# SQL – Part II

Structured Query Language

# LIKE

***expr*** LIKE ***pattern***

## Patterns

% matches any number of characters

_ matches one character

%

```
SELECT *
FROM Students
WHERE FirstName LIKE  'A%'
```

%

```
SELECT *
FROM Students
WHERE FirstName LIKE  'An%'
```

%

```
SELECT *
FROM Students
WHERE FirstName LIKE 'A%l'
```

_

```
SELECT *
FROM Students
WHERE FirstName LIKE '____y'
```

# Active learning

Find students:

- Area code is 541
- Or Gmail address

## Active learning

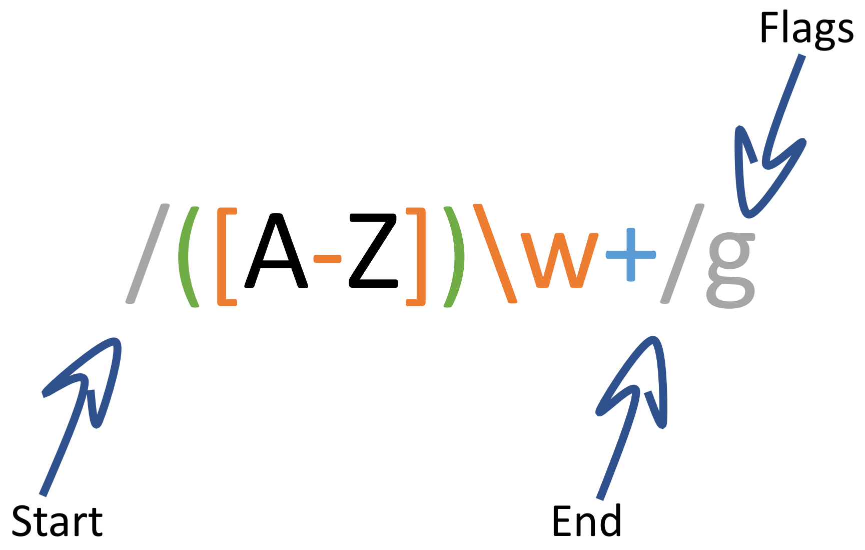
```
SELECT *
FROM Students
WHERE
    Email LIKE '%gmail%'
    OR
    Phone LIKE '%541%'
```

# REGEXP

***expr*** REGEXP ***pattern***

# Regular expressions

A regular expression is a sequence of characters that defines a pattern to search through text



```
/([A-Z])\w+/g
```

# Character classes

| Character classes | | Example | |
|---|---|---|---|
| \d | any digit | \d | +1-(444)-555-1234 |
| \D | not a digit | \D | +1-(444)-555-1234 |
| \s | space | \s | glib jocks vex dwarves! |
| \S | not a space | \S | glib jocks vex dwarves! |
| \w | any character | \w | glib jocks vex dwarves! |
| \W | not a character | \W | glib jocks vex dwarves! |
| . | any character, except \n | . | glib jocks vex dwarves! |
| [ABC] | any character in set | [aeiou] | glib jocks vex dwarves! |
| [^ABC] | negated set | [^aeiou] | glib jocks vex dwarves! |
| [A-Z] | any character in range | [g-s] | abcdefghijklmnopqrstuvwxyz |

## Anchors

| Anchors | Example | |
|---|---|---|
| ^ beginning of string | ^\w+ | she sells seashells |
| $ end of string | \w+$ | she sells seashells |
| \b word boundary | s\b | she sells seashells |
| \B not word boundary | s\B | she sells seashells |

# Quantifiers and alternation

| Quantifiers and alternation | | Example | |
|---|---|---|---|
| + | 1 or more of the previous | b\w+ | b **be** **bee** **beer** **beers** |
| * | 0 or more of the previous | b\w* | **b** **be** **bee** **beer** **beers** |
| {1,3} | Specified quantity of previous * | b\w{2,3} | b be **bee** **beer** **beer**s |
| ? | 0 or 1 of the previous (optional) | colou?r | **color** **colour** |
| ? | 0 or 1 of the previous (lazy) | b\w+? | b **be** **be**e **be**er **be**ers |
| \| | or | b(a\|e\|i)d | **bad** bud bod **bed** **bid** |

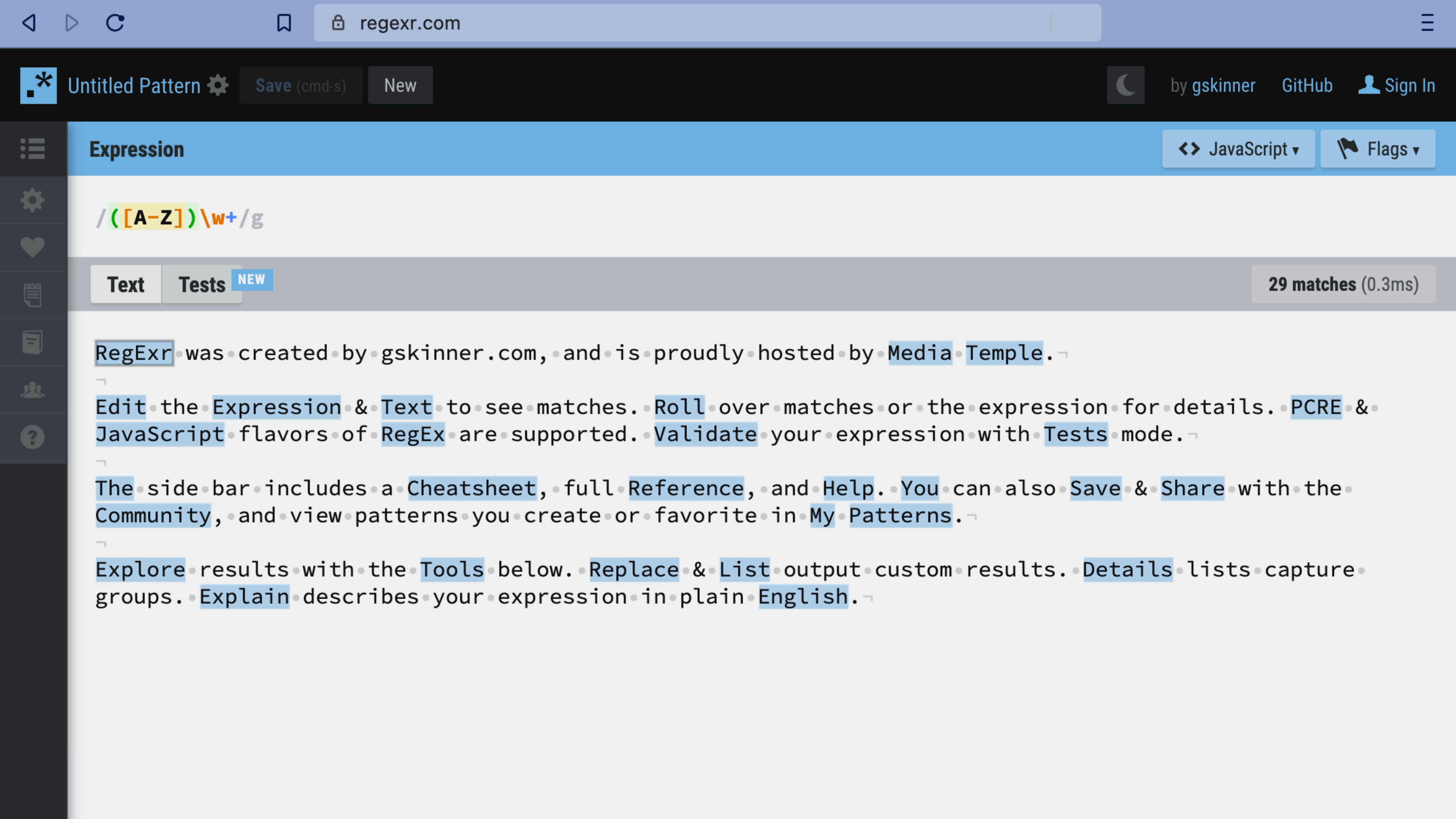
* Matches the specified quantity of the previous token. {1,3} will match 1 to 3. {3} will match exactly 3. {3,} will match 3 or more.

