CERT/DEGREE IN COMPUTING, YEAR 2

DATABASE FUNDAMENTALS

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Unit 1: Introduction to Databases

What is a database?

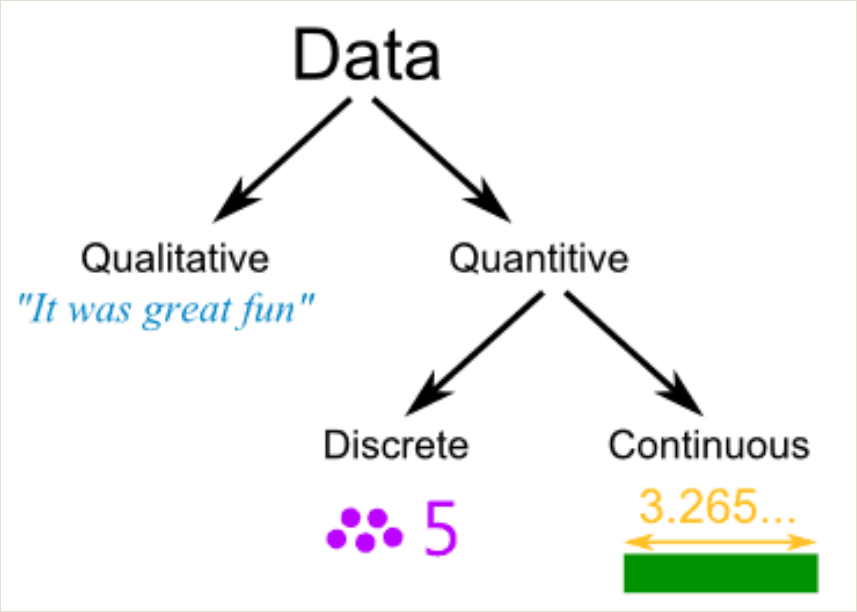
- At its simplest, a tool to store **data** permanently, i.e. a persistent data store

What is data?

- Data is a collection of facts, such as values or measurements
- It can be numbers, words, measurements, observations or even just descriptions of things.

What is data . . . .

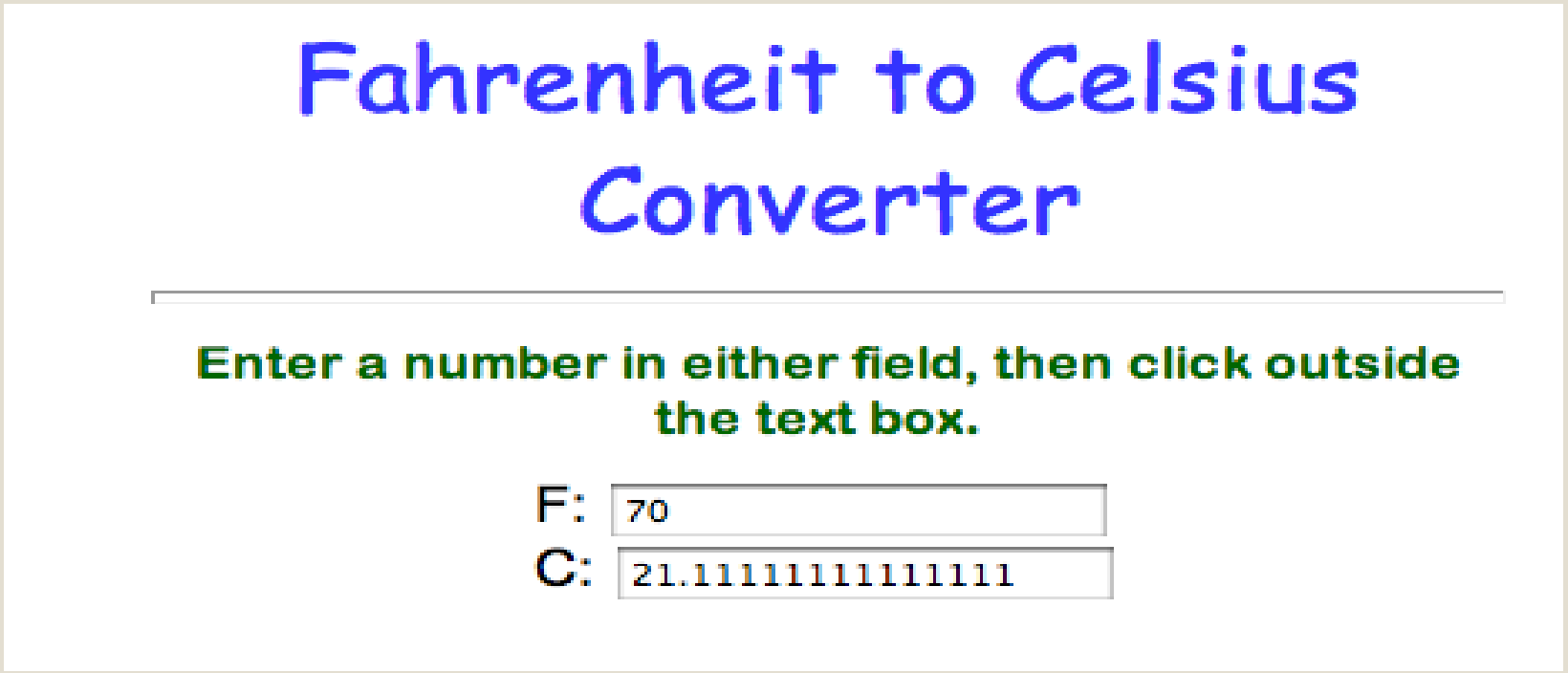
- Data can be qualitative or quantitative.
  - **Qualitative data is descriptive information (it *describes something)***
  - **Quantitative data**, is numerical information (numbers)



Collecting data

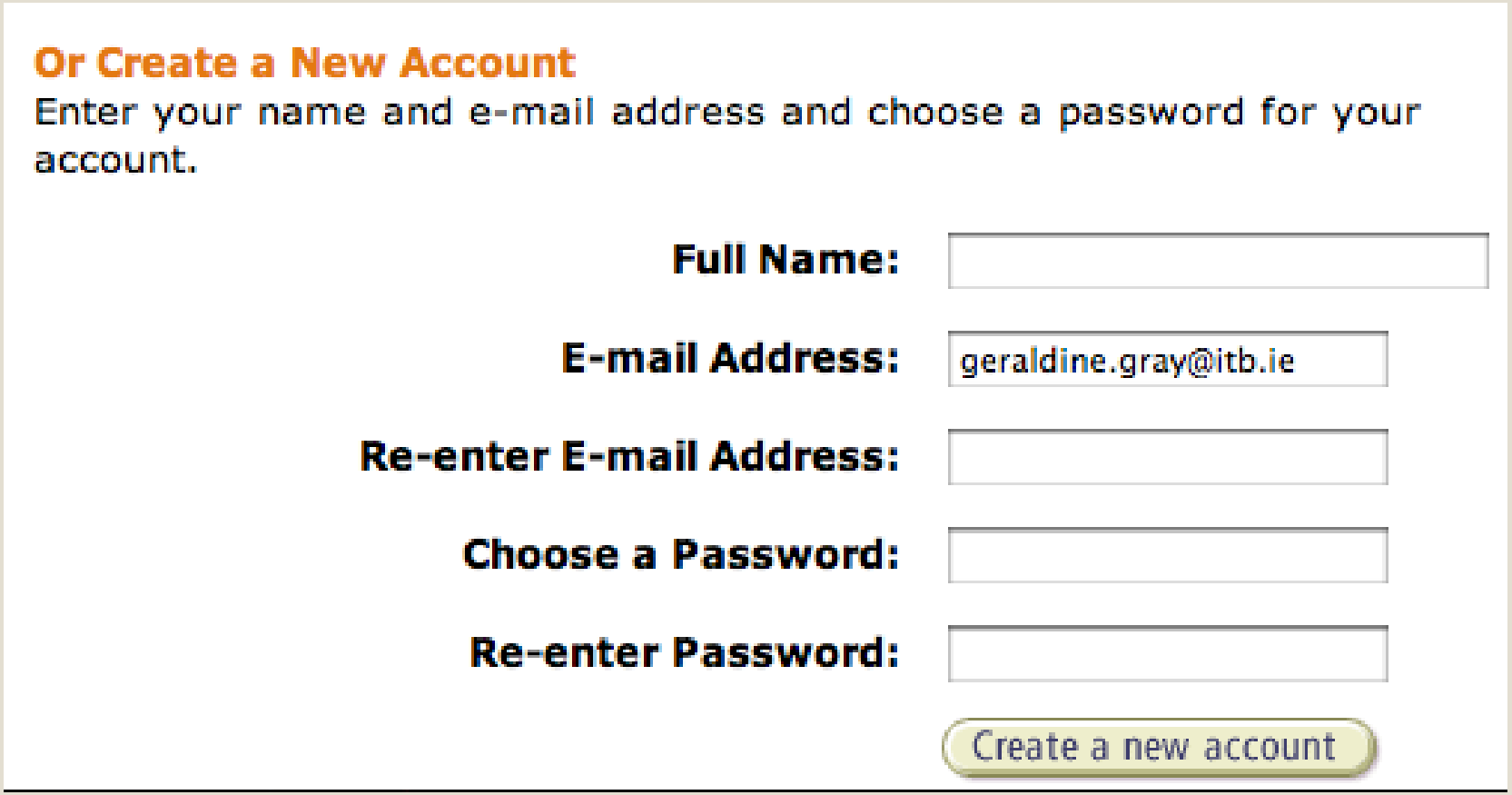
- Data is collected in many ways:
  - Observation: e.g. science experiment such as "What temperature does oil boil at"?
  - Doing a survey, e.g. the census
  - By computer programs . . .

