Introduction to Database Systems: CS312
An Overview of Databases

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Let’s discuss...

What is the function of a database?
Database Applications:

- Banking: transactions
- Airlines: reservations, schedules
- Universities: registration, grades
- Sales: customers, products, purchases
- Online retailers: order tracking, customized recommendations
- Manufacturing: production, inventory, orders, supply chain
- Human resources: employee records, salaries, tax deductions
Databases at *Our* College!

**Application:**
- Adding new students, instructors, and courses
- Registering students for courses, and generate class rosters
- Assigning grades to students,
- Computing grade point averages (GPA)
- Generating transcripts
To connect data in some meaningful way

Database applications

I have connections

Common problems

Group Work

Database Management System

Employee_ID
Name
SSN
Position
Date_Hired
Gross_Pay
Net_Pay
Life_Insurance
Pension_Benefit
Health_Care

Human Resources Database

Benefits View
Name
SSN
Health_Care

Payroll View
Name
SSN
Gross_Pay
Net_Pay
Databases were not always used as they are today ...

- They were often disconnected systems
- Isolated from other systems that contained similar data.
- (Why would anyone use this configuration??)
Meanwhile at *Batman and Associates*...  
One database was working well...

- One (simple) working database containing all company information.
Two teams join *Batman and Associates*...
The database is copied into two new identical bases for use by two different teams in the Bat-cave.
Each team gets own DB...
Batman and Associates...
Problems in the Bat-cave

- Nearly identical: no equal updating of each base.
- Teams verbally communicate changes to each other
Batman and Associates confuses an address…
What went wrong?! :-(

**Dr. Vader’s actual address?**

1\textsuperscript{st} Address:
221b Baker Street
London, England

2\textsuperscript{nd} Address:
1600 Pennsylvania Avenue,
Washington, DC

The Wonder Base

The Potter Base
Database applications were once built directly on top of file systems (i.e., permanent records of information in various spread-out files)

A firm may have managed several information sources!

Anything wrong with this picture?
Messy Data Storage?
Risks of having several different DBs for same information

- Drawbacks of using file systems to store data
  - Data redundancy and inconsistency
  - Multiple file formats, duplication of information in different files - hard to share
  - Difficulty in accessing data
  - Need to write a new program to carry out each new task
  - Data redundancy and inconsistency
  - Data isolation - multiple files and formats
Drawbacks of using file systems to store data, continued

- Data redundancy and inconsistency
- Integrity problems - The data is not accurate and consistently stored
- Data redundancy and inconsistency
- Integrity constraints (i.e., account balance \( \geq 0 \)) become "buried" in program code rather than being stated explicitly
- Hard to add new constraints or change existing ones

How many times did you see, "Data redundancy and inconsistency", here??

How many times should you see the same data in your DB??
Messy Data Storage?

- **Atomicity** of updates
  - An *atomic* transaction is an indivisible and irreducible series of database operations such that either all occur, or nothing occurs.
  - Failures may leave database in an inconsistent state with *partial* updates carried out.
  - Example: Transfer of funds from one account to another should either complete or not happen at all.
Messy Data Storage?

- **Concurrency**: transactions at same time
  - Access by multiple users
  - Access needed for performance - no slow-down
  - Uncontrolled concurrent accesses can lead to inconsistencies
    Example: Two people reading a balance (say 100) and updating it by withdrawing money (say 50 each) at the same time
Messy Data Storage?

- Security problems
  - Hard to provide user access to some, but not all, data
  - Difficult to control how data is used
  - How to watch all databases, all the time?

- Database systems offer solutions to all the above problems
Video: Finding Trends in Data

- Hans Rosling’s 200 Countries, 200 Years, 4 Minutes - The Joy of Stats
- https://www.youtube.com/watch?v=jbkSRLYSoojo
Video: Questions

1. What kind of data was likely being used for this study?
2. Where could a database serve in this project?
3. How was the data likely organized for the study?
4. What kinds of relationships were likely used to connect data points?
5. How could this study be done in absence of a database?