CSE494:INTELLIGENT NOSQL DATABASES

L:3 T:0 P:2 Credits:4

Course Outcomes: Through this course students should be able to

CO1 :: discuss the core concepts of NoSQL databases and differentiate them from traditional relational databases

CO2 :: apply CRUD operations, indexing, and query optimization techniques using MongoDB.

CO3 :: analyze various data modeling strategies such as embedding and referencing to design efficient MongoDB schemas

CO4 :: evaluate the performance impact of indexing and aggregation frameworks on complex queries

CO5 :: develop applications that integrate MongoDB with programming languages like Node.js and Python for intelligent data handling

CO6 :: create a functional mini-project using MongoDB, showcasing real-world applications and future trends like AI-driven analytics

Unit I

Introduction to NoSQL and MongoDB : Introduction to NoSQL Databases, Comparison: SQL vs. NoSQL, Overview of MongoDB, CAP Theorem and their trade-offs, NO SQL data Models - Key-value database, Column-oriented database, Document database, graph database, MongoDB Architecture, Installing MongoDB (Community Edition), Introduction to MongoDB Shell & Compass, MongoDB Atlas (Cloud) Overview

Unit II

MongoDB Basics and CRUD Operations : Databases, Collections, Documents, BSON Data Types, Creating and Dropping Databases/Collections, Data Modeling in MongoDB, Indexes & Query Optimization

Unit III

Schema Design and Data Modeling : Schema-less Nature of MongoDB, Embedding vs Referencing, One-to-One, One-to-Many, Many-to-Many Relationships, Data Modeling Best Practices, Case Studies and Examples, Validation Rules and Constraints

Unit IV

Indexing and Aggregation Framework : Indexing Basics: Single, Compound, Text Indexes, Performance with Indexing, Covered Queries and explain(), Aggregation Pipeline Concepts, Real-world Aggregation Examples

Unit V

MongoDB Integration : MongoDB Integration with: Node.js (Mongoose), Python (PyMongo), CRUD using Application Code, MongoDB for AI-based Predictive Analytics, AI-driven Query Optimization in NoSQL Databases

Unit VI

Project : Building a Mini Project, Best Practices for Production, Final Assessment / Viva / Quiz, Course Recap and Discussion, Future Trends: AI-Augmented Databases & AutoML

List of Practicals / Experiments:

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- Create NoSQL database and compare with SQL
- Perform CRUD operations on documents
- Use and explore BSON data types
- Model one-to-one/many relationships
- Apply schema validation and constraints
- Create indexes and analyze performance
- Build aggregation pipeline using stages
- Integrate MongoDB with Node.js

- Install and prepare the MongoDB environment for use
- Establish MongoDB cinnection using Python PyMongo

References:

1. MONGODB FUNDAMENTALS: A HANDS-ON GUIDE TO USING MONGODB AND ATLAS IN THE REAL WORLD by AMIT PHALTANKAR, JUNED AHSAN, MICHAEL HARRISON, LIVIU NEDOV, PACKT PUBLISHING

2. MONGODB IN ACTION by KYLE BANKER, PETER BAKKUM, SHAUN VERCH, DOUGLAS GARRETT, AND TIM HAWKINS, Manning Publication