山口教授御中
データベース 金(3)の週1th
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08-174570

(問1) $R \cup S := \{t \mid t \in R \text{ or } t \in S\}$

RUS	a	b	c
	a	d	c
	a	b	d

[no-duplicates]

$R - S := \{t \mid t \in R \text{ and } t \notin S\}$

R-S	a	d	c

[anything in R not in S, nothing from S]

$R \times S := \{tq \mid t \in R \text{ and } q \in S\}$ | $\{R \cap S = \phi\}$

As $R \cap S \neq \phi$ then we must rename R's and S's $(a,b,c) \to (a,b,c)_r$ and $(a,b,c)_s$. Further we refer as (a_r, b_r, c_r) and (a_s, b_s, c_s).

RXS	a_r	b_r	c_r	a_s	b_s	c_s
	a_r	b_r	c_r	a	b	d
	a	d	c	a_s	b_s	c_s
	a	d	c	a	b	d

$\pi_{1,3}(R)$:= removal of non-listed numerated columns AND removal of duplicate rows

$\pi_{1,3}(R)$	a	c
	a	d

$\sigma_{\lambda t(\pi_2(t)=b)}(R)$

The σ operation is a selection of logical calculus. The λ abstraction tells that we should replace the free variable 't' with the expression of selecting any b in the 2nd column [of R]. Again, $\sigma_p(R) := \{t \in R \text{ and } P(t)\}$, where $P(t)$ is a logical expression of propositional calculus, using any comparison predicate ($=, >, <, \geq, \leq$, etc.)

Here, our $P(t)$ is $\pi_2(t) = b$, and λ tells us to evaluate the $P(t)$ which follows. In short, we must select only those 2nd column values in R where the value is equivalent to 'b'. First row is b, but second row is not b.

Therefore,

$\sigma_{\lambda t(\pi_2(t)=b)}(R)$	b

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(問2) It is here I should admit my Japanese is lacking and I will probably write my answes all in English. To this extent, I will also be writing translations to problems so you understand my thought process better, esp. if I'm not sure I understand the question correctly.

"Using the 5 major operations of relational algebra, obtain any value equivalent to (a,b) in the (1st, 2nd columns) of expression R".

(1) $\sigma_{x \in f} (\pi_{1,2}(t) = (a,b)) (R)$

(2) Where $R' = \{(a,d)\}$

$\pi_{1,2}(R) \overset{(not)}{\neg} R'$

(3) If we set for $R' = \{(a,b)\}$, then...

... De Morgan's laws says I can obtain $R \cap R'$, with the union of the compliments: $R^c \cup R'^c$

(4) Where we know $R \times R'$ to be a constructive function, we must use other operations to achieve the goal. Let's also make $R' = \{()\}$ [the set of no-value;]. yet non-empty

$(\sigma_{2=B}(R)) \times R'$

(5) $\pi_{(1,2)}(R - R')$ if $R' = \{(a, d, c)\}$

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(問3) (A definition for R divide S is provided.)
Express this division in some combination of the 5 types of relational algebra.

If the cartesian product is the inverse of the division operator, then as product P is $P = R \times S$, then $P \div R = S$ and $P \div S = R$;

Relational to $R \div S$, first we must project R over attributes of R not in S, and take the cartesian product with S, over all columns from 1-n.

$\rightarrow \pi_{1,\dots,n}(R) \times S$

Next, subtract all tuples originally in R, so that all original duplicates are removed from the mapping projection. Further subtract that result from a set of an original selection of columns $1, \dots, n$ as appropriate from only set R.

$$\rightarrow \boxed{R \div S = \left(\pi_{(1,\dots,n)}(R)\right) - \left(\left(\pi_{(1,\dots,n)}(R) \times S\right) - R\right)}$$

(問4) Can commonalities of $R \wedge R'$ be expressed by relational algebra?

While this is normally done in sets quite easily with $R \wedge R'$, intersection ($\wedge$) is not a valid symbol. However, union ($\vee$) is - and De Morgan's law says $R \wedge R'$ is the same as $R^c \vee R'^c$ (the union of each's compliment set). So yes, it can be done.

(問5) Why is there relational algebra for set difference (eg. R-S), but not for compliments ($\overline{R}$, $\overline{S}$, etc.)?

All sets in question must be of finitely calculatable size, and with (any non-theoretical, serious, non-infinite/universal) sets R, S this should be feasible.

However, compliments can be relative fields with infinite (or at least large finite, approaching infinite) number of entries, or worse - the entire universe set! (Think of natural numbers $\mathbb{N}$, complex numbers $\mathbb{C}$, or even universal set $\mathbb{U}$.) It is not possible for us to comprehend any relational mapping that allows us to calculate a finite value operation on an infinite value.

(問6) Show the following are true

(1) $\sigma_{p_1}(\sigma_{p_2}(R)) = \sigma_{p_1 \wedge p_2}(R)$

To visualise, use a sample (R) of

R

p_1	p_2
1	2
3	4

On the right side, selecting both $p_1 \wedge p_2$ gives the common $p_1 \cap p_2$.
On the left side, selecting only column p_2 then p_1 also is $p_1 \cap p_2$.

(2) ?. - dimensional mismatch, so should be false

(3) This is an extension of the associative property of sets.

(問7) Show the following are true

(1) $R \cup \phi = R$

An empty set will not add nor subtract from R in an union operation of $t \in R$ or $t \in \phi$.

-correct

(2) As $R \times \phi := \{tq \mid t \in R \text{ and } s \in \phi\} \mid (R \cap \phi \neq \phi)$

Then as $s = \phi$ and mapping a product to the null set is always null, then $tq = \phi$, hence $R \times \phi = \phi$.

