Exam 1 Part 2 Solutions

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Pledge (Must be signed according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

_______________________________________________
Signature

For scoring use only:

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**Question 4 (ER Diagram) [20 points]**

Consider the following two ER diagrams:

1. **[5 points] What is the difference between the two ER diagrams?**

   The first diagram has three 2-way relationships while the second diagram has only one three-way relationship.

2. **[5 points] Which diagram is stricter with respect to expressiveness? Why?**

   The second diagram is stricter. It requires all three entities appearing in the same relationship. For example, Drinker Alex may only prefer Bud Lite in Bar-1, while Bar-1 also sells other beers but Alex doesn’t like them. Maybe Bar-2 sells Bud Lite too, but Alex doesn’t like the Bud Lite in Bar-2. And the three-way relationship also requires Bud Lite to be sold in Bar-1, while the relationships in Diagram 1 don’t enforce this constraint.

3. **[10 points] Transform the first ER model into a corresponding database schema. Identify the primary keys and foreign keys. You need not include data types in the schema.**

   Bars (name, addr, licence)
   Beers (name, manf)
   Drinkers (name, addr)
   Frequent (drinker_name, bar_name),
       drinker_name → Drinkers.name, bar_name → Bars.name
   Likes (drinker_name, beer_name)
       drinker_name → Drinkers.name, beer_name → Beers.name
   Sells (bar_name, beer_name)
       bar_name → Bars.name, beer_name → Beers.name,
Question 5 (Relational Algebra) [30 points]

We have 3 relations, all about movies: Columns in the primary key are underlined.

- Movies(title, year, director, country, rating, genre, gross, producer)
- Actors(title, year, character name, actor)
  (Title, Year) form a foreign key referencing Movies
- Awards(title, year, award, result)
  The foreign key is the same as for Movies. The values of award could be, e.g., Oscar, Golden Globe, Cesar, Palm, etc; the values of result are won or nominated. The primary key also indicates that if a movie won an award, the corresponding nomination entry is not recorded in the database.

1. [5 points] List the actors who played more than one character in the same movie.

   \[
   \rho_{R_1}(\text{Actors}) \\
   \rho_{R_2}(\text{Actors}) \\
   \pi_{R_1.\text{actor}}(\sigma_{R_1.\text{title}=R_2.\text{title}\land R_1.\text{year}=R_2.\text{year}\land \text{R1.actor}=R_2.\text{actor}\land \text{R1.cname}\neq R_2.\text{cname}}(R_1 \times R_2)
   \]

2. [5 points] Find the movies made in the 90s that won every award they were nominated for.

   \[
   \pi_{\text{title.year}}(\sigma_{\text{year}>1989\land \text{year}<2000\land \text{result}='\text{won'}}(\text{Awards}) - \\
   \pi_{\text{title.year}}(\sigma_{\text{year}>1989\land \text{year}<2000\land \text{result}='\text{nominated'}}(\text{Awards})
   \]

3. [5 points] Find the actors who only act in high grossing (more than $50 million) movies.

   \[
   \rho_{R_1}(\sigma_{\text{gross}<50}(\text{Movie} \bowtie \text{Actors})) \\
   \pi_{\text{actors}}(\text{Actors}) - \pi_{\text{actors}}(R_1)
   \]

4. [5 points] Find the movie directed by Steven Spielberg which has the highest rating.

   \[
   \rho_{R_1}(\sigma_{\text{director}='\text{Steven Spielberg'}}(\text{Movies})) \\
   \rho_{R_2}(R_1) \\
   \rho_{R_3}(1\rightarrow \text{title} , 2\rightarrow \text{year} )(\sigma_{R_1.\text{rating}<R_2.\text{rating}}(R_1 \times R_2)) \\
   \pi_{\text{sid}}(R_2 - R_3)
   \]

5. [5 points] Find all pairs of movies (m1, m2) nominated for the same award, such that m1 has a higher rating than m2, but m2 won the award.

   \[
   \rho_{R_1}(\text{Movies} \bowtie \text{Actors}) \\
   \rho_{R_2}(\text{Movies} \bowtie \text{Actors}) \\
   \pi_{R_1.\text{title}, R_1.\text{year}, R_2.\text{title}, R_2.\text{year}}(\sigma_{R_1.\text{award}=R_2.\text{award}\land \text{R1.rating}>R_2.\text{rating}\land \text{R1.result}='\text{nominated}\land \text{R2.result}='\text{won'}}(R_1 \times R_2)
   \]
6. [5 points] Find the directors who directed a movie which won all the awards that appear in the Awards table.

\[ \pi_{\text{director}}(\text{Movies} \bowtie (\pi_{\text{title,year,award}}(\sigma_{\text{result} = \text{'won'}}(\text{Awards}))/\pi_{\text{award}}(\text{Awards}))) \]