



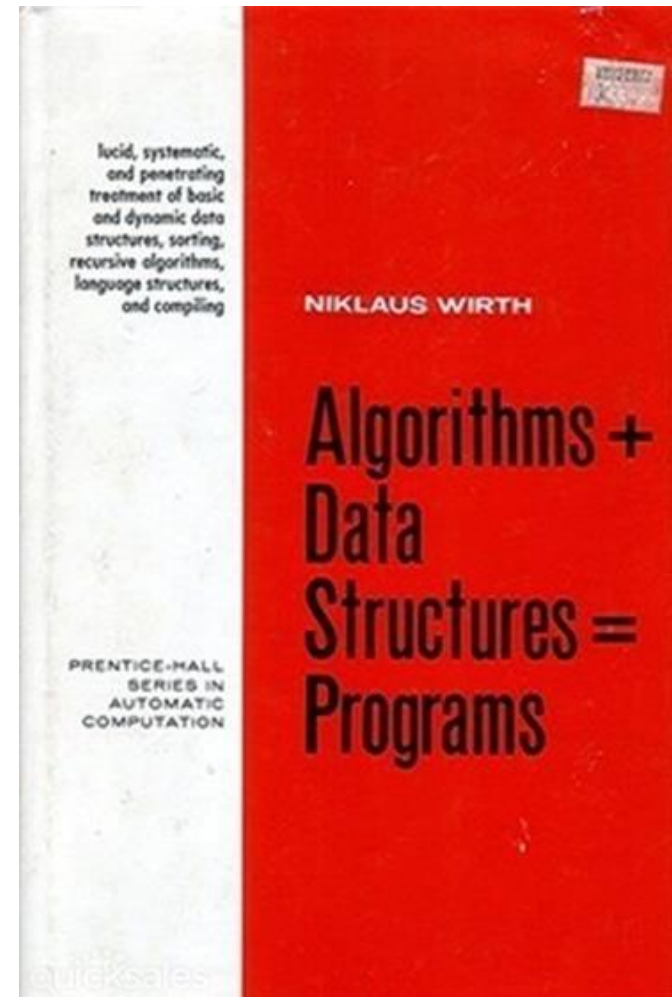
INFO 90002

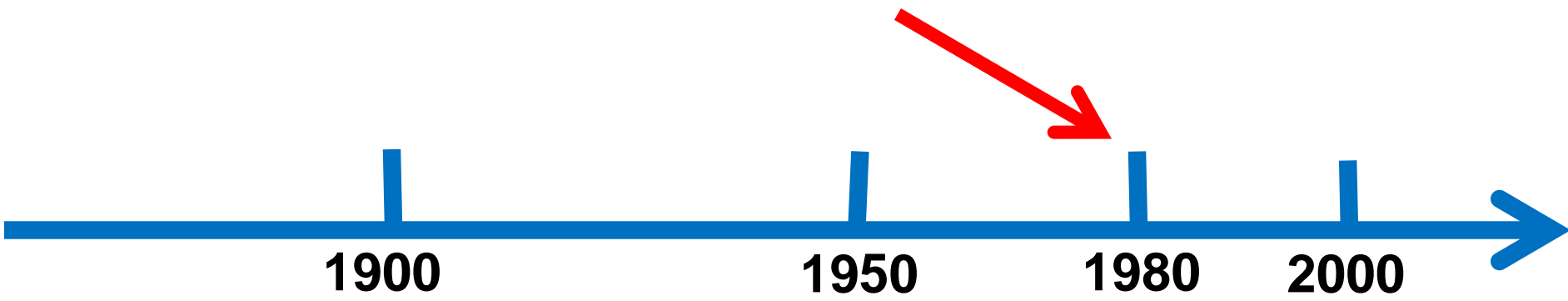
Database Systems & Information Modelling

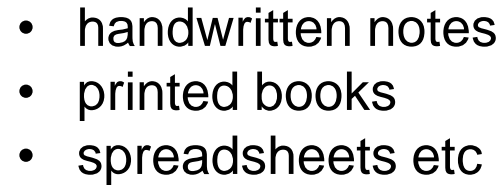
Week 01

Introduction to Databases and SQL/MySQL

- Computer systems consist of *software* (algorithms) working to process *data*.
- You will learn about creating software and algorithms in other subjects.
- This subject is about *data*.





80 NATURAL SELECTION. CHAP. IV.

NATURAL SELECTION.

How will the struggle for existence, discussed too briefly in the last chapter, act in regard to variation? Can the principle of selection, which we have seen is so potent in the hands of man, apply in nature? I think we shall see that it can act most effectually. Let it be borne in mind in what an endless number of strange peculiarities our domestic productions, and, in a lesser degree, those under nature, vary; and how strong the hereditary tendency is. Under domestication, it may be truly said that the whole organisation becomes in some degree plastic. Let it be borne in mind how infinitely complex and close-fitting are the mutual relations of all organic beings to each other and to their physical conditions of life. Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remem-

Tables

- Each row represents an instance of a set of entities
- Entities might be people, things, events, transactions...
- You can extract useful knowledge via simple, repetitive processes
- A natural fit for business and scientific data.

Tables computed according to the present obliquity of the ecliptic 1038

☉ in ♈							☉ in ♉								
Time from h. m. s.	10 ♈	11 ♈	12 ♈	Ascend ♈	2 ♈	3 ♈	Time from h. m. s.	10 ♉	11 ♉	12 ♉	Ascend ♉	2 ♉	3 ♉		
0. 0. 0	0	9	22	26	36	12	3	1. 51. 37	0	9	17	16	27	4	28
0. 3. 40	1	10	23	27	17	13	3	1. 55. 27	1	10	18	17	8	5	29
0. 7. 20	2	11	24	27	56	14	4	1. 59. 17	2	11	19	17	48	6	30
0. 11. 0	3	12	25	28	42	15	5	2. 3. 0	3	12	20	18	27	7	1
0. 14. 41	4	13	25	29	17	16	6	2. 6. 50	4	13	21	19	9	8	2
0. 18. 21	5	14	26	29	53	17	7	2. 10. 34	5	14	22	19	49	9	3
0. 22. 2	6	15	27	0	24	17	8	2. 14. 44	6	15	22	20	29	10	4
0. 25. 42	7	16	28	1	14	18	8	2. 18. 37	7	16	22	21	10	10	4
0. 29. 23	8	17	29	1	55	18	9	2. 22. 31	8	17	23	21	52	11	5
0. 33. 4	9	18	30	2	33	19	10	2. 26. 25	9	18	24	22	32	11	6
0. 36. 45	10	19	1	3	14	20	11	2. 30. 20	10	19	24	23	14	12	7
								34. 16	11	20	25	23	53	13	8
								38. 13	12	21	26	24	36	14	9
								42. 10	13	22	27	25	17	15	10
								46. 8	14	23	28	25	58	15	11
								50. 7	15	24	29	26	40	16	12
								54. 7	16	25	29	27	22	17	12
								58. 7	17	26	30	28	4	18	13
								2. 7	18	26	1	28	45	18	14
								6. 9	19	27	2	29	28	19	15
								10. 12	20	28	3	30	12	20	16
								14. 15	21	29	3	31	56	21	17
								18. 19	22	30	4	1	36	22	18
								22. 23	23	1	5	2	20	22	19
								26. 29	24	2	6	3	1	23	20
								30. 25	25	3	7	3	45	24	21
								34. 41	26	4	7	4	28	25	22
								38. 49	27	5	8	5	11	26	23
								42. 47	28	6	9	5	54	27	24
								47. 8	29	7	10	6	29	27	25

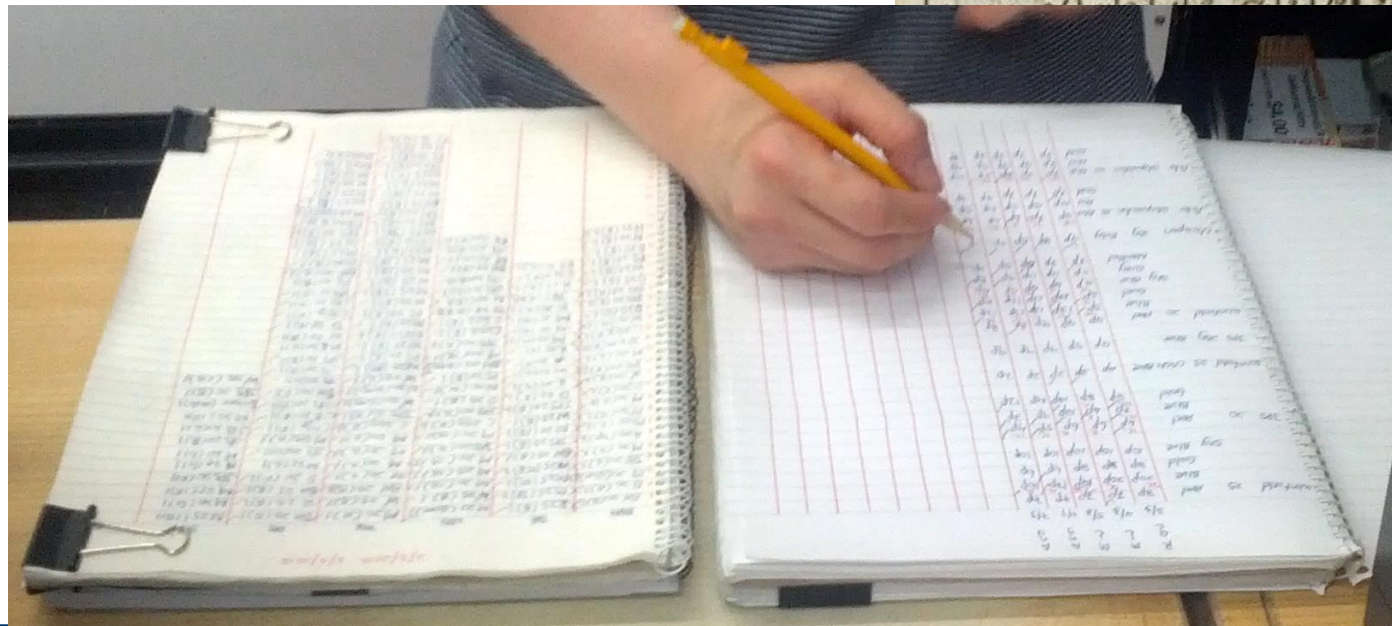
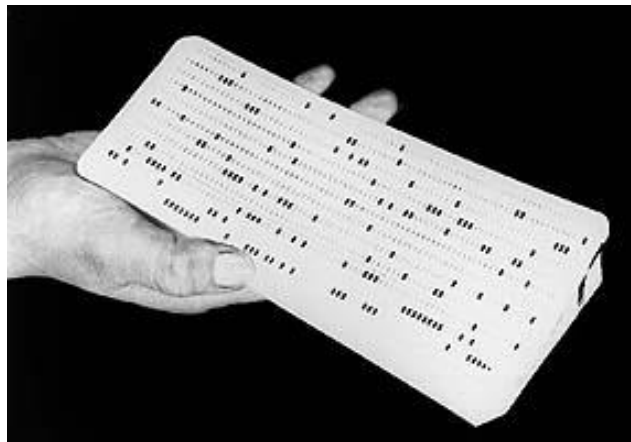


