



# Introduction to Database Systems: CS312

## An Overview of Databases

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# 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!

Database  
applications

I have  
connections

Common  
problems

Group Work



- 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

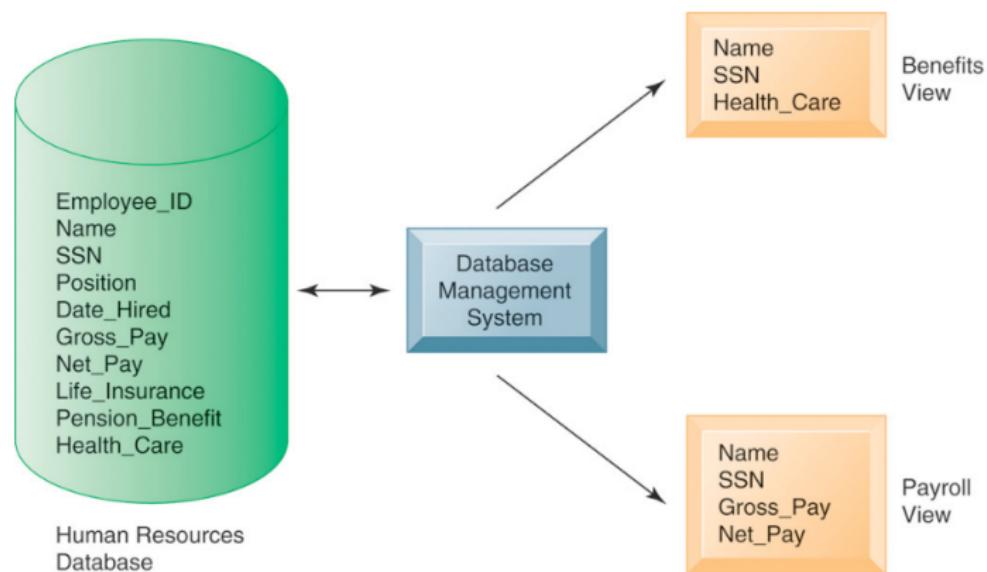
# To connect data in some *meaningful* way

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# Database - A *True Story* (sort of)

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- 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...

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- One (simple) working database containing all company information.

# Two teams join *Batman and Associates...*

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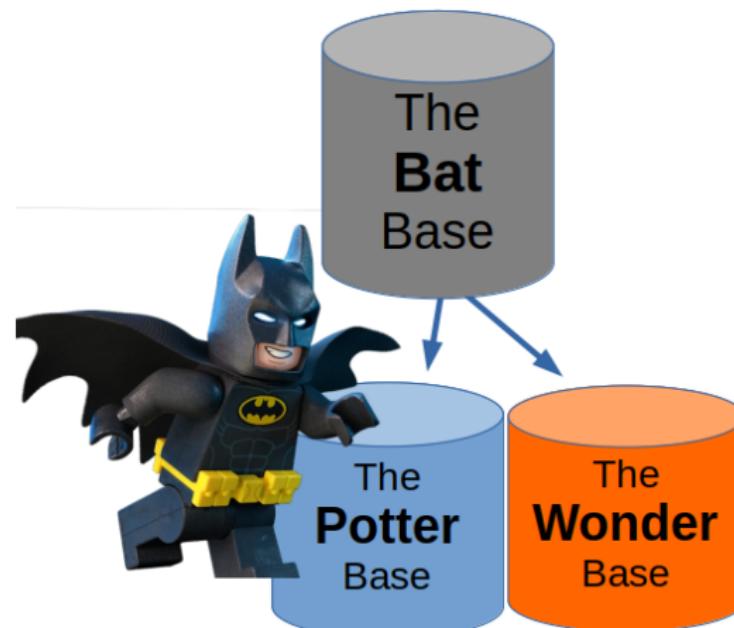


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- The database is copied into two new identical bases for use by two different teams in the Bat-cave.

# Each team gets own DB...

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# Batman and Associates...

