Weekly exercises IN3020 and IN4020
Week 4

February 11, 2022

1 Review

1. Why do we need to extend the definition of projection? Examples?
2. When is $\times$ defined?
3. What is $\bowtie_\theta$? How can you express $\bowtie_\theta$ using σ and $\bowtie$?
4. Discuss the different types of inner join operations.
5. What is the anti-join ($\triangleleft$ and $\triangleright$) and the semi-join ($\ltimes$ and $\rtimes$)?
6. Discuss the different types of outer joins.
7. Which of the following operators are idempotent? Why or why not?
   δ, π_L, σ_C, γ_L

2 Relational Algebra for sets and bags

Here are two bag relations:

```
R[A,B]: [(1,2), (3,4), (1,2), (3,5), (4,5)]
S[A,B]: [(1,2), (3,5), (3,6), (4,5), (1,3), (4,5)]
```

And two relations:

```
T[A,B]: {(1,2), (3,4), (3,5), (4,5)}
U[A,B]: {(1,2), (3,5), (3,6), (4,5), (1,3)}
```

Compute the following expressions:

1. $\sigma_{A=3}(R \cup^b S)$
2. $\sigma_{A=3}(T \cup U)$
3. $\sigma_{A=3}(T \cup^b U)$
4. $S \setminus R$

5. $U \setminus T$
6. $\pi^b_A(R)$
7. $\pi_A(R)$
8. $\pi^b_A(T)$
9. $\pi_A(T)$

3 Relation algebra computations

Here are two relations:

```
R[A,B]: {(1,2), (3,4), (1,3), (3,5), (4,5)}
S[B,C]: {(1,2), (3,5), (3,6), (4,5), (1,3), (4,6)}
```

Compute the following:

1. $\pi_{A^2,B^2,A+B}(R)$
2. $\pi_{B-1,C+1}(S)$
3. $\pi_{A,B,\text{NULL}\to C}(R)$
4. $(S \cup^b S)$
5. $(S \cup S)$
6. $\delta(R \cup^b (\rho_{B\to A,C\to B}(S)))$
7. $\gamma_{A,AVG(B)}(R)$
8. $\gamma_{B,SUM(C)}(S)$

4 Expression of operators

Consider the same two relations:

```
R[A,B]
S[B,C]
T[C,D]
```

1. Express the following Relational Algebra expression by using a theta-join:
   $\pi_{A,C}(\sigma_{A>100} R \bowtie S)$
2. Express the following Relational Algebra expression using a theta-join:
   $\pi_A(\sigma_{A>B \wedge B>4}(R \bowtie S))$
3. One can express δ a using the γ operator. How?

4. Express without anti-join:
   $R \triangleright S$

5 Constraints

In this exercise, consider four relations with the following schemas (the domains and the meaning of the attributes are as expected):

```
Product[manufacturer,model,type]
PC[model,speed,ram,hd,price]
Laptop[model,speed,ram,hd,screen,price]
Printer[model,color,type,price]
```

1. Express that `model` in `PC` is a foreign key referencing `model` in `Product`.

2. Express the constraint that no manufacturer of PCs can also produce printers.