MySQL and Set

- SQL discussed in previous lecture are for Oracle.
- However, mysql does not support the following SQL operations!
  - minus / except
  - intersect
- What should we do?
  - Write the query in an alternative way.
  - Use our knowledge in relational algebra!

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

Relational algebra

- Revisit
  - Set Union ∪
  - Set difference (minus) -
  - Set Intersection ∩
  - Join
  - Division ÷

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

Union

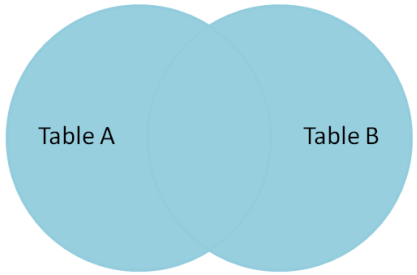
a

x	y
1	A
2	B
3	C
4	D

U

b

x	y
1	A
3	C



Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
(select * from a)
union
(select * from b);
```

x	y
1	A
2	B
3	C
4	D

```
(select * from a)
union all
(select * from b);
```

x	y
1	A
2	B
3	C
4	D
1	A
3	C

Difference

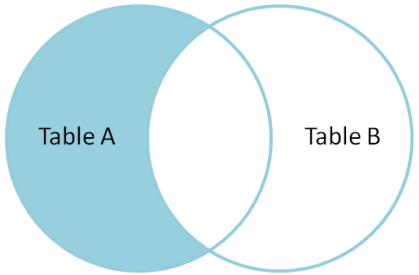
a

x	y
1	A
2	B
3	C
4	D

−

b

x	y
1	A
3	C



Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select * from a
where (x,y) not in (select *
                    from b);
```

x	y
2	B
4	D

For every tuple in a, check that it is **not** in b;

```
select * from a
where not exists (select * from b
                  where b.x=a.x and b.y=a.y)
```

x	y
2	B
4	D

For every tuple in a, check that the tuple values **does not exists** in b;

Intersection

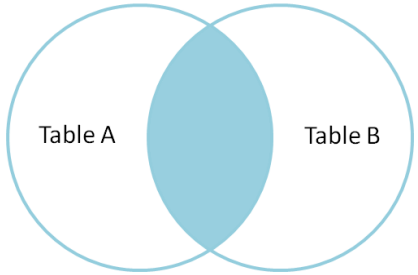
a

x	y
1	A
2	B
3	C
4	D

∩

b

x	y
1	A
3	C



Assignment Project Exam Help

```
select * from a
where (x,y) in (select * from b);
```

https://powcoder.com

x	y
1	A
3	C

Add WeChat powcoder

For every tuple in a, check that it **is also** in b;

```
select * from a
where exists (select * from b
              where b.x=a.x and b.y=a.y)
```

x	y
1	A
3	C

For every tuple in a, check that the tuple values also **exists** in b;

Join (recap)

- Natural join

PROF

pid	name	dept	rank	sal
$p1$	Adam	CS	asst	6000
$p2$	Bob	EE	asso	8000
$p3$	Cassi	CS	full	10000
$p4$	Dorothy	EE	asst	5000
$p5$	Emily	EE	asso	8500

TEACH

pid	cid	year
$p1$	$c1$	2011
$p2$	$c2$	2012
$p1$	$c2$	2012

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct PROF.pid, name, dept, rank, sal, cid, year
from PROF, TEACH
where PROF.pid = TEACH.pid
```

```
+-----+---------+------+------+-------+------+------+
| pid | name    | dept | rank | sal   | cid  | year |
+-----+---------+------+------+-------+------+------+
| p1  | Adam    | CS   | asst |  6000 | c1   | 2011 |
| p1  | Adam    | CS   | asst |  6000 | c2   | 2012 |
| p2  | Bob     | EE   | asso |  8000 | c2   | 2012 |
+-----+---------+------+------+-------+------+------+
```

Join

- Natural join

PROF

pid	name	dept	rank	sal
$p1$	Adam	CS	asst	6000
$p2$	Bob	EE	asso	8000
$p3$	Cassi	CS	full	10000
$p4$	Dorothy	EE	asst	5000
$p5$	Emily	EE	asso	8500

TEACH

pid	cid	year
$p1$	$c1$	2011
$p2$	$c2$	2012
$p1$	$c2$	2012

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select *
from PROF inner join TEACH
on PROF.pid = TEACH.pid;
```

```
+-----+---------+------+------+-------+------+------+------+
| pid | name    | dept | rank | sal   | pid  | cid  | year |
+-----+---------+------+------+-------+------+------+------+
| p1  | Adam    | CS   | asst |  6000 | p1   | c1   | 2011 |
| p1  | Adam    | CS   | asst |  6000 | p1   | c2   | 2012 |
| p2  | Bob     | EE   | asso |  8000 | p2   | c2   | 2012 |
+-----+---------+------+------+-------+------+------+------+
```

