Dealing with missing data

CLEANING DATA IN SQL SERVER DATABASES

SQL

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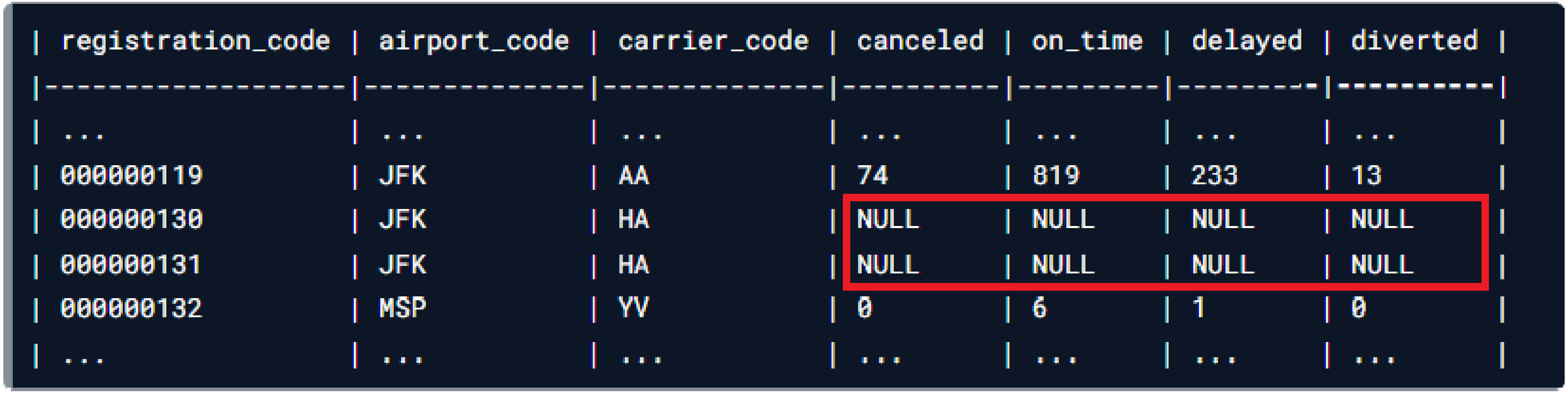
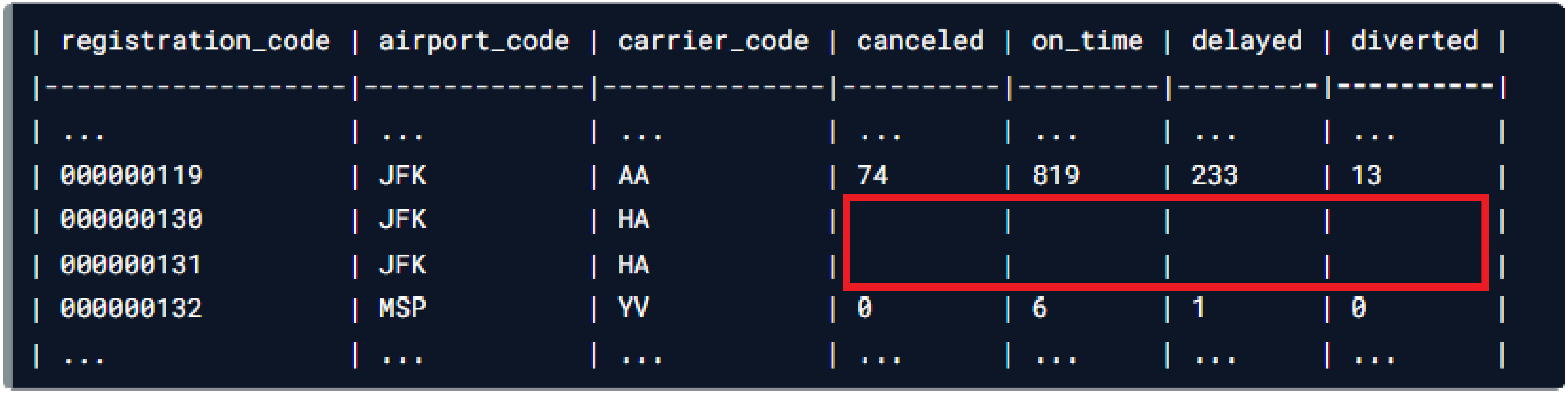
Understanding missing data



```
| registration_code | airport_code | carrier_code | canceled | on_time | delayed | diverted |
|-------------------|--------------|--------------|----------|---------|---------|----------|
| ...               | ...          | ...          | ...      | ...     | ...     | ...      |
| 000000119         | JFK          | AA           | 74       | 819     | 233     | 13       |
| 000000130         | JFK          | HA           | NULL     | NULL    | NULL    | NULL     |
| 000000131         | JFK          | HA           | NULL     | NULL    | NULL    | NULL     |
| 000000132         | MSP          | YV           | 0        | 6       | 1       | 0        |
| ...               | ...          | ...          | ...      | ...     | ...     | ...      |
```

Understanding missing data



```
| registration_code | airport_code | carrier_code | canceled | on_time | delayed | diverted |
|-------------------|--------------|--------------|----------|---------|---------|----------|
| ...               | ...          | ...          | ...      | ...     | ...     | ...      |
| 000000119         | JFK          | AA           | 74       | 819     | 233     | 13       |
| 000000130         | JFK          | HA           |          |         |         |          |
| 000000131         | JFK          | HA           |          |         |         |          |
| 000000132         | MSP          | YV           | 0        | 6       | 1       | 0        |
| ...               | ...          | ...          | ...      | ...     | ...     | ...      |
```