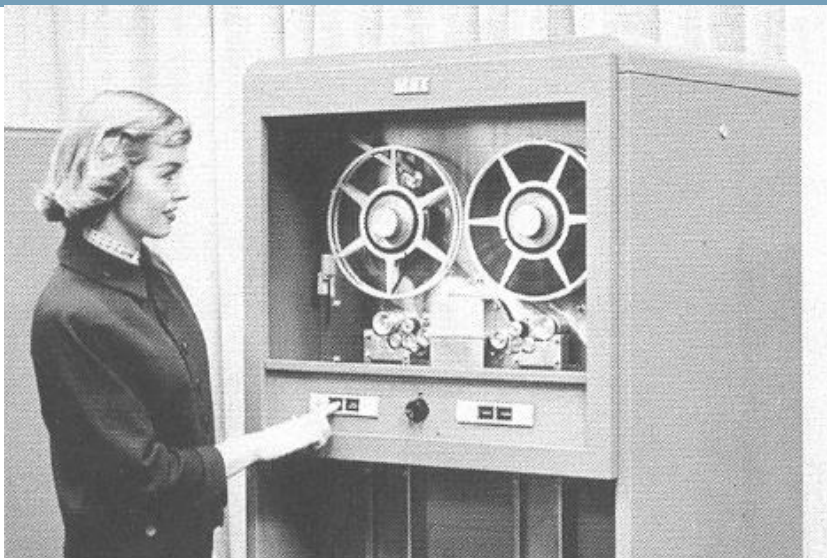
Table of rows -> Deck of cards

1890 US census

1	2	3	4	CM	UM	Jp	Ch	Oc	In	20	50	80	Dv	Un	3	4	3	4	A	E	L	a	g
5	6	7	8	CL	UL	O	Mi	Qd	Mo	25	55	85	Wd	CY	1	2	1	2	B	F	M	b	h
1	2	3	4	CS	US	Mb	B	M	0	30	60	0	2	Mr	0	15	0	15	C	G	N	c	i
5	6	7	8	No	Hd	Wf	W	F	5	35	65	1	3	Sg	5	10	5	10	D	H	O	d	k
1	2	3	4	Fh	Ff	Fm	7	1	10	40	70	90	4	0	1	3	0	2	St	I	P	e	l
5	6	7	8	Hh	Hf	Hm	8	2	15	45	75	95	100	Un	2	4	1	3	4	K	Un	f	m
1	2	3	4	X	Un	Ft	9	3	i	c	X	R	L	E	A	6	0	US	Ir	Sc	US	Ir	Sc
5	6	7	8	Ot	En	Mt	10	4	k	d	Y	S	M	F	B	10	1	Gr	En	Wa	Gr	En	Wa
1	2	3	4	W	R	OK	11	5	l	e	Z	T	N	G	C	15	2	Sw	FC	EC	Sw	FC	EC
5	6	7	8	7	4	1	12	6	m	f	NG	U	O	H	D	Un	3	Nw	Bo	Hu	Nw	Bo	Hu
1	2	3	4	8	5	2	Oc	0	n	g	a	V	P	I	Al	Na	4	Dk	Fr	It	Dk	Fr	It
5	6	7	8	9	6	3	0	p	o	h	b	W	Q	K	Un	Pa	5	Ru	Ot	Un	Ru	Ot	Un

https://www.census.gov/history/www/innovations/technology/the_hollerith_tabulator.html



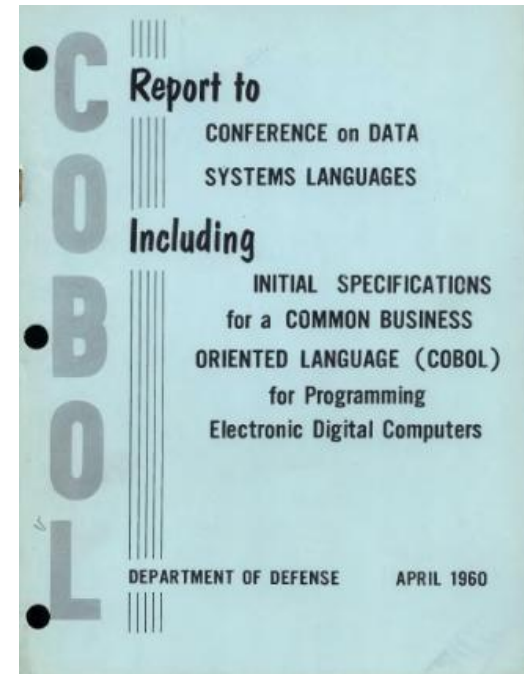


EMP_RECORD...	EMP_ID	EMP_REGION	EMP_DEPT	EMP_HIRE_D...	E...	E...	EMP_...	EMP_SALARY	EMP_NAME	EMP_SKIL
68	3715	4	153	09061987	9	6	1987	14000000	IRENE HIRSH	041085
62	39412	1	650	03119590	3	11	9590	167000000	ANN FAHEY	031099
56	1939	2	265	09281988	9	28	1988	21300000	EMILY WILM...	021077
50	3502	2	165	07041985	7	4	1985	19500000	CATHEZINE ...	011015
44	4435	2	117	05141989	5	14	1989	17000000	AGNES KING	00
68	1673	3	138	07021985	7	2	1985	16800000	MARTIN XU	041033
62	4181	3	161	02031988	2	3	1988	15900000	JOHN DURN	030045
56	1443	1	265	12028900	12	2	8900	6000000	PAT DUNN	021055
50	3607	3	127	08072000	8	7	2000	18300000	ANDREA HIN...	011014
44	1775	3	288	02051989	2	5	1989	2700000	PETER JONES	00
68	1209	2	165	05121986	5	12	1986	17300000	DIDRA WILK...	041065

<http://www.computerhistory.org/timeline/memory-storage/>

<http://groups.engin.umd.umich.edu/CIS/course.des/cis400/cobol/cobol.html>

```
DATA DIVISION.  
FILE SECTION.  
FD StudentFile.  
01 StudentRec.  
    88 EndOfStudentFile    VALUE HIGH-VALUES.  
    02 StudentId            PIC 9(7).  
    02 StudentName.  
        03 Surname          PIC X(8).  
        03 Initials         PIC XX.  
    02 DateOfBirth.  
        03 YOBirth          PIC 9(4).  
        03 MOBirth          PIC 9(2).  
        03 DOBirth          PIC 9(2).  
    02 CourseCode          PIC X(4).  
    02 Gender              PIC X.
```



Problems with flat-files:

- data access routines must be programmed in detail
- each program must include full detail of data structure
- multiple users cannot simultaneously access data
- multiple copies of data - not centrally managed

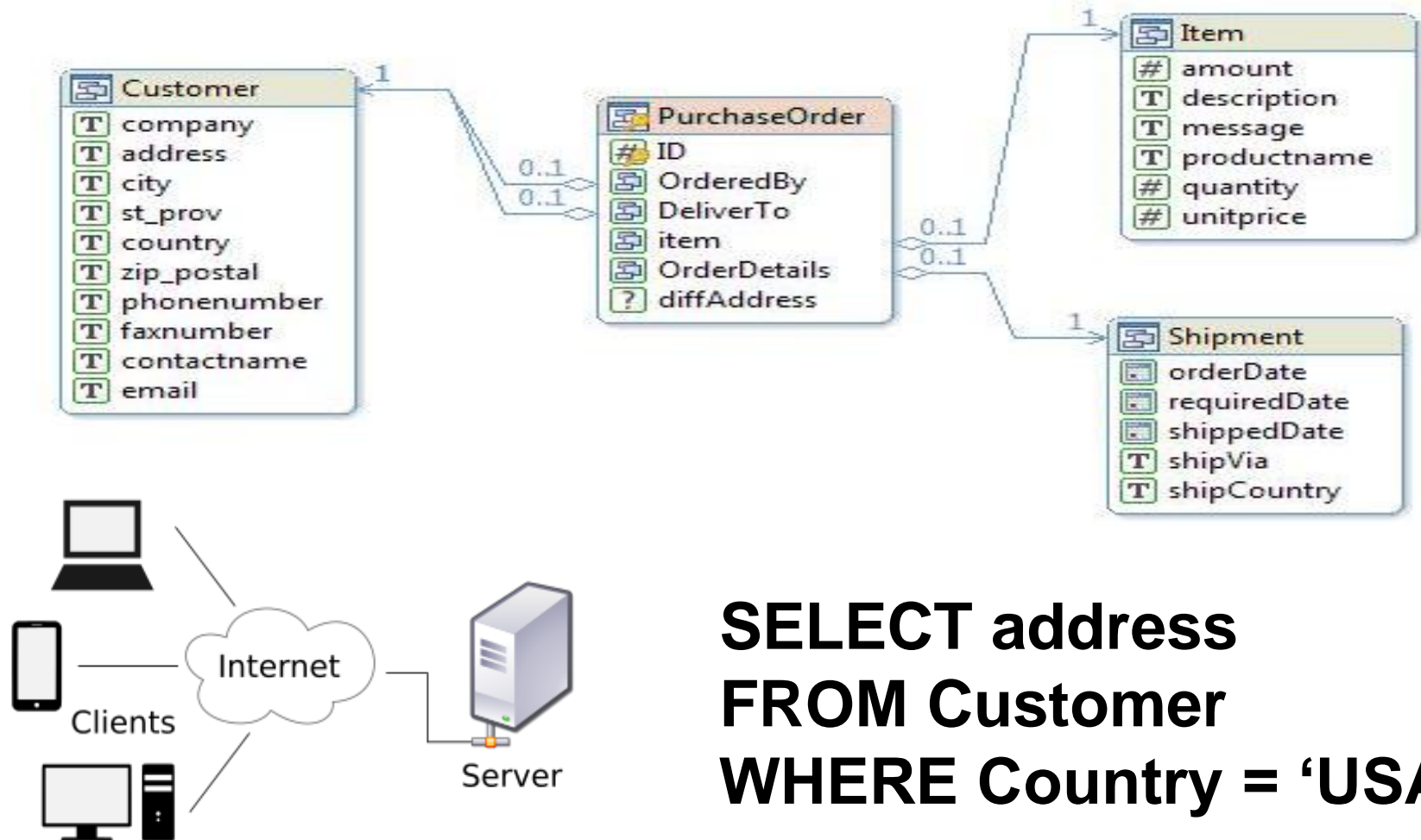
- the first relational databases from Oracle and IBM appear around 1980



