

Module Title: Databases

Type: Continuous Assessment 2

Title: Database Design

Lecturer: Greg South

College of computing training

(CCT)

2017

DATABASES

Main Project

AIM: The aim of this assignment is to design and implement a database using a structured approach.

OVERVIEW: You are required to design and implement a database for a laboratory using a structured approach, based on the below requirements.

The submission for this module is a report which will include clear screenshots of your database created and implemented.

BRIEF:

Design a database for a chemist laboratory.

You are given the following information.

A laboratory has several chemists who work on one or more projects. While working on these projects a chemist may use different laboratory equipment. The laboratory needs to know the following information about its chemists, projects and equipment.

A chemist has an employee ID, name (first and last), date of birth, age and several phone numbers. A project has a unique project ID (identifier), name, and a project start, and finish date. Equipment information which includes a serial number (unique), name, and cost. The laboratory wishes to record the date when a given piece of equipment is assigned to and returned by a particular chemist. The laboratory also wishes to record the hours a chemist works on a project.

The laboratory also has the following business rules. A chemist must be assigned to at least one project and one equipment item. A given piece of equipment need not be assigned, and a given project need not be assigned either to a chemist. [Hint partial and full participation].

The report must include the following sections.

- Requirements
- Design
- Implementation
- Testing

the details of each of the above sections, and their subsequent outputs are provided below.

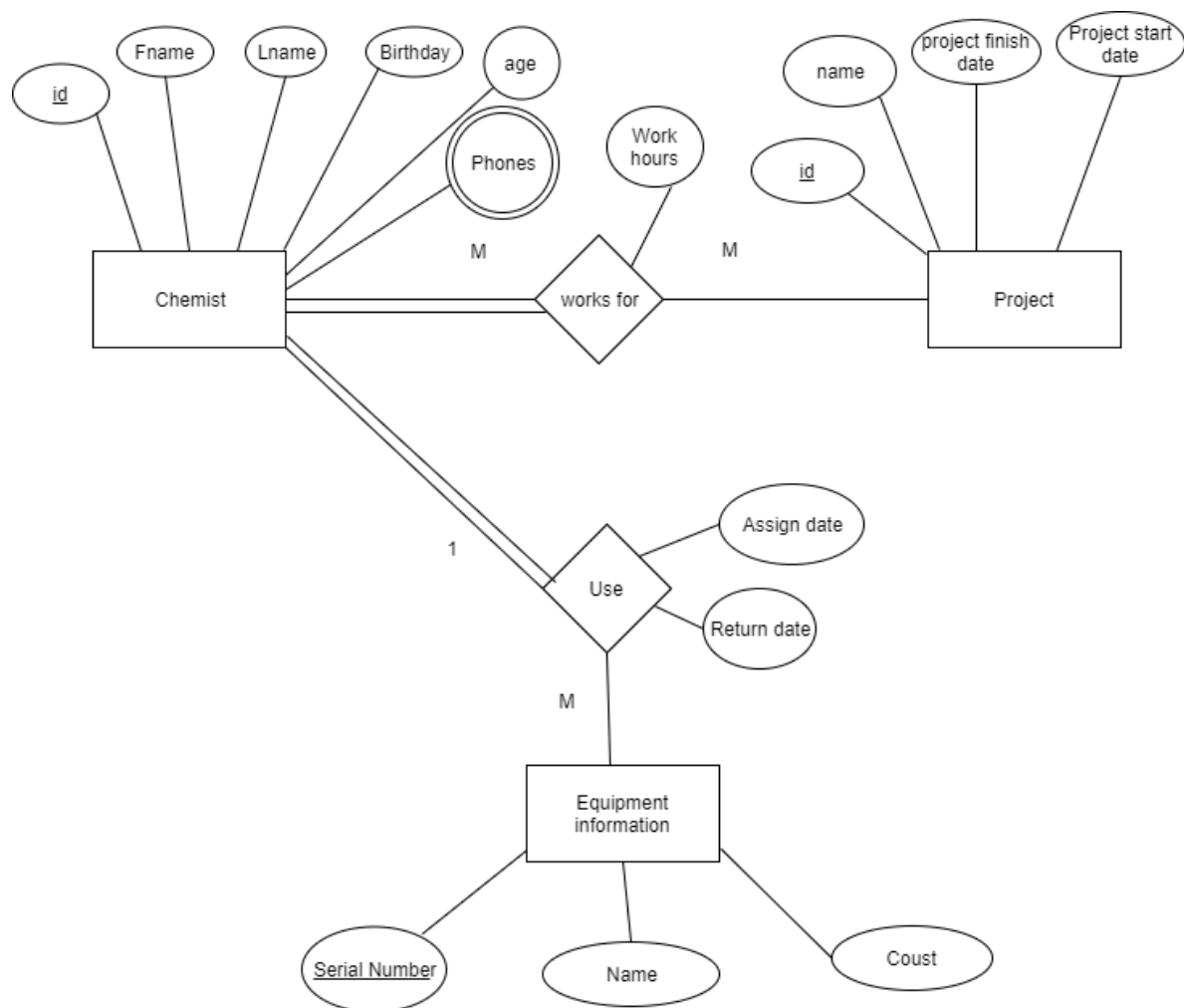
Requirements: This section is for completeness, you only need to paraphrase the above listed requirements.

