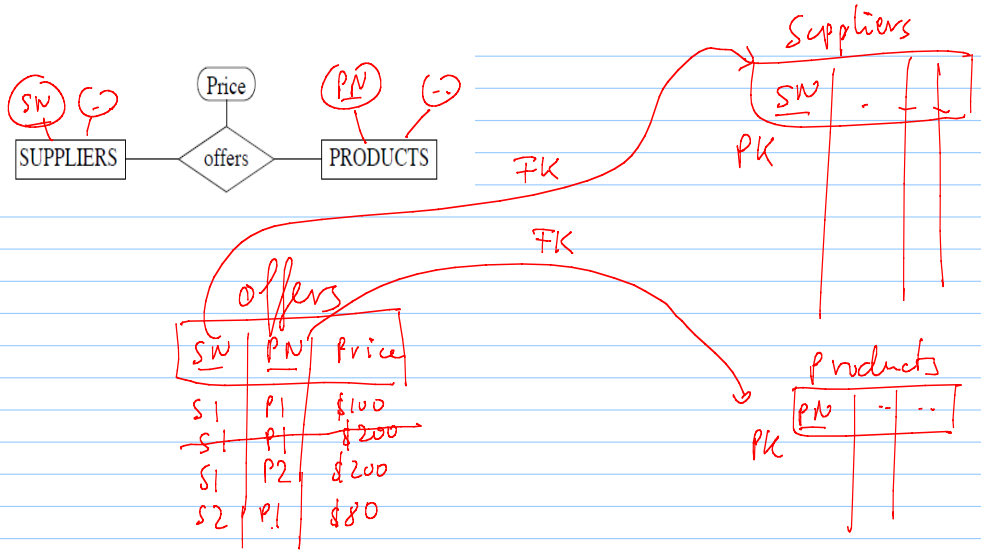
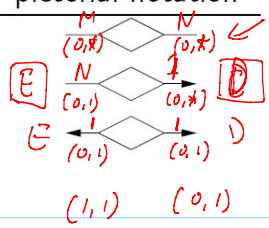


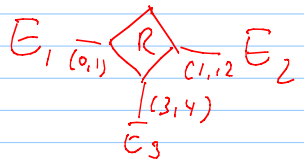
10/8/2013

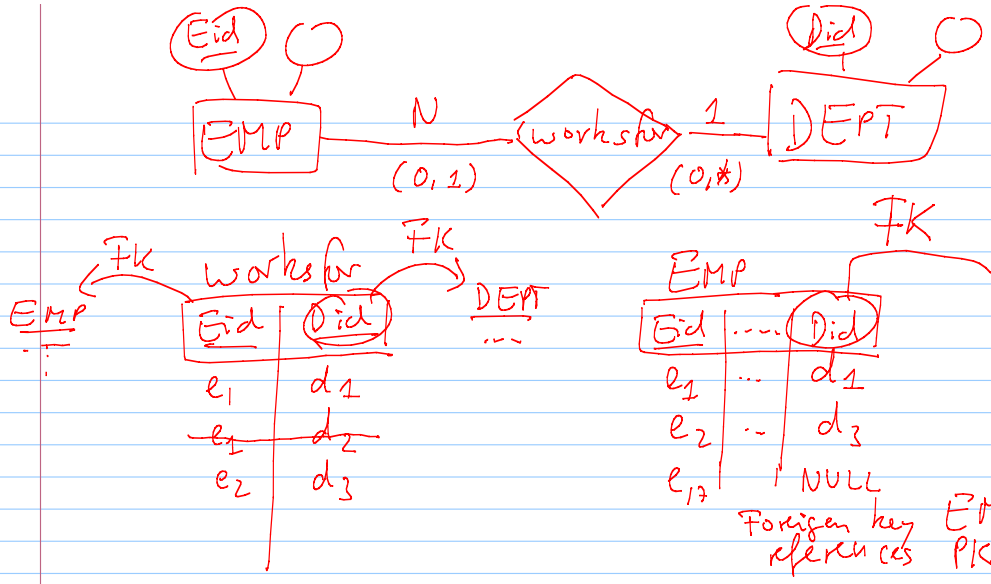
- HW #1 due ~> handing in
- 10-day drop
- PTAs