Join

- Left Outer Join (also check right outer join)

pid	name	dept	rank	sal
$p1$	Adam	CS	asst	6000
$p2$	Bob	EE	asso	8000
$p3$	Calvin	CS	full	10000
$p4$	Dorothy	EE	asst	5000
$p5$	Emily	EE	asso	8500

pid	cid	year
$p1$	$c1$	2011
$p2$	$c2$	2012
$p1$	$c2$	2012

Assignment Project Exam Help
https://powcoder.com

select * from PROF ***left outer join*** TEACH ***on PROF.pid = TEACH.pid***;

Add WeChat powcoder

pid	name	dept	rank	sal	pid	cid	year
p1	Adam	CS	asst	6000	p1	c1	2011
p1	Adam	CS	asst	6000	p1	c2	2012
p2	Bob	EE	asso	8000	p2	c2	2012
p3	**Calvin**	**CS**	**full**	**10000**	**NULL**	**NULL**	**NULL**
p4	**Dorothy**	**EE**	**asst**	**5000**	**NULL**	**NULL**	**NULL**
p5	**Emily**	**EE**	**asso**	**8500**	**NULL**	**NULL**	**NULL**

http://blog.codinghorror.com/a-visual-explanation-of-sql-joins/
http://www.codeproject.com/KB/database/Visual_SQL_Joins/Visual_SQL_JOINS_orig.jpg

Division (revisit)

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

=

y
A

Assignment Project Exam Help

$S_1 - S_2 = \{y, x\} - \{x\} = \{y\}$

https://powcoder.com

$$T_1 \div T_2 = \Pi_{S_1-S_2}(T_1) - \Pi_{S_1-S_2}\left(\Pi_{S_1-S_2}(T_1) \times T_2 - T_1\right)$$

Add WeChat powcoder

```
(select distinct y from T1)
minus
select distinct y from (
        (select * from (select distinct y from T1), T2)
         minus
        (select * from T1)
)
```

Division (MySQL)

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

=

y
A

Assignment Project Exam Help

$S_1 - S_2 = \{y, x\} - \{x\} = \{y\}$

https://powcoder.com

$$T_1 \div T_2 = \Pi_{S_1-S_2}(T_1) - \Pi_{S_1-S_2}\left(\Pi_{S_1-S_2}(T_1) \times T_2 - T_1\right)$$

Add WeChat powcoder

MySQL

- does not support minus!
- But we can use **not in** / **not exists**.

Division (MySQL: no minus)

S_1 T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

S_2 T_2

x
1
2
3

=

y
A

Assignment Project Exam Help

$S_1 - S_2 = \{y, x\} - \{x\} = \{y\}$

https://powcoder.com

$$T_1 \div T_2 = \Pi_{S_1-S_2}(T_1) - \Pi_{S_1-S_2}\left(\Pi_{S_1-S_2}(T_1) \times T_2 - T_1\right)$$

Add WeChat powcoder

```
select distinct y
from T1
where y not in (select distinct y
                from ((select distinct y from T1) as Tt, T2)
                where (y,x) not in (select * from T1)
               );
```

MySQL: Every derived table must have its own alias

Division (MySQL: no minus)

```
(select distinct y from T1)
minus
select distinct y from (
        (select * from (select distinct y from T1), T2)
         minus
        (select * from T1)
)
```

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

Same colour shows same block

Rewrite using **not in**

```
select distinct y
from T1
where y not in (select distinct y
                from ((select distinct y from T1) as Tt, T2)
                 where (y,x) not in (select * from T1)
               );
```

If you understand the relational algebra, you understand the above.

Division (not exists)