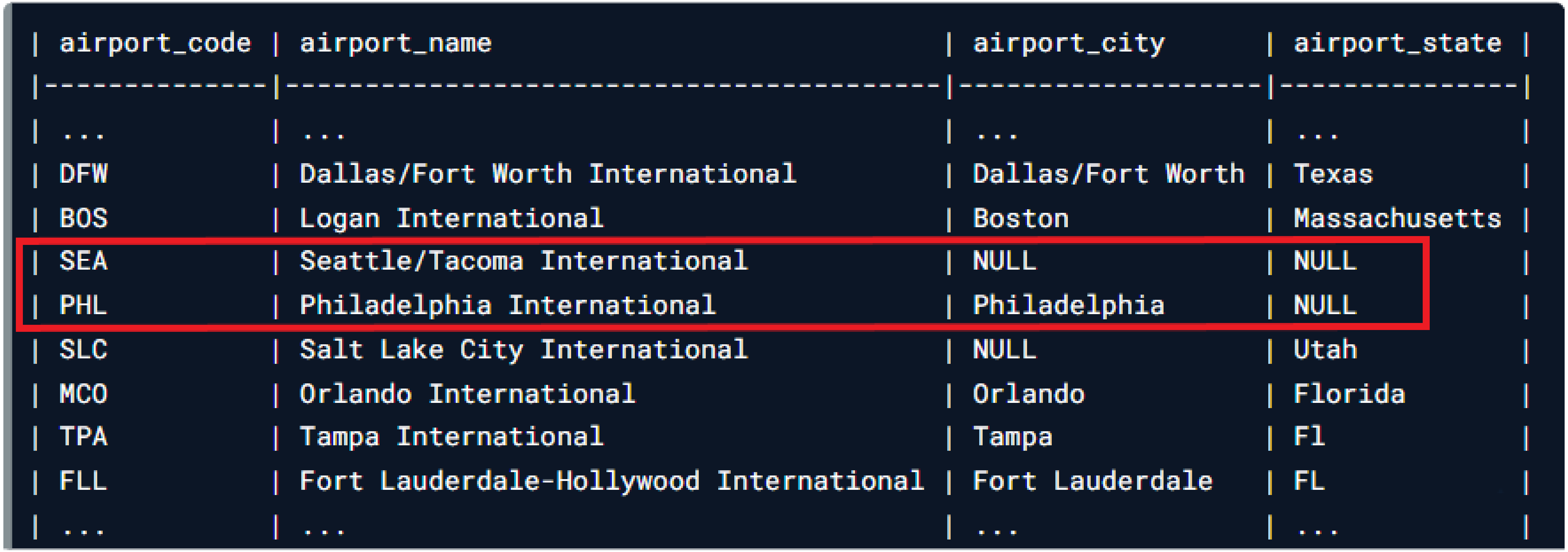
Understanding missing data - Reasons

- Intentionally
- Error when inserting data
- Data doesn't exist.

Understanding missing data - Solutions

- Recommended:
  - Investigate to get the missing values
- Depending on the business:
  - Leave as it is
  - Remove rows with missing values
  - Fill with other value (text, average, etc.)

Remove missing values - IS NOT NULL



```
| airport_code | airport_name                            | airport_city      | airport_state |
|--------------|-----------------------------------------|-------------------|---------------|
| ...          | ...                                     | ...               | ...           |
| DFW          | Dallas/Fort Worth International         | Dallas/Fort Worth | Texas         |
| BOS          | Logan International                     | Boston            | Massachusetts |
| SEA          | Seattle/Tacoma International            | NULL              | NULL          |
| PHL          | Philadelphia International              | Philadelphia      | NULL          |
| SLC          | Salt Lake City International            | NULL              | Utah          |
| MCO          | Orlando International                   | Orlando           | Florida       |
| TPA          | Tampa International                     | Tampa             | Fl            |
| FLL          | Fort Lauderdale-Hollywood International | Fort Lauderdale   | FL            |
| ...          | ...                                     | ...               | ...           |
```

Remove missing values - IS NOT NULL

```sql
SELECT * FROM airports
WHERE airport_state IS NOT NULL
```

```
| airport_code | airport_name                            | airport_city      | airport_state |
|--------------|-----------------------------------------|-------------------|---------------|
| ...          | ...                                     | ...               | ...           |
| DFW          | Dallas/Fort Worth International         | Dallas/Fort Worth | Texas         |
| BOS          | Logan International                     | Boston            | Massachusetts |
| SLC          | Salt Lake City International            | NULL              | Utah          |
| MCO          | Orlando International                   | Orlando           | Florida       |
| TPA          | Tampa International                     | Tampa             | Fl            |
| FLL          | Fort Lauderdale-Hollywood International | Fort Lauderdale   | FL            |
| ...          | ...                                     | ...               | ...           |
```

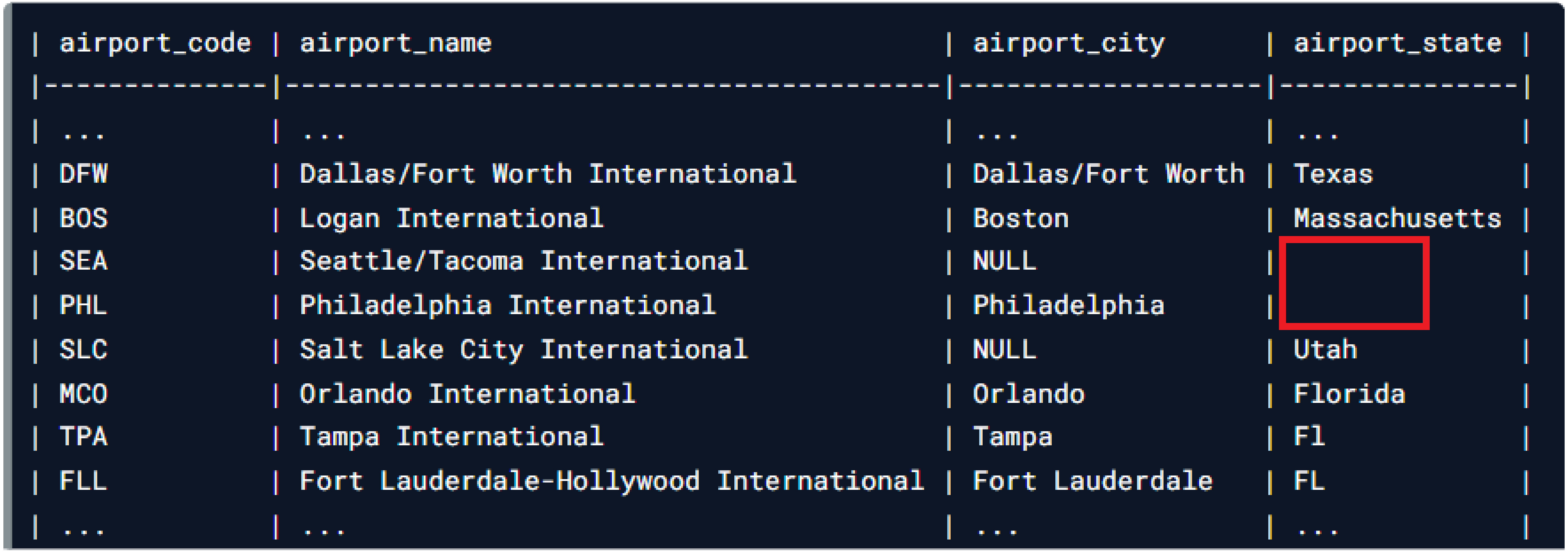
Remove missing values - IS NOT NULL

```sql
SELECT * FROM airports
WHERE airport_state IS NULL
```

```
| airport_code | airport_name                    | airport_city | airport_state |
|--------------|---------------------------------|--------------|---------------|
| SEA          | Seattle/Tacoma International | NULL         | NULL          |
| PHL          | Philadelphia International    | Philadelphia | NULL          |
```

