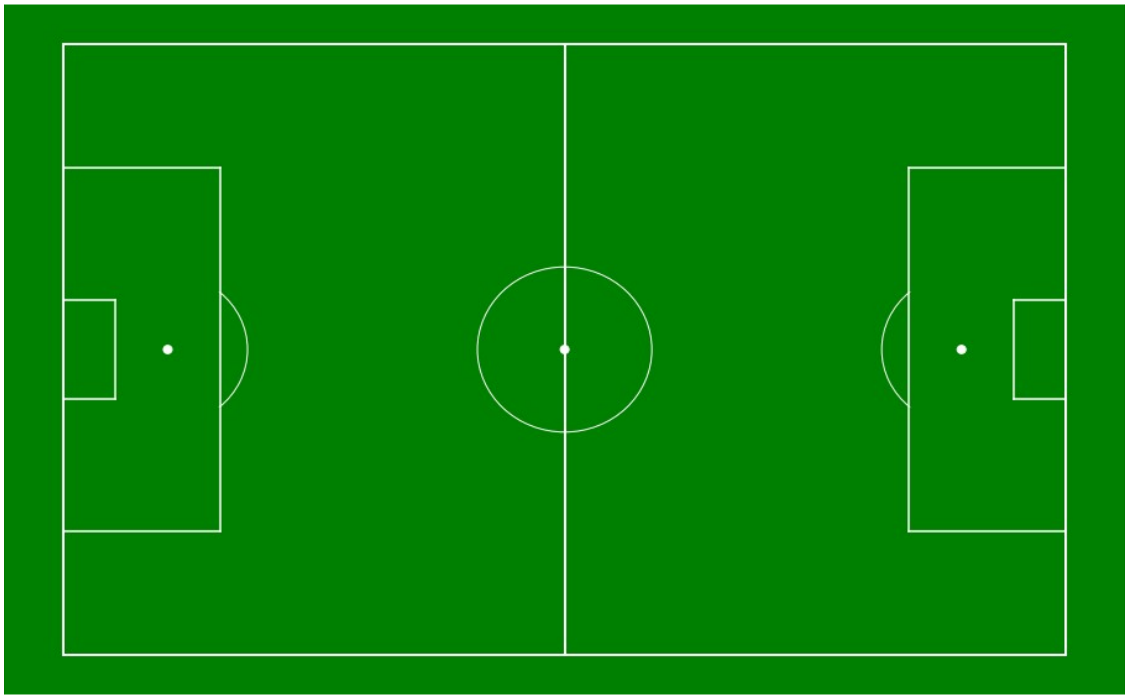
Player movement heatmap for epl top scorer

```
import json
import pandas as pd
import numpy as np
from copy import deepcopy
from bs4 import BeautifulSoup
from urllib.request import urlopen

import seaborn as sns
import plotly.express as px
import matplotlib.pyplot as plt
from matplotlib.patches import Arc

# Setting boundaries and midpoint:
x_lims = [0, 1.15]
y_lims = [0, 0.74]

x_mid = x_lims[1]/2
y_mid = y_lims[1]/2

# Setting color and linewidth:
background_color = "green"
line_color = "white"
line_width = 2.

