Cleveland State University

Department of Electrical Engineering and Computer Science

CIS 430/530 Database System and Processing (3-0-3)

Prerequisites: CIS 265

Instructor: Dr. Sunnie (Sun) Chung
Office Location: FH222 **Phone:** 216 687 4661 **Email:** sschung.cis@gmail.com
s.chung@csuohio.edu
Webpage: https://eecs.csuohio.edu/~sschung/

Office Hours: Will be announced on the class webpage each semester

Catalog Description: The course introduces fundamental concepts of relational database system (RDBMS) with design of relational databases and use of modern database systems. It explores a number of related subjects with database theory and practical design process for a conceptual Entity Relation (E-R) modeling of data, converting a conceptual E-R model to a relational database scheme, and Normalization in the Third Normal form. The course advances with practical uses of the relational database languages; Data Definition Language (DDL) to create database, Data Manipulation Language (DML) to write for insert, delete, update, and Sequel Query Languages (SQL) to retrieve information. The course also introduces database programming technologies with Stored Procedure, User Defined Functions (UDFs), Cursor, and Triggers. The course extends to modern database applications in distributed database systems with client server database programming - Embedded SQL, Dynamic SQL with Java Database Connectivity (JDBC)/Open Database Connectivity (ODBC) for building web applications with a database server as a backend system. The course also introduces advanced subjects of RDBMS with View and Transaction concept. The course also introduces subjects of the fundamental file system as physical data storages and index structures in relational database systems. Finally, the course advances with introduction of Semi-structured Database concept with XML if time permitted.

Key Concepts: Relational databases, SQL Server, ER Model, Conceptual Database Design, SQL, Complex SQL, View, Transaction, File Structure, Disk Storage System, Index, Database Programming, Stored Procedure, User Defined Function, Trigger, Distributed Client Server Database Programming, Web Service with Database Server, Java Database Connectivity (JDBC)/Open Database Connectivity (ODBC), Embedded SQL, Dynamic SQL.

Course Objectives: To study modern relational database systems for design and use of the database systems. To study modeling of data, converting conceptual data representations to a relational database scheme with normalization in the third normal form, and use of the relational database language SQL to create database and to write SQL statements for insert, delete, update and retrieve information. To study a View concept and database programming with Stored Procedure, User Defined Functions, and Triggers. To study to build modern database applications in distributed database systems - client server database programming with Embedded SQL, Dynamic SQL, and Java Database Connectivity (JDBC)/Open Database Connectivity (ODBC). Finally, to study Transaction concept for concurrency problems in distributed multi-user database systems, and file system that is used as physical data storages and database index structures for performance optimization.

Expected Outcomes:
Upon completion of this course, students should be able to:

1. Design and model conceptual data representations to a relational database scheme in normalization
2. Use of the relational database language SQL to create database and to write SQL statements for insert, delete, update and retrieve data
3. Use of Complex SQLs and Views
4. Study database programming with stored procedure, user defined functions (UDFs), and triggers

5. Study to build modern database applications in distributed database systems by writing client - server database programming with Embedded SQL, Dynamic SQL, and JDBC/ODBC
6. Study to build web service applications with a database server in JDBC/ODBC
7. Study a Transaction concept in a distributed multiuser database system
8. Study a file storage and index structures as access paths for optimization of performance of query processing

List of Required Materials:
1. Visual Studio 2019 or higher
2. SQL Server 2019 or higher
3. SQL Server Management Studio (SSMS) for Client Software

MS Software are available at the Microsoft Azure Portal site for Academic Alliance Program:
https://portal.azure.com/#home
The detailed Installation Instructions for the SQL Server and Client Software will be given in class.

Text:
1. "Fundamentals of Database Systems". Elmasri / Navathe. 7th Edition (2015). Addison/Wesley Pub Co. ISBN-13: 978-0133970777 ISBN-10: 0133970779

2. Selected Lecture Notes from Relational Database Systems and Database Industry Online Manuals on the Class Webpage:
The Link to this Class Webpage for Each Semester is given on the Class Blackboard.
You can access the class website from my webpage at https://eecs.csuohio.edu/~sschung/, then choose **Teaching -> CIS 430/530 Link**

Supplement Text:
Database Management Systems 3rd Edition by Raghu Ramakrishnan and Johannes Gehrke. Ed. McGraw-Hill.