Remove missing values - <> ''

```
SELECT * FROM airports
```



```
| airport_code | airport_name                            | airport_city       | airport_state |
|--------------|-----------------------------------------|--------------------|---------------|
| ...          | ...                                     | ...                | ...           |
| DFW          | Dallas/Fort Worth International         | Dallas/Fort Worth  | Texas         |
| BOS          | Logan International                     | Boston             | Massachusetts |
| SEA          | Seattle/Tacoma International            | NULL               |               |
| PHL          | Philadelphia International              | Philadelphia       |               |
| SLC          | Salt Lake City International            | NULL               | Utah          |
| MCO          | Orlando International                   | Orlando            | Florida       |
| TPA          | Tampa International                     | Tampa              | Fl            |
| FLL          | Fort Lauderdale-Hollywood International | Fort Lauderdale    | FL            |
| ...          | ...                                     | ...                | ...           |
```

Remove missing values - <> "

```
SELECT * FROM airports
WHERE airport_state <> ''
```

```
| airport_code | airport_name                              | airport_city       | airport_state |
|--------------|-------------------------------------------|--------------------|---------------|
| ...          | ...                                       | ...                | ...           |
| DFW          | Dallas/Fort Worth International           | Dallas/Fort Worth  | Texas         |
| BOS          | Logan International                       | Boston             | Massachusetts |
| SLC          | Salt Lake City International              | NULL               | Utah          |
| MCO          | Orlando International                     | Orlando            | Florida       |
| TPA          | Tampa International                       | Tampa              | Fl            |
| FLL          | Fort Lauderdale-Hollywood International   | Fort Lauderdale    | FL            |
| ...          | ...                                       | ...                | ...           |
```

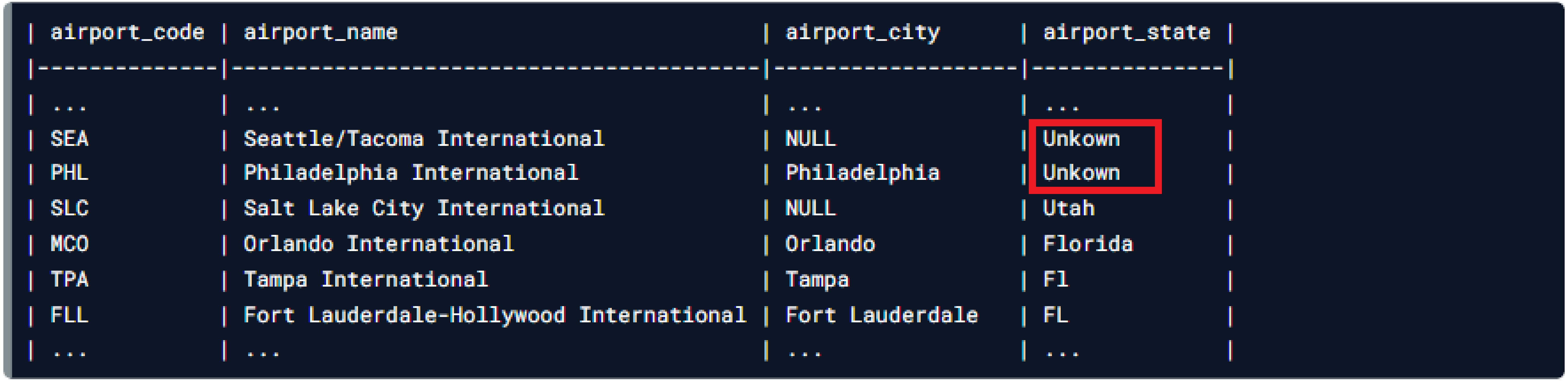
Fill with other value - ISNULL

```
ISNULL ( check_expression , replacement_value )
```

- ISNULL <> IS NULL

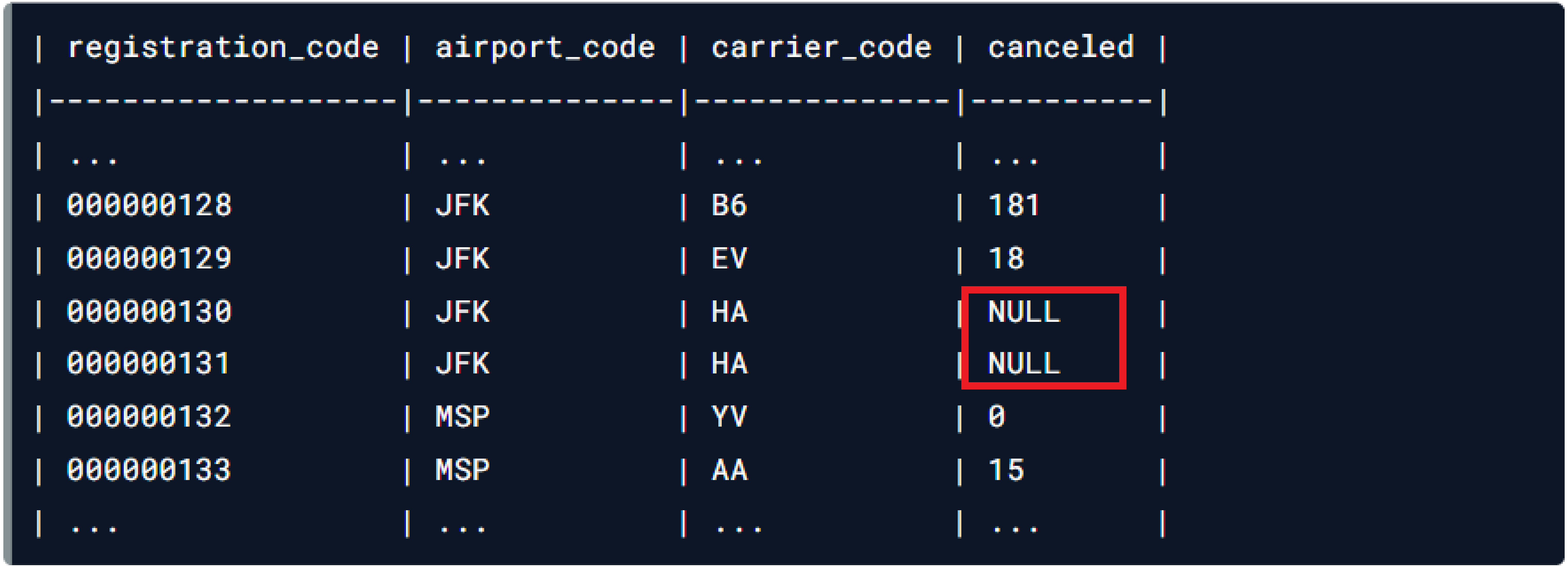
Fill with other value - ISNULL

```
SELECT
    airport_code,
    airport_name,
    airport_city,
    ISNULL(airport_state, 'Unknown') AS airport_state
FROM airports
```



```
| airport_code | airport_name                            | airport_city       | airport_state |
|--------------|-----------------------------------------|--------------------|---------------|
| ...          | ...                                     | ...                | ...           |
| SEA          | Seattle/Tacoma International            | NULL               | Unkown        |
| PHL          | Philadelphia International              | Philadelphia       | Unkown        |
| SLC          | Salt Lake City International            | NULL               | Utah          |
| MCO          | Orlando International                   | Orlando            | Florida       |
| TPA          | Tampa International                     | Tampa              | Fl            |
| FLL          | Fort Lauderdale-Hollywood International | Fort Lauderdale    | FL            |
| ...          | ...                                     | ...                | ...           |
```

