Database Systems: Concepts, Design, and Implementation
ISE 382 (4 Units)
Spring 2024

Course Description

Data model for industry applications. Modeling and designing robust databases. Implementing and querying databases with SQL. Innovations in database applications.

Objectives

To prepare students to model and build databases. Upon completion of the course, you will be able to:
- Create relational data models
- Perform normalization to eliminate anomalies
- Convert models to functioning databases
- Use Structured Query Language (SQL) to build and query databases
- Demonstrate effective use of database management systems such as
  - Microsoft Access
  - MySQL DBMS
  - MongoDB
- Test and validate database implementation with transactions
- Explain how database transactions are controlled in multiuser environments
- Describe database security and maintenance
- Describe the innovations and uses of databases in diverse applications

Instructor

Reza Jafarkhani   jafarkha@usc.edu

Lecture

MW 10:00 am – 11:50 am (PT) DMC 260 (Zoom)

Office hours

TTh 2:30 pm – 3:30 pm (PT)   RRB 211 (Zoom)

Discussion

F 9:00 am – 10:20 am (PT)   VHE 210
F 10:30 am – 11:50 pm (PT)   VHE 210

Course Producers / Email / Office Hours

Menna Elamroussy   elamrous@usc.edu   TBD
Rachel Xu   ruijingx@usc.edu   TBD

Website

blackboard.usc.edu
All lecture notes, assignments, news, announcements and grades will be posted on Blackboard. Students are expected to check Blackboard regularly. Students can customize their personal notification settings in Blackboard to be notified of class updates.

piazza.com
The preferred way to communicate with the instructor and CPs is posting on Piazza (http://piazza.com). All the students, instructor, and CPs will have access to the same class on Piazza. Information about accessing Piazza is available on Blackboard. If you have questions about assignments, labs, tests, and other aspects about this course, please post on Piazza. You can make public posts which all members can see and answer or private posts which are only accessible to instructors and CPs.

Software

Several software tools will be used in this class. All software will be available remotely (via Viterbi Virtual lab)
- Microsoft Excel
- Microsoft Word
- Microsoft Access
- MySQL Database
- MySQL Workbench
- Erwin Data Modeler
- MongoDB

Textbook

Database Systems: Design, Implementation, & Management
Authors: Carlos Coronel, Steven Morris
ISBN-10: 0357673034
ISBN-13: 978-0357673034

Grading

The weight of graded material during the semester is listed below.

Homework	40%
Projects	15%
Exam 1	20%
Exam 2	25%

Grading Scale

The following shows the grading scale to be used to determine the final letter grade.

A	$93 \leq G$
A-	$90 \leq G < 93$

$$B+ \quad 87 \leq G < 90$$
$$B \quad 84 \leq G < 87$$
$$B- \quad 81 \leq G < 84$$
$$C+ \quad 78 \leq G < 81$$
$$C \quad 75 \leq G < 78$$
$$C- \quad 72 \leq G < 75$$
$$D+ \quad 69 \leq G < 72$$
$$D \quad 66 \leq G < 69$$
$$D- \quad 63 \leq G < 66$$
$$F \quad 63 \; or \; below$$

Projects

There will be group project. Teams of 2 students each will be formed mid semester.

Grading of projects: Each project score will be divided into three parts.

Implementation	40%
Completion and correctness	40%
Evaluation	20%

Policies

No make-up exams (except for documented medical or family emergencies) will be offered nor will there be any changes made to the Final Exam schedule, except as permitted by university rules. It is the responsibility of the student to make sure projects and assignment are turned in on time. Make sure you follow the procedures outlined in each assignment or project.

Students are responsible for completing individual assignments and their fair share of team assignments by stated deadlines. Late assignment submissions will be subject to a late penalty. Assignments turned in late will have 25% of the total points deducted from the graded score for each late day up to 3 days. No assignments will be accepted later than 72 hrs from the due date. You will have 3 "grace days" for the semester. i.e., no late penalty on HW for a cumulative 3 days. No grace days are available for Project.

Students have one week to contest a grade once it has been posted on Blackboard. After this one week, the grade will not be changed. To contest a grade, create a private post on Piazza and select the grades folder. In the post, include your name, the assignment name, and your reasons.

Incomplete and Missing Grades

Excerpts for this section have been taken from the University Grading Handbook, located at http://www.usc.edu/dept/ARR/grades/gradinghandbook/index.html. Please see the link for more details on this and any other grading concerns.

A grade of Missing Grade (MG) "should only be assigned in unique or unusual situations… for those cases in which a student does not complete work for the course before the semester ends. All missing grades must be resolved by the instructor through the Correction of Grade Process. One calendar year

is allowed to resolve a MG. If an MG is not resolved [within] one year the grade is changed to [Unofficial Withdrawal] UW and will be calculated into the grade point average a zero grade points.