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

=

y
A

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists (  select * from T2
                        where not exists ( select * from T1 as s
                                               where s.y = T1.y and
                                                     s.x = T2.x
                                           )
                  );
```

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

=

y
A

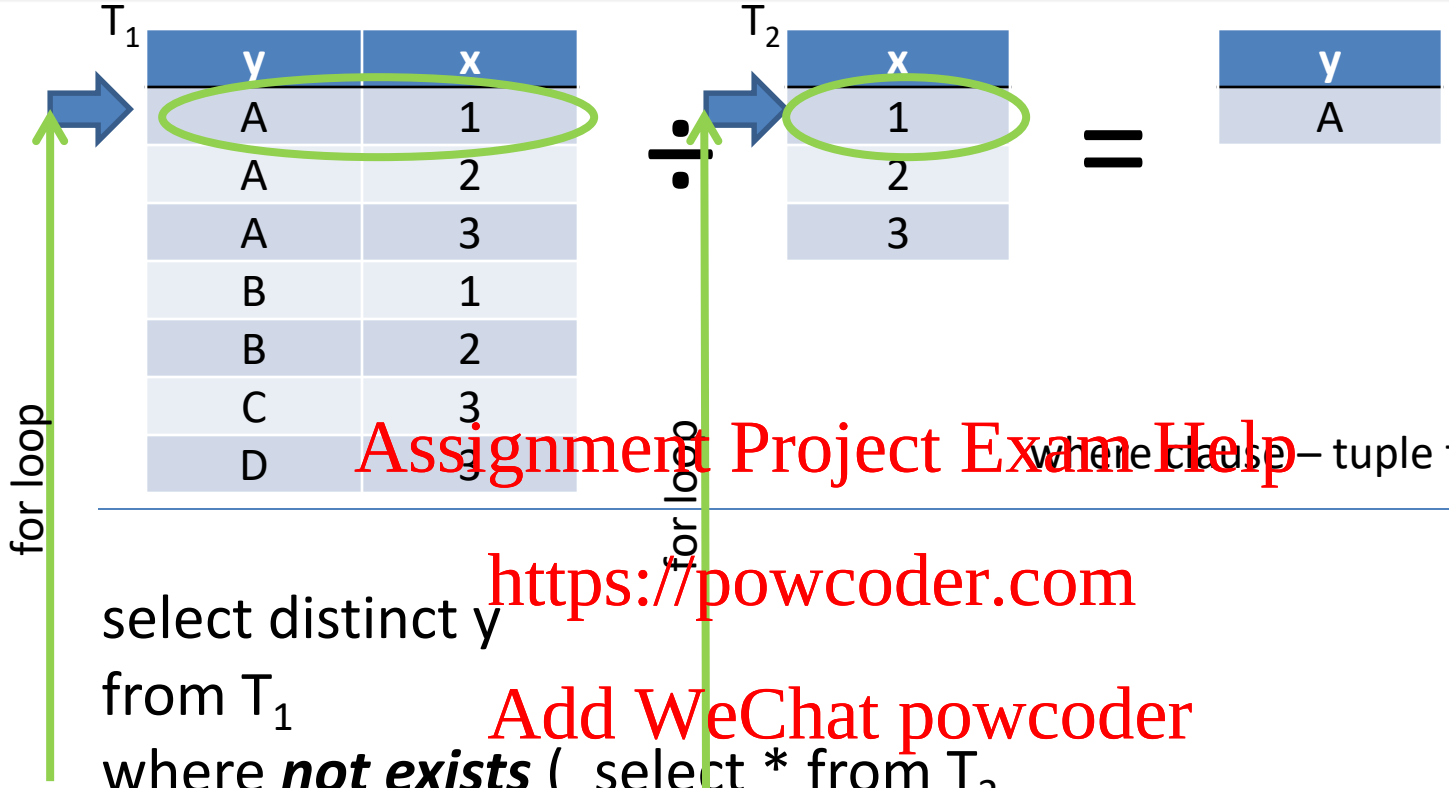
for loop

where clause – tuple filter

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct y
from T1
where not exists (  select * from T2
                        where not exists ( select * from T1 as s
                                               where s.y = T1.y and
                                                     s.x = T2.x
                                           )
                  );
```

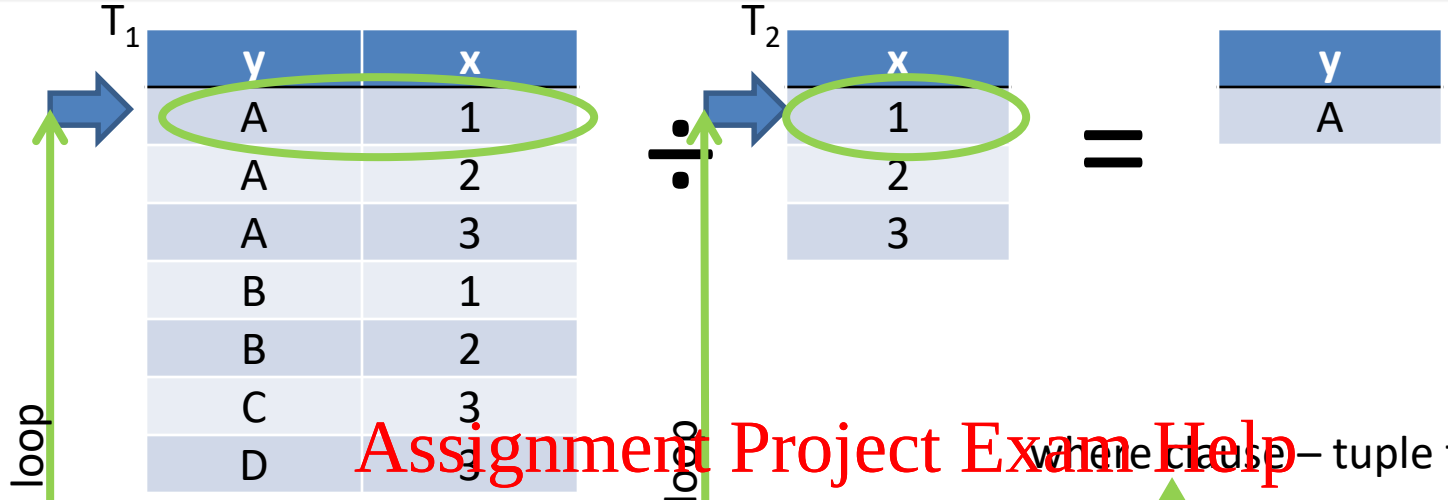
Division - analysis



Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( select * from T1 as s
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

