CS 445
Introduction to Database Systems

TTh 2:45-4:20pm

Chadd Williams

Overview

- Practical introduction to databases
  - theory + hands on projects
- Topics
  - Relational Model
    - Relational Algebra/Calculus/ Theory
  - Database Design
    - ER Diagrams
  - Structured Query Language (SQL)
  - Web accessible databases / Architecture / Model-View-Controller
  - Non-structured Data (NoSQL)
- There will be a number of lab days for hands on work

Syllabus

- *Database Management Systems* (3^{rd}), Ramakrishnan & Gehrke
- Grades:

Midterm 1	15%
Midterm 2	15%
Final	20%
Homework/Labs/Quizzes	10%
Database Projects	40%

First DB Assignment	Design Docs	8 pts
	MySQL DB	12 pts
Big DB Assignment	Design Docs	25 pts
	MySQL DB	30 pts
	Web Interface	15 pts
	Presentations	10 pts

- Quizzes: frequent, unannounced, open-note quizzes will be given
- Late Policy: No late assignments accepted
- Grade Complaints: one paragraph summary of why the grade is wrong, **within one week of receiving the graded material**

- http://zeus.cs.pacificu.edu/chadd/cs445f17

Database Projects

- All database projects are to be done using MariaDB
  - https://mariadb.org/
  - http://www.apachefriends.org/ (XAMPP) LAMP
  - PHP 5 for web projects
- Tools
  - dbeaver
  - CodeLite
- First DB Assignment
  - Learn to use MySQL & SQL
- Big Database Project
  - You (and a friend) design, document, and implement a database
  - Build a web-based front end
  - 5 minute presentation of your design / 7-10 minute presentation of your final design and implementation

- Linux skills are a must
  - ssh
  - cp
  - mv
  - cd
  - scp
  - geany
  - ls

cat

less

diff

tar

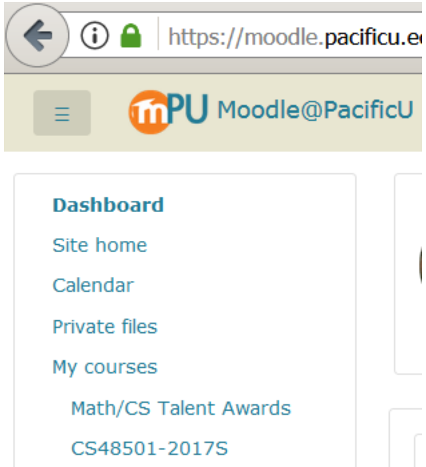
If you don't have your zeus password, see me soon!

Introduction to Databases

- Read Chapter 1
- What's a database?
  - DBMS?
- Why do we use one?
- Who uses one?
- How do we model the data?

Review Questions at the end of each chapter are great exam and quiz study guides.

Basic Database Usage Scenario

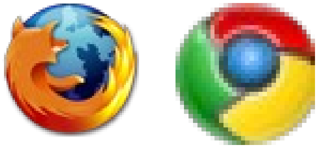


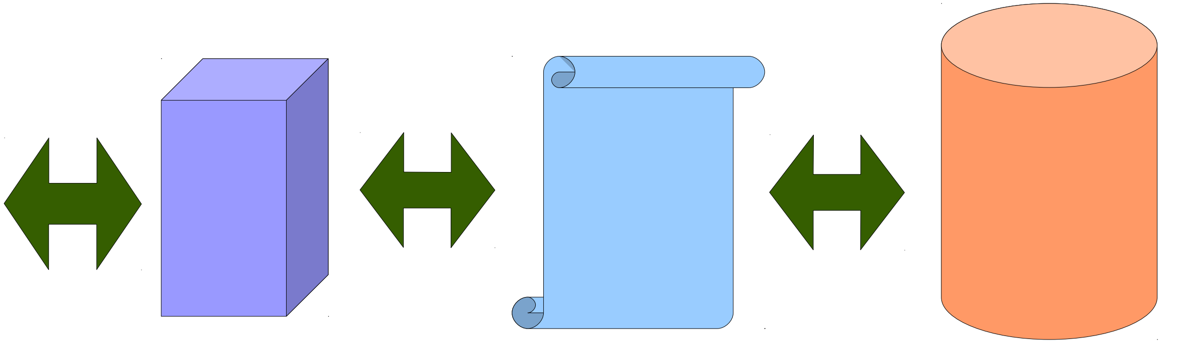
https://moodle.pacificu.e

Moodle@PacificU

- Dashboard
- Site home
- Calendar
- Private files
- My courses
  - Math/CS Talent Awards
  - CS48501-2017S