## Sample text http://bit.ly/3bJYpub

Central Park is an urban park in New York City located between the Upper West and Upper East Sides of Manhattan. It is the fifth-largest park in the city by area, covering 843 acres (341 ha). It is the most visited urban park in the United States with an estimated 38 million visitors annually, and is the most filmed location in the world. [b be bee beer beers] [she sells seashells][+1-212-360-3444]

Following proposals for a large park in Manhattan during the 1840s, it was approved in 1853 to cover 778 acres (315 ha). In 1857, landscape architects Frederick Law Olmsted and Calvert Vaux won a design competition for the park with their "Greensward Plan". Construction began the same year; existing structures, including a majority-Black settlement named Seneca Village, were seized through eminent domain and razed. The park's first areas were opened to the public in late 1858. [bad bud bod bed bid][abcdefghijklmnopqrstuvwxyz][+1 212-310-6600]

There are 21 children's playgrounds in Central Park. The largest, at three acres (12,000 m2), is Heckscher Playground. Central Park includes 36 ornamental bridges, all with different designs. "Rustic" shelters and other structures were originally spread out through the park. Most have been demolished over the years, and several have been restored. The park contains around 9,500 benches in three styles, of which nearly half have small engraved tablets of some kind, installed as part of Central Park's "Adopt-a-Bench" program. These engravings typically contain short personalized messages and can be installed for at least $10,000 apiece. "Handmade rustic benches" can cost more than half a million dollars and are only granted when the honoree underwrites a major park project.[+1 212 439 6500] [617-826-8977] [617 826 8977] [(617) 826 8977] [(617) 826-8977]



```
/([A-Z])\w+/g
```

29 matches (0.3ms)

```
RegExr was created by gskinner.com, and is proudly hosted by Media Temple.

Edit the Expression & Text to see matches. Roll over matches or the expression for details. PCRE &
JavaScript flavors of RegEx are supported. Validate your expression with Tests mode.

The side bar includes a Cheatsheet, full Reference, and Help. You can also Save & Share with the
Community, and view patterns you create or favorite in My Patterns.

Explore results with the Tools below. Replace & List output custom results. Details lists capture
groups. Explain describes your expression in plain English.
```

## Match last names that have an "a", or an "m", or a "c"

```
SELECT *
FROM Students
WHERE LastName REGEXP  'a|m|c'
```

## Match last names that start with "C", or a "D", followed by "a" or "o"

```
SELECT *
FROM Students
WHERE LastName REGEXP '(^C|^D)[ao]'
```

```
^  start of a string
[] range
```

## Match last names that start with a "D", end with an "h"

```
SELECT *
FROM Students
WHERE LastName REGEXP ' ^D.*h$ '
```

```
$ end of a string
* match 0 or more
```

## Match last names ending in "n"

```
SELECT *
FROM Students
WHERE LastName REGEXP '.*n$'
```

```
.ing$
Match ending in "ing"
```

## Last names starting with D

```
SELECT *
FROM Students
WHERE LastName REGEXP  '^D\w*'
```

## Last names with 5 characters or less

```
SELECT *
FROM Students
WHERE LastName REGEXP  '^.{1,5}$'
```

## last names starting with D and 7 characters or less

```
SELECT *
FROM Students
WHERE LastName REGEXP '^D.{1,7}$'
```

# Active learning: Match phone numbers using a regular expression

- Note MySQL syntax differences
- Escaping parenthesis
  - Traditional: **\(**
  - MySQL: **[(]**
- Digits
  - Traditional: **\d**
  - MySQL: **[0-9]**
- Space
  - Traditional: **\s**
  - MySQL: **[[:space:]]**

## Active learning

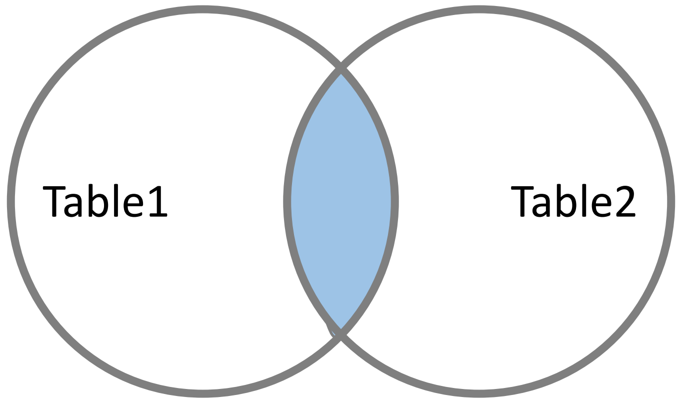
```
SELECT *
FROM Students
WHERE Phone REGEXP  '[(][0-9]{3}[)][[:space:]][0-9]{3}-[0-9]{4}'
```

```
Traditional:
\(\d{3}\)\s\d{3}-\d{4}
```

