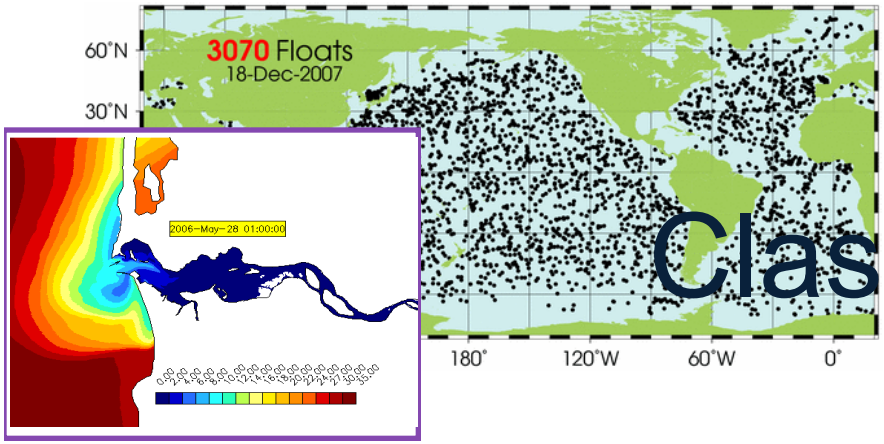
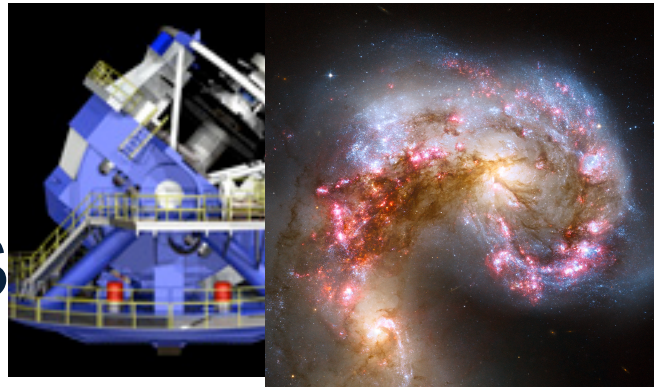
Introduction to Database Systems
CSE 414

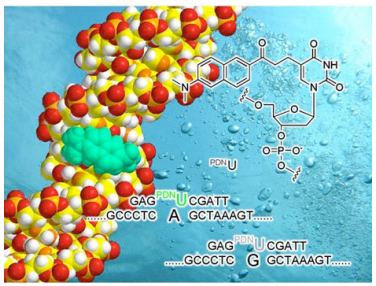
Lecture 1: Introduction

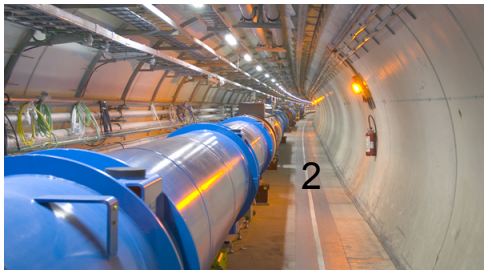


Class Goals



- 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 become more efficient
- Welcome to 414: Introduction to Database Systems
  - Existing tools PLUS data management principles





CSE 414

- New course this quarter
  - Fills a long-standing gap in CSE offerings
- Patterned closely after CSE 344
  - ("closely" = we're stealing all we can!)
  - Some changes because of different student backgrounds, interests
  - Expect some adjustments as we learn along the way

Staff

- Instructor: Hal Perkins
  - perkins@cs.washington.edu
  - Office hours: tbd + when the door is open and I'm not too swamped
- TAs:
  - Daseul Lee, dslee@cs.washington.edu
  - Joseph Xu, zhexu@cs.washington.edu
  - Office hours: see Website
- Contacting the staff: the discussion board is best for most things, but if you need to send email, please send to cse414-staff@cs.

Course Format

- Lectures MWF, 1:30pm-2:20pm
- Sections: Th 1:30-2:20, 2:30-3:20
  - Content: exercises, tutorials, demos, questions
  - See the course web for locations

- 8 Homework assignments
- 7 Web quizzes

- Midterm and final

Communications

- Web page: http://www.cs.washington.edu/414
  - Lectures will be available there (see calendar)
  - Homework assignments will be available there
  - Web quizzes will be available there
- Mailing list
  - Announcements (low traffic – must read)
  - Registered students are automatically subscribed
- Discussion board
  - Great place to ask assignment-related questions
  - Post a message today! (get gopost to track new messages for you!!!)

Textbook

Main textbook, available at the bookstore:

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

  Second edition.

Most important: COME TO CLASS ! ASK QUESTIONS !

Other Texts

Available at the Engineering Library

(not on reserve):

- *Database Management Systems*, Ramakrishnan
- *XQuery from the Experts*, Katz, Ed.
- *Fundamentals of Database Systems*, Elmasri, Navathe
- *Foundations of Databases*, Abiteboul, Hull, Vianu
- *Data on the Web,* Abiteboul, Buneman, Suciu

Grading

- Homeworks 30%
- Web quizzes 20%
- Midterm 20%
- Final 30%

Eight Homeworks

H1&H2: Basic SQL with SQLite

H3: Advanced SQL with SQL Server

H4: Relational algebra, Datalog

H5: XML and XQuery with Saxon

H6: Conceptual Design

H7: SQL in Java (JDBC)

H8: Parallel processing with MapReduce

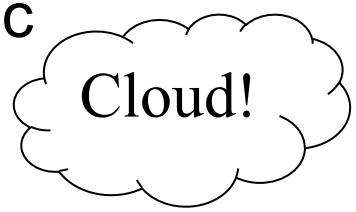
Homework assignments are due Wed. night, 11 pm – dropbox!