More on data . . .



- What is the data used by the software program above?
- Where is it stored?
- Does it need to be recorded for use later?

More on data . . (from amazon.co.uk).



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- Where is it stored?
- Does it need to be recorded for use later?

Databases

The focus of this course is

how to store data

Efficiently,

Accurately

and

Securely

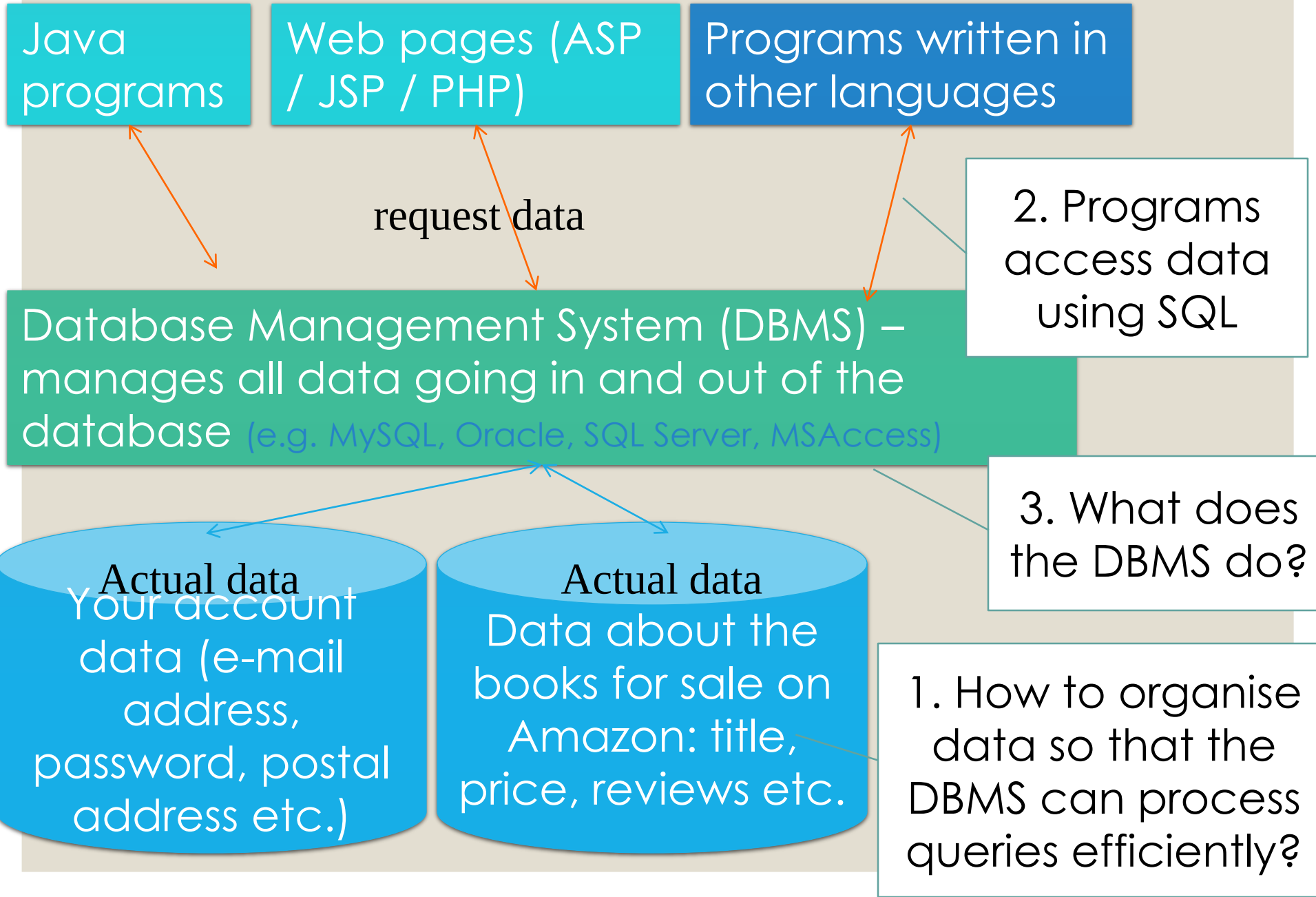
so that it can be accessed easily from software programs

The Evolution of Database

- The Evolution

- We will come back to this at the end of the course when we have considered the relational database model and the terms/concepts make sense!

The big picture . . .



