INFS1200/7900 Module 2 Assignment

Due: 21 April 2023 @ 4:00 PM AEST

Weighting: 15%

Full Name	Student ID (8 digits)

1. Overview

The purpose of this assignment is to test your ability to apply relational model principles, such as identifying integrity constraint violations in common database operations and mapping from ER to relational schema. The assignment is split into three sections. Sections A and B are to be complete individually using the assignment template provided. Section C (the RiPPLE Component) is to be completed individually on the RiPPLE platform.

2. Submission

All submissions for **Section A and Section B** must be made through an electronic marking tool called Gradescope, which will also be used for providing feedback. You **must** record all your answers in the spaces provided in this document. Altering the format or layout of this document in anyway will attract penalties. All submissions must have the above boxes filled out in order to be identified.

Section C is to be completed through the RiPPLE platform (link available on Blackboard).

3. Marking

This assignment is worth 15% of your course mark, with Section A worth 6%, Section B 6.5% and Section C 2.5%.

4. Plagiarism

The University has strict policies regarding plagiarism. Penalties for engaging in unacceptable behaviour range from loss of grades in a course through to expulsion from UQ. You are required to read and understand the policies on academic integrity and plagiarism in the course profile (Section 6.1). If you have any questions regarding acceptable level of collaboration with your peers, please see either the lecturer or your tutor for guidance. Remember that ignorance is not a defence!

In particular, you are permitted to use generative AI tools to help you complete this assessment task. However, if you do, please provide complete copies of your interactions with the AI tool in the space provided at the end of your submission. Please note that if you use generative AI but fail to acknowledge this by attaching your interaction to the end of the assignment, it will be considered misconduct as you are claiming credit for work that is not your own.

5. Task

This assignment contains three different sections. **Section A** contains a relational model schema along with other contextual information. Based on this information, you will need to analyse different database operations. For each, identify which, if any, integrity constraint(s) would be violated by these operations and how they violate said integrity

constraint. An example has been provided below. **Section B** provides you with three ER diagrams based off sample solutions from Assignment 1. For each of these diagrams, your task is to perform relational mapping and state only the *final* relational schema for the ER diagram, including any foreign keys which were created during the process. Finally in **Section C** you will need to complete some specified tasks on the RiPPLE platform.

Section A – Integrity Constraints

The following is an extract from a bus ticketing and billing system. The original ER diagram and extra information has been provided to highlight additional key constraints which are not intuitive from the relational schema. Using the ER diagram, contextual information, relational schema and instance data provided, answer the following questions. An example of how to answer the question is provided below. You may also make assumptions on domain based on the instance data (e.g. name is captured as a string).

Note: Do not take into consideration changes which may have been made by operations in earlier questions.

You may assume that all attributes in the database have NULL as an acceptable value in their domain *except* in the cases where the information provided indicates otherwise. You should not assume or imply other semantic constraints which are not explicitly mentioned/implied in the ER diagram, UoD or relational mapping. Additionally, as this assignment is based on the relational model, you should **not** base your understanding of what would/would not qualify as a constraint violation on how a DBMS (such as MySQL) would handle the operation. You may assume there are no cascading actions which occur update or deletion of foreign key values.

Brisbane Bus TravelCard

When Brisbane City Council moved to electronic bus cards, a DB was set up to manage passenger, travel card, bus and trip information. A simplified version of the DB ER diagram is given below:

ER diagram:
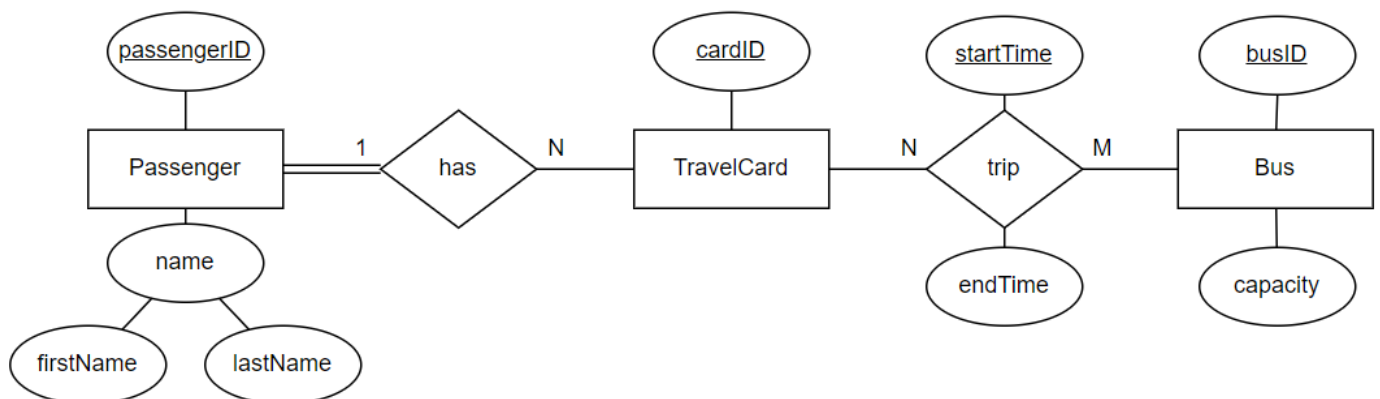
Contextual information

- All IDs are integers, with passengerID 8 digits long, cardID 10, and BusID 5.

- All name-related attributes are strings

- startTime and endTime are in standard ISO datetime format 'YYYY-MM-DD hh:mm:ss.000'. Also, startTime must occur before endTime.

Relational Schema

      Passenger (passengerID, firstName, lastName)

      TravelCard (cardID, passengerID)

      Bus (busID, capacity)

      Trip (cardID, busID, startTime, endTime)

      Foreign key references:

      TravelCard.passengerID references Passenger.passengerID

      Trip.cardID references TravelCard.cardID

      Trip.busID references Bus.busID

Instance Data:

PASSENGER

passengerID	firstName	lastName
00116701	Molly	Weasley
00117432	James	Potter
00123673	Lucy	Malfoy
00127984	Cho	Chang
00131115	Hannah	Abbot

TRAVELCARD

cardID	passengerID
0012240111	00116701
0012360114	00117432
0012450118	00123673
0012730116	00127984
0013960112	00131115
0018740113	NULL
0018460119	NULL
0018650117	00123673

TRIP

cardID	busID	startTime	endTime
0012450118	10123	2012-01-20 13:10:00	2012-01-20 14:01:04
0012730116	10123	2012-01-20 13:16:00	2012-01-20 14:00:58
0012240111	10678	2012-01-20 13:35:00	2012-01-20 14:00:00
0012450118	10456	2012-01-20 14:27:04	2012-01-20 14:27:04
0012450118	20246	2012-01-20 14:28:55	2012-01-20 14:52:26
0013960112	10456	2012-01-20 14:33:00	2012-01-20 14:45:00
0018740113	10456	2012-01-20 14:52:00	2012-01-20 15:25:00
0018460119	20680	2012-01-20 15:04:00	2012-01-20 15:13:00

BUS

busID	capacity
10123	76
10456	76
10678	76
20246	104
20680	104

Example:

Insert (10124, 'Wizards don't use muggle transport') into BUS.

Will this operation cause an integrity constraint violation? Yes / No

If yes, name the integrity constraint(s) which will be violated:

Domain Constraint Violation

If yes, explain how the integrity constraint(s) would be violated:

Domain Constraint Violation: This tuple contains a non-integer value for the *capacity* attribute, specifically 'Wizards don't use muggle transport.' Based on the information and instance data provided, it is clear the domain for the attribute is integer values and hence this operation would violate the domain constraint.

SECTION A QUESTIONS START ON NEXT PAGE

A.1   Insert <0012630115, 10123, '2012-01-20 15:23:00', '2012-01-20 15:04:17'> into TRIP.

Will this operation cause an integrity constraint violation? (Yes) /   No

If yes, name the integrity constraint(s) which will be violated:

 Referential and Semantic Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:

Semantic Integrity Constraint: In Contextual information, TRIP.endTime is mentioned that need to occur after TRIP.startTime.

In A.1operation, TRIP.startTime is "2012-01-20 15:23:00", and the TRIP.endTime is "2012-01-20 15:04:17".

Referential Integrity Constraint :TRIP.cardID suppose to references to recorded cardID, however, "0012630115" did not record in TRAVELCARD.

