

Suppose we have the following database, storing students, courses, and courses taken by students. There are two foreign keys in `courses_taken`: `sid`, referencing `students(sid)`, and `cid`, referencing `courses(cid)`.

students		courses		courses_taken	
<u>sid</u>	name	<u>cid</u>	cname	<u>sid</u>	<u>cid</u>
1	alice	1	databases	1	1
2	bob	2	calculus	2	2
3	charlie			3	1
				3	2

Question: which students took every course?

```
took_at_least_one_course <--  $\pi_{sid}(\text{courses\_taken})$ 
```

```
sid
1
2
3
```

```
all_possible_enrolments <-- took_at_least_one_course x  $\pi_{cid}(\text{courses})$ 
```

```
sid  cid
1    1
1    2
2    1
2    2
3    1
3    2
```

```
missing_enrolments <-- all_possible_enrolments - courses_taken
```

```
sid  cid
1    2
2    1
```

```
didnt_take_every_course <--  $\pi_{sid}(\text{missing\_enrolments})$ 
```

```
sid
1
2
```

```
took_every_course <-- took_at_least_one_course - didnt_take_every_course
```

```
sid
3
```