



**KOÇ  
UNIVERSITY**

# **Database Management Systems**

## **Course Introduction**

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[www.memregursoy.com](http://www.memregursoy.com)



# Today's Plan

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- **Course logistics**

- Going through the course syllabus
- Description of course policies and grading
- Q&A about course logistics

- **Motivation and sneak peek**

- Why study databases and DBMSs?
- How are they useful / why take this course?
- What will you learn in this course?



# Recording Disclaimer

- **TL;DR: The lectures are recorded**



The synchronous sessions are recorded (audiovisual recordings). The students are not required to keep their cameras on during class.

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The academic expressions, views, and discussions in the course materials including the audio-visual recordings fall within the scope of the freedom of science and art.



# Course Description

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- Undergraduate course on DBs and DBMSs
  - Both conceptual and practical aspects
- **The course will cover:**
  - Database design & conceptual data models
  - Query languages: relational algebra, SQL
  - Database normalization and schema refinement
  - Systems aspects: Transaction management, scheduling, concurrency control
  - Indexing
  - Query optimization (tentative)
  - NoSQL



# List of Topics

- Introduction [today]
- Entity-Relationship model (E-R model)
- Relational model
- E-R model to relational model conversion
- Relational algebra
- Structured Query Language (SQL)
- Functional dependencies, normal forms and normalization
- Transaction management, ACID properties, scheduling, serializability
- Concurrency control: locking, 2PL, deadlocks
- Indexing (hash-based and tree-based)
- [Tentative] Query processing and optimization
- NoSQL databases



# Instructor



## M. Emre Gürsoy

Assistant Professor @ Koç University

[www.memregursoy.com](http://www.memregursoy.com)

PhD in Computer Science, 2020, Georgia Tech  
MS in Computer Science, 2015, UCLA  
BS in Computer Sci. and Engr., 2013, Sabanci Uni.  
High school, 2009, Robert College

**Research Areas:** Data privacy, security, data analytics and mining, adversarial machine learning, IoT, security&privacy in AI

- ❑ > 40 journal, conference and workshop publications, 3 US patents
- ❑ Frequently invited reviewer for intl. IEEE/ACM journals and conferences
- ❑ Several awards and grants (EdgeSys 2020 Best Paper Award, TUBITAK CAREER Grant in 2021, etc.)



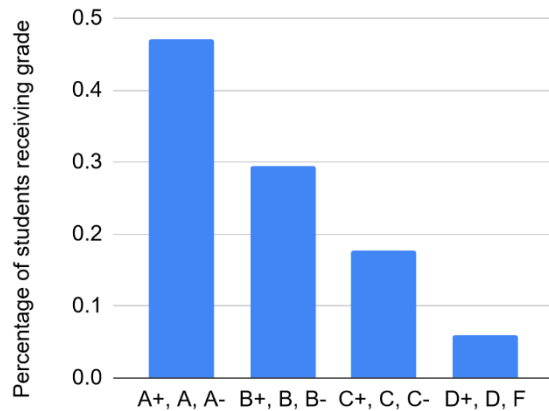
# Lectures

- Mon + Wed, 10:00-11:10 AM, SOS B10
- **Attendance and recording policy for lectures:**
  - Lectures will be held physically, in-person
  - I will open Zoom but not interact with Zoom participants
    - Zoom participation should be limited to exceptional circumstances
    - This is **different from the original syllabus I had uploaded to KUSIS**, due to the university's recommendations in the past few days
  - Lecture attendance will not be graded
    - Exception: During the semester, if <15-20% of the class is attending lectures, we may introduce grade incentives/penalties for attendance
  - Lecture recordings will be shared via Panopto
    - Do not rely on Panopto recordings alone!!

