Middle East Technical University | Department of Computer Engineering

CENG351 - Data Management and File Structures

In-class Assignment 2 - Relational Algebra - 70 minutes

Name-Surname: TEST ID Number: TEST

Story

You are applying for a job posting of lead database administrator in a competition program similar to MasterChef and you are in the theoretical exam stage. The previous administrator designed a cooking recipe database for online applications of the competition and you should answer some relational algebra questions on this database so that you can be accepted for the job.

Question 1 - 15 points

Fill the blanks with correct numbers or phrases. (Assume that all "xxxFoods" relations are union-compatible. Also, you should answer the questions by considering all possibilities.)

- The relation "IndianFoods" contains 12 rows and the relation "ChineseFoods" contains 65 rows. The maximum number of rows in "IndianFoods" - "ChineseFoods" can be 12.
- The relation "BilecikFoods" contains 20 rows and the relation "EskişehirFoods" contains 12 rows. Their intersection contains maximum 12 rows, minimum 0 rows.
- The relation "Recipe" contains 21 rows and the relation "Ingredients" contains 11 rows. Their condition join contains maximum 231 rows, minimum 0 rows.

Question 2 - 10 points

Considering the following schemas and tables:

- Review1(email, recipeName)
- Review2(email, rating, recipeName)
- Review3(email, recipeName)

Review1	
email	recipeName
sofia@google.com	Lasagna
cafeteria@metu.edu.tr	Havuc Borona

Review2		
email	rating	recipeName
sofia@google.com	4	Lasagna
yang@gg.com	2	Hot Pot

Review3	
email	recipeName
danilo@yahoo.com	Lasagna
bolu@hotmail.com	Kuru Fasulye

Which of the expressions below is not valid (legal) under the above three ReviewX relation instances.

a) $\rho(Temp1,\ Review1\ X\ Review2)$
$\rho(Result, Review1 \bowtie Temp1)$

b) $\rho(Temp1,\ Review2\ X\ Review2)$
$\rho(Result,\ Temp1\ X\ Review1)$

c) $\rho(Temp1,\ Review1\ -\ Review3)$
$\rho(Result, Review1 \bowtie Temp1)$

d) $\rho(Temp1,\ Review2\ -\ Review3)$
$\rho(Result,\ Temp1\ X\ Review1)$

e) $\rho(Temp1,\ Review1 \bowtie Review2)$
$\rho(Result, Review1 \bowtie Temp1)$

Review 2 and Review 3 are not union-compatible

Question 3 - 20 points

Consider the following schemata:

- **Cook**(email, name, surname, birthDate, expertise)
- **Recipe**(recipeName, email, creationDate, summary, price, categoryID) where email REFERENCES **Cook**
- **Ingredient**(ingredientName, energyAmount)
- **Use**(ingredientName, recipeName, email, amount) where (recipeName, email) REFERENCES **Recipe**, ingredientName REFERENCES **Ingredient**
- **Reviewer**(email, name, surname, birthdate, expertise)
- **Review**(recipeName, cookEmail, reviwerEmail, rating, reviewDate) where reviewerEmail REFERENCES **Reviewer**, recipeName REFERENCES **Recipe**, cookEmail REFERENCES **Cook**

Write a relational algebra expression that finds the names of all cooks who use less than 24 grams of soy sauce in their "Ramen" recipe.

$\rho(soyID, \Pi_{ingredientID}(\sigma_{ingredientName="soy\ sauce"}Ingredient))$

$\rho(TempUses, \Pi_{recipeName,email}(\sigma_{amount<24\,gram \wedge recipeName="Ramen"}(soyID \bowtie_{ingredientID} Use)))$

$\rho(TempRecipes, \Pi_{email}(TempUses \bowtie Recipe))$

$\rho(Names, \Pi_{names}(TempRecipes \bowtie Cook))$

Question 4 - 20 points

By using the schemata in Question 3, write a relational algebra expression that finds the name(s) of the cook(s) who submitted the recipe that uses the minimum amount of salt among categoryID 2 recipes (Assume that all recipes in categoryID 2 contain salt).

