

DSO 435 – Enterprise Data Architecture

Time: Tuesday and Thursday 2:00 PM – 3:50 PM
Place: JFF LL103
Professor: Douglas Shook, Ph.D.; <https://cio.usc.edu/about/leadership/douglas-shook-cio/>
Office hours: Tu/Th 4:00 PM – 5:00 PM at JFF, and by appointment at CAL 3rd floor
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Overview of the Course:

Other than its human resources, data arguably is the single most important asset an organization possesses. Enterprise-wide management of data architecture is a core business requirement for any successful organization today. Complete, real-time, high-integrity data is necessary for most business operations including Data Analytics (DA), Business Intelligence (BI), tailoring customer experiences with immediate, personalized data, contextualization with “Big Data,” and synchronizing and integrating legacy data with Cloud/SaaS applications, etc.

This course is motivated by a recognition of the importance of enterprise data architectures for understanding, designing, and building effective information technology for today's business organizations.

The objective of this course is to provide the prospective business or IT professional with fundamental concepts and skills in data modeling (conceptual, logical and physical), as well as in designing, building and managing the data layer to support business applications.

In addition to data modeling, considerable proficiency with Structured Query Language (SQL) will be obtained. Although object-oriented, and other database approaches will be discussed, the course focuses primarily on the use of state-of-the-art relational and object-relational databases. Oracle will be used as the primary pedagogical software in class and for required assignments.

Upon successful completion of this course, the prospective business or IT professional will be able to:

1. Design, build, and implement enterprise-grade data-layer architectures using Oracle 19c (this is your semester project).
2. Become highly proficient in creating high-integrity data models including conceptual, logical, and physical data models.
3. Perform data definitions (DDLs) and data manipulations (DMLs) using Structured Query Language (SQL).
4. Create Entity Relationship models, normalize those models, and translate those models into high-integrity [physical data models
5. Perform physical database optimization using transaction pattern and volume analyses.

Prerequisites: None

Readings/Materials:

- Hoffer, J., Topi, H & Ramesh, V. (2014). *Essentials of Database Management*. Pearson ISBN: 9780133405682 suggest using the digital version – *on reserve in Crocker Library (three-hour checkout)*
- Optional:
 - Oracle Database SQL Language Reference: <https://docs.oracle.com/en/database/oracle/oracle-database/19/sqlrf/sql-language-reference.pdf>
 - Bryla, B. & Loney, K. (2014). *Oracle 12c - The Complete Reference*, Osborne Oracle Press ISBN: 978-0-07-180174-4 *on reserve in Crocker Library (three-hour checkout); PDF on Blackboard*
- Additional articles/handouts distributed in class.

Course Details

Grading:

Class Participation, In-Class Problem Solutions	10%
In-Class Team Exercises	10%
Oracle/SQL Programming Assignments	20%
Term Project	30%
In-Class Workshops (10% each)	30%

(Extraordinary work in any of the above components will be rewarded accordingly with "grade overflow" into the other components. As per the 2022-2023 grading guidelines established by the Marshall School of Business, the average grade in this course will be 3.5, +/-0.09.)

Class Participation:

Class participation will be based upon class attendance, involvement in class discussions and responses to questions asked in class. Additionally, problems from the Hoffer text labeled "Problems and Exercises" will be assigned. Class participants will be chosen randomly to present their solutions on the board for class analysis and discussion. (Individual work)

Oracle/SQL Problems:

Two hands-on programming assignments will be done using Oracle 19c. You will turn in the computer-generated output from your work. Your accounts will be created for you on the class server. (Individual work)

Workshops:

There will be three in-class workshops where you will perform data modeling (conceptual, logical, physical), as well as some SQL (DDL, DML, etc.). There will be no exams in this class. (Individual work)

Project:

The term project will be the "cap stone" of the semester and requires the design and the implementation of this database using Oracle. The project will apply most of the issues/concepts covered during the semester and will enable you to obtain first-hand experience in designing and implementing a database from start to finish at an actual organizational site. It will be your responsibility to find a suitable project.

