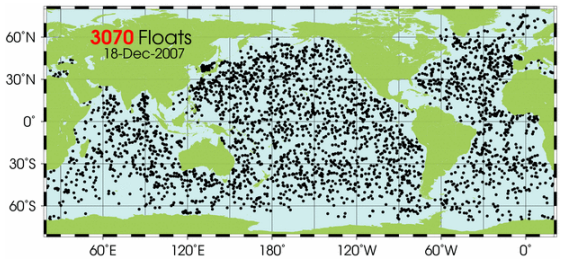
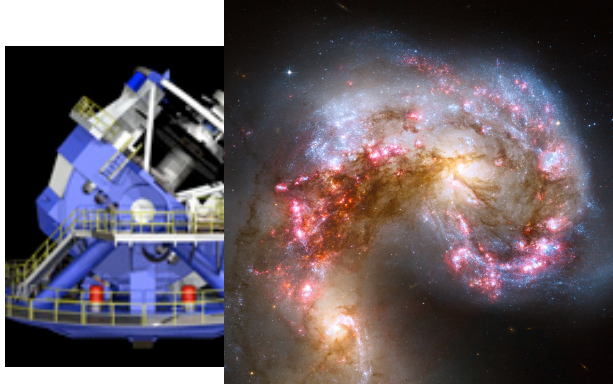
Introduction to Data Management
CSE 344

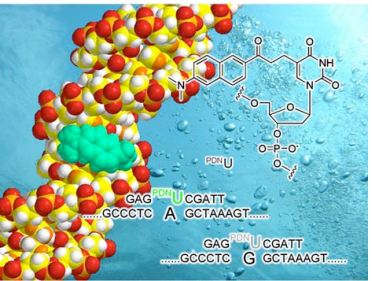
Lecture 1: Introduction

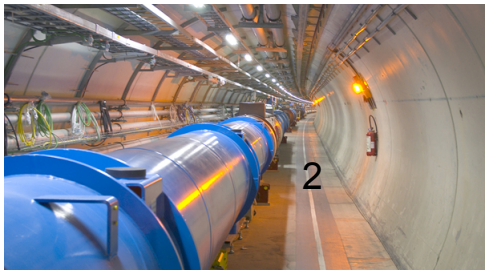


Class Goals



- The world is drowning in data!
- Need computer scientists to help manage this data
  - Help domain scientists achieve new discoveries
  - Help companies provide better services (e.g., Facebook)
  - Help governments (and universities!) become more efficient
- Welcome to 344: Introduction to Data Management
  - Existing tools PLUS data management principles
  - This is not just a class on SQL!

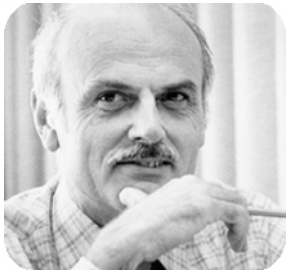




Turing Awards in Data Management

Charles Bachman, 1973

IDS and CODASYL



Ted Codd, 1981

Relational model

You could be next!!

Jim Gray, 1998

Transaction processing

Michael Stonebraker, 2014

INGRES and Postgres

Staff

- Instructor: Dan Suciu
- TA's
  - Allison Chou
  - Jingchen Hu
  - Jonathan Leang
  - Peter Li
  - Mathew Luo
  - Rajiv Veeraraghavan

Course Format

- Lectures
  - Location: here!
  - Please attend
- Sections:
  - Content: exercises, tutorials, questions, new materials (occasionally)
  - Locations: see web
  - Please attend
  - Bring your laptop
- 8 homework assignments
- 7 web quizzes
- Midterm and final
- Class and section participation
  - Post and **answer** questions (in class, piazza, etc)

Grading

- Homeworks 30%
- Web quizzes 10%
- Midterm 20%
- Final 30%
- Class participation 10%