## JOINS

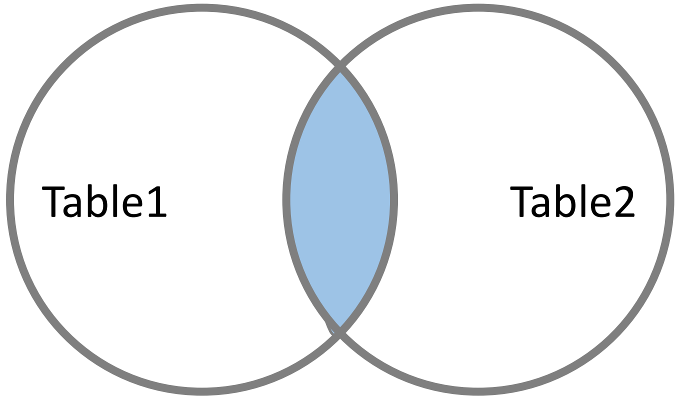
# INNER JOIN

INNER JOIN table ON

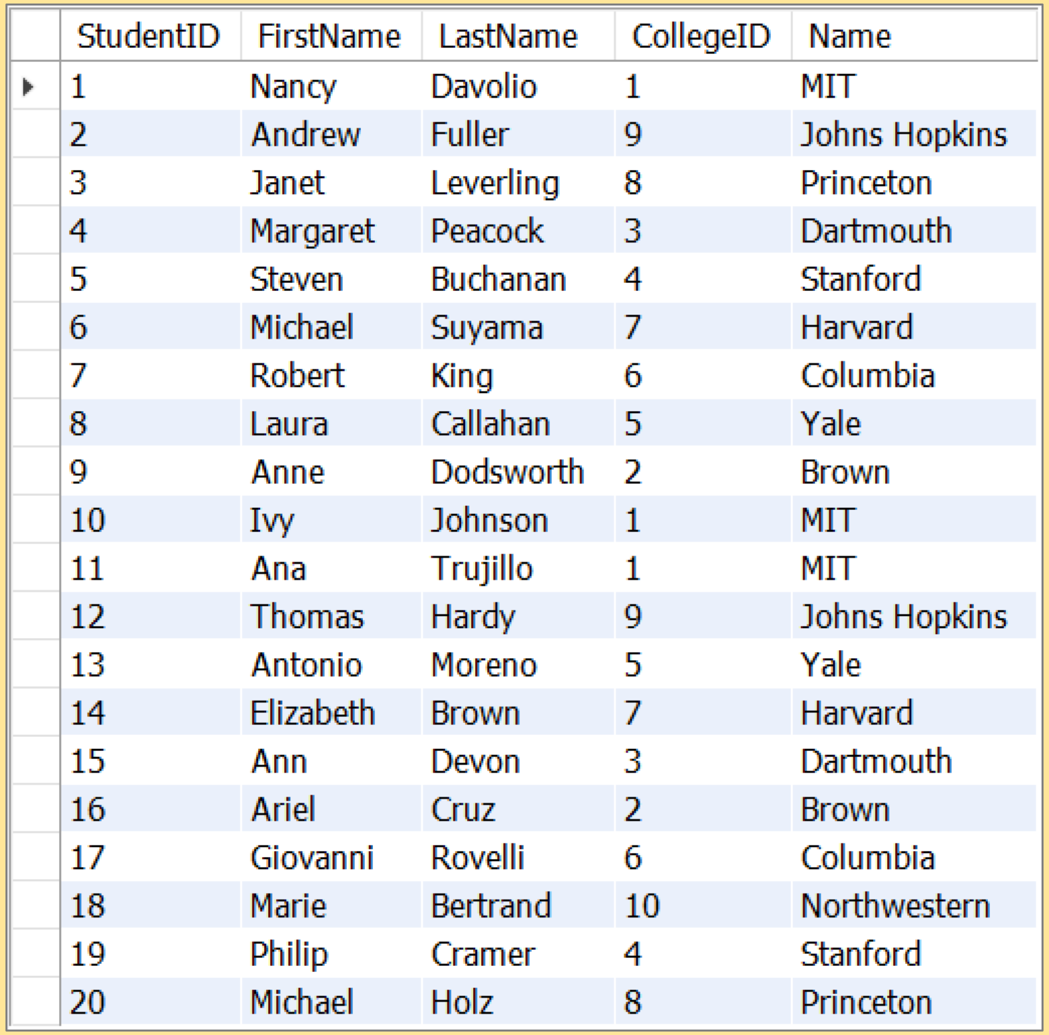


# INNER JOIN

```
SELECT table1.column, table2.column
FROM table1
INNER JOIN table2
ON table1.column = table2.column
```



## Active learning: where does each student go to college? Write the join.



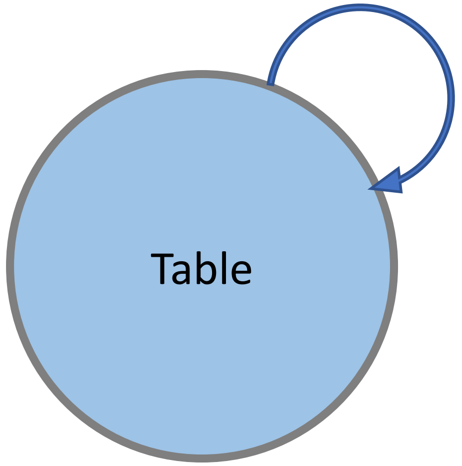
| StudentID | FirstName | LastName | CollegeID | Name |
|---|---|---|---|---|
| 1 | Nancy | Davolio | 1 | MIT |
| 2 | Andrew | Fuller | 9 | Johns Hopkins |
| 3 | Janet | Leverling | 8 | Princeton |
| 4 | Margaret | Peacock | 3 | Dartmouth |
| 5 | Steven | Buchanan | 4 | Stanford |
| 6 | Michael | Suyama | 7 | Harvard |
| 7 | Robert | King | 6 | Columbia |
| 8 | Laura | Callahan | 5 | Yale |
| 9 | Anne | Dodsworth | 2 | Brown |
| 10 | Ivy | Johnson | 1 | MIT |
| 11 | Ana | Trujillo | 1 | MIT |
| 12 | Thomas | Hardy | 9 | Johns Hopkins |
| 13 | Antonio | Moreno | 5 | Yale |
| 14 | Elizabeth | Brown | 7 | Harvard |
| 15 | Ann | Devon | 3 | Dartmouth |
| 16 | Ariel | Cruz | 2 | Brown |
| 17 | Giovanni | Rovelli | 6 | Columbia |
| 18 | Marie | Bertrand | 10 | Northwestern |
| 19 | Philip | Cramer | 4 | Stanford |
| 20 | Michael | Holz | 8 | Princeton |

## Active learning

```
SELECT S.StudentID, S.FirstName, S.LastName,
C.CollegeID, C.Name
FROM Students S
INNER JOIN Colleges C
ON S.CollegeID = C.CollegeID
```