Design: Your database design will have three phases, conceptual, logical and physical.

Your tasks are outlined below. (Total Marks: 30 marks)

Conceptual

- Using draw.io tool, produce an ER Diagram of your database requirements (using CHEN notation).



Logical • Transform the ER Model to Relational Model

State the steps you used to transform your ER diagram to a relational Model.

Step 1: Strong Entities (Step 1 Strong Entity: Mapping of Regular Entity Types) and

Step 4 (1: N Mapping of Binary 1: M Relationship Types)

Chemist (Step 1 and Step 4)

ID| F_name | L_name | Birthday | Age | Phones

Project (Step 1)

ID| Name| Project_start | Projec_end

Equipment information (Step 1)

Serial number | Name | Cost

USE (Step 4)

ID_ Chemist | ID_Serial | Assign date | Return date | S_number

Step 5: Mapping of Binary M: N Relationship Types)

WORKS FOR (Step 6)

ID_Chemist | ID_ Project | Assign _hours

• Validate the Relational Model using Normalisation

• Produce a Data Dictionary for each Relation (template provided below)

Physical

Table name	Attribute name	Contents	Type	Format	Range	Required	PK OR FK	FK Reference table
CHEMIST	ID	CHEMIST ID	CHAR(10)	XXXXXX	NA	Y	PK	
	Fname	CHEMIST FIRST NAME	VARCHAR(15)	XXXXXX	NA	Y		
	Lname	CHEMIST LAST NAME	VARCHAR(15)	XXXXXX	NA	Y		
	Birthday	CHEMIST BIRTHDAY	DATE	DD-MON-YYYY	NA	Y		
	Age	CHEMIST AGE	DATE	DD-MON-YYYY	NA	Y		
Phones	Chemist_ID	Chemist id number	CHAR(10)	XXXXXX	NA	Y	fk	
	Phone_number	Staff mobile Number	CHAR(15)	XXXXXX	NA	Y	pk	
Project	ID	PROJECT ID	CHAR(10)	XXXXXX	NA	Y	PK	
	Name	Project Name	VARCHAR(15)	XXXXXX	NA	Y		
	Project start	WHEN PROJECT STARTS	DATE	DD-MON-YYYY	NA	Y		
	Project ends	WHEN PROJECT FINISH	DATE	DD-MON-YYYY	NA	Y		
Equipment information	Serial number	SERIAL NUMBER ID	CHAR(10)	XXXXXX	NA	Y	PK	

