

# **Database Systems I**

## **CS3431**

### **Solution of Homework 2**

Problem 1 (Map ERD to Relational Model) [30 Points]

Publisher (Name, address, phone, startYear)

Author (ID, DoB, name, address)

AuthorPhone(AuthorID, Phone)

Foreign key AuthorPhone.AuthorID references Author.ID

Book (ISBN, title, type, numPages, PublishDate, PublisherName)

Novel (ISBN, sequel)

Textbook (ISBN, edition)

Foreign key Book.PublisherName references Publisher.Name

Foreign key Novel.ISBN references Book.ISBN

Foreign key Textbook.ISBN references Book.ISBN

// Note that this is one possible design. Other designs are also possible, e.g., you may have only one relation “Book” that has ‘sequel’ and ‘edition’ columns. These columns may contain nulls.

BookAuthor (ISBN, AuthorID)

Foreign key BookAuthor.ISBN references Book.ISBN

Foreign key BookAuthor.AuthorID references Author.ID

Contract (ContractID, TotalPayment, Date, NumBooks, PublisherName, AuthorID)

Foreign key Contract.PublisherName references Publisher.Name

Foreign key Contract.AuthorID references Author.ID

ContractLines (ContractID, LineNum, BookType, DueDate, PartialPayment)

Foreign key ContractLines.ContractID references Contract.ContractID

Problem 2 (Relational Algebra) [30 Points (5 Points each query)]

\*\*Note: There can be multiple possible expressions.

Q1:

$$\pi_{name} (\sigma_{phone="1-555-444-7777"} (Author \bowtie_{ID=AuthorID} AuthorPhone))$$

Q2:

$$\sigma_{ISBN="1112223333444"} (Book)$$

Q3:

$$R1 \leftarrow \sigma_{date \geq Jan-01-2007 \text{ and } date \leq Dec-31-2008 \text{ and } TotalPayment > 100,000} (Contract)$$

$$R2 \leftarrow (R1 \bowtie_{AuthorID=Author.ID} Author) \bowtie_{PublisherName=Publisher.Name} Publisher$$

$$Result \leftarrow \pi_{author.name, author.address, publisher.name, publisher.address, date} (R2)$$

Q4:

$$\pi_{publisherName}(\sigma_{cnt>10} (\gamma_{publisherName, cnt \leftarrow count(ISBN)}(Book)))$$

Q5:

$$\pi_{numPages}(\sigma_{title="TheCountry"}(Book) \bowtie \sigma_{edition=3}(TextBook))$$

Q6:

$$R1 \leftarrow \gamma_{ContractID, sumPartial \leftarrow sum(PartialPayment)}(ContractLines)$$

$$\pi_{R1.ContractID}(\sigma_{TotalPayment <> sumPartial} (R1 \bowtie Contract))$$

**Problem 3 (Relational Algebra) [15 Points (5 Points each query)]**

**\*\*Note:** There can be multiple possible correct expressions.

**Author**(name, address, URL) → A  
**Book**(ISBN, title, year, price, publisher\_Name) → B

**WrittenBy**(name, address, ISBN) → W  
**Publisher**(name, address, phone, URL) → P

**Warehouse**(code, phone, address) → H  
**Stocks**(ISBN, WH\_code, number) → S

**Shopping-Basket**(basketID, email) → SB

**basketContains**(ISBN, basketID, number) → BC

**Customer**(email, name, address, phone) → C

Q1:

$$R1 \leftarrow \hat{\pi}_{ISBN}(\sigma_{CNT=2}(\gamma_{ISBN, CNT < -Count(*)}(W)))$$

$$R2 \leftarrow \pi_{ISBN}(\sigma_{name='Mark Smith'}(W))$$

$$R3 \leftarrow R1 \setminus R2$$

$$Result \leftarrow \hat{\pi}_{title, year}(R3 \Join B)$$

Q1 (Another Sol):

$$R1 \leftarrow \pi_{ISBN}(\sigma_{CNT=2}(\gamma_{ISBN, CNT < -Count(*)}(W)))$$

$$R2 \leftarrow \pi_{ISBN}(\sigma_{name='Mark Smith'}(R1 \Join_{R1.ISBN=W.ISBN} W))$$

$$Result \leftarrow \pi_{title, year}(R2 \Join B)$$

Q2:

$$\gamma_{email, SUM < -sum(number)}(SB \Join BC)$$

Q3:

$$R1 \leftarrow \pi_{name}(\sigma_{year=2010}(B \Join_{B.ISBN=W.ISBN} W))$$

$$R2 \leftarrow \pi_{name}(\sigma_{year=2011}(B \Join_{B.ISBN=W.ISBN} W))$$

$$Result \leftarrow \delta(R1 \cap R2)$$

Problem 4 (Relational Algebra) [25 Points (5 Points each)]

<b>R</b>			<b>S</b>			
X	B	C	A	B	C	D
1	2	5	$\alpha$	$\alpha$	1	7
3	4	6	$\alpha$	$\beta$	5	7
1	2	7	$\beta$	$\beta$	12	3
			$\beta$	$\beta$	23	10

Assume we have the two relations R and S as shown above. Answer the following questions:

1. The output schema is

V	X	B	C
1	1	2	5
1	1	2	7

2. Write the output relation from the following expression (if the relation is empty, then state so):

$$\sigma_{X=3} (R \bowtie S)$$

**Empty because B column domains are different.**

3. Write the output relation from the following expression (if the relation is empty, then state so):

$$\sigma_{A>1} (\Pi_{A \leftarrow X+B, C} R) \bowtie \Pi_C (S),$$

A	C
3	5

4. Write the output relation from the following expression (if the relation is empty, then state so):

$$R - S$$

**Not allowed since R and S are not union compatible. You may also say the results is empty.**

5. Write the output relation from the following expression (if the relation is empty, then state so):

$$R \bowtie_{(X=Z \text{ or } C=Z)} \gamma_{B, \text{sum}(C) \text{ As } W, \text{min}(D) \text{ As } Z} (S)$$

X	R.B	C	S.B	W	Z
3	4	6	$\beta$	40	3
1	2	7	$\alpha$	1	7