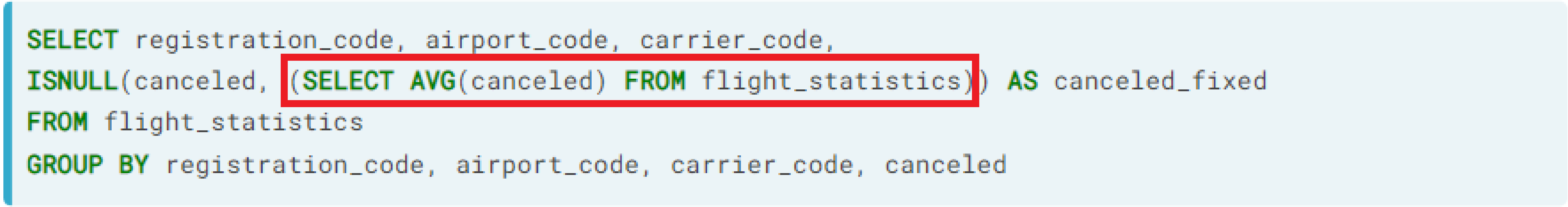
Fill with other value - ISNULL with AVG



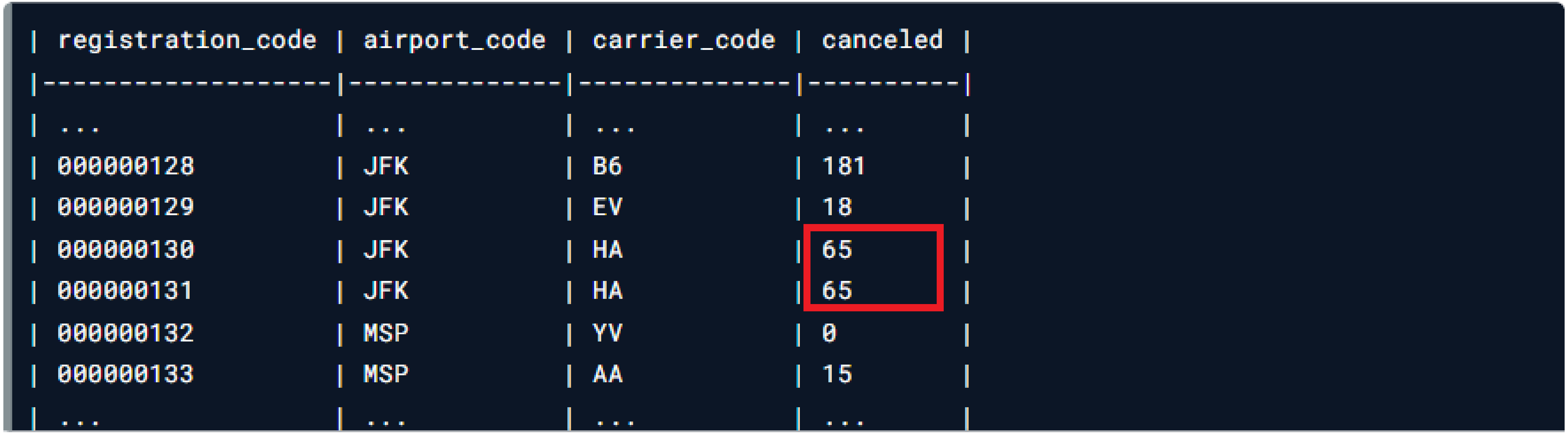
```
| registration_code | airport_code | carrier_code | canceled |
|-------------------|--------------|--------------|----------|
| ...               | ...          | ...          | ...      |
| 000000128         | JFK          | B6           | 181      |
| 000000129         | JFK          | EV           | 18       |
| 000000130         | JFK          | HA           | NULL     |
| 000000131         | JFK          | HA           | NULL     |
| 000000132         | MSP          | YV           | 0        |
| 000000133         | MSP          | AA           | 15       |
| ...               | ...          | ...          | ...      |
```

- Replace `NULL` with the average.

Fill with other value - ISNULL with AVG



```
SELECT registration_code, airport_code, carrier_code,
ISNULL(canceled, (SELECT AVG(canceled) FROM flight_statistics)) AS canceled_fixed
FROM flight_statistics
GROUP BY registration_code, airport_code, carrier_code, canceled
```



```
| registration_code | airport_code | carrier_code | canceled |
|-------------------|--------------|--------------|----------|
| ...               | ...          | ...          | ...      |
| 000000128         | JFK          | B6           | 181      |
| 000000129         | JFK          | EV           | 18       |
| 000000130         | JFK          | HA           | 65       |
| 000000131         | JFK          | HA           | 65       |
| 000000132         | MSP          | YV           | 0        |
| 000000133         | MSP          | AA           | 15       |
| ...               | ...          | ...          | ...      |
```

Fill with other value - COALESCE

```
COALESCE ( arg1, arg2, arg3, ... )
```

```
SELECT
airport_code,
airport_city,
airport_state,
COALESCE (airport_state, airport_city, 'Unknown') AS airport_state_fixed
FROM airports
```

```
| airport_code | airport_city | airport_state | airport_state_fixed |
|--------------|--------------|---------------|---------------------|
| ...          | ...          | ...           | ...                 |
| SLC          | NULL         | Utah          | Utah                |
| PHL          | Philadelphia | NULL          | Philadelphia        |
| SEA          | NULL         | NULL          | Unknown             |
| ...          | ...          | ...           | ...                 |
```

Let's practice!

