CS 631: Data Management System Design

Fall 2024 – Dr. Canan Eren

Prerequisites: Knowledge of C and Data Structures

Objective

The objective of the course is to provide an introduction to modern database systems. It focuses on the following issues: data models, conceptual data modes, the Entity-Relationship model, the Relational model, formal database query languages, Relational Algebra, the standard database language SQL, external hashing and indexing, formal database design theory, functional dependencies and normal forms, and transaction processing.

The students will learn how to design and create and then query and update a database through a small project. They will get hands-on experience with modern database management systems using the standard database language SQL.

Course (learning) outcomes

- **LO1:** Understand the data requirements of contemporary organizations and how database management systems meet them
- **LO2:** Develop conceptual data model specifications
- **LO3:** Design and implement database applications
- **LO4:** Understand how data is stored, retrieved, and maintained in different types of databases
- **LO5:** Gain experience with the existing database management systems

Time and Place

Tuesday: 1:00-3:50 PM, TIER LECT1

Instructor

Dr. Joann (Canan) Eren

Office: **GITC 4212**
Office hours: Tuesday: 4:00 – 4:40 PM
Send me an email to schedule an online meeting.

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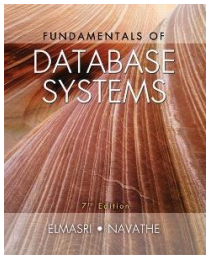
Textbooks

Fundamentals of Database Systems, 7th Edition,
R. Elmasri and S.B. Navathe
Pearson, © 2016.
ISBN-10: 0-13-397077-9
ISBN-13: 978-0-13-397077-7



COURSE OUTLINE – Topics to be covered in the course

	Chapters in Text Book	**Content**
Week 1	1, 2	**BASIC CONCEPTS** - GENERALITIES ABOUT DATABASES Introduction to databases. Database users Database systems concepts and architecture. Data models. *ASSIGNMENT 1*
Week 2, 3	3, 4	**CONCEPTUAL MODELING, DATABASE DESIGN** The Entity Relationship (ER) model The Enhanced Entity Relationship (EER) model *ASSIGNMENT 2*
Week 4	5, 9	**FROM CONCEPTUAL MODELS TO LOGICAL MODELS** Mapping ER and EER diagrams to Relational schemas *ASSIGNMENT 3*
Week 5, 6	8	**THE RELATIONAL MODEL:** CONCEPTS AND FORMAL QUERY LANGUAGES Basic Definitions, Integrity Constraints, Update Operations Relational Algebra Relational Algebra Example Queries *ASSIGNMENT 4*
Week 7		**Midterm**
Week 8, 9	6, 7	**SQL: A STANDARD DATABASE LANGUAGE** Basic Queries Complex Queries, Aggregate Functions, and Grouping Data Change Statements, Views, and Complex Constraints
Week 10	10	Using SQL in an application - Database programming
Week 11, 12	14, 15	**FORMAL DATABASE DESIGN THEORY** Functional dependencies (FDs), Inference of FDs, Normal forms *ASSIGNMENT 5*
Week 13	16, 17	**DATABASE PHYSICAL ORGANIZATION** File Organizations Indexing
Week 14	18	Query Evaluation, Query Optimization

		FINAL

Course organization

- The slides for each lecture are available before the class. A good practice is to read from your book the material to be taught in class and to come prepared.
- Five homework assignments will be given containing exercises on selected topics. Their solutions will be covered during the class hours.
- You will work in groups on a project which has three deliverables during the semester. A project demonstration (or video) is required for the last deliverable of the project.
- There will be two exams: a midterm halfway through the semester, and a final on the last day of the class.
- Lecture slides, exercises, homework assignments, and project requirements will be available for downloading in due time on this web page. Important announcements will be also placed on it. Bookmark the course web page. It is a "living document" and you have to visit it at least once a week.

Homework assignments

There will be five homework assignments. If you work reasonably on them you will get all the points. Solutions are provided for you to compare with your solutions.

Project

A project to design and implement a simple database system using a modern database management system will be assigned. It will proceed progressively through different steps. The methodology for database development learned in class should be used.

Project groups

Groups of at most 2 students are required. You can choose the classmates you want to work with. You can also work by yourselves if you prefer.

Project description and deliverables: The project has three deliverables.

> Deliverable 1: A possible solution E/R diagram (I suggest that you use this one for the second phase of the project).

Deliverable 2: A possible solution Relational Schema for Phase 2. (I suggest to use this one for the third phase of the project).

Deliverable 3: Presentation and final report.

Submissions and Late policy

The **five homework assignments** and **all 3 project deliverables** should be submitted on or before the day and time they are due **through Canvas**. Every Canvas submission should be a **SINGLE FILE** in **MS word** or **PDF** format **only**.

Late submissions will not be accepted or will get penalties.

MIDTERM and FINAL exams

All exams will be conducted in person and composed of several exercises/questions to be answered.

Make-up Exams:
Make-up exams need to be approved by the Instructor.
Consideration will be given to those students who contact me before the exam (via e-mail or phone) and provide a valid, documented reason for missing the exam.

Grading

The midterm, the assignments, the project, and the final exam contribute to the course grade as follows:

Midterm	25%	
Project	30%	Deliverables and demonstration
Assignments	10%	Five assignments
Final	35%	

Attendance and Participation

You are supposed to attend all the classes. Participation is highly encouraged to make the class more interactive. Class attendance and participation are taken into consideration by the instructor for the evaluation of the students. Experience shows that students who do not attend the classes do not perform well in the midterm and final exams. If you miss one class be sure to consult one of your classmates about the content of the lecture and visit the course web page to get notes, exercises, assignments, deadlines and announcements.

Academic Integrity

"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. ***Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.*** *If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"*

Recommended other books (not required)

INTRODUCTORY DATABASE TEXTBOOKS

- Jeffrey D. Ullman, Jennifer Widom:
  A First Course in Database Systems, 3rd Edition
  Prentice Hall, © 2008.

- Michael Kifer, Arthur Bernstein and Philip Lewis:
  Database Systems: An Application-Oriented Approach, Introductory Version, 2nd Edition
  Addison-Wesley, © 2006.

GENERAL DATABASE TEXTBOOKS

- Raghu Ramakrishnan, Johannes Gehrke:
  Database Management Systems, 3rd Edition
  WCB/McGraw-Hill, © 2003.

- Michael Kifer, Arthur Bernstein and Philip Lewis:
  Database Systems: An Application-Oriented Approach, Complete Version, 2nd Edition
  Addison-Wesley, © 2006.

- Abraham Silberschatz, Henry F. Korth, S. Sudarshan:
  Database System Concepts, 6th Edition
  McGraw-Hill , 2010.

- C. J. Date:
  An Introduction to Database Systems, 8th Edition
  Addison-Wesley, © 2004.

DATABASE THEORY

- Serge Abiteboul, Richard Hull, Victor Vianu:
  Foundations of Databases: The Logical Level.
  Addison-Wesley, 1995.

DBMS IMPLEMENTATION

- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom:
  Database Systems, The Complete Book 2nd Edition.
  Prentice-Hall, © 2009.

SQL

- A lot of resources online.

Links

ACM SIGMOD
IEEE TCDE
The VLDB Endowment
The EDBT Endowment
DBLP - Database and Logic Programming Bibliography

Interactive Online SQL Training
Advanced Online SQL Training