Official Academic Calendar

Please consult the university academic calendar for the semester and the final exam schedules at:
https://www.csuohio.edu/registrar/academic-calendar

Grading: The course grade is based on a student's overall performance through the entire Semester. The final grade is distributed among the following components:
Required:
Exams 45%: Midterm 20% and Final (Comprehensive) 25 %
Class Attendance: 5 %
Computer Labs 50% (6-7 lab assignments)

Extra Project and/or Extra Assignments will be given for the students who are in CIS530 or honor students in a contract course.

Optional: Extra Project and/or Extra Assignments may be given for the students who want to outperform.

CIS 430 and CIS 530 will be graded separately.
Note that I have a right to change the weight of each labs and exams to adjust the difference of progress of the class in each semester.

CIS 430 Grading Standard:

A	94% +	A: Outstanding (student's performance is genuinely excellent)
A-	90% - 93%	
B^+	88% - 89%	

B	82% - 87%	B: Very Good (student's performance is clearly commendable but not necessarily outstanding)
B-	80% - 82%	
C	70% - 79%	**C**: Good (student's performance meets every course requirement and is acceptable; not distinguished)
D	65%-70%	D: Below Average (student's performance fails to meet course objectives and standards)
F	<65%	F: Failure (student's performance is unacceptable)

CIS 530 Grading Standard:

A	94% +	A: Outstanding (student's performance is genuinely excellent)
A-	90% - 93%	
B^+	88% - 89%	
B	82% - 87%	B: Good (student's performance meets every course requirement and is acceptable; not distinguished)
B-	80% - 82%	B-: Below Average (student's performance is short to meet course standard)
C	70% - 79%	**C**: Below Minimum Requirements (student's performance fails to meet course objectives and standards)
F	<70%	F: Failure (student's performance is unacceptable)

Examination Policy: The one note page is not allowed to the midterm exam. Students are allowed to bring to the final exam a summary page (standard letter size) with their own notes. During the exams: (1) the use of books, cell phones, calculators, or any electronic devices is prohibited, and (2) students must not share any materials.

Make-Up Exam Policy: No makeup exams will be given unless notified and agreed to in advance. Requests will be considered only in case of exceptional demonstrated need.

Homework Policy: The students are expected to attend all classes. The class attendance will be counted toward the grade. The students are responsible for collecting the notes, handouts and any other course material distributed during the class period. All assignments must be individually and independently completed and must represent the effort of the student turning in the assignment. Should two or more students turn in *substantially the same solution* or output, in the judgment of the instructor, the solution will be considered group effort. All involved in group effort homework will receive a zero grade for that assignment. A student turning in a group effort assignment more than once will automatically receive an "F" grade for the course.

Plagiarism: All assignments and group project must be completed by the student and must represent the effort of the student turning in the assignment. Should a student turn in *substantially the same solution* or output from taking someone else's work or ideas and passing them off as one's own, in the judgment of the instructor, the solution will be considered as a plagiarism, the student will receive a zero grade for that assignment. A student turning in plagiarized assignment more than once will automatically receive an "F" grade for the course.

Late Assignment: All lab assignments are due at the beginning of class on the date specified. Laboratory Assignments handed in after the class has begun will be accepted with a 25% grade penalty for up to a week and then not accepted at all. All laboratory assignments must be completed. *Failure to do so will lower your course grade one additional letter grade.*

Student Conduct: Students are expected to do their own work. Academic misconduct, student misconduct, cheating and plagiarism will not be tolerated. Violations will be subject to disciplinary action as specified in the CSU Student Conduct Code. A copy can be obtained on the web page at: http://www.csuohio.edu/studentlife/StudentCodeOfConduct.pdf or by contacting Valerie Hinton Hannah, Judicial Affairs Officer in the Department of Student Life (MC 106 email v.hintonhannah@csuohio.edu).

