# What are JOINS?

- Joins help retrieving data from two or more database tables.
- The tables are mutually related using primary and foreign keys.

A very simple example would be users (students) and course enrollments:

**'user' table:**

| id | name | course |
|---|---|---|
| 1 | Alice | 1 |
| 2 | Bob | 1 |
| 3 | Caroline | 2 |
| 4 | David | 5 |
| 5 | Emma | (NULL) |

MySQL table creation code:

```
CREATE TABLE `user` (

	`id` smallint(5) unsigned NOT NULL AUTO_INCREMENT,

	`name` varchar(30) NOT NULL,

	`course` smallint(5) unsigned DEFAULT NULL,

	PRIMARY KEY (`id`)

);
```

The course number relates to a subject being taken in a course table…

**‘course’ table:**

| id | name |
|---|---|
| 1 | HTML5 |
| 2 | CSS3 |
| 3 | JavaScript |
| 4 | PHP |
| 5 | MySQL |

MySQL table creation code:

```
CREATE TABLE `course` (
	`id` smallint(5) unsigned NOT NULL AUTO_INCREMENT,
	`name` varchar(50) NOT NULL,
	PRIMARY KEY (`id`)
);
```

Since user.course and course.id are related, we can specify a foreign key relationship:

```
ALTER TABLE `user`

ADD CONSTRAINT `FK_course`

FOREIGN KEY (`course`) REFERENCES `course` (`id`)

ON UPDATE CASCADE;
```

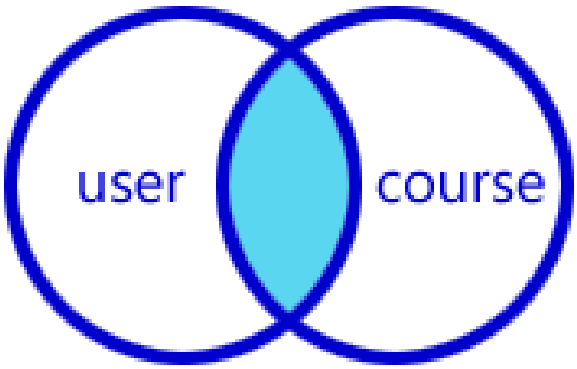
In essence, MySQL will automatically:

- re-number the associated entries in the user.course column if the course.id changes
- reject any attempt to delete a course where users are enrolled.

important: This is terrible database design!
This database is not efficient. It's fine for this example, but a student can only be enrolled on zero or one course. A real system would need to overcome this restriction — probably using an intermediate 'enrollment' table which mapped any number of students to any number of courses.

JOINs allow us to query this data in a number of ways.

## INNER JOIN (or just JOIN)




The most frequently used clause is INNER JOIN. This produces a set of records which match in both the user and course tables, i.e. all users who are enrolled on a course:

```
SELECT user.name, course.name

FROM `user` INNER JOIN `course`

on user.course = course.id;
```

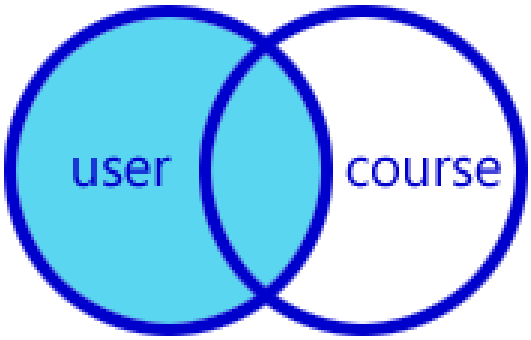
Result:

| user.name | course.name |
|---|---|
| Alice | HTML5 |
| Bob | HTML5 |
| Carline | CSS3 |
| David | MySQL |

In above JOIN query examples, we have used ON clause to match the records between table.

USING clause can also be used for the same purpose. The difference with USING is it needs to have identical names for matched columns in both tables.