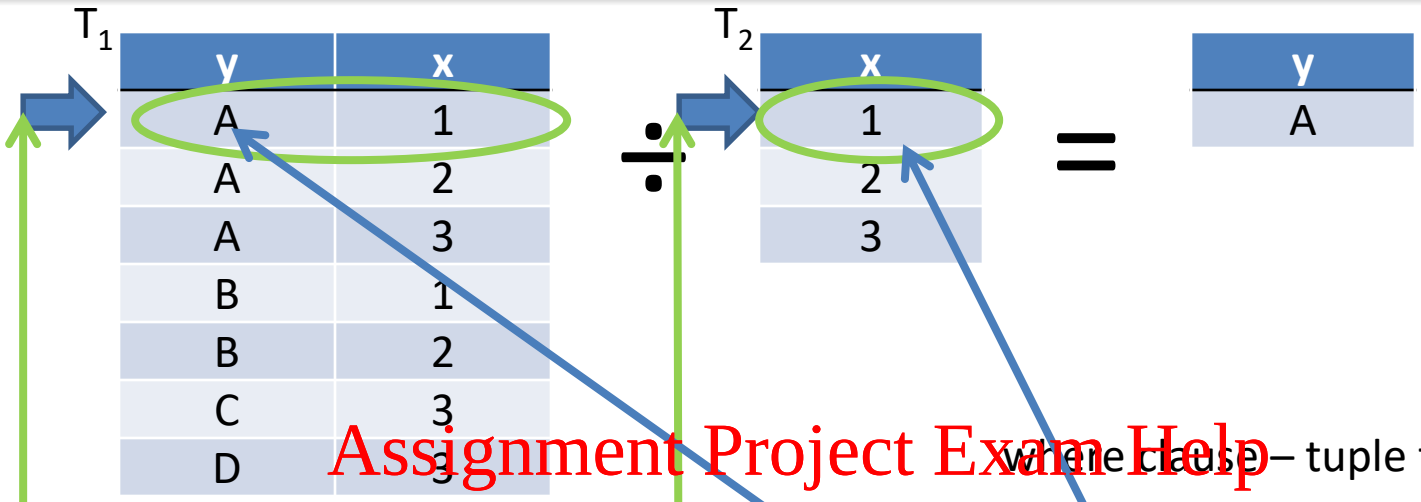
Division - analysis



Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( select * from T1 as s
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

Division - analysis

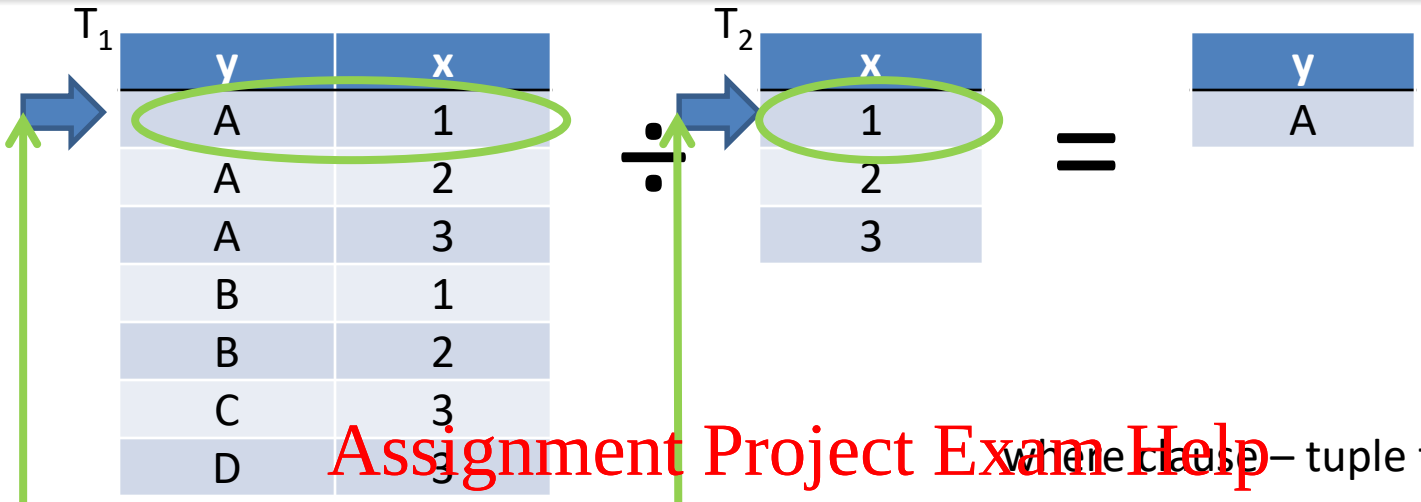


where clause – tuple filter

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( select * from T1 as s
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

