



## **COSC 3380 | Database Systems**

**Section:** 11628 | Hybrid

MoWe 08:30 AM-10:00 AM | University of Houston; Philip Guthrie Hoffman Hall; PGH 232

Prerequisite(s): A grade of C- or better in COSC 2320 or COSC 2436. Declared Computer Science majors and minors, and Computer Engineering majors. Database design with ER model, relational model and normalization up to 3NF/BCNF normal forms. Relational algebra and basic SQL queries combining filters, joins and aggregations. SQL transaction processing. Overview of DBMS internal subsystems including: storage, indexing, query optimizer, locking, recovery manager, security mechanisms. Database application development. Declared Computer Science majors and minors, and Computer Engineering majors only.

### **General Course Information**

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**Office Hours**

MonWed 10-11

### **Course Objectives and Student Learning Outcomes**

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Students will gain fundamental understanding on the theory and internal systems aspects to design, update and query a relational database, managed by a DBMS. From a theory perspective, there will be an introduction to first order logic, set theory, relational algebra, functional dependencies and normalization, up to BCNF. From a programming perspective, students will learn how to design a database with ER, create tables, indexes, schemas, as well as developing queries and transactions in SQL. Students will also learn how to embed SQL in an application programming language. The course will give an overview of the main subsystems of a DBMS,

including the file system, storage manager, locking manager, transaction scheduler, query optimizer and recovery manager.

## **Required Instructional Materials**

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Textbook: ELMASRI, R. AND NAVATHE, S. B. 2009. Fundamentals of Database Systems, 6th edition (any later edition is acceptable, all fundamental chapters are the same). Addison/ Wesley, Redwood City, California.

Access to PDF in a UH Linux server provided by the instructor.

Slides and homeworks will be posted on a Linux server.

## **Course Schedule, Assignments, and Assessments**

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1. Topics are listed on the next section, in the order they will be explained.
2. The first half of the course is more theoretical, explaining relational databases design, normalization and querying
3. The second half is more system oriented, explaining DBMS components for query and transaction processing
4. There are 4 assignments throughout the semester: 2 theory, 2 programming.

## **Discussion and Lecture Topics**

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1. Math review: set theory, boolean algebra, first order logic
2. Relational algebra, extended algebra and SQL
3. Relational model: domains, tuples, arity, cardinality
4. Functional dependencies: simple/composite keys, axioms, closures
5. Normalization: lossless decomposition, up to 3NF and BCNF, distinguishing both forms
6. Database design and software engineering: ER model, flows, enterprise architectures
7. System architecture of a DBMS: subsystems, interaction with OS: Storage, Indexing, transaction/locking manager, query optimizer
8. Transaction processing: ACID, locking, timestamping, MVCC

9. Query processing: SPJA queries, derived tables/view, optimization, cost optimization
10. Advanced (if there is time and interest): MVDs, 5NF, UDFs, pivoting, recursive queries, security, embedded database systems, machine learning.

## Grading Rubrics and Weights

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- 0%: diagnostic exam (required, individual, in class, closed-everything)
- 40%: 2 partial exams (individual, in class, closed-everything).
- 20%: 2 written theory homeworks (team of 2 students).
- 40%: 2 programming assignments (team of 2 students).
- There is no final exam.
- Bonus points: 1-3 points for most students, and up to 5 points out of 100 for outstanding students, towards final grade on a 100 scale, based on participation (in-class, answering theory and database system programming questions).

### DETAILED EXPLANATION

There is a diagnostic exam on the 1st week. Topics: discrete math, algorithms, data structures, computer architecture and programming. The exam has 10 questions, multiple choice. This exam is mandatory, but it does not count towards the final grade. Students getting 40 or lower are likely to struggle getting a C grade or better. Students who do not take the exam will be reported to UH and 5 points will be subtracted from final grade.

Exams: Each exam has weight 20% and each one covers about 40% of the course. The exams are individual, in-class, closed-everything (no Internet/computer, no notes). Each exam has 10 questions, short answer. Any student not taking an exam is required to take a short oral exam with the instructor, no exceptions.

There is no final exam.

The two written theory homeworks emphasize theory and math concepts.

Two programming assignments:

- First programming HW 20%. Learning goal: relational database terms, queries\, normalization, referential integrity. Languages: SQL + Python.

- Second programming HW 20%. Learning goal: transaction processing (adding records, updating tables consistently, complex queries, web app working in a browser). Requires designing an ER database model, normalizing tables, developing SQL transactions, defining SQL queries, and creating a web application program with JavaScript+HTML. Course will cover basics of JS development.
- Programming homeworks will be developed in 2 phases. Phase 1 will be PASS/FAIL and it is a requirement to submit Phase 2: Phase 2 will not be accepted without Phase 1 submitted and passed. A score will be assigned based on 10 test cases of varying difficulty and checking source code originality and quality. For HW2 Phase 2 there will be a short window for resubmission of minor fixes (with 0% penalty if resubmitted within 3 hours, otherwise, 10%-20% penalty depending on the number and importance of source code fixes, logistics TBA).

Bonus points for participation: 1-3 points for most students out of 100, towards final grade on a 100 scale, based on participation: in-class, answering theory and database system programming questions or making theory clarifications. Questions about Hws or calendar clarifications do not count as participation.

