



Northeastern University

College of Engineering

DAMG 7275 Advanced Database Management Systems

Course Information

Course Title: Advanced Database Management Systems

Course Number: DAMG 7275

Term and Year: Spring 2022

Credit Hour: 4

Course Format: Online

Instructor Information

Full Name: Wuping Wang

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Course Prerequisites

Graduate level INFO 6210 Minimum Grade of B

Course Description

Introduces the skill set required to become a serious database applications developer. Offers an overview of the Oracle9i object-relational database system for those who have mastered the fundamental principles of database design and are competent with basic SQL. Gives students the opportunity to develop a strong understanding of the PL/SQL programming language, which is used to create triggers, user-generated functions, stored procedures, and packages for programming Oracle objects. Emphasizes advanced SQL features and Oracle-specific SQL enhancements. Covers optimization and tuning issues. Covers corresponding material for Transact-SQL (used for Microsoft SQL Server and Sybase database systems) as time and resources permit.

Standard Learning Outcomes

Learning outcomes common to all College of Engineering Graduate programs:

- 1. An ability to identify, formulate, and solve complex engineering problems.*
- 2. An ability to explain and apply engineering design principles, as appropriate to the program's educational objectives.*
- 3. An ability to produce solutions that meet specified end-user needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.*

The Information Systems Program accepts students of different engineering backgrounds with minimum programming skills and produces first class Information Systems engineers that operate at the intersection of real-world complexity, software development, and IT management. Graduating students will be able to construct end-to-end advanced software applications that meet business needs.

Specific Learning Outcomes for the Information Systems program:

- 1. Create a strong technical foundation through diverse, high-level courses*

2. *Built crucial interpersonal skills needed to succeed in any industry*
3. *Foster a deep level of applied learning through project based case studies*

Course Outcomes and Assessment Standards

Upon successfully completing the course, students will be able to conduct the following:

- Understand and describe the Architecture of large-scale NoSQL and Relational Database Management Systems
- Design and implement Data Structure for NoSQL Databases based on the data usage pattern
- Implement and manage Data Movement, such as Replication and Data Pipelines
- Survey major Data High Availability and Data Locality approaches
- Plan for Disaster Recovery and implement its solutions to meet the business requirements
- Architect and implement the Event-Driven Data Management
- Understand Data Governance and develop code to implement its solutions
- Explore and develop code to work with Data of Complex Relationships

Books

Lena Weise (2015)

Advanced Data Management: For SQL, NoSQL, Cloud and Distributed Databases

De Gruyter, [ASIN: B019LFN2MM]

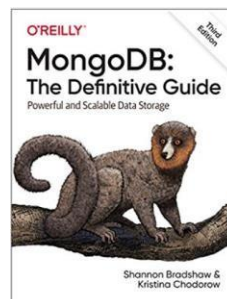
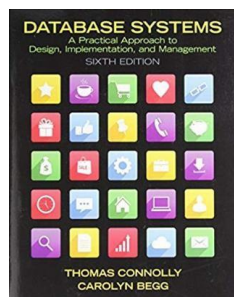
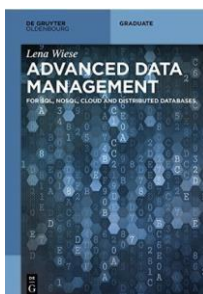
Connolly, T. M. & Begg, C. E. (2015)

Database Systems: A Practical Approach to Design, Implementation, and Management (6th Edition) Addison-Wesley Publishing, [ISBN-10: 0-13-294326-3]

The 4th or 5th Edition is also acceptable.

Kristina Chodorow, Shannon Bradshaw (2019)

MongoDB: The Definitive Guide, 3rd Edition O'Reilly Media, Inc., [ISBN 13: 978-1491954461]



Additional Course Materials:

YouTube Channel for Database Design:

<https://www.youtube.com/channel/UCP4n040ay46QjKYLmnBYCmw>

YouTube Channel for SQL Development:

<https://www.youtube.com/channel/UCwMn1c7Oq1VmW1t8gM7J5IA>

YouTube Channel for Data Mining and Database Management:

<https://www.youtube.com/channel/UCACs2TalmQuAa-M5042lBTg>

EVALUATION:

Course work balances between theory and practice. The grading components are listed below.

Assessment	% Grade
2 Quizzes	30%
5 Labs	40%
Database project	30%

ATTENDANCE

Your attendance is paramount to your success in this class. Contact the instructor if you have a question about the class attendance.