CLEANING DATA IN SQL SERVER DATABASES

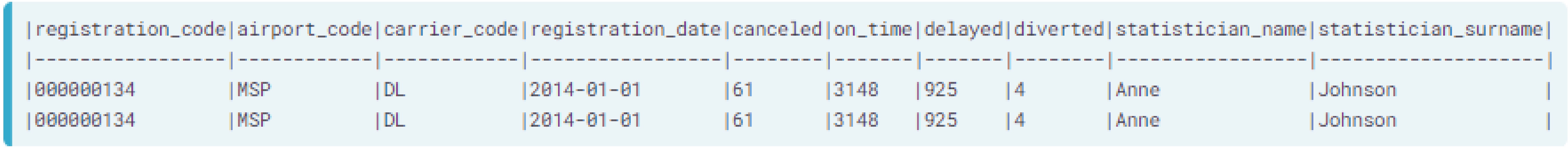
Avoiding duplicate data

CLEANING DATA IN SQL SERVER DATABASES

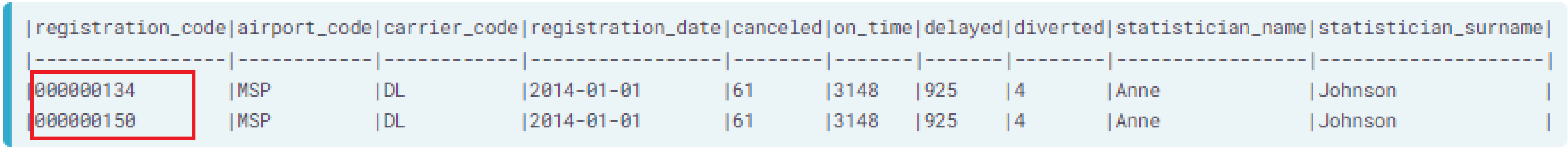
SQL

Miriam Antona
Software Engineer

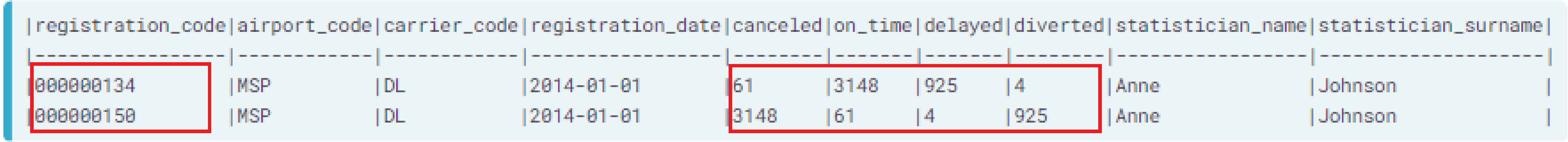
What is duplicate data?



```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
```



```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000150        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
```

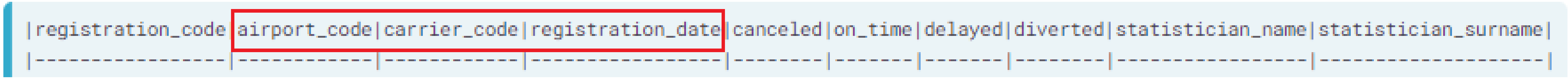


```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000150        |MSP         |DL          |2014-01-01       |3148    |61     |4      |925     |Anne             |Johnson             |
```

- Duplicate date can interfere in our analysis!

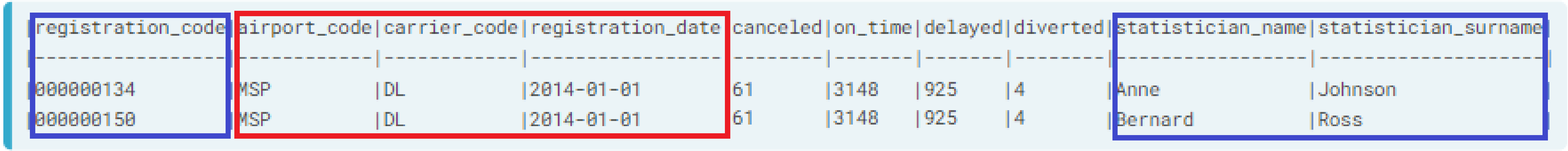
Finding repeating groups

`flight_statistics`

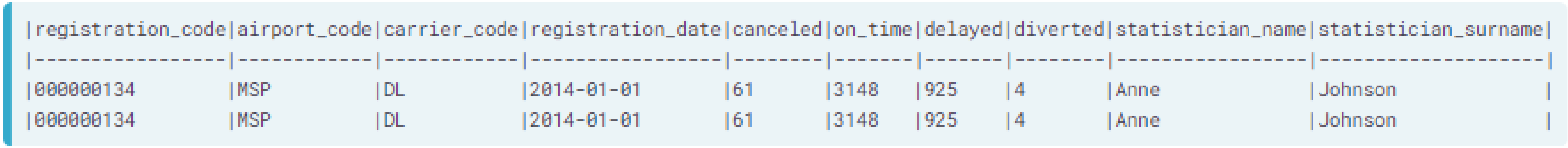


```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
```

No problem to exclude duplicate rows:



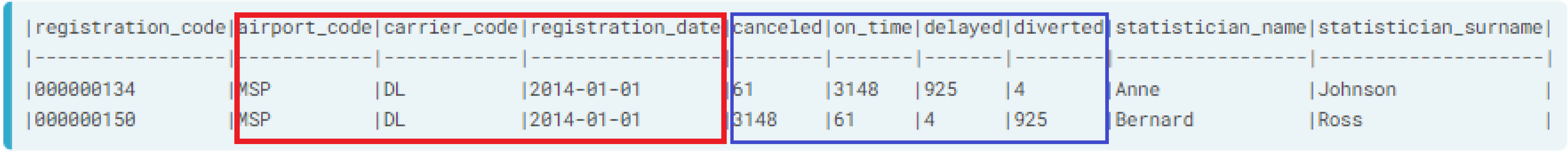
```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000150        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Bernard          |Ross                |
```



```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
```

Finding repeating groups

- We have a problem to exclude!



```
|registration_code|airport_code|carrier_code|registration_date|canceled|on_time|delayed|diverted|statistician_name|statistician_surname|
|-----------------|------------|------------|-----------------|--------|-------|-------|--------|-----------------|--------------------|
|000000134        |MSP         |DL          |2014-01-01       |61      |3148   |925    |4       |Anne             |Johnson             |
|000000150        |MSP         |DL          |2014-01-01       |3148    |61     |4      |925     |Bernard          |Ross                |
```

Investigate!

