Dr Simon D'Alfonso

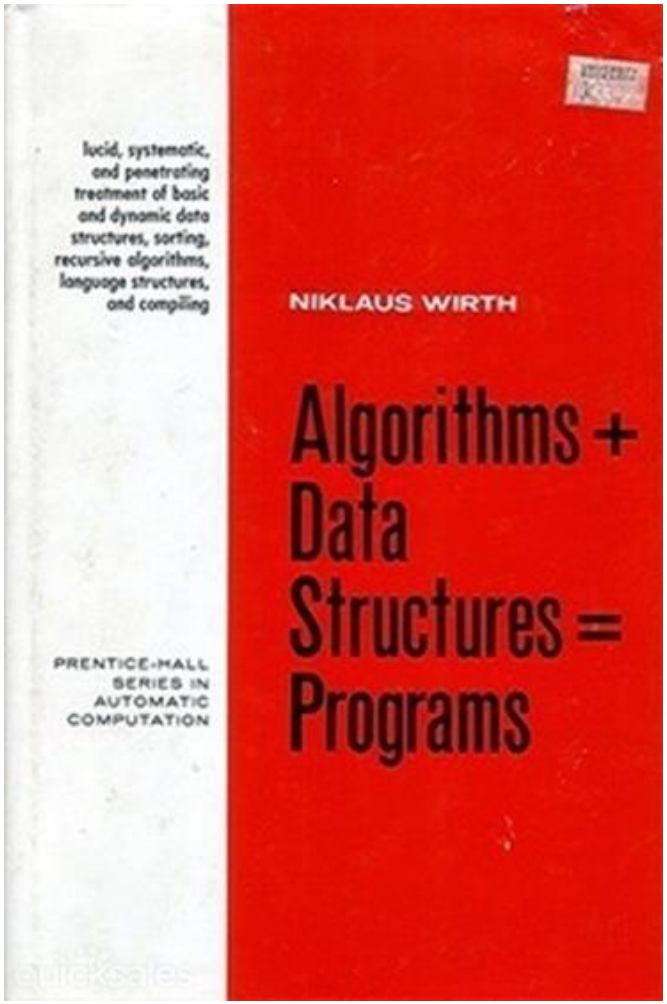
INFO 90002
Database Systems & Information Modelling

Week 01

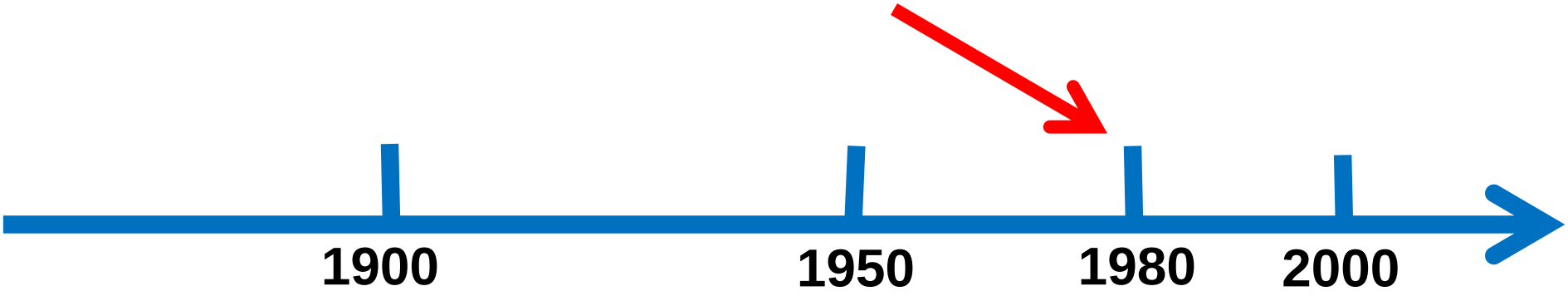
Introduction to Databases and SQL/MySQL

Context: software and data

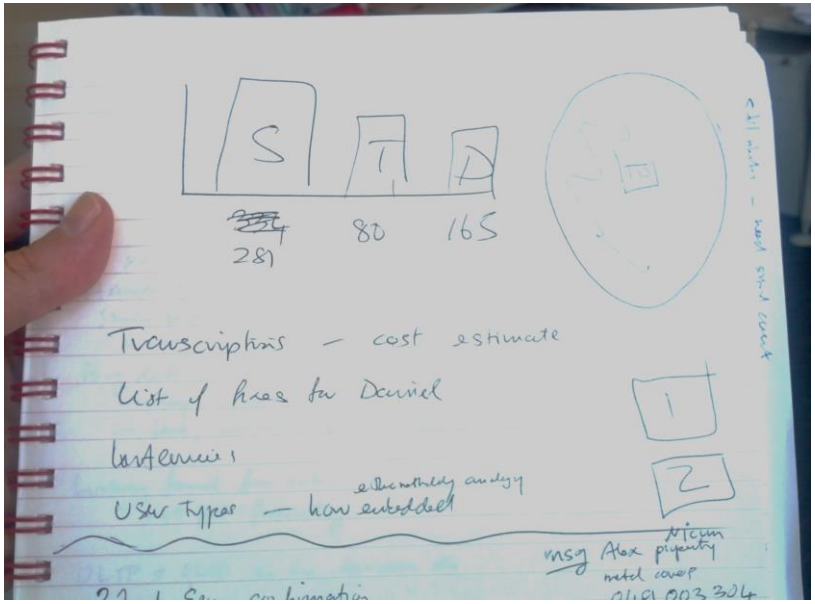
- Computer systems consist of *software* (algorithms) working to process *data*.
- You will learn about creating software and algorithms in other subjects.
- This subject is about *data*.



Introduction to databases

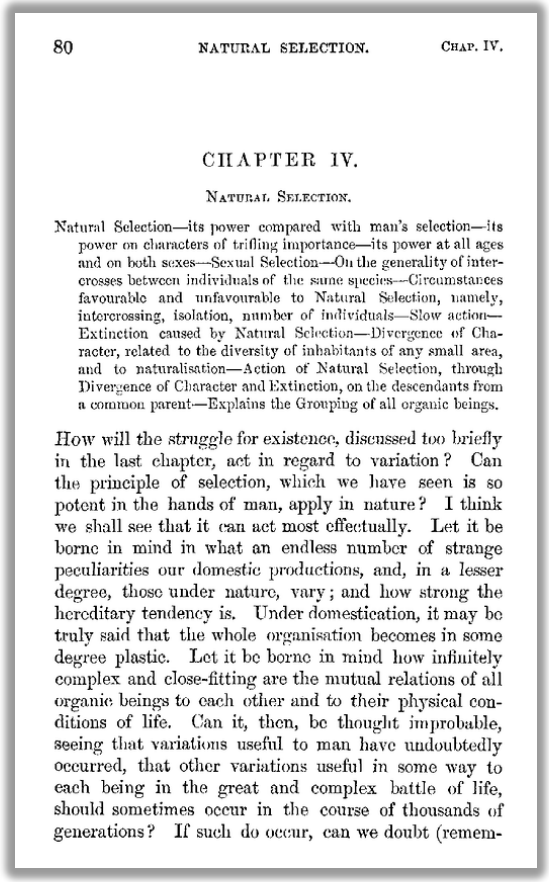


Unstructured data



- handwritten notes
- printed books
- spreadsheets etc

	A	B	C	D	E
1	My Holiday Budget ----->				
2					
3	Flights	$10,000.00			
4	Accommodation	$5,000.00	<- can this be reduced?		
5	Food	$1,000.00			
6					
7		**$16,000.00**	TOTAL		
8					
9					
10					
11					



80 NATURAL SELECTION. CHAP. IV.

CHAPTER IV.

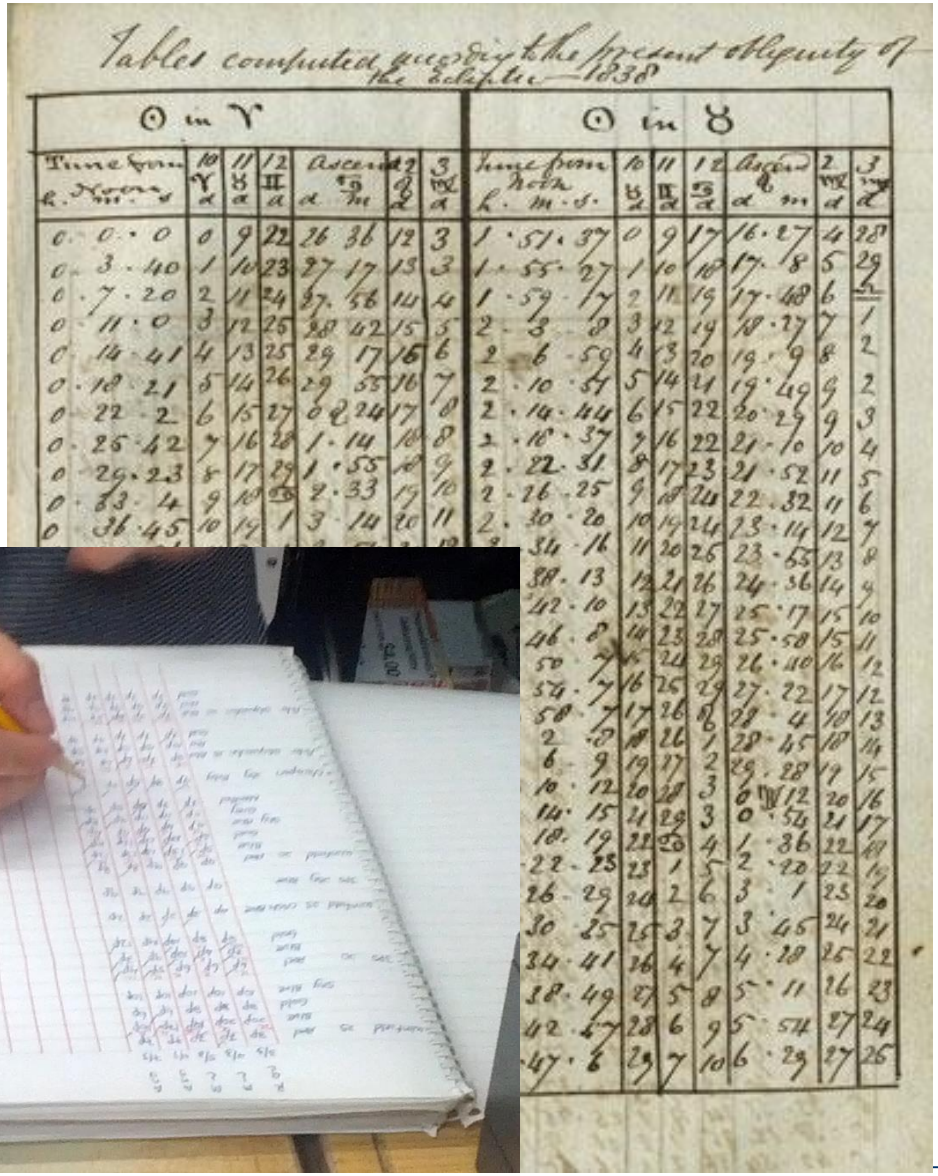
NATURAL SELECTION.

Natural Selection—its power compared with man's selection—its power on characters of trifling importance—its power at all ages and on both sexes—Sexual Selection—On the generality of intercrosses between individuals of the same species—Circumstances favourable and unfavourable to Natural Selection, namely, intercrossing, isolation, number of individuals—Slow action—Extinction caused by Natural Selection—Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation—Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent—Explains the Grouping of all organic beings.

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.



