School of Computer Science

Web and Database Computing 2019

Lecture 12: Introduction to Databases

adelaide.edu.au

seek LIGHT

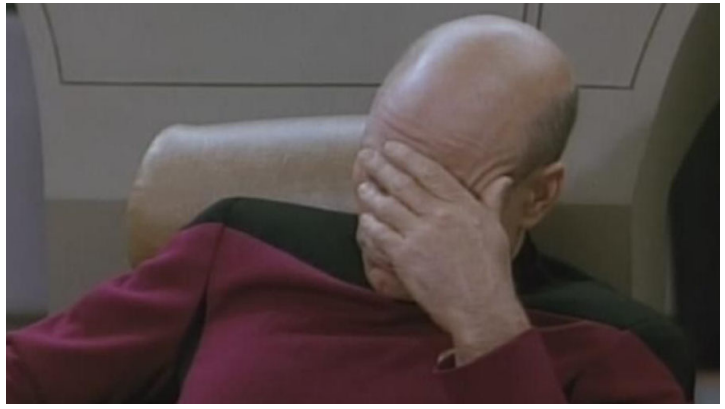
We need to talk

File 1		File 2		Lines Matched
Web-Submission/a1	7/exported/ (99%)	Web-Submission/a1	9/exported/ (99%)	59
Web-Submission/a1	6/exported/ (98%)	Web-Submission/a1	8/exported/ (98%)	70
Web-Submission/a1	1/exported/ (98%)	Web-Submission/a1	8/exported/ (98%)	47
Web-Submission/a1	0/exported/ (98%)	Web-Submission/a1	8/exported/ (98%)	47
Web-Submission/a1	0/exported/ (98%)	Web-Submission/a1	1/exported/ (98%)	47
Web-Submission/a1	3/exported/ (52%)	Web-Submission/a1	2/exported/ (65%)	49
Web-Submission/a1	0/exported/ (83%)	Web-Submission/a1	0/exported/ (83%)	53
Web-Submission/a1	7/exported/ (83%)	Web-Submission/a1	0/exported/ (83%)	53
Web-Submission/a1	7/exported/ (83%)	Web-Submission/a1	0/exported/ (83%)	53
Web-Submission/a1	8/exported/ (88%)	Web-Submission/a1	8/exported/ (96%)	43
Web-Submission/a1	1/exported/ (88%)	Web-Submission/a1	8/exported/ (96%)	43
Web-Submission/a1	0/exported/ (88%)	Web-Submission/a1	8/exported/ (96%)	43
Web-Submission/a1	7/exported/ (74%)	Web-Submission/a1	9/exported/ (54%)	38
Web-Submission/a1	5/exported/ (61%)	Web-Submission/a1	6/exported/ (63%)	58
Web-Submission/a1	1/exported/ (57%)	Web-Submission/a1	3/exported/ (59%)	40
Web-Submission/a1	5/exported/ (43%)	Web-Submission/a1	2/exported/ (52%)	40
Web-Submission/a1	4/exported/ (97%)	Web-Submission/a1	0/exported/ (97%)	23
Web-Submission/a1	3/exported/ (37%)	Web-Submission/a1	5/exported/ (39%)	28
Web-Submission/a1	7/exported/ (47%)	Web-Submission/a1	3/exported/ (49%)	39
Web-Submission/a1	1/exported/ (93%)	Web-Submission/a1	5/exported/ (63%)	38
Web-Submission/a1	1/exported/ (60%)	Web-Submission/a1	0/exported/ (55%)	30
Web-Submission/a1	0/exported/ (50%)	Web-Submission/a1	7/exported/ (56%)	29
Web-Submission/a1	0/exported/ (50%)	Web-Submission/a1	7/exported/ (56%)	29
Web-Submission/a1	7/exported/ (50%)	Web-Submission/a1	7/exported/ (56%)	29
Web-Submission/a1	0/exported/ (68%)	Web-Submission/a1	4/exported/ (21%)	23
Web-Submission/a1	7/exported/ (22%)	Web-Submission/a1	4/exported/ (21%)	25
Web-Submission/a1	2/exported/ (84%)	Web-Submission/a1	1/exported/ (84%)	32
Web-Submission/a1	5/exported/ (51%)	Web-Submission/a1	7/exported/ (61%)	36
Web-Submission/a1	8/exported/ (58%)	Web-Submission/a1	8/exported/ (63%)	21
Web-Submission/a1	0/exported/ (32%)	Web-Submission/a1	6/exported/ (43%)	32

Plaigerism

Just don't

- "I was working with a friend"
  - That's great!
  - These are individual pracs however;
    feel free to discuss strategy, but write your code separately
  - Make sure the work you submit is your own work
- "It was too hard"
  - Come see me; get help or an extension
- "I ran out of time"
  - Come see me; we can discuss alternative arrangements



These assignments are only worth 1-2% each. They exist to help you practice the concepts taught.
That's not worth the consequences of plaigerism/collusion

Okay?

Why Databases?

How to store data in a Web Application

Store on client using cookies

- Designed for a website to remember stateful information by storing user information in the user's web browser e.g.
  - Items added in a shopping cart
- Authentication cookies to know whether a user is logged in or not.
  - Data expires when the browser is closed
- Data is stored on client, so no control.

