# CMPSC 431W
# Database Management Systems

Catalog Data:

Database Management Systems (3)
Database system concepts: file organizations and retrieval algorithms; the three data models (relational, hierarchical, and network) and their database implementations.
Prerequisite: CMPSC 221; ENGL 202C.

Typical Textbook:

R. Ramakrishnan and J. Gehrke, *Database Management Systems*, 3rd Edition, McGraw-Hill Publisher.

Course Objectives:

This course provides an introduction to the design, use, application, broad knowledge, and concepts of database management systems. Topics covered include the Entity-Relationship modeling; relational data model and query languages (e.g. Relational Algebra, and SQL); database and internet applications; schema design and normalization theory for relational databases; file organization and retrieval algorithms: Query optimization techniques; transaction management, and physical database design and tuning.

Primary Course Outcomes:

This course is designed to be beneficial to students in computer science major and others interested in studying the development of software applications with large data management requirements. Upon completion of the course, students should possess the following skills:

- Analyze requirements of large-scale database applications.
- Develop entity-relational data models based on requirement analysis.
- Develop relational database designs and refine the schema based on normalization theory.
- Develop algorithms and data structures from software specifications.
- Develop computer code.
- Identify and correct software faults.
- Develop database and Web applications.
- Write clear and effective technical prose for a technical audience.
- Demonstrate independent learning by using unfamiliar computer systems and software tools to solve technical problems.
- Demonstrate an ability to work effectively in interdisciplinary teams.
- Be able to discuss major trends in industry and research activity within disciplines of databases and Web technology.
- Speak clearly and persuasively about technical subjects in large and small group settings.

Relationship to Undergraduate Program Outcomes:

CMPSC 431W supports the following Program Outcomes:

- Develop a modest (on the order of a thousand lines of code) software application, using appropriate data structures and algorithms.
- Write clear and effective technical prose.
- Demonstrate independent learning by using unfamiliar computer systems, test equipment, and software tools to solve technical problems.
- Demonstrate an ability to work effectively in multi-disciplinary teams. The term multi-disciplinary is used here in the broader sense to include teams of computer professional having different skills; e.g., one team member might be familiar with web development, whereas another might have experience with microprocessor systems.

Required Topics:

- Relational Database
  - Introduction to DBMSs
  - Relational Database Model
  - Structure
  - Creating, Deleting, and Modifying Relations/Tuples
  - Integrity Constraints
  - Relational Algebra
  - SQL Language
  - Data Definition Language (DDL)
  - Data Manipulation Language (DML)
  - Queries (simple, nested, Aggregate Ops,…)
  - Integrity Constraints
  - Null Values
  - Views
- Conceptual Database Design
  - Semantic Modeling – ER Model
  - Mapping ER to Relational
  - Schema Refinement
  - Data Dependencies
  - Normal Forms
  - Decomposition
  - Normalization
- Physical Database Design
  - Data Storage
  - Magnetic Disks
  - File Organization and Indexing
  - Tree Structured Indexing
  - Hash-Based Indexing
  - Performance Evaluation
  - Relational Operators
  - Select, Project, and Join
  - Query Optimization
  - Physical Database Design and Tuning
- Transaction Management
  - Concept of Transactions
  - ACID Properties of Transactions
  - Concurrency Control
  - Transaction Schedules
  - Serializability

Class Format: Three lectures per week - 50 minutes per lecture.

Professional Component: CMPSC 431W is a senior elective that introduces students to database management systems and design. Students complete a team project, which require them to perform application requirement analysis, database design, schema normalization, write SQL programs to create, manipulate, and access a database, and write JSP codes to implement the specified Web/database application. Projects are completed within a UNIX environment. In addition to learning about databases, students develop programming skills in database systems, in particular, the use of the SQL relational query language and web programming under the popular Oracle SQL *Plus tool and JSP. In the course project, students will create a relational database, then populate it with the given sample data, and finally access, query and update this database. Students also are required to discuss projects in groups and make presentations in class. They are also required to present their designs and findings in a clear and well-written document (~25 pages). As such, CMPSC 431W satisfies the University's "writing across the curriculum" requirement. CMPSC 431W is an elective course for Computer Science majors.

Evaluation: Final grades computed based on 100 points:

- 50 points: Exams (two midterms and a final exam)
- 35 points: Team Projects
- 12 points: Homework Assignments
- 3 points: Quizzes

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Last Revised: May 31, 2007