## LEFT JOIN



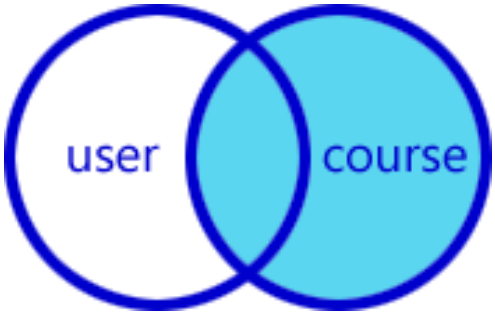
What if we require a list of all students and their courses even if they're not enrolled on one? A LEFT JOIN produces a set of records which matches every entry in the left table (user) regardless of any matching entry in the right table (course):

```
SELECT user.name, course.name

FROM `user` LEFT JOIN `course`

on user.course = course.id;
```

Result:

| user.name | course.name |
|---|---|
| Alice | HTML5 |
| Bob | HTML5 |
| Carline | CSS3 |
| David | MySQL |
| Emma | (NULL) |

## RIGHT JOIN




Perhaps we require a list all courses and students even if no one has been enrolled? A RIGHT JOIN produces a set of records which matches every entry in the right table (course) regardless of any matching entry in the left table (user):

```
SELECT user.name, course.name

FROM `user` RIGHT JOIN `course`

on user.course = course.id;
```

Result:

| user.name | course.name |
|---|---|
| Alice | HTML5 |
| Bob | HTML5 |
| Carline | CSS3 |
| (NULL) | JavaScript |
| (NULL) | PHP |
| David | MySQL |

RIGHT JOINs are rarely used since you can express the same result using a LEFT JOIN. This can be more efficient and quicker for the database to parse:

```
SELECT user.name, course.name

FROM `course` LEFT JOIN `user` on user.course = course.id;
```

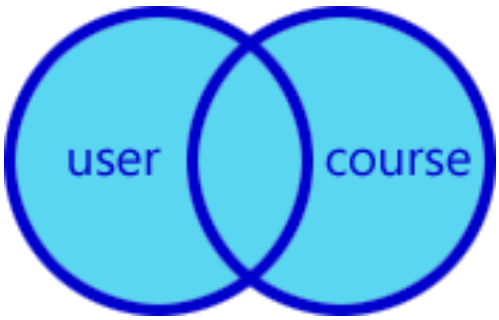
We could, for example, count the number of students enrolled on each course:

```
SELECT course.name, COUNT(user.name)

FROM `course` LEFT JOIN `user`

ON user.course = course.id

GROUP BY course.id;
```

Result:

| course.name | count() |
|---|---|
| HTML5 | 2 |
| CSS3 | 1 |
| JavaScript | 0 |
| PHP | 0 |
| MySQL | 1 |

## OUTER JOIN (or FULL OUTER JOIN)




Our last option is the OUTER JOIN which returns all records in both tables regardless of any match. Where no match exists, the missing side will contain NULL.

OUTER JOIN is less useful than INNER, LEFT or RIGHT and it's not implemented in MySQL. However, you can work around this restriction using the UNION of a LEFT and RIGHT JOIN, e.g.

```
SELECT user.name, course.name

FROM `user` LEFT JOIN `course`

on user.course = course.id


UNION


SELECT user.name, course.name

FROM `user` RIGHT JOIN `course`

on user.course = course.id;
```

Result:

| user.name | course.name |
|---|---|
| Alice | HTML5 |
| Bob | HTML5 |
| Carline | CSS3 |
| David | MySQL |
| Emma | (NULL) |
| (NULL) | JavaScript |
| (NULL) | PHP |

I hope that gives you a better understanding of JOINs and helps you write more efficient SQL queries.

## *Summary*

- JOINS allow us to combine data from more than one table into a single result set.
- JOINS have better performance compared to sub queries
- INNER JOINS only return rows that meet the given criteria.
- OUTER JOINS can also return rows where no matches have been found. The unmatched rows are returned with the NULL keyword.
- The major JOIN types include Inner, Left Outer, Right Outer, Cross JOINS etc.
- The frequently used clause in JOIN operations is "ON". "USING" clause requires that matching columns be of the same name.
- JOINS can also be used in other clauses such as GROUP BY, WHERE, SUB QUERIES, AGGREGATE FUNCTIONS etc.