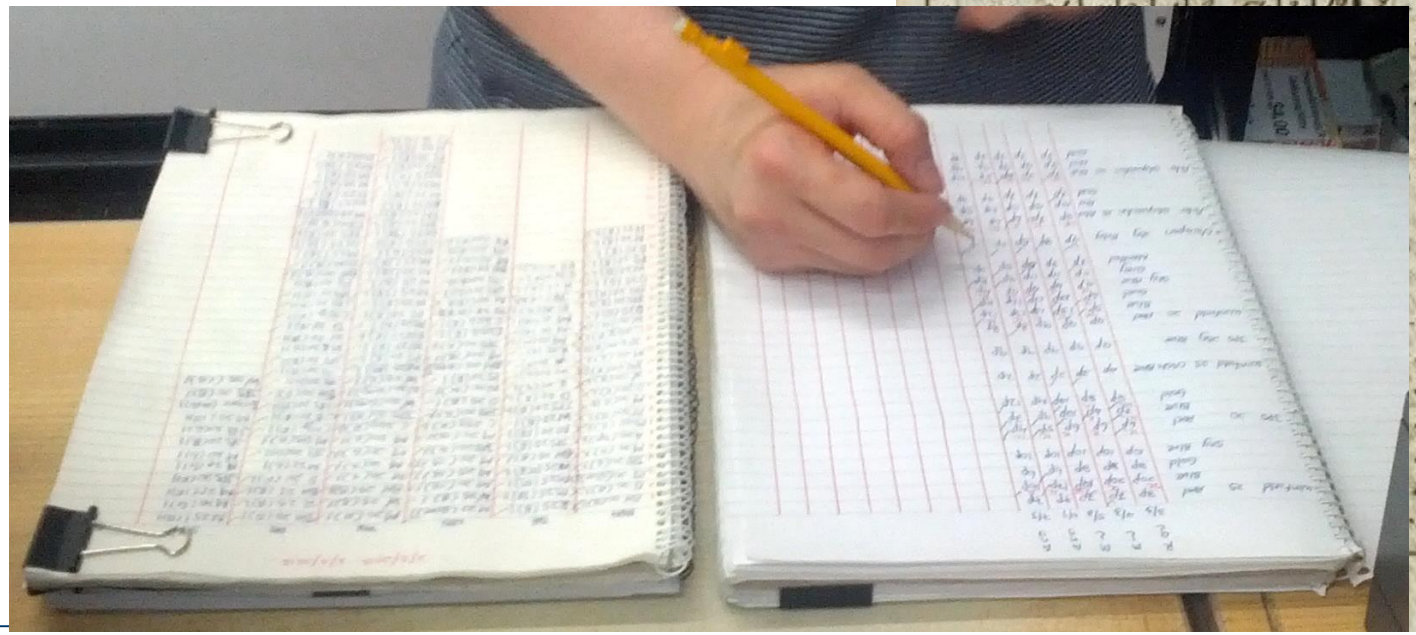
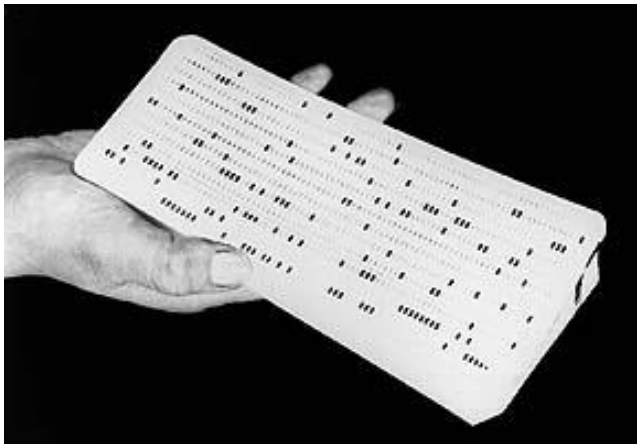


Table of rows -> Deck of cards

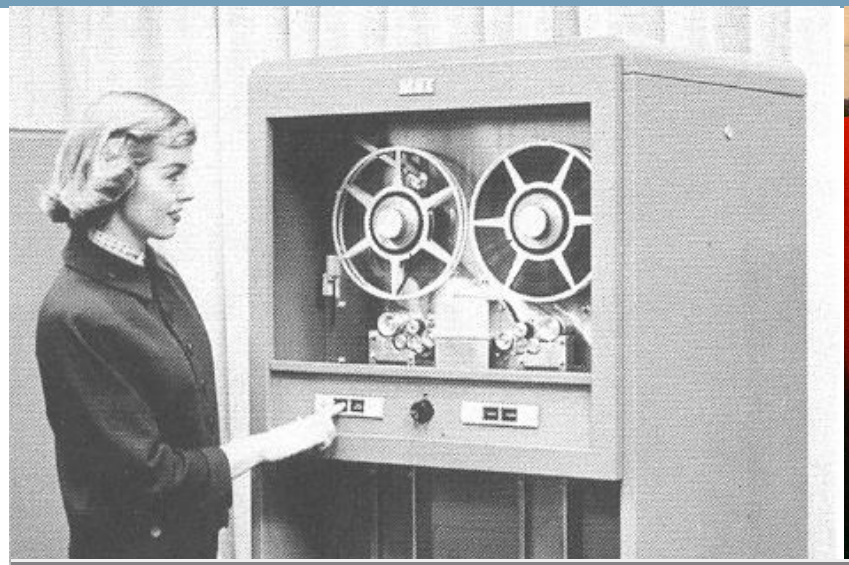
1890 US census

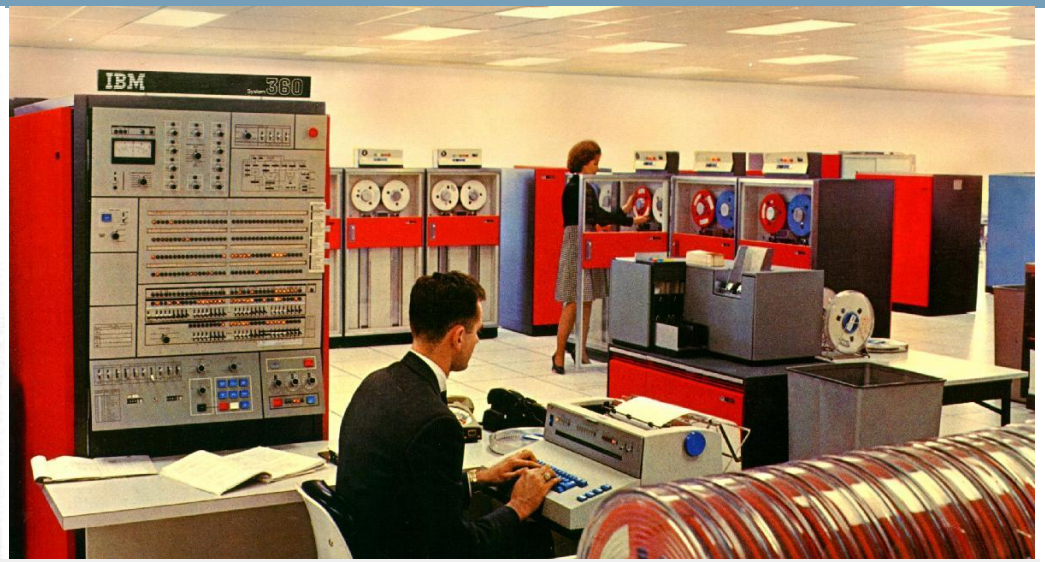
1	2	3	4	CM	UM	Jp	Ch	Oc	In	20	50	80	Dv	Un	3	4	3	4	A	E	L	a	g
5	6	7	8	CL	UL	O	Mu	Qd	Mo	25	55	85	Wd	CY	1	2	1	2	B	F	M	b	h
1	2	3	4	CS	US	Mb	B	M	0	30	60	0	2	Mr	0	15	0	15	C	G	N	c	i
5	6	7	8	No	Hd	Wf	W	F	5	35	65	1	3	Sg	5	10	5	10	D	H	O	d	k
1	2	3	4	Fh	Ff	Fm	7	1	10	40	70	90	4	O	1	3	0	2	St	I	P	e	l
5	6	7	8	Hh	Hf	Hm	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	CK	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	O	n	g	a	V	P	I	Al	Na	4	Dk	Fr	It	Dk	Fr	It
5	6	7	8	9	6	3	O	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



Tape and Disc





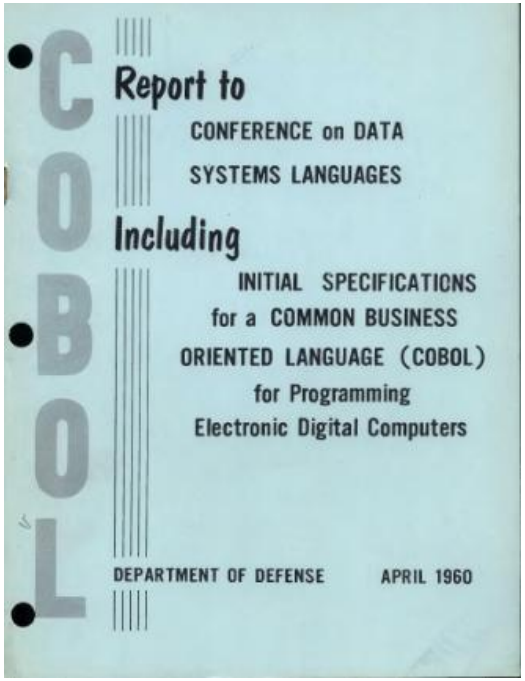
EMP_RECORD...	EMP_ID	EMP_REGION	EMP_DEPT	EMP_HIRE_D...	E...	E...	EMP_...	EMP_SALARY	EMP_NAME	EMP_SKIL
68	3715	4	153	09061987	9	6	1987	14000000	IRENE HIRSH	041085
62	39412	1	650	03119590	3	11	9590	167000000	ANN FAHEY	031099
56	1939	2	265	09281988	9	28	1988	21300000	EMILY WILM...	021077
50	3502	2	165	07041985	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/

File Processing

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

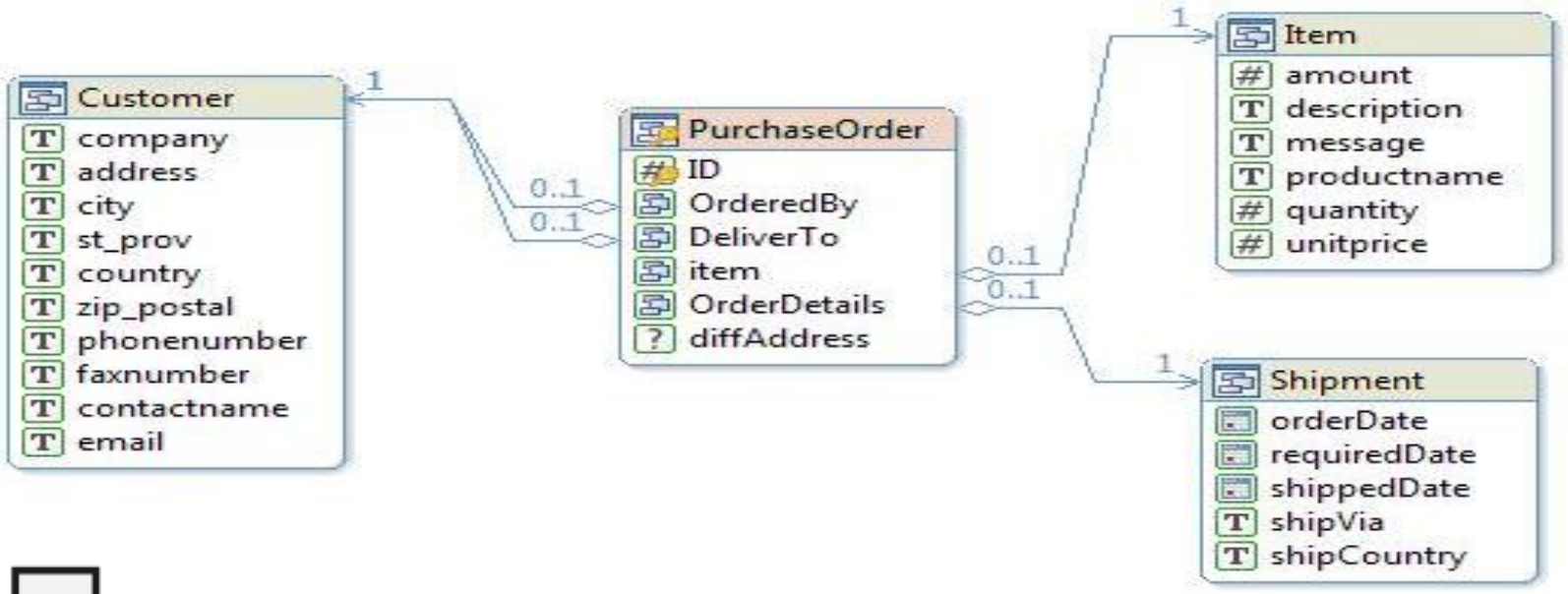
Relational Databases

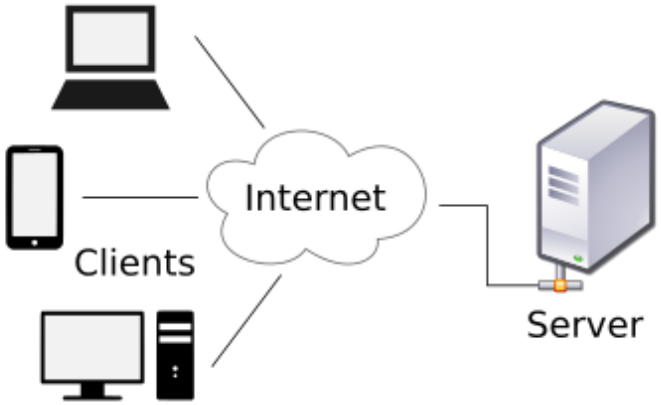
- the first relational databases from Oracle and IBM appear around 1980