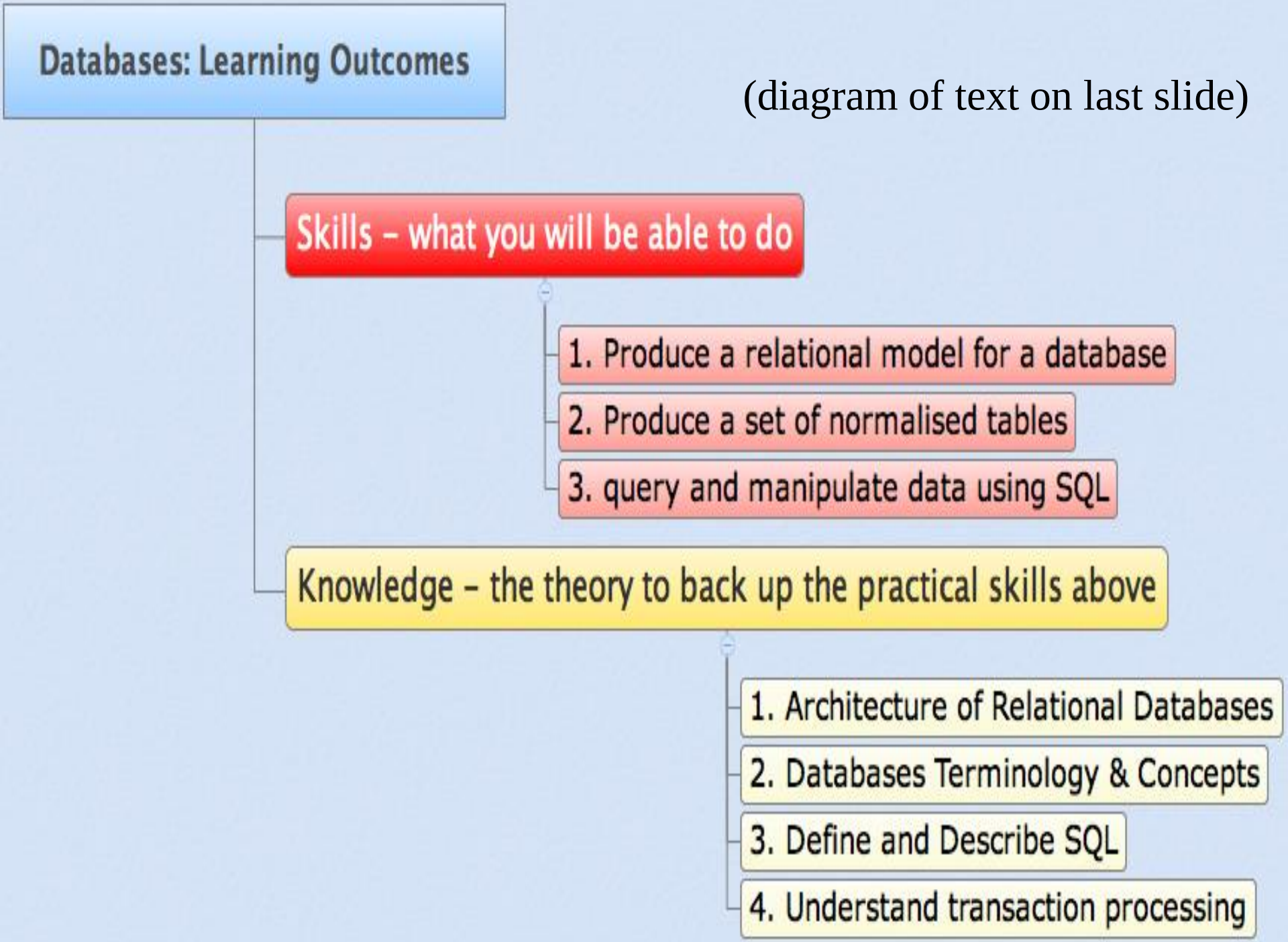
Learning outcomes . . . .

(Knowledge) Having succesfully completing this module the student will be able to:

- describe the architecture of a relational database
- define the terminology and concepts associated with relational databases
- explain various aspects of transaction processing
- define and describe **SQL**

(Skills) Having successfully completed this module, the student will be able to:

- Model database requirements using an ERD
- produce a **normalised** set of tables
- query and manipulate database objects (using **SQL**)



(diagram of text on last slide)

Topics

Topic 1: Features of a Relational Database

Topic 2: SQL

Topic 3: Database Design
(ERDs and Normalisation)

Topic 4: Transaction Processing, Security

Software: MySQL

House Keeping

Bring a printed copy of lecture notes + pen & paper to class each week

Schedule

- Continuous Assessment: 50%
- Exam: 50%
- Credits: 5

Moodle

- The enrolment key for Moodle is as follows:

- **DBF2016**

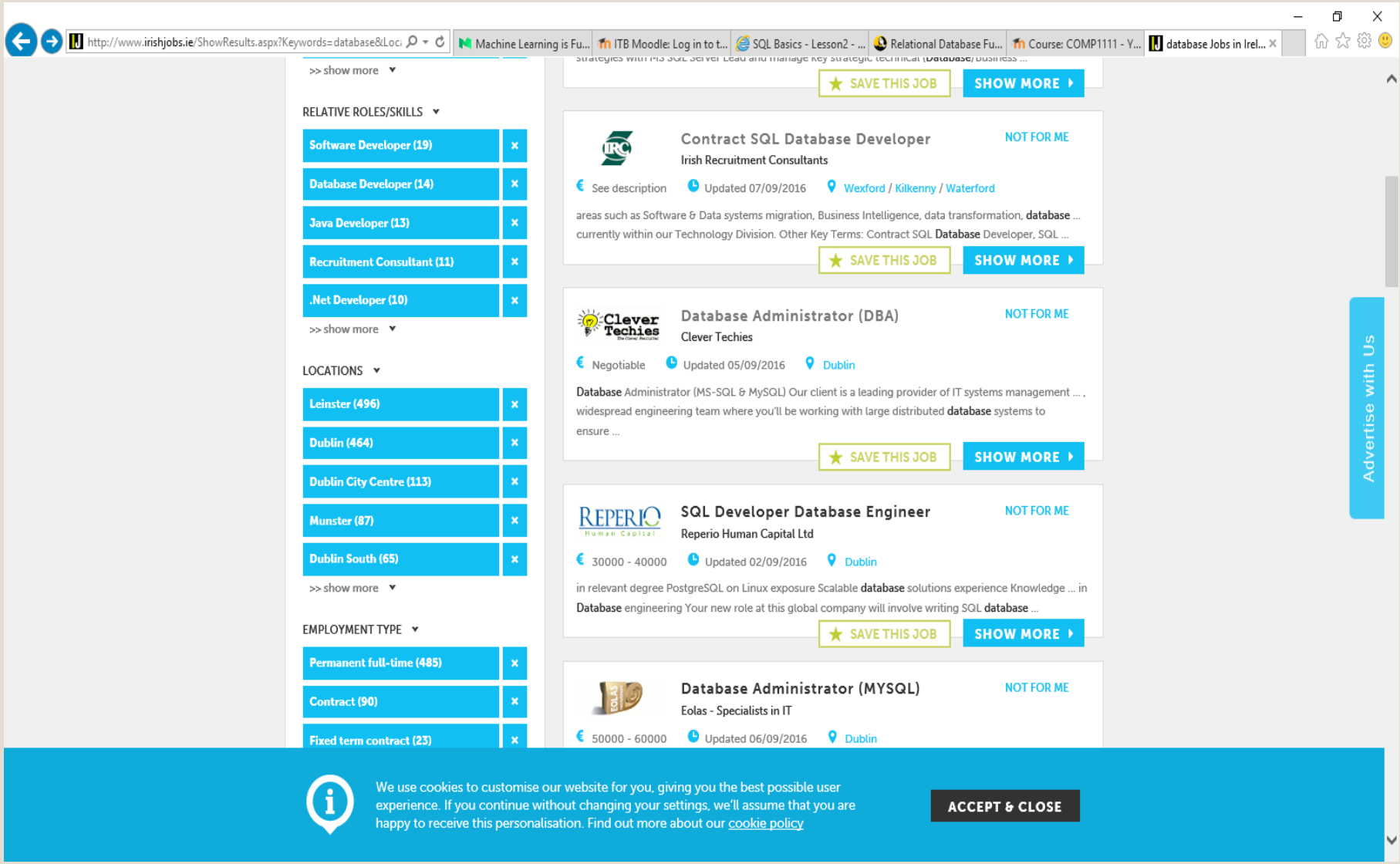
Continuous Assessment

- Total Value: 50%
  - 1. Lab worksheets - 10%
    - To be completed throughout the semester - a portfolio of lab worksheets expected and should be uploaded to Moodle weekly (**No late submissions accepted**)
  - 2. SQL in-class test- 15%
    - Will be held around week 6
  - 3. Database Design Assignment - 25%
    - Either as a class test / assignment (report)
    - Will be held/due in week 12

Why study databases?

