CSCI 4707: Practice of Database Systems

Syllabus

Units: 3

Term — Day — Time: Fall 2022, MW – 2:30-3:45 pm

Location: Rapson Hall 100
Website: Canvas, Piazza

Instructor: Yao-Yi Chiang, Ph.D. GISP
Office: Keller Hall 519
Regular Office Hours: Wednesdays after class
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Teaching Assistant: Min Namgung, Yijun Lin, Yuankun Jiao
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1. Course Description

Databases are a critical part of many applications. They enable fast, reliable access to data and support complex queries. In this course, students will learn about database design, query languages, and database management systems. The course will cover relational database models and touch on NoSQL databases. Students will also learn about recent trends in database technologies. The course will include weekly quizzes, several programming assignments, and midterm and final examinations.

2. Learning Outcome

Databases are critical in data science and analytics. They provide a way to store and organize data to be accessed and used for various purposes. However, working with databases can be challenging due to the complex nature of data and the various types of analytics the databases need to support.

In this course, you will learn how to install and use a database system. You will also learn how to design data models, implement data schema, populate data schema with existing data, and use SQL to compile and retrieve relevant information. Additionally, you will learn how to select a database system that best suits your organization's needs. By the end of this course, you will be able to use databases to solve real-world problems effectively.

3. Recommended Preparation

The students should have excellent knowledge of data structures and solid programming skills. Some background in computer algorithms is a plus but not required.

4. Textbook

Michael Mannino, Database Design, Application Development and Administration, 7th edition, ISBN-13: 9781948426060.

5. Course Notes

The course will be run as a lecture class with student participation strongly encouraged. There are weekly readings, and students are encouraged to do the readings before the discussion in class. Except for the textbook, all course materials will be available online, including the readings, lecture slides, and homework.

6. Technological Proficiency and Hardware/Software Required

Students are expected to know how to use common operating systems (e.g., MS Windows and Mac OC) and install applications on the operating systems.

Students are also expected to have their laptop or desktop computer where they can install and run software to finish the homework assignments.

7. Description and Assessment of Assignments

Homework Assignments: There will be four homework assignments. Students will finish the assignments individually. Each assignment will be graded on a scale of 0-10. The specific rubric for each assignment will be given in the assignment. Each submission will be checked for plagiarism.

Quizzes: There will be weekly quizzes based on the material from the week before.

Exams: There will be one midterm and one final exam.

Grading Breakdown

There are two necessary conditions for passing this class: (1) submission of all assignments and (2) scoring at least 50% on the final examination.

Grading Schema:

Quizzes	30%
Homework	40%
Midterm Exam	15%
Final Exam	15%
Total	100%

Grades will range from A through F. The following is the breakdown for grading:

94 – 100 = A	74 – 77 = C
90 – 94 = A-	70 –74 = C-
87 – 90 = B+	67 – 70 = D+
84 – 87 = B	64 – 67 = D
80 – 84 = B-	60 – 64 = D-
77 – 80 =C+	Below 60 is an F

Assignment Submission Policy

Homework assignments are due at 11:59 pm CT on the due date and should be submitted on Canvas. Late submissions within 24 hours of the due date will receive a 30% penalty. Late submissions after 24 hours of the due date will receive a 70% penalty.

Every student has SEVEN free late days for the homework assignments. You can use these SEVEN days for any reason separately or together to avoid the late penalty. There will be no other extensions for any reason. **You cannot use the free late days after the last day of the class.**

8. Schedule

Week	Date	Planned Topics	Quizzes/Assignments/Exams
1	9/5	*Labor Day*	
	9/7	1. Introduction 1.1 Database characteristics	HW0 distributed (no grade)
2	9/12	1.2 DBMS features 1.4 Architectures 1.5 Organizational roles	Quiz1, HW0 due
	9/14	3. Relational Model 3.1 Relational model basics 3.2 Integrity rules 3.3 Rules about referenced rows	
3	9/19	3.4 Relational Algebra Unary Operations: Restrict, Project, Summarize Binary Operations: Join, Division, etc. Postgres demo (Min Namgung)	Quiz 2, HW1 published
	9/21	4. Query formulation with SQL 4.1 Basic (restrict, project) 4.2 Joining tables 4.2 Summarizing tables	
4	9/26	4.3 Conceptual Evaluation Procedure 4.4 Critical questions to compose SELECT 4.5 Advanced Problems 4.6 Data Manipulation	Quiz 3
	9/28	5. Understanding Entity Relationship diagrams 5.1 Notation basics 5.2 Understanding Relationships (5 common use cases)	HW1 due
5	10/3	5.3 Generalization hierarchies 5.4 Business Rules and Diagram Rules	Quiz 4, HW2 published