Division - analysis



where clause – tuple filter

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

```
select distinct y
from T1
where not exists (  select * from T2
                    where not exists ( select * from T1 as s
                                       where s.y = 'A' and
                                             s.x = 1
                                     )
                 );
```

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

✗ =

y
A

Assignment Project Exam Help

where clause – tuple filter

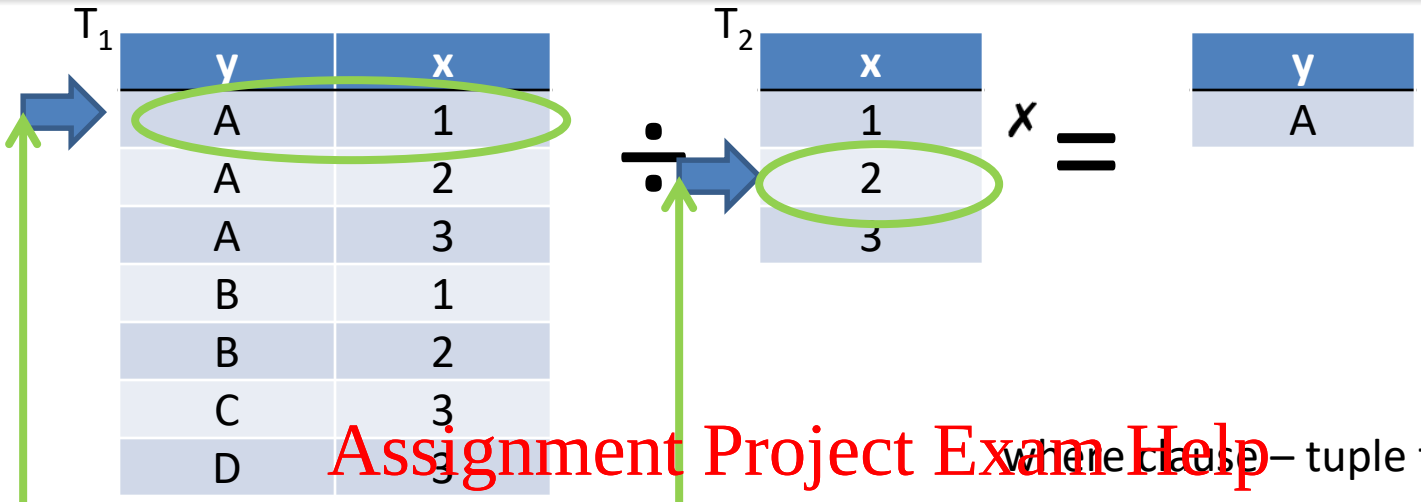
https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (
                                      )
                 );
```

y	x
A	1

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists (  select * from T2
                    where not exists ( select * from T1 as s
                                       where s.y = 'A' and
                                             s.x = 2
                                     )
                 );
```

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

✗ =

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (
                                      )
                 );
```

y	x
A	2

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

✗ ✗ =

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (
                                      )
                 );
```

y	x
A	2

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

✗ ✗ ✗ =

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (
                                      )
                 );
```

y	x
A	3

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1
2
3

=

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

```
select distinct y
from T1
where not exists (
```

Add WeChat powcoder

x
empty