In the past, students have done projects in the organization where they worked, for some department in the university, local retailers, businesses they frequent, churches, social organizations, governmental agencies, or for their friends' or relatives' businesses. I would encourage you to develop an application for a not-for-profit, or similar organization, which may be able to afford to undertake such a project for a fee. The term project will result in a coded application and a high-quality written report. The project will be undertaken in the small teams (generally between two and four members) with a minimum of three to five entities per member. Additional details regarding project requirements will be provided later. (Group work)

Class Administrivia:

Unfortunately, a certain amount of administrivia, or housekeeping, is required for any course. Although I dislike including this section in the syllabus, it is only fair to make the course expectations clearly known at the outset of the class (hopefully there will be no surprises down the road). Following are the "rules" and expectations of the class:

- I assume you will attend all class meetings. If you must miss a class, please inform me beforehand. There will be no "make-ups" for missed work due to un-excused absences (this includes workshops).
- You will be expected to have prepared for each class by reading the assigned chapters and handouts. If you do not keep up with the readings, you will neither enjoy, nor benefit from the class.
- Typically, I will use a randomized class list to call upon students to present their solutions to the assigned "Problems and Exercises" at the end of each chapter.

Information on Academic Conduct, Open Expression, Support Systems & Recording

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” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eeotix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

Open Expression Statement

An important goal of the educational experience at USC Marshall is to be exposed to and discuss diverse, thought-provoking, and sometimes controversial ideas that challenge one's beliefs. This is an important part of the training business students must receive to address and solve major issues that confront businesses in a critical and thoughtful manner. These values are reflected in the USC Marshall statement on open communication.

Marshall Learning Environment: Open Expression and Respect for All

The USC Marshall School of Business shares the University's [Unifying Values](#):

- We act with integrity in the pursuit of excellence.
- We embrace diversity, equity and inclusion to promote well-being.
- We engage in open communication and are accountable for living our values.

We value each person's humanity and voice and strive to ensure that every member of our community feels that they belong and are respected. A complete statement is located here:

<https://www.marshall.usc.edu/about/open-expression-statement>

Classroom Recording

Various portions of this class may be captured/recorded for subsequent use by the students. The links to the recordings will be placed in Blackboard and only the students in this class should have access to them. Please note that your voice and or image may be recorded in the process.

Course Schedule – Version 1.0

Date	Topic/Activities	Reading/Questions/Videos	Project Deliverables
Module 1 - Introduction to the Database Environment			
Aug. 23	Course Overview & PE Introduction Get acquainted with your classmates	none / none	
Aug. 25	Database Environment & Development Introduction to Marshall Computer Accounts	Chap. 1 / none Video: DB Environment	Team Composition
Module 2 – Basic Conceptual Data Modeling & Structured Query Language (SQL)			
Aug. 30	Conceptual Data Modeling/ERDs I <i>Lab: Introduction ERD drawing tools</i>	Chap. 2 / 7, 10, 17a-d	Client Site Selected
Sep. 1	Conceptual Data Modeling/ERDs II	(same as previous session)	
Sep. 6	Structured Query Language (SQL) I <i>Lab: Introduction to Oracle</i>	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c Video: Using SQL Developer	
Sep. 8	Conceptual Data Modeling/ERDs III	Chap. 2 / 7, 10, 17a-d	Business Function vs Entity Matrix
Sep. 13	Structured Query Language (SQL) II Team: SQL Activity	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c	
Sep. 15	Conceptual Data Modeling/ERDs IV	Chap. 2 / 7, 10, 17a-d	User Views from Client
Sep. 20	Structured Query Language (SQL) III Team: SQL Activity	Chap. 6 & handout / 4a, 4b, 4c, 7a, 7b, 8a, 8b, 8c	
Sep. 22	Conceptual Data Modeling/ERDs V Team: Modeling Activity	Chap. 2 / 7, 10, 17a-d	
Sep. 27	Enhanced Conceptual Data Modeling/ERDs I	Chap. 3 / 2a-c, 6, 7, 8	
Sep. 29	First Hands-on Workshop	none / none	
Oct. 4	First Workshop – Discussion & Analysis	none / none	
Module 3 - Enhanced Conceptual Data Modeling & Structured Query Language (SQL)			
Oct. 6	Advanced Structured Query Language (SQL) I Team: SQL Activity	Chap. 7 & handout / 1a, 1b, 2, 3, 4a, 5	
Oct. 11	Advanced Structured Query Language (SQL) II	(same as previous session)	ERD's for each user view
Oct. 13	Fall Break	none / none	
Oct. 18	Enhanced Conceptual Data Modeling II Team: Modeling Activity	Chap. 3 / 2a-c, 6, 7, 8	CDM

