

## CPS352 - DATABASE SYSTEMS

Professor:	Russell C. Bjork russell.bjork@gordon.edu	Spring semester, 2022-2023 MWF 1:50-2:50 pm KOSC 124
Office:	KOSC 242 508-843-7358 I will be available immediately after class and by appointment	Canvas course site plus public site: <a href="http://www.cps.gordon.edu/courses/cps352">http://www.cps.gordon.edu/ courses/cps352</a>

## SYLLABUS

### CATALOG DESCRIPTION:

Explores database technology; various data models, query languages, and application program-DBMS interface. Prerequisites: CPS122, CS221; MAT230 or MAT231 recommended.

### COURSE OBJECTIVES:

In general, this course is designed to introduce you to basic database management system concepts and applications.

In particular, upon completion of this course, you should be familiar with:

1. The entity-relationship and relational data models and alternatives.
2. The use of SQL.
3. Design and normalization principles for relational databases, including the various normal forms.
4. Underlying file structures used to implement databases, and their performance implications.
5. Multi-user database concerns such as crash recovery, concurrency control, security and integrity
6. Various applications of database systems.

**TEXT:** Silberschatz, Abraham, Henry F. Korth and S. Sudarshan. *Database System Concepts* (7th ed). (New York: McGraw-Hill, 2020).

**AVAILABLE ONLINE:** Selected tutorial material on SQL and IBM documentation for Db2 will be accessible from the Canvas site.

### COURSE TECHNIQUES AND PROCEDURES:

This is a survey course, in which we will attempt to gain a general familiarity with a large volume of material. For this reason, textbook reading and problem sets will play a larger-than-usual role in the course, with a proportionately reduced emphasis on actual programming. Homework exercises and two projects (one focusing on database design and the other on programming with commercial DBMS software) will provide an opportunity for you to experience practical application of the theoretical material.

## COURSE REQUIREMENTS AND EVALUATION:

1. You will be expected to read much of the textbook, as assigned in the topic schedule below. Reading assignments should be completed **BEFORE** the class hour in which the topic is discussed. Lecture presentations will assume that you have read the text, and it is expected that your participation in the class will reflect that fact. However, our classroom discussion will not rigidly follow the order of material in the text, nor will it be confined to material covered there.
2. Homework will be assigned for most classes. Homework assignments will be posted on the course Home Page in Canvas, and will be turned in under Assignments on Canvas. Solutions to homework problems will be discussed in class, and will eventually also be posted on Canvas.

All together, homework will be worth 30% of the final course grade, with the weight for each assignment being determined by the number and difficulty of the problems. (The size of the assignments, and hence the weight, will tend to be higher in the first part of the course.) Credit for homework will be awarded on the basis of the completeness and correctness of your solutions, with significant credit given for a reasonably complete attempt at solving each problem, even if the final answer is not correct.

- Homework must be turned in **BEFORE** the start of class on the date indicated. Late problem sets will **NOT** be accepted unless an extension is granted **IN ADVANCE**.
  - Homework will be turned in electronically via Canvas or email.
  - You may work together with another student on a problem set provided each of you works on each problem, and each turns in his/her own work.
  - Where a problem calls for writing a program, it is sufficient to write it out by hand; you need not enter it into the computer unless you are explicitly told to do so.
  - For some of the problems (designated "Practice Exercises" in the book), the textbook authors have posted solutions. You may not refer to these until after you have done the problem yourself, and your answer is expected to be your own work.
  - Often, solutions to other problems in the book has been posted illicitly or by "cheat" sites on the web. You may **NOT** use these, or even refer to them, for homework. If homework is turned in that is obviously derived from such a source, it will be treated as a form of plagiarism.
3. Structured Query Language (SQL) is the standard language for querying databases - even those based on some model other than the relational model for which it was developed. For this reason, it is important that you become thoroughly familiar and comfortable with using SQL. Several homework assignments will include questions that can be answered by performing a query and/or an update on an example database; you will be required to turn in a copy of the queries/updates and the answers that you got from them as part of the homework, and in some cases results will be checked in the actual database. Learning how to formulate the required queries and updates may require some searching of relevant SQL tutorial resources and reference materials; not everything needed will be presented in class.

4. Working as part of a team of 3-4 students, you will apply what you are learning to designing a relational database for an application of your own choice, requiring on the order of a dozen tables. You will be responsible for turning in (1) a description of the requirements for this system; (2) an E-R diagram; and (3) a relational schema and an actual database with simulated data. (You are not responsible for building the application - only for designing the database for it.) Specific requirements for the project will be posted on Canvas, and things that need to be turned in will be turned in under Assignments on Canvas. All parts of this project, together, will be worth 15% of the final course grade.
  
5. Working as part of a team of 3-4 students, you will do a major programming project involving the development of a DBMS application using SQL embedded in Java, using a database design and GUI furnished by the professor. Specific requirements for the project will be posted on Canvas, and things that need to be turned in will be turned in under Assignments on Canvas. This project will be worth 20% of the final grade.
  
