COMP9311:
Database Systems

Term 3 2022

Week 1 – Course Introduction

By Helen Paik, CSE UNSW

Disclaimer: the course materials are sourced from previous offerings of COMP9311 and COMP3311

Who's who in COMP9311

- Lecturer-in-Charge (LiC)
  - Helen Paik **h.paik@unsw.edu.au**
  - Office: K17 501C, Phone: (02) 9348 0382
  - Consultations:
    - » personal issues – appointments
    - » course related – ~~Zoom, Tuesday 12-2pm (Q/A, drop-in sessions)~~
- Course admin and Tutors

Tim (Course Admin)

Frank

Rahma

Daria

Why Study Databases?

Intelligent Transportation

Business Services

Natural Disasters

Public Health

Modern Military

Tourism Development

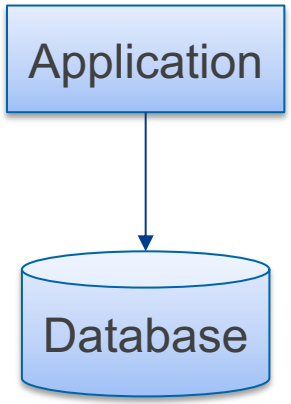
Why Study Databases?

All significant modern computer application has a large amount of data.

This needs to be:

- stored (typically on a disk device)
- manipulated (efficiently, usefully)
- shared (by many users, concurrently)
- transmitted (all around the Internet)

Red stuff handled by databases; brown by networks.



Challenges in building effective databases: efficiency, security, scalability, maintainability, availability, integration, new media types (e.g., music, video), ...

Databases: Important Themes

The field of *databases* deals with:

- *data* ... representing application scenarios
- *relationships* ... amongst data items
- *constraints* ... on data and relationships
- *redundancy* ... one source for each data item
- *data manipulation* ... declarative, procedural
- *transactions* ... multiple actions, atomic effect
- *concurrency* ... multiple users sharing data
- *scale* ... massive amounts of data

What is Data?

Data (according to Elmasri/Navathe)

- Known facts that can be recorded (and have implicit meaning)

Example:

- *Students – name, DOB, courses enrolled, etc.*
  … (who are also my thesis students)
- *Movies – title, year published, director, etc.*
  … (that I like)

What is Database?

Database (Elmasri/Navathe)

- ... a collection of **related** data ...

Data items alone are relatively useless

We need the data to have some structure

Example:

- a student records database
  - Contains information identifying **students**, **courses** they are enrolled in, **results** from past courses, ...
- IMDb movie database
  - Contains information about the **movies**, **actors**, **theatres** showing the movies, other movies the director also directed in, …

What is Database Management System

Database can be manipulated and maintained by a **database management system (DBMS)**

According to Elmasri/Navathe:

- *DBMS*: ... a collection of programs that enables users to create and maintain a database ...
- *Database system (in short)*: ... the database and DBMS together ...

COMP9311 introduces foundations & technology of databases

- skills: how to build a database using DBMS
- theory: how do you know that what you built was good

Syllabus Overview

Data modelling and database design (Week 1 to Week 3)

- ER model, ODL, ER-to-relational
- Relational model (relational algebra), mapping of ER to relational model

Database development (Week 3 to Week 5)

- SQL, views, stored procedures, triggers, aggregates
- PostgreSQL: psql (an SQL shell), PLpgSQL (procedural)
  - » PostgreSQL – lab, assignment environment
  - » SQLite: another (rather small) example of database system

Syllabus Overview

Formal DB design theory and DBMS architecture (Week 6 – Week 9)

- Normalisation, functional dependencies
- DBMS architecture: client/server, file system, relational engine
- Storage and indexing, data access operations
- Query processing: translation, optimisation, evaluation
- Transaction processing: transactions, concurrency control, recovery

Future of Databases (Week 10)

- Limitations of RDBMS's, modern/future technologies

Assessment structure

- Assignment 1 (DB design) on Weeks 1-2 topics
- Assignment 2 (SQL/PLpgSQL) on Weeks 3-5 topics
- Quizzes and Final Exam on Weeks 1-10 topics.

