

School of Computer Science, McGill University
COMP-421B Database Systems, Winter 20016

Written Assignment 1: Data Modelling / Relational Algebra

Due date: February 4, 10 am

Exercise 1: E/R Modeling (45 Points)

In this exercise you have to model the program schedule of a TV channel (e.g. CBC).

- The channel only broadcasts series (to make our life easier). A series could be your typical TV series like Coronation Street (would you believe it – still going on) or Hearland, a documentary series (e.g., fifth estate, marketplace,), or comedy show (e.g., Rick Mercer Report).
- Each series has a name (e.g. “Coronation Street”), and a duration in multiple of 30 minutes (e.g., 30, 60, 90, ...).
- Each episode within a series has an episode number or a specific sub-title or anything that would differentiate it from the other episodes of this series. Also, it has a short 300 letter description indicating what is going on in this specific episode.
- For each documentary series, the names of all staff members that work for this series are recorded. For staff members, the typical information such as id, name, address, salary are recorded.
- For each TV series, actor information is recorded such as name, birthdate, link to web-page.
- The TV channel broadcasts from 6:00 to 24:00. For each day, the program is divided into slots of half an hour each (6:00-6:30, 6:30-7:00, 23:30 - 24:00).
- Each slot in the program schedule is now assigned an episode of a series. If a series lasts longer than half an hour its episodes will cover several consecutive time slots. Each episode can be broadcast several times (reruns....).
- An important part of each TV channel are commercials. Commercial time is sold in time frames of 20 seconds. Commercials are shown in packages, each being a couple of minutes long. In each half-an-hour slot, there can be several commercial packages. For each such commercial package we keep track of when exactly within the half-an-hour slot it starts (e.g., by the offset: 5 minutes means it starts at XX:05 or XX:35), and how many frames of 20 seconds it has.
- There exist 10 price categories, each category having a different price. All frames within a commercial package belong to the same price category.
- The system keeps track of companies that want to run commercials (e.g. Ford, Toyota, Canadian Tire). Companies are identified by their name, and have a billing address.
- Companies perform bookings on a per-month basis. Below is an example of the receipt for Ford’s booking for January.

Booking
ID: 23456
From: Ford

January 2016

In packages:

01-January / slot 25 / package 1: 1 frame: 200\$

01-January / slot 25 / package 2: 2 frames: 400\$

01-January / slot 26 / package 1: 1 frame: 300\$

...

31-January / slot 31 / package 1: 1 frame: 400\$

31-January / slot 31 / package 2: 1 frame: 800\$

31-January / slot 32 / package 3: 1 frame: 400\$

Total: 30,000\$

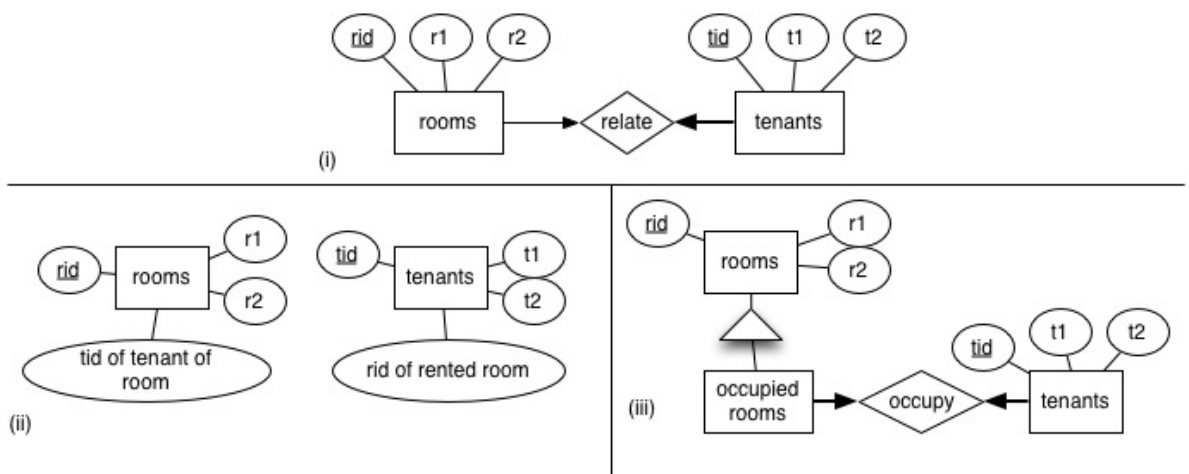
1. (30 Points) Design the E/R model for this specification. Provide adequate primary keys if necessary and underline all primary keys. Indicate two integrity constraints that must hold in the above scheme but that cannot be expressed in the E/R model.
2. (15 Points) Transform your diagram into the relational model (in the form $R(\underline{a}, b, c)$). Indicate primary keys by underlining them. Indicate foreign keys by underlining them with a dashed line and letting them point to the relation to which they relate. You do NOT need to write the SQL statements.

Exercise 2: Constraints (10 Points)

Assume a student housing building. There are rooms and their tenants. Among other things the following two integrity constraints hold.

- Each tenant has exactly one room.
- Each room has at most one tenant.

1. (15 Points) For each schema (i), (ii), (iii) indicate whether it reflects all required constraints. Give a reason for your decisions (i.e., for each schema and each constraint, give a reason why or why not the constraint is reflected in the schema).
2. (5 Points) Which of the three schemas would you prefer? Give a reason.



Exercise 3: Relational Algebra (45 Pts.)

Look at the following relational schema of a university database (with an example tuple for each relation)

Professor	(<u>pName</u> , depId, building, office, email) 'Bettina Kemme', 'COMP', 'McConnell', '109N', 'kemme@cs.mcgill.ca'
Department	(<u>depId</u> , depName, chairOfDepartment, faculty) 'COMP', 'Computer Science', 'Greg Dudek', 'Science'
Building	(<u>building</u> , administrator, address) 'McConnell', 'J. James', '3480 University Street'
Student	(<u>sid</u> , studentName, startYear, faculty) 260234715, 'B. Bridge', 2014, 'Science'
Course	(<u>cid</u> , depId, term, department, professor) 'COMP', 421, 'Winter2016', 'Bettina Kemme'
Enrolled	(<u>sid</u> , <u>depId</u> , <u>cid</u> , <u>term</u> , grade) 260234715, 'COMP', 421, 'Winter2016', 'A-'

Express the following queries using relational algebra:

1. (3 Pt) Give the names of all departments of the Faculty of Science together with the names of the department chairs.
2. (3 Pts) Give the names of all profs within the 'COMP' department who are not located in the McConnell building.
3. (5 Pts) What is the name of the administrator Prof. Kemme has to call when she has forgotten her office key?
4. (5 Pts) Give the name of the professor(s) who have taught COMP 250 and COMP 251.
5. (6 Pts) Give the cids of courses that are given by a professor who is currently department chair but not of the department that offers the course.
6. (7 Pts) Give the sids and names of all students who are enrolled in a course that is given by a prof who is not in the same faculty as the student.
7. (8 Pts) Give the name of the professor(s) and their departments that have not taught in Fall 2015.
8. (8 Pts) Give the names of all profs who have taught only one course so far.