

NoSQL and Relational Database Management

CONTENT OUTLINE

Day 1: Database Fundamentals and Introduction (8 hours)

- Introduction to database concepts and terminology
- Data models: hierarchical, network, relational, document, key-value, columnar, graph
- ACID properties vs. BASE principles
- CAP theorem and its implications
- Database selection criteria and use cases
- Overview of training technologies and lab environment setup

Day 2-3: Relational Databases with Oracle (16 hours)

- Relational database concepts and normalization (1NF, 2NF, 3NF, BCNF)
- Oracle Database architecture and installation
- SQL fundamentals: DDL, DML, DCL, TCL
- Data types, constraints, and table design
- Complex queries: joins, subqueries, aggregations, views
- Stored procedures, functions, and triggers
- Transaction management and locking mechanisms
- Hands-on exercises: Design and implement a multi-table database

Day 4: Oracle Advanced Topics (8 hours)

- Indexing strategies (B-tree, bitmap, function-based indexes)
- Query optimization and execution plans
- Backup and recovery procedures (RMAN basics)
- User management, roles, and security
- Performance tuning basics
- Practical lab: E-commerce database implementation

Day 5-6: Document Database - MongoDB (16 hours)

- Introduction to document-oriented databases and use cases
- MongoDB architecture and data modeling principles
- Installation and configuration
- CRUD operations and query language
- Aggregation framework and pipeline operators
- Indexing strategies in MongoDB
- Replication and replica sets
- Sharding concepts and implementation
- MongoDB security and authentication
- Integration with Node.js/Python
- Hands-on project: Content management system database

Day 7: Key-Value Store - Redis (8 hours)

- Understanding key-value stores and use cases
- Redis architecture and installation
- Redis data structures (strings, lists, sets, hashes, sorted sets, bitmaps)
- Redis commands and operations
- Persistence mechanisms (RDB snapshots and AOF)
- Redis as a cache layer
- Pub/Sub messaging patterns
- Redis clustering and high availability
- Integration with applications
- Practical exercises: Caching layer implementation, session management

Day 8: Wide-Column Store - Cassandra (8 hours)

- Introduction to wide-column stores and distributed databases
- Cassandra architecture: ring topology, gossip protocol
- Data modeling principles (denormalization for queries)
- CQL (Cassandra Query Language)
- Partitioning keys and clustering columns

- Replication strategies and consistency levels
- Tunable consistency (ONE, QUORUM, ALL)
- Node management and cluster operations
- Use cases: time-series data, IoT applications, high-write workloads
- Hands-on lab: IoT sensor data storage system

Day 9: Graph Database - Neo4j (8 hours)

- Graph database concepts: nodes, relationships, properties, labels
- Neo4j architecture and installation
- Cypher query language fundamentals
- Creating and querying graph structures
- Graph data modeling patterns
- Traversal algorithms and pathfinding (shortest path, all paths)
- Indexing and constraints in graph databases
- Integration with applications (Python/Java drivers)
- Use cases: social networks, recommendation engines, fraud detection, knowledge graphs
- Practical project: Social network or recommendation engine

Day 10: Integration, Best Practices, and Capstone (8 hours)

- Polyglot persistence strategies
- When to use which database (decision matrix)
- Database integration patterns and microservices
- Connection pooling and resource management
- Monitoring and performance tuning across platforms
- Cloud database services overview (AWS RDS, MongoDB Atlas, Azure Cosmos DB)
- Disaster recovery and business continuity planning
- Security best practices across platforms
- **Capstone Project:** Design and implement a multi-database application
- Project presentations and evaluation

- Course review and certification ceremony