- others appear later

Relational Databases

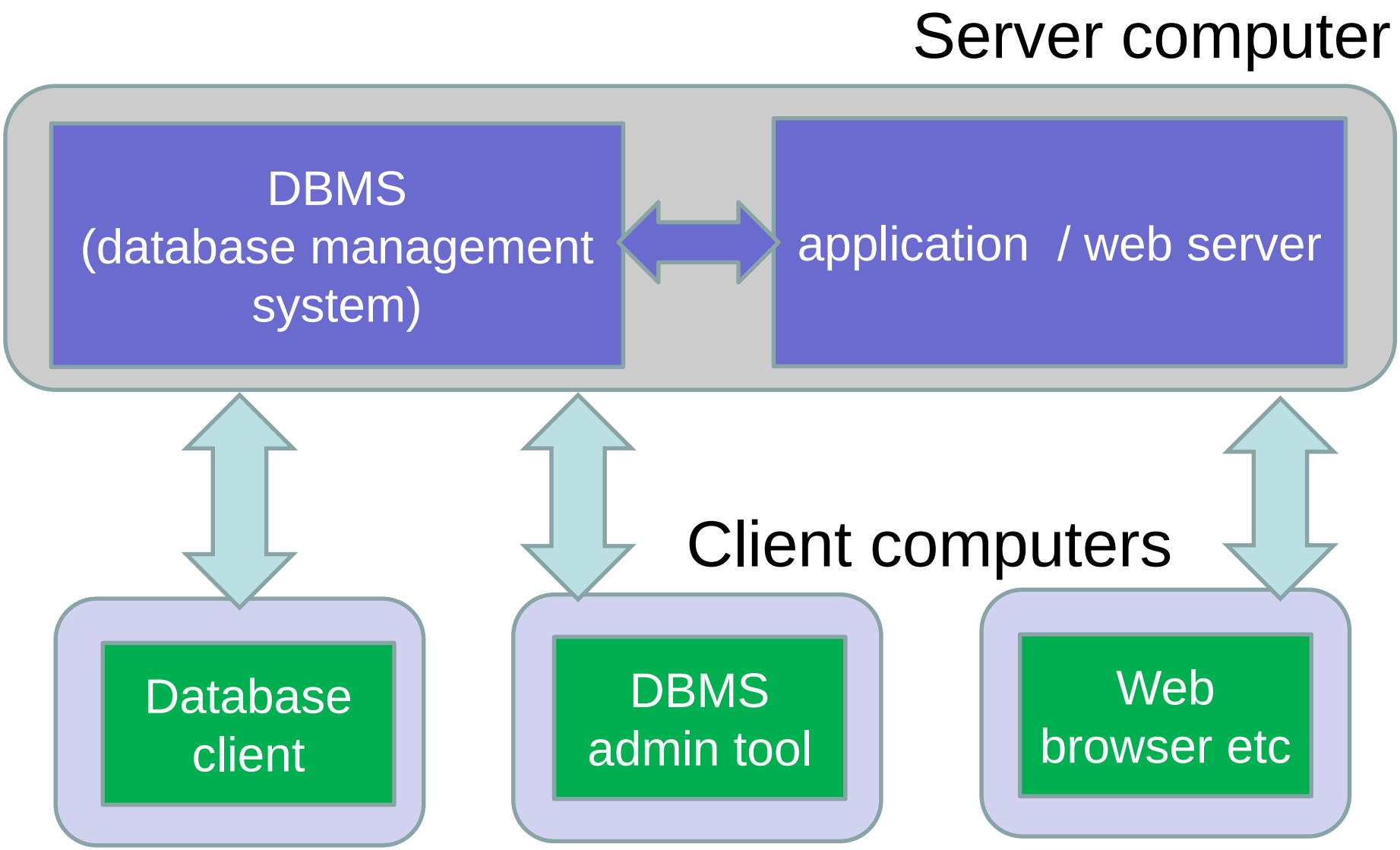
- entity-relationship diagrams, client-server architecture, SQL language



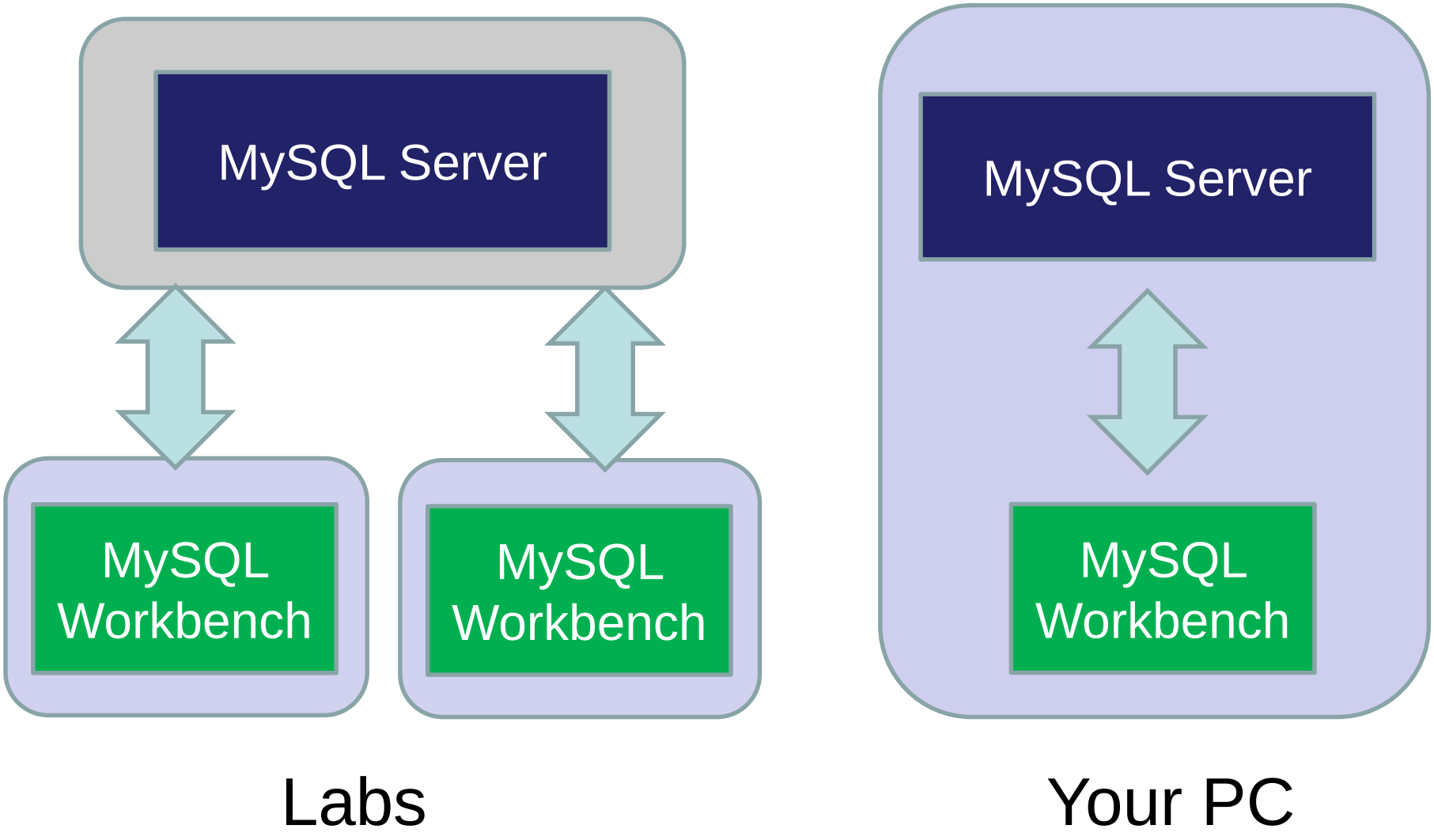


SELECT address
FROM Customer
WHERE Country = 'USA';

Client-Server … in industry

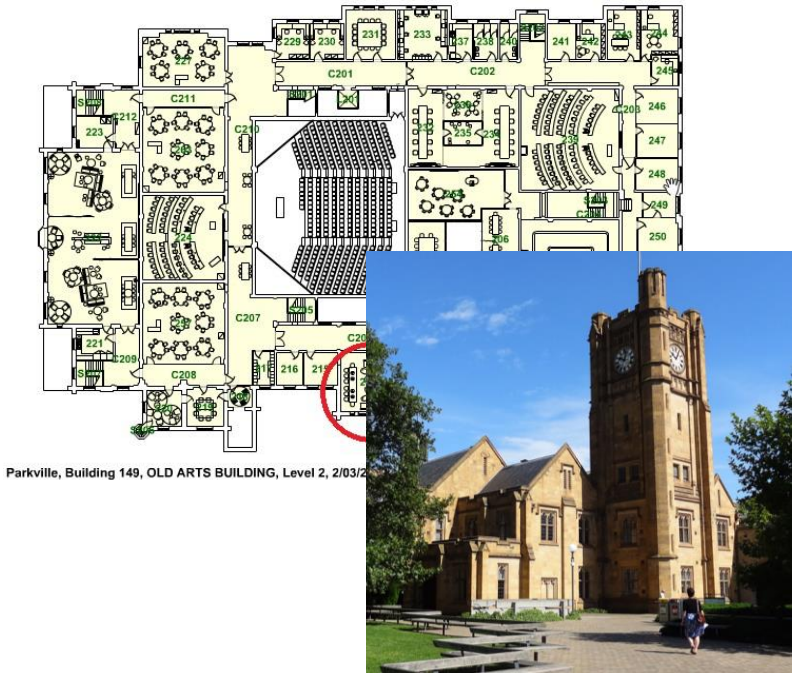


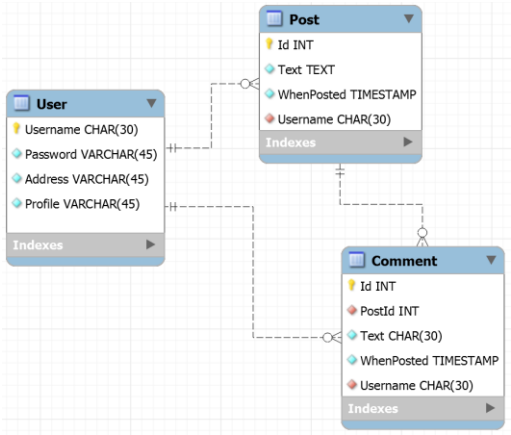
… in teaching and development



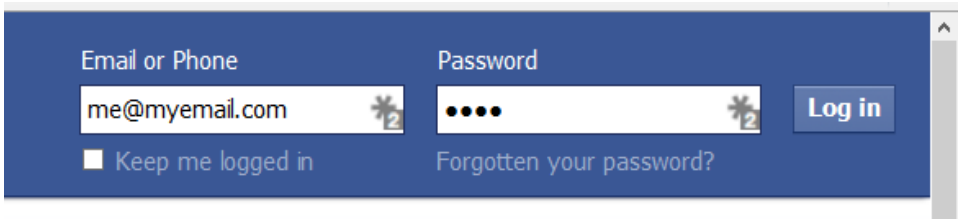
Let's design a database …

"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*





Let's design a database …



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 …

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
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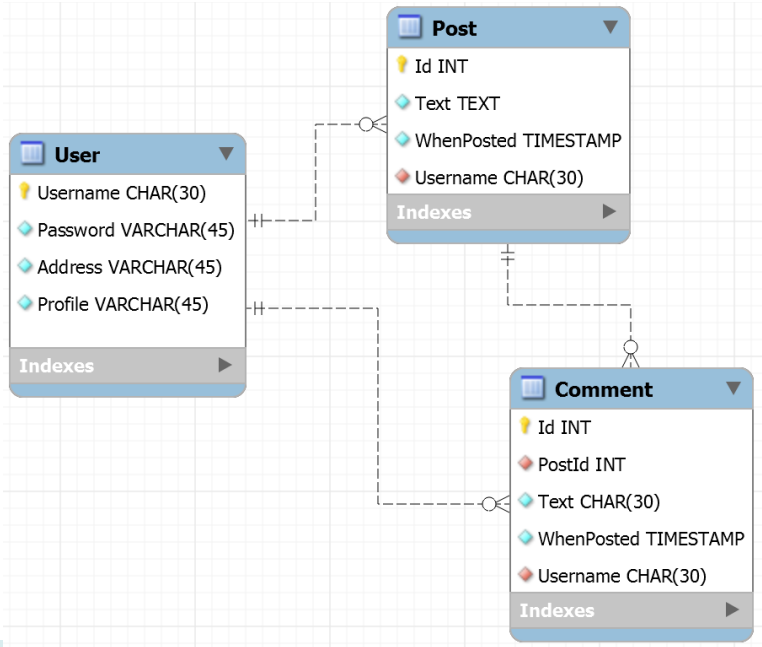
Entity-Relationship diagram:

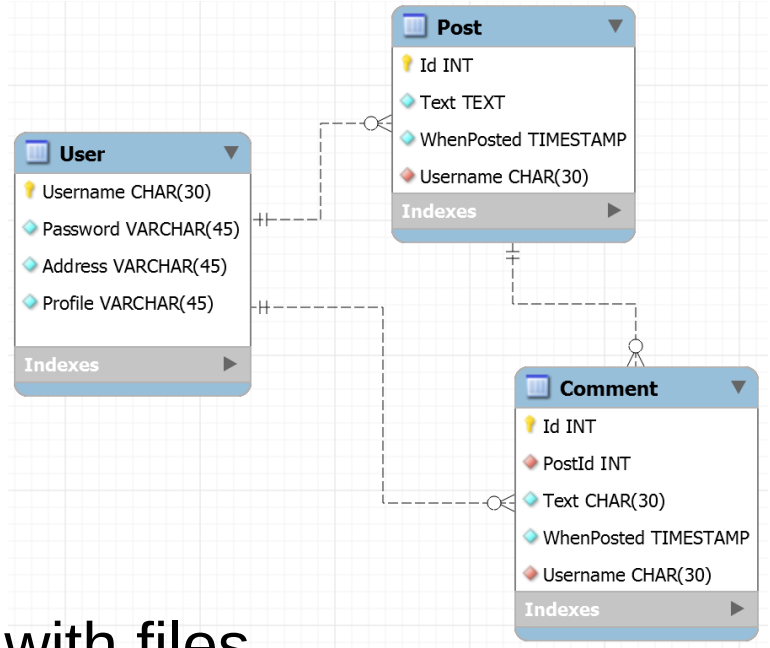


Relational notation:

User(<u>username</u>, password, address, profile)
Post(<u>id</u>, text, whenposted, *username*)
Comment(<u>id</u>, *postid*, text, whenposted)

Maintaining structure of database

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

Maintaining contents of database

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

User

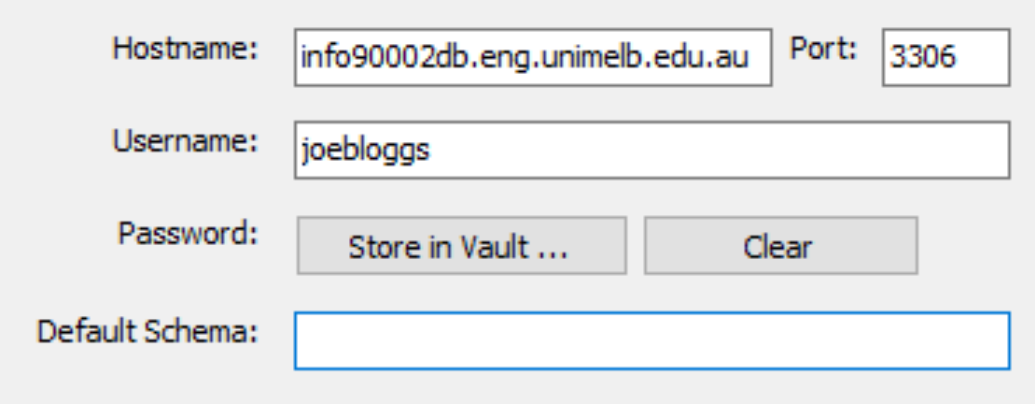
Username	Password	Address	Profile
Anne	pass1234	1 Anne st	hi I am Anne
Bill	petsname	2 Bill st	this is Bill's profile
Christine	mystreet	3 Christine st	hi everyone this is Christine!!!
David	childsname	4 David st	David's profile data

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

Maintaining users' access to database

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

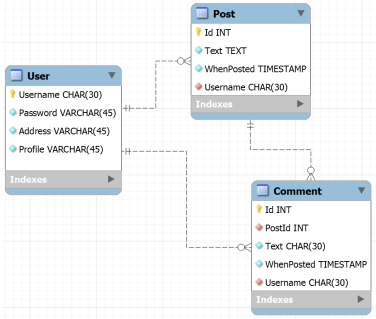
(users = I.T. staff here)



There are 4 things you can do:
CREATE a user
DROP a user
GRANT a user access rights to a table
REVOKE those rights

Database lifecycle

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



- Implement the database
  - data definition language DDL

•Create
•Drop
•Alter
•Rename

- Data access / programming
  - data manipulation language DML

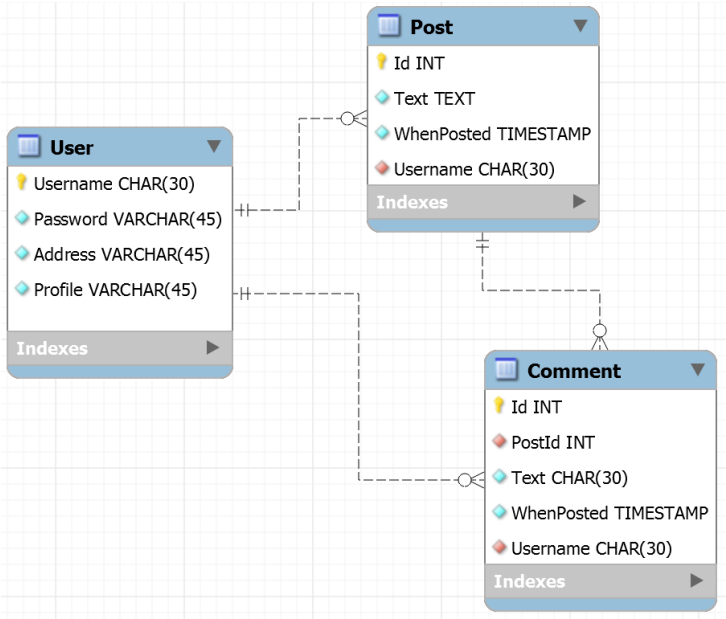
•Select
•Insert
•Update
•Delete

- Database administration
  - data control language DCL

•Grant
•Revoke

Data Modelling

- 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."

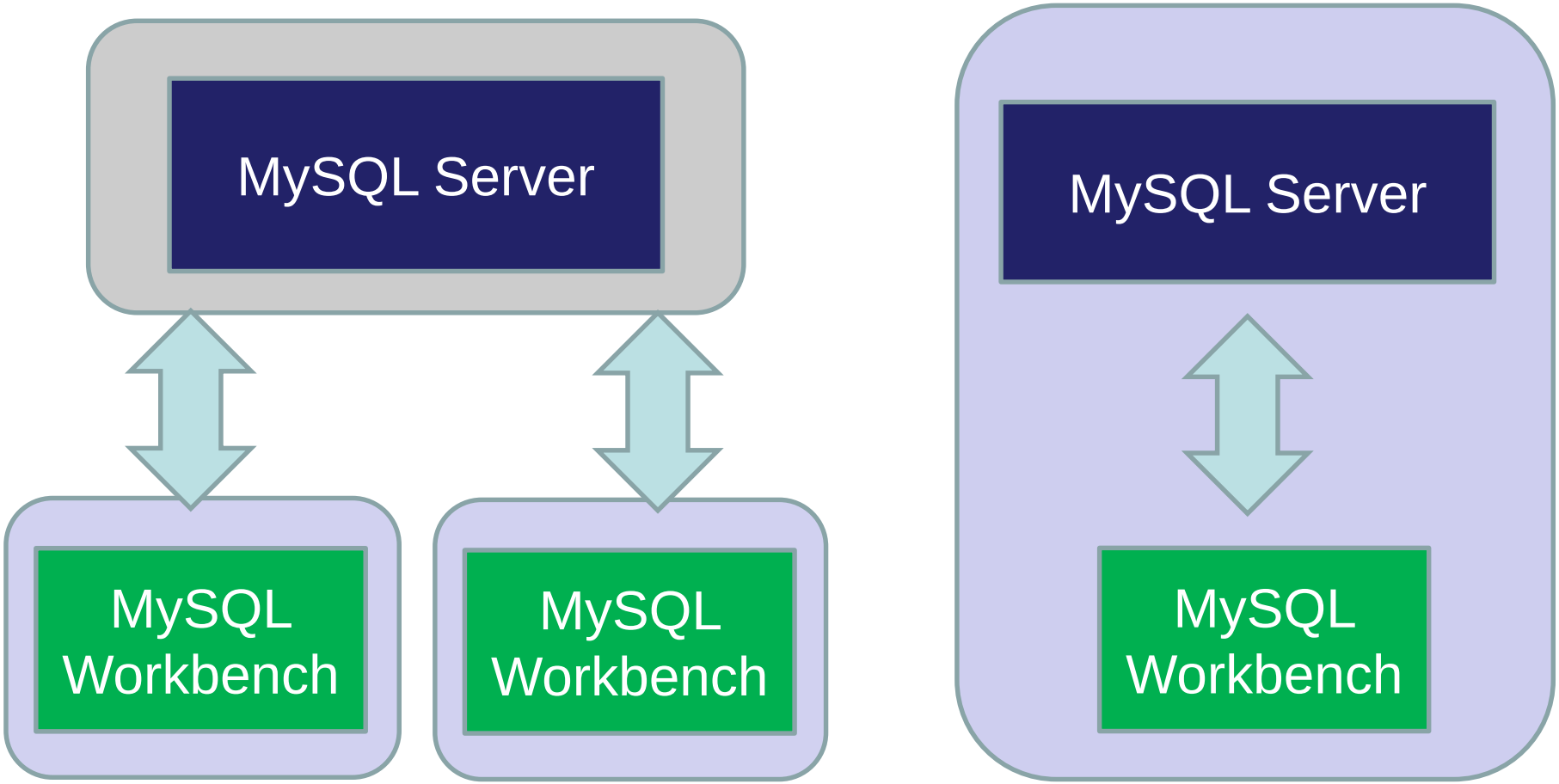
Noun-verb analysis

- 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

Coming up next

- 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

MySQL = client + server



Lab PCs … or … Your PC

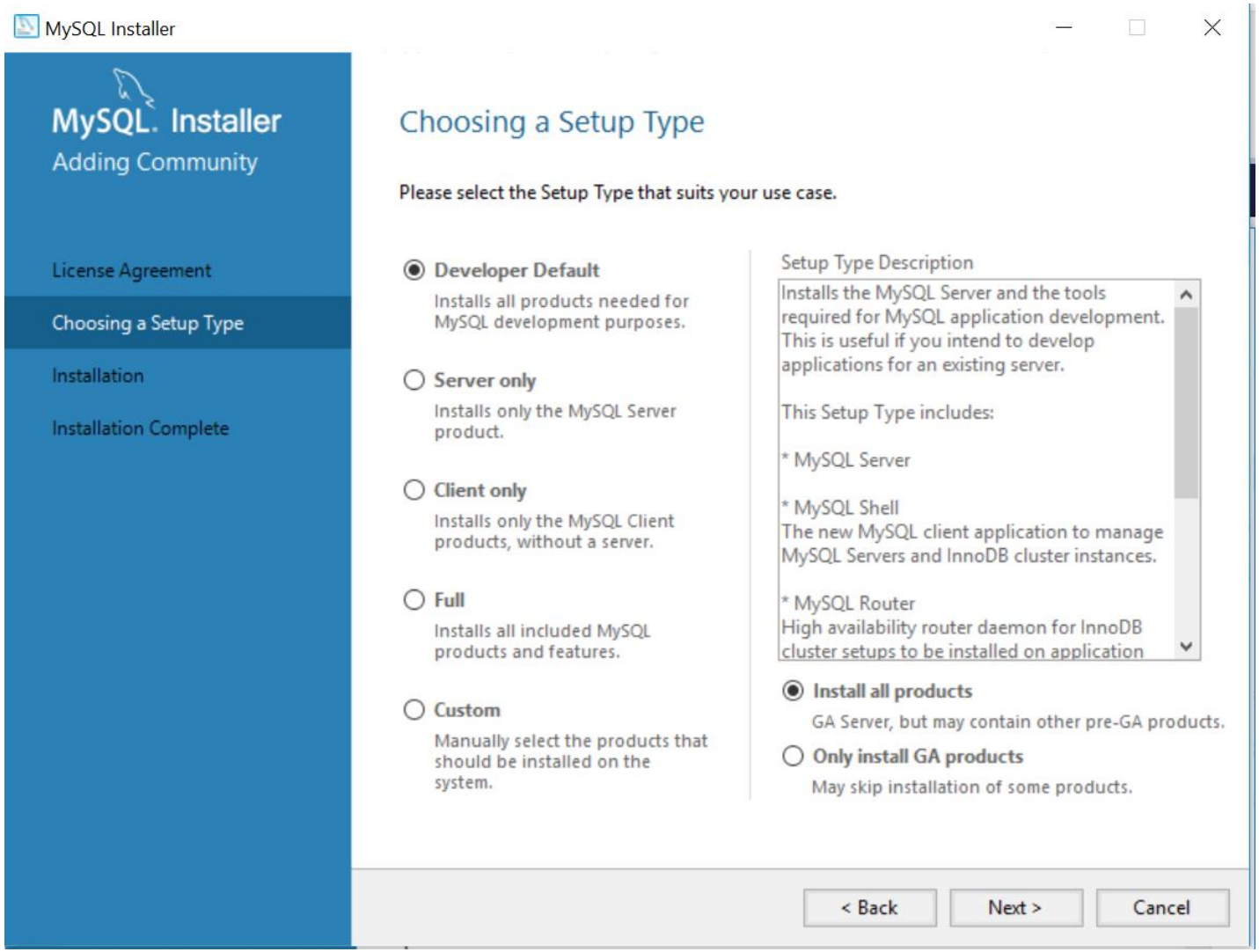
MySQL server and client

- 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)

