DAMG 6210 Data Management and Database Design

Course Information
Course Title: Data Management and Database Design
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Course Prerequisites

Course Description
Studies design of information systems from a data perspective for engineering and business applications; data modeling, including entity-relationship (E-R) and object approaches; user-centric information requirements and data sharing; fundamental concepts of database management systems (DBMS) and their applications; alternative data models, with emphasis on relational design; SQL; data normalization; data-driven application design for personal computer, server-based, enterprise wide, and Internet databases; and distributed data applications

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*

Required Tools and Course Textbooks

Books:
Jeffrey A. Hoffer, Ramesh, Heikki Topi
Modern Database Management Hoffer Database Management, Tenth Edition
Prentice Hall, [ISBN-13: 978-0-13-608839-4]

Dusan Petkovic (2016)
Microsoft SQL Server 2016: A Beginner's Guide, Sixth Edition McGraw
Hill, [ISBN: 978-1259641794]

Additional resources:
W3schools SQL Tutorial will be leveraged to develop basic SQL skills. This learning will be used to support more extensive SQL development enhancing the course objectives.

T-SQL Querying (Developer Reference) 1st Edition https://www.amazon.com/T-SQL-Querying- Developer-Reference-Ben-Gan/dp/0735685045

Software:
Students will need to download and install SQL Server database engine and SQL Server Management Studio to their local computers or in a cloud environment (Azure, Google, AWS etc). The Developer Edition of SQL Server 2019 is recommended. In addition to SQL Server

Course Schedule/Topics Covered

Week	Topic	Reading
Week 1	Introduction to Databases:	· What is a Database? · Purpose and Advantages of Databases. · Database Systems vs. File Systems.

Week 2	Data Models:	· Hierarchical Model. · Network Model. · Relational Model. · Entity-Relationship Model. · Object-relational Model. · NoSQL models (Document, Key-Value, Column-Family, Graph).
Week 3	Database Design and ER Modeling:	· Basic Concepts: Entity, Attribute, Relationship. · ER Diagrams. · Converting ER diagrams to Relational Models. · Normalization (1NF, 2NF, 3NF, BCNF). · Denormalization.
Week 4	SQL (Structured Query Language):	· Introduction to SQL. · DDL (Data Definition Language): CREATE, ALTER, DROP. · DML (Data Manipulation Language): SELECT, INSERT, UPDATE, DELETE. · SQL Joins, Sub-queries, and Set Operations. · Indexing and its importance. · Stored Procedures and Triggers. · Views and Transactions.
Week 5	Relational Database Management Systems (RDBMS):	· Overview and Architecture. · Examples: MySQL, PostgreSQL, Oracle, SQL Server. · ACID properties.
Week 6	Database Storage and Indexing:	· File Organizations: Sequential, Indexed, Hashed. · Indexing: Single-level, Multilevel. · B-trees and B+-trees. · Hashing Techniques.
Week 7	Mid-Term	
Week 8	Transaction Management:	· Transaction Concepts. · Concurrent Execution and Scheduling. · Locking and Concurrency Control. · Deadlocks: Detection, Prevention, and Recovery.
Week 9	Database Recovery:	· Recovery Concepts. · Logging Techniques: Undo, Redo, Undo/Redo. · Checkpoints.
Week 10	Database Security:	· Database Security and Authorization. · Grant and Revoke Commands. · Role-based Access Control. · Encryption and Public Key Infrastructure.
Week 11	NoSQL Databases:	· Overview and Need for NoSQL. · Types: Document, Key-Value, Column-Family, Graph. · Examples: MongoDB, Redis, Cassandra, Neo4j.

Week 12	Distributed Databases:	· Principles of Distributed Databases. · Fragmentation, Replication. · Distributed Query Processing.
Week 13	Emerging Topics:	· Big Data and Databases. · Cloud-based Databases. · Database as a Service. · In-memory Databases.
Week 14	Final Exam	
Week 15	Final Presentation	

Grading Scale

Work in this course will be graded to criteria. In other words, you will not be graded on a curve. Each assignment is designed to evaluate your achievement against one or more of the learning objectives. Different assignments emphasize different learning objectives. The meanings of grades are described below. Assignments balance between theory and practice and between individual and group work.

95-100% A	87-89.9% B+	77-79.9% C+	
	84-86.9% B	74-76.9% C	69.9% or below F
90-94.9% A-	80-83.9%B-	70-73.9% C-	

Evaluation:

Assignments balance between theory and practice and between individual and group work.

Assessment	% Grade
Mid-Term	20%
Final	30%
Participation	5%
Homework	10% 5 homeworks
Quizzes	10% 9 quizzes
Database project	25%

Database Project

Students will form teams of four and develop a relational database based on reading and class lectures. The project will have the following deliverables:

Deliverable	% of grade
P1. Topic and Objectives	3
P2. Database Design, Initial ERD	5
P3. Final ERD	5
P4. Database Implementation	7

| P5. Presentation | 5 |
| Total Project | 25% |

The rubrics for the project grading is Completeness 40%, Correctness 40%, and Creativity 20%.