- others appear later

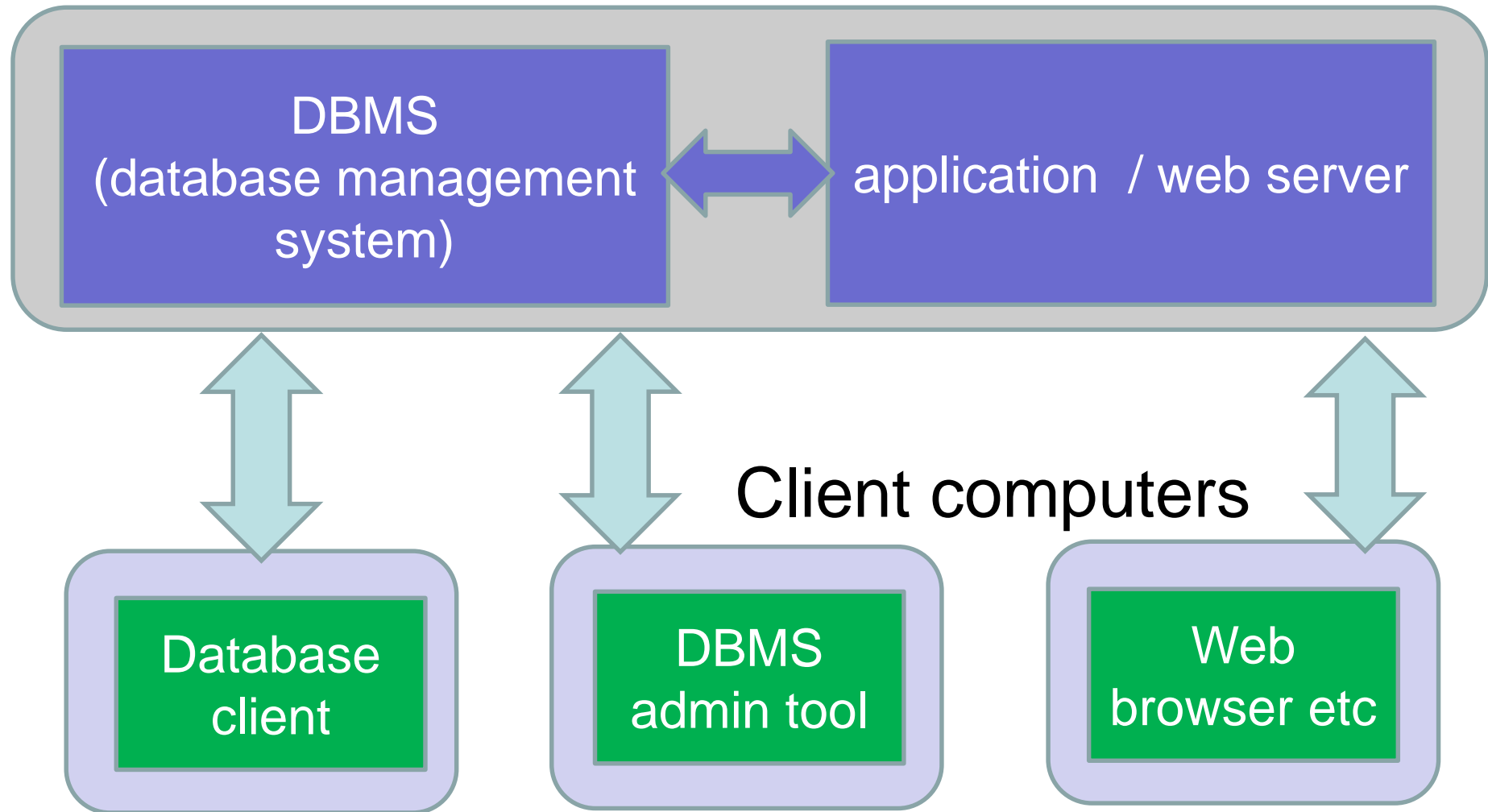


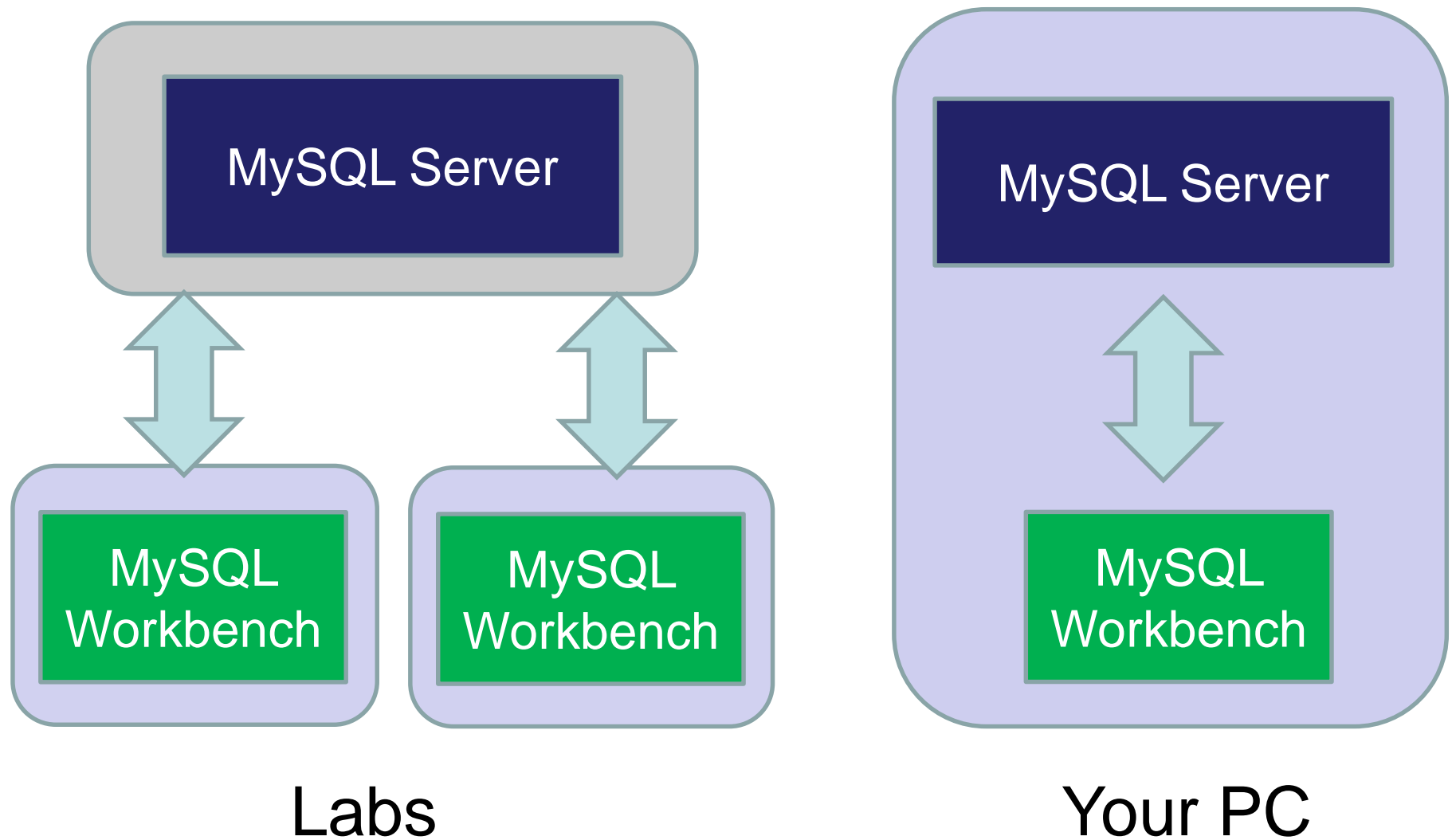
- entity-relationship diagrams, client-server architecture, SQL language



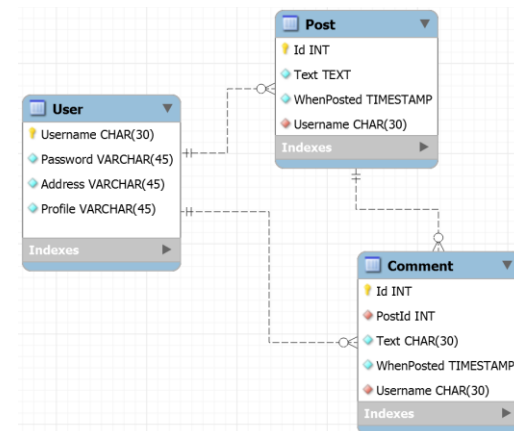
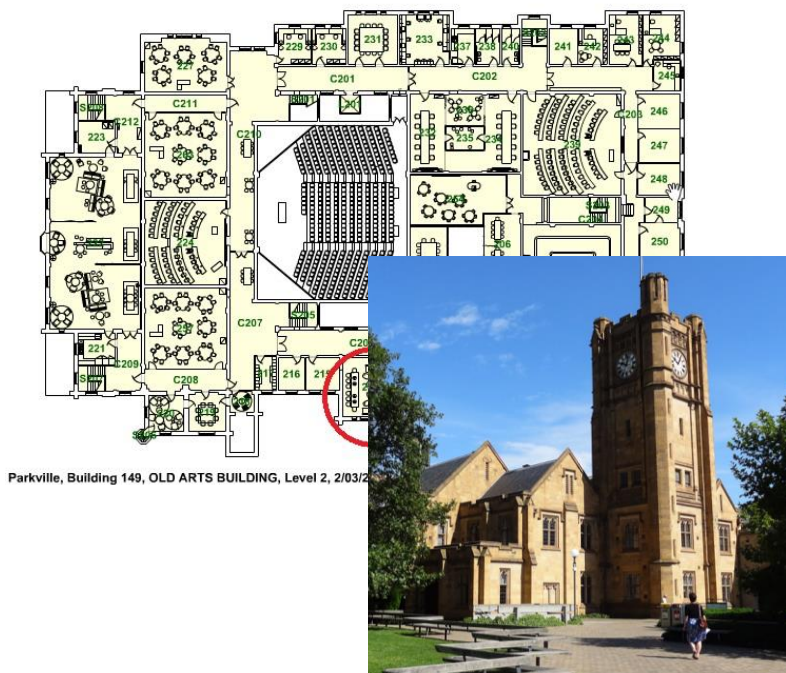
**SELECT address
FROM Customer
WHERE Country = 'USA';**