For more information consult the following web page *CSU Judicial Affairs* available at
http://www.csuohio.edu/studentlife/jaffairs/faq.html
https://www.csuohio.edu/sites/default/files/3344-21-02_Academic_Misconduct_Policy_Compliance.pdf
Contract Course Requirement for Honor Students: Honor Students in a Contract Course should complete at least 2 out of 3 of the followings:

1. Extra Project
2. One of Extra Lab Assignments
3. One of Extra Exercises

ADA Adherence: If you need course adaptations or accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible. My office location and hours are listed on top of this syllabus. If you need further information, please contact the Office of Disability Services (Main Classroom 147), phone number 216.687.2015, on the web at http://www.csuohio.edu/offices/disability/

Health and Safety: The COVID-19 pandemic is still present and serious, especially with the Delta variant. While you are in class on campus, you are required to have a properly worn mask regardless of vaccination status, always cough or sneeze into your elbow or tissue, and adhere to other public safety protocols and directives for your specific classroom/lab/studio. Students who do not follow these health and safety requirements will be instructed to leave class immediately. If you violate this protocol, you will need to leave the classroom and MAY be marked absent. Repeated violations of these health-saving protocols may lead to sanctions under the Student Code of Conduct (3344-83-04 [E] and [Z]) up to and including suspension or expulsion. Students with medical conditions that prevent them from wearing a mask should register with the Office of Disability Services to explore reasonable accommodation options as soon as possible. To register with the office, please visit their webpage at: https://www.csuohio.edu/disability/register. The CSU community thanks you for your cooperation!

Course Schedule: The schedule of topics to be covered is given below. The schedule and topics covered may vary depending upon the progress made. Please see the class website for the detailed schedule of the subjects to be covered.

Tentative Course Schedule is as follow:
(Please See the Class Webpage for More Updated Contents and Recent Schedules)

1-2 **Chapter 1 - Databases and Database Users** Elmasri. Chp. 1, 2

- 1.1 Introduction
- 1.2 An Example
- 1.3 Characteristics of the Database Approach
- 1.4 Actors on the Scene
- 1.5 Workers behind the Scene
- 1.6 Advantages of Using the DBMS Approach
- Difference between Data and Information/ Knowledge
- 1.7 A Brief History of Database Applications
- 1.8 When Not to Use a DBMS
- 1.9 Summary

Chapter 2 - Database System Concepts and Architecture

- 2.1 Data Models, Schemas, and Instances
- 2.2 Three-Schema Architecture and Data Independence
- 2.3 Database Languages and Interfaces
- 2.4 The Database System Environment
- 2.5 Centralized and Client/Server Architectures for DBMSs
- 2.6 Classification of Database Management Systems

PrepLab for Lab Assignments:

1. Installing a SQL Database Server
2. How to Use SQL Server and Client – SQL Server Management Studio

Lab Assignment 1:

Basic Database Table Creation

Basic Data Types for Columns of Tables in a Database Server

2-4 **Chapter 3 - Data Modeling Using the Entity-Relationship (ER) Model** Elmasri Chap 3,4 Lecture Notes

- 3.1 Using High-Level Conceptual Data Models for Database Design
- 3.2 An Example Database Application
- 3.3 Entity Types, Entity Sets, Attributes, and Keys
- 3.4 Relationship Types, Relationship Sets, Roles, and Structural Constraints
- 3.5 Weak Entity Types
- 3.6 Refining the ER Design for the COMPANY Database
- Normalization Theory: First and Third Normal Form
- 3.7 ER Diagrams, Naming Conventions, and Design Issues
- 3.8 Example of Other Notation: UML Class Diagrams