Relationship	$(\min_1, \max_1)$	$(\min_2, \max_2)$	pictorial notation
many-to-many	$(0, *)$	$(0, *)$	
many-to-one	$(0, 1)$	$(0, *)$	
one-to-one	$(0, 1)$	$(0, 1)$	

default, OK to omit







(Toy) Domains

StudId = {412, 307, 540} $\quad |StudId| = 3$
StudName = {Smith, Jones} $\quad |StudName| = 2$
Major = {CS, CSE, BIO } $\quad |Major| = 3$

then r = {(412, Smith, CS), (307, Jones, CSE), (412, Smith, CSE)} is a relation over StudId × StudName × Major

$3 \cdot 2 \cdot 3 = 18$ elements

# of possible instances over this Cartesian Product is 2^{18}

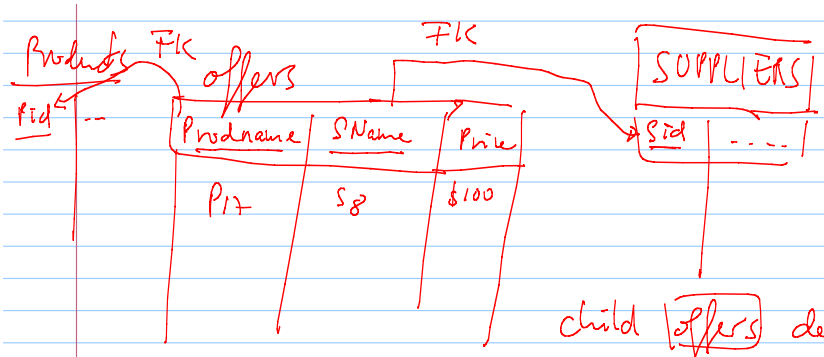
Relations are sets of tuples ⇒ no order; no duplicates

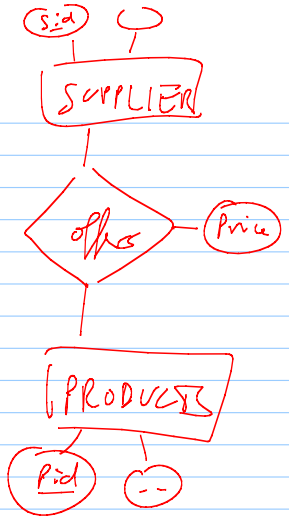
$S = \{1, 2, 3\}$
$= \{3, 1, 1, 2, 2\}$

↘ bag semantics: multiplicity is important
$\{1:2, 2:2, 3:1\}$

offers(Prodname → PRODUCTS, SName → SUPPLIERS, Price)

orders((FName, LName) → CUSTOMERS, SName →
SUPPLIERS, Prodname → PRODUCTS, Quantity)





child offers depends on parent Suppliers

Selection σ

r

A	B	C	D
α	α	1	7
~~α~~	~~β~~	~~5~~	~~7~~
~~β~~	~~β~~	~~12~~	~~3~~
β	β	23	10

$\sigma_{(A=B)\wedge(D>5)}(r)$

$(A = B) \wedge (D > 5)$

A	B	C	D
α	α	1	7
β	β	23	10

Projection Π

r

A	B	C
α	10	2
α	20	2
β	30	2
β	40	4

$\pi_{A,C}(r)$

A	C
α	2
β	2
β	4

"x 2"

select A, C
from r;

α 2
α 2
β 2
β 4

select distinct A, C
from r;

---

r

A	B
α	1
β	2

for $t_r \in r$ → 2

s

C	D	E
α	10	+
β	10	+
β	20	−
γ	10	−

for $t_s \in s$ → 4

$r \times s$

A	B	C	D	E
α	1	α	10	+
α	1	β	10	+
α	1	β	20	−
α	1	γ	10	−
β	2	α	10	+
β	2	β	10	+
β	2	β	20	−
β	2	γ	10	−

8

for $t_r \in r$
  for $t_s \in s$
    output t_r "+" t_s

select A, B, C, D, E
from r, s;

select *
from r, s;

r

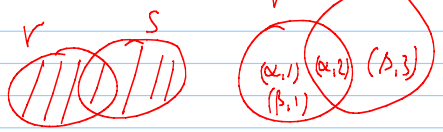
A	B
α	1
α	2
β	1

s

A	B
α	2
β	3

$r \cup s$

A	B
α	1
α	2
β	1
β	3



r

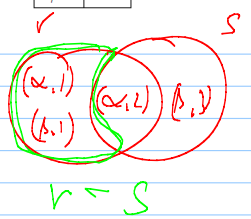
A	B
α	1
α	2
β	1

s

A	B
α	2
β	3

$r - s$

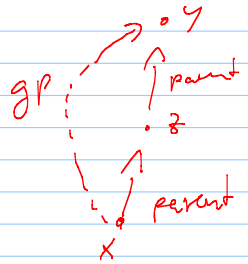
A	B
α	1
β	1



parent(C, P)