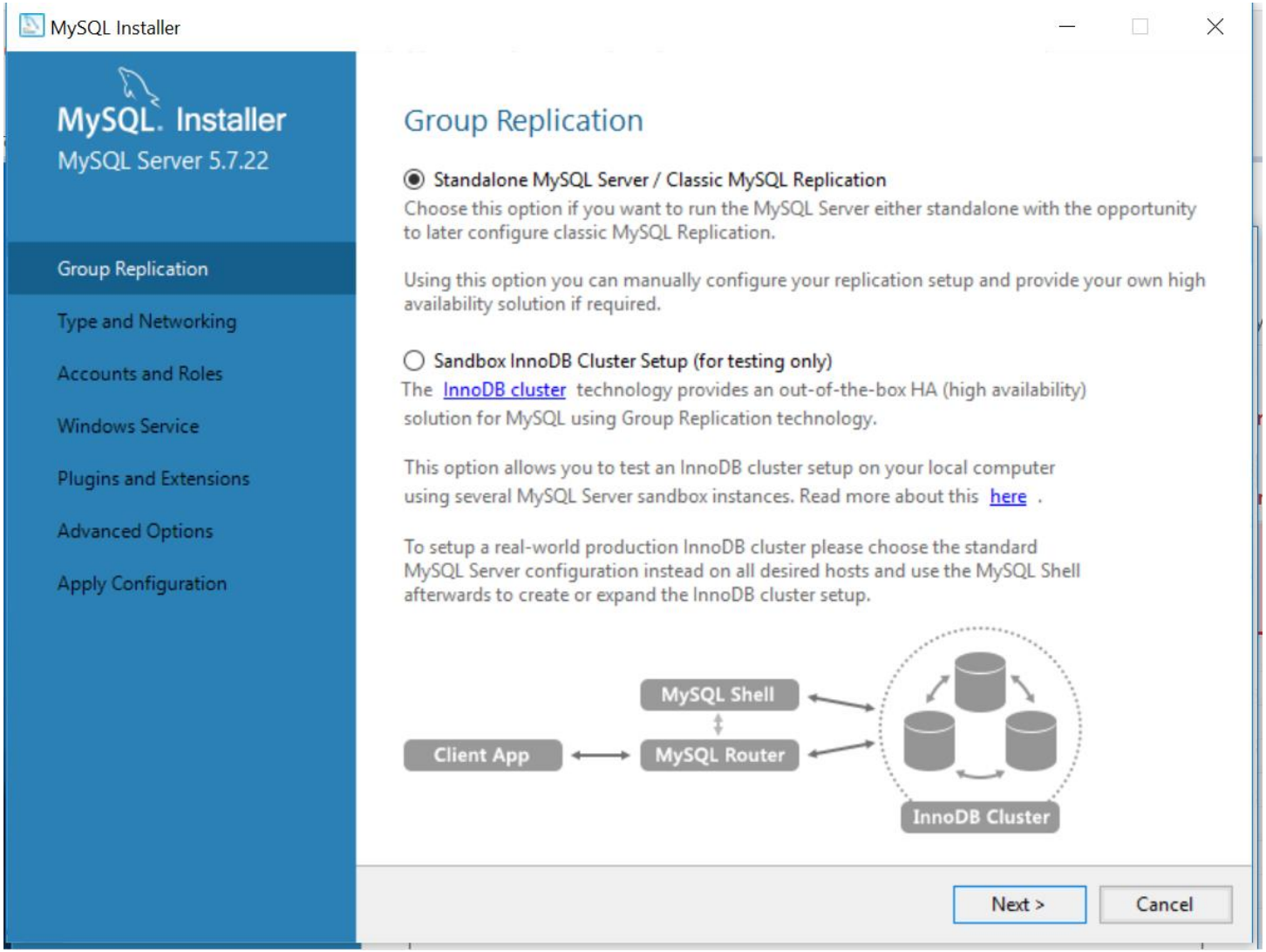
Installing MySQL

- 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.)

