

Relational Algebra: A formal query language based on a set of operations on relation

fundamental operation

✓✓ Select

✓✓ Project

- Cartesian product

Additional operation

- Natural join
- Intersection
- Assignment

• Union

• Set difference

• Rename

• Division/quotient

• θ -join

Above operations DOES NOT MODIFY the database/ record

SELECT operation (σ)

→ σ Entire row satisfying cond: C_i

This is a unary operation defined on single relation

$\sigma_{\text{year}=2016}(\text{book})$

$\sigma_{C_i}(r)$

① Show/select all the book records having publication year = 2016

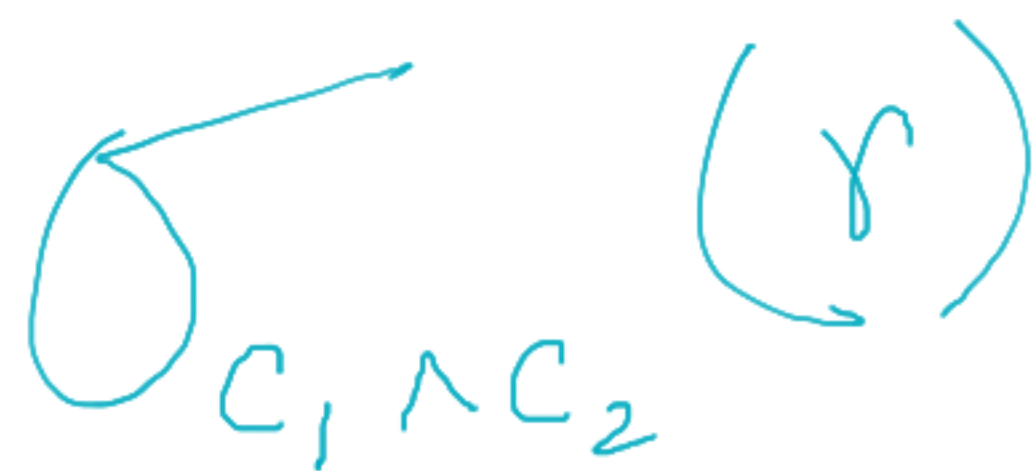
$\sigma_{\text{AccNo} \geq 10000}(\text{book})$

15501 → Yes

1009 → No

$\sigma_{(\text{AccNo} \geq 10000) \wedge (\text{year}=2016)}(\text{book})$

10002	2015	X
999	2016	X
100003	2016	✓



$C_1 := (\text{accno} \geq 10000)$
 $C_2 := (\text{year} = 2016)$
 $r := \text{book}$

$C_1 \vee C_2$ (r)

✓
 10002
 999
 100005

2015 ✓
 2016 ✓
 2016 ✓


X
 9999 2011

$(\text{title} = \text{'DBMS'}) \wedge (\text{year} = 2020)$ (book)

SELECT ALL the books WHERE title is DBMS AND year of pub. is 2020 from book relation

Book

Acc No	Year	Title
1005	2020	<u>DBMS</u> ✓
10012	2020	<u>DBMS</u>
1003	2016	DBMS

 year \neg = 2016 (bool)

↑

not

Projection (π)

$\pi_{C_i}(r)$

takes in one relation as argument and produces ~~one~~ another relation as an o/p.
This is also a UNARY operation

Book (accno, title, Year)

accno	title	Year

$\pi_{\text{accno, title}}(\text{book})$

↓

accno	title

 title (book)

How many columns?

Ans: 1

Book

Acc No	title	Year
A001	DBMS	2020
A002	OS	2019
A003	DL	2016
A004	C	2016

Π
title (Book)
→

title
DBMS
OS
DL
C

Combine 'Selection' & 'Projection'

book

AccNo	title	Year
A001	DBMS	2020
A002	OS	2019
A003	DL	2016
A004	C	2016

$\sigma_{\text{Year} = 2016}$ (book)

r

Accno	title	Year
A003	DL	2016
A004	C	2016

Find the book titles which published in 2016

$\pi_{\text{title}}(\sigma_{\text{Year} = 2016}(\text{book}))$

title
DL
C

$\leftarrow \pi_{\text{title}}(r)$

year = 2016

title, year

(book)

Acc No	title	Year
A001	DBMS	2020
A002	OS	2019
A003	DL	2016
A004	C	2016

title	Year
DBMS	2020
OS	2019
DL	2016
C	2016

title	Year
DL	2016
C	2016

$$\pi(\sigma_i(x)) \approx \sigma_i(\pi(x))$$

not always the same

H.W. : check with some examples

Cartesian Product (x)

$$a = r(A')$$

$$b = r(B')$$

A'
1 ✓
2 ✓
3 ✓

B'
A ✓
B ✓

✓ ✓ ✓
✓ ✓ ✓

How many rows and columns
in $a \times b$

Ans: #row = 6, #col = 2

$$a \times b = r(A') \times r(B')$$

A'	B'
1	A
1	B
2	A
2	B
3	A
3	B



γ

A	B
a	1
b	2
a	2

δ

B	C
3	1a
2	2b

$\gamma \times \delta$

row = 6

col = 4

$\gamma.A$	$\gamma.B$	$\delta.B$	$\delta.C$
a	1	3	1a
b	2	3	1a
a	2	3	1a
a	1	2	2b
b	2	2	2b
a	2	2	2b

$r = \text{user} \times \text{borrow}$ has how many attributes?
 $r = u \times b$

