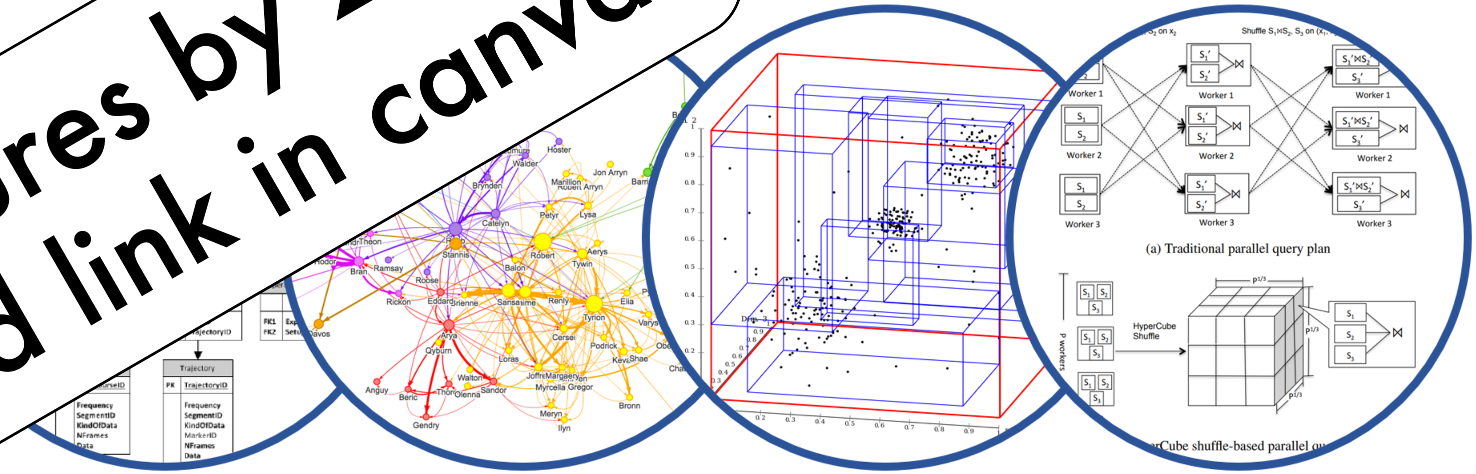
Lectures by zoom!
Find link in canvas



Database System Internals

Introduction

Paul G. Allen School of Computer Science and Engineering
University of Washington, Seattle

Course Staff

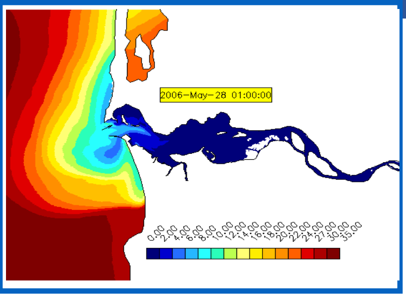
Instructors:

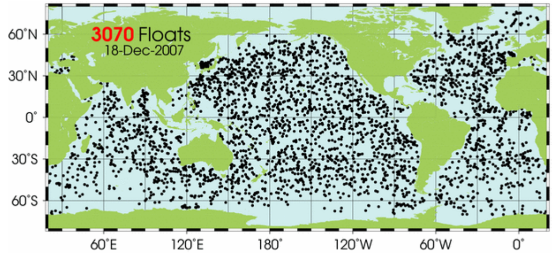
- Dan Suciu

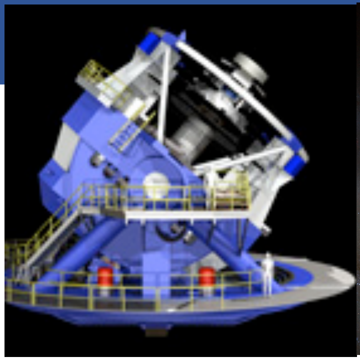
TAs:

- Kexuan Liu
- Yin Yin Low
- Remy Wang
- Ying Wang
- Yuchong Xiang
- Steven Su

Course 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
  - Help governments become more efficient
- This class: **principles of building data mgmt systems**
  - Learn how classical DBMSs are built
  - Learn key principles and techniques
  - Get hands-on experience building a working DBMS

Course Format

- Lectures MWF @ 11:30pm
- Sections: Thursday 12:30-3:20
- Homeworks
  - 5 Labs + 6 Written homeworks
- Quizzes:
  - 2 short quizzes, online (details TBD)

Communication (part 1)

- Canvas: https://canvas.uw.edu/courses/1371886
  - Zoom link is here
  - Lecture/section recordings are here
- Web page: http://www.cs.washington.edu/444
  - Lectures/Sections slides will be posted there
  - Homeworks/Labs will be available there
- Mailing list
  - Low traffic

Communication (part 2)

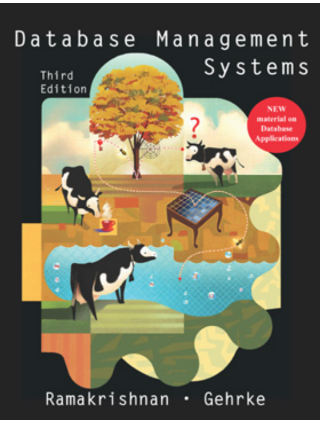
- Message board: https://piazza.com/class/k86gm4kio4653a
  - Ask questions about the course, labs, homeworks
  - Feel free to answer questions too! If you think you know how to answer but are not sure, simply say so
  - Staff will check & answer questions regularly