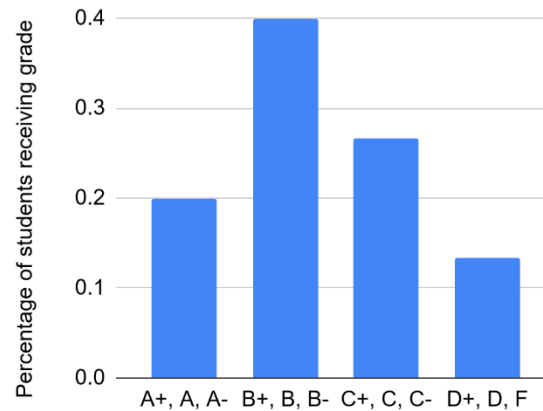


# Attendance vs Letter Grade

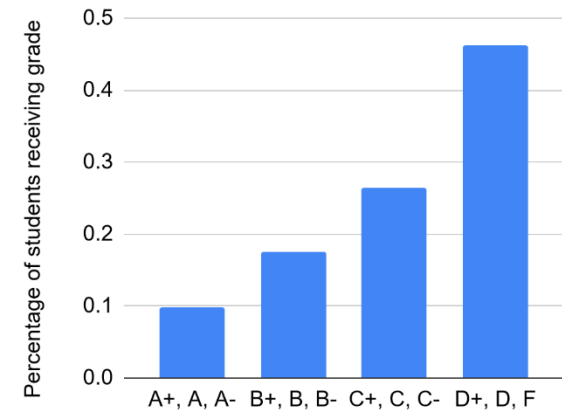
- Statistics from Spring 2023 semester
- Students are divided into 3 groups:
  - High attendance:  $\geq 65\%$  lecture attendance
  - Medium attendance: between 25-65% lecture attendance
  - Low attendance:  $< 25\%$  lecture attendance



High attendance



Medium attendance



Low attendance





# PS Sections

- You should be in **one** of the two PS sections:
  - PS-A (Friday 2:30-3:40 PM, SNA A44)
  - PS-B (Friday 10:00-11:10 AM, SNA B173)
- Will be led by TAs, same material in both sections
- Depending on the week, **problem solving** or **practical (hands-on) experience** with DBMS software
  - For the prior: questions are typically from previous years' assignments and exams!
  - For the latter, you need your laptop
    - Installation prior to coming to PS can be necessary
    - We will make announcements in such cases



# Delivery of PS Sections

- **Attendance and recording policy for PS:**
  - PS sections will be held physically, in-person
  - There is no Zoom option (probably)
  - PS attendance will **not** be graded
  - PS will not be recorded or shared
    - **This is different from the lectures!!**
    - **You must participate in the PSs to obtain exercises and their solutions**
- **We don't have PS in the first week**



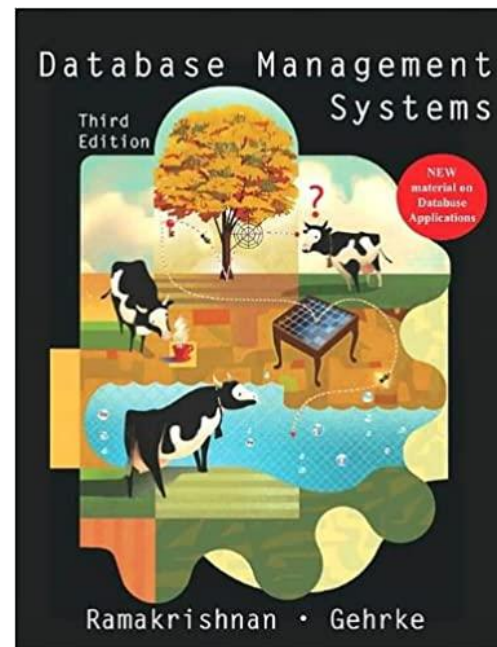
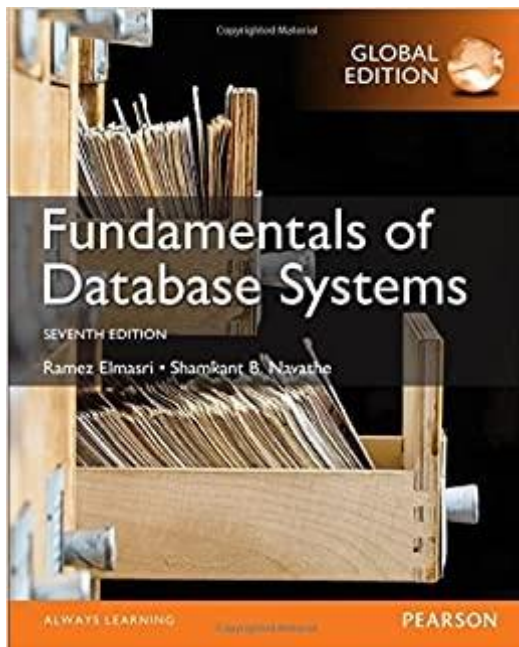
# Pre-requisites