Course Schedule – Version 1.0

Date	Topic/Activities	Readings/Questions/Videos	Project Deliverables
Module 4 - Logical Database Design			
Oct. 20	Logical Design and the Relational Model I	Chap. 4 / 1a-f, 2a-d, 3a-d	
Oct. 25	Logical Design and the Relational Model II Team: Modeling Activity	(same as previous session)	
Oct. 27	Second Hands-on Workshop	none / none	
Nov. 28	Friday – Project consult with professor	Professor provides in-depth, individual hands-on consulting assistance for your team project.	Bring all current project deliverables for review and assistance
Oct. 29	Saturday – Project consult with professor		
Nov. 1	Second Workshop Solutions, Discussion, Analysis	none / none	
Module 5 - Physical Database Design			
Nov. 3	Physical Design I	Chap. 5 / 1a, 1b	
Nov. 8	Physical Design II	(same as previous session)	
Nov. 10	Physical Database Optimization I Team: DB Performance Activity	(same as previous session)	
Nov. 15	Physical Database Optimization II	(same as previous session)	
Nov. 17	Physical Design & PL/SQL Team: PL/SQL Activity	PL/SQL handout	
Nov. 22	Third Hands-on Workshop	none / none	
Nov. 24	Thanksgiving Break (no class)	none / none	
Module 6 - The "Wrap"			
Nov. 28	Third Workshop Solutions, Discussion, Analysis	none / none	
Dec. 1	Course Coalescence <i>Tying it all together:</i> PE Presentation, Visualization Demo, Triggers & Stored Procedures, Class Evaluations	none / none	Transaction Analysis Forms
Dec. 8	Projects due from noon- 5:00 PM	none / none	Entire Project, containing all code and output

Components of the Database Design Project Report

1. Introduction

- a. Cover page
- b. Table of Contents
- c. Executive Summary

2. Planning for the Database - Please see handout "Practical Database Development" for detailed instructions

- a. Business Function-to-Data Entity Matrix (page 9)

3. Conceptual Design

- a. Entity Relationship Diagrams (ERDs) for each user view. You also must attach the original "hardcopy" of the user view for comparison - please make it clear which ERD is for which user view.
- b. Some annotation/description for each user view is expected.
- c. Create a conceptual data model (CDM) by integrating all the individual user views into one ERD
- d. Business Rules/Constraints
 - i. Domain Definitions (create domain classes and refer individual attributes to them - page 128)
 - ii. Other business rules, restrictions, constraints and requirements for the database

4. Logical Design with the Relational Model

- a. Transform the conceptual data model into a set of Third Normal Form (3NF) relations indicating all primary and foreign keys, making note of any changes from the CDM due to normalization.

5. Physical Design and Implementation with the Relational Model

- a. Functionally decompose/expand your Business Function-to-Data Entity Matrix into a Process versus Entity Matrix using the Excel spreadsheet provided on Blackboard.
- b. Four separate Transaction Analysis Forms (TAFs) of key processes (see lecture handout) with at least two showing "creates."
- c. Composite Usage Map - combine TAFs with remaining usage and volume (see lecture handouts)
- d. List of all DDL statements necessary to create the physical model, making note of any changes from the logical model due to physical design/performance considerations.
- e. List contents of all populated tables/relations to show sample data (if output wraps on the page, please format it so it is readable).
- f. List six sample queries/views and the results of their executions (show the query statements/code and the output they generated). This is a good opportunity to display your SQL skills.
- g. Summary discussion of your physical design (e.g., index creations, clustering, responses to table volumes and access patterns, denormalizations, data distribution, table partitioning, triggers, stored procedures, security issues, physical implementation of the constraints, etc.). This portion of the report "implements" your project, please be rigorous/thorough here.

6. Summary and Conclusion

- a. Discuss difficulties encountered, how you solved problems, what you like most/least about your database and what you learned (a thorough description will be appreciated here).

Please note: In addition to the PDF report, you must submit files containing all SQL code and output for your database tables, views, queries, etc. The report must be page numbered; the entries in the table of contents should appear as headings in the appropriate report sections. It should be well written in a "normal form" for business reports. As always, the report must have sufficient annotation (text) to explain why each diagram or page is in the report and what it is telling the reader. If you have questions regarding report format, please see me as I have samples from previous semesters.

Please start this project as early as possible; it will take longer to complete than you think.