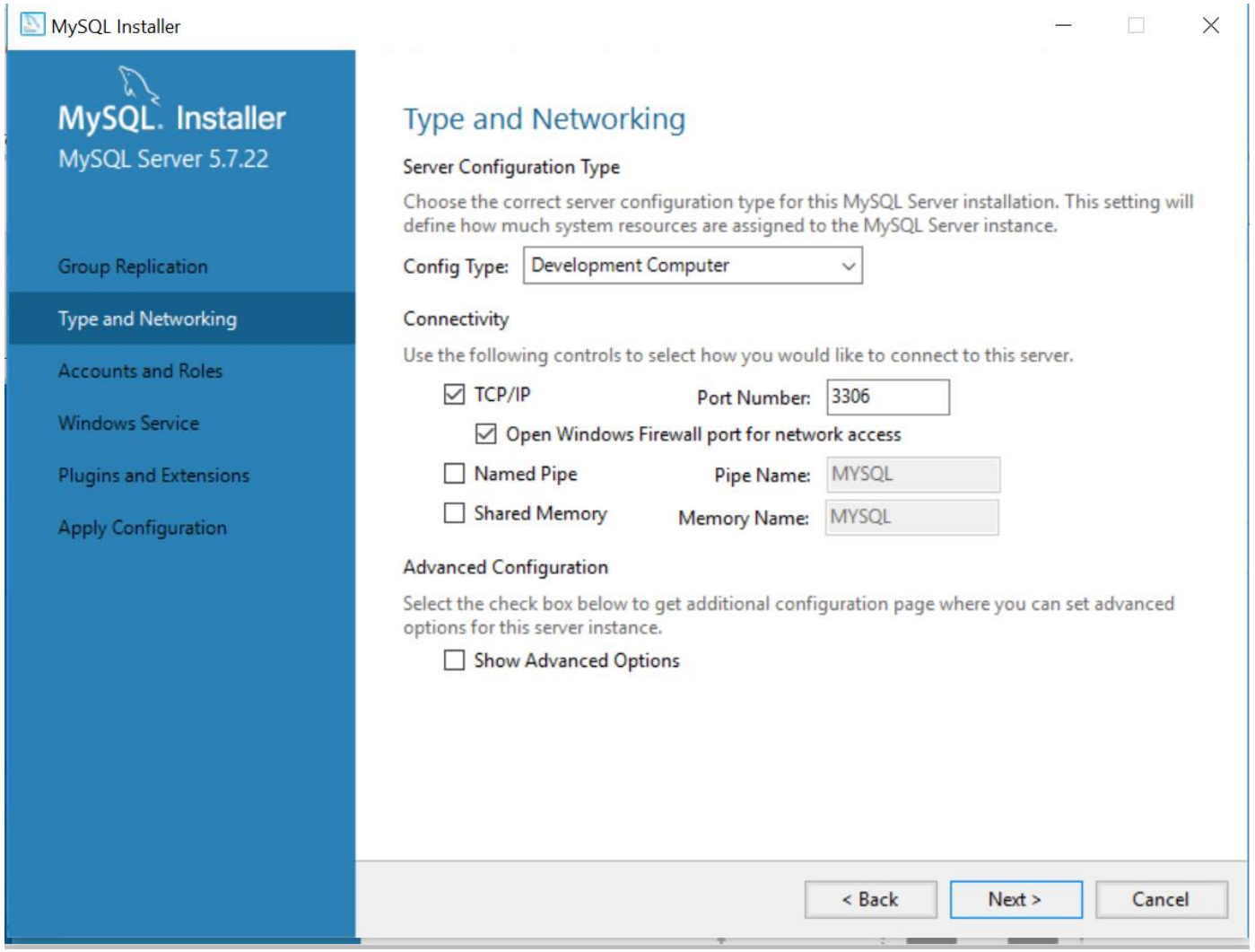
Installing MySQL



Installing MySQL



Installing MySQL



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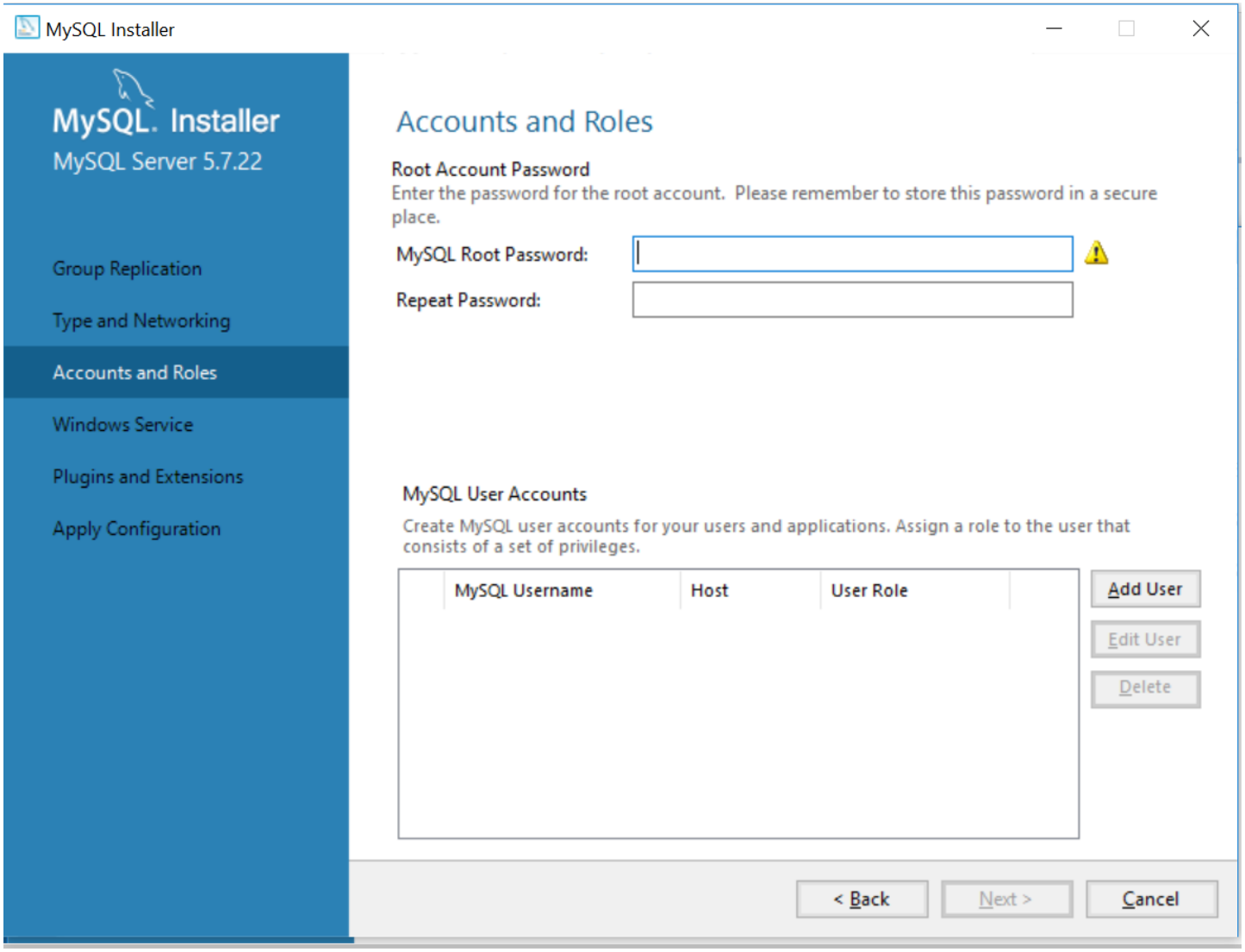
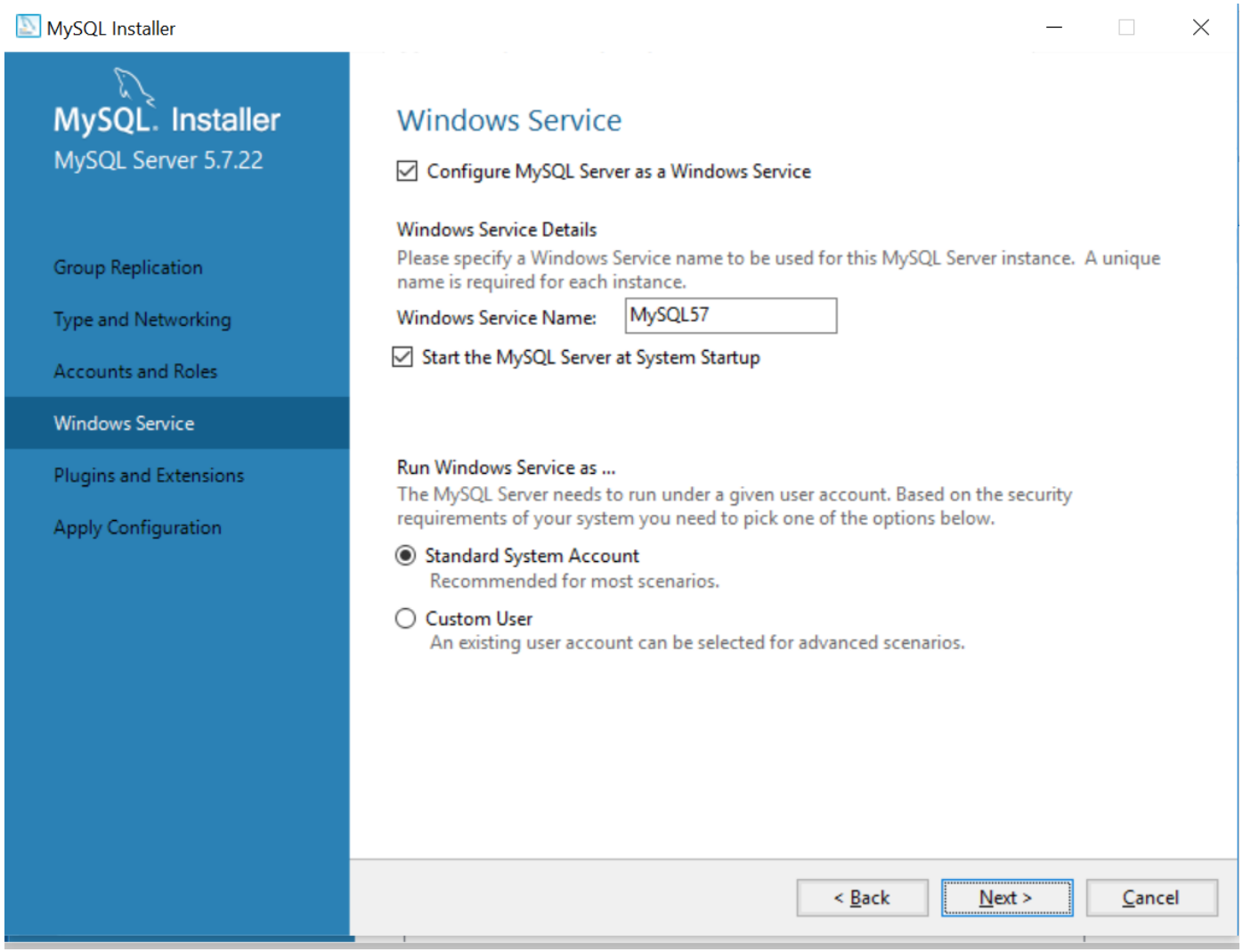
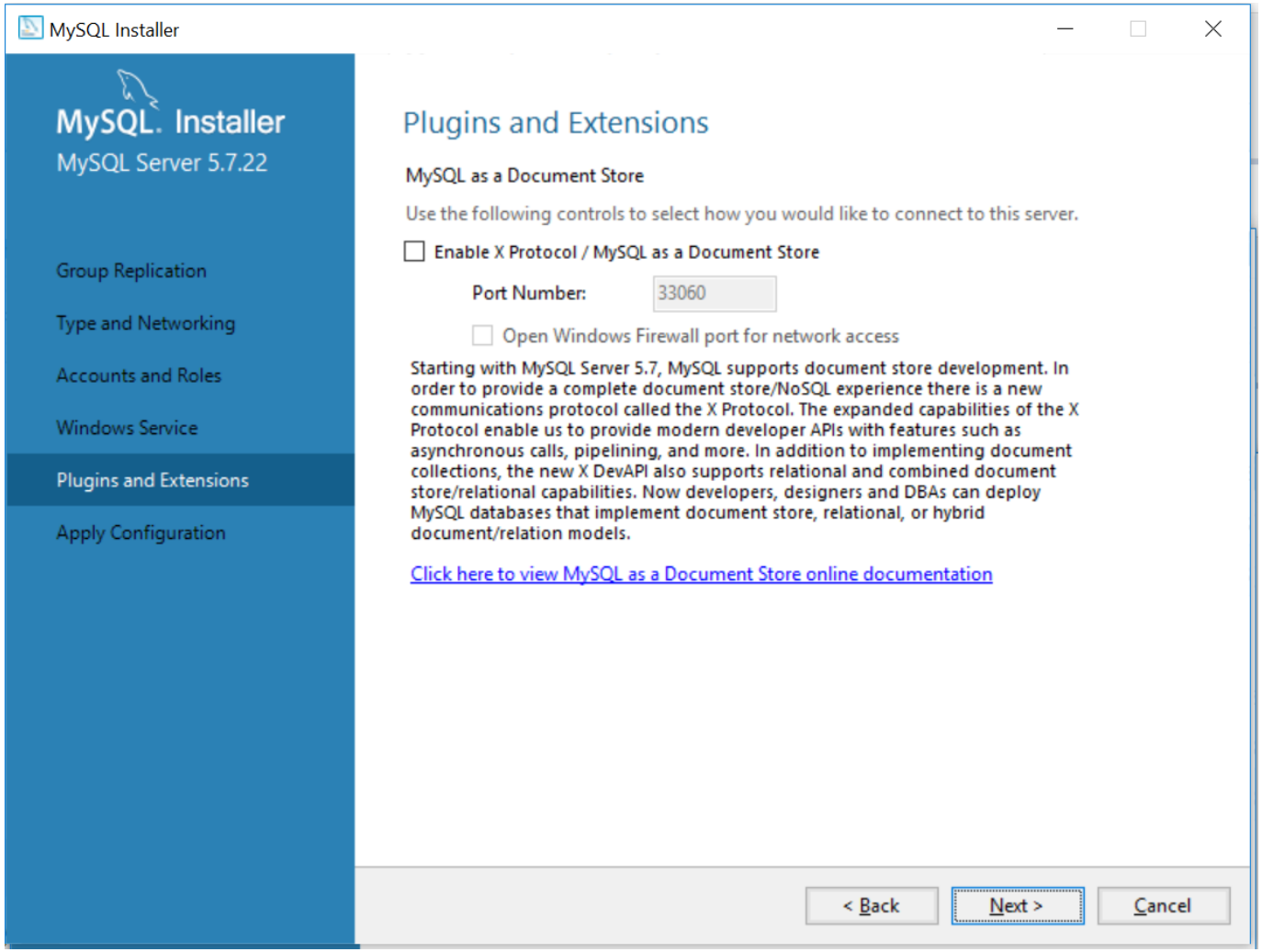


