

# Assignment Project Exam Help

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SQL Division

CS430/630  
Lecture 7

# Division

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- ▶ Used to answer queries such as:

*Find sailors who have reserved **all** boats.*

- ▶ Let A have 2 fields, x and y; B have only field y:
  - ▶  $A/B = \{ \langle x \rangle \mid \exists \langle x, y \rangle \in A, \forall \langle y \rangle \in B \}$
  - ▶ A/B contains **all x tuples** (sailors) such that **for every y** tuple (boat) in B, there is an **xy tuple in A**
  - ▶ Or, if the set of y values (boats) associated with an x value (sailor) in A contains **all** y values in B, the x value is in A/B.
- ▶ In general, x and y can be any sets of fields (not singletons)

# Examples of Division A/B

<u>sid</u>	<u>bid</u>
s1	b1
s1	b2
s1	b3
s1	b4
s2	b1
s2	b2
s3	b2
s4	b2
s4	b4

A

<u>bid</u>
b2

B1

A/B1

<u>bid</u>
b2
b4

B2

A/B2

<u>bid</u>
b1
b2
b4

B3

A/B3

<u>sid</u>
s1
s2
s3
s4

<u>sid</u>
s1
s4

<u>sid</u>
s1

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# Query 1

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*“Find the names of sailors who’ve reserved all boats”*

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 $\rho (Tempsids, (\pi_{sid, bid} Reserves) / (\pi_{bid} Boats))$   
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$\pi_{sname} (Tempsids \bowtie Sailors)$



## Query 2

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“Find sailors who’ve reserved all red boats”

$\rho(Temp, (\pi_{sid, bid}(Reserves) \Join (\pi_{bid}(\sigma_{color='red'}(Boats))))$

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 $\pi_{sname}(Temp \bowtie Sailors)$



# Expressing A/B Using Basic Operators

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- ▶ For  $A/B$ , compute all  $x$  values that are not **disqualified** by some  $y$  value in  $B$ 
  - ▶  $x$  value is **disqualified** if by attaching  $y$  value from  $B$ , we obtain an  $xy$  tuple that is not in  $A$

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**Disqualified  $x$  values:**

$\pi_x((\pi_x(A) \times B) - A)$

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**$A/B$ :**  $\pi_x(A) - \text{all disqualified tuples}$

$$\pi_x(A) - \pi_x((\pi_x(A) \times B) - A)$$



# Division in SQL

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- ▶ Not supported as primitive operator
- ▶ Need to use nested queries to express division
  - ▶ One of the most subtle queries in SQL
  - ▶ Need to pay close attention to writing SQL division queries!
- ▶ There are two ways of writing division queries
  - ▶ Using the set **EXCEPT** operator (2-level nesting)
  - ▶ Without the **EXCEPT** operator (3-level nesting)



# Division: Solution 1

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“Find sailors who’ve reserved all boats.”

With **EXCEPT**:

SELECT S.sname

FROM Sailors S

WHERE NOT EXISTS

(

(SELECT B.bid FROM Boats B)

EXCEPT

(SELECT R.bid FROM Reserves R

WHERE R.sid=S.sid)

)

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# Division: Solution 2

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“Find sailors who’ve reserved all boats.”

Without **EXCEPT**:

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```
SELECT S.sname
```

Sailors S such that  
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```
FROM Sailors S
```

WHERE NOT EXISTS (SELECT B.bid

*there is no boat B ...*

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```
FROM Boats B
```

```
WHERE NOT EXISTS (SELECT *
```

*without a Reserves tuple showing S reserved B*

```
FROM Reserves R
```

```
WHERE R.bid=B.bid
```

```
AND R.sid=S.sid))
```



“Find sailors who’ve reserved all **red** boats.”

---

“Find sailors who’ve reserved all **red** boats.”

With **EXCEPT**:

SELECT S.sname

FROM Sailors S

WHERE NOT EXISTS

(

(SELECT B.bid FROM Boats B

WHERE B.color = ‘red’)

EXCEPT

(SELECT R.bid FROM Reserves R

WHERE R.sid=S.sid) )

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“Find sailors who’ve reserved all **red** boats.”

---

“Find sailors who’ve reserved all **red** boats.”

Without **EXCEPT**:

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```
SELECT S.sname
FROM Sailors S
WHERE NOT EXISTS (SELECT B.bid
                  FROM Boats B
                  WHERE B.color='red' AND
                        NOT EXISTS (SELECT *
                                FROM Reserves R
                                WHERE R.bid=B.bid
                                       AND R.sid=S.sid))
```

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# Another Example

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```
Movies (movie_id, title,      year,          studio)
Actors (actor_id, name,      nationality)
StarsIn(actor_id, movie_id, character)
```

*“Find names of actors who star in ALL movies produced by Universal in year 1990.”*

```
SELECT A.name FROM Actors A
WHERE NOT EXISTS(
    SELECT M.movie_id FROM Movies M
    WHERE M.year=1990 AND M.studio='Universal'

    EXCEPT

    SELECT S.movie_id FROM Stars_In S
    WHERE S.actor_id=A.actor_id
)
```

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