```
);
```

Division - analysis

T_1

y	x
A	1
A	2
A	3
B	1
B	2
C	3
D	3

✓

÷

T_2

x
1
2
3

✗

=

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

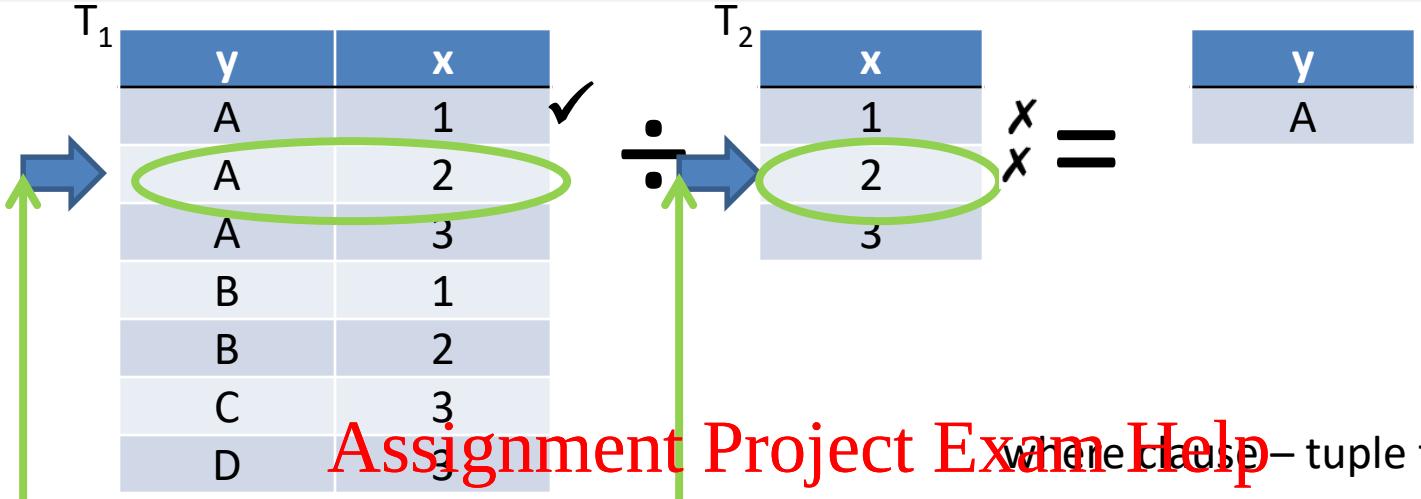
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( se
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

y	x
A	1

s

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

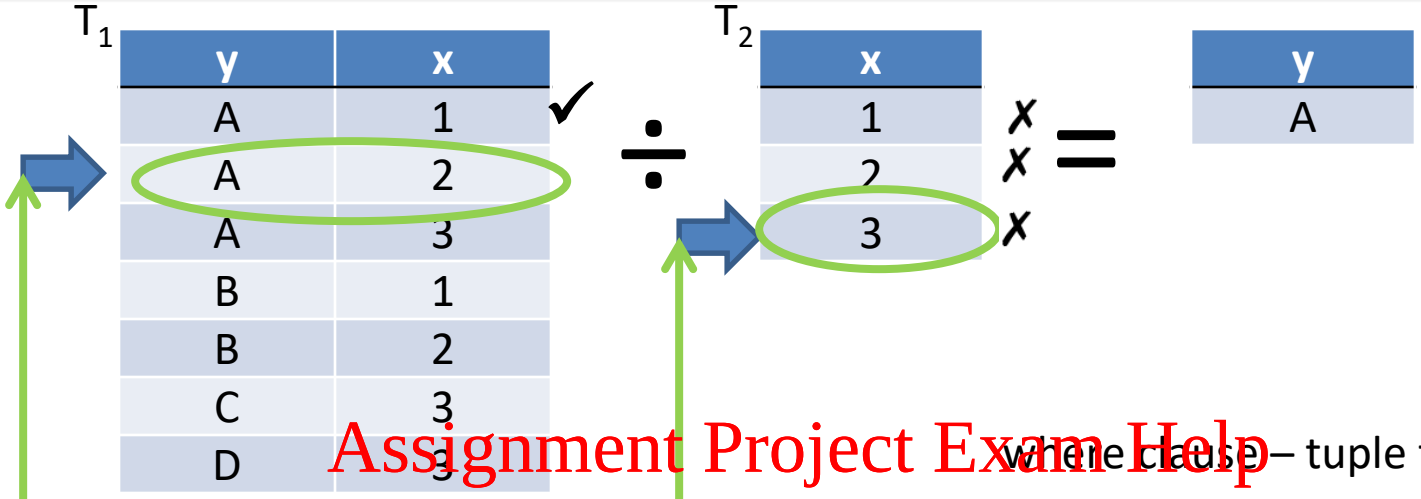
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( se
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

y	x
A	2

s

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists ( se
                                      where s.y = T1.y and
                                            s.x = T2.x
                                    )
                 );
```