## Course Policies and Procedures

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1. Office hours: students are free to meet instructor after class. The instructor will be available outside classroom or online, after every lecture. Professor will be available to answer any questions or discuss any doubts or concerns.
2. On-line lectures: about 50% of lectures will be on-line, covering programming, deeper theory and reviews for exams. There may be additional on-line lectures with optional attendance (recorded if necessary).
3. There will be a couple of optional 1-1 meetings (in the afternoon), outside official lecture time, to discuss progress and grades.
4. Messaging: we will setup a discord group, which will be monitored by TAs. MS Teams will be used mostly during online lectures, but not for Q&A messaging. Students are asked to

post questions in discord, instead of email. The goal is that everyone learns and know what is going on.

5. Teams message to instructor: preferred communication only for personal issues (medical, family, exceptional circumstances). Teams/Email should not be used to ask for HW extensions. Any HW//exam request must be made in person with the instructor, at least 3 days before the deadline. Warning: do not write email to the other Ordonez professor, in the Physics department.

## University Policies and Student Support Resources

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### Mental Health and Wellness Resources

The University of Houston has a number of resources to support students' mental health and overall wellness, including [CoogsCARE](#) and the [UH Go App](#). [UH Counseling and Psychological Services \(CAPS\)](#) offers 24/7 mental health support for all students, addressing various concerns like stress, college adjustment and sadness. CAPS provides individual and couples counseling, group therapy, workshops and connections to other support services on and off- campus. For assistance visit [uh.edu/caps](http://uh.edu/caps), call 713-743-5454, or visit a [Let's Talk](#) location in-person or virtually. Let's Talk are daily, informal confidential consultations with CAPS therapists where no appointment or paperwork is needed.

**Need Support Now? If you or someone you know is struggling or in crisis, help is available. Call CAPS crisis support 24/7 at 713-743-5454, or the National Suicide and Crisis Lifeline: call or text 988, or chat [988lifeline.org](http://988lifeline.org).**

### Title IX/Sexual Misconduct

Per the UHS Sexual Misconduct Policy, your instructor is a "responsible employee" for reporting purposes under Title IX regulations and state law and must report incidents of sexual misconduct (sexual harassment, non-consensual sexual contact, sexual assault, sexual exploitation, sexual intimidation, intimate partner violence, or stalking) about which they become aware to the Title IX office (known at UH as the Equal Opportunity Services office or "EOS"). Please know there are places on campus where you can make a report in confidence. You can find more information about resources on the UH [Title IX/Sexual Misconduct Resources page](#). Please note that you may also report concerns of discrimination based on your protected class identity to EOS.

## Reasonable Academic Adjustments/Auxiliary Aids

The University of Houston is committed to providing an academic environment and educational programs that are accessible for its students. Any student with a disability who is experiencing barriers to learning, assessment or participation is encouraged to contact the Justin Dart, Jr. Student Accessibility Center (Dart Center) to learn more about academic accommodations and support that may be available to them. Students seeking academic accommodations will need to register with the Dart Center as soon as possible to ensure timely implementation of approved accommodations. Please contact the Dart Center by visiting the website:

<https://uh.edu/accessibility/> calling (713) 743-5400, or emailing [jdcenter@Central.UH.EDU](mailto:jdcenter@Central.UH.EDU).

The [Student Health Center](#) offers a Psychiatry Clinic for enrolled UH students. Call 713-743-5149 during clinic hours, Monday through Friday 8 a.m. - 4:30 p.m. to schedule an appointment.

The [A.D. Bruce Religion Center](#) offers spiritual support and a variety of programs centered on well-being.

The [Center for Student Advocacy and Community \(CSAC\)](#) is where you can go if you need help but don't know where to start. CSAC is a "home away from home" and serves as a [resource hub](#) to help you get the resources needed to support academic and personal success. Through our [Cougar Cupboard](#), all students can get up to 30 lbs of FREE groceries a week. Additionally, we provide 1:1 appointments to get you connected to on- and off-campus resources related to essential needs, safety and advocacy, and more. The [Cougar Closet](#) is a registered student organization advised by our office and offers free clothes to students so that all Coogs can feel good in their fit. We also host a series of cultural and community-based events that fosters social connection and helps the cougar community come closer together. Visit the CSAC homepage or follow us on Instagram: @uh\_CSAC and @uhcupbrd. YOU belong here.

## Women and Gender Resource Center

The mission of the [WGRC](#) is to advance the University of Houston and promote the success of all students, faculty, and staff through educating, empowering, and supporting the UH community. The WGRC suite is open to you. Stop by the office for a study space, to take a break, grab a snack, or check out one of the WGRC programs or resources. Stop by Student Center South room B12 (Basement floor near Starbucks and down the hall from Creation Station) from 9 am to 5 pm Monday through Friday.

## **Academic Honesty Policy**

High ethical standards are critical to the integrity of any institution, and bear directly on the ultimate value of conferred degrees. All UH community members are expected to contribute to an atmosphere of the highest possible ethical standards. Maintaining such an atmosphere requires that any instances of academic dishonesty be recognized and addressed. The [UH Academic Honesty Policy](#) is designed to handle those instances with fairness to all parties involved: the students, the instructors, and the University itself. All students and faculty of the University of Houston are responsible for being familiar with this policy.

## **Excused Absence Policy**

Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston [Undergraduate Excused Absence Policy](#) and [Graduate Excused Absence Policy](#) for reasons including medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to [military service](#), [religious holy days](#), [pregnancy and related conditions](#), and [disability](#).

## **Recording of Class**

Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the [Justin Dart, Jr. Student Accessibility Center](#). If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not authorized to be shared with anyone without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.