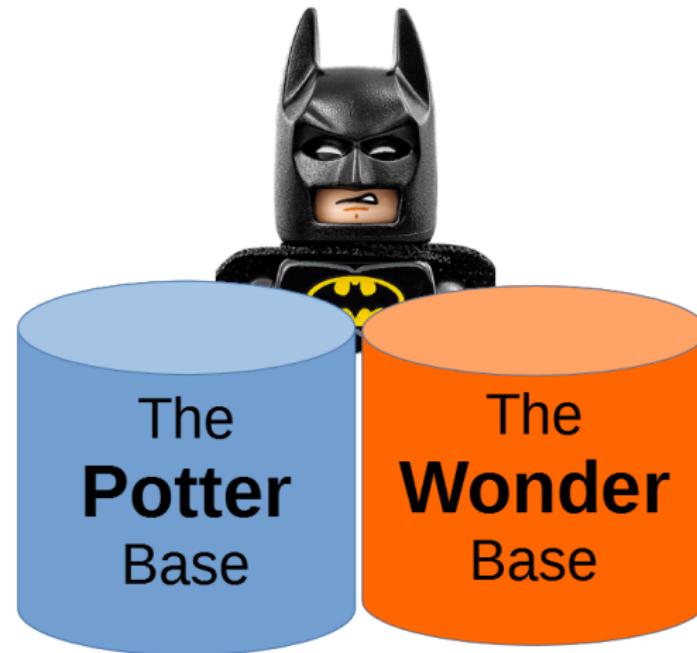
After a time, problems in the Bat-cave

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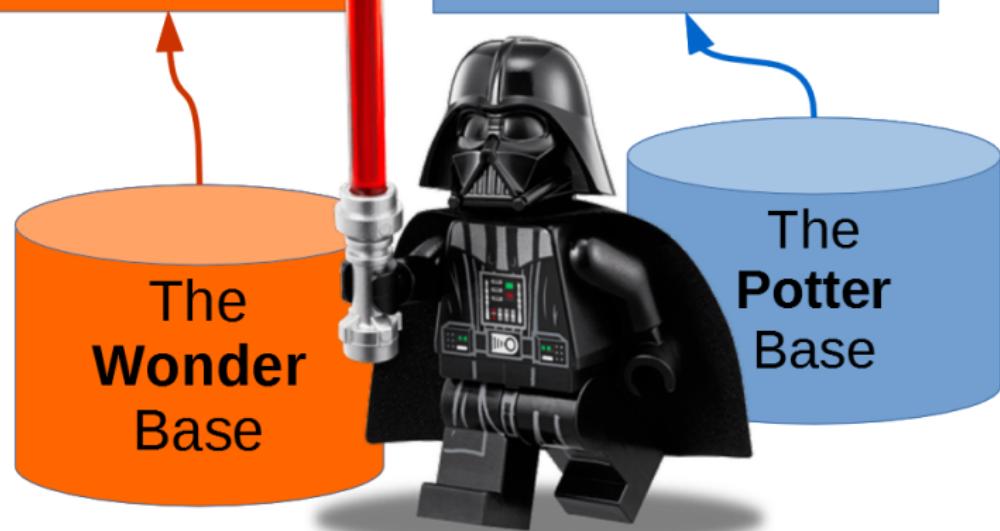
- *Nearly identical: no equal updating of each base.*
- Teams verbally communicate changes to each other



## Dr. Vader's actual address?

**1<sup>st</sup> Address:**  
221b Baker Street  
London, England

**2<sup>nd</sup> Address:**  
1600 Pennsylvania Avenue,  
Washington, DC





# How Many Databases Do You Need??

Common problems

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Let's talk about ...

