

Introduction to Database Systems

CSE 414

Write down
Webquiz token

Lecture 1: Introduction

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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 414: Introduction to Database Systems
 - Existing tools PLUS data management principles
 - This is not just a class on SQL!

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Staff

- Instructor: Ryan Maas
 - Office hours T/Th 10:30 and by appointment
- TA's
 - Andrew Wei
 - Kodiak Conrad
 - Rob Thompson
 - Joshua Bean
 - Daniel Lyu

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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)

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Grading

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

- **This is all subject to change**

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Communications

- **Web page:** <http://www.cs.washington.edu/414>
 - 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/fall2018/cse414>
 - **THE** place to ask course-related questions
 - Log in today and enable notifications

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Textbook

Main textbook, available at the bookstore:

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

REQUIRED READING !

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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

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Prerequisites

Formally: CSE143: Computer Programming II

Assume knowledge of:

- Java programming
- Basic data structures (lists, trees, objects)
- Unix (command line tools)

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Eight Homework Assignments

- H1: SQL+sqlite intro (1 week)
- H2: SQL basics (1 week)
- H3: Advanced SQL on Azure (1+ weeks)
- H4: Datalog and Relational Algebra (1+ weeks)
- H5: NoSQL: Json/SQL++ (1 week)
- H6: Spark on AWS (1+ weeks)
- H7: Schema Design (1week)
- H8: Transactional Application (1+ weeks)

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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, and Amazon web services
 - NoSQL: AsterixDB, Spark
 - Databases: sqlite, Microsoft SQL Server
 - **Git**
- Each ranges in its difficulty to setup and use
- Will require (non-trivial) time to fiddle and explore!
- The time spent learning the new technology is very useful: write everything on your CV!

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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

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Seven Web Quizzes

- <http://newgradiance.com/>
- Create account;
please use the same ID as your UW ID
- Course token will be posted on piazza
- Short tests, take many times, best score counts
- No late days – closes at 11:59pm deadline
- Provide explanations for wrong answers

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Exams

- Midterm (Nov. 1) and Final (Dec. 13)
- 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

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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
- We trust you implicitly, but will come down hard on any violations of that trust

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Lecture Notes

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

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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 Thursday)

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Now onto the real stuff...

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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 ?

- *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

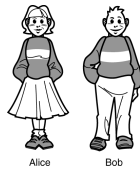
We will focus on **relational** DBMSs most quarter

An Example: Online Bookseller

- What data do we need?
 - 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?
 - 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



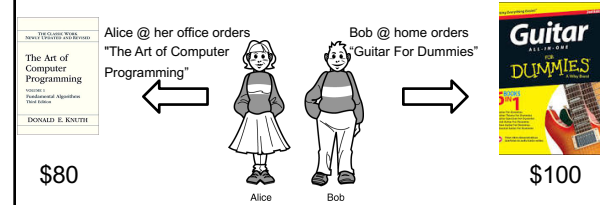
Alice Bob

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Challenges for a DBMS

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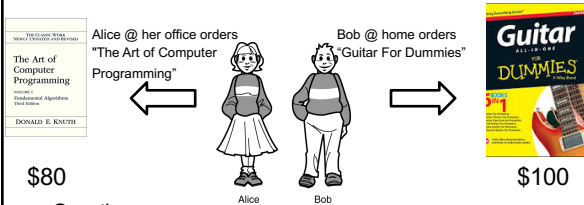


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Challenges for a DBMS

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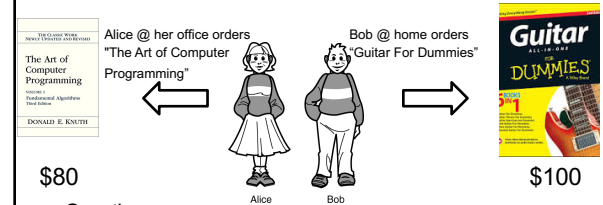
Questions:

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

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Challenges for a DBMS

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Questions:

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

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

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The players

- DB application developer:** writes programs that query and modify data (CSE414)
- DB designer:** establishes schema (CSE414)
- DB administrator:** loads data, tunes system, keeps whole thing running (CSE414, 444)
- Data analyst:** data mining, data integration (CSE414, 446, CSED 516)
- DBMS implementor:** builds the DBMS (CSE444)
- Research on new systems:** (CSE544)

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What is this class about?

- Data models
 - Relational: SQL and Datalog
 - NoSQL: SQL++
 - RDMBS internals
 - Relational algebra
 - Query optimization and physical design
 - Parallel query processing
 - Spark and Hadoop
 - Conceptual design
 - E/R diagrams
 - Schema normalization
 - Transactions
 - Locking and schedules
 - Writing DB applications
- Data models**
- Query Processing**
- Using DBMS**

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What to Do Now

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

- 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 on Thursday
 - Tutorial on git and SQLite
- Post on Piazza if you have questions about HW and lecture

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