
University Of Portsmouth
BSc (Hons) Computer Science
First Year

Database Systems Development

M30232

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20 Credits

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LECTURE: INTRODUCTION TO MODULE

📅 29-09-22

🕒 13:00

🎓 Mark

📍 RB LT1

The Module Coordinator for this module is Mark (based in BK 3.09), he's assisted by Valentin and Roy in some sessions alongside others too.

Mark is using a new piece of software to make his presentations with, this is currently in the test phases and he may change back to PowerPoint if people don't like it. Slides are available on Moodle as HTML format, they can be printed to PDF files for offline viewing.

Module Aims

This module aims to help you understand where the database sits in modern systems. It does not train us to be database administrators. It gives us the skills to design a database and the knowledge of how to access it and do so safely.

This module will start from the ground up.

Learning Outcomes

- Demonstrate the fundamental principles of database design & development
- Use appropriate analysis techniques to identify the requirements of a database.
- Design and build a relational database, given a set of requirements.
- Understand how to apply data manipulation using SQL.

Historically, this module used to focus on the elements of Computer Science which relate to databases (for example, software development lifecycles). Now, it focuses on just databases.

Content Overview

This module provides an understanding of the theory of relational database design using tools standard to the industry. We will be taught how to design databases using Crows Foot Entity Relationship Diagrams and SQL to create the database. This module will also cover normalisation.

Teaching Overview

The module is a year long, worth 20 credits and has two different styles of teaching. There will be one, one hour lecture per week. In this session, we will be taught the knowledge which we can put into practice in the following weeks practical session.

There will be one, one and a half hour practical session per week. In this session, we will practice the skills required for databases. *(N.B. This session is timetabled for two hours on the timetable, generally the lecturers will leave after an hour and a half however students can remain in the room until the end of the two hours.)*

If you are unable to make it to a lecture, you need to read the content provided on Moodle. If you are unable to make it to a practical, you need to read and do (most importantly, do) the content on Moodle; this is so you are able to complete the following practical as they all build on each other.

Resources

There are a number of resources talked through:

- Moodle - the universities Virtual Learning Environment. Notes from lectures and from practicals will be uploaded here along with quizzes and other resources.
- Google Virtual Machine - the virtual machine in which our database lives. You do not need the university VPN to access it, as it requires a SSH connection. The data is hosted by Google, the module staff have some control over the machines. More detail on this will be provided in the first practical session.
- Google Workspace
- Microsoft Office. This is available free from the university. At some point, this will include Microsoft Visio, which is useful for coursework.

Expectations

Lecturers Expectations of Students

- Turn up for lectures (from next week, the content taught in the lectures will be used in the following weeks practical sessions)
- Arrive on time (there is usually useful information given out at the beginning of sessions)
- Participate and take notes in sessions
- Catch up on sessions if you miss them
- Finish the practical work before the following weeks practical sessions
- Study for about 4 hours a week total

These things are proven to increase the likelihood that a student gets a better mark at the end of the year.

Students Expectations of Lecturers

They are nice to students; start and end sessions on time; provide students with support and feedback on work throughout the module; and to return feedback and marks on work as quickly as they can (this usually should be within two weeks).

Assessments

There are two forms of assessment in this module.

Coursework

This will be worth 50% of the overall module mark. It will be released in the next few weeks and will be due at the end of the first week after the January assessment period (probably the Friday of that week at 11pm). The content assessed will all be from the first teaching block. We will get extra marks if we include content which hasn't been taught yet.

Exam

This will be worth 50% of the overall module mark. It will take place in the May/June assessment period and be computer based. It can include anything from the entire year however we won't have to write code (probably will have to look at code and say what's wrong). It will be multiple choice questions. There will be quizzes available on Moodle which will be similar to this where we can practice.

Brief Introduction to Databases

Database

"A single, possibly large, repository of data that can be used simultaneously by many departments and users" (*Database Solutions: A Step by Step Guide to Databases* - T Connolly & C Begg)

Spreadsheets

Spreadsheets are not databases. This is because a spreadsheet cannot hold the amount of data which a database can and even though using some software, a database could be shared with multiple people, it cannot be edited by multiple people simultaneously.

This also applies to Microsoft Access.

Database Management System (DBMS)

DBMS

"The software which interacts with the users' application programs and the database" (*Database Solutions: A Step by Step Guide to Databases* - T Connolly & C Begg)

Examples of a DBMS include PostgreSQL, MySQL, SQL Server, Oracle and Mongo DB.

Why Use a Database

An alternative to databases are file based systems.

File based systems: are old fashioned; are not necessarily digital; they often contain duplicate data; are difficult to search; are very difficult to update; have the possibility to contain different file types which may not be compatible together; are inaccessible; and security may be an issue.

A database is: a modern approach; digital; duplicates can be removed; easy to search; easy to update; comprised of only one file type; capable of having multiple levels of access control; able to limit user access.





There are times at which a Database is not suitable for the setting. In this case, it may be more suitable to use a spreadsheet.

Integrated Database Environment

In an integrated database environment, the DBMS sites as a communication hub between all nodes. The DBMS is the server on which the database is hosted.

When the database is setup correctly, you can get more information out of it than you put in.

PRACTICAL: INTRODUCTION TO PRACTICALS

 29-09-22 14:00 Mark & team FTC 3rd floor

Introduction to Practical sessions

Practical documents are available on Moodle, make a copy of these and store within your university Google Drive so you can edit them during the sessions and make notes.

Access Levels

In PostgreSQL, the first level of security is that a user cannot login unless they have been given access or there is a database with the same name as their username.

We don't have `sudo` access to linux, however we have full administrative access to PostgreSQL. Don't drop the database called `upxxxxxxx` (where `xxxxxxx` is replaced with student number) or anything that is owned by `postgres` as this breaks things.

PostgreSQL

PostgreSQL is ready to accept code when the prompt ends in `=#`. If you enter part of a command and press enter, the prompt will change to `-#`, this indicates that Postgres is waiting for you to finish the command.

PostgreSQL gives some useful error messages, SQL does not.

Code Editors

A code editor should be used to write SQL into, then the SQL should be copied and pasted into the Linux machine. The only thing that should be directly entered into the shell is to connect to a different database.

This is so that a. we have a copy of what we have done and b. so that if the VM is deleted, we are able to re-build our VM with less pain than if we didn't save all the code.

A recommended setup is to use VS code, with a SQL syntax extension. VS Code comes with integrated Powershell, allowing you to ssh to the VM from the same window.

SQL

SQL works like a procedural programming language, in that it reads the code inputted line by line. This also means that long and complex lines of code can be split across many lines, making it easier to read them.

Installing The First Database

Due to an issue with the image used to build the Virtual Machines, we have to create the database which we will use for the first few sessions. The code to do this was available on Moodle, copy and paste into the code editor then copy and paste again, this time into the Postgres prompt of the linux machine. This executes and creates the database, pre-populated with some sample data.

Tasks

1. List the databases in your server

LANGUAGE: SQL

```
1 \l
```

LANGUAGE: Unknown

```
1
2      List of databases
3
4  Name          | Owner          | Encoding | Collate | Ctype | Access privileges
5 -----+-----+-----+-----+-----+-----
6 dsd_22         | up2108121     | UTF8     | C.UTF-8 | C.UTF-8 |
7 mongo-2021-fix | mongo-2021-fix | UTF8     | C.UTF-8 | C.UTF-8 |
8 postgres       | postgres      | UTF8     | C.UTF-8 | C.UTF-8 |
9 template0      | postgres      | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres      +
10                |                |          |          |          | postgres=CTc/postgres
11 template1      | postgres      | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres      +
12                |                |          |          |          | postgres=CTc/postgres
13 up2108121      | up2108121     | UTF8     | C.UTF-8 | C.UTF-8 |
14 (6 rows)
```

2. Connect to the database

LANGUAGE: SQL

```
1 \c dsd_22
```

LANGUAGE: Unknown

```
1 You are now connected to database "dsd_22" as user "up2108121".
```

3. List everything in this database

LANGUAGE: SQL

```
1 \d
```

LANGUAGE: Unknown

```
1      List of relations
2 Schema | Name          | Type  | Owner
3 -----+-----+-----+-----
4 public | category      | table | up2108121
5 public | category_cat_id_seq | sequence | up2108121
6 public | cust_order     | table | up2108121
7 public | cust_order_cust_ord_id_seq | sequence | up2108121
8 public | customer       | table | up2108121
9 public | customer_cust_id_seq | sequence | up2108121
10 public | manifest       | table | up2108121
11 public | manifest_manifest_id_seq | sequence | up2108121
12 public | product        | table | up2108121
13 public | product_prod_id_seq | sequence | up2108121
14 public | role           | table | up2108121
15 public | role_role_id_seq | sequence | up2108121
16 public | staff          | table | up2108121
17 public | staff_staff_id_seq | sequence | up2108121
18 (14 rows)
```

4. List just the tables

LANGUAGE: SQL

```
1 \dt
```

LANGUAGE: Unknown

```

1      List of relations
2 Schema |      Name      | Type |   Owner
3 -----+-----+-----+-----
4 public | category      | table | up2108121
5 public | cust_order     | table | up2108121
6 public | customer       | table | up2108121
7 public | manifest       | table | up2108121
8 public | product        | table | up2108121
9 public | role           | table | up2108121
10 public | staff          | table | up2108121
11 (7 rows)
```

5. Get a list of all the customers in the customer table

LANGUAGE: SQL

```
1 SELECT * FROM customer;
```

LANGUAGE: Unknown

```

1 cust_id |  cust_fname  |  cust_lname  |      addr1      |      addr2      |      town
2  ↳         |  postcode   |      email    | -----+-----+-----
3  ↳         | -----+-----+-----+-----+-----+-----
4  ↳ 1 | Jobey      | Boeter      | 6 Claremont Park | Truax           | La
5  ↳ Mohammedia | CV42 3EF   | jboeter0@mail.ru |                  |                  | Chemnitz
6  ↳ 2 | York       | O'Deegan    | 882 Hooker Trail |                  |                  |
7  ↳           | YA92 20J   | yodeegan1@nydailynews.com |                  |                  |
8  ↳ 3 | Penelope   | Hexter      | 25 Jackson Lane |                  |                  | Pingshan
9  ↳           | LY32 8LN   | phexter2@cbslocal.com |                  |                  |
10 ↳ 4 | Chadd      | Franz-Schoningner | 7 Division Point | Texas           | Baojia
11 ↳           | XA22 OUR   | cfranzschoningner3@google.com.hk |                  |                  |
12 ↳ 5 | Vikky      | Eke         | 293 Colorado Drive | Browning        | Kamenny
13 ↳ Privoz | WQ12 3SF   | veke4@elegantthemes.com |                  |                  |
14 ↳ 6 | Marie-francoise | Currier     | 032 Eagan Junction | Duke            |
15 ↳ Waekolong | NB52 4MV   | acurrier0@economist.com |                  |                  |
16 ↳ 7 | Benedicte  | Dozdill     | 579 Dryden Terrace |                  | Dawuhan
17 ↳           | GY32 6GQ   | cdozdill1@amazon.de |                  |                  |
18 ↳ 8 | Gorel     | Douthwaite  | 2946 Bluejay Parkway | Heath           | Sunbu
19 ↳           | PH02 3ZX   | edouthwaite2@feedburner.com |                  |                  |
20 ↳ 9 | Berengere  | Menendez    | 06154 Jackson Way | Doe Crossing    |
21 ↳ Tsagaanders | H082 5XL   | amenendez3@dell.com |                  |                  |
22 ↳ 10 | Pelagie   | Hachard     | 1777 Hauk Center |                  | Jiantou
23 ↳           | NA52 4LM   | fhachard4@blinklist.com |                  |                  |
24 ↳ 11 | Adaobi    | Musa        | 6 Clariss Ave |                  | La
25 ↳ Mohammedia | CV4 3F     | amusa9@mail.ca |                  |
26 (11 rows)
```

6. Choose a different table from the output of \dt and get a list of all the records in that table.

LANGUAGE: SQL

```
1 SELECT * FROM role;
```

LANGUAGE: Unknown

```

1 role_id |  role_name
2 -----+-----
```



```
3 1 | Order Picker
4 2 | Final Packer
5 3 | Post Sales
6 4 | Customer Retain
7 5 | Misc
8 (5 rows)
```

LECTURE: THE DATABASE ENVIRONMENT

📅 06-10-22

🕒 13:00

🎓 Mark

📍 RB LT1

Data or Information

When we think about real world things, we will generally think of these in terms of information, not data. Everyone and everything has information. We have to break information down into data to be able to store it.

Data

Facts and statistics collected together for reference or analysis
(<https://en.oxforddictionaries.com/definition/data>)

Information

The result of applying data processing to data, giving it context and meaning. Information can then be further processed to yield knowledge (<http://foldoc.org/information>)

When we need to store information in a database, we first have to break it down into data items. These can be entered into the database then pulled out again in different states. When done right, these different states should be able to tell us more information than we put in.

We also have knowledge, this is the ability to find things.

Processing Data

If we are given random data items, we can assume what they mean. For example, if we are given 1.99; cheeseburger; and Bob's Midnight Burgers, you could assume that you could purchase a cheeseburger from an establishment called Bob's Midnight Burger for £1.99. However, this might be completely wrong! It could in fact be three un-related pieces of information or we may have mis-interpreted the information completely. This shows that it is imperative we look at the context which surrounds data, before drawing information from it.

Database Management System

The Database Management System (DBMS) is the core of the database system. Every communication to the database is done through the DBMS, this includes queries, data in and data out. The DBMS also controls access to the data and schema (which is stored within the database itself).

Schema

The 'blueprint' of the database.

An advantage of using a DBMS is that different users can be restricted as to what they can access; the data can easily be managed and the DBMS provides an integrated view of an enterprise's operations. The DBMS also removes the risk of inconsistent data and improves the ease with security can be controlled.

Database Languages

There are two different types of database languages (DDL and DML), each have a different purpose. SQL is both.

Before we look at DDL and DML in more detail, we first need to understand what the term 'Query' means.

Queries

A query is the code which interacts with the database.

This can be to read the contents of the database, you can 'query the database'. However it is also the code that puts the data into the database and the code which is used to build the database in the first place.