	Name	TOOL NAME	VARCHAR(15)	XXXXXX	NA	Y		
	Cost	PRICE	NUMERIC	#####	0-9999			
USES	ID_ Chemist	USE ID	CHAR(10)	XXXXXX	NA	Y	fk	
	ID_ Equipment	Equipment ID	CHAR(10)	XXXXXX	NA	Y	fk	
	Assign date	CHEMIST DATE	DATE	DD-MON-YYYY	NA	Y		
	Return date	CHEMIST DATE	DATE	DD-MON-YYYY	NA	Y		
WORK	ID_ Chemist	WORKS FOR ATRIBUTE	CHAR(10)	XXXXXX	NA	Y	fk	
	ID_ Project	WORKS FOR ATRIBUTE	CHAR(10)	XXXXXX	NA		fk	
	Assign hours	WORK HOURS	DATE	DD-MON-YYYY	NA	Y		

- Produce MySQL create statements for each relation (Note, be sure to include constraints i.e. both Primary and Foreign Keys)

CREATE TABLE Chemist (

ID CHAR (10) NOT NULL,

fname varchar(15) NOT NULL,

lname varchar (15) NOT NULL,

Birthday DATE,

age INT,

PRIMARY KEY (ID));

CREATE TABLE phones (

Chemist_ID CHAR (10),

Phone_number CHAR (15) NOT NULL,

PRIMARY KEY (phone_number),

FOREIGN KEY (Chemist_ID) references Chemist (ID));

```
CREATE TABLE Project (  
ID CHAR (10) NOT NULL,  
Name VARCHAR (15),  
Project_start DATE,  
Project_ends DATE,  
PRIMARY KEY (ID));
```

```
CREATE TABLE Equipment (  
Serial_number CHAR (10) NOT NULL,  
Name varchar (15),  
Cost NUMERIC (8, 2),  
PRIMARY KEY (Serial_number));
```

```
CREATE TABLE USES (  
ID_Chemist CHAR (10) NOT NULL,  
ID_Equipment CHAR (10) NOT NULL,  
Assign_date DATE,  
Return_date DATE,  
PRIMARY KEY (ID_Chemist, ID_Equipment),  
FOREIGN KEY (ID_Chemist) references Chemist (ID),  
FOREIGN KEY (ID_Equipment) references Equipment (Serial_number));
```

```
CREATE TABLE WORK (  
ID_Chemist CHAR (10) NOT NULL,  
ID_Project CHAR (10) NOT NULL,  
Hours INT,  
PRIMARY KEY (ID_Chemist, ID_Project),  
FOREIGN KEY (ID_Chemist) references Chemist (ID),  
FOREIGN KEY (ID_Project) references Project (ID)
```

Implementation

Insert Statements:

Provide the SQL statements used to insert data into your relations. Each relation (table) should contain a **minimum of 5 rows**.

Your report will include the insert statements (text format) and a screen shots of your tables showing its contents. (Ensure ALL screenshots show your name/student number in title bar)

Provide the SQL statements used to insert data into your relations. Each relation (table) should contain a minimum of 5 rows

```
Thiago Petcov 2016206 - mysql -u root -p
| project |
| uses |
| work |
+-----+
6 rows in set (0.00 sec)

MariaDB [field]> INSERT INTO Chemist VALUES ('1','Helen','daly','1990-01-30','24');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO Chemist VALUES ('2','Kalina','Petcov','1988-11-30','28');
Query OK, 1 row affected (0.09 sec)

MariaDB [field]> INSERT INTO Chemist VALUES ('2','Alexei','Petcov','1988-03-19','28');
ERROR 1062 (23000): Duplicate entry '2' for key 'PRIMARY'
MariaDB [field]> INSERT INTO Chemist VALUES ('3','Alexei','Petcov','1988-03-19','28');
Query OK, 1 row affected (0.13 sec)

MariaDB [field]> INSERT INTO Chemist VALUES ('4','Thiago','Petcov','1987-03-19','29');
Query OK, 1 row affected (0.06 sec)

MariaDB [field]> INSERT INTO Chemist VALUES ('5','Joao','Petcov','1936-04-18','83');
Query OK, 1 row affected (0.08 sec)

ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to
1
MariaDB [field]> INSERT INTO Chemist VALUES ('5','Joao','Petcov','1936-04-18','83');
ERROR 1062 (23000): Duplicate entry '5' for key 'PRIMARY'
MariaDB [field]> INSERT INTO Chemist VALUES ('6','Joao','Petcov','1936-04-18','83');
Query OK, 1 row affected (0.13 sec)

MariaDB [field]> SELECT * FROM Chemist;
+-----+-----+-----+-----+-----+
| ID | fname | lname | birthday | age |
+-----+-----+-----+-----+-----+
| 1 | Helen | daly | 1990-01-30 | 24 |
| 2 | Kalina | Petcov | 1988-11-30 | 28 |
| 3 | Alexei | Petcov | 1988-03-19 | 28 |
| 4 | Thiago | Petcov | 1987-03-19 | 29 |
| 5 | Joao | Petcov | 1936-04-18 | 83 |
| 6 | Joao | Petcov | 1936-04-18 | 83 |
+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)
```