Final mark = A1+A2+Quizzes+Final Exam

Student Learning Outcomes

By the end of the course, you should be able to:

- develop accurate, non-redundant data models
- realise data models as relational database schemas
- formulate queries via the full range of SQL constructs
- use stored procedures and triggers to extend DBMS capabilities
- understand performance issues in relational database applications
- understand the overall architecture of relational DBMSs
- understand the concepts behind transactions and concurrency control
- appreciate query and transaction processing techniques within RDBMSs
- appreciate the past, present and future of database technology

Plan for the delivery of this course

Delivery of the content for learning:

- ***Textbook***: describe most syllabus topics in detail. Get a softcopy copy from the publisher, or a physical copy from the library.
- ***Lectures***:
  - describe all syllabus topics in some detail, with exercises and examples
  - Week 1 – 5: face-to-face lectures, recorded by Echo360
  - Week 7 – 10: online lectures (e.g., Zoom), recorded and uploaded to Echo360 (Note that Xiaoyang may still do F2F).
- ***Labs*** *(starting Week 1, ~ every two weeks)*: guides you through the practical skills on the database application programming part of the course
- Extra video tutorial materials on some topics

Plan for the delivery of this course, contd.

What we do to support your learning:

- Online help/support sessions
  - The tutors will create a roster to open a drop-in online help sessions to help with labs/assignments
  - Blackboard Collaborate sessions (meeting link will be posted)
- Online forum
  - course *forums* (via ”ed Discussion”)
- WebCMS3
  - all course content and links to other tools/platforms
  - all course announcements
- Email
  - If you need any help email me (h.paik@unsw.edu.au) or Tim (t.arney@unsw.edu.au)

What we expect from you

Things that we expect you to **do**:

- Follow the lecture content (i.e., weekly topics)
- Theory *exercises*: exercise/example questions (try them yourself)
- *Prac* work: lab-like exercises

You will show us your progress/learning outcomes through:

- *Assignments*: extended practical exercises
- *Quizzes*: weekly progress check
- Final exam: your learning outcomes on **both** practical and theoretical topics

What we expect from you

Importantly:

We want you to feel welcome and safe in asking questions/help online

This can only happen if we all behave respectfully towards each other when we interact online

No judgement. Everybody in the class is here to learn something and everybody in the class will help each other to have the best learning experience.

Assignments

Two assignments:

- Data modelling and SQL definitions
- Writing SQL/PLpgSQL programs
- All individual work

All assignments are submitted via WebCMS3

Some are automarked (so you must follow the specification exactly)

- plagiarism-checked (copying solutions ⇒ referred to the student ethics officer, you are likely to get 0 for the course, or 0 for the component)
- "rent-a-coder" monitored (buying solutions ⇒ referred to the student ethics officer, this is considered a highly serious offence by the university)

Quizzes

- 9 quizzes (planned), all together worth 5 marks
- cover material covered in each week
- aim to make you review materials weekly (not that hard)
- done via WebCMS3 in your own time
- starting Week 1 – check the course schedule
  - Released every Thursday after the lecture time, due the following Monday midday 12pm
  - You can ask online forums if you got any questions wrong (after the deadline)

Exam

The current plan is to do an in-person exam. But the online enrolment number (international) has to be monitored.

In any case, the exam will be held during the standard exam period.

Comprising a mixture of

- SQL, PLpgSQL, design exercises, formal theory topics
- Prac part: SQL
- All questions: typed in and submitted online (not paper-based)
- You are expected to be very already quite familiar with doing the exercises shown in the labs (message: do the labs!)

Sample exams will be available in the course website in due course …

Supplementary Exam and Special Consideration

Everyone gets **exactly one chance** to pass the Exam

If you attend the Exam:

- I assume that you are fit/healthy enough to take it (Fit-to-Sit rule at UNSW)
- no 2nd chance exams, even with a medical certificate

All Special Consideration requests:

- must *document* how *you* were affected
- must be submitted via myUNSW (see course outline)
- Supplementary Exams are held shortly after the exam period; so be prepared to be available (!)

Textbook (there are many good ones!)

Elmasri, Navathe
Fundamentals of Database Systems (7th ed, 2016)

Other good references:

Garcia-Molina, Ullman, Widom
Database Systems: The Complete Book (2nd ed, 2008)

Ramakrishan, Gehrke
Database Management Systems (3rd ed, 2003)

Silberschatz, Korth, Sudarshan
Database System Concepts (6th ed, 2010)

Kifer, Bernstein, Lewis
Database Systems: Application-Oriented Approach (2nd ed, 2006)

Earlier editions of texts are ok

NOTE: Typically database topics are taught in an order that is considered suitable by the course designer (e.g., assignment topics). Each week, I will point out which chapters of the textbook are relevant.

Database System Management

Two example DBMSs for prac work:

- SQLite (open-source, free, no server needed)
- PostgreSQL (open-source, free, full-featured)

Comments on using a specific DBMS:

- the primary goal is to learn SQL (a standard)
- the specific DBMS is not especially important
- but, each DBMS implements non-standard features
- we will use standard SQL as much as possible
- PG docs describe all deviations from standard
- **if your solution doesn't work on the server setup for in our CSE servers, it will not be accepted**.