DDL

Data Definition Language (DDL) allows the DBA or users to describe and name entities, attributes and relationships required for the applications that access it and associated integrity and security constraints. It is the set of commands which are used to define the structure of the database. These are the commands used to create, modify or remove database objects (e.g., tables, users and indexes). Listed below are a number of the most commonly used DDL commands.

LANGUAGE: SQL

```
1 CREATE DATABASE
2 CREATE TABLE
3 ALTER TABLE
4 DROP DATABASE
5 DROP TABLE
6 RENAME TABLE
```

The following is an example of SQL code which creates a new table and as part of that defines the attributes within it.

LANGUAGE: SQL

```
1 create table property_for_rent (
2     Property_id varchar(4) PRIMARY KEY,
3     Street varchar(14) not null,
4     City varchar(10) not null,
5     Postcode varchar(10) not null,
6     Type varchar(6) not null,
7     Rooms integer not null,
8     Rent decimal(6,2) not null,
9     Owner_id varchar(4) not null REFERENCES private_owner(owner_id),
10    Staff_id varchar(4) REFERENCES staff(Staff_id),
11    branch_id varchar(4) REFERENCES branch(Branch_id)
12 );
```

DML

Data Manipulation Language (DML) provides the ability to manipulate data within the database. Its commands are used to select, insert, update and delete data items within a database. Listed below are a number of the most commonly used DML commands.

When selecting attributes to display, do not use `SELECT * FROM ...` as this selects everything. Instead, use `SELECT attribute, anotherAttribute, yetAnotherAttribute FROM`

Take care when entering commands, for the configuration of our Virtual Machines, we are super users within PostgreSQL. Whatever we enter will be executed without question by the machine, this includes dropping data.

LANGUAGE: SQL

```
1 DELETE
2 INSERT
3 REPLACE
4 SELECT
5 UPDATE
```

The following is an example of SQL code which queries a table based on an attribute.

LANGUAGE: SQL

```
1 select property_id,
2 street,
3 city,
4 postcode,
5 owner_id from property_for_rent
6 where city = 'Glasgow';
```

PRACTICAL: FURTHER INTRODUCTION

📅 06-10-22

🕒 14:00

🎓 Mark & team

📍 FTC Floor 3

Introductory Tasks

1. After getting into PostgreSQL client, list the databases.

LANGUAGE: SQL

```
1 \l
```

LANGUAGE: Unknown

```

1      List of databases
2      Name          | Owner          | Encoding | Collate | Ctype  | Access privileges
3      -----+-----+-----+-----+-----+-----
4 dsd_22             | up2108121      | UTF8     | C.UTF-8 | C.UTF-8 |
5 mongo-2021-fix    | mongo-2021-fix | UTF8     | C.UTF-8 | C.UTF-8 |
6 postgres           | postgres       | UTF8     | C.UTF-8 | C.UTF-8 |
7 template0         | postgres       | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres +
8                   |                |          |          |          | postgres=CTc/postgres
9 template1         | postgres       | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres +
10                  |                |          |          |          | postgres=CTc/postgres
11 up2108121         | up2108121      | UTF8     | C.UTF-8 | C.UTF-8 |
12 (6 rows)
```

2. Connect to the dsd_22 database.

LANGUAGE: SQL

```
1 \c dsd_22
```

LANGUAGE: Unknown

```
1 You are now connected to database "dsd_22" as user "up2108121".
```

3. List the contents of the database

LANGUAGE: SQL

```
1 \d
```

LANGUAGE: Unknown

```

1      List of relations
2      Schema | Name          | Type  | Owner
3      -----+-----+-----+-----
4 public | category      | table | up2108121
5 public | category_cat_id_seq | sequence | up2108121
6 public | cust_order     | table | up2108121
7 public | cust_order_cust_ord_id_seq | sequence | up2108121
8 public | customer       | table | up2108121
9 public | customer_cust_id_seq | sequence | up2108121
10 public | manifest       | table | up2108121
11 public | manifest_manifest_id_seq | sequence | up2108121
12 public | product        | table | up2108121
13 public | product_prod_id_seq | sequence | up2108121
14 public | role           | table | up2108121
```

```

15 public | role_role_id_seq      | sequence | up2108121
16 public | staff                    | table    | up2108121
17 public | staff_staff_id_seq        | sequence | up2108121
18 (14 rows)

```

5. List just the tables

LANGUAGE: SQL

```
1 \dt
```

LANGUAGE: Unknown

```

1      List of relations
2 Schema |      Name      | Type  | Owner
3 -----+-----+-----+-----
4 public | category       | table | up2108121
5 public | cust_order     | table | up2108121
6 public | customer       | table | up2108121
7 public | manifest       | table | up2108121
8 public | product        | table | up2108121
9 public | role           | table | up2108121
10 public | staff          | table | up2108121
11 (7 rows)

```

The `\dt` command removes the sequences (which will be discussed further in a couple of weeks time).

6. Look at the structure of the role table.

LANGUAGE: SQL

```
1 \d role
```

LANGUAGE: Unknown

```

1 Table "public.role"
2 Column |      Type      | Collation | Nullable |      Default
3 -----+-----+-----+-----+-----
4 role_id | integer        |           | not null | nextval('role_role_id_seq'::regclass)
5 role_name | character varying(20) |           |          |
6 Indexes:
7   "role_pkey" PRIMARY KEY, btree (role_id)
8 Referenced by:
9   TABLE "staff" CONSTRAINT "staff_role_fkey" FOREIGN KEY (role) REFERENCES role(role_id)

```

Using SQL To Access Data

Most of the commands used so far are PostgreSQL specific commands (these are the ones which begin with `\`).

If the output from a command is too long, PostgreSQL will show a colon (:) at the bottom of the screen. To show the next screen, press the space bar. Once all the records have been seen, the screen will show (END). At this point, hit `q` to exit back to the prompt. `q` can also be pressed at the colon to exit back to the prompt from there too.

1. Read all the records in the `dsd_22` table category.

LANGUAGE: SQL

```
1 SELECT * FROM CATEGORY;
```

LANGUAGE: Unknown

```
1 cat_id | cat_name
2 -----+-----
3      1 | Men's Wear
4      2 | Ladies Wear
5      3 | Kid's Wear
6      4 | Outdoor
7      5 | Sport
8      6 | Health
9 (6 rows)
```

2. Run the following command and see if the output is different.

LANGUAGE: SQL

```
1 select * from category;
```

LANGUAGE: Unknown

```
1 cat_id | cat_name
2 -----+-----
3      1 | Men's Wear
4      2 | Ladies Wear
5      3 | Kid's Wear
6      4 | Outdoor
7      5 | Sport
8      6 | Health
9 (6 rows)
```

3. Run the following command, and see if the output is different.

LANGUAGE: SQL

```
1 select * from 'Category';
```

LANGUAGE: Unknown

```
1 ERROR:  syntax error at or near "'Category'"
2 LINE 1: select * from 'Category';
3      ^
```

4. Run the following command and see if the output is different.

LANGUAGE: SQL

```
1 select * from "Category";
```

LANGUAGE: Unknown

```
1 ERROR:  relation "Category" does not exist
2 LINE 1: select * from "Category";
3      ^
```

5. Run the following command and see if the output is different.

LANGUAGE: SQL

```
1 select * from 'category';
```

LANGUAGE: Unknown

```

1 ERROR:  syntax error at or near "'category'"
2 LINE 1: select * from 'category';
3

```

6. Run the following command and see if the output is different.

LANGUAGE: SQL

```

1 select * from "category";

```

LANGUAGE: Unknown

```

1 cat_id |  cat_name
2 -----+-----
3      1 | Men's Wear
4      2 | Ladies Wear
5      3 | Kid's Wear
6      4 | Outdoor
7      5 | Sport
8      6 | Health
9 (6 rows)

```

7. Run the \dt command again, look at the case of the table names.

8. Run the following command (nb, this is supposed to contain non-standard quote marks as copied from the Google Doc).

LANGUAGE: SQL

```

1 SELECT * FROM "category";

```

LANGUAGE: Unknown

```

1 ERROR:  relation "'category'" does not exist
2 LINE 1: SELECT * FROM "category";

```

From these exercises, it is clear that case doesn't matter when the table name is not in quotes; and that the type of quotes used matter (there are extensions available for Google Docs which allow code to be stored in them and for it to keep its formatting).

Table Structure

To see how tables are linked together, it is possible to view the table structures. This information tells you how the attributes are linked together and what the data types and sizes of said data types are (where this is applicable).

1. Run the following command.

LANGUAGE: SQL

```

1 \d customer

```

LANGUAGE: Unknown

```

1 Table "public.customer"
2 Column | Type | Collation | Nullable | Default
3

```



```

4  cust_id      | integer          |          | not null | nextval('customer_cust_id_seq'::
   ↪ regclass)
5  cust_fname  | character varying(25) |          | not null |
6  cust_lname  | character varying(35) |          | not null |
7  addr1       | character varying(50) |          | not null |
8  addr2       | character varying(50) |          |          |
9  town        | character varying(60) |          | not null |
10 postcode   | character(9)         |          | not null |
11 email       | character varying(255) |          | not null |
12 Indexes:
13   "customer_pkey" PRIMARY KEY, btree (cust_id)
14 Referenced by:
15   TABLE "cust_order" CONSTRAINT "cust_order_cust_id_fkey" FOREIGN KEY (cust_id) REFERENCES
   ↪ customer(cust_id)

```

From the output, we can see that the data type of `cust_id` is integer and the data type of `postcode` is a fixed 9 length character.

Creating new Tables in SQL

The syntax for creating a table (or relation, if we're being proper) is shown below.

```

LANGUAGE: SQL
1 CREATE TABLE tableName(
2   attributeName dataType (options),
3   attributeName dataType (options),
4   ...
5 );

```

Task

1. Create a new database with a name of your choice.
2. Connect to the database.
3. Create a new table with two attributes (one of data type INT, that is also the primary key and one that has a data type of your own choosing).

```

LANGUAGE: SQL
1 CREATE DATABASE week02;
2
3 CREATE TABLE NEWTABLE(
4   IAMNUMBER INT PRIMARY KEY,
5   IAMSTRING VARCHAR(10)
6 );

```

Now, insert a record into the table.

```

LANGUAGE: SQL
1 INSERT INTO NEWTABLE (IAMNUMBER, IAMSTRING) VALUES(12, 'cheese');

```

Now, insert another new record into the table, using the same INT value as the first record. Take note of the message which is displayed.



LANGUAGE: SQL

```
1 INSERT INTO NEWTABLE (IAMNUMBER, IAMSTRING) VALUES(12, 'ham');
```

LANGUAGE: Unknown

```
1 ERROR:  duplicate key value violates unique constraint "newtable_pkey"  
2 DETAIL:  Key (iamnumber)=(12) already exists.
```

LECTURE: DATABASE CONCEPTS

 13-10-22 13:00 Mark RB LT1

Despite the fact that the relational database model was designed by Codd in the 1970s, it is a valid system and used widely.

Key Terms

Database Term	Description
Entity	An object or a 'thing' about which data is stored.
Attributes	Some quality associated with the entity (eg ID number, username, size). These have data types (eg number, string etc) and maximum sizes. Other terms are elements and properties.
Relation	A two dimensional representation (table) of entities and/ or relationships. Other terms used are relation table or table.
Entity Set	A set of entities of the same type.
Relationship	How two relations (tables) are related to each other. Relationships are represented in relations.
Tuple	Corresponds to rows of the table or records of a relation. Other terms used are record and row.
Domain	A pool of all legal values from which actual attribute values are drawn.
Primary Key	An attribute or combination of attributes for which values uniquely identify tuples in the relation. The primary key is chosen from a set of candidate keys. If you have a numeric value which the system can generate, let it do it for you.
Candidate Key	There may be more than one potential primary keys for a relation. Each is called a candidate key or super-key.
Alternate Key	An alternate access path to data that is not via the primary key.
Composite Key	A combination of attributes that act as a candidate key in a relation. Each participating attribute in the composite key (also known as candidate key) is called a simple key.
Foreign Key	An attribute (or combination of attributes) that is a primary key in another relation. They can appear many times.
Degree	Number of attributes in a relation; also called the arity.

When designing a database, the first thing you need to think about is what entities do you need to store information about. Then think about the attributes which you need to store about each entity. Then create relations. At this point, think about the domain for any of the attributes (for example, month 1-12 or day 0-6 (Sunday to Saturday) or hours 0-23). Now think about keys.

Entity

An entity is a thing, it could be a person or a specific type of person.

To identify entities, look at the information given to you and identify the nouns. The nouns give an idea of what the entities look like but they require fine tuning.

There can be as many entities as needed.

We can describe entities using their attributes.

We now think about keys.



Primary Key

To identify what will be a primary key, we look for something that is unique. This should be something which cannot be changed. If there is nothing suitable, create your own primary key.

Foreign key

Does not have to be primary key in other table, however it has to be unique within the other table.

PRACTICAL: COUNT()

 13-10-22 14:00 Mark and team FTC Floor 3

Q1. using the `count()` function demonstrated by your tutor, how many records are there in each of the tables in the `dsd_22` database. (Remember to use `\dt` to give you a list of tables in the database.) Copy the outputs below.

```
LANGUAGE: Unknown
1 dsd_22=# select count(*) from category;
2 count
3 -----
4      6
5 (1 row)
6 dsd_22=# select count(*) from cust_order;
7 count
8 -----
9    150
10 (1 row)
11 dsd_22=# select count(*) from customer;
12 count
13 -----
14     11
15 (1 row)
16 dsd_22=# select count(*) from manifest;
17 count
18 -----
19    150
20 (1 row)
21
22 dsd_22=# select count(*) from product;
23 count
24 -----
25    100
26 (1 row)
27
28 dsd_22=# select count(*) from role;
29 count
30 -----
31      5
32 (1 row)
33
34 dsd_22=# select count(*) from staff;
35 count
36 -----
37     10
38 (1 row)
```

Q2. Use the `max()` function to find the highest value of the `role_id` attribute in the `role` table. Copy the output below

```
LANGUAGE: SQL
1 select max(role_id) from role;
```

```
LANGUAGE: Unknown
1 max
2 ----
3    5
4 (1 row)
```

Q3. Insert a new row of data into the `role` table with

LANGUAGE: SQL

```
1 INSERT INTO ROLE (ROLE_NAME) VALUES ('Pre Sales');
```

Q4. How many rows of data are now in the role table? Copy it below.

