RMIT UNIVERSITY

School of Science

# ISYS2095 Database Concepts

Assessment 1: Database Design

Assessment Type: PDF

Word limit: N/A (see instructions)

Due date: Sunday 3rd January 2021 (end of week 5)

30% of your overall grade

## Overview

The objective of this assignment is to measure your understanding of the basic concepts in the relational database model and using entity-relationship model for database design. The assessment is in two parts, split into four tasks which cover Basic ER Modelling and Basic Relational Modelling. The tasks are as follows:

**Part A: Entity-Relationship Modelling** (80 Marks)

1. Design and plan for the implementation of a database system, diagramming the design to a high standard using UML notation through the diagramming tool LucidChart.
2. Model the activities of an organisation and present the model as an Entity-Relationship (ER) diagram. Analyse this ER diagram, and possibly modify it, based on additional client requirements.
3. Map an ER diagram into a relational database schema, showing every step of the mapping

**Part B: Relational Database Model** (20 Marks)

4. Answer a series of short questions about a Relational Database model

To complete this assessment, you must be familiar with LucidChart, which is covered during the Week 1-4 activities.

## Assessment Criteria

This assessment will measure your ability to:

- Describe various data modelling and database system technologies.
- Explain the main concepts for data modelling and characteristics of database systems
- Identify issues with and compare, justify relational database design using the functional dependency concepts.

## Course Learning Outcomes

This assessment is relevant to the following Course Learning Outcomes:

- CLO 1: Describe various data modelling and database system technologies.
- CLO 2: Explain the main concepts for data modelling and characteristics of database systems
- CLO 3: Identify issues with and compare, justify relational database design using the functional dependency concepts.

# Assessment details

## Part A Entity-Relationship Modelling (80 Marks)

### Task 1: Designing an Entity-Relationship Model

*GreenGrows* is a large plant nursery wholesaler, producing plants from several sites.

- Each site has an address, a climate zone (e.g. cool-temperate), a purchase date and one or more greenhouses.
- Each greenhouse has a capacity and a greenhouse-number.
- The greenhouse-number is not unique across sites, but it is unique on a given site (for example, the first greenhouse on each site is called greenhouse-number 1, and for that site, no other greenhouse on that site would be number 1).
- Various plant species may be grown in greenhouses on the sites.
- A species has a scientific name, comprised of the genus name and the species name. It also has one or more common names and a retail item price.
- More than one species may be grown in a given greenhouse, and more than one greenhouse may grow a particular species. The species being grown in each greenhouse is recorded, along with the planting date and quantity.
- An order for plants has a unique order ID, date, and a shipping address. An order specifies one or more species of plant, and the quantity of each species required.
- *GreenGrows* staff have a unique employee ID, a name, address and phone number and have a 'home' site that they are based at. Some staff are experts on one or more species of plant.

Based on the given description, model the business rules of *GreenGrows* and present your model as an Entity-Relationship (ER) diagram. Carefully state any assumptions that you make. In your ER diagram, you must properly denote all applicable concepts, including weak or strong entities, keys, composite or multi-valued attributes, relationships and their cardinality and participation constraints.

If you cannot represent any of this information in the ER model, clearly explain what limitations in the ER model restrict you from representing your model.

You **must** use UML notation and the diagramming tool LucidChart to draw your diagram. Your diagram must be drawn to a high standard with minimal clutter. You are **not** required to map the ER model to relational model.

**A special note:** This is an open-ended question with many different models that can be derived. Your model is assessed based on how accurately it represents business rules described above.

## Task 2: Designing an Entity-Relationship Model

You are asked to design part of a database about stage performers on sea-cruise shows, including information as follows:

- A performer has an employee number, given name, contact address, bank account number and a list of shows that they are ready to perform. Note being ready to perform on a show doesn't mean they actually will perform it (they could be in the capacity of an understudy). It is also desired to be able to list the IDs of cruises that the performer has actually performed on.
- A show has a unique title, a duration and type. A show may require multiple performers.
- A cruise has a cruise ID, a start and destination port and associated start and end dates, and a list of shows scheduled for during the cruise.