C	P
C_1	P_1
C_1	P_2
C_2	P_1
C_2	P_3
P_1	P_4

gp(X, Y) ← parent(X, Z), parent(Z, Y).



par1

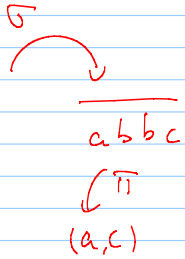
a	b
b	c

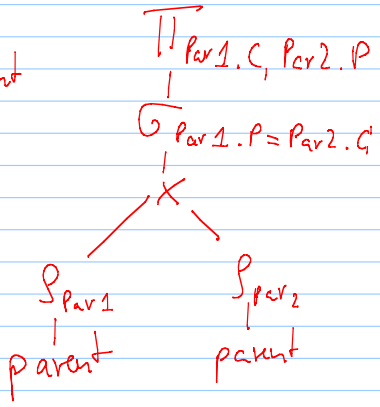
par2

a	b
b	c

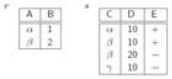
par1 × par2

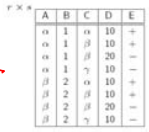
a	b	a	b
a	b	b	c
b	c	a	b
b	c	b	c





- Example: $\sigma_{A=C}(r \times s)$



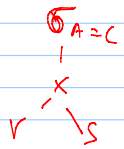


$r \times s$

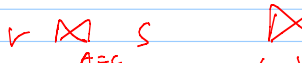
A	B	C	D	E
α	1	α	10	+
α	1	β	10	+
α	1	β	20	−
α	1	γ	10	−
β	2	α	10	+
β	2	β	10	+
β	2	β	20	−
β	2	γ	10	−

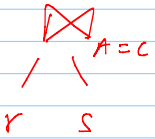
$\sigma_{A=C}(r \times s)$

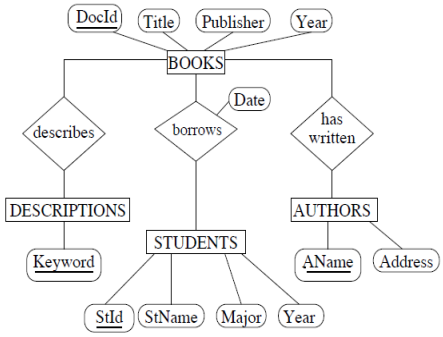
A	B	C	D	E
α	1	α	10	+
β	2	β	10	+
β	2	β	20	−



Select *
from r, s
where A = C;







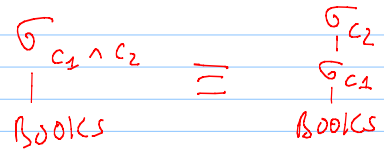
List all students with the books they can borrow.

STUDENTS × BOOKS

list all students w/ books they have borrowed:

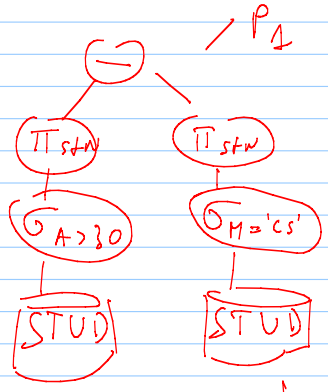
List all books published by McGraw-Hill before 1990.

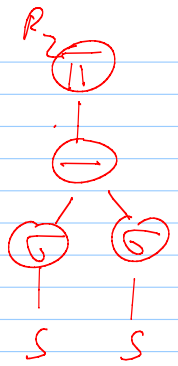
$\sigma_{\text{Publisher} = \text{'McGraw-Hill'} \wedge \text{Year} < 1990}(\text{BOOKS})$

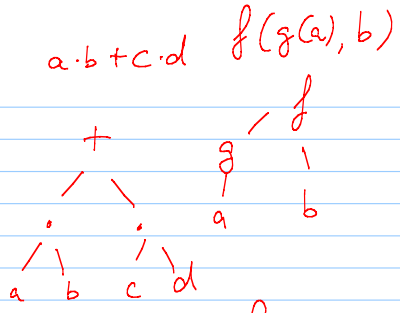


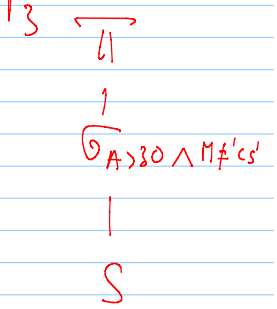
List the name of students who are older than 30 and who are not studying CS.