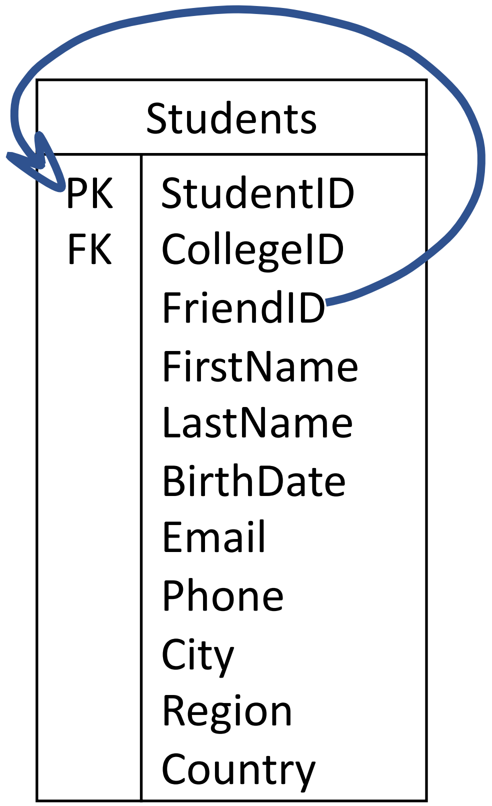
# SELF JOIN

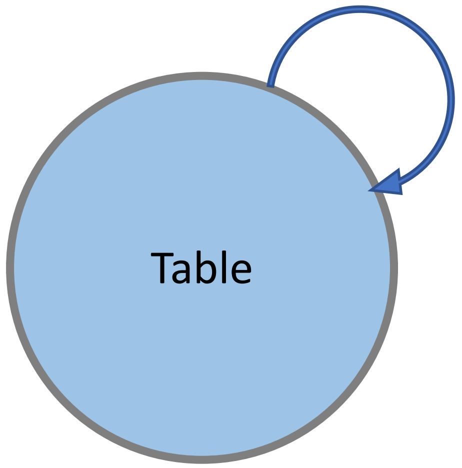
INNER JOIN table ON



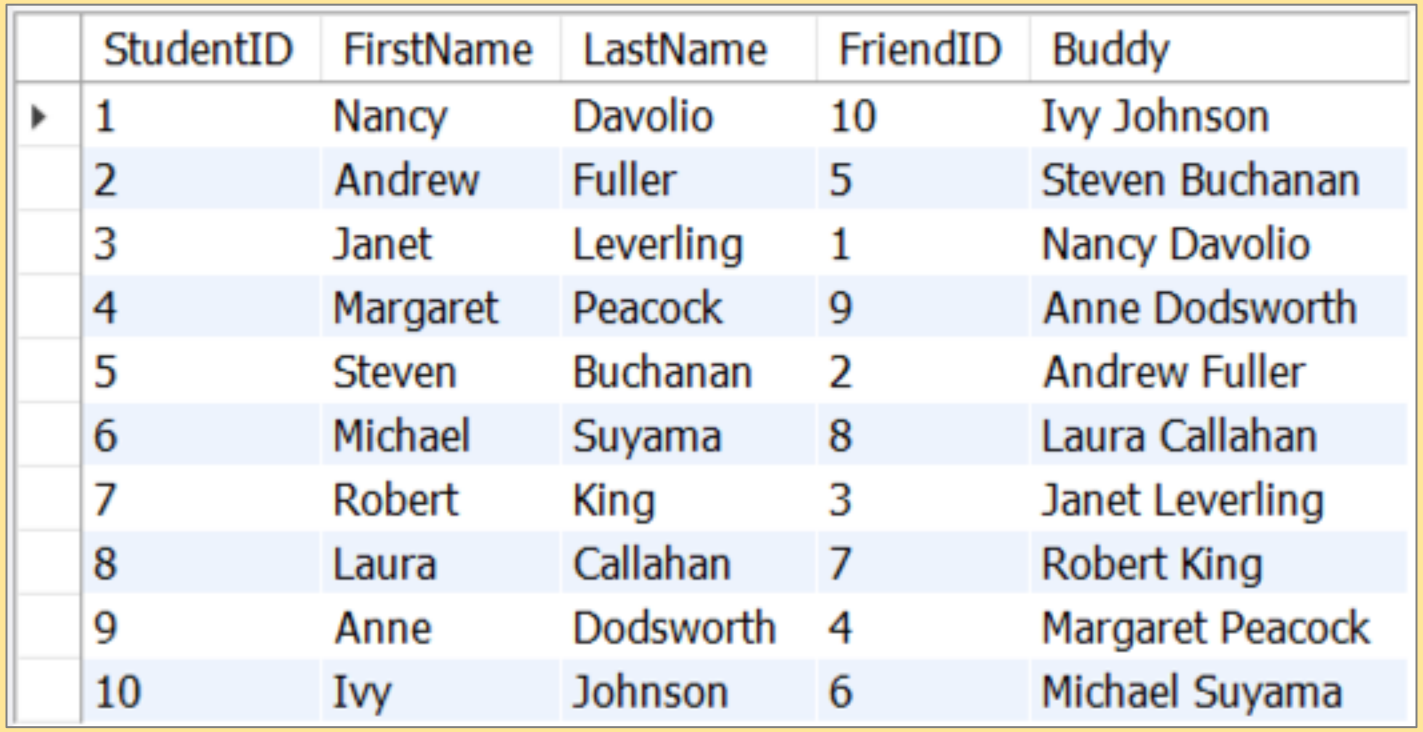
## SELF JOIN

```
SELECT column_names
FROM table AS t1
INNER JOIN table AS t2
ON t1.column = t2.column
```





# Active learning: what is the name of each friend? Write the join.



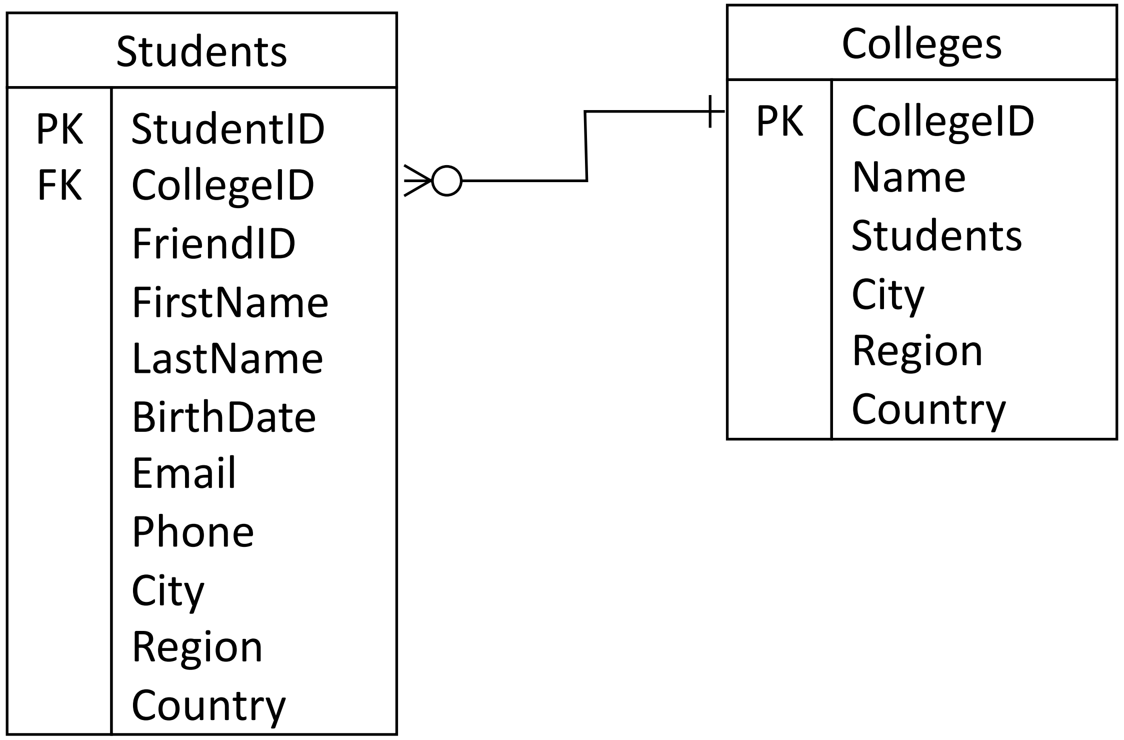
| StudentID | FirstName | LastName | FriendID | Buddy |
|---|---|---|---|---|
| 1 | Nancy | Davolio | 10 | Ivy Johnson |
| 2 | Andrew | Fuller | 5 | Steven Buchanan |
| 3 | Janet | Leverling | 1 | Nancy Davolio |
| 4 | Margaret | Peacock | 9 | Anne Dodsworth |
| 5 | Steven | Buchanan | 2 | Andrew Fuller |
| 6 | Michael | Suyama | 8 | Laura Callahan |
| 7 | Robert | King | 3 | Janet Leverling |
| 8 | Laura | Callahan | 7 | Robert King |
| 9 | Anne | Dodsworth | 4 | Margaret Peacock |
| 10 | Ivy | Johnson | 6 | Michael Suyama |

