Homework 01 - Relational Algebra

Extra Credit Early Submission Deadline: **Sunday Sep 15 @ 11:59** to GradeScope
Regular Submission Deadline: **Tuesday Sep 17 @ 11:59** to GradeScope

Directions:
1. From the File Menu, make a copy of this document in your own Google Drive account OR download an MS Word version.
2. Provide **professional-quality, type-set** solutions for each of the stated questions.
   - Do not delete the actual question statement. However, you may add additional space between the questions to accommodate your answers.
   - ***Your solutions must be typeset***. The solutions you incorporate into this document MAY NOT be handwritten. This includes not writing them on an iPad and then copying them (or a screen shot) into this document. I suggest you use some type of equation editor in your writing tool of choice or use LaTeX to typeset your responses where appropriate.
   - Pay attention to appropriate use of subscripts.
   - To reiterate, handwritten solutions in any form will receive NO CREDIT.
3. **Generate a PDF of your document with your solutions**. DO NOT upload screenshots, images, or pictures. Reminder, DO NOT delete the question statements. If you compose your solutions in LaTeX, please retype the questions (you don't need to include the tables and diagrams)
4. Upload your solutions document to GradeScope by the due date. **It is your responsibility to associate each question with your solution in GradeScope.** Failure to do so will result in no credit for any questions not linked with your solution *and will not be a valid reason to request a re-grade*.

Academic Collaboration Reminder:
Remember that you may not look at, copy, capture, screenshot, or otherwise take possession of any other students' solutions to any of these questions. Further, you may not provide your solutions in part or in whole to any other student. Doing any of the above constitutes a violation of academic honesty which could result in an F in this class and a referral to OSCCR.

What is permissible? You are free and encouraged to talk to your peers about the conceptual material from the lectures or the conceptual material that is part of this assignment. You can get a round a white board and talk through the data model described on Page 4. You and your colleagues can work through sample relational algebra expressions done in class or others that you dream up on the fly. I'm very confident that each of you knows where the line between collaborative learning and cheating sits. Please don't cross that line.

Part 1: Set Theory

Given:

Let A = {1, 2, 3, 4}, B = {1, 3, 5, 7}, C = {2, 4, 6, 8}, and D = {p, q}.

1. What is the result of the following operations? Provide your solutions in proper set notation where appropriate. [4 points each]

1.1. $(A \cup B)$

1.2. $(B \cap C) - A$

1.3. $(A \times D) \cap (B \times D)$

1.4. $(A \cap B) \times C$

Part 2: Relational Algebra Interpretation

Rel_1		
A	B	C
10	saturn	9
5	pluto	7
17	mercury	3
19	earth	5

Rel_2	
F	C
large	10
medium	5
small	3
dwarf	7

Rel_3	
A	M
10	74897
13	7.92
19	7926
17	3032

2. Determine the resulting relation instance for each of the following relational algebra expressions. Your solution to each of these will be a table of data. The order of rows or columns doesn't matter. [4 points each]

2.1 $\sigma_{(C<7)}(Rel\_2) \bowtie \sigma_{(A>12)}(Rel\_1)$

2.2 $Rel\_2 \bowtie_{(Rel\_2.C=Rel\_3.A)} Rel\_3$

2.3 $\pi_{(B,C)}(Rel\_1 \bowtie Rel\_3)$

2.4 $(\pi_{(A)}(Rel\_1)) \times (\sigma_{(C>=7)}(Rel\_2))$

3. Rewrite each of the following Relational Algebra queries so they will produce equivalent output WITHOUT using the join operator. [4 points each]