CORE IT Skill

– irishjobs.ie SQL/Databases skills



Exercise time

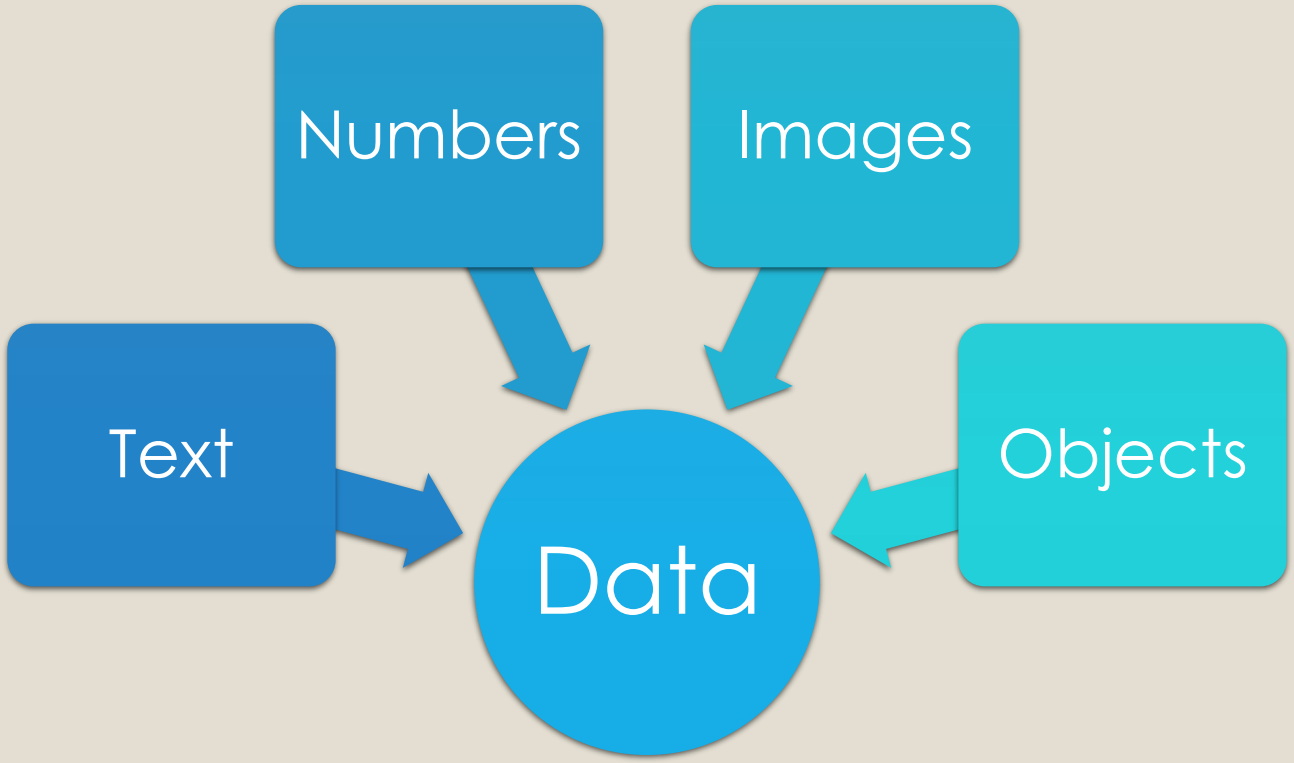
- Suppose you had to write an application for the following.
- Identify what information needs to be persistent (stored permanently) to a database . .

  - A competitor to face book
  - A recruitment web site like www.irishjobs.ie
  - A college system to handle student registrations and exam results.

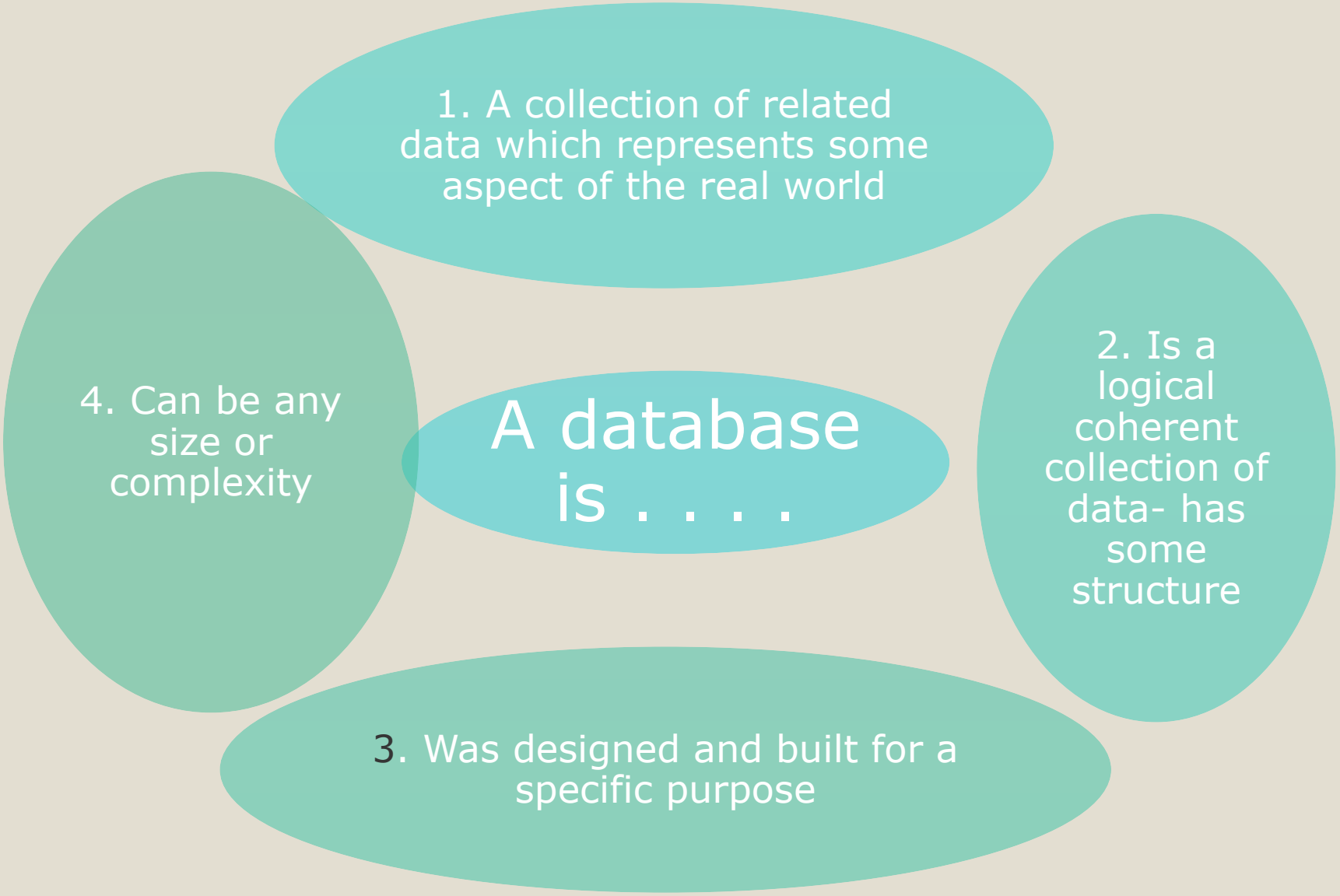
SOME BACKGROUND AND TERMINOLOGY

Some Terminology - data

1. Data: known facts that can be recorded



Some Terminology - database



Cells, Rows, Tables and Databases

- Database -- a collection of related tables describing various facets of a group of objects or events.