ca. Thiago Petcov 2016206 - mysql -u root -p

```
MariaDB [field]> INSERT INTO phones VALUES ('4', '666-888');
ERROR 1062 (23000): Duplicate entry '666-888' for key 'PRIMARY'
MariaDB [field]> INSERT INTO phones VALUES ('4', '888-888');
Query OK, 1 row affected (0.09 sec)
```

```
MariaDB [field]> INSERT INTO phones VALUES ('4', '999-888');
ERROR 1062 (23000): Duplicate entry '999-888' for key 'PRIMARY'
MariaDB [field]> INSERT INTO phones VALUES ('5', '999-888');
ERROR 1062 (23000): Duplicate entry '999-888' for key 'PRIMARY'
MariaDB [field]> INSERT INTO phones VALUES ('5', '123-567');
Query OK, 1 row affected (0.09 sec)
```

```
MariaDB [field]> DESCRIBE HP
-> ;
ERROR 1146 (42S02): Table 'field.hp' doesn't exist
MariaDB [field]> DESCRIBE phones;
```

Field	Type	Null	Key	Default	Extra
Chemist_ID	char(10)	YES	MUL	NULL	
Phone_number	char(15)	NO	PRI	NULL	

2 rows in set (0.00 sec)

```
MariaDB [field]> SELECT * FROM phones;
```

Chemist_ID	Phone_number
1	999-888
2	777-888
3	666-888
4	888-888
5	123-567

5 rows in set (0.00 sec)

ca. Thiago Petcov 2016206 - mysql -u root -p

```
1 row in set (0.00 sec)

MariaDB [field]> INSERT INTO Project VALUES ('74', 'BIRD', '1988-03-19', '2018-12-22');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO Project VALUES ('75', 'MARTE', '1989-03-19', '2019-12-22');
Query OK, 1 row affected (0.08 sec)

MariaDB [field]> INSERT INTO Project VALUES ('76', 'MARTE', '1990-03-20', '2020-12-22');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO Project VALUES ('78', 'SATURNO', '1991-03-21', '2021-12-22');
Query OK, 1 row affected (0.09 sec)
```

```
MariaDB [field]> SELECT * FROM Projects;
ERROR 1146 (42S02): Table 'field.projects' doesn't exist
MariaDB [field]> SELECT * FROM Project;
```

ID	Name	Project_start	Project_ends
73	HOPE	1987-03-19	2017-12-22
74	BIRD	1988-03-19	2018-12-22
75	MARTE	1989-03-19	2019-12-22
76	MARTE	1990-03-20	2020-12-22
78	SATURNO	1991-03-21	2021-12-22

5 rows in set (0.00 sec)

```
MariaDB [field]>
```


ca. Thiago Petcov 2016206 - mysql -u root -p

```
+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

MariaDB [field]> INSERT INTO Equipment VALUES ('1234', 'knifes', '10.00');
Query OK, 1 row affected (0.08 sec)

MariaDB [field]> INSERT INTO Equipment VALUES ('4567', 'cars', '20.00');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO Equipment VALUES ('7890', 'motorbike', '30.00');
Query OK, 1 row affected (0.09 sec)

MariaDB [field]> INSERT INTO Equipment VALUES ('0987', 'petrol', '40.00');
Query OK, 1 row affected (0.12 sec)

MariaDB [field]> INSERT INTO Equipment VALUES ('4321', 'hammer', '50.00');
Query OK, 1 row affected (0.08 sec)

MariaDB [field]> SELECT * FROM Equipments;
ERROR 1146 (42502): Table 'field.equipments' doesn't exist
MariaDB [field]> SELECT * FROM Equipment;
+-----+-----+-----+
| Serial_number | Name      | Cost |
+-----+-----+-----+
| 0987          | petrol    | 40.00 |
| 1234          | knifes    | 10.00 |
| 4321          | hammer    | 50.00 |
| 4567          | cars      | 20.00 |
| 7890          | motorbike | 30.00 |
+-----+-----+-----+
5 rows in set (0.00 sec)
```