$\pi_{\text{StName}}(\sigma_{\text{Age}>30}(\text{STUDENTS})) -$
$\pi_{\text{StName}}(\sigma_{\text{Major}='\text{CS}'}(\text{STUDENTS}))$





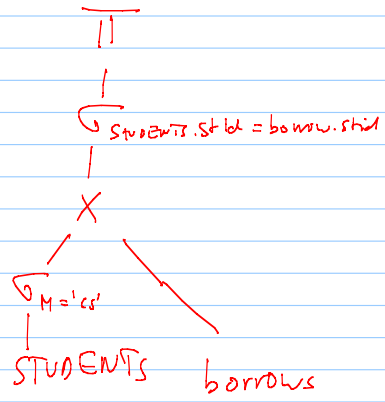




Exercise: make example where $P_1 \neq P_2$

1. *List the names of all students who have borrowed a book and who are CS majors.*

$\pi_{\text{StName}}(\sigma_{\text{STUDENTS.StId=borrows.StId}}$
$(\sigma_{\text{Major}='\text{CS}'}(\text{STUDENTS}) \times \text{borrows}))$

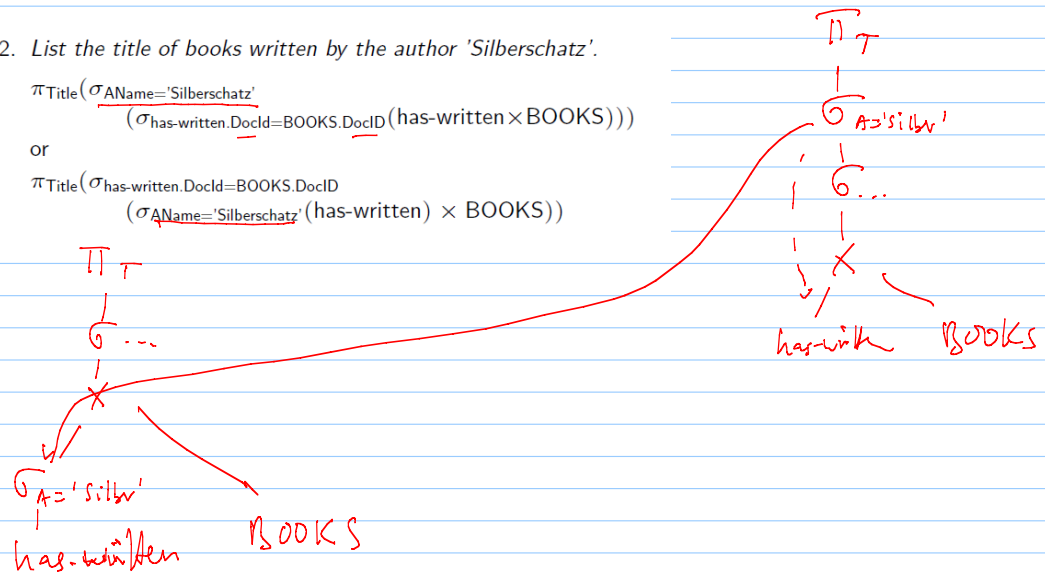


2. *List the title of books written by the author 'Silberschatz'.*

$\pi_{\text{Title}}(\sigma_{\text{AName='Silberschatz'}}(\sigma_{\text{has-written.DocId=BOOKS.DocID}}(\text{has-written} \times \text{BOOKS})))$

or

$\pi_{\text{Title}}(\sigma_{\text{has-written.DocId=BOOKS.DocID}}(\sigma_{\text{AName='Silberschatz'}}(\text{has-written}) \times \text{BOOKS}))$



4. *Find the name of the youngest student.*

$\pi_{\text{StName}}(\text{STUDENTS}) - \pi_{\text{S1.StName}}(\sigma_{\text{S1.Age}>\text{S2.Age}}(\rho_{\text{S1}}(\text{STUDENTS}) \times \rho_{\text{S2}}(\text{STUDENTS})))$