Division / quotient operation ($\div$)

$r(R)$

A	B
p	a
q	a
p	b
p	c
q	t
m	a
q	b

$s(S)$

B
a
b

if $r \div s$, then SCR

$r \div s$ has all attributes of R-S, s.t. R has combinations of all possible values of S

$r \div s$

A
p
q

$\neq \Pi_A(r \bowtie s)$

If a supplier x supplied all books those are issued to Cardno 'C01'

S_Name
x

$$\Pi_{Accno,\ Sname}(Supplier) \div \Pi_{Accno}(\sigma_{Cardno='C01'}(Borrow))$$

Sname	Accno
x	A00-1
x	A00-2

Accno
A00-1
A00-2

$$r \div s$$

$$= \Pi_{R-S}(r) - \Pi_{R-S}\left(\left(\Pi_{R-S}(r) \times s \right) - r \right)$$

H.W.

Assignment operator

$$t \leftarrow \Pi_A(r \bowtie s)$$

$$m \bowtie \left(\Pi_A(r \bowtie s) \right)$$

$$\Downarrow$$

$$m \bowtie t$$

functional dependency (F.D.)

book (AccNo, Year, title)

AccNo → Year [Year is functionally dependent on AccNo]

A01 → 2010
A01 → 2015
✗

A01 → 2015
A02 → 2015
✓

JOIN

Natural Join

$$R \bowtie S(S) = \pi_{RUS}\left(\sigma_{\substack{R.A_1 = S.A_1 \\ \vdots \\ R.A_n = S.A_n}}(R \times S)\right)$$

$$R \cap S = \{A_1, A_2, \ldots, A_n\}$$

Theta (θ) Join

$$R \bowtie_\theta S = \pi_{RUS}\left(\sigma_\theta (R \times S)\right)$$

$$A \bowtie_\theta B$$

Sqr

num	square
2	4
3	9
4	16

Cu

num	cube
2	8
3	27
5	125

Sqr ⋈ Cu

num	square	cube
2	4	8
3	9	27

Equi Join → Sqr.num = Cu.num

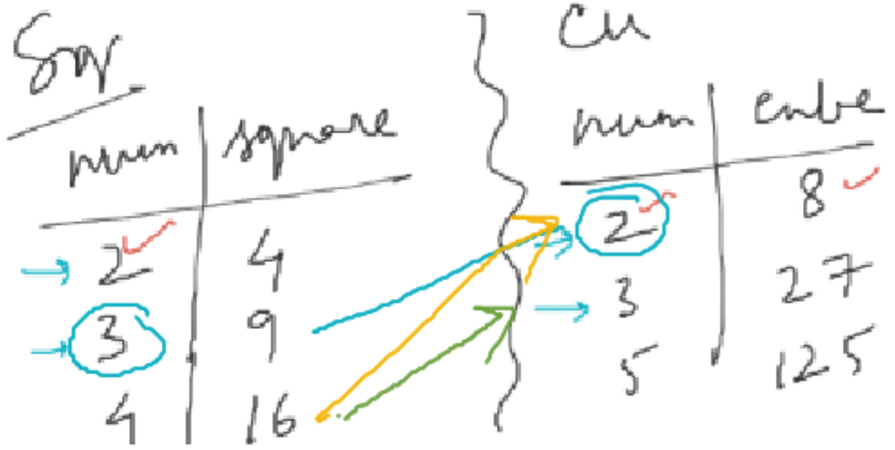
θ-Join → Sqr.num > Cu.num

Sqr.num

Sqr × Cu

Sqr.num	square	Cu.num	cube
2	4	2	8
2	4	3	27
2	4	5	125
3	9	2	8
3	9	3	27
3	9	5	125
4	16	2	8
4	16	3	27
4	16	5	125

clear check?



Sqr ⋈$_\theta$ Cu

Sq.num > Cu.num

Sq.num	Sqnare	Cu.num	cube
3	9	2	8
4	16	2	8
4	16	3	27

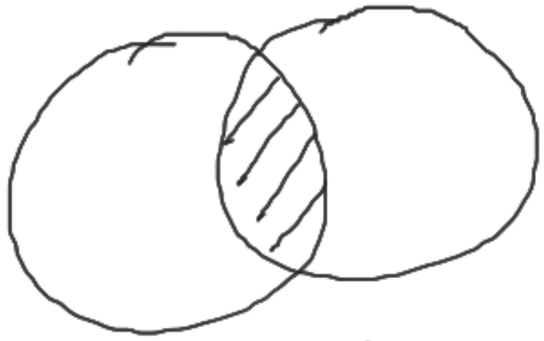
* Diff. b/w Natural Join & Equi Join

$$r \bowtie s = \Pi_{R \cup S}\left(\sigma_{r.A_1 = s.A_1 \,\ldots\, r.A_n = s.A_n}(r \times s)\right)$$

$$R \cap S = \{A_1, A_2, \ldots, A_n\}$$

In Natural Join, by default all common attributes will be taken.

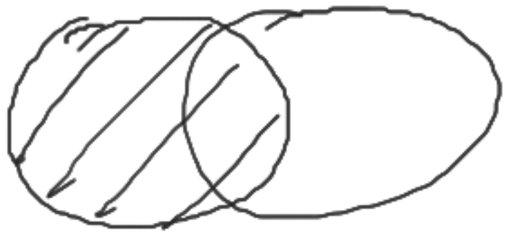
Equi-Join , we can explicitly take the attributes, on which we can perform the equality



$r \bowtie s$

inner join

Θ - Join



$r \ltimes s$

left (outer) join

$r \rtimes s$

right (outer) join

full (outer) join

$r \bowtie s$

$r \bowtie s$

$\downarrow$

$(r \ltimes s) \cup (r \rtimes s)$

$= (r \ltimes s) \cup (s \ltimes r)$

$s \ltimes r$

Sqr

num	square
2	4
3	9
4	16

Cu

num	cube
2	8
3	27
5	125

Sqr ⋈ Cu

num	square	cube
2	4	8
3	9	27
4	16	NULL

Sqr ⟕ Cu

num	square	cube
2	4	8
3	9	27
5	NULL	125

Sqr ⟗ Cu

num	square	cube
2	4	8
3	9	27
4	16	NULL
5	NULL	125

Self Join

S1 S2

Sqr

num	square
→ 2	4
→ 3	9
4	16

Cu

num	cube
→ 2	8
→ 3	27
5	125

$f_{S1}(Sq)$

$f_{S2}(Sq)$

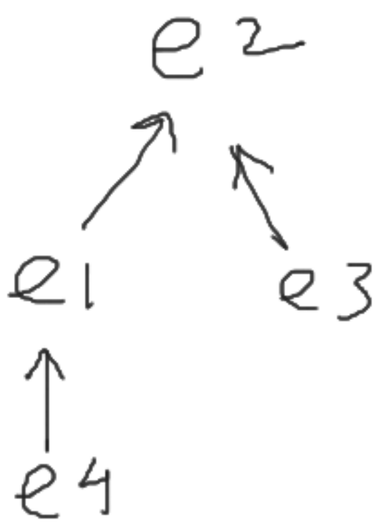
S1.num = S2.square

S1 num	S2 square
4	4

emp

input

eid	ename	mid
e1	A	e2
e2	B	NULL
e3	C	e2
e4	D	e1



output

ename	managername
A	B
B	NULL
C	B
D	A

(Self Join)

emp id	Salary
e1	1
e2	1.1
e3	1.5
e4	0.9

between 1.1 and 2

1.1, 1.5 / 1.5