- Do not post any fragments of your code

Communication (part 3)

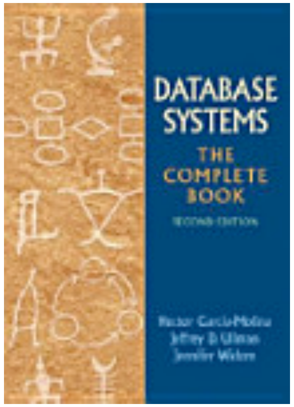
- Do **not** send questions by email unless
  - You need to discuss a personal matter
  - You want to setup an appointment
  - A question has not been answered on the board

Textbooks


Database Management Systems
Third Edition
NEW material on Database Applications
Ramakrishnan · Gehrke

Recommended textbook (pick one)

- Database Management Systems. **Third Ed**. Ramakrishnan and Gehrke. McGraw-Hill.



- *Database Systems: The Complete Book*,

Hector Garcia-Molina, Jeffrey Ullman, and Jennifer Widom. **Second edition**.

See course website for recommended chapters

Other Readings

- See Website
- There is a section on reading assignments for 544M only

Grading CSE 444

- Labs: 50%
- Six written assignments: 40%
- Four lab quizzes 10%

Grading CSE 544M

- Same as CSE 444 plus
- Another 10% for the 4 paper reviews
- Then re-normalize to add up to 100%
- Graded separately from CSE 444

Five Labs

Acks: SimpleDB lab series originally developed by Prof. Sam Madden at MIT. We work with them on improving/extending.

- Lab 1: Build a DBMS that can scan a relation on disk
  - **Released today. Part 1 is due next Monday**
- Lab 2: Build a DBMS that can run simple SQL queries and also supports data updates
- Lab 3: Add a lock manager (transactions)
- Lab 4: Add a write-ahead log (transactions)
- Lab 5: Add a query optimizer
- ~~Lab 6: Add parallel processing~~ (not this quarter)

About the Labs

Warning: I **will** run cheating-detecting software!
I have solutions from past years too.

Managed on GitLab:

https://gitlab.cs.washington.edu/cse444-20sp/simple-db-[your gitlab id]

Logistics:

- To be done **INDIVIDUALLY!**
- Each lab will take a **significant** amount of time
- Labs build on each other

Purpose

- Hands-on experience building a DBMS
- Deepen your understanding significantly
- We will build a *classical* DBMS

Six Homeworks

- HW 1 releases soon. Due next Friday.
- Written assignments – turn in in gradescope https://www.gradescope.com/
- Help review material learned in class
- Prepare you for the labs
  - One homework before each corresponding lab
- Go beyond what we implement in labs
- To be done **INDIVIDUALLY**

Exams

- No midterm!

- No final!

- Two short in-class/online quizzes

One quiz for labs 1-2, one for labs 3-4

Tests depth of your knowledge

- Only one or two open-ended questions
- Example: "Explain how data is stored in SimpleDB"
- Grades:
  - 9-10: Strength! Exceptional understanding + explanations
  - 8: You got it!
  - 7 or less: Developing knowledge – some gaps
  - 0: Did not show up or wrote nothing
- Important: We grade based on the depth of knowledge demonstrated in your answer

Late Days

- Total of **4 late-days**
- Use in 24-hour chunks on hws or labs
- **At most 2 late-days per assignment**
- **No late-days can be applied to the final lab due during finals week**

Outline (this lecture and next)

- Review of DBMS goals and features
- Review of relational model
- Review of SQL

Review: DBMS

- What is a database? Give examples
  - A collection of related files
  - E.g. payroll, accounting, products
- What is a database management system? Give examples
  - A program written by someone else that manages the database; PostgreSQL, Oracle, …
  - In 444 you are that "someone else", implementing SimpleDB

Review: Data Model

- What is a data model?
  - A mathematical formalism for data

- What is the relational data model?
  - Data is stored in tables (aka relations)
  - Data is queried via relational queries
  - Queries are *set-at-a-time*

Review: Transactions

- What is a transaction?
  - A set of instructions that must be executed all or nothing

- What properties do transactions have?
  - ACID
  - Better: Serialization, recovery

Review: Data Independence

Review: Data Independence

The application should not be affected by changes of the physical storage of data

- Indexes
- Physical organization on disk
- Physical plans for accessing the data
- Parallelism: multicore, distributed

Key Data Management Concepts

- Data models: Relational, XML, graph data (RDF)
- Schema vs. Data
- Declarative query language:
  - say what you want, not how to get it
- Data independence
  - Physical: change how data org without updating the applications
  - Logical: change schema without updating the application
- Query compiler and optimizer
- Transactions: isolation and atomicity

Course Content

Focus: how to build a classical relational DBMS

- Review of the relational model (lecture 1 and 2)
- DBMS architecture and deployments (lecture 3)
- Data storage, indexing, and buffer mgmt (lectures 4-6)
- Query evaluation (lectures 7-8)
- Query optimization (lectures 9-12)
- Transactions (lectures 13-19)
- Parallel query processing (lectures 20-23)
- Replication and distribution (lectures 24-25)
- NoSQL and NewSQL (lectures 26-27)