User



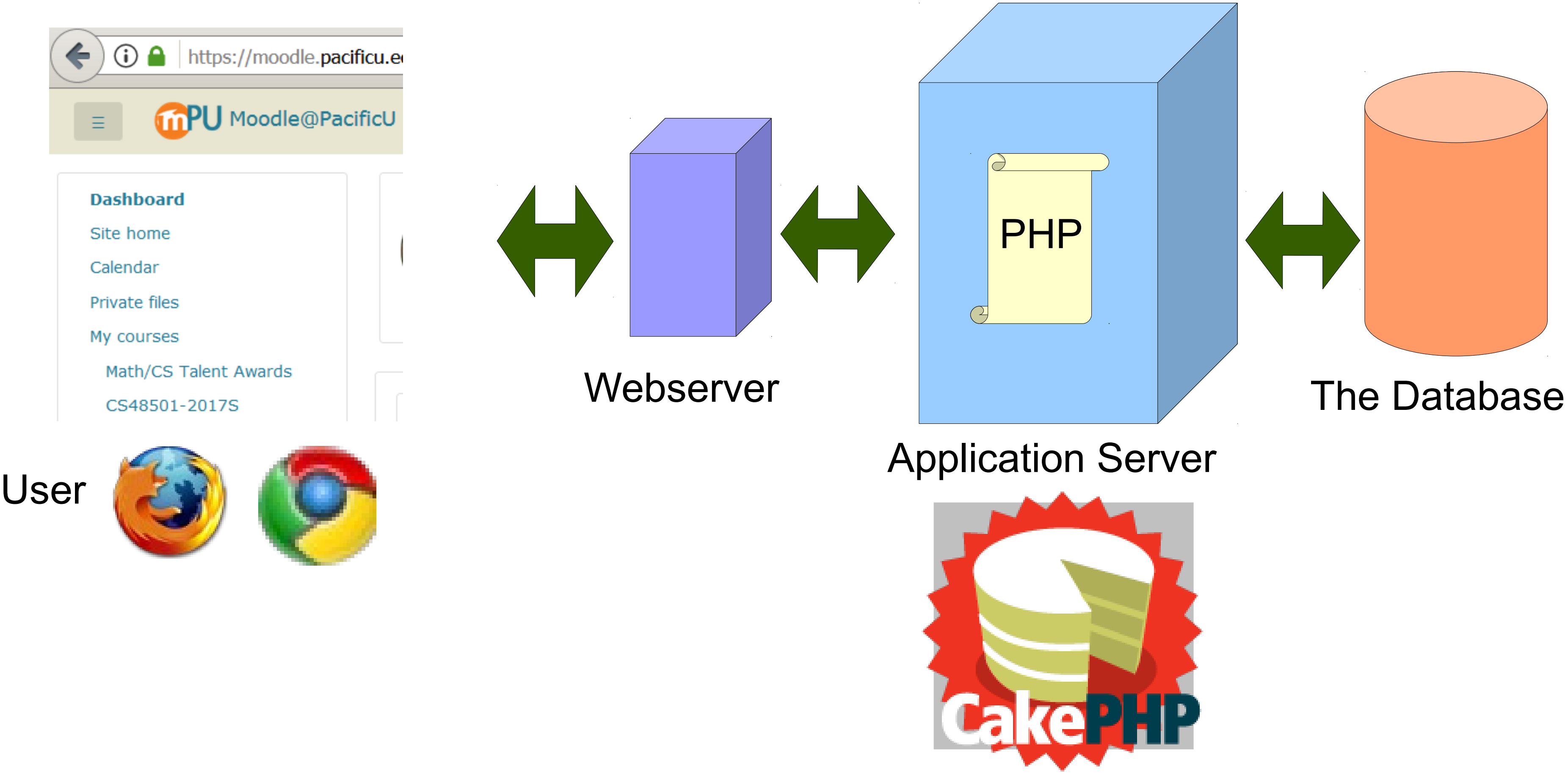


Webserver

PHP

The Database

More Complicated Database Usage Scenario



User

Webserver

PHP

Application Server

The Database

Database Trends

- SQL / RDBMS
  - relational database systems
  - entities are related to other entities
  - relationships my optionally have attributes
  - strict structure of data (tables, (rows, columns, datatypes))
  - SQL: Structured Query Language
  - Very powerful and expressive
    - ad-hoc queries
  - ACID: strict guarantees of correctness
    - Atomicity, Consistency, Isolation, Durability
  - Online Analytical Processing (OLAP)
    - business intelligence
    - complex queries / ad hoc queries
    - structured data
  - originally: poor performance on web scale data

Database Trends

- NoSQL
  - built for web data
  - Online Transaction Processing (OLTP)
    - poorly defined
    - availability, speed, concurrency, recoverability
    - high throughput/insert or update intensive
    - web services
    - often no ad-hoc queries
  - Schema-less (collection of fields)
  - built for big data / lots of text data (document store, graphs)
  - Availability/Scalability/Low Latency
  - Distributed (Consistency/Availability/Partition Tolerance (2))
  - may sacrifice consistency

Database Trends

- NewSQL
  - Relational data model
  - Make SQL scalable like NoSQL
  - Maintain ACID
  - non-locking concurrency (reads and writes don’t conflict)
  - high per node performance
  - scale-out, shared nothing architecute
  - Online Transaction Processing (OLTP)
  - VoltDB
  - MySQL Cluster database engine

Why not just use a text file/file system/XML?