## Common Problems with Databases



# How Many Databases Do You Need??

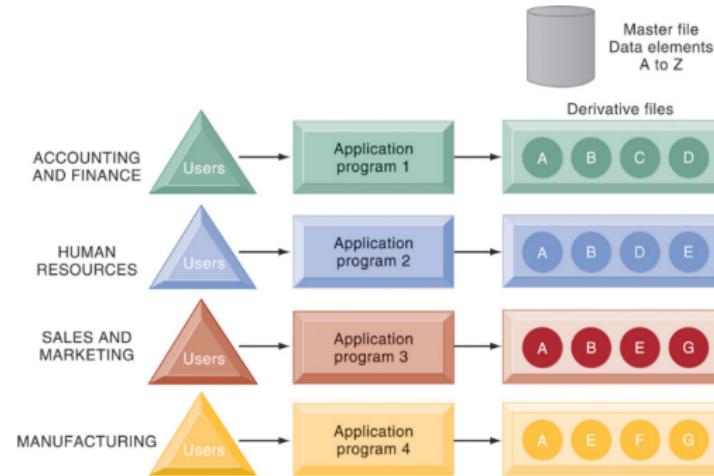
## Common problems

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- 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

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- 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

# Messy Data Storage?

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- 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??

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## • 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

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- **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?

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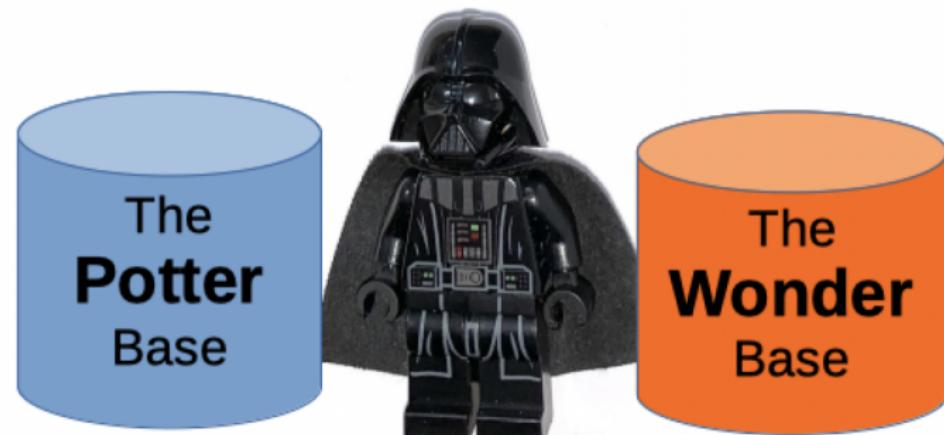
- Security problems
  - Hard to provide user access to some, but not all, data
  - Difficult to control how data is used
  - How to watch all databases, all the time?
- Database systems offer solutions to all the above problems

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*Dr. Vader's  
current address  
remained a mystery!*

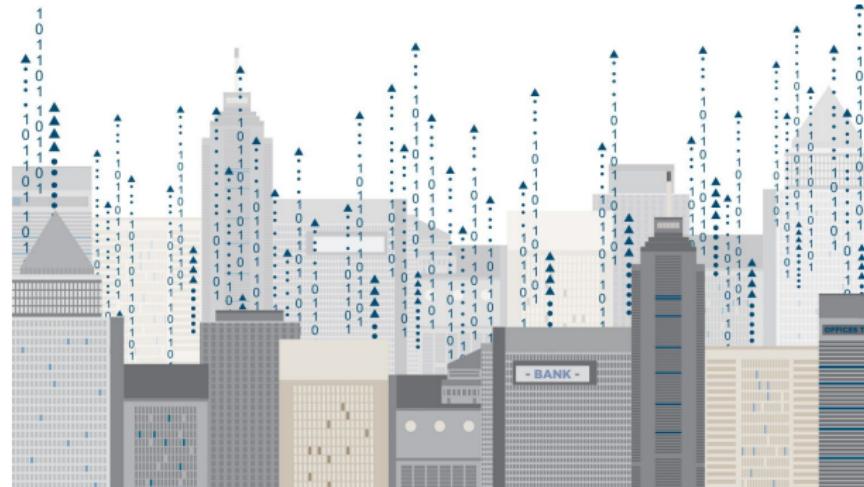
# Video: Finding Trends in Data

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- Hans Rosling's 200 Countries, 200 Years, 4 Minutes - The Joy of Stats
- <https://www.youtube.com/watch?v=jbkSRLYSOjo>

# Video: Questions to Consider

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- 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?