- **COMP202: Data Structures and Algorithms** is the pre-requisite for this course
  - It will be strictly enforced
  - I will not give consent to take COMP306 if you didn't pass COMP202 already
- Graduate students:
  - No pre-requisite from KU course pool
  - But similar background is needed
    - Proficiency in math & programming are necessary



# Course Textbook

- No mandatory textbook
- Following two books can be beneficial:
  - "Fundamentals of Database Systems" by Elmasri and Navathe
  - "Database Management Systems" by Ramakrishnan and Gehrke





# Textbook Policy

- Course lectures + slides are your **primary** resources
- Textbooks are your **secondary** resources
- We may not cover all chapters, we may not cover everything in a chapter
  - **You are responsible for material that is covered in the lectures**
  - **You should not rely on material from the books or elsewhere that is not covered in the class**
- There may be discrepancies between resources
  - Book to book, edition to edition
  - **The version that is taught in the lectures is FINAL**
  - **I will not accept objections such as: "But Chapter N of the M'th edition of book X says ..."**



# Grading (Tentative)

Midterm Exams (2x)	48% (24% each)
Final Exam	30%
Homework Assignments	12%
Group Project	10%

## ■ Midterms and Final:

- Traditional written exams, **face-to-face (on campus)**
- Scheduled by the Registrar's Office
- Mixture of question types: True/False, multiple choice, short problems, query writing, ...
- I typically offer some bonus points for extra credit
- Final exam is cumulative



# Homework Assignments

- 4 or 5 HW assignments, expected: 4
  - Total worth:  $4 \times 3\% = 12\%$
  - Not difficult if you actually know the topics
- HWs for conceptual topics will be “pen and paper”
- Most HWs will require implementation
  - Ex: **data science** (Python) with **SQL** back-end

**HOMEWORK ASSIGNMENTS MUST BE COMPLETED INDIVIDUALLY. ALSO, USING CHATGPT OR SIMILAR TOOLS IN HOMEWORK ASSIGNMENTS IS FORBIDDEN.**



# Late Homework Policy

- For late submission of HWs:
  - Up to 10 mins late: **-5% penalty**
  - 10 mins to 1 hour late: **-20% penalty**
  - > 1 hour late: **not accepted**
- Exceptions: emergencies (e.g., medical) with proper documentation (accepted by KU Health Center)
  - As much as possible, let me know **ahead of time**
- Do not ask for extensions close to a deadline (or after a deadline) – I want to be fair to all students





# Group Project

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- 4-5 students per group (tentatively)
- In the second half of the semester
- Pick one application area of DBMSs and implement a DBMS-powered software project
  - Back-end **must** use DBMS, front-end is your choice
- Steps:
  1. Design your application and database
  2. Populate DB with real/realistic data
  3. Integrate complex queries & functionalities
  4. Demonstrate working prototype



# Project Ideas

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- Movie tracking and rating site (mini-IMDB)
- Supermarket management app
  - Products, employees, customers, purchases, ...
- University management app (mini-KUSIS)
- Library management app
  - Books, authors, customers, borrowing/selling
- E-commerce or online retail site (mini-Amazon)
- Real estate and house rental site
  
- **Functionality is important**
- **Making good use of course concepts is important**



# Academic Honesty

- Collaboration is allowed only in the **Group Project**
- In all other graded items, **STUDENTS MUST WORK INDIVIDUALLY.**
- Violations will be immediately reported to the University Disciplinary Committee.
  - No warnings will be given to the involved student(s)
  - No tolerance to cheating