Based on the information and instance data provided, all TRIP.startTime occurred before TRIP.endTime, and also TRIP.cardID had been recorded in TRAVELCARD.cardID. Therefore, operation A.1 would violate Referential and Semantic Integrity Constraint.

A.2   Insert the tuple <00127984, 'Paritosh', 'Patil'> into PASSENGER.

Will this operation cause an integrity constraint violation? (Yes) /   No

If yes, name the integrity constraint(s) which will be violated:

 Key Constraint

If yes, explain how the integrity constraint(s) would be violated:

Key Constraint : PASSENGER.passengerID is key attribute.
In A.2 operation, PASSENGER.passengerID "00127984" has been recorded as Cho's. Based on the information and instance data provided, indeed every passenger is given their own, unique passengerID. Thus, the operation would violate the Key Constraint.

A.3   Insert <00127984, 10123, '2012-01-20 13:10:00', '2012-01-20 14:01:04'> into TRIP.

Will this operation cause an integrity constraint violation? (Yes) /   No

If yes, name the integrity constraint(s) which will be violated:

 Key and Domain Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:
Domain Integrity Constraint : TRIP.cardID suppose to be a 10-digit number.
However, in A.3 operation, 8-digit number "00127984" is given.
Key Integrity Constraint : TRIP.startTime is primary key, so it could not be recorded twice. However, operation A.3 insert a identical starttime that had been recorded.
Based on the information and instance data provided, indeed all the TRIP.cardID is 10-digit number, and there is no repeatitive TRIP.startTime.Thus, operation A.3 would violate both Key and Domain Integrity Constraint.

A.4 Modify the tuple <0012450118, 20246, '2012-01-20 14:28:55', '2012-01-20 14:52:26'> in TRIP by changing it to <0012450118, 20246, NULL, '2012-01-20 14:52:26'>.

Will this operation cause an integrity constraint violation? (Yes) / No

If yes, name the integrity constraint(s) which will be violated:

Entity Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:

Entity Integrity Constraint : one of the key is modified to "NULL".
Trip.startTime is one of the key attribute of entity "Trip". Based on the information and instance data provided, all of the other record of Trip has their not "NULL" starttime.
Thus, operation A.4 would violate Entity Integrity Constraint.

A.5 Modify the tuple <00123673, 'Lucy', 'Malfoy'> in PASSENGER by changing it to <00131115, 'Lucius', 'Malfoy'>.

Will this operation cause an integrity constraint violation? (Yes) / No

If yes, name the integrity constraint(s) which will be violated:

 Key Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:

Key Constraint : PASSENGER.passengerID is a key attribute of entity PASSENGER.
In operation A.5 the PASSENGER.passengerID for Lucy is modified to the same as Hannah.
Based on the information and instance data provided, there is no repeatitive passengerID.
Therefore, operation A.5 would violate Key Integrity Constraint.

A.6 Delete any tuple in the BUS relation with a capacity greater than 80.

Will this operation cause an integrity constraint violation? (Yes) / No

If yes, name the integrity constraint(s) which will be violated:

Referential Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:

Referential Integrity Constraint : 2 TRIP.busIDs would reference nothing.
If operation A.6 is run, then the buses 20246, 20680 would be deleted.
Then, 2 of the trips, which TRIP.busID is 20246 and 20680, will now reference to nothing. It cause invalid references in database. Therefore, operation A.6 could not be run because it violate Referential Integrity Constraint.

A.7   Delete the tuple <0018460119, NULL> from TRAVELCARD.

Will this operation cause an integrity constraint violation? (Yes) /   No

If yes, name the integrity constraint(s) which will be violated:

 Referential Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:
Referential Integrity Constraint : a TRIP.cardID would reference to nothing.
If tuple <0018460119> from TRAVELCARD is deleted, then TRIP.cardID which referenced to
"0018460119" would now reference to nothing, which cause an invalid reference in the
database. Based on the information and instance data provided, all of the TRIP.cardID
reference the TRAVELCARD.cardID which had been recorded. Thus, operation A.7 violate the
Referential Integrity Constraint.

A.8   Insert the tuple <NULL, NULL, NULL> into PASSENGER.

