CS 348 - Homework 3

Relational Algebra, Procedure and Trigger

Fall 2022

This assignment is to be completed by individuals. You should only talk to the instructor, and the TA about this assignment. You may also post questions (and not answers) to Campuswire. There will be a 10% penalty if the homework is submitted 24 hours after the due date, a 20% penalty if the homework is submitted 48 hours after the due date, or a 30% penalty if the homework is submitted 72 hours after the due date. The homework will not be accepted after 72 hours, as a solution will be posted by then.

Submission Instructions: For questions 1 to 9, write your answers on the latex file provided with this homework and generate a pdf file. Submit your latex file to Brightspace. Submit your pdf file to Gradescope. For questions 10 and 11, write your code in the supplied skeleton files. Submit your files to Brightspace.

Sample syntax:

$\pi_{A,B}(R \bowtie S)$

$\pi_{A,B}(R \bowtie_{R.A=S.A} S)$

$\pi_{A,B}(R \times S)$

$\pi_{A,B}((\sigma_{R.A=123 \wedge S.B<=20000}(R \bowtie S))$

$\pi_{A,B}((\sigma_{R.A=123 \wedge S.B<=20000}(R \bowtie S))$

$\pi_{A,B}(R \rtimes S)$

$\pi_{A,B}(R \ltimes S)$

$\pi_{A,B}(R \rtimes S)$

$R \cap S \cup T - U$

1. (4 points): List all genres.

   Answer:

   $\pi_{genre} video\_game$

2. (5 points): List names and ranks of games working on the 'Wii' platform.

   Answer:

$a1 \leftarrow video\_game\ vg \bowtie_{vg.platform\_id=p.platform\_id}\ platform\ p$
$a2 \leftarrow \sigma_{platform\_name='Wii'}\ a1$
$a3 \leftarrow \pi_{name,rank}\ a2$

3. (5 points): Redo the previous query using cross product(no join operation is allowed).

   Answer:

   $a1 \leftarrow video\_game \times platform$
   $a2 \leftarrow \sigma_{video\_game.platform\_id=platform.platform\_id}\ a1$
   $a3 \leftarrow \sigma_{platform\_name='Wii'}\ a2$
   $a4 \leftarrow \pi_{name,rank}\ a3$

4. (6 points): For platforms developed by Sony, list the platform name, the developer name (i.e., Sony), and the names of games working on the platform. Include platforms that have no games.

   Answer:

   $a_1 \leftarrow \sigma_{name='Sony'}\ (platform \bowtie developer)$
   $a_2 \leftarrow a_1 \rtimes_{platform.developer\_id=video\_game.publisher\_id}\ video\_game$
   $a_3 \leftarrow \pi_{platform\_name,developer.name,video\_game.name}\ a_2$

5. (5 points): List all possible video game name and region pairs (e.g., ('Pokemon Ruby/Pokemon Sapphire', 'North America'), ('Pokemon Ruby/Pokemon Sapphire', 'Japan'), ..., ('Pokemon Black/Pokemon White', 'North America'), ('Pokemon Black/Pokemon White', 'Japan'), ... etc.). The video game does not have to have a sales record in the region.

   Answer:

   $a_1 \leftarrow \pi_{name}\ region$
   $a_2 \leftarrow \pi_{name}\ video\_game$
   $a_3 \leftarrow a_1 * a_2$

6. (8 points) List the ids of the developers (publishers) who have **never** developed games in the "Sports" genre.

   Answer:

   $t_1 \leftarrow \pi_{publisher\_id}(\sigma_{genre=\text{“}Sports''}(\mathsf{video\_games} \bowtie_{\mathsf{video\_games}.publisher\_id=\mathsf{developer}.id} \mathsf{developer}))$
   $\mathsf{result} \leftarrow \pi_{id}(\mathsf{developer}) - t_1$

7. (10 points) List the name of video games which either have sales record in Japan, or has developer's (publisher) headquarter in Japan.