LANGUAGE: SQL

```
1 select count(*) from role;
```

LANGUAGE: Unknown

```
1 count
2 -----
3      6
4 (1 row)
```

Q5. What is the maximum value of the role_id now? Copy it below.

LANGUAGE: SQL

```
1 select max(role_id) from role;
```

LANGUAGE: Unknown

```
1 max
2 -----
3      6
4 (1 row)
```

Q6. Delete this new row with

LANGUAGE: SQL

```
1 DELETE FROM ROLE WHERE ROLE_NAME = 'Pre Sales';
```

LANGUAGE: Unknown

```
1 DELETE 1
```

Q7. How many rows of data are now in the role table? Copy it below.

LANGUAGE: Unknown

```
1 count
2 -----
3      5
4 (1 row)
```

Q8. What is the maximum value of the role_id now? Copy it below.

LANGUAGE: Unknown

```
1 max
2 -----
3      5
4 (1 row)
```

Q9. Reinsert the row of data into the role table again with

LANGUAGE: SQL

```
1 INSERT INTO ROLE (ROLE_NAME) VALUES ('Cleaning Team');
```

LANGUAGE: Unknown

```
1 INSERT 0 1
```

Q10. How many rows of data are now in the role table? Copy it below.

LANGUAGE: Unknown

```
1 count
2 -----
3          6
4 (1 row)
```

Q11. What is the maximum value of the role_id now? Copy it below.

LANGUAGE: Unknown

```
1 max
2 ----
3          6
4 (1 row)
```

Q12. Create a random value using the random function. Copy the value below

LANGUAGE: SQL

```
1 SELECT RANDOM();
```

LANGUAGE: Unknown

```
1          random
2 -----
3 0.175315219908953
4 (1 row)
```

Q12a. Create another random number. Copy the value below

LANGUAGE: SQL

```
1 SELECT RANDOM();
```

LANGUAGE: Unknown

```
1          random
2 -----
3 0.272884896956384
4 (1 row)
```

Q13. Create one more random value but now multiply it by 11. Remember that to multiply you do not use x but use the * symbol. Run this code 5 times and copy the values below.

LANGUAGE: Unknown

```
1 dsd_22=# select random()*11;
2          ?column?
```

```

3 -----
4 9.60335403773934
5 (1 row)
6 dsd_22=# select random()*11;
7      ?column?
8 -----
9 0.160588529892266
10 (1 row)
11
12 dsd_22=# select random()*11;
13      ?column?
14 -----
15 5.25661591161042
16 (1 row)
17
18 dsd_22=# select random()*11;
19      ?column?
20 -----
21 7.78145408304408
22 (1 row)
23 dsd_22=# select random()*11;
24      ?column?
25 -----
26 10.1819118564017
27 (1 row)

```

Q14. Connect to your home database, upxxxxxxx and run the following code to create a new table and insert some random numbers into it.

LANGUAGE: SQL

```

1 create table numb1(numb_id int primary key, ran_val decimal(17,15));
2
3 insert into numb1(numb_id, ran_val) values
4 (1,random()),(2,random()),(3,random()),(4,random()),(5,random()),(6,random()),(7,random()),(8,
   ↪ random()),(9,random()),(10,random());

```

LANGUAGE: Unknown

```

1 INSERT 0 10

```

Q14a. Check that there are 10 rows of data with `SELECT COUNT(*) FROM NUMB1;` If not, check your output for any error messages. You should get responses below except the prompt will be your student id number.

LANGUAGE: Unknown

```

1 count
2 -----
3      10
4 (1 row)

```

Q15. Run a `SELECT * FROM NUMB1;` Copy the output below.

LANGUAGE: Unknown

```

1  numb_id |      ran_val
2  -----+-----
3       1 | 0.481754711363465
4       2 | 0.020102311857045
5       3 | 0.541421711910516
6       4 | 0.046512784436345
7       5 | 0.842869907151908
8       6 | 0.137599688488990
9       7 | 0.925696460530162
10      8 | 0.765472991392016
11      9 | 0.712954005226493

```



```

12      10 | 0.161490791942924
13 (10 rows)

```

Q15a. Compare the values that you get with the values below. They should be different. This is because the code used inserts a fixed value, the numb_id and a completely random value into the ran_val attribute for each row.

```

LANGUAGE: Unknown
1 test_num=# SELECT * FROM NUMB1;
2 numb_id |      ran_val
3 -----+-----
4      1 | 0.477631121408194
5      2 | 0.978080025874078
6      3 | 0.516494689509273
7      4 | 0.849129045847803
8      5 | 0.484937957022339
9      6 | 0.895700289402157
10     7 | 0.852438564877957
11     8 | 0.727535046637058
12     9 | 0.062769805546850
13    10 | 0.594313766807318
14 (10 rows)

```

Q16. Find the highest value of ran_val using the max() function. Copy it below.

```

LANGUAGE: SQL
1 select max(ran_val) from numb1;

```

```

LANGUAGE: Unknown
1      max
2 -----
3 0.925696460530162
4 (1 row)

```

Q17. Find the lowest value of ran_val using the min() function. Copy it below.

```

LANGUAGE: SQL
1 select min(ran_val) from numb1;

```

```

LANGUAGE: Unknown
1      min
2 -----
3 0.020102311857045
4 (1 row)

```

Q18. What is the average value of ran_val. Reminder: look at the basic functions document for ideas.

```

LANGUAGE: SQL
1 select avg(ran_val) from numb1;

```

```

LANGUAGE: Unknown
1      avg

```

```
2 -----
3 0.46358753642998640000
4 (1 row)
```

Q19. What is the current timestamp on your server? Copy it below

LANGUAGE: SQL

```
1 select now();
```

LANGUAGE: Unknown

```
1          now
2 -----
3 2022-10-13 13:43:49.196518+00
4 (1 row)
```

Q20. What is the first name of the customer with the ID number of 3?

LANGUAGE: SQL

```
1 select cust_fname from customer where cust_id=3;
```

LANGUAGE: Unknown

```
1 cust_fname
2 -----
3 Penelope
4 (1 row)
```

Q21. What is the category id number of the outdoor category? Copy below.

LANGUAGE: SQL

```
1 select cat_id from category where cat_name='Outdoor';
```

LANGUAGE: Unknown

```
1 cat_id
2 -----
3      4
4 (1 row)
```

Q22. How many orders in the cust_order table are for cust_id 15? Copy below.

LANGUAGE: SQL

```
1 select count(*) from cust_order where cust_id=15;
```

LANGUAGE: Unknown

```
1 count
2 -----
3      0
4 (1 row)
```

Q23. List the first and last names of the staff members who live in Portsmouth. Copy below.

LANGUAGE: SQL

```
1 select staff_fname, staff_lname from staff where town='Portsmouth';
```

LANGUAGE: Unknown

```
1 staff_fname | staff_lname
2 -----+-----
3 Niel       | Welsby
4 Janeva     | Gillicuddy
5 (2 rows)
```

Q24. What values does addr1 and addr2 have for the staff member whose id = 4? Copy below.

LANGUAGE: SQL

```
1 select addr1 , addr2 from staff where staff_id=4;
```

LANGUAGE: Unknown

```
1 addr1      | addr2
2 -----+-----
3 959 Algoma Plaza |
4 (1 row)
```

Q25. How many members of staff have the role value of 3? Copy below.

LANGUAGE: SQL

```
1 select count(*) from staff where role=3;
```

LANGUAGE: Unknown

```
1 count
2 -----
3      3
4 (1 row)
```

Q26. How many products are in the product category = 2?

LANGUAGE: SQL

```
1 select count(*) from product where prod_id=2;
```

LANGUAGE: Unknown

```
1 count
2 -----
3      1
4 (1 row)
```

LECTURE: COURSEWORK & ENTITY RELATIONSHIP DIAGRAMS

📅 20-10-22

🕒 13:00

🎓 Mark

📍 RB LT1

Coursework

Coursework

The coursework is now available on Moodle, within Assessment and Support Materials.

The deadline for the coursework isn't until February.

It is recommended to submit the files to Moodle well in advance of the deadline because there is a chance there will be a technical issue with Moodle when the deadline is, no extenuating circumstances will be given if this is the case.

The Entity Relationship Diagram submitted must be produced digitally, hand drawn diagrams will gain 0 credits.

Mark uses Mocakroo and Lucid Charts for generating dummy data and drawing ERDs respectively. This is what works well for him, there are other platforms available for both, with more information in the Coursework document.

Entity Relationship Diagrams

Entity Relationship Diagrams (ERDs) are diagrams which show how entities are related, down to the detail of what the attributes are and how they relate to each other as well.

Business Rules

When designing databases, business rules will be taken into consideration.

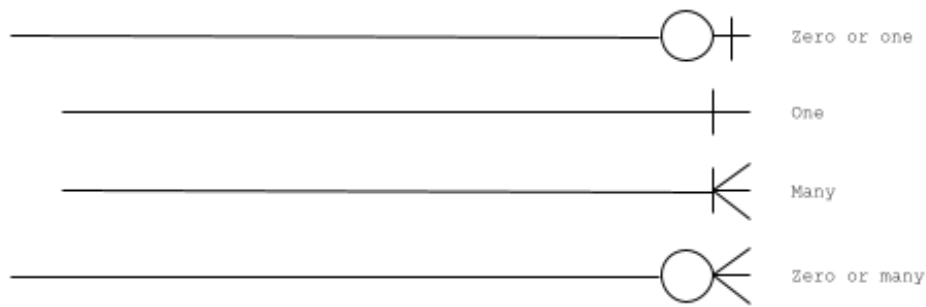
Business Rules

A statement that defines how a company does stuff or how stuff works within a company.

We can use business rules to help guide us on how to design databases.

Relationship Links

We will be using Crows Foot Notation, there are a number of other types of notation however we won't look at any of these.



Crow's feet notation

When designing entities, it is important to name them in the singular, for example `pig` not `pigs`, and to use underscore notation where multiple words comprise the entity name, not camel notation.

Many-to-many relationships are not permitted. We will return to this in a future lecture.

Constraints

Constraint

A rule that protects your data or enforces certain behaviour.

For example, a constraint may be set to be `NOT NULL`, this would ensure that whenever a row of data is inserted into a table, that attribute would have to contain data.

Keys are constraints. The primary key is automatically set to be `NOT NULL`, we do not have to specify that when creating a table. We could use a default constraint, to specify the time that a record was entered into a table.

Check constraints can be used to validate data as it is entered, for example a price must contain two decimal places. Check may be needed as part of the coursework.

PRACTICAL: SQL AND ENTITIES

📅 20-10-22

🕒 14:00

🎓 Mark & Team

📍 FTC 3rd Floor

Task 1: Run the provided code and observe the outputs.

Run the following DDL code.

```
LANGUAGE: SQL
1 CREATE DATABASE customer_db;
2
3 \c customer_db
4
5 CREATE TABLE customer1 (cust_id SERIAL PRIMARY KEY, cust_fname VARCHAR(20) NOT NULL, cust_lname
   ↪ VARCHAR(20) NOT NULL);
6
7 \d customer1
8
9 ALTER TABLE customer1 ADD COLUMN cust_email varchar(100) NOT NULL UNIQUE;
10
11 \d customer1
12
13 DROP TABLE customer1;
14
15 -- check that the table is gone now
16
17 -- anything in the line after the two dashes is a comment by the way
18
19 \l
20 \d customer1
```

Run the following DML code.

Creating a new table and populating it with some dummy data.

```
LANGUAGE: SQL
1 CREATE TABLE customer (cust_id SERIAL PRIMARY KEY, cust_fname VARCHAR(20) NOT NULL, cust_lname
   ↪ VARCHAR(20) NOT NULL, cust_email varchar(60) NOT NULL);
2
3 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (22, 'Kamil', 'Novak',
   ↪ 'kamnovak@gmail.com');
4
5 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (66, 'Aarav', 'Anand',
   ↪ 'aanand98@gmail.com');
6
7 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (67, 'Alia', 'Anand',
   ↪ 'aanand98@gmail.com');
```

Viewing what is in the table

```
LANGUAGE: SQL
1 SELECT * FROM customer;
2
3 SELECT cust_fname, cust_email from customer;
```

Selecting only the attributes which we need, so we don't have to retrieve all of the data from a table.

```
LANGUAGE: SQL
1 SELECT cust_email, cust_id, cust_fname, cust_lname from customer;
```

Insert more records, some of these return errors.

```
LANGUAGE SQL

1 UPDATE customer SET cust_email = 'i_love_elephants_1@gmail.com' where cust_id = 66;
2 SELECT * FROM customer;
3
4 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (67,'Alia', 'Anand','
    ↳ aanand98@gmail.com');
5
6 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (70,'Connor', 'Murphy
    ↳ ','connormurphy99@gmail.com');
7
8 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (71,'Connor', 'Murphy
    ↳ ','connormurphy199@gmail.com');
9
10 INSERT INTO customer (cust_id, cust_fname, cust_lname, cust_email) VALUES (1,'Tim', 'Nice-but-
    ↳ Dimm','alongemailaddresswillfit@quitealongdomainnametoo.com');
11
12 INSERT INTO customer ( cust_fname, cust_lname, cust_email) VALUES ('Tim', 'Nice-but-Dimm','
    ↳ averylongemailaddresswillnotfit11111111111111111111111111111111111111111111a@quitealongdomainnametoo
    ↳ .com');
```

Task 2: Write SQL code for the following questions.