- This is all subject to change

Communications

- Web page: http://www.cs.washington.edu/344
  - Syllabus (course information)
  - Schedule: add to your calendar
  - Lecture/section notes will be available there
  - Homework assignments will be available there
  - Link to web quizzes is there
- Piazza
  - Sign up: https://piazza.com/washington/fall2017/cse344
  - **THE** place to ask course-related questions
  - Log in today and enable notifications
- Class mailing list
  - You are automatically subscribed
  - Low traffic, only important announcements

Textbook

Main textbook, available at the bookstore:

- *Database Systems: The Complete Book*,
  Hector Garcia-Molina,
  Jeffrey Ullman,
  Jennifer Widom

  Second edition.

REQUIRED READING !

Other Texts

Available at the Engineering Library
(some on reserve):

- *Database Management Systems*, Ramakrishnan
- *Fundamentals of Database Systems*, Elmasri, Navathe
- *Foundations of Databases*, Abiteboul, Hull, Vianu
- *Data on the Web,* Abiteboul, Buneman, Suciu

Eight Homework Assignments

H1: Sqlite intro (1 wk)

H2: Sqlite basics (1 wk)

H3: Advanced SQL on Azure (1⅔ weeks)

H4: Datalog and Relational Algebra (1⅓weeks)

H5: NoSQL: Json/SQL++ (1 wk)

H6: Spark on AWS (1⅓weeks)

H7: Schema Design (1wk)

H8: Transactional Application (1⅓weeks)

New this year: submit via git

About the Assignments

- You will learn/practice the course material:
  - SQL, RA, parallel db, transactions, ...
- You will also learn lots of new technology
  - Cloud computing: Azure, Cloud9, AWS
  - NoSQL: AsterixDB, LogicBlox
  - Git
- The time spent learning the new technology is very useful: write everything on your CV!

Deadlines and Late Days

- Assignments are expected to be done on time, but things happen, so…
- You have up to 4 late days
  - No more than 2 on any one assignment
  - Use in 24-hour chunks
- Late days = safety net, not convenience!
  - You should not plan on using them
  - If you use all 4 you are doing it wrong

Seven Web Quizzes

- http://newgradiance.com/
- Create account;
  please use the same ID as your UW ID
- Provide token (on the whiteboard)
- Short tests, take many times, best score counts
- No late days – closes at 11:00 deadline
- Provide explanations for wrong answers

Exams

- Midterm (Nov. 1) and Final (Dec. 11)
- You may bring letter-size piece of paper with notes
  - May write on both sides
  - Midterm: 1 sheet, Final: 2 sheets
- Closed book. No computers, phones, watches,...
- Location: in class

Academic Integrity

- Anything you submit for credit is expected to be your own work
  - Of course OK to exchange ideas, but not detailed solutions
  - We all know difference between collaboration and cheating
  - Attempt to gain credit for work you did not do is misconduct
- I trust you implicitly, but will come down hard on any violations of that trust

Lecture Notes

- Will be available before class online
- Feel free to bring them to class to take notes

Using Electronics in Class

In the lectures:

- Opened laptops may disturb neighbors
- Please sit in the back if you take notes on laptop; pads / surfaces are OK
- Please don't check your email / youtube / fb

In the sections:

- Always bring your laptop (starting tomorrow)

Now onto the real stuff…

Outline of Today's Lecture

- Overview of database management systems

- Course content

Database

What is a database ?

Give examples of databases

Database

What is a database ?

- A collection of files storing related data

Give examples of databases

Database

What is a database ?

- A collection of files storing related data

Give examples of databases

- Accounts database; payroll database; UW's students database; Amazon's products database; airline reservation database

Database Management System

What is a DBMS ?

Give examples of DBMSs

Database Management System

What is a DBMS ?