$\rho(Cat2Recipes, \Pi_{recipeName,email}(\sigma_{categoryID=2}Recipe))$

$\rho(SaltAmount, \Pi_{email1,amount}(Cat2Recipes \bowtie (Use \bowtie (\sigma_{ingredientName="salt"}Ingredient))))$

$\rho(Pairs(1\to email1, 2\to amount1, 3\to email2, 4\to amount2), SaltAmount \times SaltAmount)$

$\rho(Temp, \Pi_{email1}(\sigma_{amount1>amount2}Pairs))$

$\rho(Name, \Pi_{name}(Cook \bowtie (\Pi_{email}Cat2Recipes - Temp)))$

Question 5 - 20 points

By using the schemata in Question 3, write a relational algebra expression that finds the names of ingredients that all recipes submitted by the cook(s) named "Hanife" contain.

$\rho(HanifeRecipes, \Pi_{recipeName,email}(\sigma_{name="Hanife"}(Cook \bowtie Recipe)))$

$\rho(TempIngredients, \Pi_{ingredientID}((HanifeRecipes \bowtie Use) / HanifeRecipes))$

$\rho(IngredientNames, \Pi_{ingredientName}(TempIngredients \bowtie Ingredient))$

Question 6 - 15 points

Reviewer				
email	name	surname	birthdate	expertise
yk@ceng.metu.edu.tr	yavuz	kara	14.02.1998	Chinese
og@ceng.metu.edu.tr	oguz	godelek	20.05.1998	Turkish
asu@ceng.metu.edu.tr	aslı umay	ozturk	17.01.1998	Chinese
cu@ceng.metu.edu.tr	can	unaldı	14.11.1995	Italian
rfc@ceng.metu.edu.tr	recep fırat	cekinel	15.12.1995	Italian

Review				
recipeName	cookEmail	reviewerEmail	rating	reviewDate
Bottarga	italian@yahoo.com	og@ceng.metu.edu.tr	1	11.01.2019
Risotto	chefchef@gmail.com	rfc@ceng.metu.edu.tr	4	14.02.2018
Dim Sums	yang@aliyun.com	asu@ceng.metu.edu.tr	2	01.01.2019
Risotto	superchef@hotmail.com	cu@metu.edu.tr	5	12.11.2020
Hot Pot	wang@metu.edu.tr	asu@ceng.metu.edu.tr	4	01.05.2019
Dim Sums	yang@aliyun.com	yk@ceng.metu.edu.tr	1	02.01.2022
Lasagne	chefchef@gmail.com	yk@ceng.metu.edu.tr	4	02.11.2020
Lasagne	chefchef@gmail.com	cu@ceng.metu.edu.tr	4	02.01.2020
Kuru Fasulye	mehmetchef@gg.com	asu@ceng.metu.edu.tr	3	05.02.2019
Hot Pot	chen@aliyun.com	yk@ceng.metu.edu.tr	2	02.01.2021
Kuru Fasulye	mehmetchef@gg.com	og@ceng.metu.edu.tr	4	02.12.2019

Draw the relation tables that are the results of the relational algebra expressions below (Note: x > y when comparing dates means x is a date later than y).

- $\Pi_{email,name}((\sigma_{reviewDate<01.01.2020 \wedge reviewDate>19.12.2018}(Review)) \bowtie_{email=reviewerEmail} Reviewer) \cup \Pi_{email,name}(\sigma_{birthdate>01.01.1996} Reviewer)$

email	name
og@ceng.metu.edu.tr	oguz
asu@ceng.metu.edu.tr	aslı umay
yk@ceng.metu.edu.tr	yavuz

- $\Pi_{name,expertise}(\text{Reviewer} \bowtie_{email=reviewerEmail} (\sigma_{cookEmail=\text{"}chefchef@gmail.com\text{"}} Review))$

name	expertise
yavuz	Chinese
can	Italian
recep fırat	Italian