1. Create a new database called `code_test`.

```
LANGUAGE: SQL
1 CREATE DATABASE code_test;
```

- ## 2. Connect to this new database

```
LANGUAGE: SQL
1 \c code_test
```

3. Create a new table called `table_one`, which has the following attributes

- Record_id an integer
- Att_1 a varchar that will hold upto 30 characters
- Att_2 a char that will hold 10 characters
- Att_3 a decimal that can hold the value of 9.99.

```
LANGUAGE: SQL
1 CREATE TABLE table_one(Record_id INT PRIMARY KEY, Att_1 VARCHAR(30), Att_2 CHAR(10), Att_3
  ↳ DECIMAL(3,2));
```

4. Look at the structure of this table once you have created it. Show the output below.

```
LANGUAGE: SQL
1 \d table one
```

```

1  Table "public.table_one"
2  Column |          Type          | Collation | Nullable | Default
3  -----+-----+-----+-----+-----

```

```

4 record_id | integer | | not null |
5 att_1     | character varying(30) | | |
6 att_2     | character(10) | | |
7 att_3     | numeric(3,2) | | |
8 Indexes:
9 "table_one_pkey" PRIMARY KEY, btree (record_id)

```

5. Alter the table by adding a new column called Att_4 that will hold another integer.

```

LANGUAGE: SQL
1 ALTER TABLE table_one ADD COLUMN Att_4 INT;

```

6. Look at the structure of this table again once you have added this new column. Show the output below.

```

LANGUAGE: SQL
1 \d table_one

```

```

LANGUAGE: Unknown
1
2          Table "public.table_one"
3  Column | Type | Collation | Nullable | Default
4 -----+-----+-----+-----+-----
5 record_id | integer | | not null |
6 att_1     | character varying(30) | | |
7 att_2     | character(10) | | |
8 att_3     | numeric(3,2) | | |
9 att_4     | integer | | |
10 Indexes:
11 "table_one_pkey" PRIMARY KEY, btree (record_id)

```

7. Insert two records into the table called table_one

(a) Record_id = 1, Att_1 = continent , Att2 = 0oIP\$fguj , Att_3 = 9.99 , Att_4 = 42

(b) Record_id = 2, Att_1 = Portsmouth University , Att2 = Violet , Att_3 = 9.99 , Att_4 = 9999

```

LANGUAGE: SQL
1 INSERT INTO table_one (Record_id, Att_1, Att_2, Att_3, Att_4) VALUES (1, 'continent', '0
   ↳ olP[dollarSign]fguj', 9.99, 42);
2 INSERT INTO table_one (Record_id, Att_1, Att_2, Att_3, Att_4) VALUES (2, 'Portsmouth
   ↳ University', 'Violet', 9.99, 9999);

```

8. Get all for the data from the table

```

LANGUAGE: SQL
1 SELECT * FROM table_one;

```

9. Get a screenshot of the data

```

LANGUAGE: Unknown
1 record_id | att_1 | att_2 | att_3 | att_4
2 -----+-----+-----+-----+-----
3 1 | continent | 0oIP[dollarSign]fguj | 9.99 | 42
4 2 | Portsmouth University | Violet | 9.99 | 9999
5 (2 rows)

```


10. Change the value of Att_4 in record 1 from 44 to 66

LANGUAGE: SQL

```
1 UPDATE table_one SET Att_4 = 66 WHERE record_id = 1;
```

11. Get the data from the table for only record 1

LANGUAGE: SQL

```
1 SELECT * FROM table_one WHERE record_id = 1;
```

12. Get a screenshot of the results.

LANGUAGE: Unknown

```
1 record_id | att_1 | att_2 | att_3 | att_4
2 -----+-----+-----+-----+-----
3 1 | continent | 0o1P[dollarSign]fguj | 9.99 | 66
4 (1 row)
```

LECTURE: ERD, ATTRIBUTES & DATATYPES

📅 27-10-22

🕒 13:00

🎓 RB LT1

📍 Mark

Attributes

An entity is a thing. The attributes, of an entity, are the things which describe the thing. We need to be able to identify individual entities.

Example: People

If we are having a person as an entity, the attributes we will probably need are: date of birth; given name; family name. There are attributes which we don't need to store (for example: weight, height).

Addresses

When we store people, we will usually store their address in their record. This will be explored when do normalisation after consolidation week.

GDPR

When we store data, we have to be sure we are being GDPR compliant and storing what you need to store.

GDPR states that you must ensure the personal data you are processing is:

- adequate - sufficient to properly fulfil your stated purpose;
- relevant - has a rational link to that purpose; and
- limited to what is necessary - you do not hold more than you need for that purpose.

Data Types

Now we know what attributes we need to store about the attribute, we need to think about types of data that is.

Names

Names are made up from characters, these could include apostrophes and hyphens. There is a question here as to how long names can be. A rule of thumb would be to use 20 characters for first name and 25 for surnames.

Numeric

There are a number of different numeric data types.

- `smallint` - holds an integer range -32768 to +32767
- `integer` - holds an integer range -2147483648 to +2147483647
- `bigint` - holds an integer range -9223372036854775808 to +9223372036854775807

- `decimal` - holds a decimal number with up to 131072 digits before the decimal point; up to 16383 digits after the decimal point
- `real` - similar to decimal but provides 6 decimal digits precision
- `double` - similar to real but provides 15 decimal digits precision
- `serial` - holds an integer range 1 to 2147483647
- `bigserial` - holds an integer range 1 to 9223372036854775807

Characters

There are a number of different character data types.

Phone numbers should be stored as a character not as a numeric data type as they will often have leading zeros.

- `text` - variable 'unlimited' length
- `character/ char` - fixed length (blank padding is added if less than given size)
- `varying character / varchar` - variable length with limit

Dates and Times

There are a number of different date/ time data types.

- `timestamp without timezone` - both date and time (no time zone) range 4713 BC to 294276 AD with 1 microsecond resolution
- `timestamp with timezone` - both date and time (with time zone) range 4713 BC to 294276 AD with 1 microsecond resolution
- `date` - date without time range 4713 BC to 5874897 AD with 1 day resolution
- `time without timezone` - time of day (no date) range 00:00:00 to 24:00:00 with 1 microsecond resolution
- `time with timezone` - time of day (no date), with time zone range 00:00:00 to 24:00:00 with 1 microsecond resolution and adjustment for time zone

Example of drawing up an entity

If we have a draft entity with the following attributes `cust_id`, `cust_name`, `addeess`, `email`. This presents a number of problems.

If we want to search for a specific name, this is more complicated because the customer name is stored as a single attribute where it should be multiple attributes.

Addresses should not be stored as a single attribute.

Break down data

We should break down information into usable data. For example, addresses should be broken down into: `address1`, `address2`, `town`, `county`, `postcode`, `country`.

Names should be broken down into `firstName`, `lastName`. It could also be argued that a single middle name could also be included.



Adding data types

- cust_id - int
- cust_fname - varchar
- cust_mname - varchar
- cust_lname - varchar
- addr1 - varchar
- addr2 - varchar
- town - varchar
- postcode - char (could be a varchar)
- email - varchar

Sizes of data types

Now we have worked out what data types we want to use, we need to think about the sizes of those data types.

LECTURE: NORMALISATION

 10-11-22 13:00 Mark RB LT1

Introduction to Normalisation

Normalisation is the process of designing a database in a way that reduces data redundancy and makes the database more efficient. As part of doing this, we have set rules to follow which enables us to decide what is stored in an entity and then within a table. There are five levels of normalisation, information which has not been normalised is in zero form and a database that has been normalised will be in 3rd normal form.

First Normal Form

Rules for a table to be in 1NF:

- It should only have single (atomic) valued attributes/ columns (each column should not hold more than one value)
- Values stored in a column should be of the same domain (this means don't hold char data in one row and int in another, both in the same columns)
- All the columns in a table should have unique names (there cannot be two or more columns or attributes with the same name)
- The order in which data is stored doesn't matter

Whilst converting data to the first normal form, you may find that a new entity is created. This can be done to reduce data redundancy.

Second Normal Form

Rules for a table to be in 2NF:

- Be in 1NF
- Have no partial dependencies

A partial dependency is where part of an attribute can be identified by something other than the primary key.



Third Normal Form

Rules for a table to be in 3NF:

- Be in 2NF
- Not have transitive dependencies

A transitive dependency is a n attribute which is dependent on an attribute which is not the primary key.

PRACTICAL: KEYS & JOINS

 10-11-22 14:00 Mark and team FTC Floor 3

1. Connect to the `dsd_22` Database
2. Drop the `dsd_22` database using the code shown below and show the output below.

LANGUAGE: SQL

```
1 DROP DATABASE dsd_22;
```

LANGUAGE: Unknown

```
1 ERROR: cannot drop the currently open database
```

3. If you were unable to drop the database, how did you do it? Show your code below.

LANGUAGE: SQL

```
1 \c up2108121
2 DROP DATABASE dsd_22;
```

LANGUAGE: Unknown

```
1 DROPPED DATABASE
```

4. Create the table but do not create any table of contents

LANGUAGE: SQL

```
1 CREATE DATABASE dsd_22;
```

5. Exit Postgres client but don't close connection to the VM
6. Download the code from Moodle
7. Use SCP through the terminal to copy the file to the virtual machine
8. Run the code to populate the database
9. Connect to the `dsd_22` database.
10. Check that the tables have been created with the `\dt` command and to check that there is data in each of them, select the number of rows in each table.

LANGUAGE: Unknown

```
1 SELECT COUNT(*) FROM category;
2 count
3 -----
4      6
5 (1 row)
6
7 SELECT COUNT(*) FROM cust_order;
8 count
9 -----
10    150
```

```

11 (1 row)
12
13 SELECT COUNT(*) FROM customer;
14    count
15 -----
16      11
17 (1 row)
18
19 SELECT COUNT(*) FROM manifest;
20    count
21 -----
22     150
23 (1 row)
24
25 SELECT COUNT(*) FROM product;
26    count
27 -----
28     100
29 (1 row)
30
31 SELECT COUNT(*) FROM role;
32    count
33 -----
34      5
35 (1 row)
36
37 SELECT COUNT(*) FROM staff;
38    count
39 -----
40     10
41 (1 row)

```

11. Get a printout of the structure of each table by using the \d command.

```

LANGUAGE: Unknown
1 \d category
2    Table "public.category"
3 Column |          Type          | Collation | Nullable |          Default
4 -----+-----+-----+-----+-----
5
6 cat_id | integer                |           | not null | nextval('category_cat_id_seq'::
7         ↳ regclass)
8 cat_name | character varying(40) |           |         |
9 Indexes:
10 "category_pkey" PRIMARY KEY, btree (cat_id)
11 Referenced by:
12   TABLE "product" CONSTRAINT "product_prod_cat_fkey" FOREIGN KEY (prod_cat) REFERENCES
13     ↳ category(cat_id)
14
15 \d cust_order
16    Table "public.cust_order"
17 Column | Type | Collation | Nullable |          Default
18 -----+-----+-----+-----+-----
19
20 cust_ord_id | integer |           | not null | nextval('cust_order_cust_ord_id_seq'::
21         ↳ regclass)
22 staff_id | integer |           |         |
23 cust_id | integer |           |         |
24 Indexes:
25 "cust_order_pkey" PRIMARY KEY, btree (cust_ord_id)
26 Foreign-key constraints:
27 "cust_order_cust_id_fkey" FOREIGN KEY (cust_id) REFERENCES customer(cust_id)
28 "cust_order_staff_id_fkey" FOREIGN KEY (staff_id) REFERENCES staff(staff_id)
29 Referenced by:
30   TABLE "manifest" CONSTRAINT "manifest_cust_ord_id_fkey" FOREIGN KEY (cust_ord_id)
31     ↳ REFERENCES cust_order(cust_ord_id)
32
33 \d customer
34    Table "public.customer"
35 Column |          Type          | Collation | Nullable |          Default
36 -----+-----+-----+-----+-----
37

```

```

32      ↪
33 cust_id      | integer                |                | not null | nextval('customer_cust_id_seq'
34      ↪ '::regclass)
35 cust_fname  | character varying(25) |                | not null |
36 cust_lname  | character varying(35) |                | not null |
37 addr1       | character varying(50) |                | not null |
38 addr2       | character varying(50) |                |          |
39 town        | character varying(60) |                | not null |
40 postcode    | character(9)           |                | not null |
41 email       | character varying(255) |                | not null |
42 Indexes:
43 "customer_pkey" PRIMARY KEY, btree (cust_id)
44 Referenced by:
45 TABLE "cust_order" CONSTRAINT "cust_order_cust_id_fkey" FOREIGN KEY (cust_id) REFERENCES
46      ↪ customer(cust_id)
47
48 \d manifest
49      Table "public.manifest"
50 Column      | Type      | Collation | Nullable |          Default
51 -----
52      ↪
53 manifest_id | integer   |           | not null | nextval('manifest_manifest_id_seq'::
54      ↪ regclass)
55 cust_ord_id | integer   |           | not null |
56 prod_id     | integer   |           | not null |
57 Indexes:
58 "manifest_pkey" PRIMARY KEY, btree (manifest_id)
59 Foreign-key constraints:
60 "manifest_cust_ord_id_fkey" FOREIGN KEY (cust_ord_id) REFERENCES cust_order(cust_ord_id)
61 "manifest_prod_id_fkey" FOREIGN KEY (prod_id) REFERENCES product(prod_id)
62
63 \d product
64      Table "public.product"
65 Column      | Type      | Collation | Nullable |          Default
66 -----
67      ↪
68 prod_id     | integer   |           | not null | nextval('product_prod_id_seq'::
69      ↪ regclass)
70 prod_name   | character varying(50) |           | not null |
71 prod_cat    | integer   |           | not null |
72 Indexes:
73 "product_pkey" PRIMARY KEY, btree (prod_id)
74 Foreign-key constraints:
75 "product_prod_cat_fkey" FOREIGN KEY (prod_cat) REFERENCES category(cat_id)
76 Referenced by:
77 TABLE "manifest" CONSTRAINT "manifest_prod_id_fkey" FOREIGN KEY (prod_id) REFERENCES
78      ↪ product(prod_id)
79
80 \d role
81      Table "public.role"
82 Column      | Type      | Collation | Nullable |          Default
83 -----
84      ↪
85 role_id     | integer   |           | not null | nextval('role_role_id_seq'::
86      ↪ regclass)
87 role_name   | character varying(20) |           |          |
88 Indexes:
89 "role_pkey" PRIMARY KEY, btree (role_id)
90 Referenced by:
91 TABLE "staff" CONSTRAINT "staff_role_fkey" FOREIGN KEY (role) REFERENCES role(role_id)
92
93 \d staff
94      Table "public.staff"
95 Column      | Type      | Collation | Nullable |          Default
96 -----
97      ↪
98 staff_id    | integer   |           | not null | nextval('staff_staff_id_seq