- *A big program written by someone else that allows us to manage efficiently a large database and allows it to persist over long periods of time*

Give examples of DBMSs

- Oracle, IBM DB2, Microsoft SQL Server, Vertica, Teradata
- Open source: MySQL (Sun/Oracle), PostgreSQL, CouchDB
- Open source library: SQLite

We will focus on relational DBMSs most quarter

An Example: Online Bookseller

- What data do we need?
  -
  -
  -
  -
- What capabilities on the data do we need?
  -
  -
  -

An Example: Online Bookseller

- What data do we need?
  - Data about books, customers, pending orders, order histories, trends, preferences, etc.
  - Data about sessions (clicks, pages, searches)
  - Note: data must be persistent! Outlive application
  - Also note that data is large… won't fit all in memory
- What capabilities on the data do we need?
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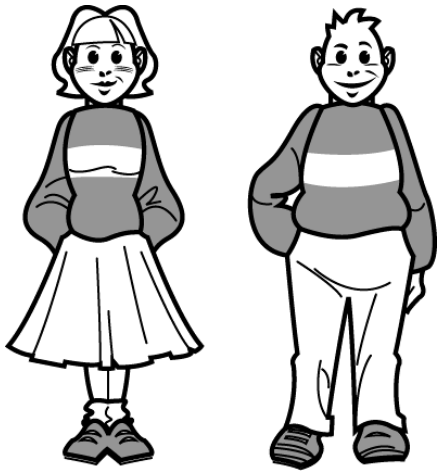
  - Note: data must be persistent! Outlive application
  - Also note that data is large… won't fit all in memory
- What capabilities on the data do we need?
  - Insert/remove books, find books by author/title/etc., analyze past order history, recommend books, …
  - Data must be accessed efficiently, by many users
  - Data must be safe from failures and malicious users

Challenges for a DBMS

Alice and Bob receive a $200 gift certificate as wedding gift



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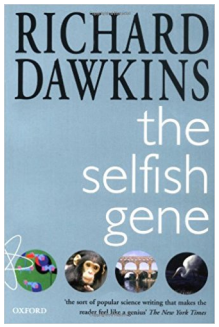
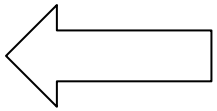
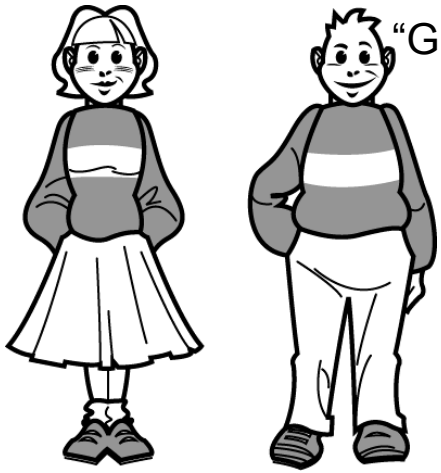


$80

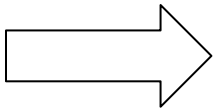
Alice @ her office orders
"The Selfish Gene"

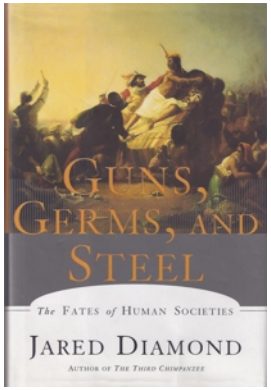




Alice Bob

Bob @ home orders
“Guns, germs, and steel”





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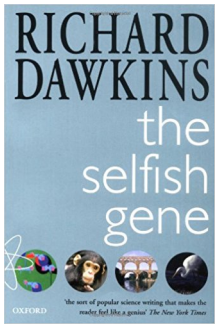

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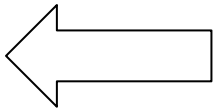