Store on the server using variables or sessions:

- Allow user information to be stored on the server instead of the client.
- Data is not persistent. The information is lost when the server is restarted.

What about information that needs to persist between restarts of the server?

We can store information in files

But! we will need to write code to:

- Check data integrity.
  - Make sure the values are valid
- Handle all the ways to access the data
  - Return different parts of the data as needed
- Manage concurrent access
  - What if a second functions reads the data before the first has written an update?
- Ensure that repeated data in multiple files is updated everywhere when changed.
- Control access to the data through permissions.

Database Management Systems

Databases are applications that are optimized for storing and accessing data efficiently.

Several database models exist:

- Flat file
- Network
- Object Oriented
- Document store
- and more..

The most common model is by far the relational model (Codd 1970)

- Underpinned by a mathematical model (relational algebra)
- Most common implementations include Oracle, MySQL/MariaDB, Microsoft SQL server

What is a Relational Database?

Consider a store

The store wants to keep a record of all of their customers and the items they've purchased.

How do we store that data?

Keep the data in one big spreadsheet/table?

First Name	Family Name	Phone Number	Item	Price	Barcode	Date Purchased
Alice	Smith	0412 345 678	Cling Wrap	1.19	12345 78654	2019-03-30
Bob	James	0498 765 432	Detergent	12.34	48325 65404	2019-04-01
Bob	James	0498 765 432	Cling Wrap	1.19	12345 78654	2019-04-01
Bob	James	0498 765 432	Blanket	39.99	64597 15632	2019-04-01
Bob	James	0498 765 432	Mushrooms	9.99	85146 15647	2019-04-01
Carol	Parker	0411 222 333	Cling Wrap	1.19	12345 78654	2019-04-02

Save it in a single file, or store the rows as an array of objects

One big spreadsheet/table has problems

First Name	Family Name	Phone Number	Item	Price	Barcode	Date Purchased
Alice	Smith	0412 345 678	Cling Wrap	1.19	12345 78654	2019-03-30
Bob	James	0498 765 432	Detergent	12.34	48325 65404	2019-04-01
Bob	James	0498 765 432	Cling Wrap	1.19	12345 78654	2019-04-01
Bob	James	0498 765 432	Blanket	39.99	64597 15632	2019-04-01
Bob	James	0498 765 432	Mushrooms	9.99	85146 15647	2019-04-02
Carol	Parker	0411 222 333	Cling Wrap	1.19	12345 78654	2019-04-02

Data is duplicated.

What if we want to change things?

Split into multiple tables instead!

Customer

CustID	First Name	Family Name	Phone Number
1	Alice	Smith	0412 345 678
2	Bob	James	0498 765 432
3	Carol	Parker	0411 222 333

Item

ItemID	Item	Price	Barcode
1	Cling Wrap	1.19	12345 78654
2	Detergent	12.34	48325 65404
3	Blanket	39.99	64597 15632
4	Mushrooms	9.99	85146 15647

Purchase Contents

PurchaseID	ItemID
1	1
2	2
2	1
2	3
3	4
4	1

Purchase

PurchaseID	CustID	Purchase Date
1	1	2019-03-30
2	2	2019-04-01
3	2	2019-04-02
4	3	2019-04-02

Relational databases

- Separate data into Entities; 2-dimensional tables that consist of
    - Attributes, i.e., column headers
    - Tuples, i.e., rows in a table.

      Entity Name

Attribute1	**Attribute2**
1st	Tuple
2nd	Tuple
3rd	Tuple

    - Where each tuple is unique.
- Logical connections between the Entities define Relationships between them.

The blueprint for a relational is called the Database Schema

Database Schema

The schema defines the relational model for a database; how data is divided into tables in Database design has an impact on storage requirements and efficiency of accessing data.

Good schema design delivers:

- Minimal redundancy of information
  - The same information should not appear in multiple places
- Easy to understand the relationship of the data
  - Information is properly organised or split into logical pieces it easy to access.
- Database performs fast and efficiently
  - Data is organised to find information, with fewer steps, and without retrieving more data than needed.

Important because most web applications are transaction intensive, i.e., users are often creating, reading, updating, and deleting data.

Things to Consider for a Good Design

- Break data into logical pieces
  - Should given name and family name be stored in the same column?
- Avoid storing duplicate non-uniform data
- Avoid repeating groups
  - Don't store data separated by delimiters
- How to search for students enroll Math?

Name	Level	Courses
Alice Smith	Level 3	WDC, ADDS
Bob James	Level II	CS, ADDS
Carol Parker	3rd Level	CS, WDC

How would we fix this table?

Quiz!

Refresher:

- 5 questions in the next 5 slides
  These do **not** appear in the PDF of the slideshow
- Answers in the online quiz visible after all 3 attempts
- 3 attempts at the quiz
- Keep highest mark
- Can be completed any time in the next 24h
- 0.5% of your final grade

< /quiz >


THE UNIVERSITY
of ADELAIDE

What's happening

Due:

- Prac Exercise 4 available + due date extended. Websub coming soon.
- Start forming groups for your group project.
  - 4 people
  - Must be in same **Practical** session (not workshop)

This week:

- Workshops
- Introduction to NodeJS & AJAX

Further learning:

- Download and install Node.js
- Try setting up your first Express server.
- Try making AJAX requests with Insomnia