(問8) Using any valid 5-operations of relational algebra make a table R{(name, address, phone)} from tables P{(name, phone)} and Q{(name, address)}?

This is often referred to as a natural join, of symbol '⋈'. Here we must do $R = P \bowtie Q$.

This is equivalent to:

$R = \pi_{p.name,\, p.phone,\, q.address} (\sigma_{p.name = q.name} (P \times Q))$

in long-form relational-algebraic notation.

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(問 9) A relation is created R(Supplier, Item) based off items each [Store] supplier will sell. Make an expression of relational algebra to show such a situation relation 'R' for items sold at all the stores.

Supplier (column) = S
Items (column) = I

Table →

S	I
⋮	⋮

$\pi_{(S,I)}\left(\sigma_{(S \neq S \wedge I = I)}(R)\right)$ = common items that all stores will sell

(問 10) Using the relations on the 1st page of the handout [Movie, StarsIn, MovieStar, MovieExec, Studio] Show the following situations in relational algebraic form.
Also (問 11) write answers of 10 in relational logic form.

(1) Black & White (non-color) films after 1970 'titles'
→ Non-color → where boolean inColor = 0 → show this
→ After 1970 → where year > 1970

$\pi_{title}(\sigma_{(incolor=0 \wedge year>1970)}(Movie))$ or

$\{t.title \mid t \in Movie, incolor = 0 \wedge year > 1970\}$

(2) MGM-produced, monochrome, post-1970 movie 'titles' → show this

$\pi_{title}(\sigma_{(incolor=0 \wedge year>1970 \wedge studioname='MGM')}(Movie))$ or

$\{t.title \mid t \in Movie, incolor = 0 \wedge year > 1970 \wedge studioname='MGM'\}$

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(問10/11 cen.) (3) MGM's address

$\pi_{address}(\sigma_{(name=MGM)}(Studio))$

(where π (project) operation removes duplicates already)

or

$\{t.address \mid Studio, name=MGM\}$

(4) Sandra Bullock's birthday

$\pi_{birthdate}(\sigma_{(name='Sandra\ Bullock')}(MovieStar))$ or

$\{t.birthdate \mid MovieStar, name='Sandra\ Bullock'\}$

(5) Movie stars from the 1980 (hit?) title 'Love'

$\pi_{starName}(\sigma_{movieYear=1980 \wedge movieTitle='Love'}(StarsIn))$ or

$\{t.starName \mid StarsIn, movieYear=1980 \wedge movieTitle='Love'\}$

(6) Names of producers with a net worth of greater than \$10,000,000 (10 million USD)

$\pi_{name}(\sigma_{(netWorth>10000000)}(MovieExec))$ or

$\{t.name \mid MovieExec, netWorth>10000000\}$

Fun Fact:

ちなみに、僕はGeorge Lucasと同じ町の「Modesto」で日本へ来る前まで学校行ったり、そこで育ちました。

(7) Male (movie) stars living in Malibu, names

$\pi_{name}(\sigma_{(address='Malibu' \wedge gender='M')}(MovieStar))$ or

$\{t.name \mid MovieStar, address='Malibu' \wedge gender='M'\}$

(8) Names of male actors who starred in 'Terms of Endearment'.

$\pi_{StarsIn.starName}(\sigma_{(StarsIn.movieTitle='Terms\ of\ Endearment' \wedge MovieStar.gender='M' \wedge StarsIn.starName=MovieStar.Name)}(StarsIn \times MovieStar))$

or

$\{t.(StarsIn.starName) \mid StarsIn \times MovieStar\} \wedge$
$\{StarsIn \times MovieStar \mid t \in StarsIn, u \in MovieStar, t.starName=u.Name \wedge t.movieTitle='Terms\ of\ Endearment' \wedge u.gender='M'\}$

(9) Names of movie stars in MGM's 1995 films.

$\pi_{StarsIn.starName}(\sigma_{(Movie.year=1995 \wedge Movie.studioName='MGM' \wedge Movie.title=StarsIn.MovieTitle)}(Movie \times StarsIn))$

$\{t.(StarsIn.StarName) \mid Movie \times StarsIn\} \wedge$
$\{Movie \times StarsIn \mid t \in StarsIn, u \in Movie, u.year=1995 \wedge u.studioName='MGM' \wedge u.title=t.MovieTitle\}$

(10) Producer of Star Wars

$\pi_{producerC}(\sigma_{(title='Star\ Wars')}(Movie))$

$\{t.producerC \mid Movie, title='Star\ Wars'\}$

[以下略]

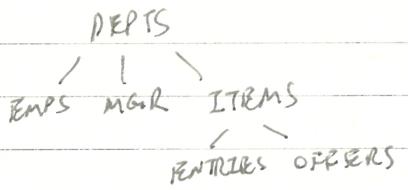
Lockbook

(問12) What are things that Excel can do that relational algebra cannot? The opposite way around?

Excel can calculate total numbers of things to find sum and average - functions not closed by the properties of relational algebra.
Also, it can conduct transitive matrix calculations to determine the reachability of point A to point B.

In the opposite direction, all five relational algebra operations can be done with basic functions of excel or from macro programs based on those basic functions.

(問13) Convert tree 'DEPTS' to relational algebra?



(relation)

$$\hookrightarrow R = \left(\pi_{EMPS,\, MGR,\, ITEMS}(DEPTS)\right) \cup$$

$$\left(\pi_{ENTRIES,\, OFFERS}(ITEMS) \;\middle|\; ITEMS = ENTRIES \times OFFERS\right)$$

(問14) Convert the relational schematic problem 25 to a relational flowchart object-oriented model?

→ Wait, what is problem 25? Also, this is a good place to end, so I will stop week 1 homework here.