College of San Mateo
Official Course Outline

1. **COURSE ID:** CIS 133 **TITLE:** NoSQL Databases
   Units: 3.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; 96.0-108.0 Homework hours; 144.0-162.0 Total Student Learning hours
   Method of Grading: Grade Option (Letter Grade or Pass/No Pass)
   Recommended Preparation:
   CIS 254, completion of or concurrent enrollment in CIS 132.

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Introduction to non-relational (NoSQL) data models, such as Key-Value, Document, Column, Graph and Object-Oriented database models. Advantages and disadvantages of the different data architecture patterns will be discussed. Hands-on experience with a representative sample of open-source NoSQL databases will be provided. The rapid and efficient processing of data sets with a focus on performance, reliability, and agility will be covered. Big Data, distributed and cloud computing concepts will be introduced. Intended for students with previous programming experience.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Define NoSQL, its characteristics and history, and the primary benefits for using NoSQL databases
   2. Define the major types of NoSQL databases including a primary use case and advantages/disadvantages of each type
   3. Create wide-column, document, key-value, graph and object-oriented databases, add content, and run queries
   4. Describe the NoSQL data architecture patterns
   5. Use NoSQL to manage Big Data.
   6. Develop NoSQL desktop and cloud database solutions.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Define NoSQL, its characteristics and history, and the primary benefits for using NoSQL data
   2. Define the major types of NoSQL databases including a primary use case and advantages/disadvantages of each type
   3. Create wide-column, document, key-value, graph and object-oriented databases, add content, and run queries
   4. Describe the NoSQL data architecture patterns
   5. Perform basic database administration tasks.
   6. Develop NoSQL desktop and cloud database solutions.

6. **COURSE CONTENT:**
   Lecture Content:

1. Introduction to NoSQL
• What is NoSQL
• NoSQL Overview
• NoSQL Database Environment
• NoSQL Options

2. When to Use NoSQL
• Benefits to using NoSQL DB
• Backend Management
• Deployment
• Front-End Development
• Open Source
• Drawbacks to Using NoSQL DB
• Open Source
• NoSQL vs. SQL

3. Introduction to NoSQL Development
- Schemaless Development
- Data Models
- Distribution Models
- Consistency
- Categories of NoSQL
  - Key-Value Stores
  - Wide-Column Family Stores
  - Document Databases
  - Graph Databases
  - Object-Oriented Databases
  - Others
- NoSQL Scalability
- Searching

4. Wide-Column Databases - NoSQL
- Column Family
- Key and Keyspace
- Categories of NoSQL
- Examples
  - Cassandra
  - MapR
  - Others

5. Key-Value Databases - NoSQL
- Major Keys
- Minor Keys
- Values
- Examples
  - Oracle NoSQL Database
  - Redis
  - Others

6. Document Databases - NoSQL
- Attributes
- Metadata
- Formats
- XML
- JSON and BSON
- Examples
  - ElasticSearch
  - CouchDB
  - MongoDB
  - Others

7. Graph Databases - NoSQL
- Edges
- Nodes
- Relationships
- Examples
  - Neo4J
  - InfoGrid
  - GraphBase
  - Others

8. Object-Oriented Databases - NoSQL
- Object-Oriented Concepts
- Object Stores
- Examples
  - ZODB
  - ObjectDB
  - Others

9. Cloud Computing with NoSQL Databases
- Big Data
- Remote Searches
- Hadoop
- MapReduce
- REST
- AWS

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**
   Typical methods of instruction may include:
   A. Lecture
   B. Directed Study
   C. Activity

D. Discussion
E. Other (Specify): Lecture will be used to introduce new topics. Teacher will model problem-solving techniques. Class will solve a problem together, each person contributing a potential "next step". Students will participate in short in-class projects (in teacher-organized small groups) to ensure that students experiment with the new topics in realistic problem settings. Teacher will invite questions AND ANSWERS from students, generating discussion about areas of misunderstanding. Teacher will create and manage an internet conference for discussion of course topics. Students will work in small groups to solve assignments.

8. **REPRESENTATIVE ASSIGNMENTS**

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

Students will complete and submit exercises and assignments on a weekly or biweekly basis.

Typical assignments would include:
Designing a NoSQLdatabase employing the NoSQL models
Querying a database updating and deleting database content
Writing applications that interact with NoSQL databases
Employing XML and JSON to retrieve data
Using NoSQL technologies to extract and manipulate web-based data
Non-relational, distributed database design and creation using NoSQL web-based databases
Write applications that use visualization and graphing to display data
Use Big Data technologies such as Hadoop and MapReduce

Reading Assignments:

Students will read assigned chapters in the textbook and supplemental handouts.

Other Outside Assignments:

Students will be required to watch videos.

9. **REPRESENTATIVE METHODS OF EVALUATION**

Representative methods of evaluation may include:

A. Class Participation
B. Class Work
C. Exams/Tests
D. Group Projects
E. Homework
F. Projects
G. Quizzes
H. Written examination
I. Bi-weekly quizzes (short answer-from textbook material) to provide feedback to students and teacher. Assessment of student contributions during class discussion and project time. Individual database design assignments. Midterm and Final exams (short answer from textbook material), general problem solving (similar to in-class work), short database design segments (similar to assignments). Assessment of group participation on course projects, including peer-assessment of participation and contribution to the group effort.

10. **REPRESENTATIVE TEXT(S):**

Possible textbooks include:

A. Meier & Kaufmann. *SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management*, 2nd ed. Springer, 2023
B. Bradshaw & Chodorow. *MongoDB: The Definitive Guide: Powerful and Scalable Data Storage*, 3rd ed. O'Reilly, 2019
C. Pivert. *NoSQL Data Models: Trends and Challenges*, 1st ed. Wiley, 2018

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Course Originator: Kamran Eftekhari