Detecting duplicate data - ROW_NUMBER()

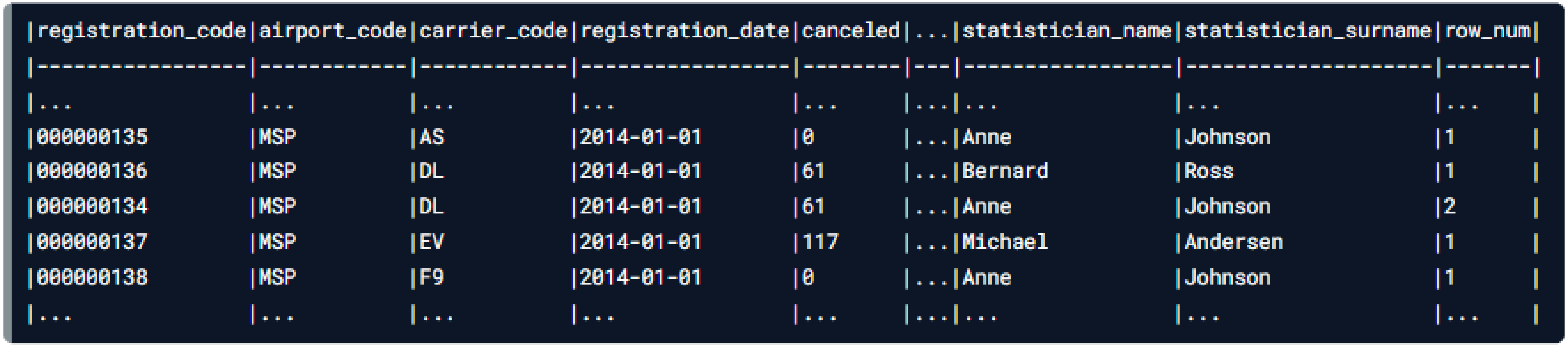
```
ROW_NUMBER () OVER (
      [ PARTITION BY
         value_expression ,
         ... [ n ] ]
        order_by_clause )
```

- Partitions = repeating groups
- Returns a number starting at 1 for the first row in every partition
- Returns sequential number for each row within the same partition

Detecting duplicate data - ROW_NUMBER()

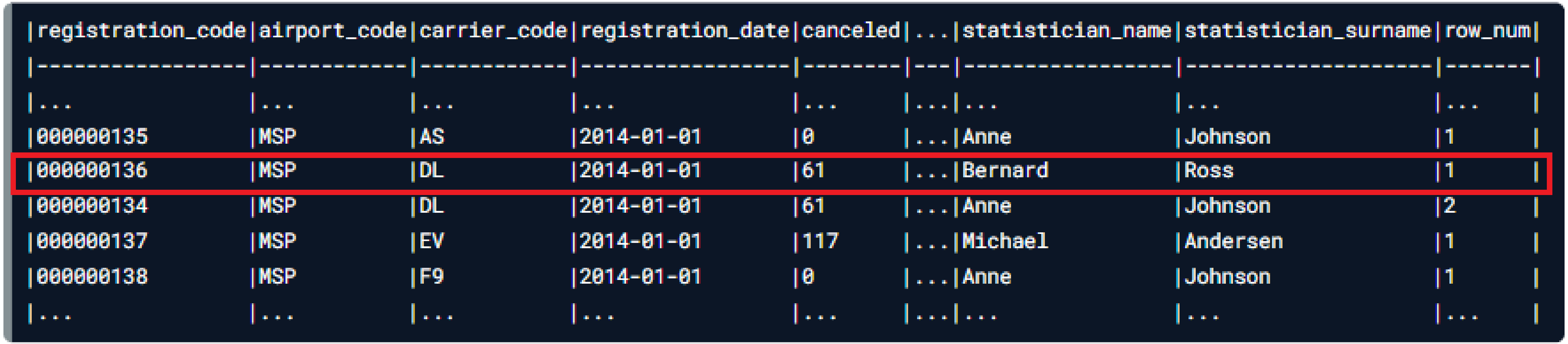
```
SELECT *,
       ROW_NUMBER() OVER (
            PARTITION BY
                airport_code,
                carrier_code,
                registration_date
            ORDER BY
                airport_code,
                carrier_code,
                registration_date
        ) row_num
FROM flight_statistics
```

Detecting duplicate data - ROW_NUMBER()



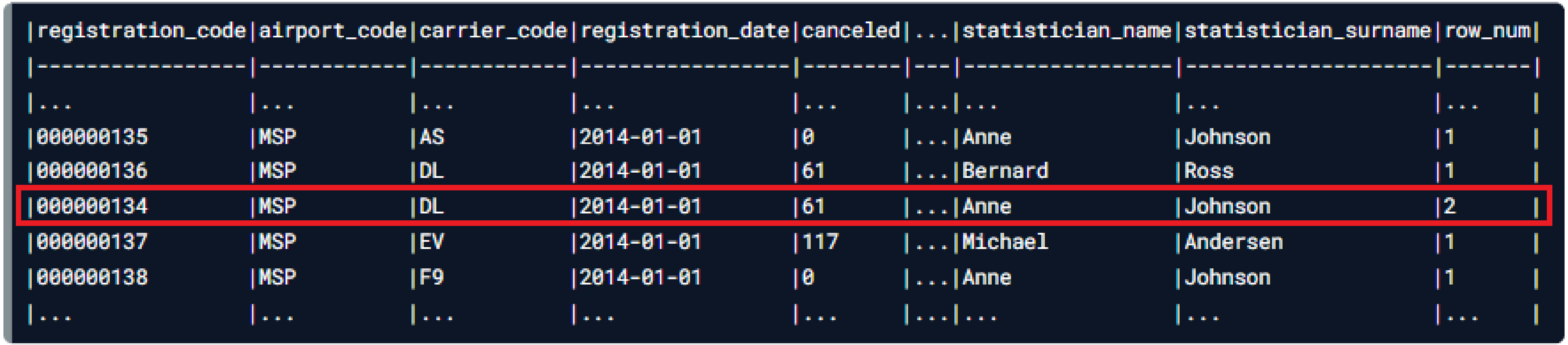
```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|---|-----------------|--------------------|-------|
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
|000000135        |MSP         |AS          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000136        |MSP         |DL          |2014-01-01       |61      |...|Bernard          |Ross                |1      |
|000000134        |MSP         |DL          |2014-01-01       |61      |...|Anne             |Johnson             |2      |
|000000137        |MSP         |EV          |2014-01-01       |117     |...|Michael          |Andersen            |1      |
|000000138        |MSP         |F9          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
```

Detecting duplicate data - ROW_NUMBER()



