

## Division

Ok – this is one of the tougher ones. First, let’s make sure you are clear on what division is. Taking the statement “Find all the students that are enrolled in all the classes taught at 11-12:15”. This can clearly be done a number of ways - let’s use division to accomplish it.

The relational algebra looks like:

$$\Pi_{SName,ClassID}(\text{Students} \bowtie \text{Enrolled}) / \Pi_{ClassID}(\sigma_{TimeOffered='11-12:15'}(\text{Class}))$$

Ok – so how do we do this in SQL? By utilizing the WHERE NOT EXISTS clause and a nested query with correlation. Remember that WHERE NOT EXISTS returns a FALSE if the subquery returns any rows.

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```
mysql> SELECT * FROM Students;
```

SID	SName	NumCredits
1	Elmer Fudd	48
2	Roger Ramjet	20
3	Alice Wonderland	72

```
3 rows in set (0.00 sec)
```

```
mysql> SELECT * FROM Enrolled;
```

SID	ClassID	Grade
1	CS314	NULL
1	CS575	NULL
2	CS430	NULL
2	CS575	NULL
3	CS314	NULL
3	CT320	NULL

```
6 rows in set (0.00 sec)
```

```
mysql> SELECT * FROM Class;
```

ClassID	TimeOffered
CS314	11-12:15
CS430	12:30-1:45
CS575	NULL
CT320	11-12:15

```
4 rows in set (0.00 sec)
```

```
mysql> SELECT S.SName FROM Students S
```

```
-> WHERE NOT EXISTS
```

```
-> (SELECT C.ClassID FROM Class C
```

```
-> WHERE C.TimeOffered = "11-12:15" and NOT EXISTS
```

```
-> (SELECT E.ClassID FROM Enrolled E
```

```
-> WHERE E.ClassID = C.ClassID AND S.SID = E.SID ));
```

SName
Alice Wonderland

```
1 row in set (0.00 sec)
```

So let's examine this query.

```
SELECT S.SName FROM Students S
WHERE NOT EXISTS
  (SELECT C.ClassID FROM Class C
   WHERE C.TimeOffered = "11-12:15" and NOT EXISTS
     (SELECT E.ClassID FROM Enrolled E
      WHERE E.ClassID = C.ClassID AND S.SID = E.SID ));
```

We have two nested queries with correlation. The nesting is going to inspect it row by row. NOT EXISTS returns a TRUE if the subquery returns no rows.

The innermost subquery builds a list of all the Classes a student is taking. The NOT EXISTS clause then returns a TRUE if the Class/Student combos that do not have an entry. The TimeOffered check eliminates all the combos not at the right time. The outermost query returns a true if for that student, there does not exist a enrollment record for a class offered at that time. Otherwise stated:

For every student  
There is no class without  
an Enrollment record showing the student is enrolled.