Window Functions

INTERMEDIATE SQL

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Working with aggregate values

- Requires you to use `GROUP BY` with **all** non-aggregate columns

```
SELECT
  country_id,
  season,
  date,
  AVG(home_goal) AS avg_home
FROM match
GROUP BY country_id;
```

```
ERROR: column "match.season" must appear in the GROUP BY
clause or be used in an aggregate function
```

Introducing window functions!

- Perform calculations on an already generated result set (a *window*)
- Aggregate calculations
  - Similar to subqueries in `SELECT`
  - Running totals, rankings, moving averages

What's a window function?

- *How many goals were scored in each match in 2011/2012, and how did that compare to the average?*

```
SELECT
  date,
  (home_goal + away_goal) AS goals,
  (SELECT AVG(home_goal + away_goal)
     FROM match
     WHERE season = '2011/2012') AS overall_avg
FROM match
WHERE season = '2011/2012';
```

```
| date       | goals | overall_avg       |
|------------|-------|-------------------|
| 2011-07-29 | 3     | 2.71646           |
| 2011-07-30 | 2     | 2.71646           |
| 2011-07-30 | 4     | 2.71646           |
| 2011-07-30 | 1     | 2.71646           |
```

What's a window function?

- *How many goals were scored in each match in 2011/2012, and how did that compare to the average?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals,
    AVG(home_goal + away_goal) OVER() AS overall_avg
FROM match
WHERE season = '2011/2012';
```

```
| date       | goals | overall_avg       |
|------------|-------|-------------------|
| 2011-07-29 | 3     | 2.71646           |
| 2011-07-30 | 2     | 2.71646           |
| 2011-07-30 | 4     | 2.71646           |
| 2011-07-30 | 1     | 2.71646           |
```

Generate a RANK

- *What is the rank of matches based on number of goals scored?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals
FROM match
WHERE season = '2011/2012';
```

```
| date       | goals |
|------------|-------|
| 2011-07-29 | 3     |
| 2011-07-30 | 2     |
| 2011-07-30 | 4     |
| 2011-07-30 | 1     |
```

Generate a RANK

- *What is the rank of matches based on number of goals scored?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals,
    RANK() OVER(ORDER BY home_goal + away_goal) AS goals_rank
FROM match
WHERE season = '2011/2012';
```

```
| date       | goals | goals_rank |
|------------|-------|------------|
| 2012-04-28 | 0     | 1          |
| 2011-12-26 | 0     | 1          |
| 2011-09-10 | 0     | 1          |
| 2011-08-27 | 0     | 1          |
```

Generate a RANK

- *What is the rank of matches based on number of goals scored?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals,
    RANK() OVER(ORDER BY home_goal + away_goal DESC) AS goals_rank
FROM match
WHERE season = '2011/2012';
```

```
| date       | goals | goals_rank |
|------------|-------|------------|
| 2011-11-06 | 10    | 1          |
| 2011-08-28 | 10    | 1          |
| 2012-05-12 | 9     | 3          |
| 2012-02-12 | 9     | 3          |
```

Key Differences

- Processed *after* every part of query except `ORDER BY`
  - Uses information in result set rather than database
- Available in PostgreSQL, Oracle, MySQL, SQL Server...
  - ...but NOT SQLite

Let's Practice!

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Window Partitions

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OVER and PARTITION BY

- Calculate separate values for different categories
- Calculate *different* calculations in the same column

```
AVG(home_goal) OVER(PARTITION BY season)
```

Partition your data

- *How many goals were scored in each match, and how did that compare to the overall average?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals,
    AVG(home_goal + away_goal) OVER() AS overall_avg
FROM match;
```

```
| date       | goals | overall_avg |
|------------|-------|-------------|
| 2011-12-17 | 3     | 2.73210     |
| 2012-05-01 | 2     | 2.73210     |
| 2012-11-27 | 4     | 2.73210     |
| 2013-04-20 | 1     | 2.73210     |
| 2013-11-09 | 5     | 2.73210     |
```

Partition your data

- *How many goals were scored in each match, and how did that compare to the season's average?*

```
SELECT
    date,
    (home_goal + away_goal) AS goals,
    AVG(home_goal + away_goal) OVER(PARTITION BY season) AS season_avg
FROM match;
```

```
| date       | goals | season_avg  |
|------------|-------|-------------|
| 2011-12-17 | 3     | 2.71646     |
| 2012-05-01 | 2     | 2.71646     |
| 2012-11-27 | 4     | 2.77270     |
| 2013-04-20 | 1     | 2.77270     |
| 2013-11-09 | 5     | 2.76682     |
```

PARTITION by Multiple Columns

```
SELECT
  c.name,
  m.season,
  (home_goal + away_goal) AS goals,
  AVG(home_goal + away_goal)
      OVER(PARTITION BY m.season, c.name) AS season_ctry_avg
FROM country AS c
LEFT JOIN match AS m
ON c.id = m.country_id
```

```
| name        | season    | goals     | season_ctry_avg |
|-------------|-----------|-----------|-----------------|
| Belgium     | 2011/2012 | 1         | 2.88            |
| Netherlands | 2014/2015 | 1         | 3.08            |
| Belgium     | 2011/2012 | 1         | 2.88            |
| Spain       | 2014/2015 | 2         | 2.66            |
```

PARTITION BY considerations

- Can partition data by 1 or more columns
- Can partition aggregate calculations, ranks, etc

Let's Practice!

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Sliding Windows

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Sliding Windows

- Perform calculations relative to the current row
- Can be used to calculate running totals, sums, averages, etc
- Can be partitioned by one or more columns

Sliding Window Keywords