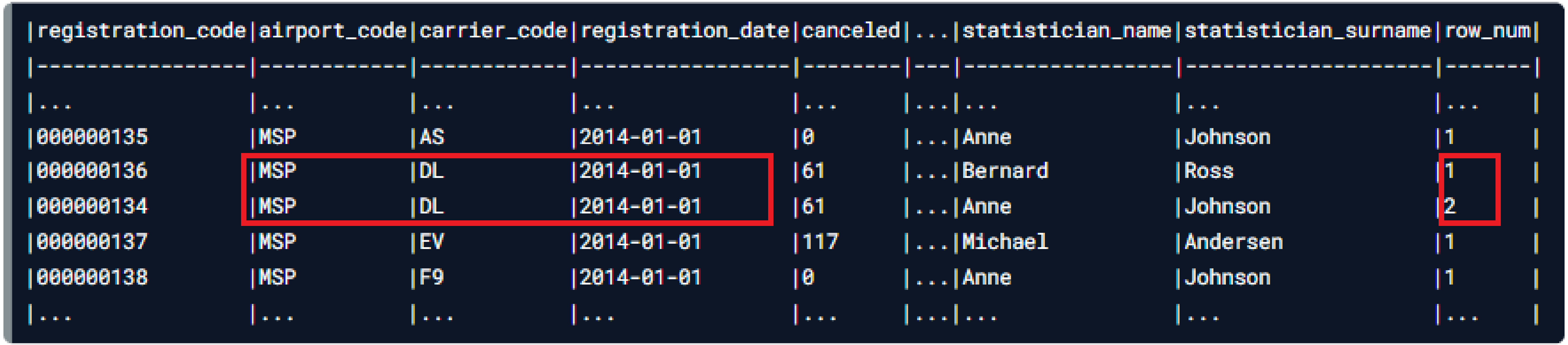
```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|---|-----------------|--------------------|-------|
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
|000000135        |MSP         |AS          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000136        |MSP         |DL          |2014-01-01       |61      |...|Bernard          |Ross                |1      |
|000000134        |MSP         |DL          |2014-01-01       |61      |...|Anne             |Johnson             |2      |
|000000137        |MSP         |EV          |2014-01-01       |117     |...|Michael          |Andersen            |1      |
|000000138        |MSP         |F9          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
```

Detecting duplicate data - ROW_NUMBER()



```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|---|-----------------|--------------------|-------|
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
|000000135        |MSP         |AS          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000136        |MSP         |DL          |2014-01-01       |61      |...|Bernard          |Ross                |1      |
|000000134        |MSP         |DL          |2014-01-01       |61      |...|Anne             |Johnson             |2      |
|000000137        |MSP         |EV          |2014-01-01       |117     |...|Michael          |Andersen            |1      |
|000000138        |MSP         |F9          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
```

Detecting duplicate data - ROW_NUMBER()



```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|---|-----------------|--------------------|-------|
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
|000000135        |MSP         |AS          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000136        |MSP         |DL          |2014-01-01       |61      |...|Bernard          |Ross                |1      |
|000000134        |MSP         |DL          |2014-01-01       |61      |...|Anne             |Johnson             |2      |
|000000137        |MSP         |EV          |2014-01-01       |117     |...|Michael          |Andersen            |1      |
|000000138        |MSP         |F9          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
```

- **Get** duplicate rows:
  - row_num > 1
- **Exclude** duplicate rows:
  - row_num = 1

Getting only duplicate rows

```
WITH cte AS (
    SELECT *,
        ROW_NUMBER() OVER (
            PARTITION BY
                airport_code,
                carrier_code,
                registration_date
            ORDER BY
                airport_code,
                carrier_code,
                registration_date
        ) row_num
    FROM flight_statistics
)
SELECT * FROM cte
WHERE row_num > 1;
```

Getting only duplicate rows

```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|---|-----------------|--------------------|-------|
|000000131        |JFK         |EV          |2014-02-28       |18      |...|Anne             |Johnson             |2      |
|000000134        |MSP         |DL          |2014-01-01       |61      |...|Anne             |Johnson             |2      |
|000000142        |MSP         |OO          |2014-01-01       |76      |...|Anne             |Johnson             |2      |
|000000143        |MSP         |OO          |2014-01-01       |76      |...|Anne             |Johnson             |3      |
```

Excluding duplicate rows

```
WITH cte AS (
    SELECT *,
        ROW_NUMBER() OVER (
            PARTITION BY
                airport_code,
                carrier_code,
                registration_date
            ORDER BY
                airport_code,
                carrier_code,
                registration_date
        ) row_num
    FROM flight_statistics
)
SELECT * FROM cte
WHERE row_num = 1;
```

Excluding duplicate rows

```
|registration_code|airport_code|carrier_code|registration_date|canceled|...|statistician_name|statistician_surname|row_num|
|-----------------|------------|------------|-----------------|--------|...|-----------------|--------------------|-------|
|...              |...         |...         |...              |...     |...|...              |...                 |1      |
|000000126        |JFK         |VX          |2014-01-31       |12      |...|Bryan            |Page                |1      |
|000000133        |MSP         |AA          |2014-01-01       |15      |...|Peter            |Johnson             |1      |
|000000135        |MSP         |AS          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000136        |MSP         |DL          |2014-01-01       |61      |...|Bernard          |Ross                |1      |
|000000137        |MSP         |EV          |2014-01-01       |117     |...|Michael          |Andersen            |1      |
|000000138        |MSP         |F9          |2014-01-01       |0       |...|Anne             |Johnson             |1      |
|000000139        |MSP         |FL          |2014-01-01       |8       |...|Anne             |Johnson             |1      |
|000000140        |MSP         |MQ          |2014-01-01       |20      |...|Anne             |Johnson             |1      |
|000000141        |MSP         |OO          |2014-01-01       |76      |...|Anne             |Johnson             |1      |
|000000132        |MSP         |YV          |2013-12-01       |0       |...|Michael          |Andersen            |1      |
|...              |...         |...         |...              |...     |...|...              |...                 |...    |
```

Let's practice!

Dealing with different date formats

CLEANING DATA IN SQL SERVER DATABASES

SQL

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Software Engineer

Different date formats

- US English (month/day/year)
  - 04/15/2008
- Spanish (day/month/year)
  - 15/04/2008
- ...

Checking the date format of our tables

```
SELECT *
FROM pilots
```

```
| pilot_code | pilot_name | pilot_surname | carrier_code | entry_date |
|------------|------------|---------------|--------------|------------|
| 1          | Thomas     | Peters        | HA           | 2011-10-01 |
| 2          | Hiroki     | Konoe         | MQ           | 2011-01-21 |
| 3          | Arturo     | Montero       | UA           | 2012-12-28 |
| 4          | David      | Captain       | US           | 2000-10-01 |
| 5          | Ainhoa     | Guerrera      | VX           | 2000-10-05 |
| 6          | Alvin      | Andersen      | OO           | 2012-01-15 |
| 7          | William    | Champy        | F9           | 2011-03-15 |
| ...        | ...        | ...           | ...          | ...        |
```