- Data Independence
- Efficient Data Access
- **Data Integrity and Security**
- Data Administration
- Concurrent Access/Crash Recovery
- Reduced Application Development Time

(page 9)

Storing data in the DB

- Data Models
- Semantic Data Model (high level)
  - Entity-Relationship (ER) Model
    - Entity:
    - Relationship:
- Relational Data Model (low level)
- Schema
- Constraints/Integrity

Relational Databases

- Well defined structure of data
    - schema

- Flexible queries

NoSQL databases
schema

queries

What's inside a Relational database?

- Tables

- Indexes/Keys

- Data

How do we access the data?

- Query Language
  - Structured Query Language (SQL)
  - What types of queries can we run?

What about multiple users?

- Transactions

- Concurrency

Dirty Details

- Figure 1.3 page 20

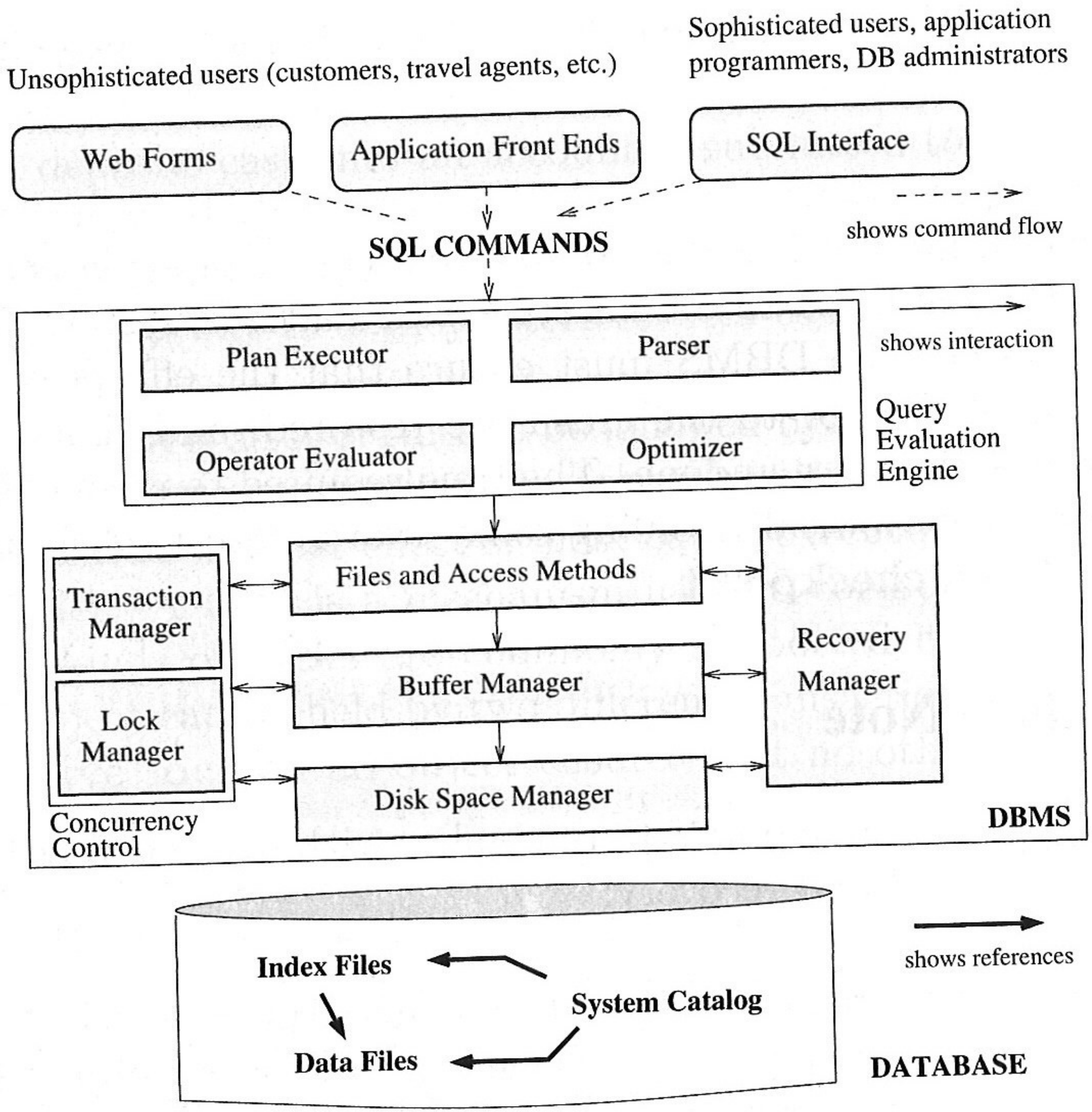


Figure 1.3 Architecture of a DBMS