Server computer





“What is unique about ICT ... In no other discipline is there such an emphasis on developing artefacts (e.g., computer and information systems) which are so abstract and complex and where modelling tools and methods are essential. The systems that ICT professionals deal with cannot be seen or handled in the same simple and direct manner as products of other applied disciplines ...” *from the Australian Computer Society CBOK*



Email or Phone

me@myemail.com

Password

••••

Log in

☐ Keep me logged in

[Forgotten your password?](#)

User

Username	Password	Address	Profile
Anne	pass1234	1 Anne st	hi I am Anne
Bill	petsname	2 Bill st	this is Bill's profile
Christine	mystreet	3 Christine st	hi everyone this is Christine!!!
David	childsname	4 David st	David's profile data

Post

Id	Text	WhenPosted	Username
1	Here's what I had for lunch	2015-01-24 20:09:02	Bill
2	What's everyone doing tonight?	2015-01-24 20:09:02	Anne
3	check out this great CAT VIDEOZ!!!	2015-01-24 20:09:02	David
4	now look what I had for dinner	2015-01-24 20:09:02	Bill
5	I love Game of Thrones	2015-01-24 20:09:02	Anne
6	I am posting a lot today...	2015-01-24 20:09:02	Anne

Comment

Id	PostId	Text	WhenPosted	Username
1	3	ha ha great video!!	2015-01-24 14:01:33	Christine
2	2	going to the movies	2015-01-24 14:01:33	Bill
3	2	oh that sound nice!	2015-01-24 14:01:33	Anne

Let's design a database ...

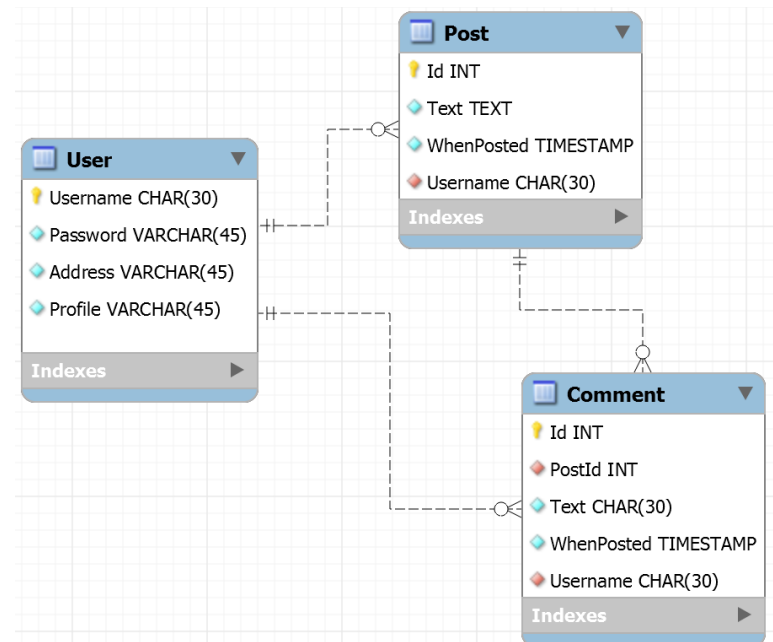
WEEDPOGATTS

Username	Password	Address	Profile
Anne	pass1234	1 Anne st	hi I am Anne
Bill	petsname	2 Bill st	this is Bill's profile
Christine	mystreet	3 Christine st	hi everyone this is Christine!!!
David	childsname	4 David st	David's profile data

Id	Text	WhenPosted	Username
1	Here's what I had for lunch	2015-01-24 20:09:02	Bill
2	What's everyone doing tonight?	2015-01-24 20:09:02	Anne
3	check out this great CAT VIDEOZ!!!	2015-01-24 20:09:02	David
4	now look what I had for dinner	2015-01-24 20:09:02	Bill
5	I love Game of Thrones	2015-01-24 20:09:02	Anne
6	I am posting a lot today...	2015-01-24 20:09:02	Anne

Id	PostId	Text	WhenPosted	Username
1	3	ha ha great video!!	2015-01-24 14:01:33	Christine
2	2	going to the movies	2015-01-24 14:01:33	Bill
3	2	oh that sound nice!	2015-01-24 14:01:33	Anne

Entity-Relationship diagram:



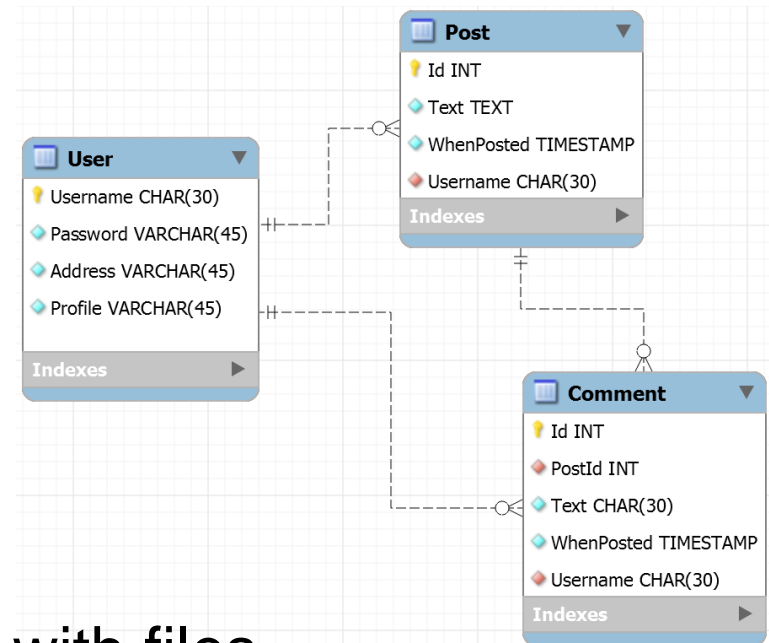
Relational notation:

User(username, password, address, profile)

Post(id, text, whenposted, *username*)

Comment(id, *postid*, text, whenposted)

What commands do we need to manipulate the *structure* of our tables?



Working with tables is like working with files – there are 4 things you can do:

- CREATE a table
- DROP (i.e. delete) a table
- ALTER a table (e.g. add a column)
- RENAME a table



What commands do we need to manipulate the *contents* of our tables?

User

Username	Password	Address	Profile
Anne	pass1234	1 Anne st	hi I am Anne
Bill	petsname	2 Bill st	this is Bill's profile
Christine	mystreet	3 Christine st	hi everyone this is Christine!!!
David	childsname	4 David st	David's profile data

You simply need to be able to:
SELECT, or read, data from the table
INSERT new rows into the table
DELETE existing rows from the table
UPDATE existing rows in the table



What commands do we need to control *users'* access to our tables?

(users = I.T. staff here)

Hostname: info90002db.eng.unimelb.edu.au Port: 3306

Username: joebloggs

Password:

Default Schema:

There are 4 things you can do:

CREATE a user

DROP a user

GRANT a user access rights to a table

REVOKE those rights

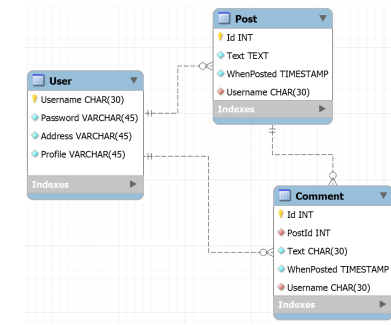
- Design the database
 - data modelling, E-R diagrams

- Implement the database
 - data definition language DDL

- Data access / programming
 - data manipulation language DML

- Database administration
 - data control language DCL

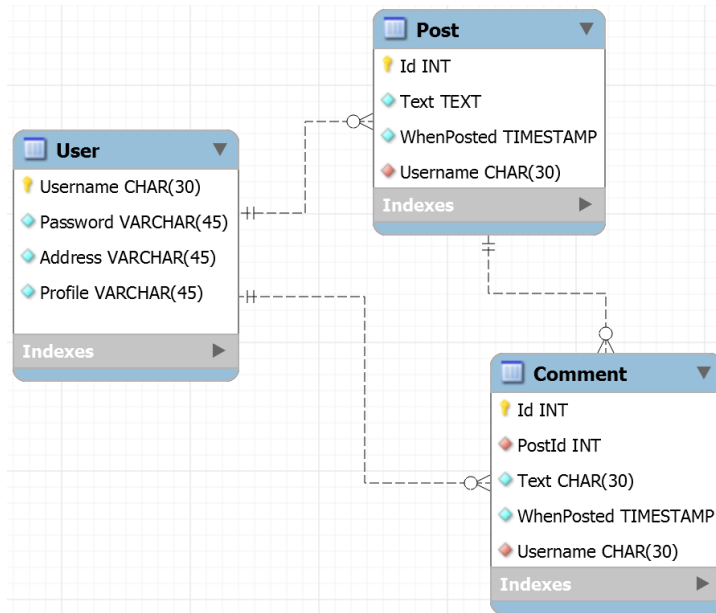
- Create
- Drop
- Alter
- Rename



- Select
- Insert
- Update
- Delete

- Grant
- Revoke

- What are the entities that need to be tracked?
- What attributes will be recorded about each entity?
- What are the relationships between entities?
- What are the cardinalities of relationships?



You will be given requirements such as:

“We have many users.

Users may enter posts into the system.

Each post is entered by exactly one user.