- Format: `yyyy-MM-dd`

Functions to modify the date formats

- `CONVERT`
- `FORMAT`

CONVERT

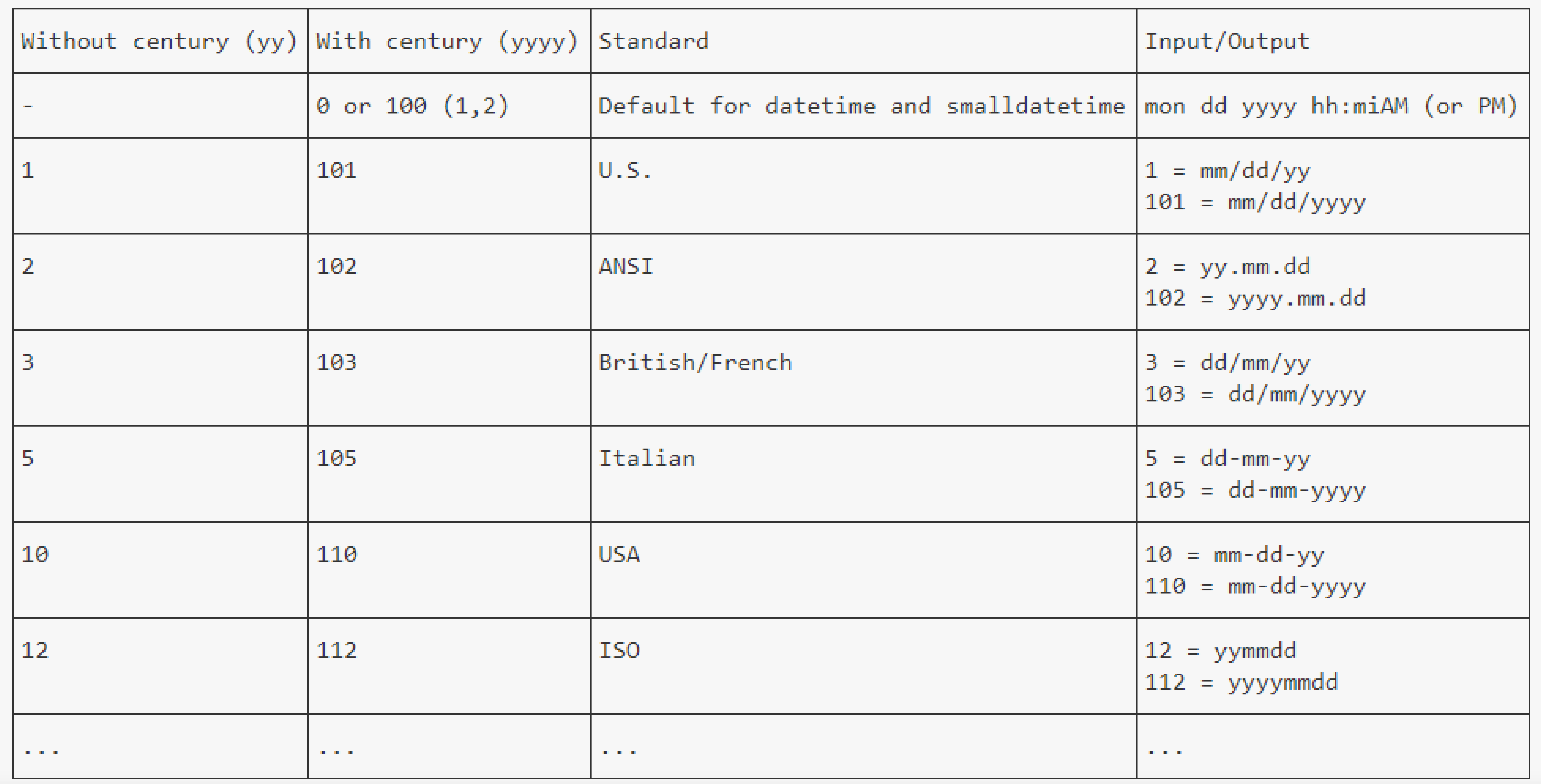
```
CONVERT(data_type[(length)], expression [, style])
```

CONVERT

```
SELECT
    CONVERT(VARCHAR(11), CAST(entry_date AS DATE), 0) AS '0',
    CONVERT(VARCHAR(10), CAST(entry_date AS DATE), 1) AS '1',
    CONVERT(VARCHAR(10), CAST(entry_date AS DATE), 101) AS '101',
    CONVERT(VARCHAR(10), CAST(entry_date AS DATE), 2) AS '2',
    CONVERT(VARCHAR(10), CAST(entry_date AS DATE), 120) AS '202'
FROM pilots
```

```
| 0           | 1        | 101        | 2        | 202        |
|-------------|----------|------------|----------|------------|
| Oct 1 2011  | 10/01/11 | 10/01/2011 | 11.10.01 | 2011-10-01 |
| Jan 21 2011 | 01/21/11 | 01/21/2011 | 11.01.21 | 2011-01-21 |
| Dec 28 2012 | 12/28/12 | 12/28/2012 | 12.12.28 | 2012-12-28 |
| Oct 1 2000  | 10/01/00 | 10/01/2000 | 00.10.01 | 2000-10-01 |
| ...         | ...      | ...        | ...      | ...        |
```

CONVERT



Without century (yy)	With century (yyyy)	Standard	Input/Output
-	0 or 100 (1,2)	Default for datetime and smalldatetime	mon dd yyyy hh:miAM (or PM)
1	101	U.S.	1 = mm/dd/yy 101 = mm/dd/yyyy
2	102	ANSI	2 = yy.mm.dd 102 = yyyy.mm.dd
3	103	British/French	3 = dd/mm/yy 103 = dd/mm/yyyy
5	105	Italian	5 = dd-mm-yy 105 = dd-mm-yyyy
10	110	USA	10 = mm-dd-yy 110 = mm-dd-yyyy
12	112	ISO	12 = yymmdd 112 = yyyymmdd
...	...	...	...

FORMAT

```
FORMAT ( value, format [, culture ] )
```

- More flexible than `CONVERT`
- Worse performance
- Not recommended for high data volume

FORMAT

```
SELECT FORMAT (CAST(entry_date AS DATE), 'd', 'en-US' ) AS 'US English Result',
       FORMAT (CAST(entry_date AS DATE), 'd', 'de-de' ) AS 'German Result',
       FORMAT (CAST(entry_date AS DATE), 'D', 'en-US' ) AS 'US English Result',
       FORMAT (CAST(entry_date AS DATE), 'dd/MM/yyyy') AS 'DateTime Result'
from pilots
```

```
| US English Result | German Result | US English Result         | DateTime Result |
|-------------------|---------------|---------------------------|-----------------|
| 10/1/2011         | 01.10.2011    | Saturday, October 1, 2011 | 01/10/2011      |
| 1/21/2011         | 21.01.2011    | Friday, January 21, 2011  | 21/01/2011      |
| 12/28/2012        | 28.12.2012    | Friday, December 28, 2012 | 28/12/2012      |
| ...               | ...           | ...                       | ...             |
```

Let's practice!

CLEANING DATA IN SQL SERVER DATABASES