```
ROWS BETWEEN <start> AND <finish>
```

```
PRECEDING
FOLLOWING
UNBOUNDED PRECEDING
UNBOUNDED FOLLOWING
CURRENT ROW
```

Sliding Window Example

```
-- Manchester City Home Games
SELECT
  date,
  home_goal,
  away_goal,
  SUM(home_goal)
     OVER(ORDER BY date ROWS BETWEEN
          UNBOUNDED PRECEDING AND CURRENT ROW) AS running_total
FROM match
WHERE hometeam_id = 8456 AND season = '2011/2012';
```

```
| date       | home_goal | away_goal | running_total |
|------------|-----------|-----------|---------------|
| 2011-08-15 | 4         | 0         | 4             |
| 2011-09-10 | 3         | 0         | 7             |
| 2011-09-24 | 2         | 0         | 9             |
| 2011-10-15 | 4         | 1         | 13            |
```

Sliding Window Frame

```
-- Manchester City Home Games
SELECT date,
       home_goal,
       away_goal,
       SUM(home_goal)
          OVER(ORDER BY date
          ROWS BETWEEN 1 PRECEDING
          AND CURRENT ROW) AS last2
FROM match
WHERE hometeam_id = 8456
      AND season = '2011/2012';
```

date	home_goal	away_goal	last2
2011-08-15	4	0	4
2011-09-10	3	0	7
2011-09-24	2	0	5
2011-10-15	4	1	6

Let's Practice!

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Bringing it all Together

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What you've learned so far

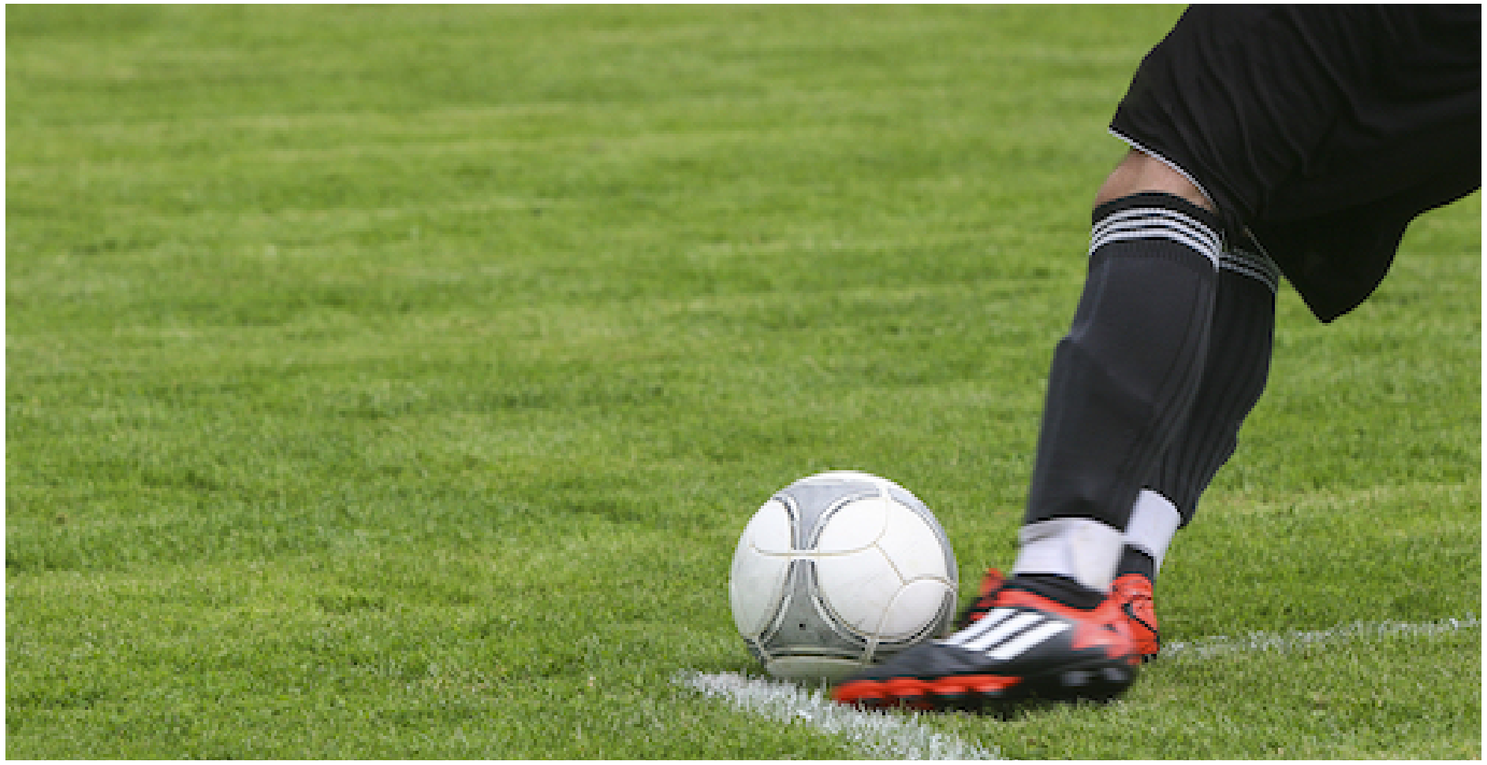
- `CASE` statements
- Simple subqueries
- Nested and correlated subqueries
- Common table expressions
- Window functions

Let's do a case study!

Who defeated Manchester United in the 2013/2014 season?

Steps to construct the query

- Get team names with CTEs
- Get match outcome with `CASE` statements
- Determine how badly they lost with a window function



Getting the database for yourself

Full European Soccer Database

Let's Practice!

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