Spring 2023

CS 331: Database System Design & Mgmt

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New Jersey Institute of Technology
Department of Computer Science

Spring 2023 Section 004
Michael Renda

Mon/Wed 10:00 – 11:20pm, Kupf 207
Prerequisite(s): CS 114 or equivalent.

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All Email communication between students and faculty should be accomplished using NJIT Email accounts.

# CS 331 Database System Design and Management

The objective of the course is to introduce 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, the Relational algebra, the standard database language SQL, external hashing and indexing, formal database design theory, functional dependencies and normal forms, and transaction processing.

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

- 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 existing database management systems.

Required Textbook(s):
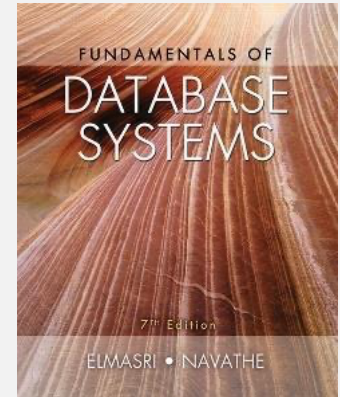
Fundamentals of Database Systems, 7th Edition, R. Elmasri and S.B. Navathe Pearson, © 2016.

Recommended other books (not required):

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

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 which you should try to solve. Most of them are discussed in class in subsequent lectures.
- Six homework assignments will be given containing exercises on selected topics.
- You will work in groups on a project which has three deliverables during the semester. A project demonstration is required for the last deliverable of the project.

Attendance and Participation:

Students are expected to attend all classes. Absence does not excuse a student from the responsibility for class work or assignments that are missed. Class attendance and participation are taken into consideration by the instructor for the evaluation of students. Experience shows that students who do not attend classes do not perform well in the midterm and final exams.

If you miss a class, be sure to consult one of your classmates about the content of the lecture and visit the course area in Canvas to get notes, exercises, assignments, and announcements.

Classroom Conduct Policies:

- **Turn off cell phones during class**
- **No food or drink are allowed in class**
- **No surfing the Internet, instant messaging, or visiting any social network during lecture**
- **Raise your hand and wait to be recognized**
- **Academic Integrity**

Homework Assignments

There will be six homework assignments. If you work reasonably on them, you will get all the points

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

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.*

Instructor's Syllabus Statement

This syllabus is subject to change due to student interests, special needs, cancellations, or instructor's decision.

Finally, Welcome. Explore your text options, make sure you have reliable technology, explore the online technology we will be using, and enjoy the adventure.

Groups of at most 3 students are required. You can choose the classmates you want to work with. You can also work by yourselves if you prefer. Once you have formed a group, you must fill a form available in class or in my office during office hours. If you do not express any preference, I will put you in a group randomly.

Project phases
The project has three deliverables:
- An E/R diagram
- A Relational Schema
- A set of working SQL statements that demonstrate the creation, update, and use of the designed database. In addition, the final report will demonstrate the proper analysis and design of the database in 3rd normal form. Each group needs to contact the TA to fix an appointment for demonstrating the final deliverable.

Submissions and Late policy
Homework assignments and all 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 unless otherwise specified.
Late submissions will not be accepted or will get penalties.

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

Peer Tutoring
YWCC maintains an active program of peer tutors. The tutors for any course have received a grade of A for that course. Most of the undergraduate tutors offer assistance with CS 331. You can find a complete list of tutors and their availability at Undergraduate Tutoring. In addition, there is tutoring available for the graduate level of this course – CS 631. Any of those tutors should also be able to help for this course as well. The schedule is available at Graduate Tutoring.

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

Midterm	30%	
Project	25%	Deliverables and demonstrations
Assignments	10%	Six assignments
Final	35%	

The letter grade is based on the overall course score.

Grade Formula						
Grade	A	B+	B	C+	C	D
Overall Course Score Cutoff	90	85	80	75	70	60

Course Outline

BASIC CONCEPTS - GENERALITIES ABOUT DATABASES
    Introduction to databases. Database users
    Database systems concepts and architecture. 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 Organization
    Indexing

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"

Accommodations

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of the Office of Accessibility Resources & Services (OARS), Kupfrian Hall 201, to discuss your specific needs. A Letter of Accommodation Eligibility from the OARS authorizing your accommodations will be required.