Database

Student Table

StudentID	StudentName	CourseCode
B00001234	Joe Bloggs	BN002
B00051413	Ann Ryan	BN001
B00012136	John Smith	BN005

Course Table

Course Code	Course Name
BN001	Certificate in Computer Engineering
BN002	Certificate in Computing
BN005	Certificate in Business Studies

Cells, Rows, Tables and Databases

- Table -- a series of rows describing separate objects or events.
  - (tables are also called relations)

StudentID	StudentName	CourseCode
B00001234	Joe Bloggs	BN002
B00051413	Ann Ryan	BN001
B00012136	John Smith	BN005

Cells, Rows, Tables and Databases

- Row -- a group of values representing a single instance of an entity – an object or event.
  - (rows are also called tuples)

B00001234	Joe Bloggs	BN002

Cells, Rows, Tables and Databases

- Cell -- a single value, an item of data.

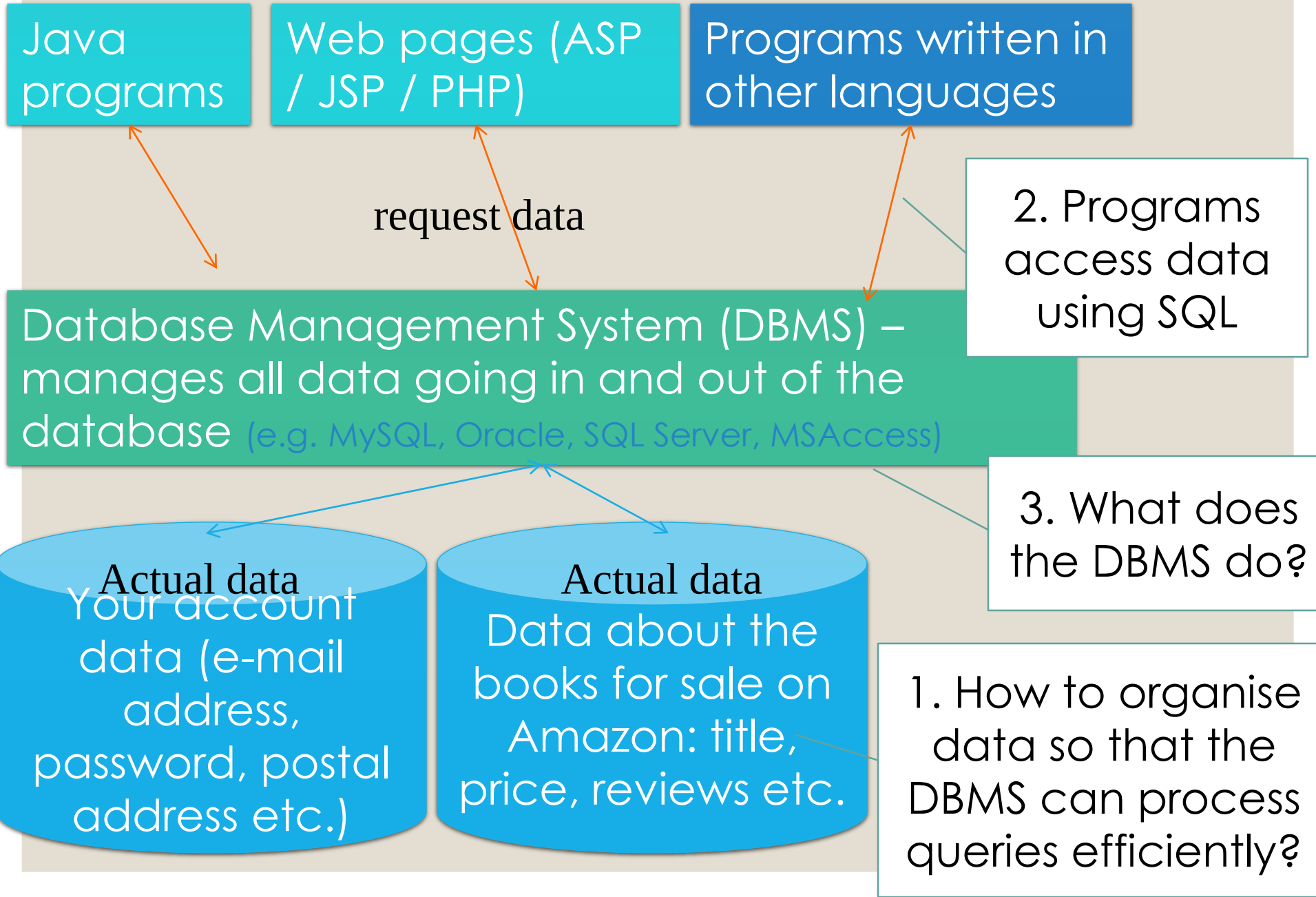
B00001234

More on terminology – a database management system (DBMS)

- A collection of programs that enables users to create and maintain a database.
  - Records the structure of the data in the databases (meta data)
  - Handles request from users and programs to:
    - Add data the database
    - Delete data from the database
    - Update data in the database
    - Query the database (makes requests such as list all books sold by amazon in the last 30 minutes)

CRUD application – Acrostic for an application using a database. The letters stand for Create, Read, Update and Delete

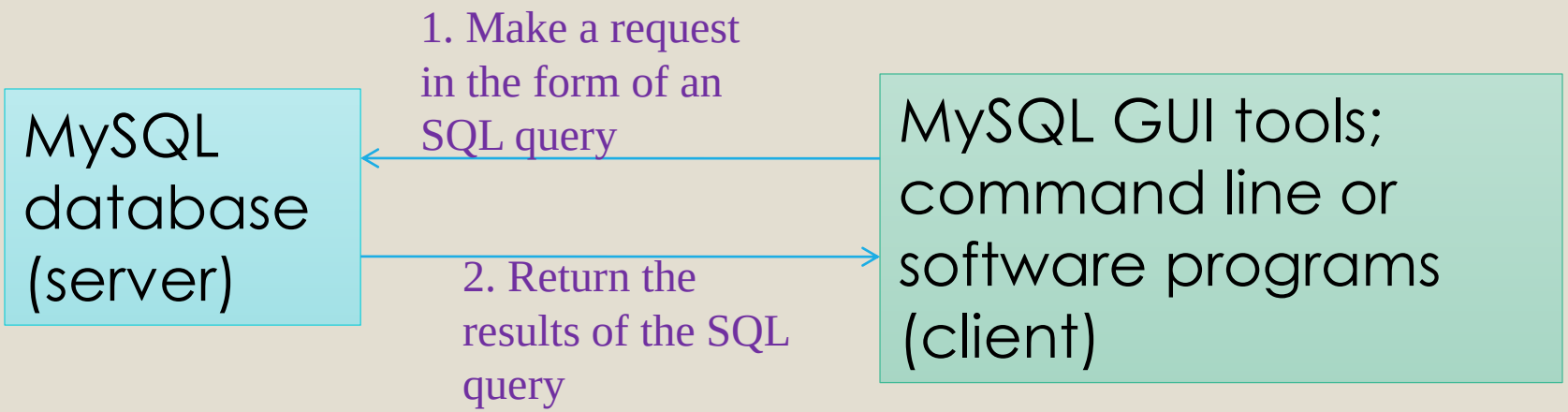
The big picture . . .



MySQL – the DBMS we will be using in the lab

- MySQL is a Relational Database Management System (RDBMS).
- MySQL is the most popular Open Source database implementation
- MySQL Database Server is very fast, reliable, and easy to use.
- The MySQL Database Software is a client/server system.

MySQL – Client / Server



- Client program can be a MySQL command line client, GUI (Graphical User Interface) client, or a program written in any language such as C, Perl, PHP, Java that has an interface to the MySQL server.