Koç University Student Code of Conduct:

<https://apdd.ku.edu.tr/en/academic-policies/student-code-of-conduct/>



# Exam Policy

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- As of the beginning of the semester, I plan to conduct all exams physically, in-person
- Unless there is a university-wide rule that enforces all exams to be held online, **EVERYONE must take in-person exams with no exceptions**
  - By taking this course, you are assumed to have read and understood this rule



# Make-up Exams

- You can get a make-up exam if you miss a midterm or final with a **valid** excuse
  - Must be accepted and approved by the University (e.g., Health Center), and sent to me officially
- A **single, joint make-up exam** is given at the end of the semester
  - Covers all topics
  - You take this make-up regardless of which exam you missed (counts in place of your missing exam)
  - **Friendly advice:** take the regular exams 😊



**Done with the logistics part...**

**Questions?**



# Basic Definitions

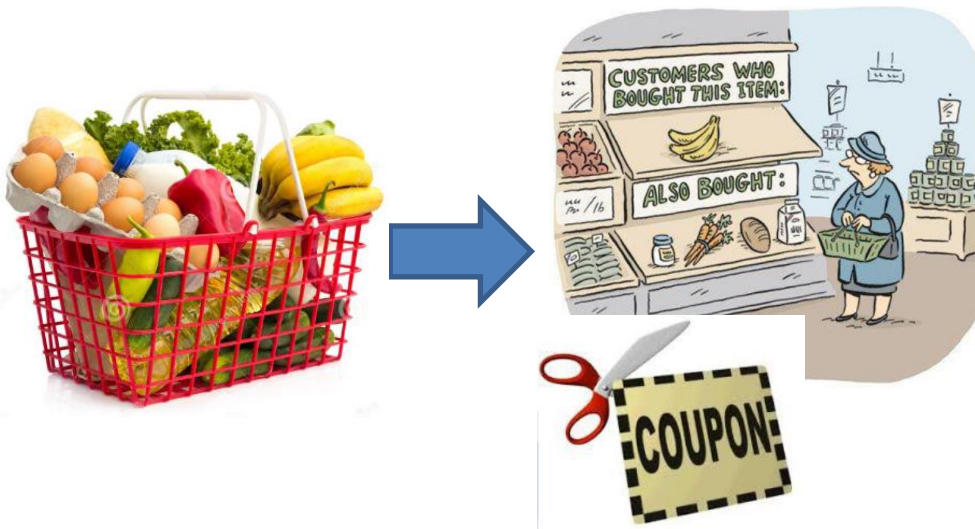
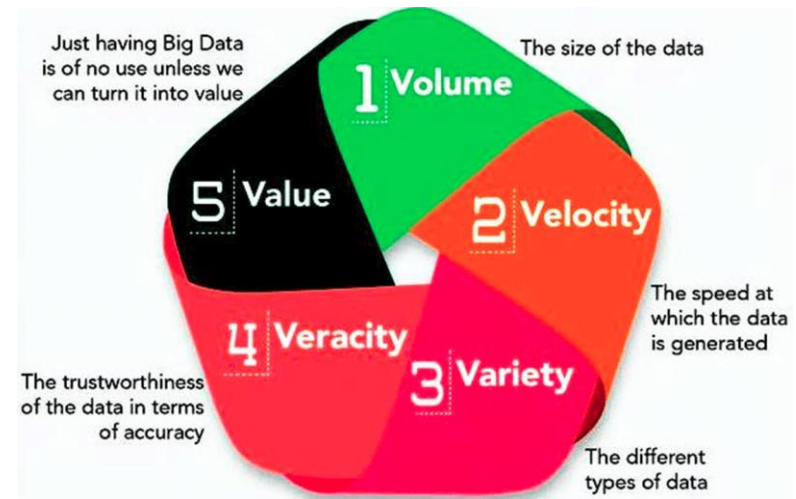
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- **Data:** Known facts that can be recorded and have an implicit meaning.
- **Database (DB):** A collection of related data.
- **Database Management System (DBMS):** A software package or system to facilitate the creation and maintenance of a computerized database.



