Data Management and Databases

Welcome to the Data Management and Databases course!

About the course

- During the course we will learn among other things:
  - The key concepts and terminology of data management and databases
  - Design and document database's structure based on the requirements
  - Retrieve and manipulate database's data with SQL
- Each week there's two different teaching sessons:
  - Lectures where we go through the theory of the weekly topics
  - Laboratory sessions where we apply what we've learned by working on exercises together
- The teaching sesson schedule can be found in the course's Moodle page
- There's mandatory weekly exercises that need to be submitted in Moodle before the next week's lecture

Introduction to databases

Database

> Data: "A representation of facts or ideas in a formalized manner capable of being communicated or manipulated by some process"

> Base: "A permanent structure for housing something"

- In a digital world we are constantly accessing and manipulating stored information:
  - When we open our favourite messaging app, we can see the previously sent messages and we can send new messages
  - When we pay a bill and transfer money from one bank account to another
- These kind of shared collections of logically related information are *databases*

Definition of database

- Database is...
  - a *shared collection* of
  - *logically related persistent data* and
  - a *description of this data*,
  - designed to meet the *information needs*

Definition of database

- "shared collection": database is accessible to specific applications, users and organizations
- "logically related data": the different pieces of information has logical relations, e.g. message's in a messaging app are related to the sender and the receiver users
- "persistent data": data is in a permanent storage and doesn't and unexpectactly wanish
- "description of this data": on top of the actual data such as user's name, database contains *metadata* like table and column names
- "information needs": the kind of information stored in the database is use-case specific
    - For example a simple messaging app needs to store information about users and messages

Data management

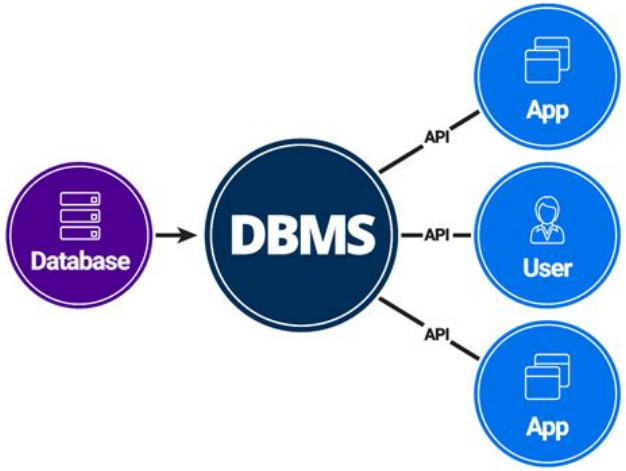
- *Data management* is the development, maintenance and coordination of *database systems*
- A database system consists of five major components: *hardware*, *software*, *data* (the database), *procedures* and *users*
- Procedures refer to the policies, conventions, instructions and rules that govern the design and use of the database

The objective of data management

- The objective of data management is to design, implement, coordinate and maintain database systems in such a way that all the required data is:
  - Valid and consistent
  - Up to date
  - Available in the required format
  - Available when needed
  - Fetrievable fast enough
  - Safe from different types of technical failures and accidents
  - Protected from unauthorized access and other types of misuse

Database Management System (DBMS)

- One of the major components of a database system is the software
- *Database Management System* (DBMS) is the software that:
  - Controls all access to the database
  - Allows users to define the database, usually through a *Data Definition Language* (DDL)
  - Allows users to insert, update, delete, and retrieve data from the database, usually through a *Data Manipulation Language* (DML)



