyze complex query execution plans, identify cost bottlenecks, and apply advanced indexing strategies
- Diagnose lock contention, bloat, I/O saturation, and system bottlenecks using system catalogs and extension metrics

- Execute reliable physical and logical backup, point-in-time recovery (PITR), and zero-downtime maintenance strategies
- Harden PostgreSQL environments through role-based access control, encryption, auditing, and enterprise compliance practices

Prerequisites

- Hands-on experience administering relational databases (PostgreSQL, SQL Server, Oracle, or MySQL)
- Solid understanding of core SQL, indexing concepts, transactions, and ACID principles
- Familiarity with Linux command line administration, shell scripting, and server configuration
- Basic understanding of network configurations, storage systems, and enterprise backup concepts

Target Audience

- Senior Database Administrators and Database Engineers managing production PostgreSQL clusters
- Platform Engineers, Site Reliability Engineers (SREs), and DevOps Leads overseeing database infrastructure
- System Architects and Technical Leads evaluating PostgreSQL for high-throughput or mission-critical workloads
- Data Engineers responsible for backend database efficiency, migrations, and performance optimization

Training outline

1. PostgreSQL Core Architecture and Internals

Process architecture

1. Postmaster process and client connection handling
2. Backend processes and query execution lifecycle
3. Background writer and checkpointer processes
4. Autovacuum worker architecture
5. WAL writer and archiver processes

Memory architecture

1. Shared memory structures and shared buffers

2. Work memory and maintenance work memory allocations
3. WAL buffers and temporary buffers
4. OS page cache interaction and kernel page management

Storage layout and transaction management

1. Heap file organization and page structure
2. Tuple headers and MVCC implementation
3. Write-Ahead Logging (WAL) internals and checkpointing
4. Transaction isolation levels and concurrency control

2. Advanced Performance Tuning and Diagnostics

Server parameter optimization

1. Memory configuration strategies
2. Disk write and WAL tuning parameters
3. Planner cost constants adjusting for modern storage
4. Parallel query execution tuning

Deep-dive query optimization

1. EXPLAIN and EXPLAIN ANALYZE execution plan breakdown
2. Node types, scan methods, and join strategies
3. Statistics collector configuration and custom targets
4. Advanced indexing strategies including B-Tree, GIN, GiST, and BRIN

3. Autovacuum, Maintenance, and Database Health

Vacuum and bloat management

1. Autovacuum cost-based delay and threshold formulas
2. Vacuum freeze operations and transaction ID wraparound prevention
3. pg_repack and non-blocking maintenance operations
4. Index bloat identification and REINDEX CONCURRENTLY usage

Connection management and scalability

1. Connection overhead and scalability limitations
2. PgBouncer architecture, pooling modes, and configuration
3. Odyssey connection pooling for high-concurrency environments
4. Load balancing write vs read-traffic strategies

4. High Availability, Replication, and Recovery

Replication strategies

1. Physical streaming replication setup and monitoring
2. Synchronous vs asynchronous replication modes
3. Replication slots, WAL retention, and cascading replication
4. Logical replication setup, publication, and subscription management

High availability and failover

1. HA topology design and quorum considerations
2. Patroni architecture and DCS integration
3. Automated failover, fencing, and split-brain prevention
4. Health checking and client reconnection patterns

Backup and Point-In-Time Recovery (PITR)

1. Physical backup strategies with pgBackRest and Barman
2. Write-Ahead Log archiving workflows
3. Point-In-Time Recovery execution and verification
4. Disaster recovery testing and RPO/RTO optimization

Disclaimer

This course outline is provided as a general training framework and proposed scope of coverage only. It does not constitute a fixed agenda, binding commitment, official certification pathway, partnership representation, or guaranteed delivery sequence. The trainer reserves the right, at his professional discretion, to amend, expand, condense, reorder, replace, or otherwise modify any portion of the content, emphasis, structure, tools, demonstrations, or delivery approach without prior notice, based on participant background, organizational requirements, technology changes, platform availability, security considerations, and instructional judgment.

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