   Answer:

   $t_0(vg\_name, region\_id) \leftarrow \pi_{name,region\_id}(\mathsf{video\_games} \bowtie_{\mathsf{video\_games}.rank=\mathsf{games\_sales}.game\_rank} \mathsf{games\_sales})$
   $t_1 \leftarrow t_0 \bowtie \sigma_{name=\text{“}Japan''}(\mathsf{region})$
   $t_2 \leftarrow \pi_{vg\_name}(t_1)$
   $t_3(vg\_name, headquarters) \leftarrow \pi_{\mathsf{video\_games}.name,headquarters}(\mathsf{video\_games} \bowtie_{\mathsf{video\_games}.publisher\_id=\mathsf{developer}.id} \mathsf{dev}$
   $t_4 \leftarrow \pi_{vg\_name}(\sigma_{headquarters=\text{“}Japan''}(t_3))$
   $\mathsf{result} \leftarrow t_2 \cup t_4$

8. (10 points) List names of platforms that have only **ONLY** "Sport" games.

Answer:

$$t_1 \leftarrow \pi_{platform\_id}(\sigma_{genre=\text{“}Sports\text{”}}(\mathsf{video\_games}) \bowtie \mathsf{platform})$$
$$t_2 \leftarrow \pi_{platform\_id}(\sigma_{genre\neq\text{“}Sports\text{”}}(\mathsf{video\_games}) \bowtie \mathsf{platform})$$
$$\mathsf{result} \leftarrow \pi_{platform\_name}((t_1 - t_2) \bowtie \mathsf{platform})$$

9. (12 points) List the name of any developer who has published video games in all genres.

Answer:

$$t_1 \leftarrow \pi_{genre,publisher\_id}(\mathsf{video\_games} \bowtie_{\mathsf{video\_games}.publisher\_id\ \mathsf{developer}.id} \mathsf{developer})$$
$$t_2 \leftarrow \pi_{genre,publisher\_id}(\mathsf{video\_games} \times \mathsf{developer})$$
$$t_3 \leftarrow \pi_{publisher\_id}(t_2 - t_1)$$
$$t_4 \leftarrow \pi_{id}(\mathsf{developer}) - t_3$$
$$t_5 \leftarrow pi_{name}(t_4 \bowtie \mathsf{developer})$$

10. Triggers (15 points). We can use triggers to keep track of all changes in a database. Create triggers on the developer table to keep track of all changes in the name and headquarters attributes. Store those changes in the table developer_log (attr, old_value, new_value), where attr is equal to either 'name' or 'headquarters'. In updates, save the old and new value of attributes that have changed. In inserts, save the values of the

new row in the new_value column (old_value must be set to an empty string). In deletes, save the values of the deleted row in the old_value attribute while setting new_value to an empty string.

For example, consider the following statements.

Insert Into developer (5, 'ABC', 'Germany');
Update developer set name = 'DEF' WHERE id = 5;
Update developer set name = 'GHI', headquarters = "Italy" WHERE id = 5;
Delete FROM Developer Where id = 5;

The developer_log must look like the following:

(attr, old_value, new_value)
name, "", "ABC"
headquarters, "", "Germany"

name, "ABC", "DEF"

name, "DEF", "GHI"
headquarters, "Germany", "Italy"

name, "ABC", ""
headquarters, "Germany", ""

11. Stored Procedure (20 points). Consider the video games database. Suppose we want to recommend N games to a friend. The first requirement is that the recommended games must have different genres, work on different platforms, and published by different companies. The second requirement is that those N games are best sellers (i.e., try to increase the sum of total sales as much as possible). For example, if N is 5 then the list of games will be the following.

```
mysql> select * from result;
+-------+--------------------------+---------------+---------+----------------------+-------------+
| rank1 | name                     | platform_name | genre   | game_publisher       | total_sales |
+-------+--------------------------+---------------+---------+----------------------+-------------+
|     1 | Wii Sports               | Wii           | Sports  | Nintendo             |       82.74 |
|    16 | Kinect Adventures!       | X360          | Misc    | Microsoft            |       21.82 |
|    17 | Grand Theft Auto V       | PS3           | Action  | Take-Two Interactive |       21.39 |
|    29 | Gran Turismo 3: A-Spec   | PS2           | Racing  | Sony                 |       14.97 |
|    34 | Call of Duty: Black Ops 3 | PS4           | Shooter | Activision           |       14.24 |
+-------+--------------------------+---------------+---------+----------------------+-------------+
5 rows in set (0.00 sec)
```

Figure 1: Stored Procedure Expected Output

Note that game with rank 2 is not included because it has the same publisher as game with rank 1 and the latter has a higher total sales. Similarily, game with rank 17 was

not included because it shares the same genre ‘Action’ as game with rank 16 while the latter has a higher total sales.

The stored procedure receives one parameter (N) and save its output in the result table (create-table statement is included in the schema.sql file).