```



```

    ↪ '::regclass)
96 staff_fname | character varying(25) | | not null |
97 staff_lname | character varying(35) | | not null |
98 addr1       | character varying(50) | | not null |
99 addr2       | character varying(50) | | |
100 town        | character varying(60) | | not null |
101 postcode    | character(9) | | not null |
102 home_email  | character varying(255) | | not null |
103 work_email  | character varying(100) | | not null |
104 role        | integer | | not null |
105 Indexes:
106 "staff_pkey" PRIMARY KEY, btree (staff_id)
107 Foreign-key constraints:
108 "staff_role_fkey" FOREIGN KEY (role) REFERENCES role(role_id)
109 Referenced by:
110 TABLE "cust_order" CONSTRAINT "cust_order_staff_id_fkey" FOREIGN KEY (staff_id) REFERENCES
    ↪ staff(staff_id)#

```

12. Compare the printouts to the ERD found on Moodle.

13. Use the ERD to see which tables are related to which table.

14. How many rows of data do you get from the following:

```

LANGUAGE: SQL
1 Select * from product, category;

```

```

LANGUAGE: Unknown
1
2 prod_id | prod_name | prod_cat | cat_id |
3 ↪ cat_name
4 -----+-----+-----+-----+-----
5 1 | Multi-layered multi-tasking initiative | 2 | 1 | Men's
6 ↪ Wear
7 2 | Operative analyzing task-force | 1 | 1 | Men's
8 ↪ Wear
9 3 | Exclusive client-server array | 5 | 1 | Men's
10 ↪ Wear
11 4 | Balanced client-server product | 6 | 1 | Men's
12 ↪ Wear
13 5 | Exclusive background website | 5 | 1 | Men's
14 ↪ Wear
15 6 | Pre-emptive holistic intranet | 6 | 1 | Men's
16 ↪ Wear
17 7 | Re-engineered cohesive methodology | 1 | 1 | Men's
18 ↪ Wear
19 8 | Robust directional projection | 2 | 1 | Men's
20 ↪ Wear
21 9 | Inverse transitional infrastructure | 4 | 1 | Men's
22 ↪ Wear
23 10 | Multi-tiered explicit paradigm | 6 | 1 | Men's
24 ↪ Wear
25 ...
26 (600 rows)

```

15. Look at the printout for the question above and find the category of the product "Multi-layered multi-tasking initiative"

16. Use the following command to narrow down the search

```

LANGUAGE: SQL
1 select * from category, product where prod_name = 'Multi-layered multi-tasking initiative'
    ↪ ;

```

When we don't join tables properly, the output we are given is called a 'Cartesian Product'. This is bad.

17. Run the following code

LANGUAGE: SQL

```
1 select * from category
2 join product on category.cat_id = product.prod_cat;
```

LANGUAGE: Unknown

```
1 cat_id | cat_name | prod_id | prod_name |
2 -----+-----+-----+-----+
3      2 | Ladies Wear |      1 | Multi-layered multi-tasking initiative |
4      1 | Men's Wear |      2 | Operative analyzing task-force |
5      5 | Sport |      3 | Exclusive client-server array |
6      6 | Health |      4 | Balanced client-server product |
7      5 | Sport |      5 | Exclusive background website |
8      6 | Health |      6 | Pre-emptive holistic intranet |
9      1 | Men's Wear |      7 | Re-engineered cohesive methodology |
10     2 | Ladies Wear |      8 | Robust directional projection |
11     4 | Outdoor |      9 | Inverse transitional infrastructure |
12     6 | Health |     10 | Multi-tiered explicit paradigm |
13 ...
14 (100 rows)
```

18. How many rows are returned now.
100

19. Write the code to find the category information for the product "Multi-layered multi-tasking initiative"

LANGUAGE: SQL

```
1 select * from category
2 join product on category.cat_id = product.prod_cat
3 where prod_name = 'Multi-layered multi-tasking initiative';
```

LANGUAGE: Unknown

```
1 cat_id | cat_name | prod_id | prod_name | prod_cat
2 -----+-----+-----+-----+-----+
3      2 | Ladies Wear |      1 | Multi-layered multi-tasking initiative |      2
4 (1 row)
```

20. Run the following code

LANGUAGE: SQL

```
1 select count(*) from customer, cust_order;
```

This will connect every customer to every order stored in the `cust_order` table.

LANGUAGE: Unknown

```
1 count
2 -----
3 1650
4 (1 row)
```

21. Write a query that will display the customer's first name, their last name and the order numbers, stored in the `cust_order` table as the `cust_ord_id`, but only for the customer with the `cust_id` of 1. Copy the code and the printout below.

LANGUAGE: SQL

```
1 select customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id from customer
2 join cust_order on customer.cust_id = cust_order.cust_id
3 where cust_order.cust_id = 1;
```

LANGUAGE: Unknown

```
1 cust_fname | cust_lname | cust_ord_id
2 -----+-----+-----
3 Jobey      | Boeter    | 26
4 Jobey      | Boeter    | 34
5 Jobey      | Boeter    | 39
6 Jobey      | Boeter    | 57
7 Jobey      | Boeter    | 68
8 Jobey      | Boeter    | 71
9 Jobey      | Boeter    | 77
10 Jobey     | Boeter    | 91
11 Jobey     | Boeter    | 98
12 Jobey     | Boeter    | 99
13 Jobey     | Boeter    | 131
14 Jobey     | Boeter    | 143
15 Jobey     | Boeter    | 146
16 (13 rows)
```

22. Now try to see if you can add the `staff_fname`, the `staff_lname` to the above printout. You will need to join the `staff` table. Look at the ERD and the printout from to find the matching primary key and foreign key

LANGUAGE: SQL

```
1 select customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id, staff.staff_fname
2      ↗ , staff.staff_lname from customer
3 join cust_order on customer.cust_id = cust_order.cust_id
4 join staff on cust_order.staff_id = staff.staff_id
5 where cust_order.cust_id = 1;
```

LANGUAGE: Unknown

```
1 cust_fname | cust_lname | cust_ord_id | staff_fname | staff_lname
2 -----+-----+-----+-----+-----
3 Jobey      | Boeter    | 26 | Montgomery | Housegoe
4 Jobey      | Boeter    | 34 | Hanan       | Gloster
5 Jobey      | Boeter    | 39 | Hanan       | Gloster
6 Jobey      | Boeter    | 57 | Nikoletta   | Shrimpton
7 Jobey      | Boeter    | 68 | Montgomery  | Housegoe
8 Jobey      | Boeter    | 71 | Nikoletta   | Shrimpton
9 Jobey      | Boeter    | 77 | Hanan       | Gloster
10 Jobey     | Boeter    | 91 | Niel        | Welsby
11 Jobey     | Boeter    | 98 | Montgomery  | Housegoe
12 Jobey     | Boeter    | 99 | Janeva      | Gillicuddy
```

```

13 Jobey      | Boeter      |      131 | Aura        | Clewlowe
14 Jobey      | Boeter      |      143 | Janeva      | Gillicuddy
15 Jobey      | Boeter      |      146 | Montgomery  | Housegoe
16 (13 rows)

```

23. If you have got this far, try to get a printout that joins the `role` table, the `staff` table, the `cust_order` table and the `customer` table. Retrieve the roles of anyone who has worked on an order for `cust_id` of 4.

LANGUAGE: SQL

```

1 select customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id, staff.staff_fname
   ↪ , staff.staff_lname, role.role_id, role.role_name from customer
2 join cust_order on customer.cust_id = cust_order.cust_id
3 join staff on cust_order.staff_id = staff.staff_id
4 join role on staff.role = role.role_id
5 where customer.cust_id = 4;

```

LANGUAGE: Unknown

```

1 cust_fname | cust_lname | cust_ord_id | staff_fname | staff_lname | role_id |
   ↪ role_name
2 -----+-----+-----+-----+-----+-----+-----
3 Chadd      | Franz-Schoningher |      1 | Aura        | Clewlowe     |      3 | Post
   ↪ Sales
4 Chadd      | Franz-Schoningher |      7 | Aura        | Clewlowe     |      3 | Post
   ↪ Sales
5 Chadd      | Franz-Schoningher |     66 | Montgomery  | Housegoe     |      1 | Order
   ↪ Picker
6 Chadd      | Franz-Schoningher |     81 | Janeva      | Gillicuddy   |      5 | Misc
7 Chadd      | Franz-Schoningher |     93 | Niel        | Welsby       |      2 | Final
   ↪ Packer
8 Chadd      | Franz-Schoningher |     97 | Aura        | Clewlowe     |      3 | Post
   ↪ Sales
9 Chadd      | Franz-Schoningher |    107 | Hanan       | Gloster      |      4 |
   ↪ Customer Retain
10 Chadd      | Franz-Schoningher |    109 | Nikoletta   | Shrimpton    |      4 |
   ↪ Customer Retain
11 Chadd      | Franz-Schoningher |    124 | Aura        | Clewlowe     |      3 | Post
   ↪ Sales
12 Chadd      | Franz-Schoningher |    129 | Nikoletta   | Shrimpton    |      4 |
   ↪ Customer Retain
13 (10 rows)

```

LECTURE: JOINS AND NARROWING FOCUS

📅 17-11-22

🕒 13:00

🎓 Mark

📍 RB LT1

Introduction to Joins

Joins are key to understanding how to get useful information out of a database. Data in an individual table is of limited use, to get good data, we need to join multiple tables together. We might only want some information.

To get these individual items from one table, we can do this with

LANGUAGE: SQL

```
1 SELECT firstName, lastName, emailAddress FROM TABLE;
```

However, this will still return every record.

We can narrow this down, using the `WHERE=condition` clause. For example,

LANGUAGE: SQL

```
1 SELECT firstName, lastName, emailAddress WHERE town = 'Portsmouth';
```

This will give us all the records where the town attribute is equal to Portsmouth

What if we want to get data from multiple tables? Here we have to use Joins.

Joins

To create a join between two tables, one table needs to have a foreign key where that is the primary key in the other table you wish to join.

When creating joins between tables, it's important to ensure that the correct attributes in each table are joined. Just because a result is produced from the query, it doesn't necessarily mean it's the right one.

The data types between the two attributes which are being joined have to match whilst the names used in each table do not.

Cartesian Product

This is the result of a wrong join.

It is where every single record in one table is joined to every single record in another table. For example, two tables: customer and order. Customer has 11 records and order has 150. 150×11 gives 1650 rows as output. This provides a big problem when attempting to join two big tables together.

The Correct Way

When joining two tables correctly, we have to tell the DBMS what values match.

LANGUAGE: SQL

```
1 SELECT CUSTOMER.CUST_ID, CUST_ORD_ID FROM CUSTOMER JOIN cust_order ON CUSTOMER.CUST_ID =  
   ↳ CUST_ORDER.CUST_ID;
```

Query above returns 150 rows of data. We know this is correct as it is the same as the number of rows in orders table.

Another Correct Way

We do not have to use the `join` keyword, instead we can use the `WHERE` condition.

LANGUAGE: SQL

```
1 SELECT CUST_LNAME, CUST_ORD_ID FROM CUSTOMER, CUST_ORDER WHERE CUSTOMER.CUST_ID = CUST_ORDER.  
   ↪ CUST_ID;
```

This will happily produce 150 rows.

To join more than two tables, we have to use an `AND` statement in the `WHERE` condition.

PRACTICAL: NORMALISATIONS AND JOINS

📅 24-11-22

🕒 14:00

🎓 Val

📍 FTC Floor 3

Order of Execution

1. FROM & JOIN (chose and join tables to get base data)
2. WHERE & SUBQUERY/ INTERSECTION/ UNION/ EXCEPT (filters the base data)
3. GROUP BY (aggregates the base data)
4. HAVING (filters the aggregated ata)
5. SELECT (returns the final data, as functionality not displayed)
6. ORDER BY (sort the final data)
7. LIMIT (limits the returned data to a row count)
8. display data

Task 1

See Google Doc and Lucid Chart.

Task 2

1. Write a query to retrieve the first and last names of the customers in the customer table. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT cust_fname, cust_lname from customer;
```

LANGUAGE: Unknown

```
1  cust_fname | cust_lname
2  -----+-----
3  Jobey      | Boeter
4  York       | O'Deegan
5  Penelope   | Hexter
6  Chadd      | Franz-Schoninger
7  Vikky      | Eke
8  Marie-françoise | Currier
9  Bénédicte  | Dozdill
10 Görel      | Douthwaite
11 Bérengère   | Menendez
12 Pélagie    | Hachard
13 Adaobi     | Musa
14 (11 rows)
```

2. Write a query to retrieve the first and last names and the towns they live in of the customers in the customer table. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT cust_fname, cust_lname, town FROM customer;
```

LANGUAGE: Unknown

```

1  cust_fname | cust_lname | town
2  -----+-----+-----
3  Jobey      | Boeter     | La Mohammedia
4  York       | O'Deegan   | Chemnitz
5  Penelope   | Hexter     | Pingshan
6  Chadd      | Franz-Schoningner | Baojia
7  Vikky      | Eke        | Kamenný řPivoz
8  Marie-françoise | Currier    | Waekolong
9  Bénédicte  | Dozdill    | Dawuhan
10 Görel      | Douthwaite | Sunbu
11 Bérengère   | Menendez   | Tsagaanders
12 Pélagie     | Hachard    | Jiantou
13 Adaobi     | Musa       | La Mohammedia
14 (11 rows)
```

3. Print out the first and last name of the customer / customers who live in La Mohammedia. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT cust_fname, cust_lname FROM customer WHERE town= 'La Mohammedia';
```

LANGUAGE: Unknown

```

1  cust_fname | cust_lname
2  -----+-----
3  Jobey      | Boeter
4  Adaobi     | Musa
5  (2 rows)
```

4. Get the structure of the tables customer and cust_order using the \d command. Copy the code and the answer below.

LANGUAGE: Unknown

```

1 dsd_22=# \d customer
2
3          Table "public.customer"
4  Column | Type | Collation | Nullable | Default
5  -----+-----+-----+-----+-----
6  cust_id | integer |          | not null | nextval('customer_cust_id_seq'::
7  regclass)
8  cust_fname | character varying(25) |          | not null |
9  cust_lname | character varying(35) |          | not null |
10 addr1      | character varying(50) |          | not null |
11 addr2      | character varying(50) |          |          |
12 town       | character varying(60) |          | not null |
13 postcode   | character(9) |          | not null |
14 email      | character varying(255) |          | not null |
15
16 Indexes:
17   "customer_pkey" PRIMARY KEY, btree (cust_id)
18
19 Referenced by:
20   TABLE "cust_order" CONSTRAINT "cust_order_cust_id_fkey" FOREIGN KEY (cust_id) REFERENCES
21   customer(cust_id)
22
23 dsd_22=# \d cust_order
24
25          Table "public.cust_order"
26  Column | Type | Collation | Nullable | Default
27  -----+-----+-----+-----+-----
28
```