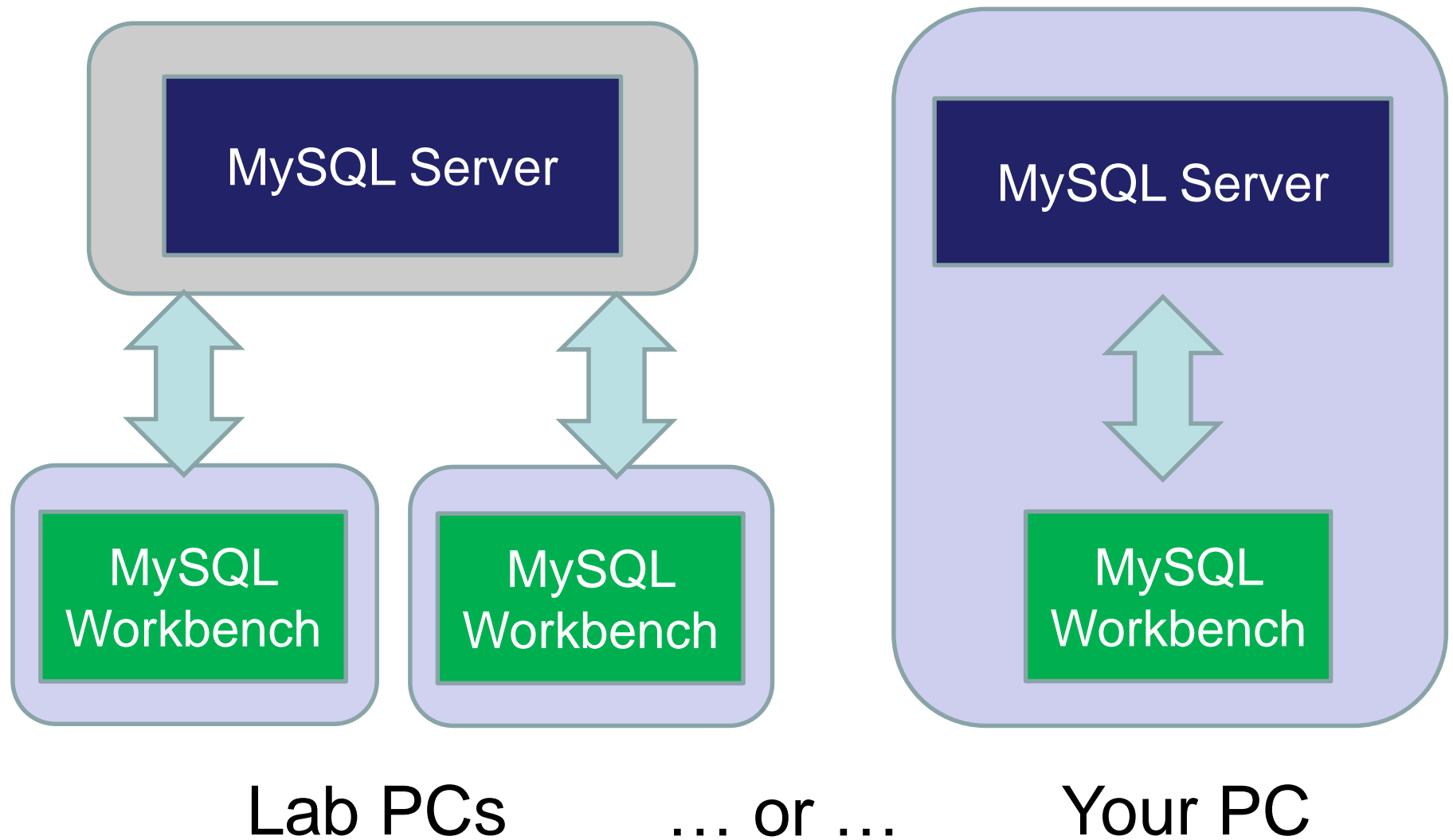
Users can comment on posts.

A post can be commented on many times.”

- An investment bank has a number of **branches**. Within each branch a number of **departments** operate and are structured in a hierarchical manner. The bank employs around 3000 **staff** who are **assigned to work** in the various **departments** across the **branches**. There are essentially three types of special **employees** where extra details required by the system. There are **dealers** who carry out **investments** who have **limits** imposed upon them for how much they can spend. There are **IT compliance managers** who's **Basel2 role** is required to be stored and there are **HR managers** that need have their **assessment number** recorded (along with other details not specified here).
- We need a database to record staff details including which department and branch they are assigned...
- Coming up in the 3rd hour



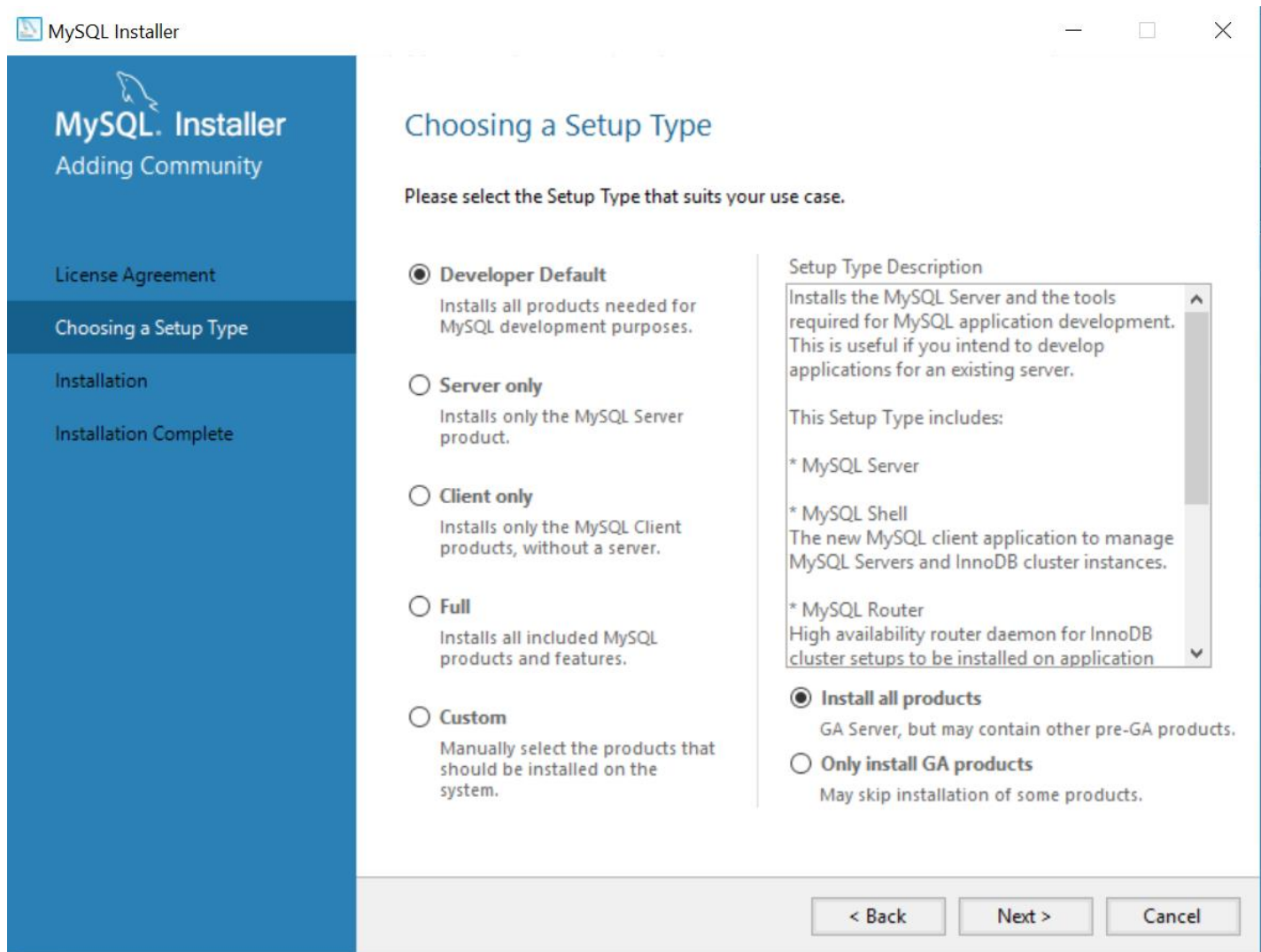
- MySQL server and client
- installing MySQL
- creating an E-R diagram
- connecting to a server
- creating tables
- inserting/updating/deleting data
- reading data from tables

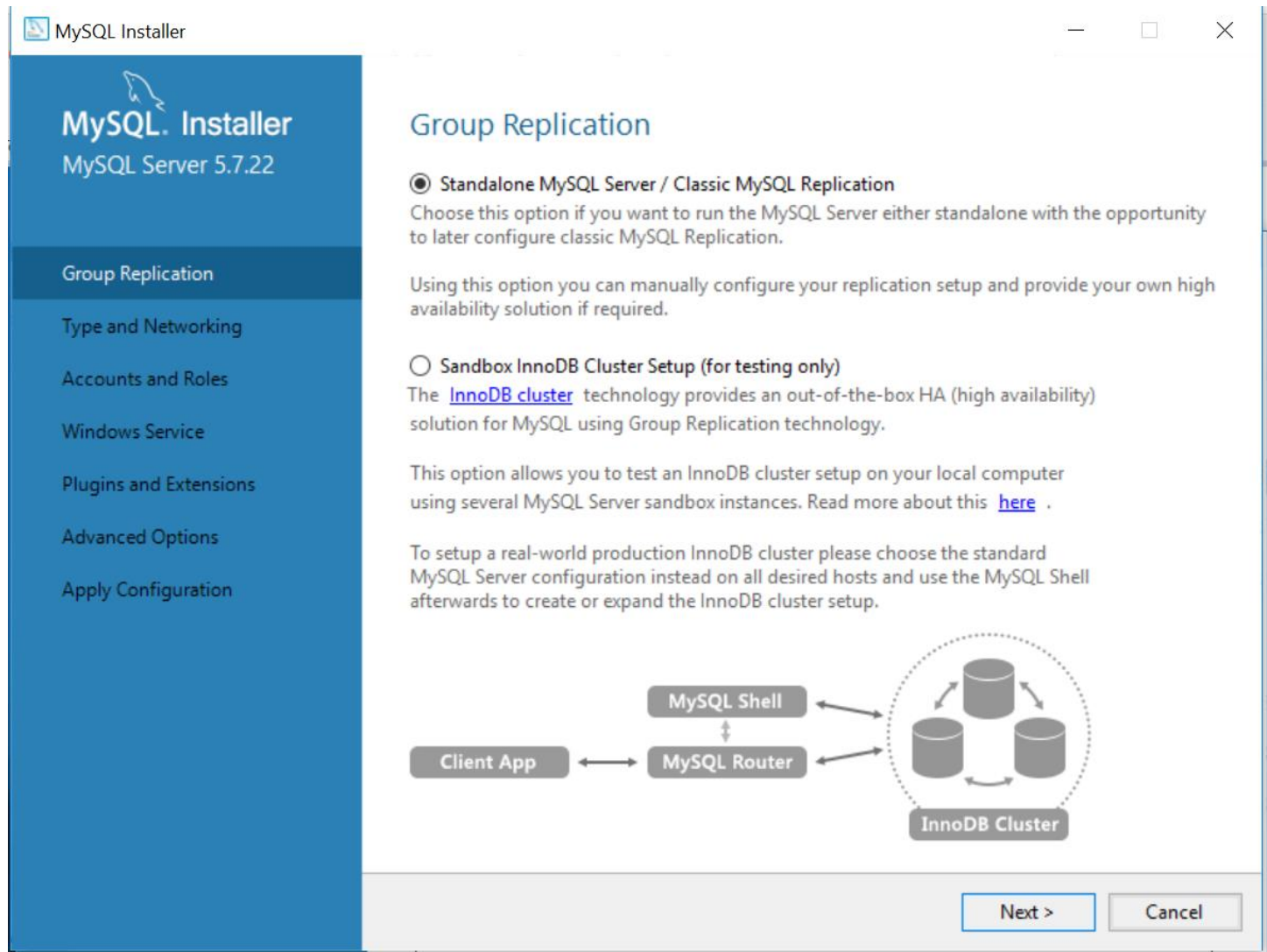




- what you can do with the **client alone**:
 - create E-R diagrams
- what you can do when **connected to a server**
 - create a working database
 - convert E-R diagram to a database
 - insert/update/delete/read data
- where servers might be
 - localhost (software running on your PC)
 - network (software running on a server host)