LATE WORK

All assignments must be submitted to the class Blackboard site for the course on the due date before 11:59 pm. If you turn in an assignment late, 10% credit will be deducted from the total score for each day after the deadline.

Assignments turned in more than one week late may not receive credit. In the case of unexpected events, you must contact the instructor before the assignment due date in order to receive a grace period.

ACADEMIC HONESTY & PLAGIARISM

Occurrences of academic dishonesty, such as submitting work that is not the student's own, will be dealt with according to the NEU's and COE's policies on the academic dishonesty. Students who allow their work to be copied will be treated the same as those who copy it.

Please go to the link below and read what constitutes the academic dishonesty and how the University will respond to such incidents:

<http://www.northeastern.edu/osccr/academic-integrity-policy/>

Academic integrity is important for two reasons. First, independent and original work ensures that students derive the most from their educational experience and the pursuit of knowledge. Second, academic dishonesty violates the most fundamental values of an intellectual community and depreciates the achievements of the entire University. It is the student's responsibility to know and follow the codes of academic dishonesty.

GRADING CRITERIA

Work in this course will be graded to criteria. In other words, you won't be graded on a curve. Each assignment is designed to test your achievement against one or more of the learning objectives. Different assignments emphasize different learning objectives. The meanings of grades are described below:

Letter	Percent
A	100-97
A-	96-90
B+	89-87
B	86-84
B-	83-80
C+	79-77
C	76-74
C-	73-70

Subjects

1. Survey and describe the logical and physical architecture of the large-scale NoSQL, NewSQL and SQL databases
2. Riak, Cassandra, Azure NoSQL Cosmos DB, MongoDB Atlas, TinkerPop, and Relational databases will be covered
3. Design, implement and compare different data structures based on the data usage pattern
4. Write SQL, CQL, JavaScript and Gremlin code to work with different types of data
5. Investigate the major data movement technologies and identify a use case for each option
6. Write code to implement data replication
7. Architect and deploy the Data High Availability and Data Locality solutions
8. Plan for the disaster recovery and implement the disaster recovery solutions
9. Design the Event-Driven Data Management and write code to implement it
10. Survey and describe the data governance solutions
11. Write code to implement the data governance solutions
12. Write code to work with complex data

Project

P1: Project Plan (5 points)

Select a topic, a data model and a target platform. The platform may be a relational, NoSQL, or a combination of both. Also determine the objectives or the scope of the project. For working with the database data after implementing the database(s), either develop an application and/or use tools.

P2: Design (5 points)

Create an ERD (Entity Relationship Diagram) to depict the database design. Also prepare an architecture diagram displaying how different components of the project will eventually work together to accomplish the project objectives.

P3: Implementation (10 points)

Write code and/or use tools to implement the ERD and architecture.

P4: Work with the database Data (5 points)

Develop an application and/or use tools to work with data stored in the database(s).

P5: Presentation (5 points)

Prepare a slide deck to showcase the project. A live demo is fine. Make sure all of the project deliverables are up to date and in synchronization.

Class Schedule

Important Note: Changes may occur to the syllabus at the instructor's discretion. When changes are made, students will be notified via Blackboard and/or in-class announcement.

Week One: September 9 – 13

Course Introduction

Review of Data Hierarchy and Aggregation

Reading

- chapter 1: “Background” (Advanced Data Management)

Week Two: September 14 - 20

NewSQL

Azure SQL Database

Data Pipeline

Use SQL MERGE, Trigger and SQL Server Job to Build Data Pipelines

Reading

- chapter 2: “Relational Database Management Systems” (Advanced Data Management)
- chapter 3: “New Requirements, Not only SQL and the cloud” (Advanced Data Management)

Week Three: September 21 - 27

Multi-Model Database Management System Cosmos DB Gremlin Graph Database

Gremlin Query Language

Azure Cosmos DB Gremlin graph support:

<https://docs.microsoft.com/en-us/azure/cosmos-db/gremlin-support>

Reading

- chapter 4: “Graph Databases” (Advanced Data Management)
- chapter 5: “XML Databases” (Advanced Data Management)

Assignment

P1

Lab 1 (Data Hierarchy, Data Aggregation and Server-side Modules)

Week Four: September 28 - October 4

Cosmos DB SQL API Database

Cosmos DB Cassandra Database

Cassandra Database and CQL (Cassandra Query Language)