## Active learning

```
SELECT
    Students.StudentID, Students.FirstName,
    Students.LastName, Students.FriendID,
    CONCAT(Friend.FirstName, ' ', Friend.LastName) AS Buddy
FROM Students
INNER JOIN Students Friend
ON Students.FriendID = Friend.StudentID
```

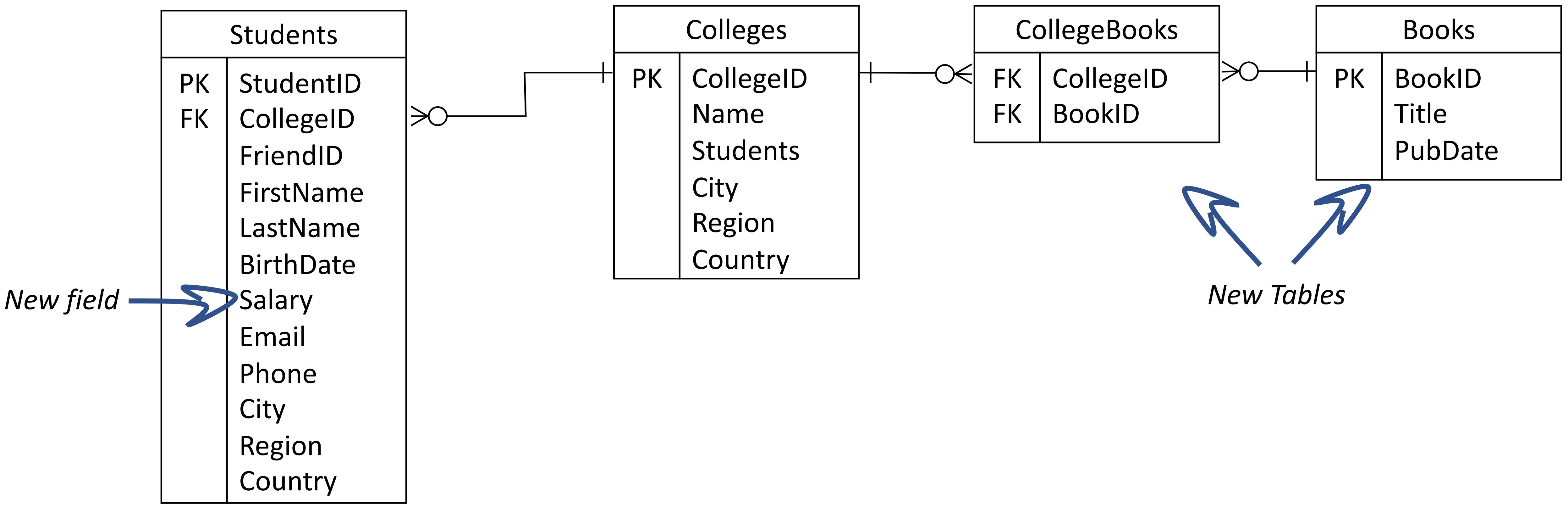
## JOINING MULTIPLE TABLES

# We started with



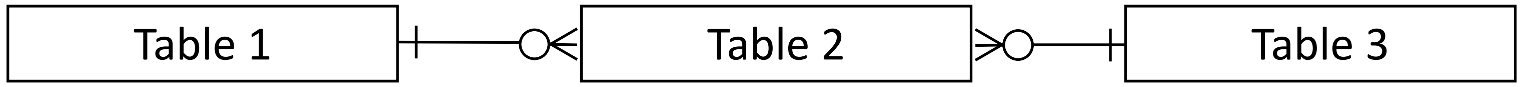
## Let's add

Colleges can write multiple books.
Books can have multiple colleges.



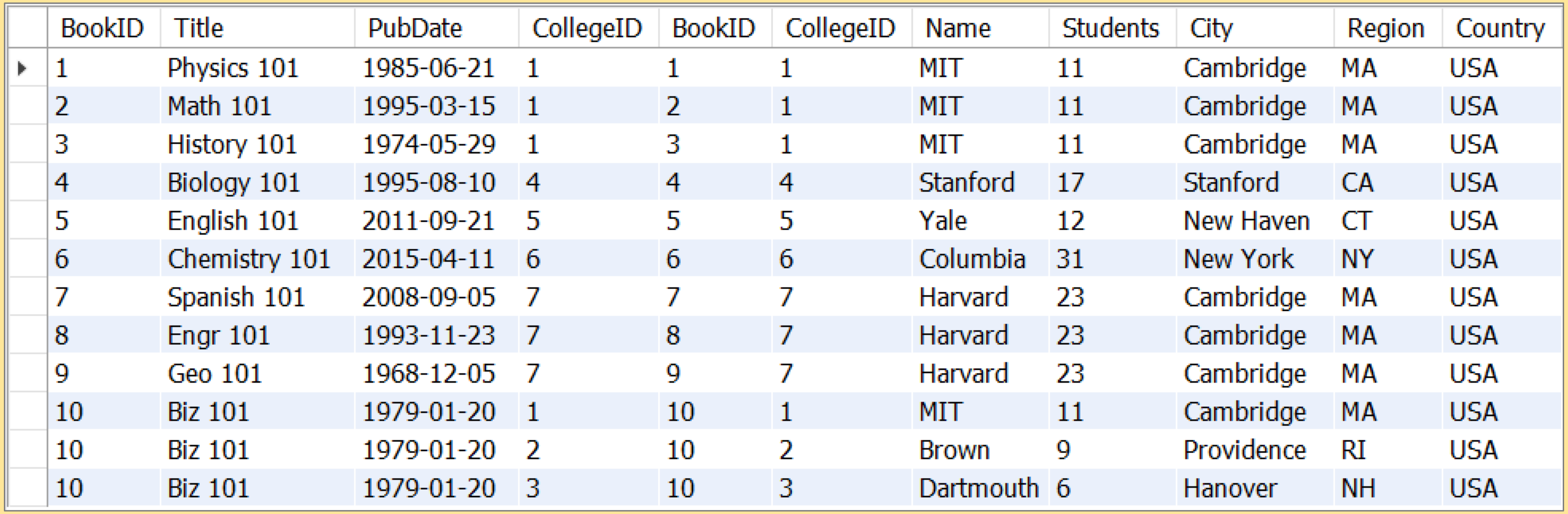
# Multiple table join

```
Table1 → Table 2, 1:N
Table3 → Table 1, 1:N
```



```
SELECT *
FROM table1 t1
JOIN table2 cb
   ON t1.columnID = t2.columnID
JOIN table3 t3
   ON t3.columnID = t2.columnID
```