6. There will be three examinations given as shown in the course schedule below. The first two will account for 10% and the final 15% of the final course grade (total 35%). Exams will be open book, open notes. At least the first two will be take-home.

Summary:	Homework	30%
	Database design project	15%
	Programming project	20%
	Three Exams	<u>35%</u>
		100%

7. Your final grade will be computed on the basis of a weighted sum of the items listed above.  
The following are minimum guaranteed grades for the percentages indicated:

87% - 89.9%: B+	93% - 100%: A	90% - 92.9%: A-
77% - 79.9%: C+	83% - 86.9%: B	80% - 82.9%: B-
67% - 69.9%: D+	73% - 76.9%: C	70% - 72.9%: C-
	63% - 66.9%: D	60% - 62.9%: D-

## ACADEMIC DISHONESTY

From the Gordon College Student Handbook: "Academic dishonesty—which occurs chiefly in the form of cheating and plagiarism—is regarded by Gordon College as a major violation of both the academic and spiritual principles of this community. A student who commits an act of academic dishonesty will receive disciplinary sanctions, which may include a failing grade on an assignment or failure of the course; in extreme cases and/or a repeat offense, the student may also face academic suspension or expulsion from the College. Given the serious consequences of academic dishonesty, students are encouraged to discuss any difficulties openly with their instructors instead of resorting to dishonest conduct." The handbook also defines plagiarism as "presenting another person's words, work or opinions as one's own. " Academic dishonesty will not be tolerated. You know better. Just don't!

## **COMPUTER USE IN CLASS**

If you have a laptop, you may find it useful to bring it to class when we are working with SQL (see schedule below). In any case, electronic devices (computers, tablets, phones, etc.) may be used in class **ONLY** for class work, including note taking, consulting class materials, and in-class assignments.

Using electronic devices for non-academic activities during class (email, social networking, games, internet browsing, etc.) will cause the student to lose the privilege of using electronic devices in class.

## **POLICY STATEMENT ON EXTENSIONS AND INCOMPLETES:**

1. Extensions of the due dates for homework or projects **MAY** be given in the event of extenuating circumstances (such as illness, personal emergency) **IF** you submit a brief written request to the professor as soon as possible after the circumstances arise.
2. A grade of Incomplete **MAY** be given without penalty **IF** you are unable to complete the course work by the last day of the term due to major illness or other similar emergency. You must apply for this using the form provided by the registrar. Such a request will only be granted if you are substantially up-to-date with your course work and were making good progress in the course up to the time that the difficulty arose. Of course, you must complete all work for the course by the midpoint of the next semester in accordance with College policy.

## **ATTENDANCE POLICY:**

Regular class attendance is expected of all students, and class attendance will be recorded. Absences from class will be classified as "excused" or "unexcused". An excused absence is one where the student misses class for a compelling reason (such as sickness, a field trip for another course, or an athletic competition, but not something like alarm clock issues) and has requested an excused absence. A student may request an excused absence up to three times in the semester by simply notifying the professor via email of the reason for the absence - prior to missing the class if possible. If it is necessary to miss more than three classes, the student must provide written documentation (such as a health center or doctor's note, or a notification from an athletic coach) for additional absences - otherwise they will be considered unexcused. A student who anticipates the need to miss multiple classes due to athletic competitions or other student activities must furnish written documentation, should review the college's attendance policy in the catalog, and must then discuss alternatives to class attendance with the professor at the start of the semester.

Normally homework or other written work due at a class where the student has an excused absence must be turned in prior to the class, but the professor may choose to allow work to be turned in late without penalty in the case of an unanticipated absence.

At the end of the semester, the student's final average will be reduced 1% for each unexcused absence after the first. A student who has more than 12 unexcused absences will fail the course automatically.

A student who is habitually late will have late arrival for class counted as a half absence for that class, and a student who sleeps through most or all of a given class session will be counted as absent for that class.

## **STUDENTS WITH DISABILITIES:**

Our academic community is committed to providing access to a Gordon education for students with disabilities. A student with a disability who intends to request academic accommodations should follow this procedure:

1. Meet with a staff person from the Academic Success Center (ASC) and provide them with current documentation of the disability.
2. Obtain a Faculty Notification Form from the Academic Success Center, listing appropriate accommodations.
3. Submit this form to professors and discuss accommodations with them, ideally within the first two weeks of class.

Some accommodations need more time to arrange, so communicating early in the semester is important. For more information, consult the Academic Success Center webpage:  
<http://www.gordon.edu/academicaccessibility> or email [asc@gordon.edu](mailto:asc@gordon.edu).