Reading

- chapter 6: “Key-valued Stores and Document Databases” (Advanced Data Management)
- chapter 7: “Column Stores” (Advanced Data Management)
- chapter 2: “Getting Started” (MongoDB: The Definitive Guide)

Assignment

Lab 2 (Data Pipelines)

Week Five: October 5 - 11

SQL and JSON

Import Data into Cosmos DB

Relational Database vs Document Database

Reading

- chapter 10: “Distributed Database Systems” (Advanced Data Management)
- chapter 11: “Data Fragmentation” (Advanced Data Management)
- chapter 16: “Choosing a Shard Key” (MongoDB: The Definitive Guide)

Week Six: October 12 - 18

Design and implement data structures for MongoDB based on the data usage pattern MongoDB

Database on MongoDB Atlas

Import Data into MongoDB on MongoDB Atlas

XML

Reading

- chapter 12: “Replication and Synchronization” (Advanced Data Management)
- chapter 3: “Creating, Updating and Deleting Documents” (MongoDB: The Definitive Guide)
- chapter 4: “Querying” (MongoDB: The Definitive Guide)

Assignment

P2

Week Seven: October 19 - 25 Cosmos DB MongoDB Database

Reading

- chapter 7: “Aggregation” (MongoDB: The Definitive Guide)

Assignment

Lab 3 (Data Structures for Document Database)

Week Eight: October 26 - November 1 Quiz 1, in class

Attendance is mandatory

Week Nine: November 2 - 8 Riak Database

SQL CURSOR

SQL and Graphs

Use Iterative Approach and CURSOR for processing graphs SQL Node Table, Edge Table and MATCH()

Reading

Graph processing with SQL Server and Azure SQL Database:

<https://docs.microsoft.com/en-us/sql/relational-databases/graphs/sql-graph-overview?view=sql-server-ver15>

Assignment

P3

Week Ten: November 9 - 15

Data High Availability,

Data Locality and Disaster Recovery Dynamic SQL

Reading

- chapter 24: “Distributed DBMSs – Concepts and Design” (Database Systems: A Practical Approach to Design, Implementation, and Management)
- chapter 25: “Distributed DBMSs – Advanced Concepts” (Database Systems: A Practical Approach to Design, Implementation, and Management)

Assignment

Lab 4 (SQL and Graphs)

Week Eleven: November 16 - 22 New Database Technologies

Reading

- chapter 14: “Further Database Technologies” (Advanced Data Management)

- chapter 15: “Concluding Remarks” (Advanced Data Management)

Assignment

P4

Lab 5 (Dynamic SQL)

Week Twelve: November 23 - 29

No class

Week Thirteen: November 30 - December 6 Quiz 2, in class

Attendance is mandatory

Week Fourteen: December 7 - 13

Project Presentation, in class Attendance is mandatory

Assignment

P5

Week Fifteen: December 14 - 19

TBD

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is very important to the College of Professional Studies. Your comments will make a difference in the future planning and presentation of our curriculum.

At the end of this course, please take the time to complete the evaluation survey at <https://neu.evaluationkit.com>. Your survey responses are **completely anonymous and confidential**. For courses 6 weeks in length or shorter, surveys will be open one week prior to the end of the courses; for courses greater than 6 weeks in length, surveys will be open for two weeks. An email will be sent to your HuskyMail account notifying you when surveys are available.

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations,

tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to <http://www.northeastern.edu/osccr/academic-integrity-policy/> to access the full academic integrity policy.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit <http://www.northeastern.edu/drc/getting-started-with-the-drc/>.

Library Services

The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for Education specific resources, visit <http://subjectguides.lib.neu.edu/edresearch>.

24/7 Blackboard Technical Help

For immediate technical support for Blackboard, call 617-373-4357 or email help@northeastern.edu

Within Blackboard, open a support case via the red support button on the right side of the screen, click Create Case

myNortheastern, e-mail, and basic technical support

Visit the [Information Technology Services \(ITS\) Support Portal](#)

Email: help@northeastern.edu

ITS Customer Service Desk: 617-373-4357

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity and social justice while building a climate of inclusion on and beyond campus. In the classroom, member of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration and an awareness of global perspectives on social justice.

Please visit <http://www.northeastern.edu/oidi/> for complete information on Diversity and Inclusion

TITLE IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty and staff.

In case of an emergency, please call 911.

Please visit www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.