MySQL

- Download from: http://dev.mysql.com/downloads/
- MySQL can be installed as a service which starts automatically when your machine starts up.
  - Can add icons on the desktop for starting and stopping the server.
- Alternatively it can be started from a terminal window.
- Default administrator user name and password is:

User name: root

Password:

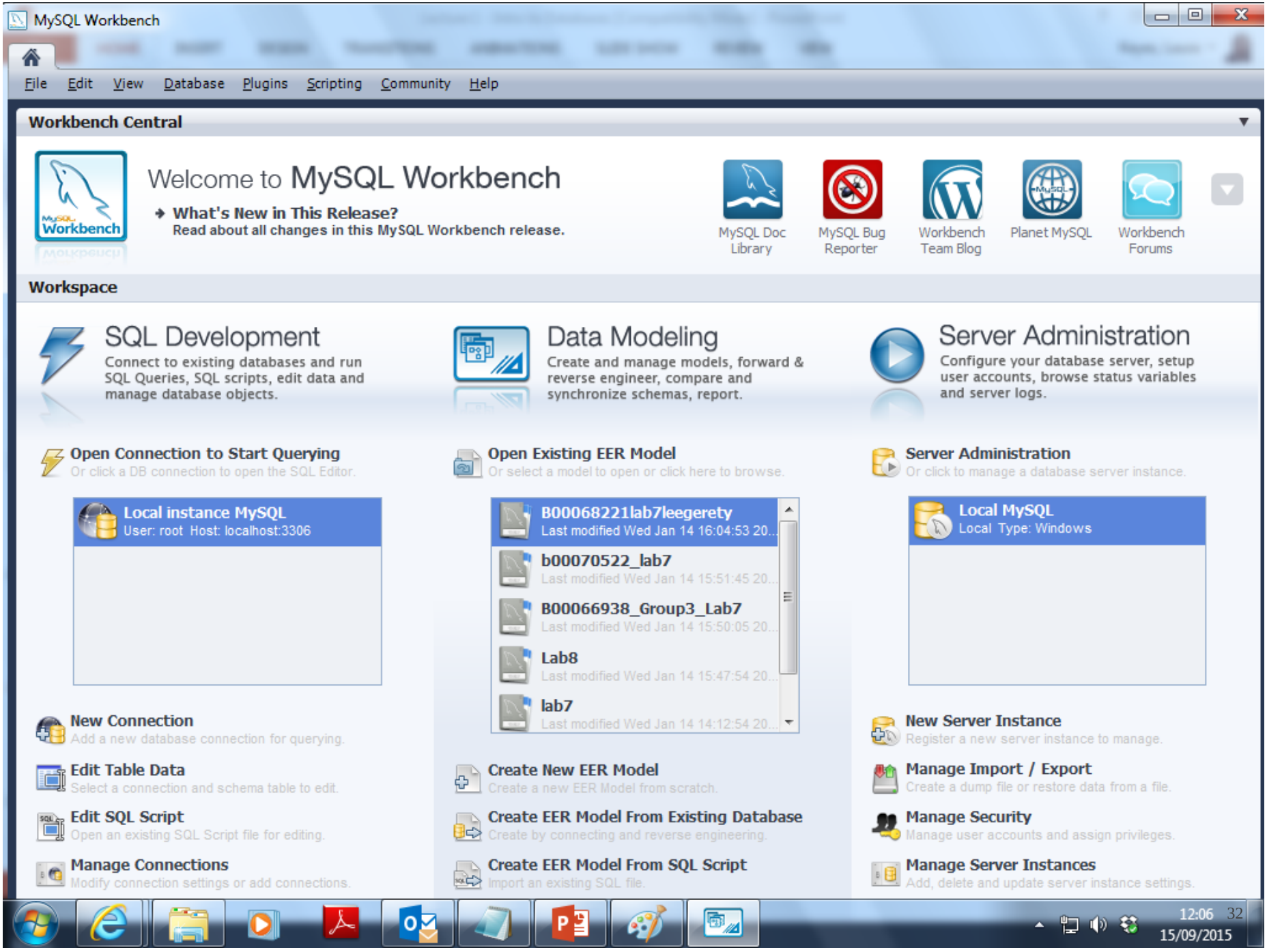
Starting MySQL

To start the MySQL server, select start-> program files-> mysql -> mysql server 5.7 ->mysql command line client.

Just hit enter when asked for a password (the password is NULL on installation)

Alternatively, you can run the following from a terminal window:

c:\program files\mysql\mysql server 5.0\bin\mysqld --console


MySQL Workbench
File Edit View Database Plugins Scripting Community Help
Workbench Central
Welcome to MySQL Workbench
What's New in This Release?
Read about all changes in this MySQL Workbench release.
MySQL Doc Library
MySQL Bug Reporter
Workbench Team Blog
Planet MySQL
Workbench Forums
Workspace
SQL Development
Connect to existing databases and run SQL Queries, SQL scripts, edit data and manage database objects.
Data Modeling
Create and manage models, forward & reverse engineer, compare and synchronize schemas, report.
Server Administration
Configure your database server, setup user accounts, browse status variables and server logs.
Open Connection to Start Querying
Or click a DB connection to open the SQL Editor.
Local instance MySQL
User: root Host: localhost:3306
Open Existing EER Model
Or select a model to open or click here to browse.
B00068221lab7leegerety
Last modified Wed Jan 14 16:04:53 20...
b00070522_lab7
Last modified Wed Jan 14 15:51:45 20...
B00066938_Group3_Lab7
Last modified Wed Jan 14 15:50:05 20...
Lab8
Last modified Wed Jan 14 15:47:54 20...
lab7
Last modified Wed Jan 14 14:12:54 20...
Server Administration
Or click to manage a database server instance.
Local MySQL
Local Type: Windows
New Connection
Add a new database connection for querying.
Edit Table Data
Select a connection and schema table to edit.
Edit SQL Script
Open an existing SQL Script file for editing.
Manage Connections
Modify connection settings or add connections.
Create New EER Model
Create a new EER Model from scratch.
Create EER Model From Existing Database
Create by connecting and reverse engineering.
Create EER Model From SQL Script
Import an existing SQL file.
New Server Instance
Register a new server instance to manage.
Manage Import / Export
Create a dump file or restore data from a file.
Manage Security
Manage user accounts and assign privileges.
Manage Server Instances
Add, delete and update server instance settings.
12:06
15/09/2015

What have you just started?

Answer: A MySQL database **instance**.

- The term instance means a complete database environment, including the RDBMS software, table structures and other objects.
- Each database instance can store multiple databases (also called schemas).
- Each database will contain multiple tables.

Database instance

A MySQL Database **Instance**

RDBMS software

Sales **database** (also called a **schema**)

- Customer **table** holding details of all customers
- Sales order **table** holding details of all sales
- Promotions **table** showing details of all current promotions

and other tables . . . .

Payroll **database** (also called a **schema**)