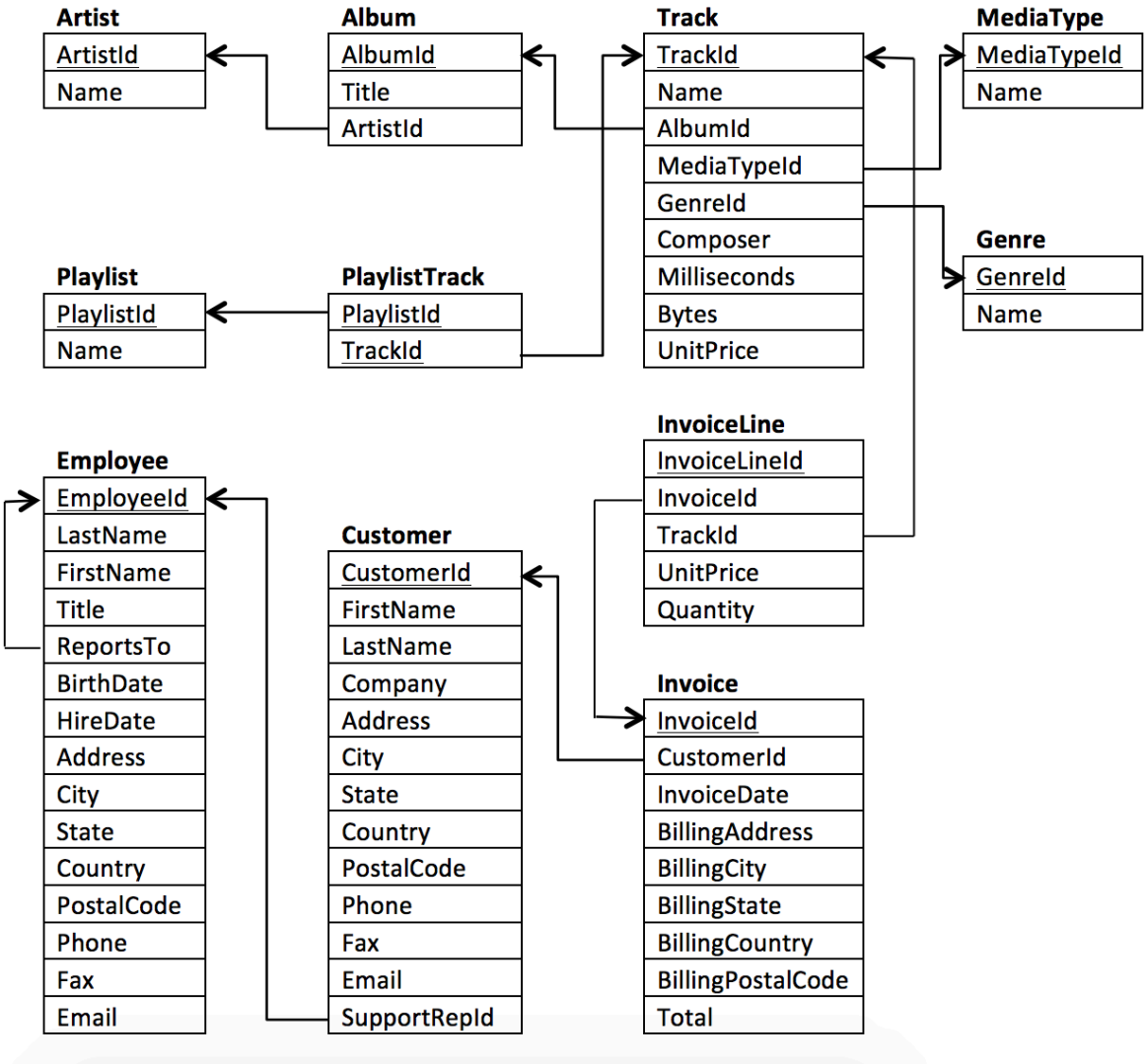
3.1 $\sigma_{(C<7)}(Rel\_2) \bowtie \sigma_{(A>12)}(Rel\_1)$

3.2 $Rel\_2 \bowtie_{(Rel\_2.C=Rel\_3.A)} Rel\_3$

Part 3: Relational Algebra Query Generation

This is the data model for the Chinook Database, which supports a fictitious music e-commerce site that sells *tracks*. Each track is stored in a particular digital format and has an associated genre; many tracks may share the same genre, however. The site also supports playlists, where one single track can be part of multiple playlists but may not be included as part of any playlist. An artist may have created 1 or more albums, but may not have created any. Each customer order is memorialized in an invoice which is composed of one or more InvoiceLines, each representing one track purchased. Note that the Quantity attribute of InvoiceLine indicates the *number of copies of the particular track that was purchased as part of the associated invoice*. Every customer is assigned an employee representative, and each employee is supervised by another employee. It is possible that an employee has no customers assigned to them. Since the CEO does not report to another employee, this is stored in the database as the CEO reporting to themselves.

Each arrow represents a foreign key/primary key relationship. The arrow points *from* the child relation *to* the parent relation.



Use the Chinook Data Model on the previous page to construct Relational Algebra queries for each of the following prompts. [15 points each]

4. Management needs a list of the first names, last names, and email addresses of all customers from Massachusetts and Connecticut. You were told that the database stores the regular two character code for each state.

5. We need to encourage artists to broaden their appeal by producing tracks in the 'Rock' genre. Provide a list of artist names whose tracks ***only*** fall in the 'Rock' genre.

6. Chinook is pushing the use of playlists by having sales reps reach out to customers. Provide a list of the names and email addresses of all employees that represent customers who have purchased tracks that do not appear on any playlist. (Note, the customer may have also purchased tracks that appear on a playlist in addition to some that don't appear on a playlist).

7. Provide a list of names, titles, and email addresses of the managers of any employee that represents a customer that has placed at least 1 individual order with a total in excess of $250.00.