Submission instruction:

Project submission instructions:

Please upload required project documents into Drive/GitHub and make the URL " public viewable " and share the URLs as Summary sheet (pdf or doc) on Canvas.

Your summary sheet should include links to all required documents submitted.

*One submission per team

P1. Topic and Objectives

Form a team of four members. Each team will collaborate to decide a database topic. The database topics may be like Book Store, University Registration, etc. Each team will also establish the mission statement and identify the mission objectives that the database will accomplish. The mission objectives may be like Book Sale, Inventory Control, etc.

Database Design and Initial ERD

Based on reading and class lectures, each team will create an initial Entity-Relationship diagram (ERD) that depicts a database for a real or fictitious business. This database will allow for data collection, processing, and reporting for an organization. It is strongly suggested that each team model a database for a type of organization that they have deep understanding---such as the current or previous work experience or a personal hobby. In the past, students have created databases to capture data about video rental stores, bike repair shops, beer tasting/review professionals, athletic leagues, and airlines. Students are encouraged to use their imagination!

Each team will submit an ERD for the database of their choosing. The target for the initial ERD is 10 entities or more. In addition to the ERD, students should submit a database design document containing the description of the business problems being addressed by their database, list all entities and how they are related to each other, and key design decisions.

For the part of the business problems being addressed, this section could be like the mission objective document completed earlier. Additionally, and more importantly, this document should contain your team's key database design decisions, such as why an entity is included and how that entity is related to other entities.

* Entity-Relationship Diagramming tool, Microsoft Visio or Toad Data Modeler can be downloaded for free. You may also use free tools such as: GitMind, Gliffy, Visual Paradigm, Draw.io, Lucidchart, SqlDBM, DBDiagram.io and QuickDBD

Final ERD

Based on the instructor's feedback of the initial ERD, each team will make improvements to the initial ERD. These changes will be regarding further 'normalization' of the database entities, reducing redundant data, and recognizing additional entities.

In addition to submitting a fine-tuned ERD, each team will also submit a brief description identifying the changes made to the initial ERD. It is also important to update the design document to reflect the modern design changes. Resubmission of the updated design document is not required at this time.

Database Implementation

Each team will submit the 'SQL code' to implement the database design as well as enter a minimal amount of data (at least ten rows for each table) using the SQL INSERT scripts, Data Import Wizard, and/or stored procedures. Specific objects to be reflected in the code include the database, tables, data types, primary and foreign keys, and views.

Each team is expected to create the following database objects:

- at least 3 stored procedures containing input and output parameters

- at least 3 views (often used for reporting purposes).

- At least 1 DML trigger

- at least 3 Table-level CHECK Constraints

- Computed Columns based on a user defined function (UDF)

- Column Data Encryption

- at least 3 non-clustered indexes

- Power BI /Tableau for data visualization

- Graphical User Interface (GUI) for CRUD operations a plus (optional)

* Submission instruction:
- Summary document summarizing what you have submitted

- 1 .sql file containing all DDLs for all database objects created.

- 1 .sql containing insert statements for data population

- A zipped file containing files used for GUI, dashboard, or reports

- PDFs showing images of data visualizations created

Project Presentation

Each team will present the database design project to the class. The presentation should include the following items.

1) A Power Point slide deck, containing highlights, to highlight the project

2) The design documents

3) The final ERD

4) Sample DDL statements for implementing the database (stored procedures, views, triggers)

5) Visualizations created (Using PowerBI/Tableau/SSRS)

6) Live demo of the project displaying the database, and the visualization layer

Attendance/Late Work Policy

Attendance Policy

Students are expected to complete course readings, participate in class discussions or other learning activities during the unit, and complete written assignments for each unit during the time of that unit. It is understood that there might be one week when active participation in ongoing class conversations and learning activities might be delayed.
Beyond one week time, if there is an absence or lateness in participation (1) faculty must be notified in advance; (2) grades will be adjusted accordingly.

Late Work Policy

Students must submit assignments by the deadline in Western time zone noted in the syllabus. Students must communicate with the faculty prior to the deadline if they anticipate work will be submitted late.
Work submitted late without prior communication with faculty will not be graded.

End-of-Course Evaluation Surveys
Your feedback regarding your educational experience in this class is particularly 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 Husky Mail 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.

University Health and Counseling Services

As a student enrolled in this course, you are fully responsible for assignments, work, and course materials as outlined in this syllabus and in the classroom. Over the course of the semester if you experience any health issues, please contact UHCS.

For more information, visit https://www.northeastern.edu/uhcs.

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 https://drc.sites.northeastern.edu.

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 https://library.northeastern.edu.

24/7 Canvas Technical Help
For immediate technical support for Canvas, call 617-373-4357 or

email help@northeastern.edu Canvas Faculty Resources: https://canvas.northeastern.edu/faculty-resources/

Canvas Student Resources: https://canvas.northeastern.edu/student-resources/

For assistance with my Northeastern e-mail, and basic technical support:

Visit ITS at https://its.northeastern.edu

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, members 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 **https://www.northeastern.edu/ouec** for a complete list of reporting options and resources both on- and off-campus.*