Will this operation cause an integrity constraint violation? (Yes) /   No

If yes, name the integrity constraint(s) which will be violated:

 Entity Integrity Constraint

If yes, explain how the integrity constraint(s) would be violated:

Entity Integrity Constraint : primary key PASSENGER.passengerID is "NULL".
PASSENGER.passengerID is a primary key of PASSENGER, so the value of it could not be "
NULL". Based on the information and instance data provided, all other valid
PASSENGER.passengerID is not "NULL".
Therefore, operation A.8 violate the Entity Integrity Constraint.

SECTION B QUESTIONS START ON NEXT PAGE

Section B – Relational Mapping

For this diagram, complete ER to relation mapping and state your **final** relational schema, including any foreign keys which were created in the process.

- Your answers <u>must</u> follow the notation used in the lecture slide (a format guide will be posted on blackboard).

- Additionally, all foreign key definitions <u>must</u> directly follow the table for which they are defined.

Extended Bus TravelCard Database

To handle more complicated fares and billing, including transfers, and to accommodate more than one card reader per bus, the basic DB design in Section A was expanded to the DB below.

Note that this EER diagram shares some common features with the ER diagram from Section A, but some elements have changed as well as additions made.

EER diagram:
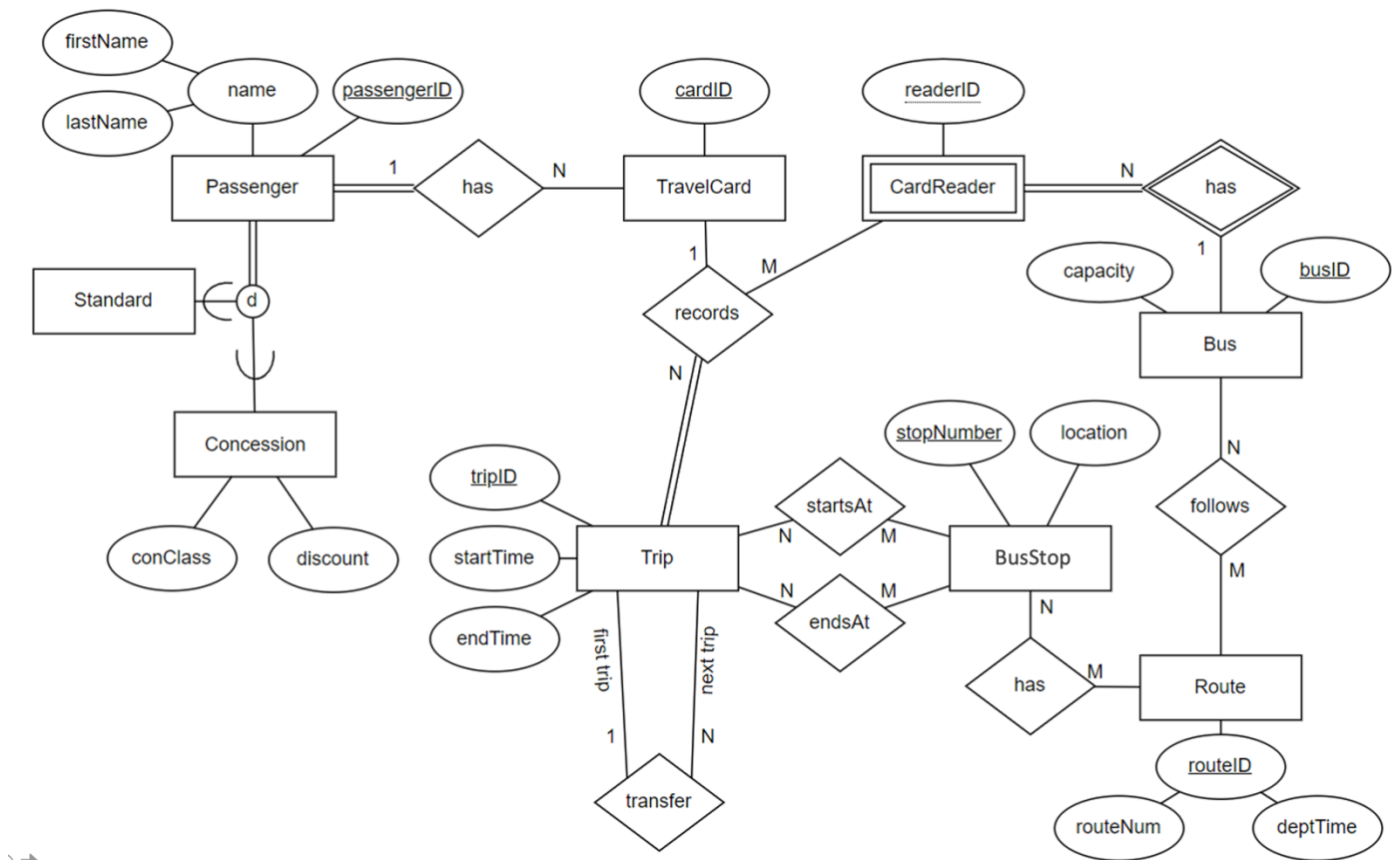
Additional information:

- Buses can have more than one card reader, and different readers can be used for a single trip on a single bus.

- A transfer occurs when the end of one trip is followed by the start of another trip from the same location within 15 minutes.

- Multi-hop transfers are also possible and are chained together for billing purposes, with any sequence of transfers completed within 2 hours billed as a single trip.

Section B answer: *Please put your mapping in the box below*

Passenger [passengerID, firstName, lastName]

TravelCard [cardID, passengerID]

TravelCard.passengerID referees Passenger.passengerID

Bus [busID, capacity]

Route [routeNum, deptTime]

BusStop[stopNumber, location]

CardReader [busID, readerID]

CardReader.busID references Bus.busID

Trip[tripID, startTime, endTime, nexttripID]

Trip.nexttripID references Trip.tripID

Follows[busID, routeNum, deptTime]

Follows.busID references Bus.busID

Follows. {routeNum, deptTime} references Route.{routeNum, deptTime}

Has [routeNum, deptTime, stopNumber]

Has.{routeNum, deptTime} references Route. {routeNum, deptTime}

Has.stopNumber references BusStop.stopNumber

startsAt [storNumber. tripID]

startAt.stopNumber references BusStop.stopNumber

startAt.tripID references Trip.tripID

endsAt.[stopNumber, tripID]

endsAt.stopNumber references BusStop.stopNumber

endsAt.TripID references Trip.tripID

records[busID, readerID, tripID, cardID]

records. {busID, readerID} references CardReader. {busID, readerID}

records.tripID references Trip.tripID

records.cardID references TravelCard.cardID

standard [passengerID]

standard.passengerID references Passenger.passengerID

Concession [passengerID, conClass, discount]

Concession.passengerID references Passenger.passengerID

Documenting the use of Generative AI

Please note that if you have used generative AI in any manner, you are required to provide a transcript of your engagement with the system in this section. You can simply copy and paste your discussion with the generative AI system below. It is fine if it goes across multiple pages.

A reminder that a failure to reference AI use may constitute student misconduct under the Student Code of Conduct.

Section C – RiPPLE Task

Using the RiPPLE online software, you must complete the following activities before the assignment due date:

- **Resource Creation**: Create one or more effective resource. For a learning resource to be considered as effective it needs to pass a moderation process which is administered by your peers and the teaching team. Teaching staff will be spot-checking to review moderations performed by just peers and change the outcome if necessary.

- **Resource Moderation**: Moderate 4 or more resources effectively. An effective moderation means that you have completed the moderation rubric and have provided a detailed justification for your judgement as well as constructive feedback on how the resource can be improved. Simply saying a resource is "good" does not qualify. Again, teaching staff will be spot-checking the quality of moderations and change the outcome when necessary.

- **Answering Questions**: Answer 10 or more questions correctly. To answer a resource correctly your first response must be correct. You can attempt as many questions as you want, and incorrect answers do not count against you. Only answers from the Practice tab are counted. Answering in-class RiPPLE activity questions does not count towards questions answers.

These tasks are to be completed through the RiPPLE platform, via the link available on Blackboard.

Note: For the above three activities, the resources you create, moderate and answer **must** be in the following categories on RiPPLE:

- Relational-model

- Map-ER-Schema

Creating, moderating or answering questions from other categories will not be counted towards your mark for the RiPPLE component of this assignment.