# Why Do We Need DBs?

- There are large volumes of data everywhere
- We need to store and process this data effectively, before we can use it or turn it into value







# Who Uses DBs?

- **DBs are pervasive in many industries**
  - **Banking**
    - Client information, accounts, cards, money transactions, ...
  - **Airlines**
    - Flights, bookings, scheduling, pilots, customers, ...
  - **Telecommunication**
    - Customer info, call archives, bills, balances, ...
  - **Sales and/or e-commerce**
    - Products, buyers, sellers, pricing, sales records, shipping records, ...
  - **Education**
    - Students, instructors, courses, course schedules, grades, ...
  - ... and many more!



# A Simple Database

- University DB:
  - University has many courses
  - A course can be taught by different instructors in different years and semesters, and can have different sections
  - Courses have prerequisites, but different sections of the same course should have same prerequisites
  - Students enroll into courses and receive letter grades
  - Students can take a course multiple times (but not in the same semester)
  - ...

**COURSE**

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

**SECTION**

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	04	King
92	CS1310	Fall	04	Anderson
102	CS3320	Spring	05	Knuth
112	MATH2410	Fall	05	Chang
119	CS1310	Fall	05	Anderson
135	CS3380	Fall	05	Stone

**GRADE\_REPORT**

Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

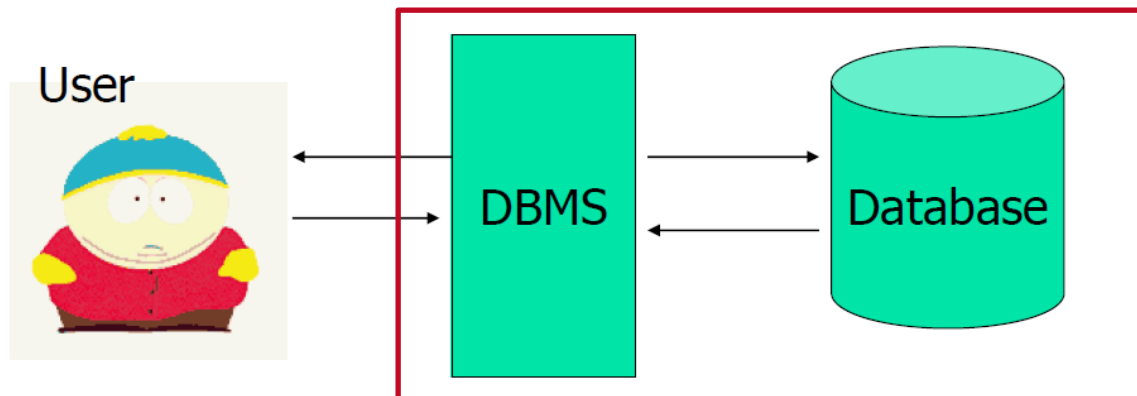
**PREREQUISITE**

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310



# Need for DB+DBMS Experts

- Most large-scale software projects have a database component
- Someone needs to:
  - Design the DB (what are the tables? what are the data types?)
  - Implement the DB and set up the related environment
  - Maintain and refine the DB (e.g., changing requirements)
  - Write complex queries, ensure query efficiency
  - Ensure procedures exist for backups, data recovery, data integrity, parallelism, concurrency, ...





# Advantages of DBMSs

- "Can't we just store data in large txt/csv files?"
- DBMSs offer several advantages:
  - Data integrity and consistency
  - Remove or disallow duplicates
  - Persistent, durable storage; backup and recovery
  - Parallelism, support for concurrent usage
  - Indexing, efficient query processing (much faster than scanning through large txt/csv files!)
  - ... and many more that we won't cover in this course (e.g.: access control mechanisms for security)
- But of course there could be cases where DBMSs may be **infeasible** (e.g.: embedded systems) or **overkill** (5 kb csv file, quick 30 LoC script)