Database Systems: Concepts, Design, and Implementation

ISE 382 (4 Units)
Spring 2021

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, students 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
  - Teradata 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

Office hours
MW 11:50 am – 12:30 pm (PST)

Lecture
MW 10:00 am – 11:50 am (PST)

Discussion
F 9:00 am – 10:20 am (PST)
F 10:30 am – 11:50 am (PST)
Course Producers / Email / Office Hours
Mansi Shah, mansipra@usc.edu Th 5:30 pm-7:30 pm (PST)
Dharmin Umesh Shah, dharminu@usc.edu Tu 1:00 pm-3:00 pm (PST)

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
- Teradata SQL Assistant
- MongoDB

Textbook

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

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<tr>
<td>Homework</td>
<td>40%</td>
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<tr>
<td>Projects</td>
<td>15%</td>
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<tr>
<td>Exam 1</td>
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<td>Exam 2</td>
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Grading Scale
The following shows the grading scale to be used to determine the final letter grade.
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).”
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Jan 18: No Class (MLK Holiday)

Jan 20: 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

Jan 25: Lecture 2 - Data Modeling
- Overview of Data Models
- Business Rules
- Relational data model

Reading Assignment: Chapter 2

- Entities
- Attributes
- Relationships

Reading Assignment: Chapters 2 and 3

Feb 1: 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

Feb 3: Lecture 5 – Entity-Relationship diagrams
- E-R diagrams for modeling business requirements
- Degrees of relationships
- Associative entities

Reading Assignment: Chapter 4

Feb 8: Lecture 6 – Entity-Relationship Models contd.
- Subtypes and supertypes
Reading Assignment: Chapter 5

Feb 10: Lecture 7 – Update, insert and delete (CRUD)
- Handling update, insert and delete records for various types of relationships

Reading Assignment: Instructor notes

Feb 15: No Class (President's Day Holiday)

Feb 17: Lecture 8 – Normalization
- Anomalies and the need for normalization
- Normal forms

Reading Assignment: Chapter 6

- First normal form
- Second normal form
- Third normal form

Reading Assignment: Chapter 6

Feb 24: Lecture 10 – Normalization contd.
- Boyce-Codd, Fourth normal form
- De-normalization

Reading Assignment: Chapter 6

Mar 1: Lecture 11 – Normalization contd.

Mar 3: Lecture 12 – Structured Query Language (SQL)
- Data Definition Language (DDL)
- Data Manipulation Language (DML)

Reading Assignment: Chapter 7

Mar 8: Lecture 13 – SQL (contd)
- SQL syntax

Reading Assignment: Chapter 7

Mar 10: Lecture 14 – SQL (contd)
- Sub queries

Reading Assignment: Chapter 8

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

Reading Assignment: Chapter 8

Mar 17: Exam 1

Mar 22: Lecture 16 – SQL (contd)
- Constraints
- Indexes
- SQL Functions

Reading Assignment: Chapter 8

Mar 24: Lecture 17 – SQL (contd)
- Aggregation
- Grouping

Reading Assignment: Chapter 8

Mar 29: Lecture 18 – SQL (contd)
- Advanced JOINs
- Cross join, inner join, outer join, full join
- Correlated subqueries

Reading Assignment: Chapter 8

Mar 31: Lecture 19 – SQL (contd)
- Relational set operators: Union, intersect
- Views

Reading Assignment: Chapter 8

Apr 5: Lecture 20 – CRUD with SQL
- Insert
- Update
- Delete

Reading Assignment: Chapter 10

Apr 7: No Class (Wellness Day)

Apr 12: Lecture 21 – Multiuser databases
- Concurrency in multiuser databases
- Database transactions and their properties
- Transaction management
- Locking methods
Reading Assignment: Chapter 10

Apr 14: Lecture 22 – Database security
- Disaster preparedness
- Backup and Recovery strategies
- Securing databases
- SQL Injection

Reading Assignment: Instructor notes

Apr 19: 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

Apr 21: Lecture 24 – Business Intelligence Systems
- Big data
- Data warehouses and data marts
- Business reporting and intelligence
- Data mining

Reading Assignment: Instructor notes

Apr 26: Lecture 25 – Innovations in database systems
- Distributed databases
- NoSQL databases
- NewSQL databases
- Columnar storage

Reading Assignment: Chapter 13

Apr 28: Lecture 26 – In-memory databases for real time analytics
- NoSQL
  - Why NoSQL
  - Key Value pairs
  - MongoDB

May 10: Exam 2
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 Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.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