- It may be useful to install the free MySQL Server and Workbench software on your own computer. Version 8.
- Download the appropriate installer from <http://dev.mysql.com/downloads/mysql/>
- (free 'Community' version vs pay-for 'Enterprise' version)
- Mac users may get better results from MAMP
 - <https://www.mamp.info/en/downloads/>
- Web developers may prefer (or already have) XAMPP or Bitnami WAMP
 - <https://www.apachefriends.org/download.html>
 - <https://bitnami.com/stack/wamp>
- Start the installation and proceed through several steps. (Some are illustrated in the following pages.)







MySQL Installer

MySQL Server 5.7.22

Group Replication

Type and Networking

Accounts and Roles

Windows Service

Plugins and Extensions

Apply Configuration

Type and Networking

Server Configuration Type

Choose the correct server configuration type for this MySQL Server installation. This setting will define how much system resources are assigned to the MySQL Server instance.

Config Type: Development Computer

Connectivity

Use the following controls to select how you would like to connect to this server.

☒ TCP/IP Port Number: 3306

☒ Open Windows Firewall port for network access

☐ Named Pipe Pipe Name: MYSQL

☐ Shared Memory Memory Name: MYSQL

Advanced Configuration

Select the check box below to get additional configuration page where you can set advanced options for this server instance.

☐ Show Advanced Options

< Back Next > Cancel




MySQL Installer

MySQL Server 5.7.22

- Group Replication
- Type and Networking
- Accounts and Roles**
- Windows Service
- Plugins and Extensions
- Apply Configuration

Accounts and Roles

Root Account Password
Enter the password for the root account. Please remember to store this password in a secure place.

MySQL Root Password: 

Repeat Password:

MySQL User Accounts
Create MySQL user accounts for your users and applications. Assign a role to the user that consists of a set of privileges.

MySQL Username	Host	User Role
----------------	------	-----------

[Add User](#)
[Edit User](#)
[Delete](#)

[< Back](#) [Next >](#) [Cancel](#)



MySQL Installer

MySQL. Installer
MySQL Server 5.7.22

Group Replication

Type and Networking

Accounts and Roles

Windows Service

Plugins and Extensions

Apply Configuration

Windows Service

☒ Configure MySQL Server as a Windows Service

Windows Service Details
Please specify a Windows Service name to be used for this MySQL Server instance. A unique name is required for each instance.

Windows Service Name:

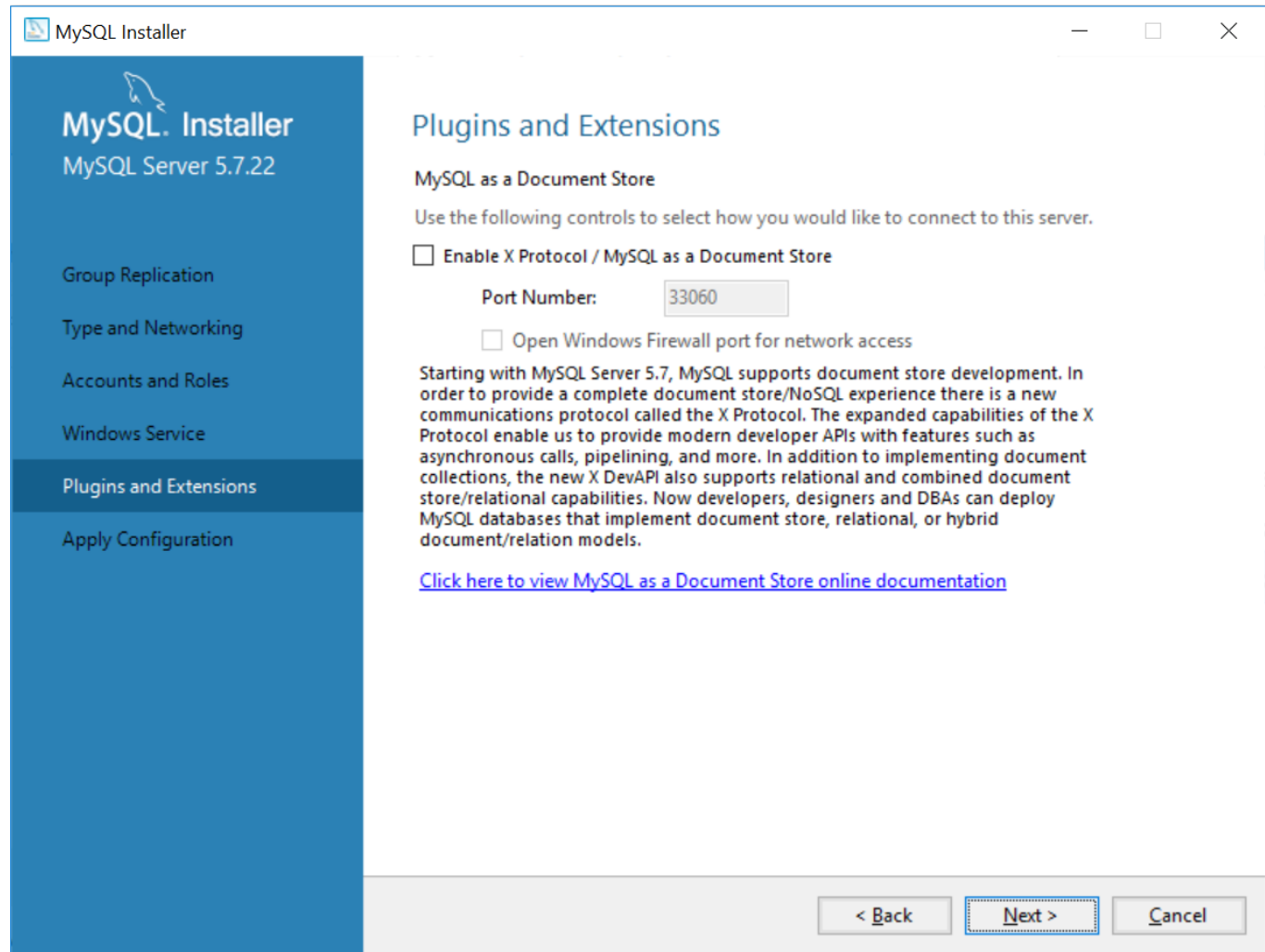
☒ Start the MySQL Server at System Startup

Run Windows Service as ...
The MySQL Server needs to run under a given user account. Based on the security requirements of your system you need to pick one of the options below.

☒ **Standard System Account**
Recommended for most scenarios.

☐ **Custom User**
An existing user account can be selected for advanced scenarios.

< Back Next > Cancel





MySQL Installer

MySQL. Installer
Samples and Examples

Connect To Server

Apply Configuration

Connect To Server

Here are the compatible MySQL Svr instances installed in this computer.
Please select the ones where the sample schemas and data will be created.

☐ Show MySQL Server instances maybe running in read-only mode

	Server	Port	Arch...	Type	Status
<input checked="" type="checkbox"/>	MySQL Server 5.7.23	3306	X64	Stand-alone Server	Running

Now give us the credentials we should use (needs to have root privileges).
Click "Check" to make sure they work.

User: Credentials provided in Server configuration

Password:

Check

Next > Cancel



The screenshot displays the MySQL Workbench application window. The interface is divided into several panes:

- Navigator:** Located on the left, it shows the 'SCHEMAS' pane with a tree view of databases. The 'socialmedia' database is selected.
- Query Window:** The central pane shows a SQL query: `SELECT * FROM post;`
- Result Grid:** Below the query window, it displays the results of the query in a table format:

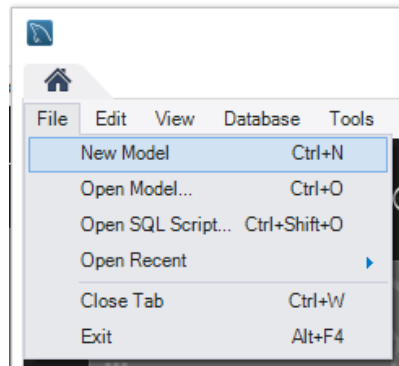
Id	Text	WhenPosted	Username
1	Here's what I had for lunch	2018-02-25 12:05:01	Bill
2	What's everyone doing tonight?	2018-02-25 12:05:01	Anne
3	check out this great CAT VIDEOZ!!!	2018-02-25 12:05:01	David
4	now look what I had for dinner	2018-02-25 12:05:01	Bill
5	I love Game of Thrones	2018-02-25 12:05:01	Anne
6	I am posting a lot today...	2018-02-25 12:05:01	Anne

Below the result grid, the 'Output' pane shows the execution details:

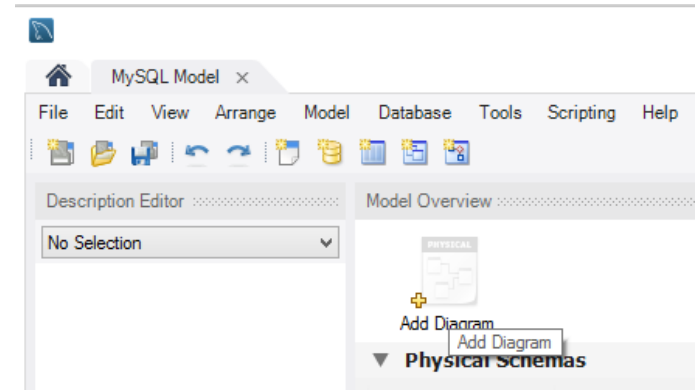
Time	Action	Message	Duration / Fetch
1 18:14:20	SELECT * FROM post	6 row(s) returned	0.000 sec / 0.000 sec

On the right side, the 'SQL Additions' pane provides documentation for the `SELECT` statement, including its syntax and common clauses.