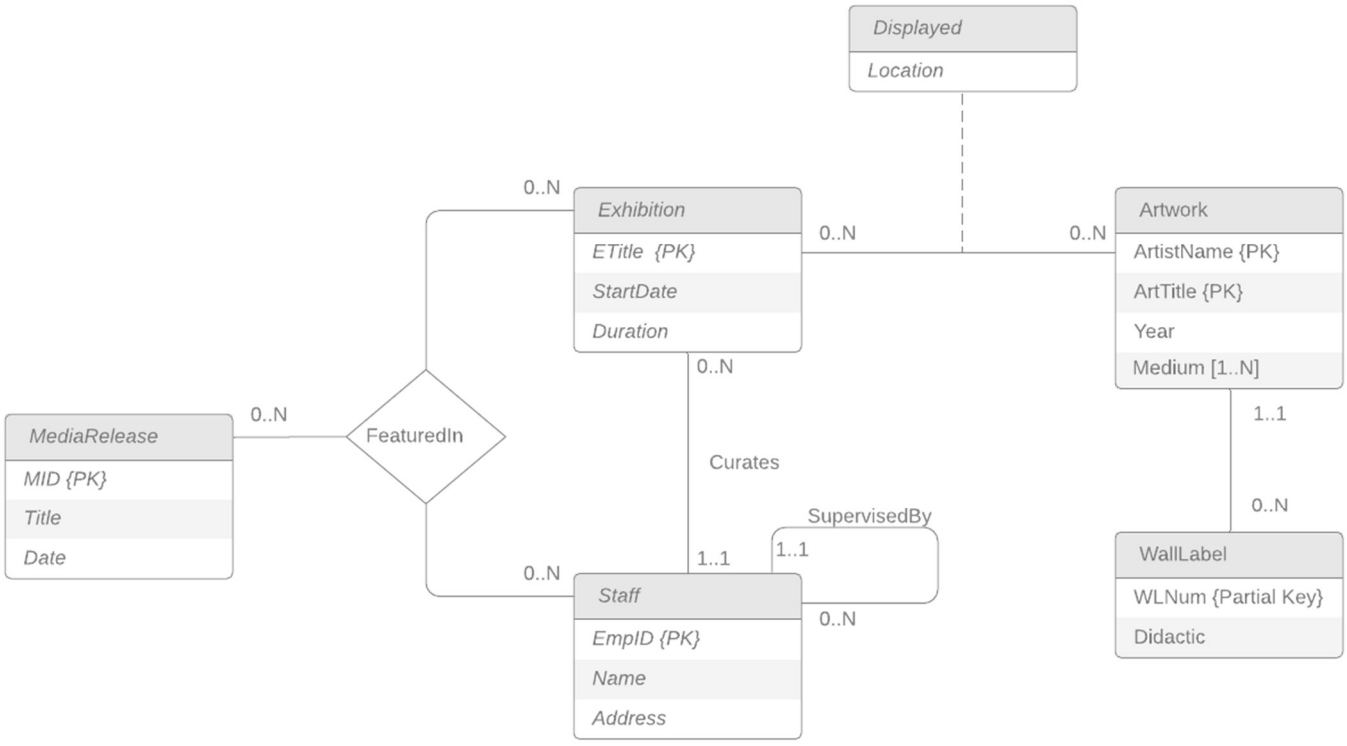
Based on the above information, model the database requirements as an Entity-Relationship (ER) diagram. Carefully state any assumptions that you make. In your ER diagram, you must properly denote all applicable concepts, including weak or strong entities, keys, composite or multi-valued attributes; relationships and their cardinality and participation constraints.

After presenting your ER model to management, you are asked if it can be used to perform the following additional task: produce, for each cruise, a list of scheduled shows and, for each such show, a list of the performers who performed on it.

Explain, referring to your ER model how to produce the requested list. If it is not possible to produce the list from the model, state why, modify the model and provide the modified ER diagram (in addition to your original ER diagram), explaining how it can accommodate this requirement.

## Task 3: Mapping an ER Model to a Relational Database Schema

Consider the following ER diagram, which models aspects of an art gallery. Map this ER diagram into a relational database schema. Show every step of the mapping. No marks are awarded to the final schema if you do not show the partially built schema at the end of each step. Indicate the primary key (underlined) and foreign key (with an asterisk) in each relation.