## **TENTATIVE SCHEDULE OF TOPICS:**

Date	Topic(s)	Reading	Homework/ Exams / Projects Due
W 1/11	Course Introduction; Fundamental DBMS Concepts		<b>Start Design Project</b>
F 1/13	(continued)	ch. 1	
M 1/16	<i>Martin Luther King Jr. Birthday - no class</i>		
W 1/18	The Relational Model; Relational Algebra	§ 2.1-2.4	
F 1/20	(continued)	§ 2.5-2.6.5	
M 1/23	(continued)	§ 2.6.6-2.7	
W 1/25	Entity-Relationship Data Modeling	§ 6.1-6.7	
F 1/27	(continued)		
M 1/30	Oral Presentations / Class Discussion of Design Project Requirements		<b>DESIGN PROJECT REQUIREMENTS</b>
W 2/1	SQL	§ 3.1-3.2; Skim/review § 3.3-3.7, 3.9-3.10 as necessary	
F 2/3	(continued)	Read § 3.8, 4.1, 4.3, 5.4 carefully	
M 2/6	(continued)	§ 4.4-4.5	

W 2/8	(continued)	§ 5.3; 4.2	
F 2/10	(continued)	§ 4.7	
M 2/13	Oral Presentations/Discussions of Design Project E-R Diagrams; (Start Relational Calculus if time)		<b>DESIGN PROJECT E-R DIAGRAM</b>
W 2/15	Relational Calculus; QBE	§ 27.1-27.3; briefly look at 27.4 (available online at <a href="http://db-book.com">db-book.com</a> )	
F 2/17	Review and Catch up		<b>TAKE-HOME EXAM 1 DISTRIBUTED (TOPICS THROUGH SQL)</b>
M 2/20	Database Normalization	§ 7.1-7.2	
W 2/22	(continued)	§ 7.3	<b>TAKE-HOME EXAM 1 DUE</b>
F 2/24	(continued)	§ Read § 7.4.1, 7.4.2; Skim § 7.4.3, 7.4.4;	
M 2/27	(continued)	§ 7.5	
W 3/1	(continued)	§ 7.6-7.7, 7.9; § 28.1 (available online at <a href="http://db-book.com">db-book.com</a> )	
F 3/3- F 3/10	<i>Quad and Spring Breaks - no class</i>		
M 3/13	Oral Presentations/Discussions of Design Project Database Schema		<b>DESIGN PROJECT DATABASE SCHEMA/ IMPLEMENTATION; Start Programming Project</b>
W 3/15	Oral Presentations (continued)		
F 3/17	Complex Data Types; Support for OO	§ 8.1-8.2	
M 3/20	Database Application Development	§ 9.1-9.2; § 9.8-9.8.1; § 5.1;	
W 3/22	Analytics; Decision Support Systems; Data Mining	§ 11.1-11.3; 5.5	
F 3/24	(continued)	§ 11.4-11.5	

M 3/27	DBMS Storage Devices and File Structures	ch. 12 (all); §13.1-13.2	<b>PROGRAMMING PROJECT PART I DUE</b>
W 3/29	BTree and Hashed Indices	§ 14.1-14.6	
F 3/31	(continued)	§ 4.6	
M 4/3	Review and Catch-Up		<b>TAKE-HOME EXAM 2 DISTRIBUTED (TOPICS RELATIONAL CALCULUS .. ANALYTICS ETC.)</b>
W 4/5	Efficient Query Processing Strategies;	§ 15.1-15.3; § 15.5-15.5.1	
F 4/7	<i>Good Friday - no class</i>		
M 4/10	<i>Easter Monday - no class</i>		
W 4/12	Query Processing Optimization	§ 16.1-16.3; § 16.5-16.5.1	<b>TAKE-HOME EXAM 2 DUE</b>
F 4/14	The Transaction Concept	§ 17.1-17.5	
M 4/17	(continued)	§ 17.6-17.11	<b>PROGRAMMING PROJECT PART II MILESTONE DUE</b>
W 4/19	Concurrency Control	§ 18.1-18.9	
F 4/21	Recovery	§ 19.1-19.6	
M 4/24	Database System Architectures; Parallel and Distributed Databases	§ 20.1-20.2; § 20.3 intro; § 20.4-20.4.2; § 20.5-20.8	
W 4/26	Map/Reduce Paradigm; NoSQL Database Systems	§ 10.3	
F 4/28	Guest Speaker - Dr. Tuck	<a href="https://cloud.google.com/blog/products/databases/reflecting-on-spanner-papers-sigops-hall-of-fame-award">https:// cloud.google.com/ blog/products/ databases/ reflecting-on- spanner-papers- sigops-hall-of- fame-award</a>	
M 5/1	Guest Speaker - Simon Miner		<b>PROGRAMMING PROJECT PART II EVERYTHING DUE</b>

**W 5/3      Review and Catch Up**

**F 5/5      2:15-4:15 PM Final Exam**

**NOTE:** All reading assignments above are in the text by Silberschatz et al. (Chapters 27, 28 are only available online at [www.db-book.com](http://www.db-book.com)) Some of the homework assignments will also include suggested readings in Birchall - accessible on the Canvas site.