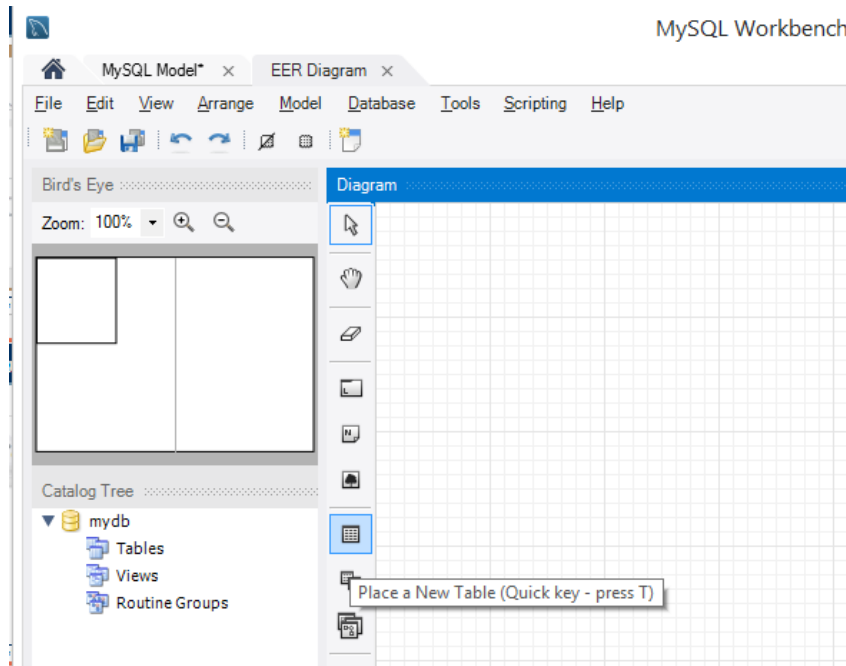
1



2

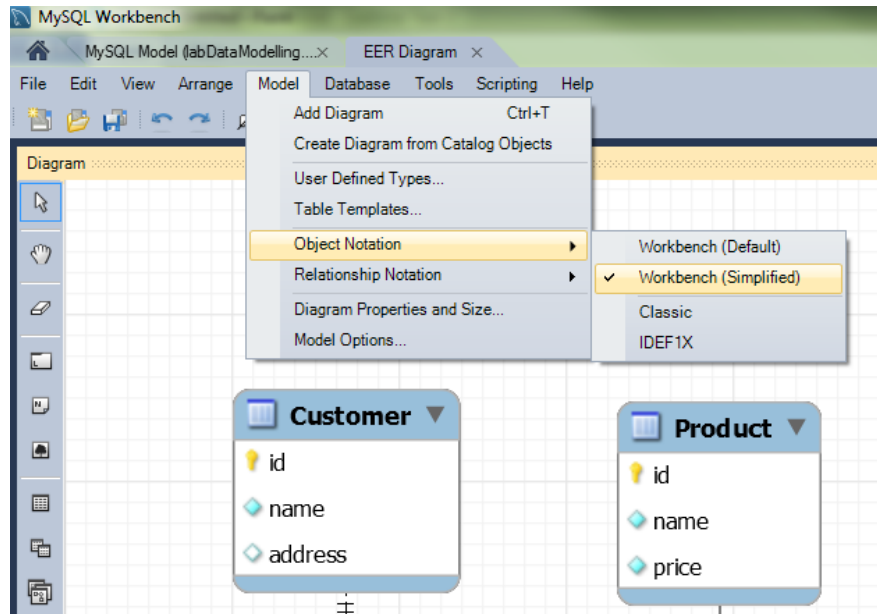


3

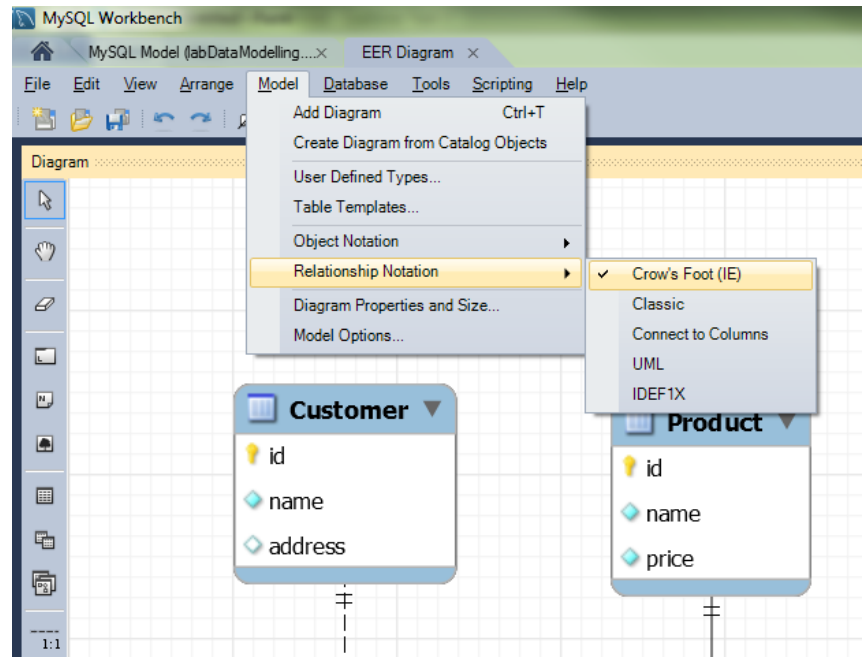


MySQL Workbench

Object notation

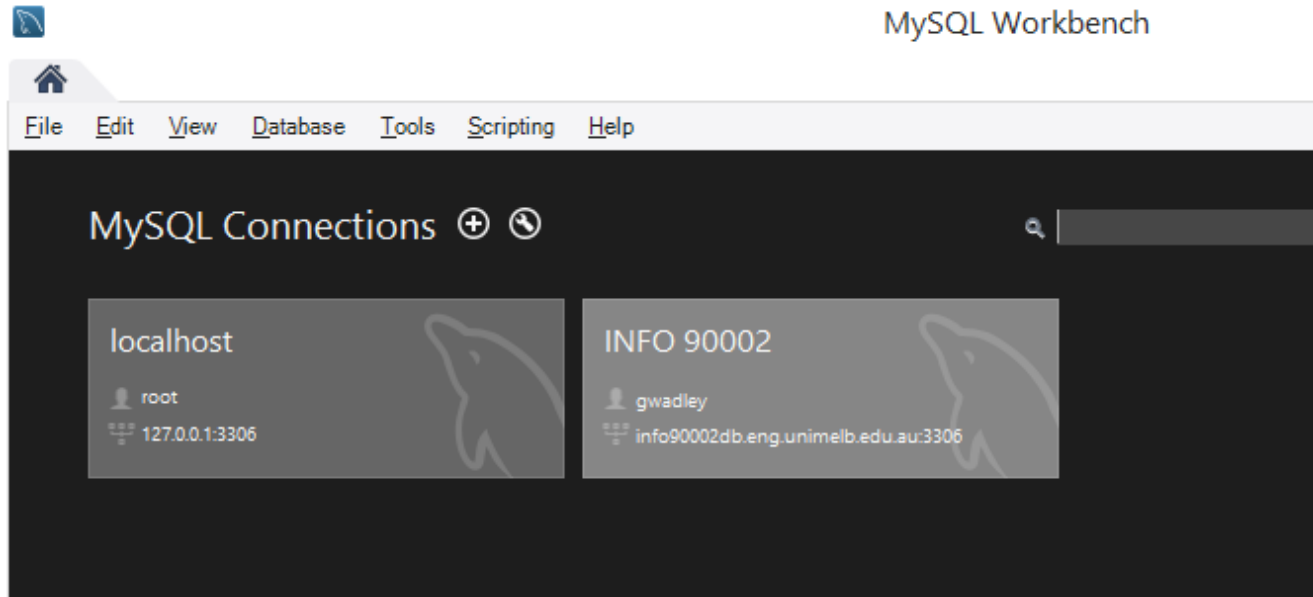


Relationship notation

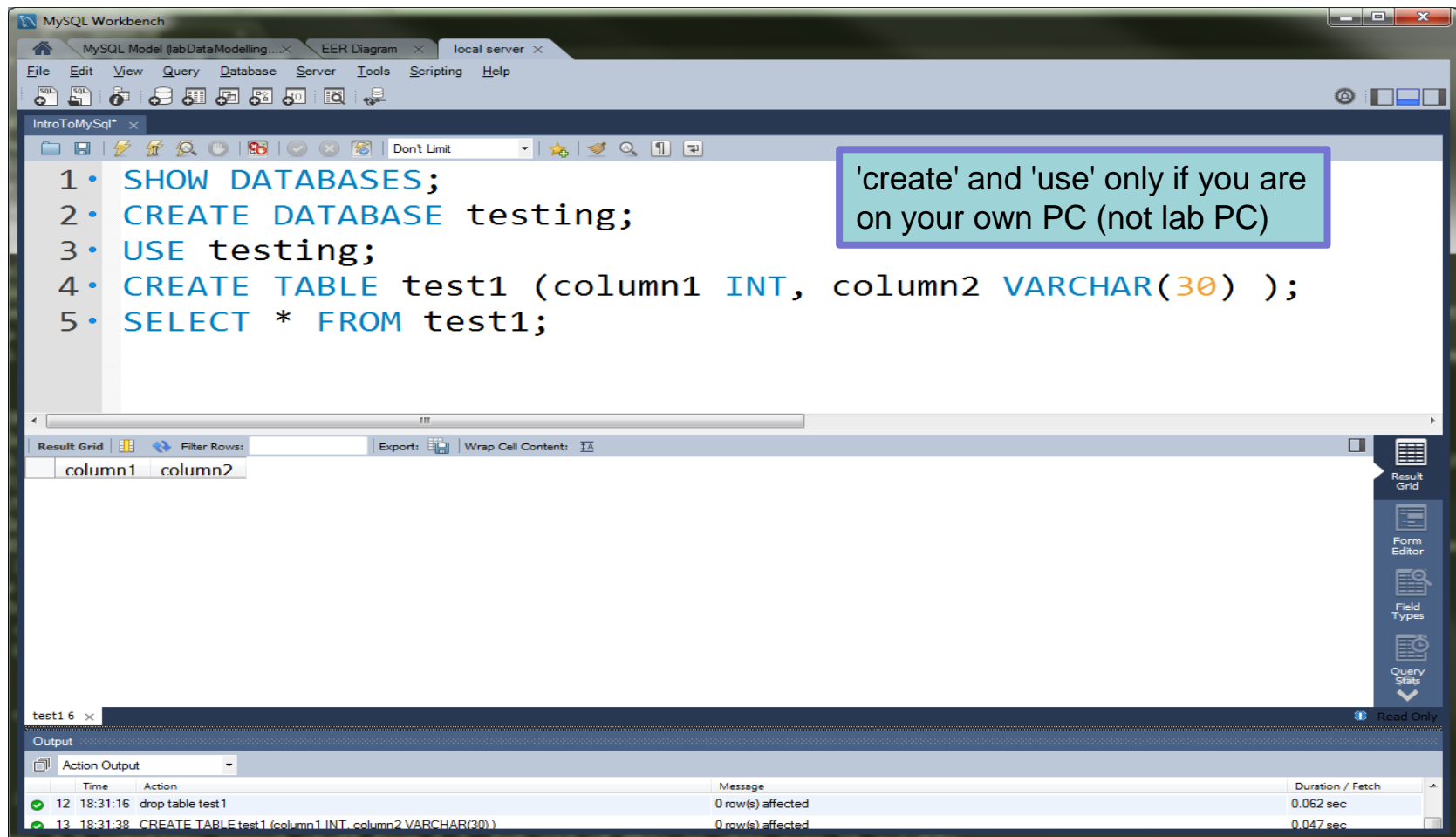




- create (store locally) one or two connections to servers
 - to the University database server
 - to your localhost (the server on your PC, if you installed MySQL)
 - (use the + sign to add a new connection)
 - click on the connection to connect to that server



- run these SQL statements one at a time
- to run a statement, place cursor on it and hit Ctrl-Enter



The screenshot shows the MySQL Workbench interface. The main window displays a list of SQL statements:

1. `SHOW DATABASES;`
2. `CREATE DATABASE testing;`
3. `USE testing;`
4. `CREATE TABLE test1 (column1 INT, column2 VARCHAR(30));`
5. `SELECT * FROM test1;`

A callout box highlights the instruction: 'create' and 'use' only if you are on your own PC (not lab PC).

The bottom panel shows the 'test1' table structure with columns 'column1' and 'column2'. The 'Output' panel at the bottom displays the execution results:

Time	Action	Message	Duration / Fetch
12 18:31:16	drop table test1	0 row(s) affected	0.062 sec
13 18:31:38	CREATE TABLE test1 (column1 INT, column2 VARCHAR(30))	0 row(s) affected	0.047 sec



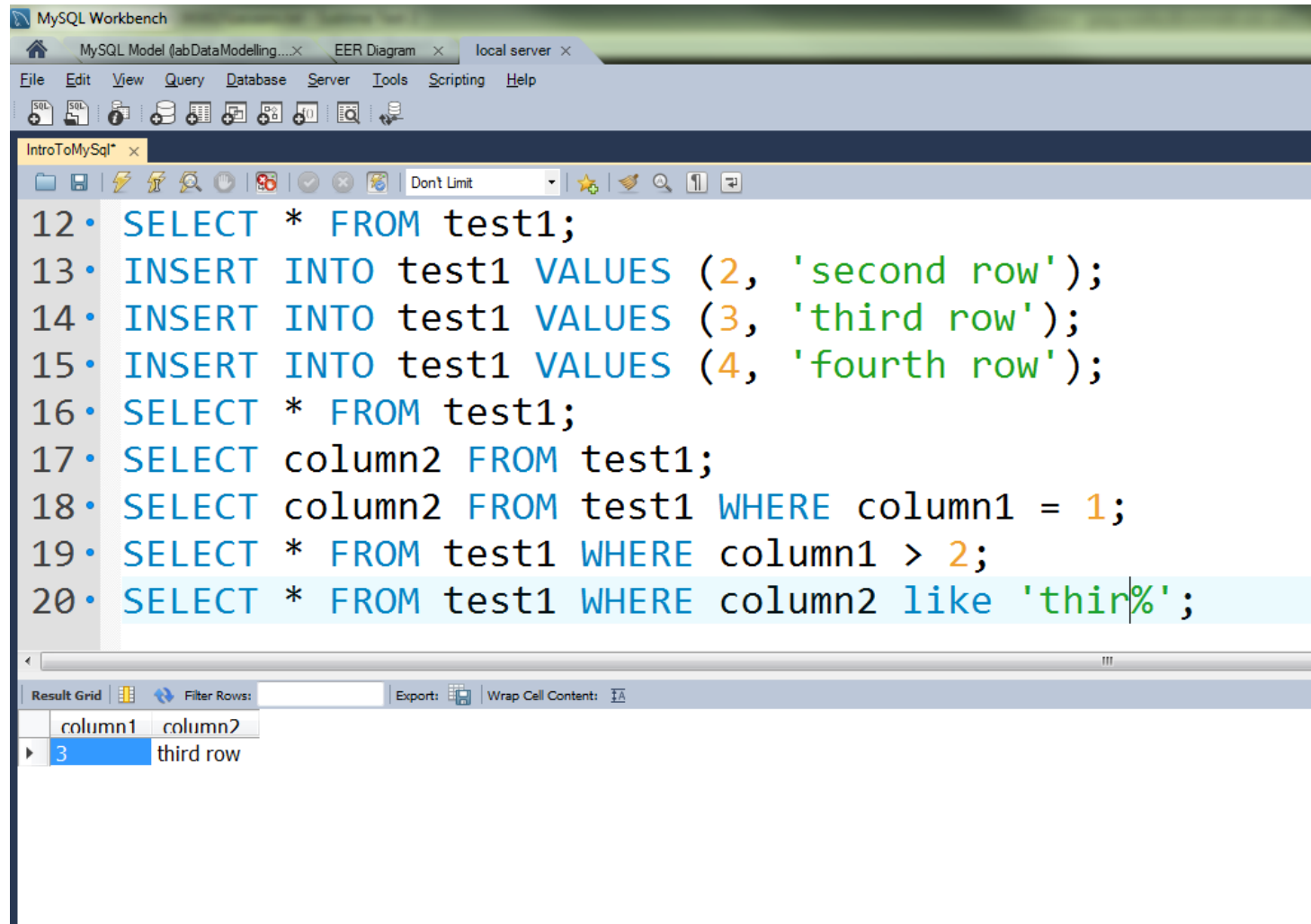
- run these SQL statements one at a time
- to run a statement, place cursor on it and hit Ctrl-Enter

The screenshot shows the MySQL Workbench interface. The main editor window contains the following SQL statements:

```
5. SELECT * FROM test1;
6. INSERT INTO test1 VALUES (1, 'my first row');