## Part B (20 Marks)

## Task 4: Relational Database Model

This task uses a relational database schema and instance adapted from Fundamentals of Database Systems, Elmasri and Navathe. (Question 5.11), given below.

**EMPLOYEE**

| Fname | Minit | Lname | Ssn | Bdate | Address | Sex | Salary | Super_ssn | Dno |
|---|---|---|---|---|---|---|---|---|---|
| John | B | Smith | 123456789 | 1965-01-09 | 731 Fondren, Houston, TX | M | 30000 | 333445555 | 5 |
| Franklin | T | Wong | 333445555 | 1955-12-08 | 638 Voss, Houston, TX | M | 40000 | 888665555 | 5 |
| Alicia | J | Zelaya | 999887777 | 1968-01-19 | 3321 Castle, Spring, TX | F | 25000 | 987654321 | 4 |
| Jennifer | S | Wallace | 987654321 | 1941-06-20 | 291 Berry, Bellaire, TX | F | 43000 | 888665555 | 4 |
| Ramesh | K | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble, TX | M | 38000 | 333445555 | 5 |
| Joyce | A | English | 453453453 | 1972-07-31 | 5631 Rice, Houston, TX | F | 25000 | 333445555 | 5 |
| Ahmad | V | Jabbar | 987987987 | 1969-03-29 | 980 Dallas, Houston, TX | M | 25000 | 987654321 | 4 |
| James | E | Borg | 888665555 | 1937-11-10 | 450 Stone, Houston, TX | M | 55000 | NULL | 1 |

**DEPARTMENT**

| Dname | Dnumber | Mgr_ssn | Mgr_start_date |
|---|---|---|---|
| Research | 5 | 333445555 | 1988-05-22 |
| Administration | 4 | 987654321 | 1995-01-01 |
| Headquarters | 1 | 888665555 | 1981-06-19 |

**DEPT_LOCATIONS**

| Dnumber | Dlocation |
|---|---|
| 1 | Houston |
| 4 | Stafford |
| 5 | Bellaire |
| 5 | Sugarland |
| 5 | Houston |

**WORKS_ON**

| Essn | Pno | Hours |
|---|---|---|
| 123456789 | 1 | 32.5 |
| 123456789 | 2 | 7.5 |
| 666884444 | 3 | 40.0 |
| 453453453 | 1 | 20.0 |
| 453453453 | 2 | 20.0 |
| 333445555 | 2 | 10.0 |
| 333445555 | 3 | 10.0 |
| 333445555 | 10 | 10.0 |
| 333445555 | 20 | 10.0 |
| 999887777 | 30 | 30.0 |
| 999887777 | 10 | 10.0 |
| 987987987 | 10 | 35.0 |
| 987987987 | 30 | 5.0 |
| 987654321 | 30 | 20.0 |
| 987654321 | 20 | 15.0 |
| 888665555 | 20 | NULL |

**PROJECT**

| Pname | Pnumber | Plocation | Dnum |
|---|---|---|---|
| ProductX | 1 | Bellaire | 5 |
| ProductY | 2 | Sugarland | 5 |
| ProductZ | 3 | Houston | 5 |
| Computerization | 10 | Stafford | 4 |
| Reorganization | 20 | Houston | 1 |
| Newbenefits | 30 | Stafford | 4 |

**DEPENDENT**

| Essn | Dependent_name | Sex | Bdate | Relationship |
|---|---|---|---|---|
| 333445555 | Alice | F | 1986-04-05 | Daughter |
| 333445555 | Theodore | M | 1983-10-25 | Son |
| 333445555 | Joy | F | 1958-05-03 | Spouse |
| 987654321 | Abner | M | 1942-02-28 | Spouse |
| 123456789 | Michael | M | 1988-01-04 | Son |
| 123456789 | Alice | F | 1988-12-30 | Daughter |
| 123456789 | Elizabeth | F | 1967-05-05 | Spouse |



Most of the attribute names are self-explanatory. Super_SSN refers to corresponding employee's supervisor's SSN (Social Security Number). This example is based on US system, assume SSN is similar to Australian Tax File Number.