```

22 cust_ord_id | integer |          | not null | nextval('cust_order_cust_ord_id_seq'::regclass)
23 staff_id   | integer |          |          |
24 cust_id    | integer |          |          |
25 Indexes:
26   "cust_order_pkey" PRIMARY KEY, btree (cust_ord_id)
27 Foreign-key constraints:
28   "cust_order_cust_id_fkey" FOREIGN KEY (cust_id) REFERENCES customer(cust_id)
29   "cust_order_staff_id_fkey" FOREIGN KEY (staff_id) REFERENCES staff(staff_id)
30 Referenced by:
31   TABLE "manifest" CONSTRAINT "manifest_cust_ord_id_fkey" FOREIGN KEY (cust_ord_id)
   ↳ REFERENCES cust_order(cust_ord_id)

```

5. According to the answer from question 4, what are the names of the attributes in both tables that are the primary key and foreign keys? (hint - look at the section “Foreign-key constraints:” that appears in one of your outputs. Remember we are looking at customer and cust_order)

customer pk - cust_id

cust_order pk - cust_ord_id

cust_order fk - cust_id

cust_order fk - staff_id

6. List all of the categories. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT * FROM category;
```

LANGUAGE: Unknown

```

1  cat_id | cat_name
2  -----+-----
3       1 | Men's Wear
4       2 | Ladies Wear
5       3 | Kid's Wear
6       4 | Outdoor
7       5 | Sport
8       6 | Health
9 (6 rows)

```

7. What is the id number for the category Sport? Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT cat_id from category where cat_name='Sport';
```

LANGUAGE: Unknown

```

1  cat_id
2  -----
3       5
4 (1 row)

```

8. Write a query that joins the product table and the category table and prints out the prod_name and the appropriate category. Copy the query and the answer below. (You can copy the just first screen of data if you want)

LANGUAGE: SQL

```

1 SELECT product.prod_name, category.cat_name FROM product
2 JOIN category ON category.cat_id = product.prod_cat;

```

LANGUAGE: Unknown

1	prod_name	cat_name
2	-----+-----	
3	Multi-layered multi-tasking initiative	Ladies Wear
4	Operative analyzing task-force	Men's Wear
5	Exclusive client-server array	Sport
6	Balanced client-server product	Health
7	Exclusive background website	Sport
8	Pre-emptive holistic intranet	Health
9	Re-engineered cohesive methodology	Men's Wear
10	Robust directional projection	Ladies Wear
11	Inverse transitional infrastructure	Outdoor
12	Multi-tiered explicit paradigm	Health
13	...	
14	(100 rows)	

9. Write a query that will list each staff member's first and last name along with their work email and the role name that they hold. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT staff.staff_fname, staff.staff_lname, staff.work_email, role.role_name from staff
2 JOIN role ON staff.role = role.role_id;
```

LANGUAGE: Unknown

1	staff_fname	staff_lname	work_email	role_name
2	-----+-----+-----+-----			
3	Montgomery	Housegoe	Montgomery.Housegoe@dsd.com	Order Picker
4	Niel	Welsby	Niel.Welsby@dsd.com	Final Packer
5	Jillene	Revitt	Jillene.Revitt@dsd.com	Post Sales
6	Harriette	Fewster	Harriette.Fewster@dsd.com	Post Sales
7	Aura	Clewlowe	Aura.Clewlowe@dsd.com	Post Sales
8	Hanan	Gloster	Hanan.Gloster@dsd.com	Customer Retain
9	Nikoletta	Shrimpton	Nikoletta.Shrimpton@dsd.com	Customer Retain
10	Tim	Illem	Tim.Illem@dsd.com	Misc
11	Nell	Olsson	Nell.Olsson@dsd.com	Misc
12	Janeva	Gillicuddy	Janeva.Gillicuddy@dsd.com	Misc
13	(10 rows)			

10. Write a query that will show the last name and the role of staff members who put together orders from the customer whose last name is Eke. Include the cust_order_id and the customer's first and last names. Copy the query and the answer below.

LANGUAGE: SQL

```
1 SELECT staff.staff_lname, role.role_name, cust_order.cust_ord_id, customer.cust_fname, customer
   ↪ .cust_lname FROM staff
2 JOIN role ON staff.role = role.role_id
3 JOIN cust_order ON cust_order.staff_id = staff.staff_id
4 JOIN customer ON customer.cust_id = cust_order.cust_id
5 WHERE customer.cust_lname = 'Eke';
```

LANGUAGE: Unknown

1	staff_lname	role_name	cust_ord_id	cust_fname	cust_lname
2	-----+-----+-----+-----+-----				
3	Welsby	Final Packer	82	Vikky	Eke
4	Clewlowe	Post Sales	90	Vikky	Eke
5	Welsby	Final Packer	105	Vikky	Eke
6	Housegoe	Order Picker	115	Vikky	Eke
7	Gillicuddy	Misc	118	Vikky	Eke
8	Welsby	Final Packer	130	Vikky	Eke
9	Shrimpton	Customer Retain	132	Vikky	Eke
10	Welsby	Final Packer	135	Vikky	Eke

```

11 Housegoe | Order Picker | 145 | Vikky | Eke
12 (9 rows)

```

11. Write a query that lists only the category names and the customer's last names for orders that have been placed by people who live in Sunbu. Copy the query and answer below.

LANGUAGE: SQL

```

1 SELECT customer.cust_lname, category.cat_name FROM customer
2 JOIN cust_order ON customer.cust_id = cust_order.cust_id
3 JOIN manifest ON cust_order.cust_ord_id = manifest.cust_ord_id
4 JOIN product ON product.prod_id = manifest.prod_id
5 JOIN category ON category.cat_id = product.prod_cat
6 WHERE customer.town = 'Sunbu';

```

LANGUAGE: Unknown

```

1 cust_lname | cat_name
2 -----+-----
3 Douthwaite | Outdoor
4 Douthwaite | Sport
5 Douthwaite | Kid's Wear
6 Douthwaite | Outdoor
7 Douthwaite | Sport
8 Douthwaite | Sport
9 Douthwaite | Ladies Wear
10 Douthwaite | Outdoor
11 Douthwaite | Sport
12 Douthwaite | Ladies Wear
13 (10 rows)

```

12. This is a bit harder than the previous queries. Try to group the orders and count the number of orders in each category for the results from q11. (hint - this might be a bit difficult. Grouping does not allow a WHERE, use HAVING instead). Copy the query and answer below.

LANGUAGE: SQL

```

1 SELECT customer.cust_lname, count(category.cat_name), category.cat_name FROM customer
2 JOIN cust_order ON customer.cust_id = cust_order.cust_id
3 JOIN manifest ON cust_order.cust_ord_id = manifest.cust_ord_id
4 JOIN product ON product.prod_id = manifest.prod_id
5 JOIN category ON category.cat_id = product.prod_cat
6 GROUP BY customer.cust_lname, category.cat_name, customer.town
7 HAVING customer.town='Sunbu';

```

LANGUAGE: Unknown

```

1 cust_lname | count | cat_name
2 -----+-----+-----
3 Douthwaite | 1 | Kid's Wear
4 Douthwaite | 2 | Ladies Wear
5 Douthwaite | 3 | Outdoor
6 Douthwaite | 4 | Sport

```

LECTURE: TYPES OF JOINS

📅 01-12-22

🕒 13:00

🎓 Mark

📍 RB LT1

The joins we have looked at so far are **inner** joins. This displays the data where the tables overlap. For example

LANGUAGE: SQL

```
1 SELECT CUSTOMER.CUST_ID, CUST_ORDER.CUST_ORD_ID FROM CUSTOMER
2 JOIN CUST_ORDER ON CUSTOMER.CUST_ID=CUST_ORDER.CUST_ID;
```

Will probably use this the most.

Left Join

This will produce everything from the left table (**customer**) and the overlapping data from the right hand table (**cust_order**) where there is a match on the common attribute to both (**cust_id**)

LANGUAGE: SQL

```
1 SELECT CUSTOMER.CUST_ID, CUST_ORDER.CUST_ORD_ID FROM CUSTOMER
2 LEFT JOIN CUST_ORDER ON CUSTOMER.CUST_ID= CUST_ORDER.CUST_ID;
```

Right Join

This will return everything from the right table (**cust_order**) and common data where it is there.

LANGUAGE: SQL

```
1 SELECT CUSTOMER.CUST_ID, CUST_ORDER.CUST_ORD_ID FROM CUSTOMER
2 RIGHT JOIN CUST_ORDER ON CUSTOMER.CUST_ID= CUST_ORDER.CUST_ID;
```

It is important to use the correct join for the situation as when used incorrectly as you won't get the data returned which you are expecting.

Outer Joins

This gives everything from all the tables mentioned in the query.

LANGUAGE: SQL

```
1 SELECT role_name, staff_lname, staff_fname FROM staff FULL OUTER JOIN
2 ROLE ON ROLE=role_id;
```

Will probably use this the least.

Things To Remember

- Use the correct type of join for the job
- Match like for like

PRACTICAL: FURTHER JOINS

📅 01-12-22

🕒 14:00

🎓 Mark etc

📍 FTC 3

Tutor Led

We need to insert two more roles into the Role table.

LANGUAGE: SQL

```
1 INSERT INTO ROLE (role_name)
2 VALUES ('Cleaner');
3
4 INSERT INTO ROLE (role_name)
5 VALUES ('Pre Sales');
```

Then run the following.

LANGUAGE: SQL

```
1 SELECT count(*)
2 FROM ROLE;
```

This generates the following output

LANGUAGE: Unknown

```
1 count
2 -----
3      7
4 (1 row)
```

Student Tasks

1. Write a query that correctly displays the staff members first and last names, their email addresses and their roles. Use the method that uses the JOIN keyword. Copy the code and answer below.

LANGUAGE: SQL

```
1 SELECT staff.staff_fname, staff.staff_lname, staff.home_email, role.role_name FROM staff
2 JOIN role on staff.role = role.role_id;
```

LANGUAGE: Unknown

staff_fname	staff_lname	home_email	role_name
Montgomery	Housegoe	mhousegoe2@ucoz.ru	Order Picker
Niel	Welsby	nwelsby0@rambler.ru	Final Packer
Jillene	Revitt	jrevitt8@cornell.edu	Post Sales
Harriette	Fewster	hfewster7@independent.co.uk	Post Sales
Aura	Clewlowe	aclewlowe5@google.com.au	Post Sales
Hanan	Gloster	hgloster3@blogger.com	Customer Retain
Nikoletta	Shrimpton	nshrimpton1@unblog.fr	Customer Retain
Tim	Illem	tillem9@dedecms.com	Misc
Nell	Olsson	nolsson6@jiathis.com	Misc
Janeva	Gillicuddy	jgillicuddy4@altervista.org	Misc

(10 rows)

2. Rewrite the query created in 1 but this time use the WHERE keyword. Copy the code and answer below.

LANGUAGE: SQL

```
1 SELECT staff.staff_fname, staff.staff_lname, staff.home_email, role.role_name FROM staff, role
2 WHERE staff.role = role.role_id;
```

LANGUAGE: Unknown

staff_fname	staff_lname	home_email	role_name
Montgomery	Housegoe	mhousegoe2@ucoz.ru	Order Picker
Niel	Welsby	nwelsby0@rambler.ru	Final Packer
Jillene	Revitt	jrevitt8@cornell.edu	Post Sales
Harriette	Fewster	hfewster7@independent.co.uk	Post Sales
Aura	Clewlowe	aclewlowe5@google.com.au	Post Sales
Hanan	Gloster	hgloster3@blogger.com	Customer Retain
Nikoletta	Shrimpton	nshrimpton1@unblog.fr	Customer Retain
Tim	Illem	tillem9@dedecms.com	Misc
Nell	Olsson	nolsson6@jiathis.com	Misc
Janeva	Gillicuddy	jgillicuddy4@altervista.org	Misc

(10 rows)

3. List the customer first and last names with their email addresses and the product names of the products they have ordered. But only for the customers who live in Waekolong. Copy the code and the answer below.