About the Homeworks

- Homework assignments will take time but most time should be spent *learning*

- Very practical assignments

- Put everything on your resume!!!
  - SQL, SQLite, SQL Server, SQL Azure JDBC, XML, XQuery, Saxon, Amazon Elastic MapReduce, Hadoop, Pig Latin, …



Deadlines & Late Days

- Assignments are expected to be done on time, but things happen, so…
- You have up to 4 late days to use during the quarter on Homeworks only
  - No more than 2 on any one assignment
  - Use in 24-hour chunks

Academic Integrity

- Anything you submit for credit is expected to be your own work
  - But of course you should exchange ideas with others – just not detailed solutions
  - We all know the difference between appropriate collaboration and cheating
  - If you attempt to gain credit for work you did not do, or help others do so, it's misconduct
- I trust you implicitly, but will come down hard on any violations of that trust we find

Seven Web Quizzes

- Class token on the white board: write it down
- Short online tests
- Can take many times: best score counts!
- Provide explanations for wrong answers
- Will help you
  - Test your knowledge
  - Stay in synch with class
  - Get ready for homeworks

Web quizzes are due Friday night (tentative, may change)

Exams

- Midterm and Final
- Open book, open notes (no computers!)
- Check course website for dates
- Location: in class

Outline of Today's Lecture

1. Overview of database management systems
   1. Why they are helpful
   2. What are some of their key features
   3. What are some of their key concepts

2. 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

- 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, Informix), Microsoft (SQL Server, Access)
- Sybase
- Open source: MySQL (Sun/Oracle), PostgreSQL
- Open source library: SQLite

We will focus on relational DBMSs most quarter

An Example: Online Bookseller

- What data do we need?
  - Data: Information on books, customers, pending orders, order histories, trends, preferences, etc. Massive data: hundreds of GB and growing!
- What capabilities on the data do we need?
  - Add books, find a specific book, list all books in a certain category and price range, generate an order history, produce sales figures grouped by state, etc
- Data is persistent: outlives application
- Data is safe: from failures, malicious users, etc
- Multi-user access

Multi-user discussion

- Jane and John both have ID number for gift certificate (credit) of $200 they got as a wedding gift
  - Jane @ her office orders "The Selfish Gene, R. Dawkins" ($80)
  - John @ his office orders "Guns and Steel, J. Diamond" ($100)

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

Summary: Required Data Management Functionality

- Describe real-world entities in terms of data
- Store data persistently
- Query & update efficiently
- Change structure; e.g., add attributes
- Concurrency control: simultaneous updates
- Crash recovery
- Security and integrity

Discussion

- Did you ever encounter a data management problem?
  - Experimental data from a homework?
  - Personal data?
  - Other data?
- How did you manage your data?

DBMS Benefits

- Expensive to implement all these features inside the application
- DBMS provides these features (and more)
- DBMS simplifies application development

Client/Server Architecture

- There is a single *server* that stores the database (called DBMS or RDBMS):
  - Usually a beefy system
  - But can be your own desktop…
  - … or a huge cluster running a parallel DBMS
- Many *clients* run apps and connect to DBMS
  - E.g. Microsoft's Management Studio
  - Or psql (for PostgreSQL)
  - More realistically some Java or C++ program
- Clients "talk" to server using JDBC protocol

People

- **DB application developer**: writes programs that query and modify data (414)
- **DB designer**: establishes schema (414)
- **DB administrator**: loads data, tunes system, keeps whole thing running (414, 444)
- **Data analyst**: data mining, data integration (414, 446)
- **DBMS implementor**: builds the DBMS (444)

Key Data Mngmt Concepts

- **Data models**: how to describe real-world data
  - Relational, XML, graph data (RDF)
- **Schema v.s. data**
- **Declarative query language**
  - Say what you want not how to get it
- **Data independence**
  - Physical independence: Can change how data is stored on disk without maintenance to applications
  - Logical independence: can change schema w/o affecting apps
- **Query optimizer** and compiler
- **Transactions**: isolation and atomicity

What This Course Contains

- **Focus: Using DBMSs**
- Relational Data Model
  - SQL, Relational Algebra, Relational Calculus, datalog
- Semistructured Data Model
  - XML, XPath, and XQuery
- Conceptual design
  - E/R diagrams, Views, and Database normalization
- Transactions
- Parallel databases, MapReduce, and Pig-Latin
- Data integration and data cleaning

What to Do Now

http://www.cs.washington.edu/414

- Webquiz 1 will be open shortly
  - Create account at http://newgradiance.com/
  - Use course token
  - Webquiz due this Friday
- Homework 1 posted by Wednesday
  - Simple queries in SQL Lite
  - Homework due next Wednesday