Arrows indicate foreign keys and the corresponding attributes in parent relation. In the case of Super_SSN, the parent relation is the Employee relation itself (self-referencing).

1. All employees working on project 3 are being reassigned (and having their hours transferred) to project 2. The data entry operator has executed the following SQL statement:

```
UPDATE works_on
   SET pno = 2
   WHERE pno = 3;
```

   Write down all the integrity constraints violated by the above operation, and why. If the operation does not violate any constraints, indicate this as 'no violations'.

2. The manager of Administration, Jennifer S Wallace (SSN 987654321) has left the company and had her roles filled by Alicia Zelaya (SSN 999887777). The data entry operator has executed the following SQL statement:

```
DELETE FROM employee
   WHERE ssn = 987654321;
```

   However, it was not successful.
   a) Write down all the integrity constraints violated by the above operation, and why. If the operation does not violate any constraints, indicate this as 'no violations'.
   b) Using SQL DELETE and UPDATE statements, show how Jennifer can be removed from the database.

3. The Newbenefits project is going to be relocated to, and managed from, Headquarters. The data entry operator has executed the following SQL statement:

```
UPDATE project
   SET dnum = 1
   WHERE pnumber = 30;
```

   a) Write down all the integrity constraints violated by the above operation, and why. If the operation does not violate any constraints, indicate this as 'no violations'.
   b) Given the database state, is the above SQL statement logically correct? Why or why not?

4. Alicia J Zelaya (SSN 999887777) has a new, as yet unnamed, daughter. To record Alicia's new dependent, the data entry operator has executed the following SQL statement:

```
INSERT INTO dependent (essn, sex, bdate, relationship)
   VALUES (999887777,'F', '2020-12-14', 'Daughter');
```

   Write down all the integrity constraints violated by the above operation, and why. If the operation does not violate any constraints, indicate this as 'no violations'.

## Referencing guidelines

Use Harvard referencing style for this assessment. You must acknowledge all the courses of information you have used in your assessments.

Refer to the RMIT Easy Cite referencing tool to see examples and tips on how to reference in the appropriated style. You can also refer to the library referencing page for more tools such as EndNote, referencing tutorials and referencing guides for printing.

## Submission

You should submit one PDF document with all answers together. You must use LucidChart to work on Part 1 of your assignment. You may use Word or any other word processor to compile your submission. At the end, convert it into PDF format. Do not submit Word files. if that option is not available on your system there are free pdf converters online you can utilise. e.g. http://convertonlinefree.com/ Submit to the assessment page in canvas by the due date.

## Academic integrity and plagiarism

Academic integrity is about honest presentation of your academic work. It means acknowledging the work All code or other material that is not original must be fully credited. That is, any material that is copied or derived from another source must be clearly identified as such and the original author must be identified. Sometimes students assist each other with an assignment, but end up working together too closely, so that the students' separate solutions have significant parts in common; unless the solutions were developed independently, they are regarded as plagiarised.

Plagiarism is a very serious offence. Any submissions determined to be a result of plagiarism willbe deemed as an academic misconduct and harsh penalties apply. It is also an offence for students to allow their work to be plagiarised by another student. You should familiarize yourself with the university website for Academic Integrity Policy, Procedures and Guidelines: https://www.rmit.edu.au/students/student-essentials/rights-andresponsibilities/academic-integrity

All work is to be done individually and plagiarism of any form will be dealt with according to the RMIT plagiarism policy.

## Penalties for late submissions

Late submissions of assignments will be penalised as follows. For 1 to 5 days late, a penalty of 10% (i.e. 10% out of total marks, not 10% out of your marks) per day. For assignments more than 5 days late, 100% penalty applies.

## Special Consideration

If unexpected circumstances affect your ability to complete the assignment you can apply for special consideration. If you seek a short extension, you can directly contact the lecturer. For longer extensions, you must follow instructions provided at: http://www1.rmit.edu.au/students/specialconsideration

## Assessment declaration

When you submit work electronically, you agree to the assessment declaration.