CS 411: Database Systems

Course Description

As an introductory course for databases, this course studies the fundamentals of using and implementing relational and non-relational database management systems. First, from the user perspective (i.e., how to use a database system), the course will discuss conceptual data modeling, physical data modeling, computing on data, designing schemas, querying databases, and manipulating databases. We will study both the relational and "NoSQL" databases such as document and graph databases. Further, from the system perspective (i.e., how to design and implement a database system), the course will study data accessing and indexing.

Course Prerequisite

- Background: CS 225 Data Structures.

- Programming: You should be comfortable in programming and can quickly learn a new language if needed. you should be able to use major programming languages such as Python and Java. You will use Python for the machine problems and any language for the final project.

Course Goals

By the end of the course, you will be able to:

- Use a database system for storing, managing, and querying data.

- Design and create a data-driven application using a database system.

- Identify the differences between relational and non-relational (NoSQL) systems and their target use cases and applications.

- Design and implement data indexing techniques.

Textbook (Optional, Recommended)

A textbook is **not** required. However, for a comprehensive reference, the following is useful.

[Database Systems: The Complete Book, 2nd edition](), by Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer D. Widom.

Topics

We will study eight topics in this class.

- Topic 1: Conceptual Data Modeling

- Topic 2: Physical Data Modeling

- Topic 3: Computing on Data

- Topic 4: Designing Schemas

- Topic 5: Querying Databases: The Relational Way

- Topic 6: Querying Databases: The Non-relational Ways

- Topic 7: Manipulating Databases

- Topic 8: Accessing and Indexing Data

Elements of This Course

The course is comprised of the following elements:

- **Lecture Video**. Each topic will be covered through about 6 to 10 individual lecture videos that range from 5 to 20 minutes long.

- **Assignment Quiz**. Each topic comes with an assignment quiz as a mandatory assignment for your own practice. You are required to complete each assignment quiz. There are unlimited attempts of a quiz, and they will be graded by completion.

- **Exam Quiz**. There will be a total of 3 exam quizzes given throughout the course, each of which covers 2-3 topics with a retry chance for each quiz. You are required to take each quiz and, if you wish, you can retry once for a quiz, whose score will be **capped at 92%** (which means a grade A)-- i.e., retry score = **MIN(retry raw score, 92%)**. If you take a retry, the final score of the quiz will be the better one of the two attempts, i.e., final quiz score = **MAX(first try score, retry score)**.

- **Machine Problem (MP)**. There will be about 5 machine problems given approximately bi-weekly. Each MP will take about 1-2 hours to complete, as a hands-on computer exercise to practice techniques covered in classes. The MPs will build up incrementally to lay the foundation for the end-of-semester project.

- **Project.** Based upon MP work, in a team of two students, you will complete an end-of-semester project in the last one-third of the semester to build an end-to-end database application. We will allow working on projects individually but with the same amount of work and expectations.

Class Schedule

Week	Monday	Sunday	Topic	Video Length	Asmt	Exam	MP No	MP Topic	Project
1	05-19	05-25	Topic 1: Conceptual Data Modeling	0:55:40	1		MP1	Setting Up Database Environments	
2	05-26	06-01	Topic 2: Physical Data Modeling	2:02:15	2				
3	06-02	06-08	Topic 3: Computing on Data	1:32:29	3	Q1	MP2	Implementing Relational Operators	
4	06-09	06-15	Topic 4: Designing Schemas	1:35:13	4	(T01, T02, T03)			
5	06-16	06-22	Topic 5: Querying Databases: The Relational Way (1)(2)	1:52:14	5		MP3	Designing Database Schemas	
6	06-23	06-29	Topic 6: Querying Databases: The Non-relational Ways (1)	2:26:21	6				
7	06-30	07-06	Topic 6: Querying Databases: The Non-relational Ways (2)		7	Q2	MP4	Querying MySQL	
8	07-07	07-13	Topic 7: Manipulating Databases (1)	2:46:10	8	(T04, T05, T06)			Project
9	07-14	07-20	Topic 7: Manipulating Databases (2)		9		MP5	Querying MongoDB and Neo4j	
10	07-21	07-27	Topic 8: Accessing and Indexing Data (1)	3:56:05	10				
11	07-28	08-03	Topic 8: Accessing and Indexing Data (2)(3)		11	Q3			
12	08-04	08-10	Course Conclusion			(T07, T08)			

Coursework Deadlines

For all coursework deadlines, please refer to the Course Deadlines, Policies, and Academic Calendar page.

Grading Distribution and Scale

Grading Distribution

Your final grade will be calculated based on the activities listed in the table below. Your official final course grade will be listed in Enterprise. The course grade you see displayed in Coursera may not match your official final course grade.

Grading Component	Occurrence	Grading Percentage
Assignment Quizzes	13	10%
Exam Quizzes	3	30%
MP	About 5	40%
Project	1	20%
Total		100%

Extra Credits

There are a few extra credit activities-- such as answering questions in our class forum and extra MP questions -- which we encourage you to participate in with the incentive of getting extra credits. We will announce such opportunities separately.

1. We will reward the top 5% of students with 2% extra credits in the overall grade based on their reputation points on Campuswire. The reputation point is related to the number and quality of questions/answers each student posts on Campuswire in this course. A leaderboard can be found at the bottom-right of the Class feed page.

Grading Scale

Grading will follow the following cutoffs based on the total scores achieved.

Grade-Matching Guarantee: We understand grade disparity may cause unnecessary distraction and confusion, so we will guarantee our final grade average to be better than or match *the highest-graded section of the same class* according to the statistics reported at Grade disparity between sections at UIUC. That is, if our raw average is lower than the highest reported, we will curve the scores to match.

Total	Grade
90% - 100%	A (A-, A, A+)
80% - 89%	B (B-, B, B+)
70% - 79%	C (C-, C, C+)

Total	Grade
60% - 69%	D (D-, D, D+)
Below 60%	F

Student Code and Policies

A student at the University of Illinois at the Urbana-Champaign campus is a member of a University community of which all members have at least the rights and responsibilities common to all citizens, free from institutional censorship; affiliation with the University as a student does not diminish the rights or responsibilities held by a student or any other community member as a citizen of larger communities of the state, the nation, and the world. See the University of Illinois Student Code for more information.

Academic Integrity

All students are expected to abide by the campus regulations on academic integrity found in the Student Code of Conduct. These standards will be enforced and infractions of these rules will not be tolerated in this course. Sharing, copying, or providing any part of a homework solution or code is an infraction of the University's rules on academic integrity. We will be actively looking for violations of this policy in homework and project submissions. Any violation will be punished as severely as possible with sanctions and penalties typically ranging from a failing grade on this assignment up to a failing grade in the course, including a letter of the offending infraction kept in the student's permanent university record.

Again, a good rule of thumb is: *Keep every typed word and piece of code your own*. If you think you are operating in a gray area, you probably are. If you would like clarification on specifics, please contact the course staff.

Disability Accommodations

Students with learning, physical, or other disabilities requiring assistance should contact the instructor as soon as possible. If you're unsure if this applies to you or think it may, please contact the instructor and Disability Resources and Educational Services (DRES) as soon as possible. You can contact DRES at 1207 S. Oak Street, Champaign, via phone at (217) 333-1970, or via email at disability@illinois.edu.