CS 5530: Database Systems

Course Details and Objectives
Spring 2021

COVID-19$^\Delta$

Items marked with the Δ symbol indicate special changes in how CS 5530 is offered in Spring 2021 due to COVID-19, and should not be expected in future classes.

Description of CS 5530

Databases are "under the hood" of almost every internet service and big data system. The objective of this course is to help students understand the principals, design, and use of databases. Students will gain experience formally designing relational databases, manipulating and accessing databases using command-line tools and workbench tools, and programmatically accessing and manipulating databases to construct software systems that solve data-driven problems such as an online marketplace or social media platform. We will study the principles of structured information storage and retrieval including relational algebra, normal forms and integrity constraints, and will begin to study some of the underlying algorithms and data structures of a database engine. We will study database systems mostly in the context of SQL.

Learning Outcomes

Upon completion of CS 5530, students will be able to:

1. apply data modeling concepts such as the relational model and entity-relation model to identify and reason about the data needs of a problem (including entity and referential integrity) and design a database solution to the problem

2. discuss common normal forms and utilize them in database design

3. use relational algebra to reason about queries, and use a declarative query language such as SQL to interact with a relational database

4. design a database and related queries and integrate them into a full software system using a high-level programming language to solve a complex data-driven problem

5. reason about and discuss basic database performance criteria, including the effect of index choice and query formulation

6. identify where explicit transactions and isolation levels are needed, and show an understanding of transaction processing in an RDBMS

Meetings$^\Delta$

CS 5530 is purely online this semester, and there are no synchronous class meetings. Lecture videos and materials will be posted on Canvas weekly.

Instructor

Daniel Kopta, *Email:* `dkopta@cs.utah.edu`

Website

The class website is on Canvas: `utah.instructure.com`. It will contain all pertinent course info and materials, such as lectures, assignments, and announcements. All of your grades will be posted on this site so you can keep up with them throughout the semester. We will send messages to everyone in the class, such as corrections to assignments, changes to due dates, clarifications, etc. through Canvas. Students are required to check their email and the class web page regularly until final grades are posted.

Project

A large portion of the course will consist of a multi-phase project throughout the semester, in which students will implement a learning management system (LMS) like Canvas in roughly the following phases:

1. Design a database to serve the specific goal of the project. This will be a high-level abstract design in the form of an entity-relationship diagram.

2. Implement your design by creating SQL tables in your database that satisfy the relational requirements.

3. Implement the back-end of a web server to provide user-friendly access to the system. This interface will programmatically generate database queries based on user input, and return relevant information to the provided front-end.

4. Deploy your LMS online.

Assignments

This course will also have smaller standalone assignments designed to practice a specific aspect of the material. These will be programming assignments, written/diagram assignments, or executing SQL queries in your database. These will typically take one week each.

Quizzes

There is a short quiz on Canvas associated with each lecture. In general, there will be two quizzes due each week, and they are designed to not take very long. Quizzes will not be accepted late. The lowest two quiz scores will be dropped.

Tools

Databases will be implemented using MySQL. Testing and simple administration will be done via MySQL command-line tools. The web server will be implemented in C# with ASP.NET Core in Visual Studio 2019. You will need Windows and Visual Studio for this course. If you use a Mac, it is **strongly** recommended you install Windows natively with Bootcamp, instead of trying to use a Windows VM.

Late Assignments and Regrades$^{\Delta}$

Each assignment's deadline is followed by a three-day late period. You may use the late period on one assignment with no penalty. Unused late assignment allotments will not grant extra credit. Second and subsequent late assignments will incur a penalty of 15% of the assignment's max value if submitted within the 24-hour period following the due date. This penalty increases by 15% per 24-hour period, up to three days. Work submitted more than three days late will not receive credit. An assignment is considered late if submitted any amount of time past the deadline, as measured by the submission system. Any delays caused by the submission system or corrupt/lost files is not an excuse for lateness. **Do not risk submitting at the last minute**. Late days apply to assignments only; other work, such as quizzes, will not be accepted late. It is your responsibility to alert the course staff of any grading errors within 1 week of grades being released for the affected assignment.

Exams

The midterm exam will take place during Week 7 (the week of March 1), and the final exam will take place during Week 15 (the week of April 26).

Grading

Your work for each category will be weighted as follows:

- 30% project

- 30% assignments

- 10% quizzes

- 15% midterm exam

- 15% final exam

Letter grades will be assigned using the below scale, where X is your total score. Scores will not be rounded.

	$90 > X \geq 87$ B+	$80 > X \geq 77$ C+	$70 > X \geq 67$ D+	
$100 \geq X \geq 93$ A	$87 > X \geq 83$ B	$77 > X \geq 73$ C	$67 > X \geq 63$ D	$60 > X \geq 0$ E
$93 > X \geq 90$ A-	$83 > X \geq 80$ B-	$73 > X \geq 70$ C-	$63 > X \geq 60$ D-	

Getting Help

The TAs and I are here to help you. We are available outside of scheduled office hours by appointment.

The TAs will hold regular help hours throughout the week via Zoom. I will hold office hours for any help with the material, including help with homework via Zoom. Help hours and office hours will be posted online after the semester starts.

Use Piazza to contact the course staff. For sensitive or private issues, contact me directly. Do not try to contact us via Canvas submission comments on your assignment, since we will not see them.

Teamwork

Some of the work in this class will be done in teams of two. The unfortunate reality of working in teams is that sometimes your teammates do not contribute their fair share. Everyone is responsible for completing all coursework on time, even if your teammate does not contribute fairly. Scores will not be adjust upward, and extensions will not be granted due to difficulties with teammates. Pick your team wisely! Inform the course staff of any problems with your team as soon as they arise.

Cheating

See the University of Utah Student Code for a detailed description of the university policy on cheating, and read the Cheating Policy for this class posted on Canvas. Any student found cheating will fail the course.

College of Engineering Guidelines

https://www.coe.utah.edu/semester-guidelines

School of Computing Guidelines

https://www.cs.utah.edu/socguidelines/

Safety

The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

Violence and harassment based on race, national origin, color, religion, age, disability, sex or gender (which includes sexual orientation and gender identity/expression) is a civil rights offense and will not be tolerated. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776.

Students with Disabilities

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

Tentative Course Content

- Relational Model

- Keys

- Entity-Relationship Model

- Integrity Constraints

- Relational Algebra

- SQL

- SQL in C#, LINQ

- Injection Attacks

- Model, View, Controller (MVC) Software Architecture

- Transactions

- Passwords and Security

- Indexes

- B-Trees and R-Trees