## Active learning: colleges for book titles

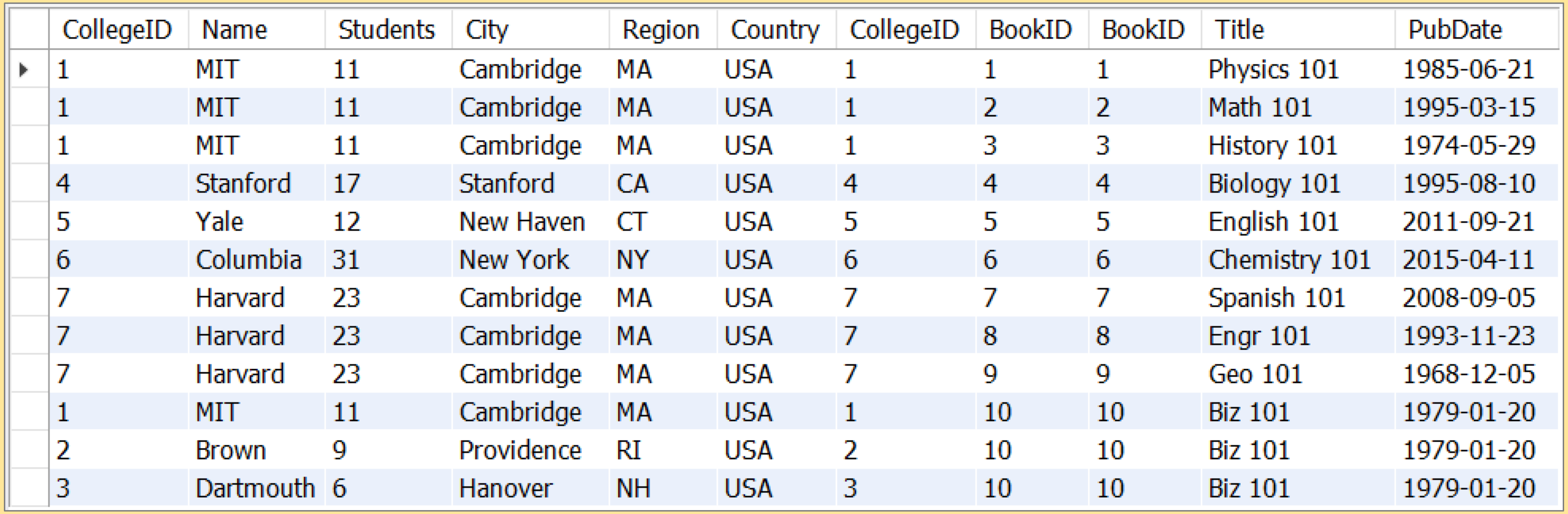


| BookID | Title | PubDate | CollegeID | BookID | CollegeID | Name | Students | City | Region | Country |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Physics 101 | 1985-06-21 | 1 | 1 | 1 | MIT | 11 | Cambridge | MA | USA |
| 2 | Math 101 | 1995-03-15 | 1 | 2 | 1 | MIT | 11 | Cambridge | MA | USA |
| 3 | History 101 | 1974-05-29 | 1 | 3 | 1 | MIT | 11 | Cambridge | MA | USA |
| 4 | Biology 101 | 1995-08-10 | 4 | 4 | 4 | Stanford | 17 | Stanford | CA | USA |
| 5 | English 101 | 2011-09-21 | 5 | 5 | 5 | Yale | 12 | New Haven | CT | USA |
| 6 | Chemistry 101 | 2015-04-11 | 6 | 6 | 6 | Columbia | 31 | New York | NY | USA |
| 7 | Spanish 101 | 2008-09-05 | 7 | 7 | 7 | Harvard | 23 | Cambridge | MA | USA |
| 8 | Engr 101 | 1993-11-23 | 7 | 8 | 7 | Harvard | 23 | Cambridge | MA | USA |
| 9 | Geo 101 | 1968-12-05 | 7 | 9 | 7 | Harvard | 23 | Cambridge | MA | USA |
| 10 | Biz 101 | 1979-01-20 | 1 | 10 | 1 | MIT | 11 | Cambridge | MA | USA |
| 10 | Biz 101 | 1979-01-20 | 2 | 10 | 2 | Brown | 9 | Providence | RI | USA |
| 10 | Biz 101 | 1979-01-20 | 3 | 10 | 3 | Dartmouth | 6 | Hanover | NH | USA |

# Active learning: colleges for books

```
SELECT *
FROM books b
JOIN collegebooks cb
    ON b.bookID = cb.bookID
JOIN colleges c
    ON c.collegeID = cb.collegeID
```

# Active learning: books for colleges



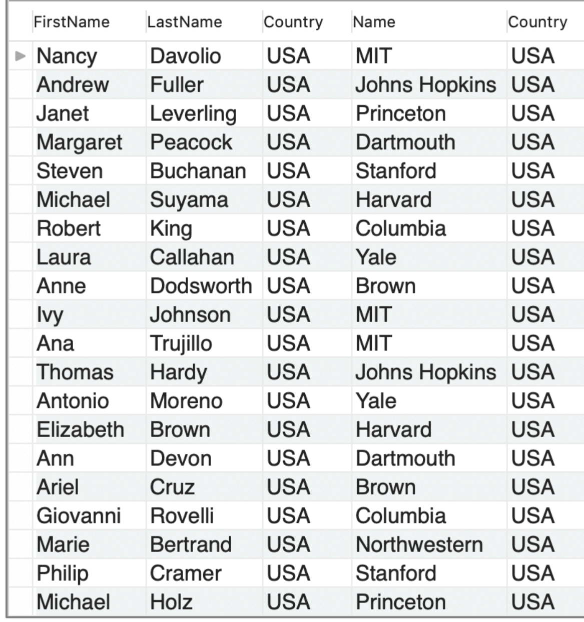
| CollegeID | Name | Students | City | Region | Country | CollegeID | BookID | BookID | Title | PubDate |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MIT | 11 | Cambridge | MA | USA | 1 | 1 | 1 | Physics 101 | 1985-06-21 |
| 1 | MIT | 11 | Cambridge | MA | USA | 1 | 2 | 2 | Math 101 | 1995-03-15 |
| 1 | MIT | 11 | Cambridge | MA | USA | 1 | 3 | 3 | History 101 | 1974-05-29 |
| 4 | Stanford | 17 | Stanford | CA | USA | 4 | 4 | 4 | Biology 101 | 1995-08-10 |
| 5 | Yale | 12 | New Haven | CT | USA | 5 | 5 | 5 | English 101 | 2011-09-21 |
| 6 | Columbia | 31 | New York | NY | USA | 6 | 6 | 6 | Chemistry 101 | 2015-04-11 |
| 7 | Harvard | 23 | Cambridge | MA | USA | 7 | 7 | 7 | Spanish 101 | 2008-09-05 |
| 7 | Harvard | 23 | Cambridge | MA | USA | 7 | 8 | 8 | Engr 101 | 1993-11-23 |
| 7 | Harvard | 23 | Cambridge | MA | USA | 7 | 9 | 9 | Geo 101 | 1968-12-05 |
| 1 | MIT | 11 | Cambridge | MA | USA | 1 | 10 | 10 | Biz 101 | 1979-01-20 |
| 2 | Brown | 9 | Providence | RI | USA | 2 | 10 | 10 | Biz 101 | 1979-01-20 |
| 3 | Dartmouth | 6 | Hanover | NH | USA | 3 | 10 | 10 | Biz 101 | 1979-01-20 |