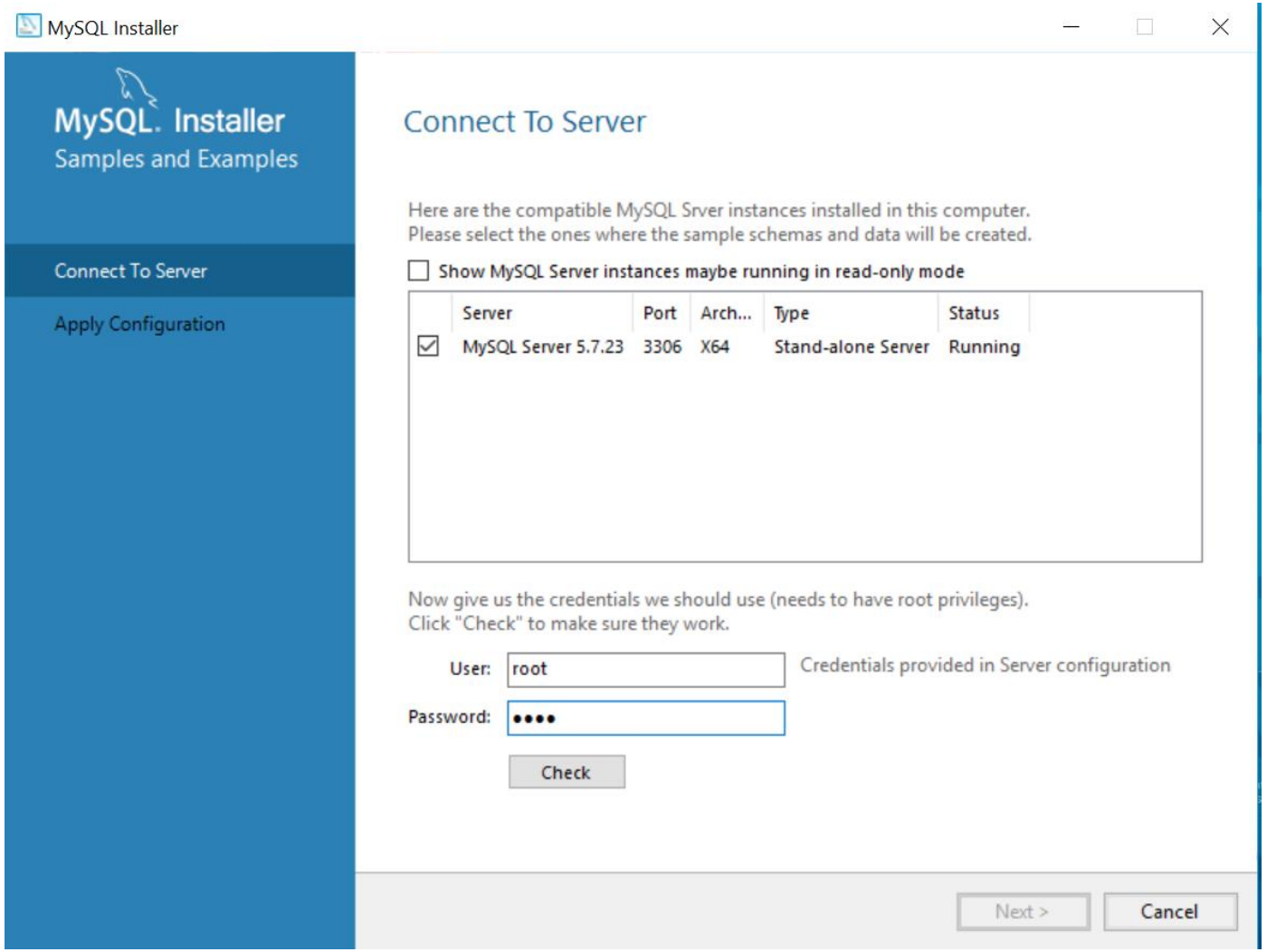
Installing MySQL



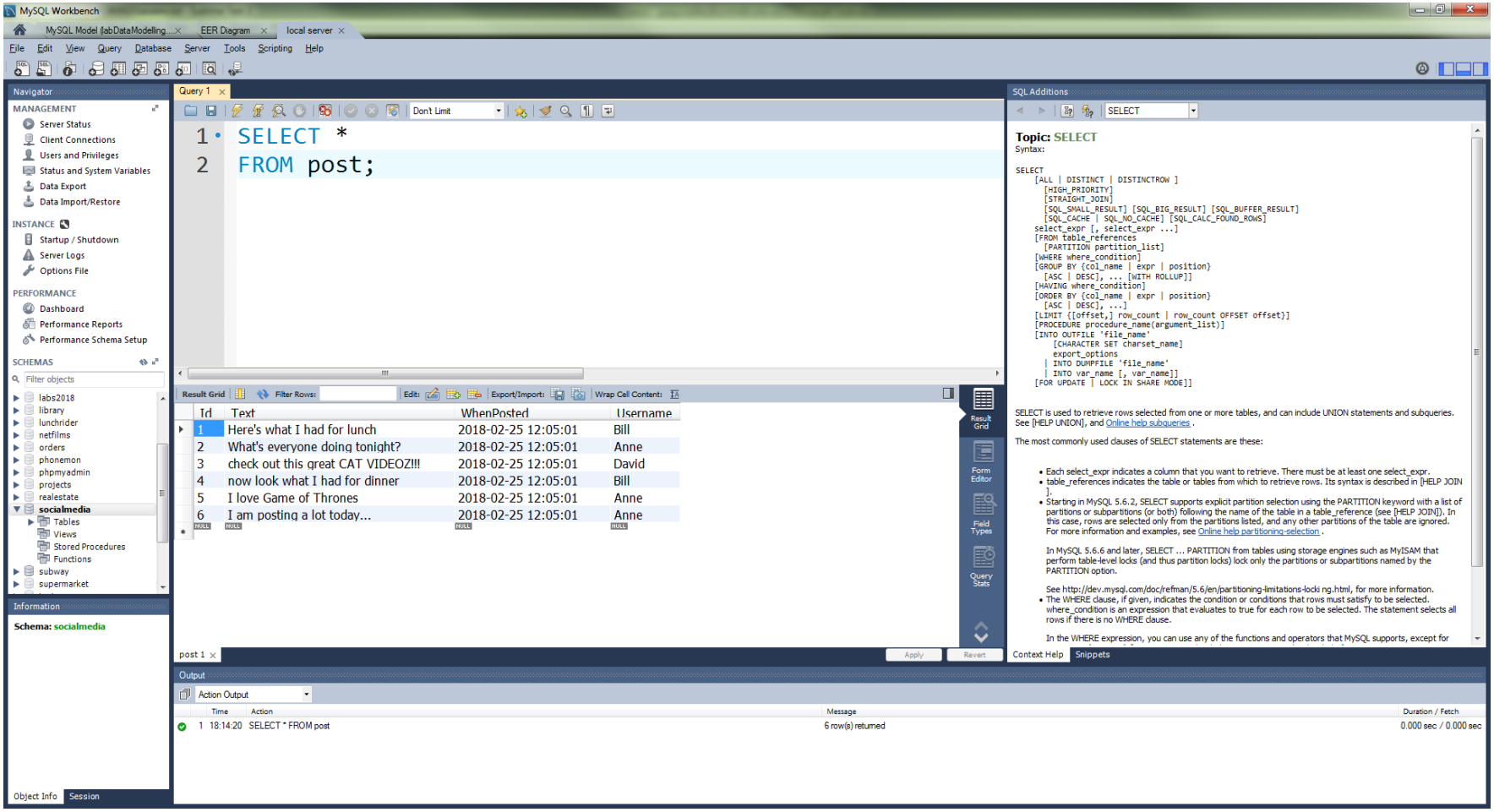
Installing MySQL



Installing MySQL

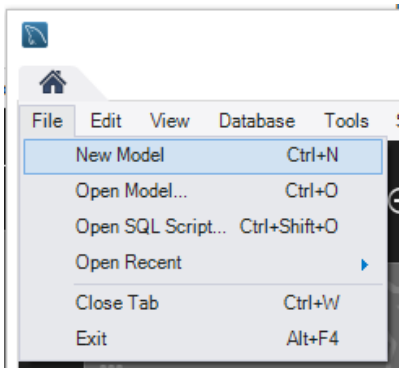


MySQL Workbench user interface

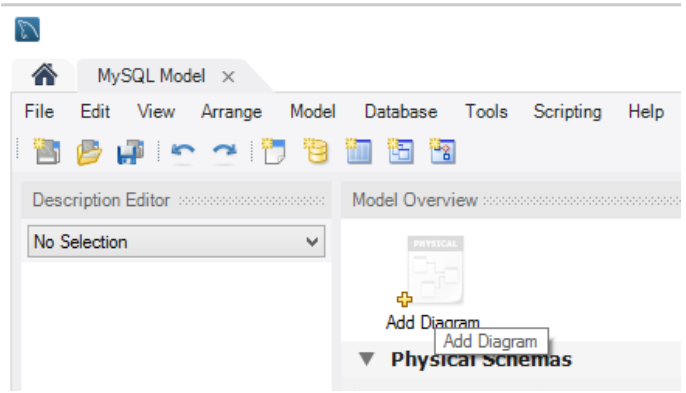


creating an E-R diagram

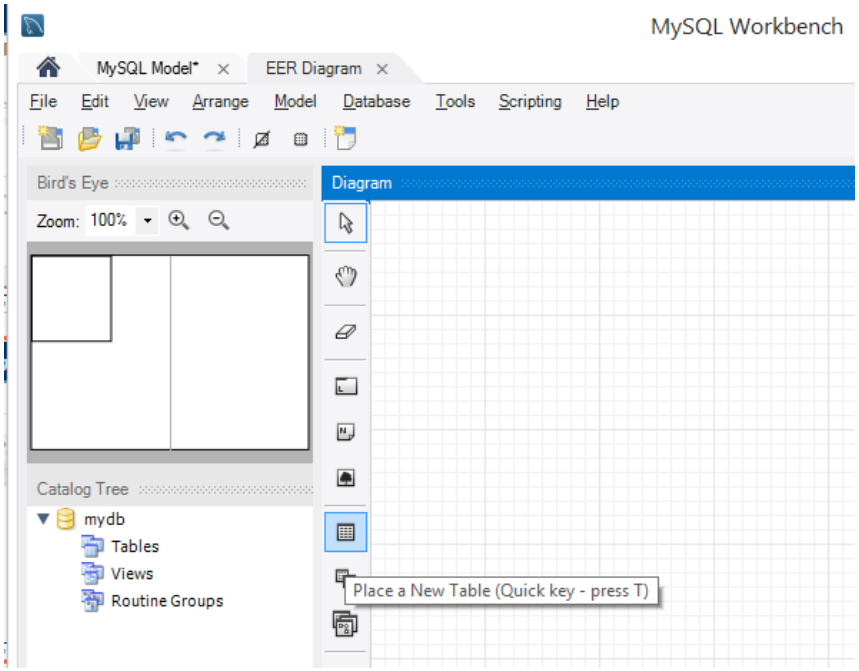
1



2

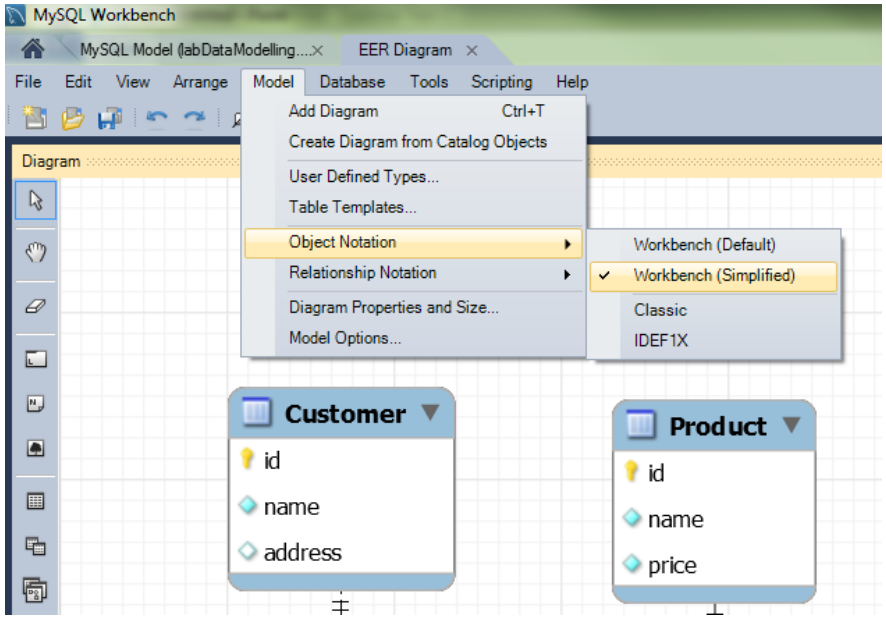


3

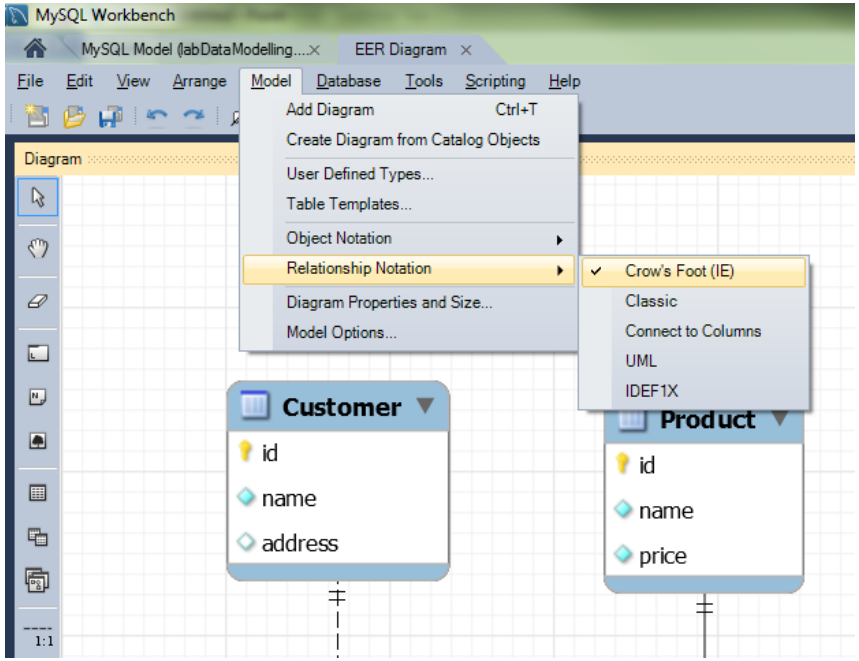


menu settings

Object notation

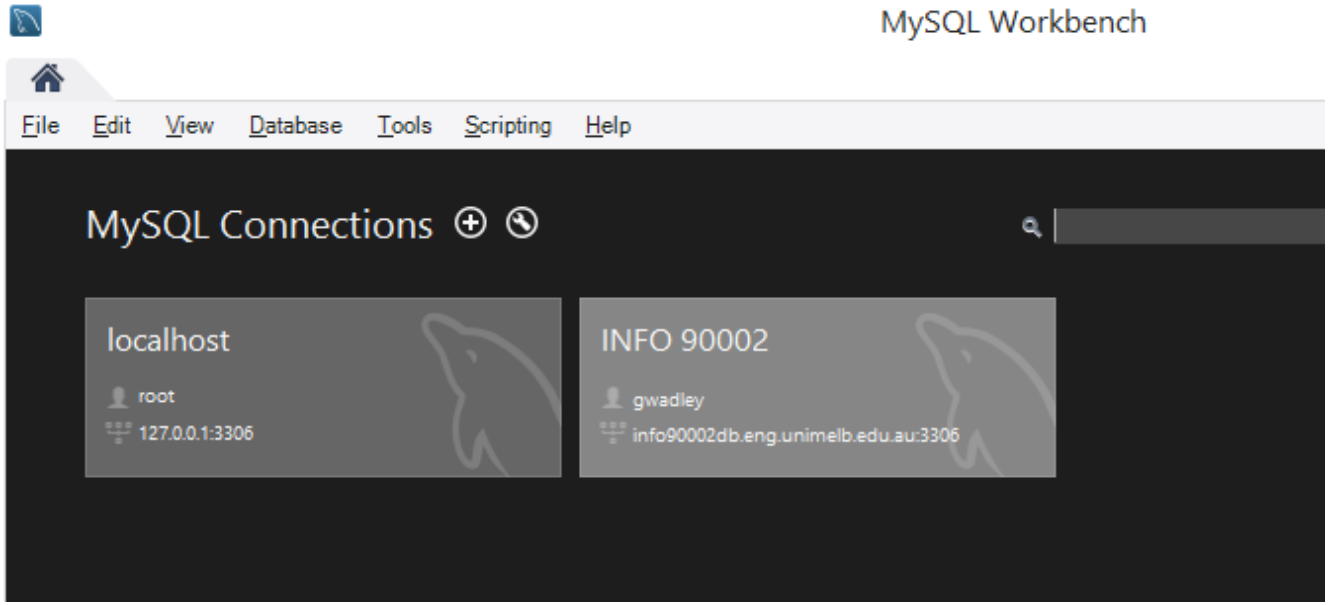


Relationship notation