A grade of Incomplete (IN) "is assigned when work is no completed because of documented illness or other 'emergency' **occurring after the twelfth week** of the semester (or 12ᵗʰ week equivalency for any course scheduled for less than 15 weeks)."

Statement on Academic Conduct and Support Systems

Academic Conduct:
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Student Accessibility Services
Provides certification for students with disabilities and helps arrange relevant accommodations. http://osas.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu

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January 8: Lecture 1 - Introduction
- Brief history of databases and their role in information systems
- Different types of databases and their organizational context
- Survey of DBMS

Reading Assignment: *Chapter 1*

January 10: Lecture 2 - Data Modeling
- Overview of Data Models
- Business Rules
- Relational data model

Reading Assignment: *Chapter 2*

January 15: **MLK Birthday (No Class)**

January 17: Lecture 3 – Data Modeling contd.
- Entities
- Attributes
- Relationships

Reading Assignment: *Chapters 2 and 3*

January 22: Lecture 4 – Data Modeling contd.
- Keys: Primary, Foreign, candidate, surrogate, super
- Minimum and maximum cardinality
- Relationship strength: Identifying and non-identifying

Reading Assignment: *Chapter 3*

January 24: Lecture 5 – Entity-Relationship diagrams
- ER diagrams for modeling business requirements
- Degrees of relationships
- Associative entities

Reading Assignment: *Chapter 4*

January 29: Lecture 6 – Entity-Relationship Models contd.
- Subtypes and supertypes

Reading Assignment: *Chapter 5*

January 31: Lecture 7 – Update, insert and delete (CRUD)
- Handling update, insert and delete records for various types of relationships

Reading Assignment: *Instructor notes*

February 5: Lecture 8 – Normalization
- Anomalies and the need for normalization
- Normal forms

Reading Assignment: *Chapter 6*

February 7: Lecture 9 – Normalization contd.
- First normal form
- Second normal form
- Third normal form

Reading Assignment: *Chapter 6*

February 12: Lecture 10 – Normalization contd.
- Boyce-Codd, Fourth normal form
- De-normalization

Reading Assignment: *Chapter 6*

February 14: Lecture 11 – Normalization contd.

February 19: **President's Day (No Class)**

February 21: Lecture 12 – Structured Query Language (SQL)
- Data Definition Language (DDL)
- Data Manipulation Language (DML)

Reading Assignment: *Chapter 7*

February 26: Lecture 13 – SQL (contd)
- SQL syntax

Reading Assignment: *Chapter 7*

February 28: Lecture 14 – SQL (contd)
- Sub queries

      Reading Assignment: *Chapter 8*

March 4: Lecture 15 – SQL (contd)
- Querying multiple tables using JOIN

      Reading Assignment: *Chapter 8*

Exam 1: Wednesday, March 6, <u>10 am – 11:50 am</u>

March 11:

      Spring Recess (No Class)

March 13:

March 18: Lecture 16 – SQL (contd)
- Constraints
- Indexes
- SQL Functions

      Reading Assignment: *Chapter 8*

March 20: Lecture 17 – SQL (contd)
- Aggregation
- Grouping

      Reading Assignment: *Chapter 8*

March 25: Lecture 18 – SQL (contd)
- Advanced JOINs
- Cross join, inner join, outer join, full join
- Correlated subqueries

      Reading Assignment: *Chapter 8*

March 27: Lecture 19 –SQL (contd)
- Relational set operators: Union, intersect
- Views

      Reading Assignment: *Chapter 8*

April 1: Lecture 20 – CRUD with SQL
- Insert
- Update
- Delete

Reading Assignment: *Chapter 10*

April 3: Lecture 21 – Multiuser databases
- Concurrency in multiuser databases
- Database transactions and their properties
- Transaction management
- Locking methods

Reading Assignment: *Chapter 10*

April 8: Lecture 22 – Database security
- Disaster preparedness
- Backup and Recovery strategies
- Securing databases
- SQL Injection

Reading Assignment: *Instructor notes*

April 10: Lecture 23 – Database applications
- Client/Server architecture
- Database applications and their environments
- Database connectivity – ODBC/JDBC etc.
- Apps, web and mobility
- ERP systems
- E-commerce
- Social networks
- Cloud computing

Reading Assignment: *Chapter 14*

April 15: Lecture 24 – Business Intelligence Systems
- Big data
- Data warehouses and data marts
- Business reporting and intelligence
- Data mining

Reading Assignment: *Instructor notes*

April 17: Lecture 25– Innovations in database systems
- Distributed databases
- NoSQL databases
- NewSQL databases

- Columnar storage

Reading Assignment: *Chapter 13*

April 22: Lecture 26 – In-memory databases for real time analytics

- NoSQL
- Why NoSQL
- Key Value pairs
- MongoDB

April 24: Lecture 26 – Final Exam Review

Exam 2: Monday, May 6, <u>8 am - 10 am</u>