## Active learning: books for colleges

```
SELECT *
FROM colleges c
JOIN collegebooks cb
   ON c.collegeID = cb.collegeID
JOIN books b
   ON b.bookID = cb.bookID
```

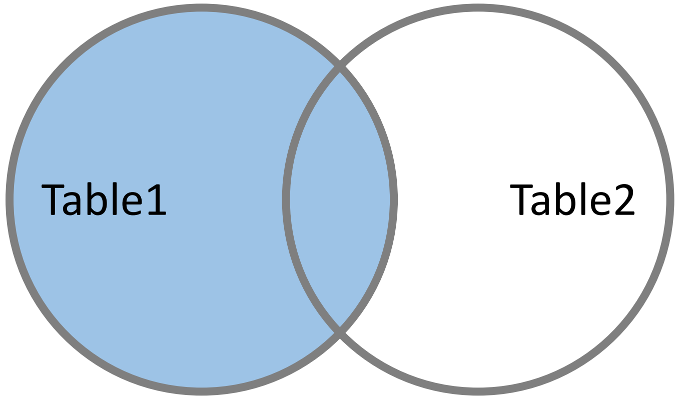
## MORE JOINS

# LEFT JOIN



| FirstName | LastName | Country | Name | Country |
|---|---|---|---|---|
| Nancy | Davolio | USA | MIT | USA |
| Andrew | Fuller | USA | Johns Hopkins | USA |
| Janet | Leverling | USA | Princeton | USA |
| Margaret | Peacock | USA | Dartmouth | USA |
| Steven | Buchanan | USA | Stanford | USA |
| Michael | Suyama | USA | Harvard | USA |
| Robert | King | USA | Columbia | USA |
| Laura | Callahan | USA | Yale | USA |
| Anne | Dodsworth | USA | Brown | USA |
| Ivy | Johnson | USA | MIT | USA |
| Ana | Trujillo | USA | MIT | USA |
| Thomas | Hardy | USA | Johns Hopkins | USA |
| Antonio | Moreno | USA | Yale | USA |
| Elizabeth | Brown | USA | Harvard | USA |
| Ann | Devon | USA | Dartmouth | USA |
| Ariel | Cruz | USA | Brown | USA |
| Giovanni | Rovelli | USA | Columbia | USA |
| Marie | Bertrand | USA | Northwestern | USA |
| Philip | Cramer | USA | Stanford | USA |
| Michael | Holz | USA | Princeton | USA |

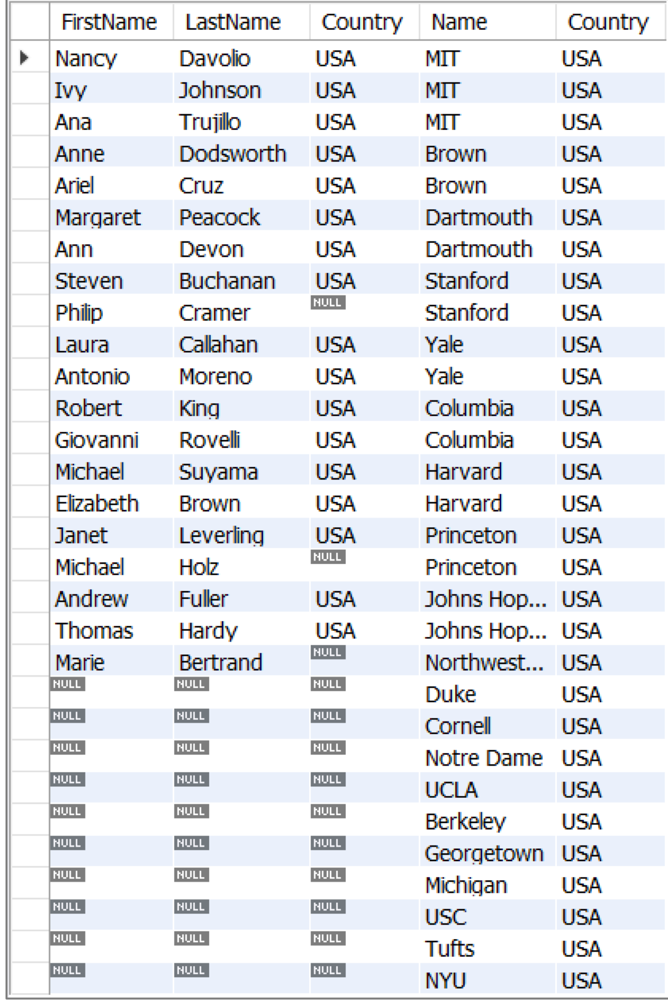
```
SELECT Students.FirstName, Students.LastName,
Students.Country, Colleges.Name, Colleges.Country
FROM Students
LEFT JOIN Colleges
ON Students.CollegeID = Colleges.CollegeID;
```



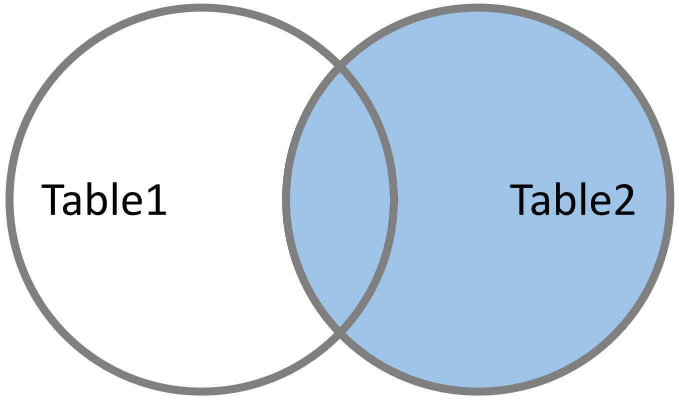
```
SELECT column_names
FROM table1
LEFT JOIN table2
ON table1.column = table2.column
```

# RIGHT JOIN

SELECT Students.FirstName, Students.LastName, Students.Country, Colleges.Name, Colleges.Country
FROM Students
RIGHT JOIN Colleges
ON Students.CollegeID = Colleges.CollegeID