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, customer.email, product.prod_name FROM
   ↳ customer
2 JOIN cust_order ON customer.cust_id=cust_order.cust_id
3 JOIN manifest ON cust_order.cust_ord_id=manifest.cust_ord_id
4 JOIN product on manifest.prod_id=product.prod_id
5 WHERE customer.town='Waekolong';
```

LANGUAGE: Unknown

cust_fname	cust_lname	email	prod_name
Marie-françoise	Currier	acurrier0@economist.com	Vision-oriented attitude-oriented
↳ core			
Marie-françoise	Currier	acurrier0@economist.com	Balanced client-server product
Marie-françoise	Currier	acurrier0@economist.com	Exclusive client-server array
Marie-françoise	Currier	acurrier0@economist.com	Universal encompassing conglomeration
Marie-françoise	Currier	acurrier0@economist.com	Synergistic homogeneous ability
Marie-françoise	Currier	acurrier0@economist.com	Universal exuding protocol
Marie-françoise	Currier	acurrier0@economist.com	Universal global hub
Marie-françoise	Currier	acurrier0@economist.com	Balanced real-time info-mediaries
Marie-françoise	Currier	acurrier0@economist.com	Integrated 24/7 interface
Marie-françoise	Currier	acurrier0@economist.com	Re-engineered explicit software
Marie-françoise	Currier	acurrier0@economist.com	Customizable cohesive capacity
Marie-françoise	Currier	acurrier0@economist.com	Robust mission-critical complexity
Marie-françoise	Currier	acurrier0@economist.com	Organic clear-thinking system engine
Marie-françoise	Currier	acurrier0@economist.com	Stand-alone composite Graphical User
↳ Interface			

(14 rows)

4. Write a query that returns all categories and the product names and order the output into category order. Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT category.cat_name, product.prod_name FROM category
2 JOIN product ON product.prod_cat = category.cat_id
3 ORDER BY category.cat_name;

```

LANGUAGE: Unknown

```

1  cat_name | prod_name
2  -----
3  Health   | Exclusive multimedia middleware
4  Health   | Pre-emptive holistic intranet
5  Health   | Ameliorated next generation orchestration
6  Health   | Monitored asynchronous function
7  Health   | Right-sized mission-critical pricing structure
8  Health   | Profound human-resource forecast
9  Health   | Realigned client-driven database
10 Health   | Seamless optimal leverage
11 Health   | User-friendly encompassing array
12 Health   | Customizable cohesive capacity
13 ...
14 (100 rows)

```

5. Rewrite the query for Q4 so that the output is ordered by category, then the product id. Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT category.cat_name, product.prod_name FROM category
2 JOIN product ON product.prod_cat = category.cat_id
3 ORDER BY category.cat_name, product.prod_id;

```

LANGUAGE: Unknown

```

1  cat_name | prod_name
2  -----
3  Health   | Balanced client-server product
4  Health   | Pre-emptive holistic intranet
5  Health   | Multi-tiered explicit paradigm
6  Health   | Monitored asynchronous function
7  Health   | Right-sized mission-critical pricing structure
8  Health   | Open-architected homogeneous concept
9  Health   | Fully-configurable full-range interface
10 Health   | Customizable cohesive capacity
11 Health   | Seamless optimal leverage
12 Health   | Realigned client-driven database
13 ...
14 (100 rows)

```

6. How can you prove that the product id is being used to do the ordering? (You may have already done this in Q5). Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT category.cat_name, product.prod_name, product.prod_id FROM category
2 JOIN product ON product.prod_cat = category.cat_id
3 ORDER BY category.cat_name, product.prod_id;

```

LANGUAGE: Unknown

```

1  cat_name | prod_name | prod_id
2  -----
3  Health   | Balanced client-server product | 4
4  Health   | Pre-emptive holistic intranet  | 6

```

```

5 Health      | Multi-tiered explicit paradigm           | 10
6 Health      | Monitored asynchronous function          | 20
7 Health      | Right-sized mission-critical pricing structure | 23
8 Health      | Open-architected homogeneous concept      | 37
9 Health      | Fully-configurable full-range interface   | 46
10 Health     | Customizable cohesive capacity           | 54
11 Health     | Seamless optimal leverage                | 57
12 Health     | Realigned client-driven database          | 59
13 ...
14 (100 rows)

```

7. Write a query that will list all staff members first and last names along with their email addresses that are cleaners. Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT staff.staff_fname, staff.staff_lname, staff.work_email FROM staff
2 JOIN role ON staff.role=role.role_id
3 WHERE role.role_name='Cleaner';

```

LANGUAGE: Unknown

```

1 staff_fname | staff_lname | work_email
2 -----+-----+-----
3 (0 rows)

```

8. How many staff are there who have the role Misc? Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT count(*) FROM staff
2 JOIN role ON staff.role = role.role_id
3 WHERE role.role_name='Misc';

```

LANGUAGE: Unknown

```

1 count
2 -----
3      3
4 (1 row)

```

9. What are the addresses of the staff that are returned by the query for Q8? You should output their first and last names too. Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT staff.staff_fname, staff.staff_lname, concat_ws(' ', addr1, addr2, town, postcode) AS "
   ↪ address"
2 FROM staff
3 JOIN role ON role.role_id = staff.role
4 WHERE role.role_name='Misc';

```

LANGUAGE: Unknown

```

1 staff_fname | staff_lname | address
2 -----+-----+-----
3 Janeva      | Gillicuddy  | 6999 Kings Park Sachtjen Portsmouth P005 5SF
4 Nell       | Olsson      | 18424 Kenwood Court Farmco Havant P022 6DL
5 Tim         | Illem       | 85 Lillian Way Farragut Southsea P093 0CN
6 (3 rows)

```


10. List the product id numbers with their names that start with the letters Re . Copy the code and the answer below.

LANGUAGE: SQL

```
1 SELECT prod_id, prod_name FROM product
2 WHERE prod_name LIKE 'Re%';
```

LANGUAGE: Unknown

```
1 prod_id | prod_name
2 -----+-----
3      7 | Re-engineered cohesive methodology
4     11 | Re-engineered explicit software
5     18 | Re-engineered actuating capability
6     26 | Realigned 5th generation artificial intelligence
7     39 | Realigned homogeneous hub
8     56 | Reduced fresh-thinking process improvement
9     59 | Realigned client-driven database
10    76 | Re-engineered 24/7 knowledge base
11 (8 rows)
```

11. List the product id numbers with their names that have the word value in the name somewhere. Copy the code and the answer below.

LANGUAGE: SQL

```
1 SELECT prod_id, prod_name FROM product
2 WHERE prod_name LIKE '%value%';
```

LANGUAGE: Unknown

```
1 prod_id | prod_name
2 -----+-----
3      80 | Profound value-added intranet
4 (1 row)
```

12. List the product names along with their id numbers that have Value somewhere in their name. Copy the code and the answer below

LANGUAGE: SQL

```
1 SELECT prod_id, prod_name FROM product
2 WHERE prod_name LIKE '%Value%';
```

LANGUAGE: Unknown

```
1 prod_id | prod_name
2 -----+-----
3 (0 rows)
```

13. List the customer first and last names along with their email addresses, the customer order id, the category names and the product names for orders that have been placed for all products that have the word able in the name. (The case matters). Order by the category and the product name. The output should have the category names in alphabetical order then within each category the products should be ordered in alphabetical order. Copy the code and the answer below.

LANGUAGE: SQL

```

1 SELECT customer.cust_fname, customer.cust_lname, customer.email, cust_order.cust_ord_id,
   ↪ category.cat_name, product.prod_name from customer
2 JOIN cust_order ON customer.cust_id=cust_order.cust_id
3 JOIN manifest ON cust_order.cust_ord_id=manifest.cust_ord_id
4 JOIN product on manifest.prod_id=product.prod_id
5 JOIN category on category.cat_id=product.prod_cat
6 WHERE product.prod_name LIKE '%able%'
7 ORDER BY category.cat_name, product.prod_name;

```

LANGUAGE: Unknown

```

1  cust_fname | cust_lname | email | cust_ord_id | cat_name
2  ↪ |
3  prod_name
4  -----+-----+-----+-----+-----
5  ↪
6  Bérengère | Menendez | amenendez3@dell.com | 64 | Health
7  ↪ | Customizable cohesive capacity
8  Marie-françoise | Currier | acurrier0@economist.com | 133 | Health
9  ↪ | Customizable cohesive capacity
10 Bérengère | Menendez | amenendez3@dell.com | 102 | Health
11 ↪ | Fully-configurable full-range interface
12 Chadd | Franz-Schoninger | cfranzschoninger3@google.com.hk | 7 | Health
13 ↪ | Team-oriented stable project
14 Chadd | Franz-Schoninger | cfranzschoninger3@google.com.hk | 81 | Health
15 ↪ | Team-oriented stable project
16 Bénédicte | Dozdill | cdozdill1@amazon.de | 24 | Kid's
17 ↪ Wear | Configurable analyzing solution
18 Bérengère | Menendez | amenendez3@dell.com | 21 | Kid's
19 ↪ Wear | Configurable analyzing solution
20 Bérengère | Menendez | amenendez3@dell.com | 113 | Kid's
21 ↪ Wear | Configurable analyzing solution
22 Jobey | Boeter | jboeter0@mail.ru | 91 | Kid's
23 ↪ Wear | Configurable analyzing solution
24 Jobey | Boeter | jboeter0@mail.ru | 39 | Outdoor
25 ↪ | Switchable tangible product
26 Jobey | Boeter | jboeter0@mail.ru | 26 | Outdoor
27 ↪ | Switchable tangible product
28 Vikky | Eke | veke4@elegantthemes.com | 105 | Sport
29 ↪ | Configurable methodical firmware
30 Vikky | Eke | veke4@elegantthemes.com | 118 | Sport
31 ↪ | Customizable well-modulated encryption
32 Pélagie | Hachard | fhachard4@blinklist.com | 89 | Sport
33 ↪ | Virtual stable Graphic Interface
34 (14 rows)

```

LECTURE SECURITY BASICS I

📅 08-12-22

🕒 13:00

🎓 Mark

📍 RB LT1

This lecture has been split into two parts, the second part will take place after the Christmas break.

Next week's lecture will be part about MS Learn (& part about Databases) and the practical next week is optional, aimed around coursework questions.

A View on Security

Stealing data is very different to stealing physical objects. To steal data, you just have to make a copy of it; whereas with physical things, you have to pick up the physical thing. At one time, physical security was talked about much more. Nowadays, the physical hardware is stored on the cloud where this is dealt with by someone else.

When working on developing applications, you have to 'sanitise' data which is passed to the database.

The biggest risk to data is those who have access to it, generally this will be people who work for the company.

PostgreSQL Basic Security

Our user account in our Postgres install has full administrative rights to Postgres. This is the Superuser account which no one else should have access to. By default, you cannot access the server from a different IP address; it is possible to allow other IP addresses to have access to this however this is un-advised.

Currently, the superuser on our databases doesn't have a password. In the real world, this is very stupid and should never happen. As superusers we can change and set other users passwords.

Roles

In Postgres, a role is the same as a user.

Before you can login to Postgres, there has to be a role in the DBMS to allow you to login. This username is case sensitive.

As well as having a role/ user there has to be other things in the database. For us, this is the table called our up number.

Users should (in the real world, must) be given passwords. Constraints and change-after-time policies can be set. When the user is created, the password is set. This is a potential security risk as if someone else can get into your account, they can view your terminal history, including the passwords you've entered in terminal in plain text.

Users have to be given the ability to log in. Removing the log in ability, can be useful for people who are working temporarily for a company.

The syntax to create a role as follows:

LANGUAGE: SQL

```
1 CREATE role [userName] with login password '[password]';
```

Where [userName] and [password] are replaced with values you wish to enter.

There is also a `CREATE user` command however this returns the same value as `CREATE role`.

When creating a role, this will create a database called their username, this is essential and should not be deleted.

After creating a role, you have to specify permissions for the different users. However, you can login (if you have login permission) and see all the names of all the databases.

Views

Including views in the coursework will give additional marks.

View

A pre-written query

This enables us to delegate access to certain parts of a table.

When you create views, you can give users access to be able to run that query.

To create a view, the syntax follows

LANGUAGE: SQL

```
1 CREATE [viewName] AS [queryString];
2
3 --eg
4 CREATE VIEW CUST_NAMES AS SELECT CUST_FNAME, CUST_LNAME FROM customer;
```

The view above can be executed as

LANGUAGE: SQL

```
1 SELECT * FROM CUST_NAMES;
```

This will display a list of all the customers first names and customers last names.

PRACTICAL: MORE JOINS

📅 08-12-22

🕒 14:00

🎓 Mark & Co

📍 FTC 3

1. Once you have run the code in this week's tutor section, write a left join that joins the customer and cust_order tables.

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 LEFT JOIN cust_order ON customer.cust_id=cust_order.cust_id;
```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2	-----	-----	-----
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(252 rows)		

2. Write a right join that joins the customer and cust_order tables

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 RIGHT JOIN cust_order ON customer.cust_id=cust_order.cust_id;
```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2	-----	-----	-----
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	Bénédicte	Dozdill	11
14	...		
15	(250 rows)		

3. write an inner join that joins the customer and cust_order tables.

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 JOIN cust_order ON customer.cust_id=cust_order.cust_id;
```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2			
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(250 rows)		

4. Write a right join that joins the customer and cust_order tables.

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 RIGHT JOIN cust_order ON customer.cust_id=cust_order.cust_id;
```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2			
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(251 rows)		

5. Write an inner join that joins the customer and cust_order tables.

LANGUAGE: SQL

```
1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 JOIN cust_order ON customer.cust_id=cust_order.cust_id;
```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2			
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(251 rows)		

6. Write a left join that joins the customer and cust_order tables.

LANGUAGE: SQL

```

1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM customer
2 LEFT JOIN cust_order ON customer.cust_id=cust_order.cust_id;

```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2			
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(262 rows)		

7. Rewrite the query for number 6 but reverse the order of the tables. If you started with the customer table in the query and joined cust_order then rewrite starting with cust_order and join customer.

LANGUAGE: SQL

```

1 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM cust_order
2 LEFT JOIN customer ON customer.cust_id=cust_order.cust_id;

```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
2			
3	Chadd	Franz-Schoninger	1
4	York	O'Deegan	2
5	Marie-françoise	Currier	3
6	Bérengère	Menendez	4
7	Bénédicte	Dozdill	5
8	Bénédicte	Dozdill	6
9	Chadd	Franz-Schoninger	7
10	Bénédicte	Dozdill	8
11	Penelope	Hexter	9
12	York	O'Deegan	10
13	...		
14	(251 rows)		

8. Depending on the number of rows that are returned from questions 6 and 7, rewrite the one that has the highest number of results so that the result is sorted firstly by the cust_id and then the cust_ord_id. Copy the query AND THE FIRST SCREEN OF DATA RETURNED BELOW. Make sure you have more than 1 cust_id in the results.

LANGUAGE: SQL

```

1 -- use query from question 6
2 SELECT customer.cust_fname, customer.cust_lname, cust_order.cust_ord_id FROM cust_order
3 LEFT JOIN customer ON customer.cust_id=cust_order.cust_id
4 ORDER BY customer.cust_id, cust_order.cust_ord_id;

```

LANGUAGE: Unknown

1	cust_fname	cust_lname	cust_ord_id
---	------------	------------	-------------

```

2  -----+-----+-----
3  Jobey      | Boeter      |      26
4  Jobey      | Boeter      |      34
5  Jobey      | Boeter      |      39
6  Jobey      | Boeter      |      57
7  Jobey      | Boeter      |      68
8  Jobey      | Boeter      |      71
9  Jobey      | Boeter      |      77
10 Jobey      | Boeter      |      91
11 Jobey      | Boeter      |      98
12 Jobey      | Boeter      |      99
13 Jobey      | Boeter      |     131
14 Jobey      | Boeter      |     143
15 Jobey      | Boeter      |     146
16 York       | O'Deegan    |       2
17 York       | O'Deegan    |      10
18 York       | O'Deegan    |      19
19 ...
20 (251 rows)

```

9. Write a query that uses outer joins on the customer, the cust_order table and the staff table. It must return the cust_id, cust_ord_id and the staff_id as well as the staff members last name and their work email address.

LANGUAGE: SQL