y	x
A	3

s

Division - analysis

T_1

y	x
A	1 ✓
A	2 ✓
A	3
B	1
B	2
C	3
D	3

÷

T_2

x
1 ✗
2 ✗
3 ✗

=

y
A

Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

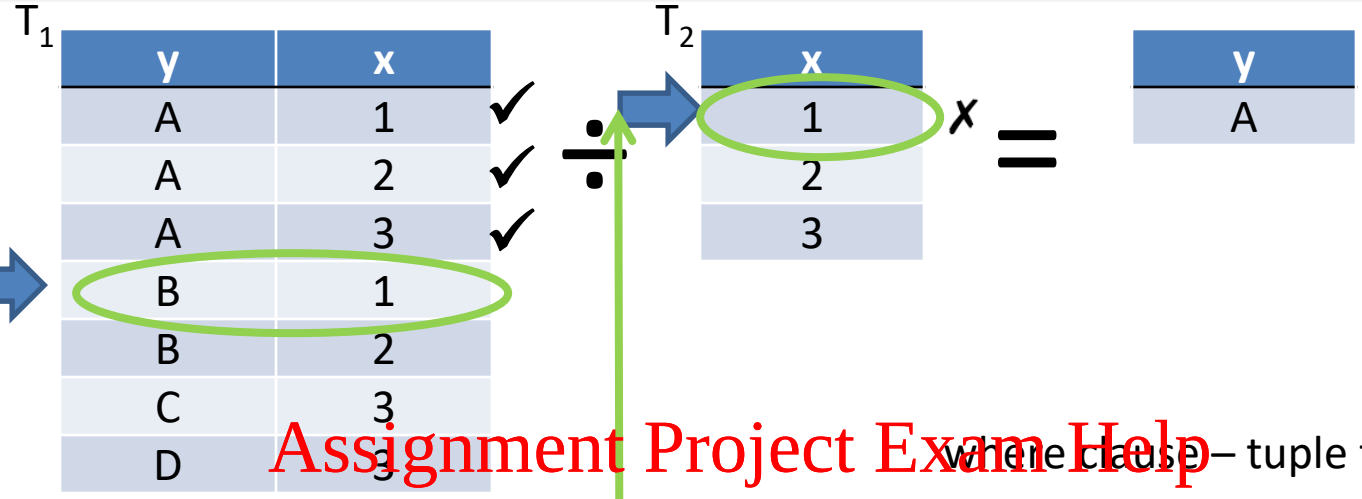
```
select distinct y
from T1
where not exists (
```

Add WeChat powcoder

x
empty

```
);
```

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

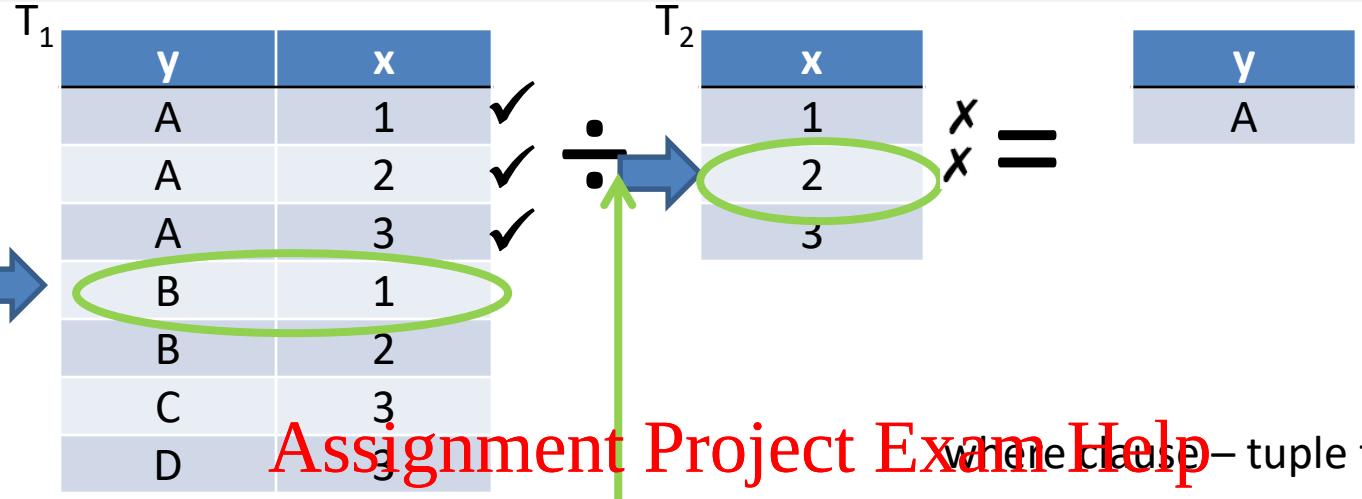
https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (select * from s
                                     where s.y = T1.y and
                                           s.x = T2.x
                                     )
                   );
```

y	x
B	1

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

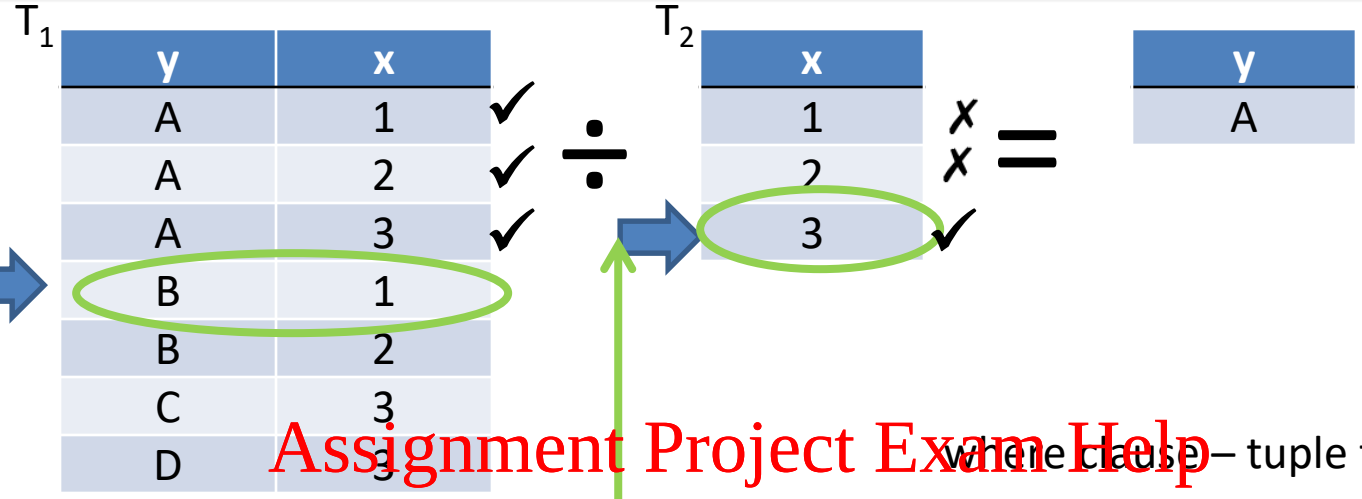
Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (se
                                     where s.y = T1.y and
                                           s.x = T2.x
                                     )
                   );
```