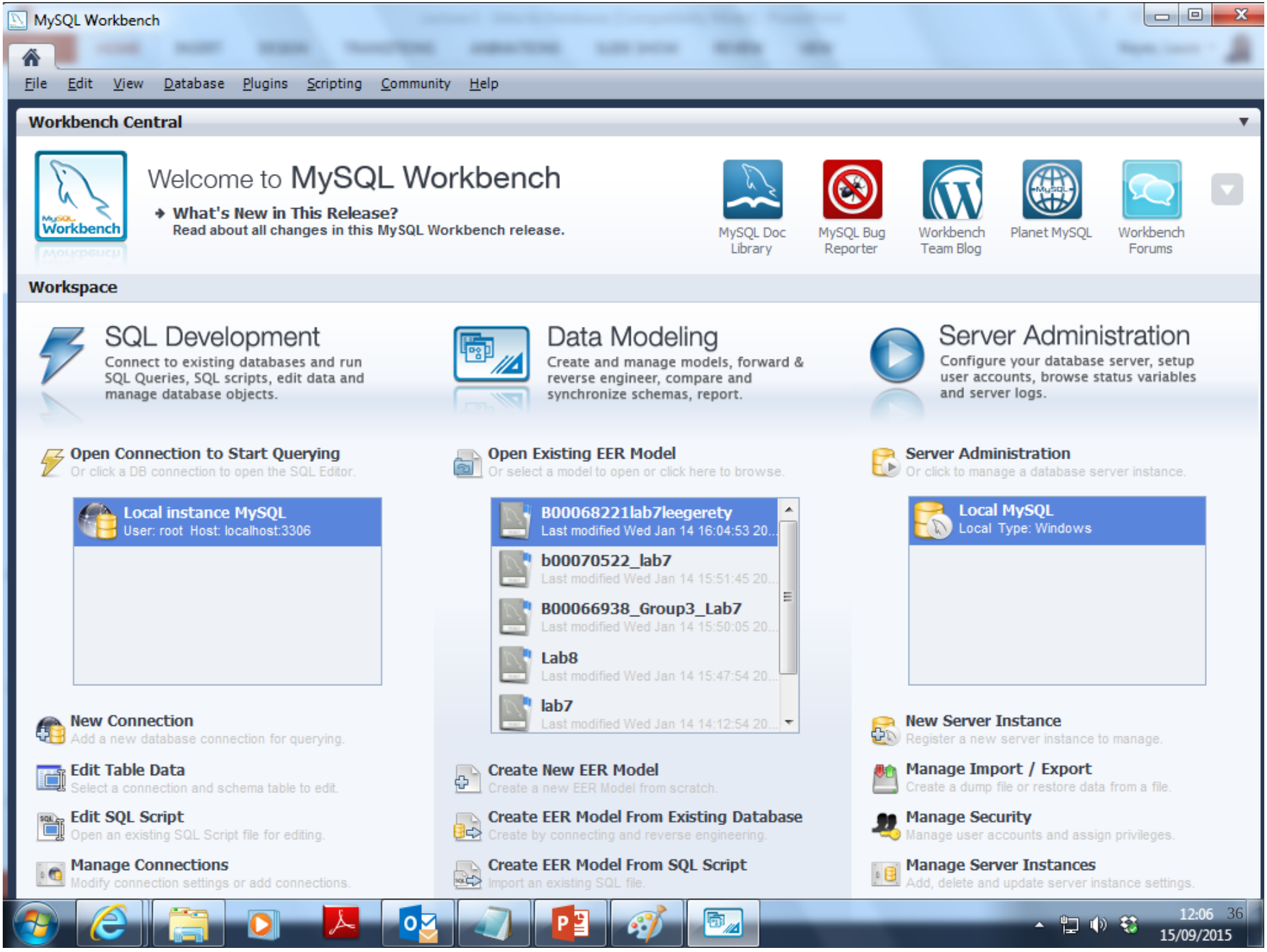
- Employee **table** holding details of all employees
- Tax_bands **table** holding details of current tax bands and rates

and other tables . . . .

Working with MySQL

Once the server is started, you can interact with it using GUI clients such as:

- MySQL Administrator:- Server Administration to manage the database objects and users.
- MySql Query Browser:- for running SQL queries.
- MySQL workbench:- incorporates both tools above and an EER modelling tool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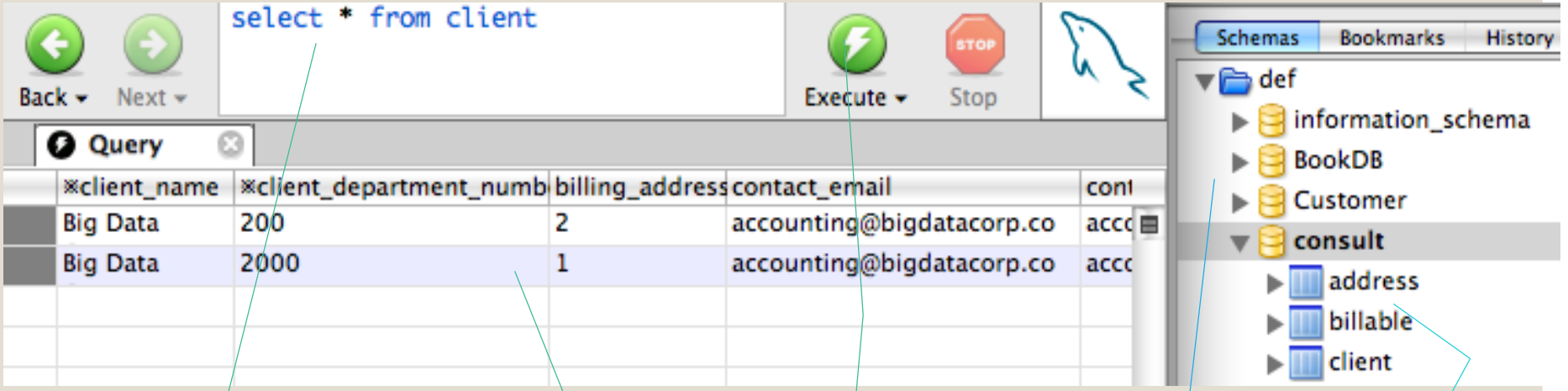
MySQL Query Browser

- SQL queries can be run from MySQL Query Browser.