		5.5 Alternative notations	
	10/5	6. Composing Entity Relationship diagrams 6.1 AnalyzIng Business information needs 6.1 Identifying Entities, Relationships, 6.2 Diagram Refinements	
6	10/10	6.3 Finalizing ERDs 6.4 Conversion of ERDs to DB Tables	Quiz 5
	10/12	7. Normalization of Relational Tables 7.1.1 Modification Anomalies 7.1.2 Functional Dependencies 7.2 Major Normal Forms 7.2.1-7.2.2 1NF, BCNF 7.2.3 Simple synthesis procedure	HW2 due
7.	10/17	7.3 Multivalued dependencies, 4NF 7.4 5NF 7.5 Practical concerns	Quiz 6
	10/19	8. Physical Database Design 8.1. Problem statement (input, output, objectives, constraints) 8.2. Secondary storage (e.g., disks) 8.3. File structures (Unordered, and ordered sequential files, Hash files)	
8.	10/24	8.3.File structures (Btree, Bitmap index, Column storage, Oracle case study)	Quiz 7
	10/26	8.4. Query Optimization 8.4.1. Translation tasks 8.4.2. Improving optimization results	Accommodation letters due: Email with a subject line (accommodation letter for CSCI 4707 midterm exam) to Min Namgung (namgu007@umn.edu)

9.	10/31	Practice Midterm Exam	Quiz 8
	11/2	**Midterm Examination (2:35-3:45 pm)**	
10.	11/7	8.5 Index Selection 8.6 Additional Choices in Physical Design 8.6.1 Denormalization 8.6.2 Record formatting 8.6.3 Parallel processing (e.g., RAID)	Quiz 9, HW3 published
	11/9	9.1 Outer Join 9.2 Type I and II nested queries 9.2.3 Difference Problem 9.2.4 Nesting in FROM	
11	11/14	9.3 Relational Division 9.4 Null Value Effects 9.5 OMIT: Querying Hierarchical Data	Quiz 10
	11/16	17. Transaction Management 17.1 Database Transactions Basics, ACID properties, ... 17.2 Concurrency Control, Interference Problems	HW3 due
12	11/21	17.2.3 Two Phase Locking, ... 17.3 Recovery Management 17.4 Transaction Design 17.5 Workflow Management	Quiz 11, HW4 published
	11/23	Data Warehouses (DW) 12.1 Definition, Motivation, Contrast with OLTP 13.1 Multidimensional model of data, Data cube concepts and operations 13.2 DW conceptual models. e.g.,: star, constellation, snowflake schemas 13.2 Oracle CREATE DIMENSION statement	

13	11/28	15.2 SQL extensions: CUBE, ROLLUP,.. 15.4 Physical DM: Materialized views, query rewrite	Quiz 12
	11/30	19 Object and NoSQL databases 19.1 Motivation 19.2 SQL:2016 Object features: User defined datatypes, tables, subtables, path expressions	HW4 due
14	12/5	19.3 Oracle object features (e.g., XML library) 19.4 NoSQL (Key Value, Columnar)	Quiz 13
	12/7	Spatial databases	
15	12/12	Database and AI	Quiz 14
	12/14	Practice Final Examination	
	12/17	**Final Exam, Saturday, 8:00 to 10:00 a.m.**	

9. Modality Transparency:

This course is scheduled as an in-person course. I intend to hold all class sessions in person except if situational factors arise, such as the personal illness of the instructor, when the class may be held synchronously via Zoom or recorded for later viewing.

10. Statement on Academic Conduct and Support Systems

Academic Conduct[1]

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using course materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, misrepresenting or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code.) If it is determined that a student

[1] This is a direct copy from https://communitystandards.umn.edu/syllabus-insertion

has cheated, the student may be given an "F" or an "N" for the course, and may face additional sanctions from the University.

The Office for Community Standards has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty.

Beware of websites that advertise themselves as being “tutoring websites.” It is not permissible to upload any instructor materials to these sites without their permission or copy material for your own homework assignments from these various sites.

If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class, e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources if electronic aids are permitted or prohibited during an exam.

Support Systems

A number of student services can be found on: https://onestop.umn.edu/ and https://disability.umn.edu/.

11. Legitimate (i.e., Excused) Absences

While **makeup work for legitimate absences** is part of University policy, faculty and instructors choose how to accommodate absences based on their course. In this course, excused absences will be handled as follows:

- Students are expected to obtain notes from a classmate of class material missed.
- Students may request a make-up assignment for class material missed.
- Please note that I do not intend to record class sessions at the request of individual students.
- We will drop your four lowest quiz scores, so we will not have makeup quizzes.

COVID-19 Symptoms, Vaccination, Excused Absences, and Face Coverings

You should stay at home if you experience any signs of illness or have a positive COVID-19 test result. If this occurs, please consult with your healthcare provider about an appropriate course of action. I will follow these same protocols and will let you know if the delivery of this course has to be temporarily changed as a result of my own circumstances. Absences related to illness, including COVID-19 symptoms, for yourself or your dependents, are **legitimate “excused” absences**

Vaccines: COVID-19 Vaccinations (or approved exemptions) are required for all students and employees. Learn about vaccine and booster appointments on campus by visiting the FAQ on Get the Vax page.

Face coverings: Up-to-date policy information is available on the Safe Campus page. The University expects all community members to respect those who choose to wear a mask, as well as those who choose not to wear one.

I don't intend to wear a mask in class myself, and I fully support your individual choices around masking.

Indoor masking continues to be an important tool in high-risk situations. High-quality masks (N-95 or certified KN-95) will be available to students in Fall 2022. Check the Safe Campus website for information on the location(s) for each campus.

Testing: Information on *When*, *Where*, and *What if* for testing is available on MTest webpage.

The above policies and guidelines are subject to change. The University regularly updates **pandemic guidelines** in response to guidance from health professionals and in relation to the prevalence of the virus and its variants in our community.