7. INSERT INTO test1 VALUES (2, 'my second row');
8. SELECT * FROM test1;
9. UPDATE test1 SET column2 = 'my second row, changed' WHERE column1 = 2;
10. SELECT * FROM test1;
11. DELETE FROM test1 WHERE column1 = 2;
12. SELECT * FROM test1;
```

Below the editor, the Result Grid is visible, showing the results of the last executed query (SELECT * FROM test1;):

column1	column2
1	my first row



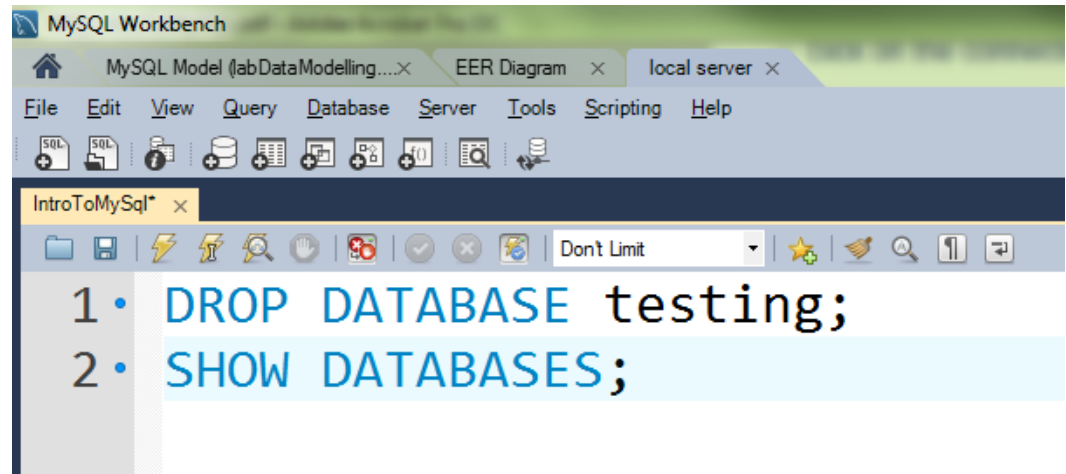
The screenshot shows the MySQL Workbench interface. The top menu bar includes File, Edit, View, Query, Database, Server, Tools, Scripting, and Help. The toolbar contains icons for various database operations. The main editor window, titled 'IntroToMySQL*', contains the following SQL queries:

```
12. SELECT * FROM test1;
13. INSERT INTO test1 VALUES (2, 'second row');
14. INSERT INTO test1 VALUES (3, 'third row');
15. INSERT INTO test1 VALUES (4, 'fourth row');
16. SELECT * FROM test1;
17. SELECT column2 FROM test1;
18. SELECT column2 FROM test1 WHERE column1 = 1;
19. SELECT * FROM test1 WHERE column1 > 2;
20. SELECT * FROM test1 WHERE column2 like 'thir%';
```

Below the editor, the 'Result Grid' tab is active, displaying the results of the last query. The grid has two columns: 'column1' and 'column2'. The first row shows the value '3' in the 'column1' column and 'third row' in the 'column2' column.

column1	column2
3	third row

if you like, clean up what we did this lesson with these commands ->



- For a comprehensive overview of MySQL Workbench features, read the manual at <https://dev.mysql.com/doc/workbench/en/wb-intro.html> or watch the official tutorial video.

(Note that the video shows an older version of Workbench: the home screen looks different.)

https://youtu.be/X_umYKqKaF0