CS317, Files and Database Systems:

Exercise #2 – Relations, Relational Algebra and Tuple Calculus

DUE: As Indicated on Canvas and Syllabus

Please thoroughly read DBMS text, Chapter 3 & 5, thoroughly (skipping Chapter #4 on normalization). Also, please read E.F. Codd’s paper, “A Relational Model of Data for Large Shared Data Banks”, available on Canvas and through the Hazy library. You may use MySQL if you want to continue practicing DDL/DML to verify your relational algebra and tuple calculus expressions (with equivalent SQL), but this assignment is purely theoretical. I have scanned and uploaded Chapter #4 from Conolly and Begg on Canvas to assist you with understanding relational algebra, tuple calculus and the formal basis of SQL and so you can work problems from this reference textbook.

Exercise #2 Requirements:

1) [15 points] Based on your reading and understanding of DBMS through Chapter 3, examine online documentation you can find at http://www.microsoft.com/en-us/server-cloud/products/sql-server/ and from Oracle for MySQL (http://www.oracle.com/technetwork/database/mysql/index.html) in the LAMP configuration we are using in class or other possible configurations, and identify support and compare for the following:
   a) [5 pts] Client-server architecture features for both
   b) [5 pts] Web-services features for both
   c) [5 pts] Service-oriented architecture for both

   Or, if you prefer, please read E.F. Codd’s paper in detail and provide the following:
   a) [5 pts] Summary of the paper and why it’s a landmark paper for DBMS.
   b) [5 pts] Comparison of the 5 Join operations we have covered in class and the Join operations described by E.F. Codd and note any differences and explain.
   c) [5 pts] Did E.F. Codd describe the relational algebra and calculus sufficiently to describe the basis for a relationally complete language like core SQL? Why or why not?

2) [10 points] For this next exercise, be sure you have read Connolly-Begg Chapter 4 made available on Canvas.

The following tables form part of a database held in a relational DBMS:-

Hotel (hotelNo, hotelName, city)
Room (roomNo, hotelNo, type, price)
Booking (hotelNo, guestNo, dateFrom, dateTo, roomNo)
Guest (guestNo, guestName, guestAddress)
where Hotel contains hotel details and hotelNo is the primary key;
    Room contains room details for each hotel and (roomNo, hotelNo) forms the primary key;
    Booking contains details of the bookings and (hotelNo, guestNo, dateFrom) forms the primary key;
and Guest contains guest details and guestNo is the primary key.

a) [5 pts] Identify the FK (Foreign Keys) in this schema.
b) [5 pts] Explain how the entity and referential integrity rules apply to these relations.

3) [30 points] Based on your reading of Connolly-Begg Chapter 5, and using the Hotel schema from problem #2 also defined at the start of the Exercises at the end of Chapter 4 (page 118), describe the relations that would be produced by the following relational algebra operations:
a) [5 pts] \( \Pi_{\text{hotelNo}} (\sigma_{\text{price} > 50} (\text{Room}) ) \)
b) [5 pts] \( \sigma_{\text{Hotel}.\text{hotelNo} = \text{Room}.\text{hotelNo}} (\text{Hotel} \times \text{Room}) \)
c) [5 pts] \( \Pi_{\text{hotelName}} (\text{Hotel} \bowtie \text{Hotel}.\text{hotelNo} = \text{Room}.\text{hotelNo} (\sigma_{\text{price} > 50} (\text{Room}))) \)
d) [5 pts] \( \Pi_{\text{guestName}, \text{hotelNo}} (\text{Booking} \bowtie \text{Booking}.\text{guestNo} = \text{Guest}.\text{guestNo} \bowtie \text{Guest}) \div \Pi_{\text{hotelNo}} (\sigma_{\text{city} = \text{London}} (\text{Hotel})) \)

4) [30 points] Based on your reading of Connolly-Begg Chapter 5, and using the Hotel schema from problem #2 also defined at the start of the Exercises at the end of Chapter 4 (page 118), provide the equivalent tuple relational calculus expressions for each of the relational algebra queries that follow:
a) [5 pts] \( \Pi_{\text{hotelNo}} (\sigma_{\text{price} > 50} (\text{Room}) ) \)
b) [5 pts] \( \sigma_{\text{Hotel}.\text{hotelNo} = \text{Room}.\text{hotelNo}} (\text{Hotel} \times \text{Room}) \)
c) [5 pts] \( \Pi_{\text{hotelName}} (\text{Hotel} \bowtie \text{Hotel}.\text{hotelNo} = \text{Room}.\text{hotelNo} (\sigma_{\text{price} > 50} (\text{Room}))) \)
d) [5 pts] \( \Pi_{\text{guestName}, \text{hotelNo}} (\text{Booking} \bowtie \text{Booking}.\text{guestNo} = \text{Guest}.\text{guestNo} \bowtie \text{Guest}) \div \Pi_{\text{hotelNo}} (\sigma_{\text{city} = \text{London}} (\text{Hotel})) \)

5) [15 points] Based on your reading of Connolly-Begg Chapter 5, and using the Hotel schema from problem #2 also defined at the start of the Exercises at the end of Chapter 4 (page 118), provide the tuple relational calculus expressions and relational algebra expression for each new relation as described:
a) [5 pts] List of all hotels
b) [5 pts] List the name and cities of all guests.

c) [5 pts] List of the price and type of all rooms at the Grosvenor Hotel.

Overall, provide a well-documented professional report of your findings, output, and tests so that it is easy for a colleague (or instructor) to understand what you’ve done, what worked, what did not and why (even if you can’t complete to your satisfaction). Include any SQL source code and commands you write (or modify). I will look at your report first, so it must be well written and clearly address each problem providing clear and concise responses to receive credit, but I will look at your SQL (record each successful command you issue if interactive) as well if I have questions.

In this class, you’ll be expected to consult the Oracle MySQL reference manual and tutorial pages and to do some reading and research on your own, so practice this in this first lab and try to answer as many of your own questions as possible, but do come to office hours and ask for help if you get stuck.

Upload all SQL you develop and your report completed using MS Word or as a PDF to Blackboard and include any supporting information you want in appendices (ideally example output should be integrated into the report directly, but if not, clearly label in the report and by filename if test and example output is not pasted directly into the report). Your report must include SQL so I can repeat your queries and replicate your results. Please zip your solution with your last name embedded in the file name.
CS317 Grading Rubric

[15 points] Reading, analyzing and summarizing technical materials:

[5 pts] a) ____________________________________________________________

[5 pts] b) ____________________________________________________________

[5 pts] c) ____________________________________________________________

[10 points] Knowledge and understanding of the relational model:

[5 pts] a) ____________________________________________________________

[5 pts] b) ____________________________________________________________

[30 points] Understanding of relational algebra

[5 pts] a) ____________________________________________________________

[5 pts] b) ____________________________________________________________

[5 pts] c) ____________________________________________________________

[5 pts] d) ____________________________________________________________

[5 pts] e) ____________________________________________________________

[5 pts] f) ____________________________________________________________

[30 points] Understanding of tuple relational calculus

[5 pts] a) ____________________________________________________________

[5 pts] b) ____________________________________________________________

[5 pts] c) ____________________________________________________________

[5 pts] d) ____________________________________________________________

[5 pts] e) ____________________________________________________________

[5 pts] f) ____________________________________________________________

[30 points] Applying relational algebra and calculus

[5 pts] a) ____________________________________________________________

[5 pts] b) ____________________________________________________________

[5 pts] c) ____________________________________________________________