ca. Thiago Petcov 2016206 - mysql -u root -p

```
MariaDB [field]> INSERT INTO USES VALUES ('1', '0987', '1987-03-03', '1887-04-04');
Query OK, 1 row affected (0.08 sec)

MariaDB [field]> INSERT INTO USES VALUES ('2', '1234', '1989-03-03', '1988-04-05');
Query OK, 1 row affected (0.09 sec)

MariaDB [field]> INSERT INTO USES VALUES ('3', '4321', '1990-03-03', '1989-04-05');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO USES VALUES ('4', '4567', '1991-04-03', '1992-04-05');
Query OK, 1 row affected (0.75 sec)

MariaDB [field]> INSERT INTO USES VALUES ('5', '7890', '1993-04-03', '1994-04-05');
Query OK, 1 row affected (0.61 sec)

MariaDB [field]> SELECT * FROM USES;
+-----+-----+-----+-----+
| ID_Chemist | ID_Equipment | Assign_date | Return_date |
+-----+-----+-----+-----+
| 1          | 0987         | 1987-03-03  | 1887-04-04  |
| 2          | 1234         | 1989-03-03  | 1988-04-05  |
| 3          | 4321         | 1990-03-03  | 1989-04-05  |
| 4          | 4567         | 1991-04-03  | 1992-04-05  |
| 5          | 7890         | 1993-04-03  | 1994-04-05  |
+-----+-----+-----+-----+
5 rows in set (0.01 sec)

MariaDB [field]>
```

Thiago Petcov 2016206 - mysql -u root -p

5 rows in set (0.01 sec)

MariaDB [field]> INSERT INTO WORK VALUES ('1', '73','100');
Query OK, 1 row affected (0.84 sec)

MariaDB [field]> INSERT INTO WORK VALUES ('2', '74','200');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO WORK VALUES ('3', '75','300');
Query OK, 1 row affected (0.08 sec)

MariaDB [field]> INSERT INTO WORK VALUES ('4', '76','400');
Query OK, 1 row affected (0.11 sec)

MariaDB [field]> INSERT INTO WORK VALUES ('5', '78','400');
Query OK, 1 row affected (0.09 sec)

MariaDB [field]> SELECT * FROM WORK;

ID_Chemist	ID_Project	Hours
1	73	100
2	74	200
3	75	300
4	76	400
5	78	400

5 rows in set (0.00 sec)

MariaDB [field]>

Testing

Illustrate how your database has met its aforementioned requirements.

To do this you need to be able to write the SQL that will provide the following information.

1. A list of all chemists (FIRSTNAME AND LASTNAME ONLY) working in the company.

```
ca. Thiago Petcov 2016206 - mysql -u root -p
5 rows in set (0.00 sec)

MariaDB [field]> SELECT fname, lname FROM Chemist;
+-----+-----+
| fname | lname |
+-----+-----+
| Helen | daly   |
| Kalina| Petcov |
| Alexei| Petcov |
| Thiago| Petcov |
| Joao  | Petcov |
| Joao  | Petcov |
+-----+-----+
6 rows in set (0.00 sec)

MariaDB [field]>
```

2. A list of all projects that started after 2017-01-01

```
ca. Thiago Petcov 2016206 - mysql -u root -p

MariaDB [field]> SELECT * FROM project WHERE Project_start>'2017-01-01';
+-----+-----+-----+-----+
| ID | Name   | Project_start | Project_ends |
+-----+-----+-----+-----+
| 79 | NASA   | 2017-01-09    | 2017-12-31   |
| 80 | GOJIRA | 2017-02-02    | 2017-05-19   |
| 81 | SPIDER | 2017-03-01    | 2017-10-11   |
+-----+-----+-----+-----+
3 rows in set (0.00 sec)

MariaDB [field]>
```