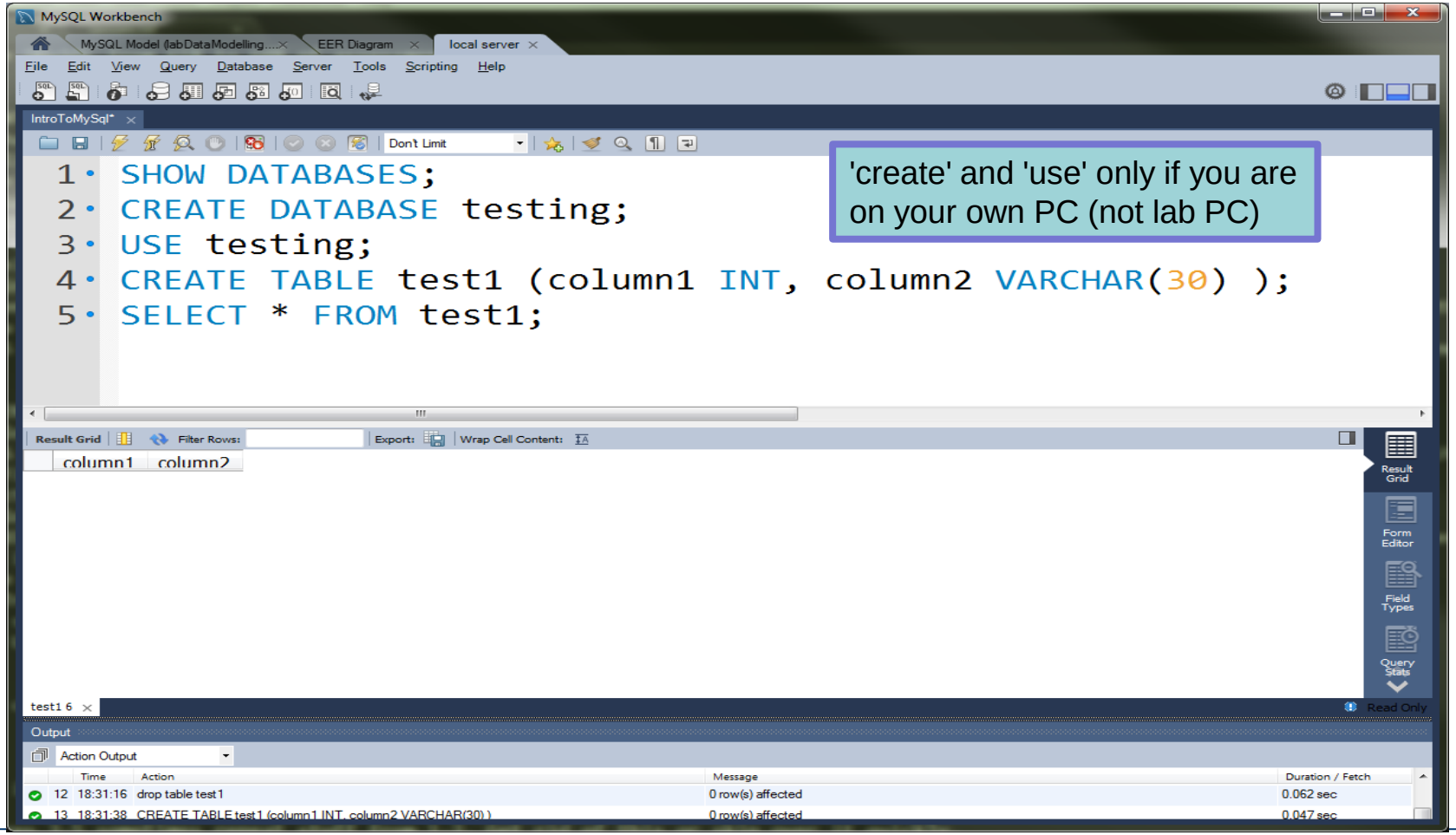
connecting to a server

- 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



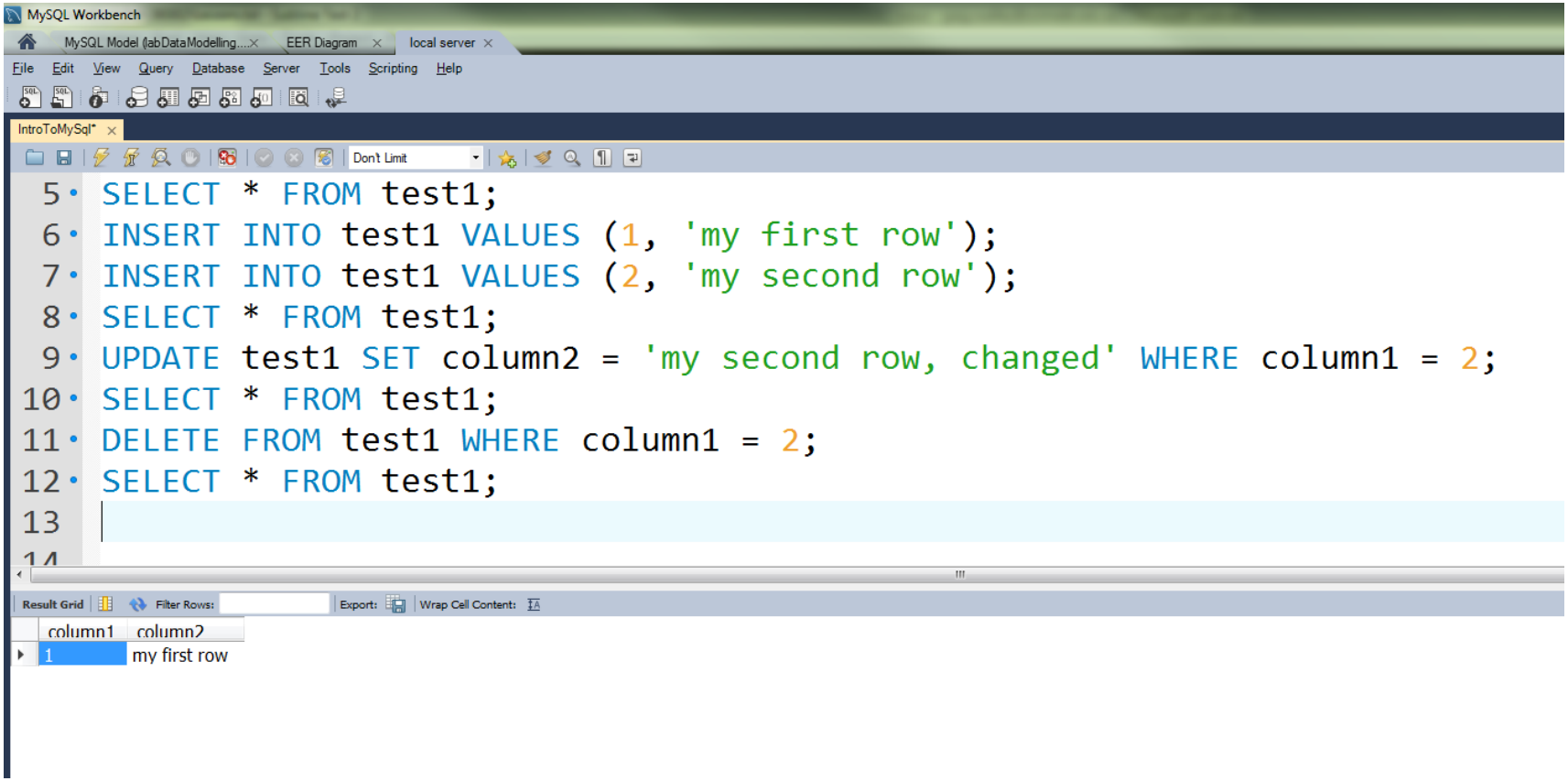
creating tables

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

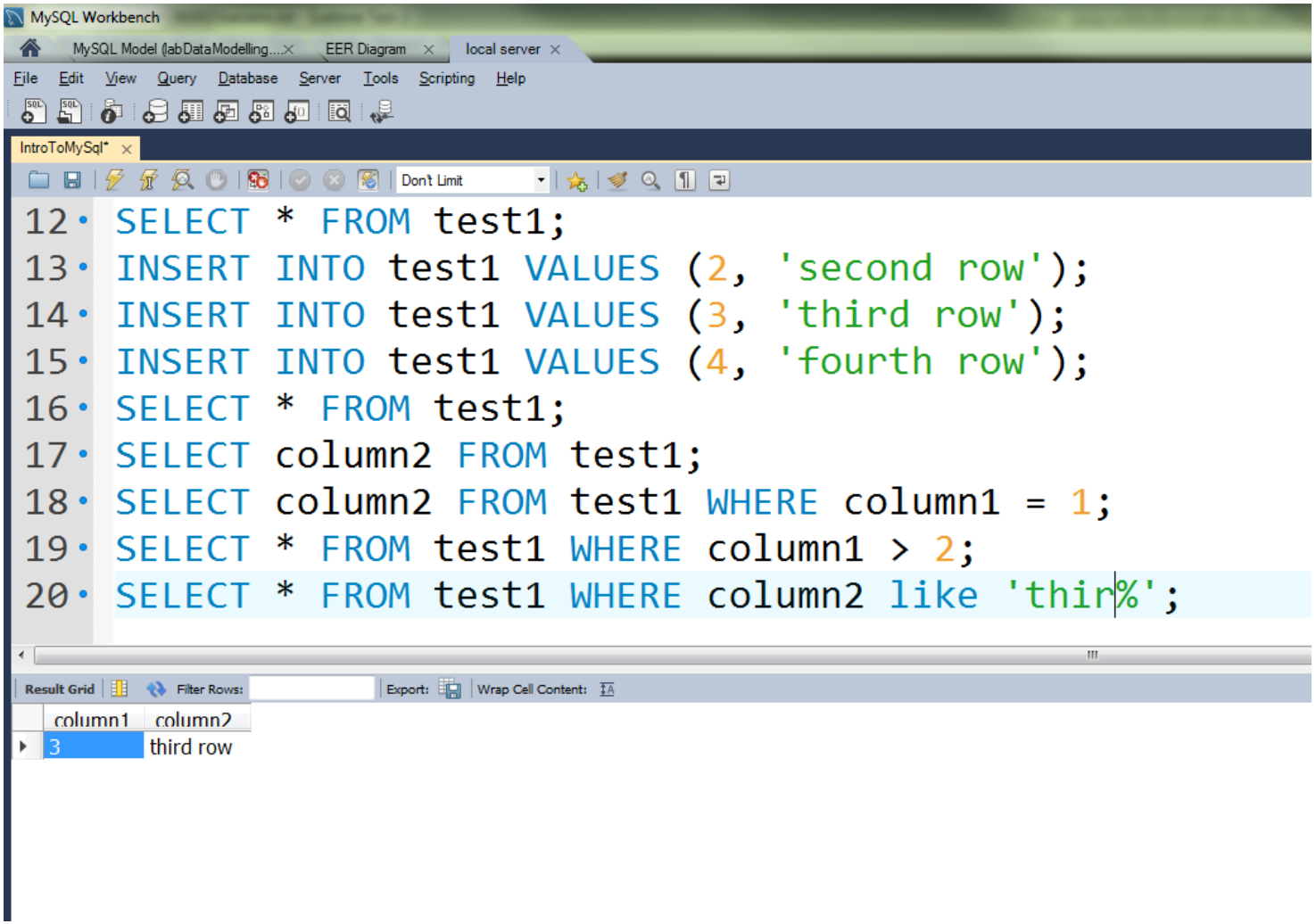


inserting/updating/deleting data

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

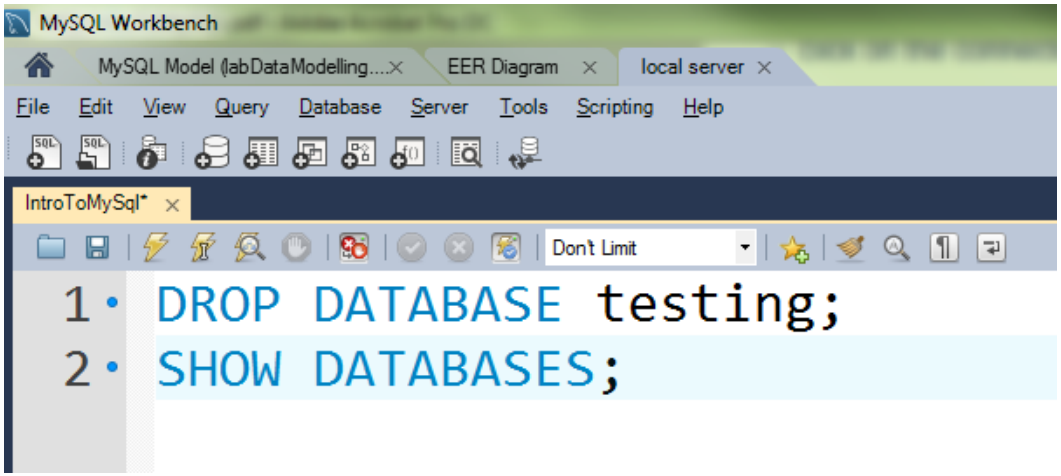


reading data from tables



clean up / more information

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