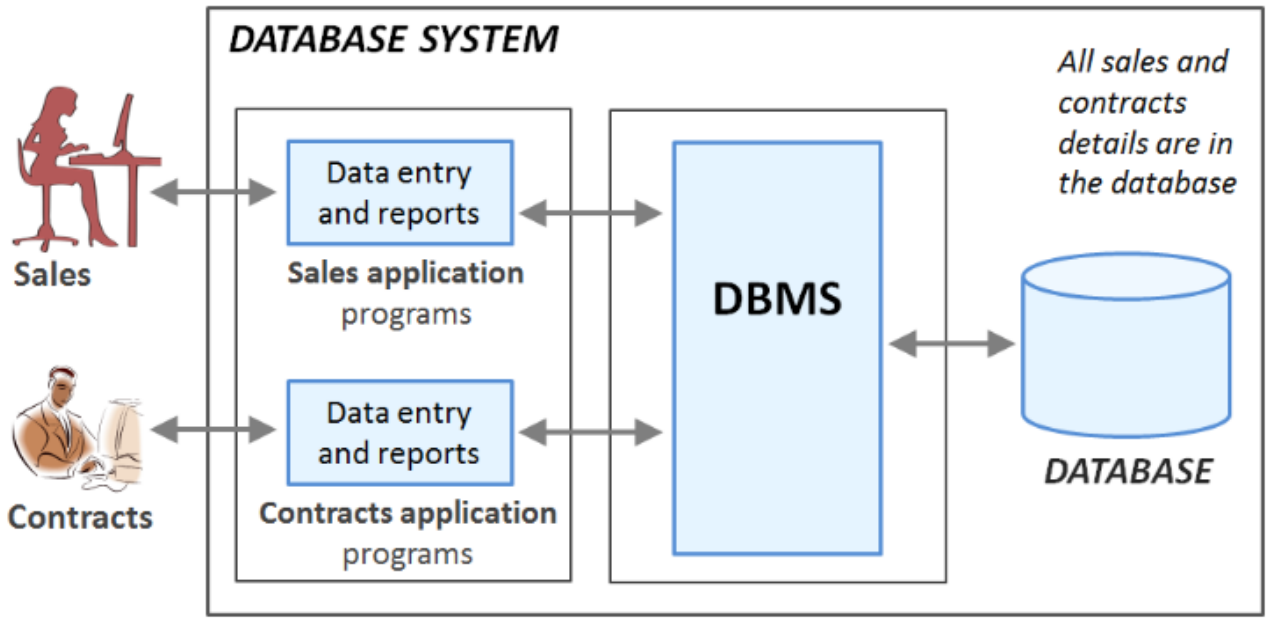
Database Management System (DBMS)

- Nowadays, the relational database management system (RDBMS) is the de facto standard
- SQL is the formal and de facto database language standard for RDBMSs
- SQL has both DDL and DML features
- There are multiple RDBMS products, such as *MySQL* and *PostgreSQL*

Database system example

- A real estate company is renting properties
- Each property has a property owner and possibly a lease if the property is rented
- Each lease has a client who is renting the property from the owner
- The company has a sales team responsible for finding clients for the available properties and a contracts team responsible for managing the leases

- People in the sales and contracts teams access the same database system
- Each team use a separate application that communicates with the DBMS using a data manipulation language
- The DBMS retrieves and manipulates data in the database on behalf of the application



In the database, the structure of sales and contracts details is the following:

- *PrivateOwner* (ownerNo, fName, lName, address, telNo)
- *PropetyForRent* (propertyNo, street, city, postcode, rooms, rent, ownerNo)
- *Client* (clientNo, fName, lName, address, telNo, prefType, maxRent)
- *Lease* (leaseNo, propertyNo, clientNo, paymentMethod, deposit, paid, rentStart, rentFinish)

The PrivateOwner table contains data such as:

ownerNo	fName	lName	address	telNo
1	John	Smith	360 Mary St	(855) 766-3792
2	Jessica	Miller	2109 Yonge St	(416) 840-4465
...	...	...	...	...

Functions of a DBMS

- The most fundamental function of DBMS is *retrieving and manipulating data in the database*
- This function should be provided in such a way that the physical level storage structures are completely hidden from the user
    - This offers a great amount of flexibility: the storage structures can change without the need to touch the application's code
- Other important functions of a DBMS are:
    - Integrity Services
    - Transaction Support
    - Concurrency Control Services
    - Recovery Services
    - Authorization Services

Summary

- *Database* is a shared collection logically related persistent data
- Database is designed to meet specific information needs
- *Data management* is the development, maintenance and coordination of *database systems*
- *Database management system* (DBMS) is a software that allows users to insert, update, delete, and retrieve data from the database
- The most fundamental function of DBMS is *retrieving and manipulating data in the database*