3. The phones numbers for a specific chemist (e.g. chemist Employee ID 1). You can filter by the Emp_No of the Chemist.

```
ca. Thiago Petcov 2016206 - mysql -u root -p
MariaDB [field]> SELECT * FROM phones;
+-----+-----+
| Chemist_ID | Phone_number |
+-----+-----+
| 1          | 999-888      |
| 2          | 777-888      |
| 3          | 666-888      |
| 4          | 888-888      |
| 5          | 123-567      |
+-----+-----+
5 rows in set (0.00 sec)

MariaDB [field]> SELECT chemist_ID as ID_chemist, Phone_number FROM phones WHERE chemist_ID = '1';
+-----+-----+
| ID_chemist | Phone_number |
+-----+-----+
| 1          | 999-888      |
+-----+-----+
1 row in set (0.00 sec)

MariaDB [field]>
```

4. Using an SQL function, return how many chemists work in the company?

```
ca. Thiago Petcov 2016206 - mysql -u root -p
6 rows in set (0.00 sec)

MariaDB [field]> SELECT COUNT(DISTINCT ID) AS 'No of Chemist working in the Company' FROM Chemist;
+-----+-----+
| No of Chemist working in the Company |
+-----+-----+
| 6                                     |
+-----+-----+
1 row in set (0.06 sec)

MariaDB [field]>
```

5. For each chemist, the amount of equipment they have checked out this year (I.E. >2017-01-01). [Hint this query will use Group By, and you only need to calculate how many pieces of equipment a chemist has checked out. (2 mark)] Your answer should contain the following similar columns.

```
ca. Thiago Petcov 2016206 - mysql -u root -p
MariaDB [field]> SELECT * FROM uses;
+-----+-----+-----+-----+
| ID_Chemist | ID_Equipment | Assign_date | Return_date |
+-----+-----+-----+-----+
| 1          | 0987         | 1987-03-03 | 1887-04-04 |
| 2          | 1234         | 1989-03-03 | 1988-04-05 |
| 3          | 4321         | 1990-03-03 | 1989-04-05 |
| 4          | 4567         | 1991-04-03 | 1992-04-05 |
| 5          | 7890         | 1993-04-03 | 1994-04-05 |
| 8          | 7373         | 2017-09-01 | 2017-09-25 |
+-----+-----+-----+-----+
6 rows in set (0.00 sec)

MariaDB [field]> SELECT ID_Chemist, COUNT(ID_Equipment) AS 'Equipment checked in 2017' FROM uses WHERE Assign_date > '2017-01-01' GROUP BY ID_Chemist;
+-----+-----+
| ID_Chemist | Equipment checked in 2017 |
+-----+-----+
| 8          | 1                          |
+-----+-----+
1 row in set (0.00 sec)

MariaDB [field]>
```

I hereby declare that all of the work shown here is my own work.

Student's Name: Thiago Petcov

Student Number: 2016206

Date:

Marking Scheme Summary

Description	Weighting
1 Student uses draw.io tool, to produce an ER Diagram of database requirements (using CHEN notation).	0 to 6 Marks
2 Student transforms the ER Model to Relational Model and states the steps used to transform your ER diagram to a relational Model	0 to 5 marks
3 Student validates the Relational Model using Normalisation and produces a Data Dictionary for each Relation (template provided below)	0 to 5 Marks
4 Student produces MySQL create statements for each relation (Note, be sure to include constraints i.e. both Primary and Foreign Keys)	0 to 5 Marks
5 Student provides insert statements, providing the SQL statements used to insert data into your relations. Each relation (table) should contain a minimum of 5 rows.	0 to 3 Marks
6 Student provides testing and writes the correct SQL statements to illustrate how your database has met its aforementioned requirements.	0 to 6 marks
TOTAL	30