y	x
B	2

s

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

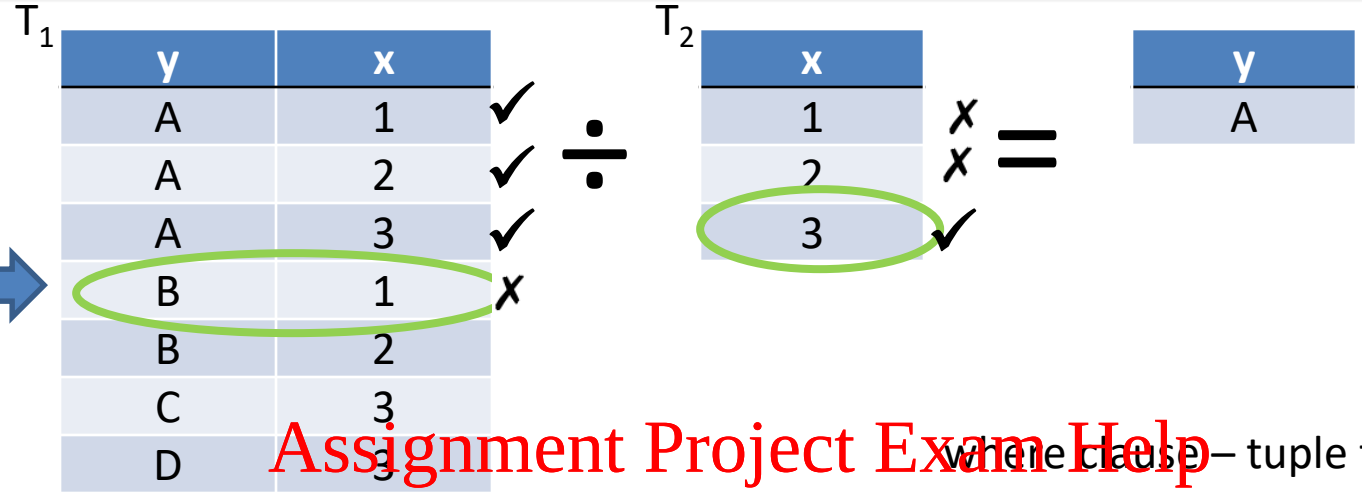
https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (select * from s
                                     where s.y = T1.y and
                                           s.x = T2.x
                                     )
                   );
```

y	x
B	3

Division - analysis



Assignment Project Exam Help

where clause – tuple filter

https://powcoder.com

```
select distinct y
from T1
where not exists (
```

Add WeChat powcoder

x
3

```
);
```

Division - analysis

T_1

y	x	
A	1	✓
A	2	✓
A	3	✓
B	1	✗
B	2	✗
C	3	✗
D	3	✗

÷

T_2

x
1
2
3

=

y
A

where clause – tuple filter

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

```
select distinct y
from T1
where not exists ( select * from T2
                   where not exists (select * from T1 as s
                                     where s.y = T1.y and
                                           s.x = T2.x
                                     )
                 );
```

MySQL and Set

- ***This slide*** is outside Exam Syllabus

- There are at least three other techniques to rewrite Division SQL queries in MySQL.

Assignment Project Exam Help
https://powcoder.com
Add WeChat powcoder

- http://users.abo.fi/soini/divisionEnglish.pdf
- See blackboard for a cache.
- A clear pictorial explanation is also provided.