Chapter 7 - The Enhanced Entity-Relationship (EER) Model

- 7.1 Subclasses, Superclasses, and Inheritance
- 7.2 Specialization and Generalization
- 7.3 Constraints and Characteristics of Specialization and Generalization Hierarchies
- 7.4 Modeling of UNION Types Using Categories
- 7.5 An Example UNIVERSITY EER Schema, Design Choices, and Formal Definitions
- 7.6 Example of Other Notation: Representing Specialization and Generalization in UML Class Diagrams
- 7.7 Data Abstraction, Knowledge Representation, and Ontology Concepts

Lab Assignment 2_1:

Data Modeling Using the Entity-Relationship Model

ER- Modeling, Database Design

5 – 8	**Chapter 4 - SQL-99: Schema Definition, Constraints, Queries, and Views** • 4.1 SQL Data Definition and Data Types • 4.2 Specifying Constraints in SQL • 4.3 Schema Change Statements in SQL • 4.4 Basic Queries in SQL • 4.5 More Complex SQL Queries • 4.6 INSERT, DELETE, and UPDATE Statements in SQL **Lab Assignment 2_2**: Build Company Database Creation of Schema and Population of the Database and Run SQLs over Company Database **Lab Assignment 3**: Run SQLs over Company Database **Chapter 5 – Complex SQL** • 5.1 Correlated Subquery • 5.2 IN/NOT IN, EXISTS/NOT EXISTS • 5.3 Aggregate Functions • 5.4 GROUP BY, HAVING • 5.5 Subquery in FROM Clause • 5.6 GRANT/REVOKE • 5.7 Additional Features of SQL • 5.8 Summary **Lab Assignment 4**: Retrieve Complex SQLs over Company Database **Lab Assignment 5**: Create Views and Make Use of it for Database Applications **Chapter 6 - The Relational Algebra and Relational Calculus** • 6.1 Unary Relational Operations: SELECT and PROJECT • 6.2 Relational Algebra Operations from Set Theory • 6.3 Binary Relational Operations: JOIN and DIVISION • 6.4 Additional Relational Operations • 6.5 Examples of Queries in Relational Algebra **Extra Exercise** on Relational Algebra on DIVISION	Elmasri – Chap5, 6 Lecture Notes
9 - 11	**Introduction to Database Programming:** Data Types; Conditional and Flow Control Statements; Cursor Stored Procedure	Chap 14, 15 Lecture Notes

User Defined Function (UDF), User Defined Type (UDT)
Table Function
Embedded SQL
Dynamic SQL
Java Database Connectivity (JDBC)/
Open Database Connectivity (ODBC)

Lab Assignment 6: Create System Triggers and Stored Procedure to implement application related business rules

Extra Lab Assignment6: Implementing Table Function Using Stored Procedure and Cursor

12-13	• Implementing Constraints as Triggers • Implementing Views (Virtual Tables) in SQL • Transactions, COMMIT, ROLL BACK, and Dealing with Constraint Violations	Chap 10 Lecture Notes
14	• Web Programing with PHP	Lecture Notes

Extra Project: Building a Web Service Application on WAMP Server using PHP and Mysql

15	**Disk Storage, Basic File Structures, and Hashing** • 13.1 Introduction • 13.2 Secondary Storage Devices • 13.3 Buffering of Blocks • 13.4 Placing File Records on Disk • 13.5 Operations on Files • 13.5 Operations on Files • 13.6 Files of Unordered Records (Heap Files) • 13.7 Files of Ordered Records (Sorted Files) • 13.8 Hashing Techniques • 13.9 Other Primary File Organizations • 13.10 Parallelizing Disk Access Using RAID Technology • 13.11 New Storage Systems • 13.12 Summary	Elmasri Chap17
16-17	**Indexing Structures for Files** • 14.1 Types of Single-Level Ordered Indexes • 14.2 Multilevel Indexes • 14.3 Dynamic Multilevel Indexes Using B-Trees and B+-Trees • 14.4 Indexes on Multiple Keys • 14.5 Other Types of Indexes • 14.6 Summary	Elmasri Chap18

Extra **Introduction of Semi-Structured Database**

NOTE: The instructor reserves the right to retain, for pedagogical reasons, either the original or a copy of your work submitted either individually or as a group project for this class. Students' names will be deleted from any retained items.