1. Type in an SQL query

2. Click on Execute

3. Query results are displayed here

Available databases

Tables in the database

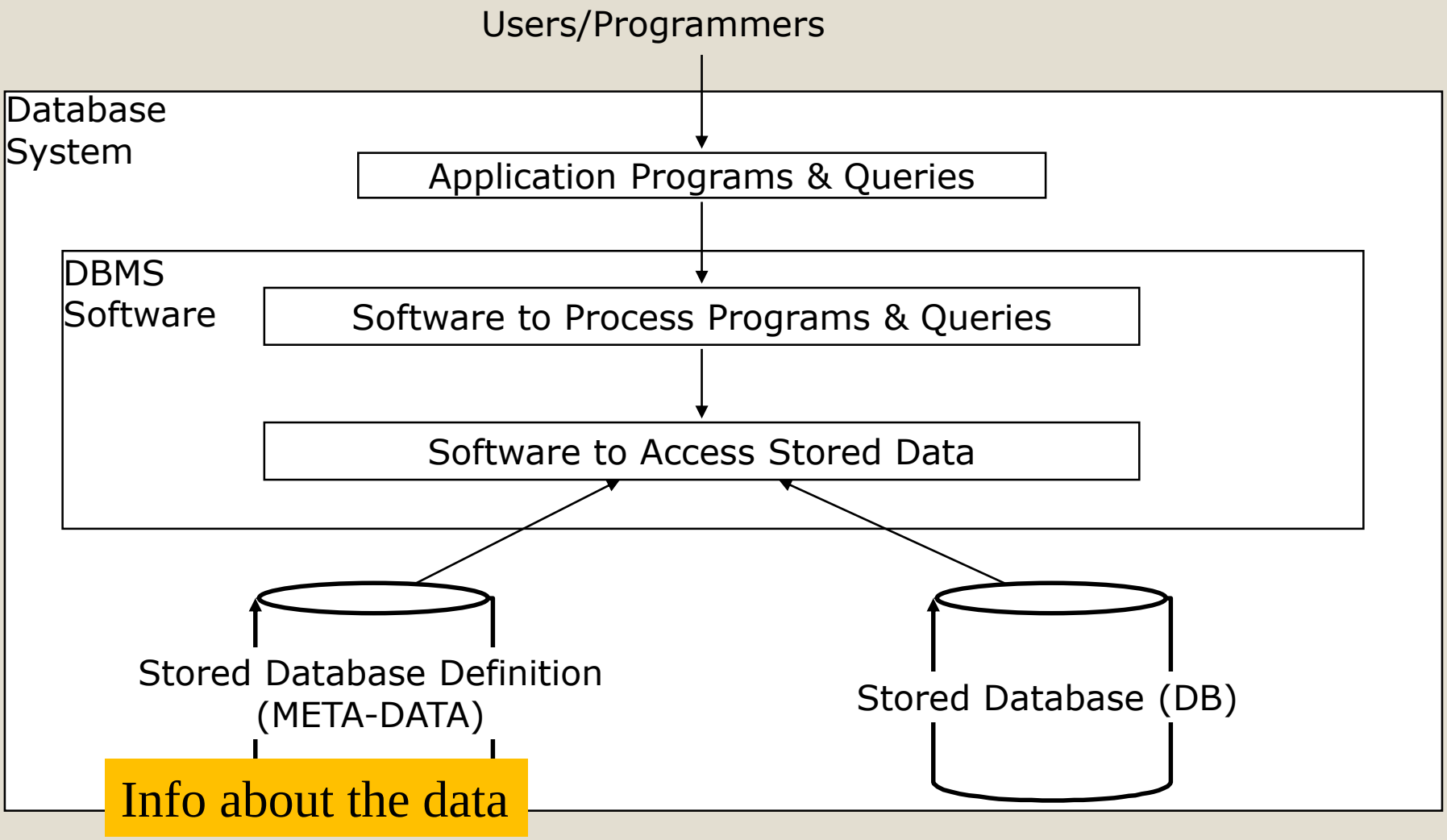
Some initial SQL queries

- Show databases: list all the database the current user has access to
- Use *databaseName*: tells MySQL which database to run the queries against, e.g. Use consult
- Describe *tablename* gives the column names and definitions of a table in the database, e.g. Describe client
- Select * from *tablename* lists all the data in the specified table, e.g. Select * from client

More on terminology – a database system

- The database system is the term given to all of the following together:
  - The DBMS,
  - The data
  - And the programs that access and maintain the data

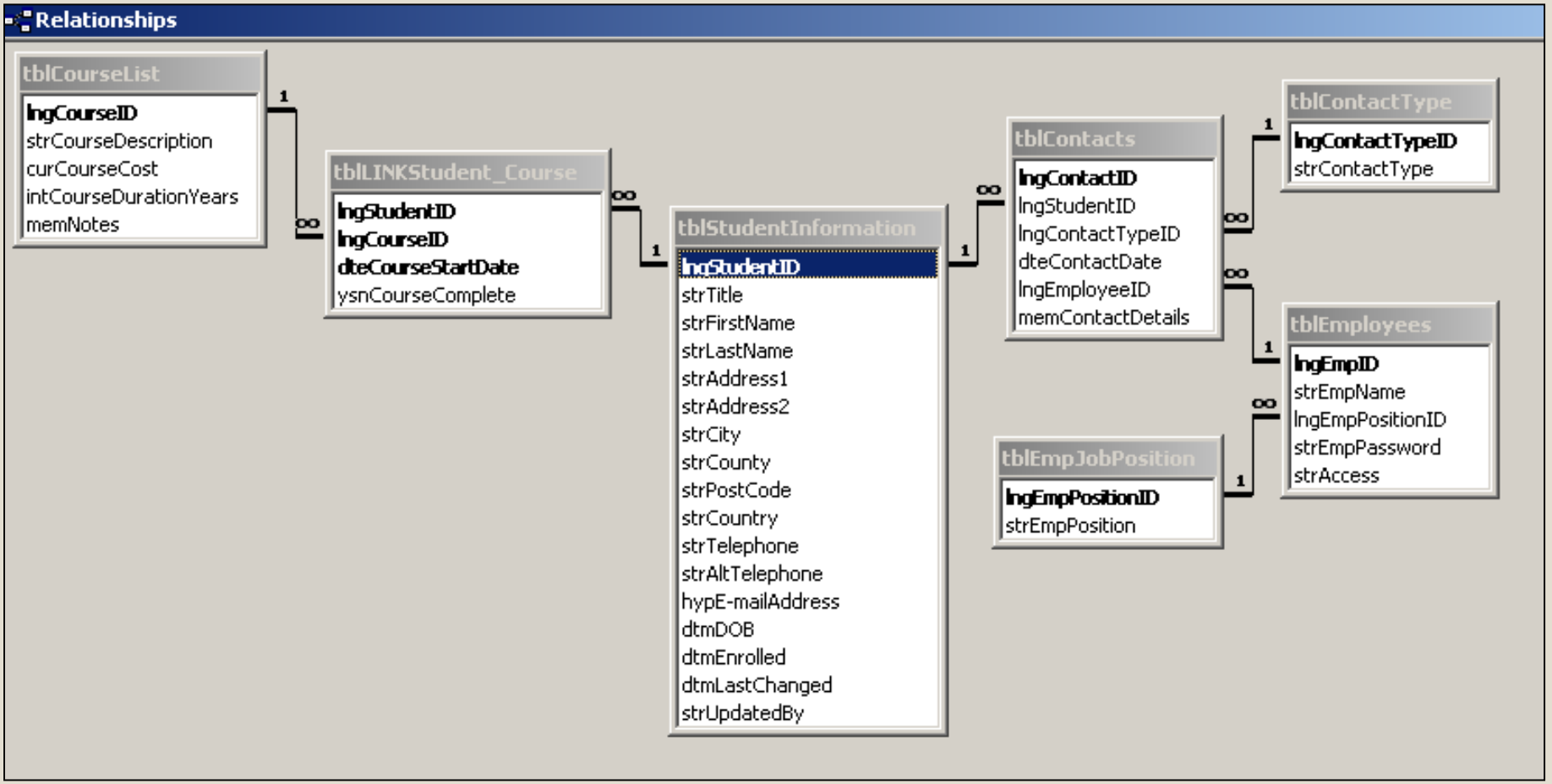
A database system



Advantages of using a database

- The programmer does not need to know how to store the data.
- The programmer does not need to know where to store the data.
- The programmer does not need to know how to manage the data.

Exercise – Interpret the following:



Summary

- Definitions:
  - Data & sources of data
  - DBMS
  - Database Systems
- MySQL
  - Open source RDBMS
  - Tables organised into schema
  - GUI tools: administrator, query browser, EER
- Job market

Books

- Essential Reading:
- Colin Ritchie - **Relational Database Principles,** Letts Educational

- Recommended Reading:
- R.L. Warrender – **Databases**, Crucial
- McFadden et al, **Modern Database Management**, Addison Wesley
- Elmasri/Navaithe, **Fundamentals of Database Systems**, Addison Wesley
- Date, **An Introduction to Database Systems**, Addision Wesley
- Connolly & Beggs, **Database Systems**, Addison Wesley
- McDermid, Donald C, **Software Engineering for Information Systems,** Blackwell

More on books . . .

- There are many book's in the library covering an introduction to database systems, all of which cover most of the material in this course. Here are details of some of them.

Book	Comment
Watson et al, Data Management: Databases and Organisations John Wiley.	I would recommend this book as a starting point for those new to databases. It gives a comprehensive introduction to the topic, but lacks detail in sections.

McFadden et al, Modern Database Management Addison Wesley	**These three books give the best coverage of the topics on the course.**
Colin Ritchie, Relational Database Principles, Continuum International Publishing Group	
Connolly & Begg, Database Systems, Pearson Education	

More on books

Elmasri/Navaithe, Fundamental of Database Systems, Addison Wesley	For those with previous experience in databases and want to extent their knowledge, this book goes into more detail than the previous three books, and also covers relational algebra, the mathematical theory of relational databases.
Date, An Introduction to Database Systems, Addison Wesley	Date is probably the best know database book, and has been for many years. It is suitable if you want to extent your knowledge beyond the scope of this course.

Short Video

- Video:

Intro to Databases and SQL

URL: http://www.youtube.com/watch?v=UeJKioNqe5w