✓ $u \rightarrow \underline{u.\text{card no}}, u.\text{bname}, u.\text{badd}$
✓ $b \rightarrow \underline{b.\text{acc no}}, \underline{b.\text{card no}}, b.\text{date}$

Find acc. no.s of all books issued to "chandra"

$\pi_{b.\text{acc no}} \left(\sigma_{(u.\text{bname} = \text{"chandra"}) \wedge (u.\text{card no} = b.\text{card no})} (u \times b) \right)$

\neg $\text{accno} \wedge (\text{user} \times \text{borrow})$

$\equiv \neg \text{accno}(\text{borrow})$

\neg
True / False

~~0001~~
~~1001~~
~~0001~~

Since user does not have
accno

Users

A	B	C
Card no	b name	b addr
C001	ABC	pat
C002	xyz	luc

get acc no. of those books have been borrowed

borrow

D	E	F
b acc no	b card no	b addr
A001	C001	240124 ✓✓
A002	C002	20224 ✓✓

$\pi_{b acc no}$ (borrow)

b acc no
A001
A002

240124
200224

$\pi_{acc no}$ (User X borrow)

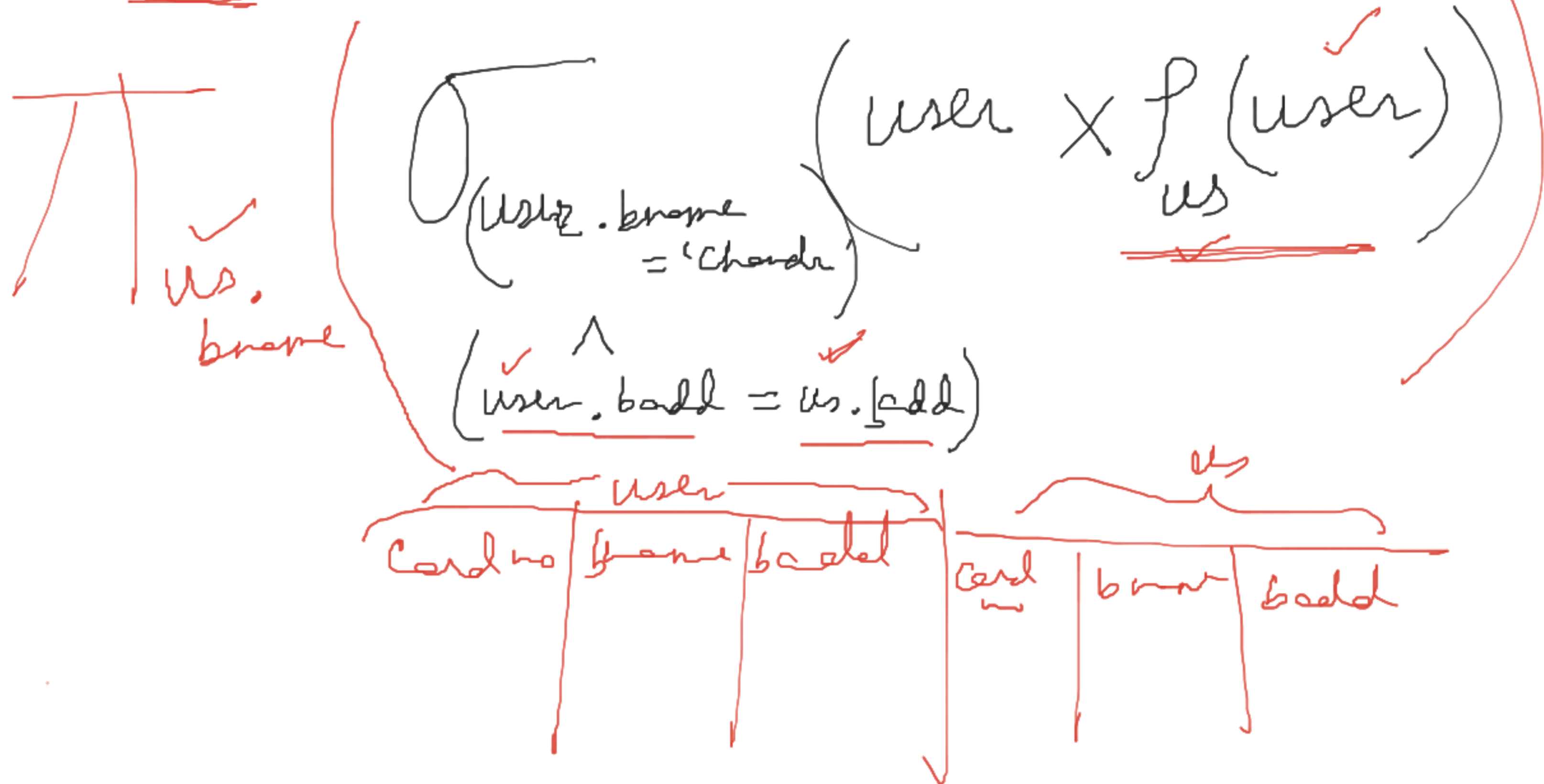
A001
A002

240124
200224

A	B	C	D	E	F
C001			A001	✓ 240124	
C001			A002	→ 201224	
C002			A001	✓ 240124	
C002			A002	→ 200224	

RENAME operation (f) rho

Find the name of all users who have the same address as "chandra"



old name
of relation

new name
of relation