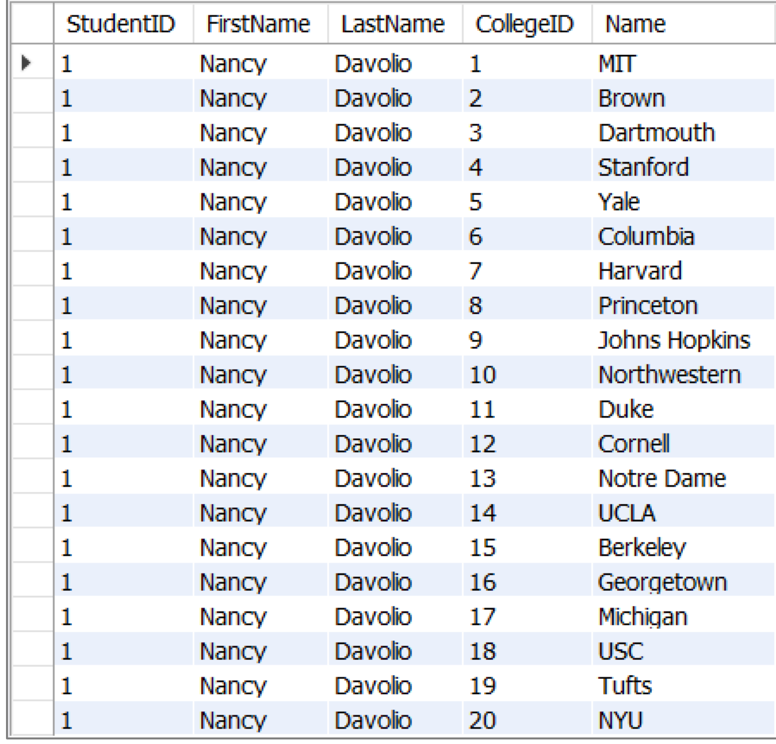
| FirstName | LastName | Country | Name | Country |
|---|---|---|---|---|
| Nancy | Davolio | USA | MIT | USA |
| Ivy | Johnson | USA | MIT | USA |
| Ana | Trujillo | USA | MIT | USA |
| Anne | Dodsworth | USA | Brown | USA |
| Ariel | Cruz | USA | Brown | USA |
| Margaret | Peacock | USA | Dartmouth | USA |
| Ann | Devon | USA | Dartmouth | USA |
| Steven | Buchanan | USA | Stanford | USA |
| Philip | Cramer | NULL | Stanford | USA |
| Laura | Callahan | USA | Yale | USA |
| Antonio | Moreno | USA | Yale | USA |
| Robert | King | USA | Columbia | USA |
| Giovanni | Rovelli | USA | Columbia | USA |
| Michael | Suyama | USA | Harvard | USA |
| Elizabeth | Brown | USA | Harvard | USA |
| Janet | Leverling | USA | Princeton | USA |
| Michael | Holz | NULL | Princeton | USA |
| Andrew | Fuller | USA | Johns Hop... | USA |
| Thomas | Hardy | USA | Johns Hop... | USA |
| Marie | Bertrand | NULL | Northwest... | USA |
| NULL | NULL | NULL | Duke | USA |
| NULL | NULL | NULL | Cornell | USA |
| NULL | NULL | NULL | Notre Dame | USA |
| NULL | NULL | NULL | UCLA | USA |
| NULL | NULL | NULL | Berkeley | USA |
| NULL | NULL | NULL | Georgetown | USA |
| NULL | NULL | NULL | Michigan | USA |
| NULL | NULL | NULL | USC | USA |
| NULL | NULL | NULL | Tufts | USA |
| NULL | NULL | NULL | NYU | USA |



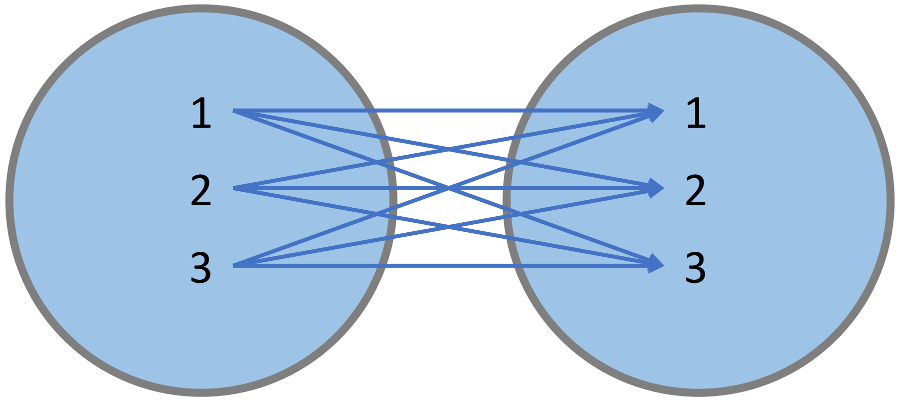
SELECT column_names
FROM table1
RIGHT JOIN table2
ON table1.column = table2.column

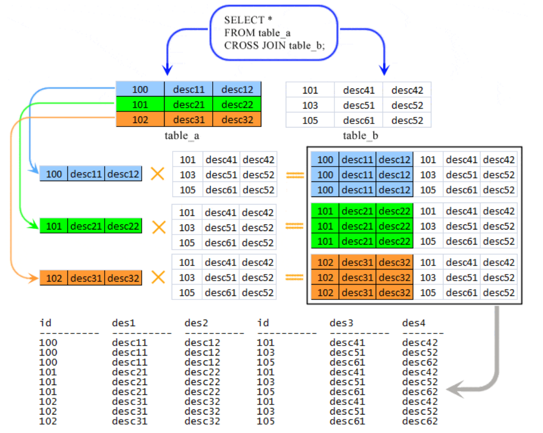
# CROSS JOIN

```sql
SELECT S.StudentID, S.FirstName, S.LastName,
C.CollegeID, C.Name
FROM Students S
CROSS JOIN Colleges C
WHERE S.StudentID=1
```



| StudentID | FirstName | LastName | CollegeID | Name |
|---|---|---|---|---|
| 1 | Nancy | Davolio | 1 | MIT |
| 1 | Nancy | Davolio | 2 | Brown |
| 1 | Nancy | Davolio | 3 | Dartmouth |
| 1 | Nancy | Davolio | 4 | Stanford |
| 1 | Nancy | Davolio | 5 | Yale |
| 1 | Nancy | Davolio | 6 | Columbia |
| 1 | Nancy | Davolio | 7 | Harvard |
| 1 | Nancy | Davolio | 8 | Princeton |
| 1 | Nancy | Davolio | 9 | Johns Hopkins |
| 1 | Nancy | Davolio | 10 | Northwestern |
| 1 | Nancy | Davolio | 11 | Duke |
| 1 | Nancy | Davolio | 12 | Cornell |
| 1 | Nancy | Davolio | 13 | Notre Dame |
| 1 | Nancy | Davolio | 14 | UCLA |
| 1 | Nancy | Davolio | 15 | Berkeley |
| 1 | Nancy | Davolio | 16 | Georgetown |
| 1 | Nancy | Davolio | 17 | Michigan |
| 1 | Nancy | Davolio | 18 | USC |
| 1 | Nancy | Davolio | 19 | Tufts |
| 1 | Nancy | Davolio | 20 | NYU |





```sql
SELECT *
FROM table_a
CROSS JOIN table_b;
```

| | | |
|---|---|---|
| 100 | desc11 | desc12 |
| 101 | desc21 | desc22 |
| 102 | desc31 | desc32 |

| | | |
|---|---|---|
| 101 | desc41 | desc42 |
| 103 | desc51 | desc52 |
| 105 | desc61 | desc52 |

```
id          des1        des2        id          des3        des4
----------  ----------  ----------  ----------  ----------  -------
100         desc11      desc12      101         desc41      desc42
100         desc11      desc12      103         desc51      desc52
100         desc11      desc12      105         desc61      desc62
101         desc21      desc22      101         desc41      desc42
101         desc21      desc22      103         desc51      desc52
101         desc21      desc22      105         desc61      desc62
102         desc31      desc32      101         desc41      desc42
102         desc31      desc32      103         desc51      desc52
102         desc31      desc32      105         desc61      desc62
```