```

1 SELECT c.cust_id, co.cust_ord_id, s.staff_id, s.staff_lname, s.work_email FROM customer c
2 FULL OUTER JOIN cust_order co ON c.cust_id=co.cust_id
3 FULL OUTER JOIN staff s ON s.staff_id=co.staff_id;

```

LANGUAGE: Unknown

```

1  cust_id | cust_ord_id | staff_id | staff_lname | work_email
2  -----+-----+-----+-----+-----
3      4 |      1 |      6 | Clewlowe    | Aura.Clewlowe@dsd.com
4      2 |      2 |      5 | Gillicuddy  | Janeva.Gillicuddy@dsd.com
5      6 |      3 |      2 | Shrimpton   | Nikoletta.Shrimpton@dsd.com
6      9 |      4 |      5 | Gillicuddy  | Janeva.Gillicuddy@dsd.com
7      7 |      5 |      6 | Clewlowe    | Aura.Clewlowe@dsd.com
8      7 |      6 |      4 | Gloster     | Hanan.Gloster@dsd.com
9      4 |      7 |      6 | Clewlowe    | Aura.Clewlowe@dsd.com
10     7 |      8 |      3 | Housegoe   | Montgomery.Housegoe@dsd.com
11     3 |      9 |      6 | Clewlowe    | Aura.Clewlowe@dsd.com
12     2 |     10 |      5 | Gillicuddy  | Janeva.Gillicuddy@dsd.com
13     7 |     11 |      6 | Clewlowe    | Aura.Clewlowe@dsd.com
14     9 |     12 |      4 | Gloster     | Hanan.Gloster@dsd.com
15     7 |     13 |      4 | Gloster     | Hanan.Gloster@dsd.com
16     7 |     14 |      4 | Gloster     | Hanan.Gloster@dsd.com
17     6 |     15 |      4 | Gloster     | Hanan.Gloster@dsd.com
18     9 |     16 |      5 | Gillicuddy  | Janeva.Gillicuddy@dsd.com
19    10 |     17 |      5 | Gillicuddy  | Janeva.Gillicuddy@dsd.com
20     7 |     18 |      3 | Housegoe   | Montgomery.Housegoe@dsd.com
21     2 |     19 |      3 | Housegoe   | Montgomery.Housegoe@dsd.com
22 ...
23 (266 rows)

```

10. Rewrite the query from 9 and filter the results to show only those customers who have not placed an order. (Remember that any customer who has placed an order will have a cust_ord_id associated with them).

LANGUAGE: SQL

```

1 SELECT c.cust_id, co.cust_ord_id, s.staff_id, s.staff_lname, s.work_email FROM customer c
2 FULL OUTER JOIN cust_order co ON c.cust_id=co.cust_id
3 FULL OUTER JOIN staff s ON s.staff_id=co.staff_id
4 WHERE co.cust_ord_id IS NULL AND c.cust_id IS NOT NULL;

```


LANGUAGE: Unknown

	cust_id	cust_ord_id	staff_id	staff_lname	work_email
1					
2					
3	25				
4	27				
5	33				
6	31				
7	34				
8	32				
9	24				
10	28				
11	30				
12	29				
13	35				
14	(11 rows)				

11. Write a query that will display the staff first and last names, their work email addresses, the customer order id, the customer id and the customer's first and last names along with the products that are in the customer's orders. The results must be ordered by customer last name order. Copy the query AND THE FIRST SCREEN OF DATA RETURNED BELOW. (Make sure you have more than 1 customer in the results).

LANGUAGE: SQL

```

1 SELECT s.staff_fname, s.staff_lname, s.work_email, co.cust_ord_id, c.cust_id, c.cust_fname, c.
   ↪ cust_lname, p.prod_name FROM customer c
2 JOIN cust_order co ON c.cust_id=co.cust_id
3 JOIN staff s ON s.staff_id=co.staff_id
4 JOIN manifest ON manifest.cust_ord_id = co.cust_ord_id
5 JOIN product p ON p.prod_id = manifest.prod_id
6 ORDER BY c.cust_lname;

```

LANGUAGE: Unknown

	staff_fname	staff_lname	work_email	cust_ord_id	cust_id	cust_fname
1	↪	↪	↪	↪	↪	↪
2		cust_lname	prod_name			
3						
4						
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12. Write a query that will show only the customer contact details who have NEVER placed an order. It is up to you to decide what we mean by contact details. Copy the output and query below.


LANGUAGE: SQL


```
1 SELECT c.cust_fname, c.email FROM customer c
2 FULL OUTER JOIN cust_order co ON c.cust_id = co.cust_id
3 WHERE co.cust_ord_id IS NULL;
```

LANGUAGE: Unknown

```
1  cust_fname |          email
2  -----+-----
3  Jen        | jsettle222@google.ca
4  Fawnia     | fpetchell1@networkadvertising.org
5  Nealy      | nstanley7@arstechnica.com
6  Tine       | tclopton5@typepad.com
7  Cody       | clago8@rambler.ru
8  Lonnie     | lmacgilpatrick6@uiuc.edu
9  Evie       | 3vi3@google.wh
10 Mireielle  | mkillner2@cafepress.com
11 Falkner    | fgrouer4@dion.ne.jp
12 Kaine      | klawford3@imdb.com
13 Theadora   | tajsik9@sfgate.com
14 (11 rows)
```

LECTUER: CHRISTMAS LECTURE

 15-12-22

 13:20

 Mark

 RB LT1

Regardless of the scenario, we have to start with picking out the entities for the Entity Relationship Diagram.

If there is something which happens to an entity, for example a service, then if you store that data in the entity, you won't be able to view information about that event once it is overwritten. You have to store the event in a different table.

There should never be entities which are not connected/ related to any other entities in the ERD.

Coursework Advice

If you have 20-30 entities, you've broken down the coursework too much. Somewhere between 6 and 11 is the right number.

LECTURE: DATABASE SECURITY - PRIVILEGES

📅 26-01-23

🕒 13:00

🎓 Mark

📍 RB LT1

NB: This lecture was not delivered as scheduled due to staff sickness. Notes have been taken from the slides made available on Moodle.

Privileges

When we say 'privileges' we are referring to what someone can do. We should never allow someone to do everything in a database, except the database admin.

It is the role of the database administrator to work out what access levels users will need to the database. Deciding which privileges someone needs is complicated and often factors such as their job role or position in the company come into play. For example, what data does someone in the sales team need access to; or what access should a boss have, read only to everything? There may be multiple people within one department who have different levels of access. Ultimately, there isn't a nice 'one size fits all' rule which can be applied to giving the right level of access. Levels of access have to be considered on a case-by-case basis.

Setting Access Levels

Access can be granted on different levels and different activities. Users can be given access to entire databases, some tables or only some views. They can be given permissions to select data, insert data, update data or delete data.

Users can also be given access to create views however this is not always a good idea.

Encryption

PostgreSQL has several different types of data security, this includes: PGP (Pretty Good Privacy); and Hashing (using md5, sha1, sha225, sha256, sha348 and sha512). By default encryption is disabled, to enable it the following line of code needs to be run.

```
LANGUAGE: SQL
```

```
1 CREATE EXTENSION pgcrypto;
```

There are many benefits to using encryption, these include: the data is not available in clear text; and without the key the data cannot be read. However there are a number of downsides: encryption & decryption is slow. Often it is worth taking the time to do this however there will be some data in the database which does not need to be encrypted, for example product names.

Salt

Salting adds some text to the value you need to encrypt. When salting is not used and the same encryption algorithm is used, all input data will be the same when encrypted, this can lead to security issues. However, if salting is used and a salt value is added before encryption, even if two input values are the same once encrypted (permitting they have different salt values) the outputs will be completely different.

PostgreSQL has an inbuilt salt value generation function (`gen_salt()`) which produces a random salt value. The hashing algorithm used is stored in the encrypted string produced by the algorithm so that the data can be decrypted; otherwise you wouldn't be able to decrypt data as the salt generation function is random.

SQL Injection

SQL Injection

A web security vulnerability that allows an attacker to interfere with the queries than an application makes to its database.

This needs to be stopped both at the application and database level. This is done by sanitising user inputs at the application level (can be done in any programming language) and by using views at the database level.

There are a number of methods which can be used to prevent SQL injection: using stored procedures, enforcing least privileges, and having multiple database users.

PRACTICAL: SECURITY ONE

📅 26-01-23

🕒 14:00

🎓 Val & Co

📍 FTC 3

T1. Create a new role. Call this new role your first name. It must be given a password and the ability to login. Copy your code and response below:

LANGUAGE: SQL

```
1 CREATE ROLE thomas WITH LOGIN PASSWORD 'highlySecure1!';
```

T2. Try to use this new role by using the following code

LANGUAGE: Pseudocode

```
1 psql -h localhost -p 5432 -U thomas
```

Output:

LANGUAGE: Pseudocode

```
1 Password for user thomas:
2 psql: FATAL: database "thomas" does not exist
```

T3. As your normal user, create a new database that has the same name as your new role. This needs to be owned by the new user.

LANGUAGE: SQL

```
1 CREATE DATABASE thomas OWNER thomas;
```

Outputs:

LANGUAGE: Pseudocode

```
1 CREATE DATABASE
```

T4. Try to use this new role by using the following code

LANGUAGE: Pseudocode

```
1 psql -h localhost -p 5432 -U thomas
```

Outputs

LANGUAGE: Pseudocode

```
1 Password for user thomas:
```

T5. What does the prompt look like when you log in with your new role? Copy it below.

LANGUAGE: Pseudocode

```
1 thomas=>
```

T6. List the databases available. Copy the output below.

LANGUAGE: Pseudocode

```

1 thomas=> \l
2
3           Name          |          Owner          | List of databases
4           Name          |          Owner          | Encoding | Collate | Ctype | Access privileges
5 -----+-----+-----+-----+-----+-----+-----
6 code_test              | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
7 customer_db            | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
8 dsd_22                 | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
9 mongo-2021-fix         | mongo-2021-fix         | UTF8     | C.UTF-8 | C.UTF-8 |
10 postgres              | postgres               | UTF8     | C.UTF-8 | C.UTF-8 |
11 template0             | postgres               | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres +
12                        |                        |          |          |          | postgres=Ctc/postgres
13 template1             | postgres               | UTF8     | C.UTF-8 | C.UTF-8 | =c/postgres +
14                        |                        |          |          |          | postgres=Ctc/postgres
15 thomas                | thomas                 | UTF8     | C.UTF-8 | C.UTF-8 |
16 up2108121              | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
17 up2108121_cw           | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
18 week02                | up2108121              | UTF8     | C.UTF-8 | C.UTF-8 |
19 (11 rows)

```

T7. Connect to a different database and list the tables. Copy the output below.

LANGUAGE: Pseudocode

```

1 thomas=> \c dsd_22
2 SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, bits: 256, compression: off)
3 You are now connected to database "dsd_22" as user "thomas".
4 dsd_22=>

```

T8. Select all of the data in one of the tables listed in T7. Copy the output below.

LANGUAGE: SQL

```
1 SELECT * FROM manifest;
```

LANGUAGE: Pseudocode

```
1 ERROR: permission denied for table manifest
```

T9. As your normal user, make the new role a superuser with the following code:

LANGUAGE: SQL

```
1 ALTER ROLE thomas WITH SUPERUSER;
```

T10. Make sure your new role is logged out with \q and then log in again. What does the prompt now look like? Copy this prompt below

LANGUAGE: Pseudocode

```

1 up2108121@up2108121:~ psql -h localhost -p 5432 -U thomas
2 Password for user thomas:
3 psql (11.18 (Debian 11.18-0+deb10u1))
4 SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, bits: 256, compression: off)
5 Type "help" for help.
6
7 thomas=#

```

T11. List the databases available. Copy the output below.

LANGUAGE: Pseudocode

```
1 thomas=# \l
```

```

2
3      Name      |      Owner      |      List of databases
4      +-----+-----+-----+-----+-----+-----+
5      code_test  | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
6      customer_db | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
7      dsd_22     | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
8      mongo-2021-fix | mongo-2021-fix | UTF8      | C.UTF-8 | C.UTF-8 |
9      postgres   | postgres        | UTF8      | C.UTF-8 | C.UTF-8 |
10     template0   | postgres        | UTF8      | C.UTF-8 | C.UTF-8 |
11     +-----+-----+-----+-----+-----+-----+
12     template1   | postgres        | UTF8      | C.UTF-8 | C.UTF-8 |
13     +-----+-----+-----+-----+-----+-----+
14     thomas      | thomas          | UTF8      | C.UTF-8 | C.UTF-8 |
15     up2108121   | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
16     up2108121_cw | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
17     week02      | up2108121       | UTF8      | C.UTF-8 | C.UTF-8 |
18 (11 rows)

```

T12. Connect to a different database and list the tables. Copy the output below.

```

LANGUAGE: Pseudocode
1 \c up2108121_cw
2 \dt
3
4 List of relations
5 Schema |      Name      | Type |      Owner
6 +-----+-----+-----+-----+
7 public | boat           | table | up2108121
8 public | boat_spec      | table | up2108121
9 public | boatyard       | table | up2108121
10 public | customer       | table | up2108121
11 public | role           | table | up2108121
12 public | service        | table | up2108121
13 public | service_contents | table | up2108121
14 public | service_item   | table | up2108121
15 public | service_staff  | table | up2108121
16 public | staff          | table | up2108121
17 public | staff_role     | table | up2108121
18 (11 rows)

```

T12. Select all of the data in one of the tables listed in T7. Copy the output below.

```

LANGUAGE: SQL
1 \c dsd_22
2 SELECT * FROM manifest;

```

```

LANGUAGE: Pseudocode
1 manifest_id | cust_ord_id | prod_id
2 +-----+-----+-----+
3          1 |          1 |      84
4          2 |          2 |       1
5          3 |          3 |      91
6          4 |          4 |       5
7          5 |          5 |      97
8          6 |          6 |      74
9          7 |          7 |      88
10         8 |          8 |      97
11         9 |          9 |      66
12        10 |         10 |      43
13        11 |         11 |      78
14        12 |         12 |      24
15        13 |         13 |      69
16        14 |         14 |      25
17        15 |         15 |       4
18        16 |         16 |      32
19        17 |         17 |      66

```


20	18		18		13
21	19		19		83
22	20		20		4
23	21		21		45
24	22		22		4
25	23		23		93
26	24		24		45
27	...				