Department of Computer Science

CS 331: Database System Design and Management

Fall 2024

Prerequisite: CS 114 or equivalent

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.

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

Course (learning) outcomes

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

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.
- After the theory on a certain topic is presented, you can download the corresponding questions and exercises you should try to solve. Most of them are discussed in class in subsequent lectures.
- Five homework assignments will be given containing exercises on selected topics.
- You will work in groups on a project with three to four deliverables during the semester. A project demonstration 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, project requirements, and other material will be available for download in due time on this web page. Important

announcements will also be placed on it. Bookmark the course web page. It is a "living document," and you must visit it at least once a week.

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Time and Place

Tuesday: 8:30 AM - 9:50 AM

Thursday: 8:30 AM - 9:50 AM

CULM LECT 2

Instructor

Naren Khatwani

Office hours:

Thursday (11 am - 1 pm) GITC - 4325
(Office hours are not valid on the Reading day, during exam periods, holidays, and breaks)

If you cannot meet my office hours, email me to schedule an appointment.

Web page: https://narenkhatwani.com/

Email: nk88@njit.edu

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

Attendance and Participation

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

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

Project groups -

Groups of at most 3 students are required. You can choose the classmates you want to work with. You can also work by yourself if you prefer. To form a group, you must complete a form on the class Canvas page. If you do not express any preference, I will put you in a group randomly.

Project phases

The project has three deliverables. Each group must contact the TA to fix an appointment to demonstrate the final application (see lecture schedule above).

Example solutions for the project:

A possible solution E/R diagram for Phase 1 (I suggest you use this one for the project's second phase).

A possible solution is the relational schema for Phase 2. (I suggest using this one for the project's third phase).

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 is in MS Word or **PDF** format **only**. **No hard copies or handwritten assignments will be accepted.**

Late submissions will not be accepted or will get penalties.

Grading:

Midterm	25%	
Project	25%	Deliverables and demonstration
Assignments	10%	Four assignments
Attendance and Class Participation	5%	
Final	35%	

Course Outline:

Topics to be covered in the course

BASIC CONCEPTS - GENERALITIES ABOUT DATABASES Introduction to databases and Database users Database systems concepts and architecture and Data models.
CONCEPTUAL MODELING, DATABASE DESIGN The Entity Relationship (ER) model The Enhanced Entity Relationship (EER) model
THE RELATIONAL MODEL: CONCEPTS AND FORMAL QUERY LANGUAGES Basic Definitions, Integrity Constraints, Update Operations Relational Algebra Relational Algebra Example Queries
FROM CONCEPTUAL MODELS TO LOGICAL MODELS Mapping ER and EER diagrams to Relational schemas
SQL: A STANDARD DATABASE LANGUAGE Data Definition, Basic Integrity Constraints, Schema Changes, Basic Queries Complex Queries, Aggregate Functions, and Grouping Data Change Statements Views and Complex Constraints Using SQL in an Application Database Programming
FORMAL DATABASE DESIGN THEORY Functional dependencies (FDs), Inference of FDs, Normal forms

DATABASE PHYSICAL ORGANIZATION

File Organizations

Indexing

MIDTERM and FINAL exams

The midterm and final exams will comprise 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.

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*

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

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.