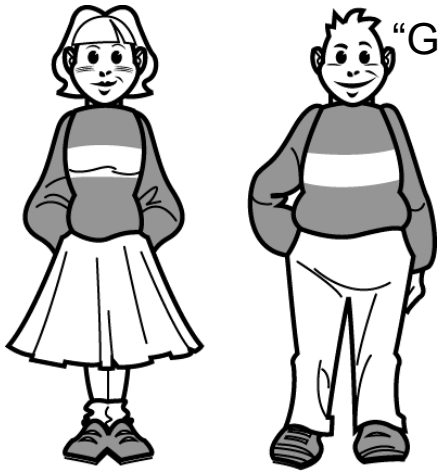

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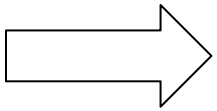

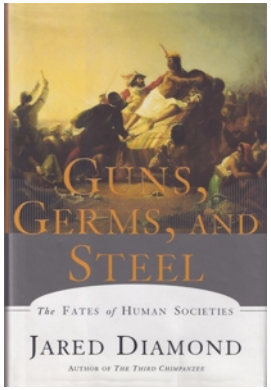

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Questions:

- What is the ending credit?
- What if second book costs $130?
- What if system crashes?

Challenges for a DBMS

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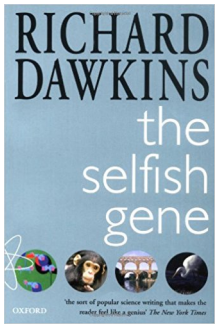

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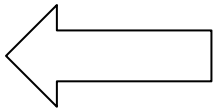

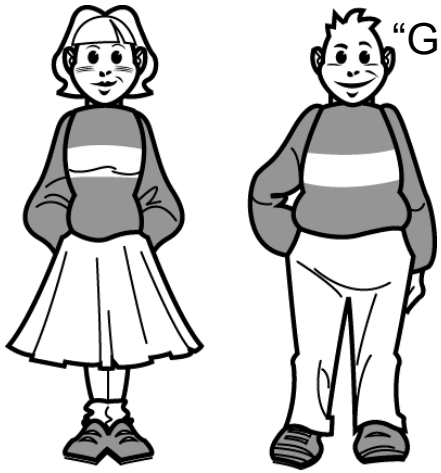

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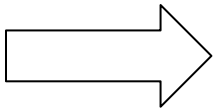

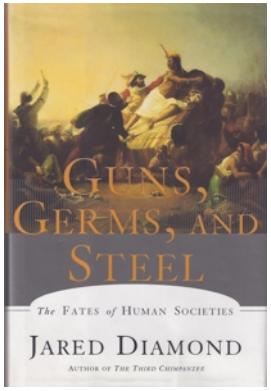

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Lesson: a DBMS needs to handle various scenarios

What a DBMS Does

- Describe real-world entities in terms of stored data
- Persistently store large datasets
- Efficiently query & update
  - Must handle complex questions about data
  - Must handle sophisticated updates
  - Performance matters
- Change structure (e.g., add attributes)
- Concurrency control: enable simultaneous updates
- Crash recovery
- Security and integrity

The players

- **DB application developer**: writes programs that query and modify data (344)
- **DB designer**: establishes schema (344)
- **DB administrator**: loads data, tunes system, keeps whole thing running (344, 444)
- **Data analyst**: data mining, data integration (344, 446)
- **DBMS implementor**: builds the DBMS (444)

Data Management Concepts

- Data model
- Declarative query language
- Data independence
- Query optimization
- Physical design
- Transactions

What is this class about?

- Unit 1: Intro (today)
- Unit 2: Relational Data Models and Query Languages
- Unit 3: Non-relational data
- Unit 4: RDMBS internals and query optimization
- Unit 5: Parallel query processing
- Unit 6: DBMS usability, conceptual design
- Unit 7: Transactions
- Unit 8: Advanced topics (time permitting)

What to Do Now

http://www.cs.washington.edu/344

- Homework 1 is posted
  - Simple queries in SQL Lite
  - Due on Tuesday, 10/3
- Webquiz 1 is open
  - Create account at http://newgradiance.com/
  - Sign up for class online
  - Due on Friday, 10/6
- First sections
  - Tutorial on git, and on SQL Lite
- Post on Piazza if you have questions about HW and lecture