# Create figure:
fig = plt.figure(facecolor=background_color, figsize=(16, 10))
ax = fig.add_subplot(111, facecolor=background_color)

# Pitch Outline & Centre Line
plt.plot([x_lims[0], x_lims[0]], [y_lims[0], y_lims[1]],
linewidth=line_width, color=line_color)  # left goal-line
plt.plot([x_lims[0], x_lims[1]], [y_lims[1], y_lims[1]],
linewidth=line_width, color=line_color)  # Upper side-line
plt.plot([x_lims[1], x_lims[1]], [y_lims[1], y_lims[0]],
linewidth=line_width, color=line_color)  # Right goal-line
plt.plot([x_lims[1], x_lims[0]], [y_lims[0], y_lims[0]],
linewidth=line_width, color=line_color)  # Lower side-line
plt.plot([x_mid, x_mid], [y_lims[0], y_lims[1]], linewidth=line_width,
color=line_color)  # Center line
# Left Penalty Area
plt.plot([x_lims[0]+.18, x_lims[0]+.18], [y_mid - .22, y_mid + .22],
color=line_color)
plt.plot([x_lims[0], x_lims[0]+.18], [y_mid + .22, y_mid + .22],
color=line_color)
plt.plot([x_lims[0], x_lims[0]+.18], [y_mid - .22, y_mid - .22],
color=line_color)

# Right Penalty Area
```

```
plt.plot([x_lims[1] - .18, x_lims[1] - .18], [y_mid - .22, y_mid +
.22], color=line_color)
plt.plot([x_lims[1], x_lims[1] - .18], [y_mid + .22, y_mid + .22],
color=line_color)
plt.plot([x_lims[1], x_lims[1] - .18], [y_mid - .22, y_mid - .22],
color=line_color)
 # Left 6yd box Area
plt.plot([x_lims[0]+.06, x_lims[0]+.06], [y_mid - .06, y_mid + .06],
color=line_color)
plt.plot([x_lims[0], x_lims[0]+.06], [y_mid + .06, y_mid + .06],
color=line_color)
plt.plot([x_lims[0], x_lims[0]+.06], [y_mid - .06, y_mid - .06],
color=line_color)

# # Right 6yd box Area
plt.plot([x_lims[1] - .06, x_lims[1] - .06], [y_mid - .06, y_mid +
.06], color=line_color)
plt.plot([x_lims[1], x_lims[1] - .06], [y_mid + .06, y_mid + .06],
color=line_color)
plt.plot([x_lims[1], x_lims[1] - .06], [y_mid - .06, y_mid - .06],
color=line_color)

# Prepare Circles
centre_circle = plt.Circle((x_mid, y_mid), .1, color=line_color,
fill=False)
centre_spot = plt.Circle((x_mid, y_mid), 0.005, color=line_color)
left_pen_spot = plt.Circle((x_lims[0]+0.12, y_mid), 0.005,
color=line_color)
right_pen_spot = plt.Circle((x_lims[1] - 0.12, y_mid), 0.005,
color=line_color)

# Draw Circles
ax.add_patch(centre_circle)
ax.add_patch(centre_spot)
ax.add_patch(left_pen_spot)
ax.add_patch(right_pen_spot)

# Prepare Arcs
left_arc = Arc((x_lims[0] + .12, y_mid), height=.183, width=.183,
angle=0, theta1=310, theta2=50, color=line_color)
right_arc = Arc((x_lims[1] - .12, y_mid), height=.183, width=.183,
angle=0, theta1=130, theta2=230, color=line_color)

# Draw Arcs
ax.add_patch(left_arc)
ax.add_patch(right_arc)

plt.axis("off")
```

```
(-0.057499999999999996, 1.2075, -0.037, 0.777)
```



Scrapping the data from Understat website

```
scrape_url = "https://understat.com/player/8260"
page_connect = urlopen(scrape_url)
page_html = BeautifulSoup(page_connect,"html.parser")

page_html.findAll(name="script")[3].text
```

```
{"type":"string"}
```

```
json_raw_string = page_html.findAll(name="script")[3].text

start_ind = json_raw_string.index("\\")
stop_ind = json_raw_string.index("')")

json_data = json_raw_string[start_ind:stop_ind]
json_data
```

```
{"type":"string"}
```

```
json_data = json_data.encode("utf8").decode("unicode_escape")

shots_df = pd.json_normalize(json.loads(json_data))

shots_df.columns
```

```
Index(['id', 'minute', 'result', 'X', 'Y', 'xG', 'player', 'h_a',
'player_id',
       'situation', 'season', 'shotType', 'match_id', 'h_team',
'a_team',
       'h_goals', 'a_goals', 'date', 'player_assisted', 'lastAction'],
      dtype='object')
```

```
shots_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 238 entries, 0 to 237
Data columns (total 20 columns):
 #   Column            Non-Null Count  Dtype 
---  ------            --------------  ----- 
 0   id                238 non-null    object
 1   minute            238 non-null    object
 2   result            238 non-null    object
 3   X                 238 non-null    object
 4   Y                 238 non-null    object
 5   xG                238 non-null    object
 6   player            238 non-null    object
 7   h_a               238 non-null    object
 8   player_id         238 non-null    object
 9   situation         238 non-null    object
 10  season            238 non-null    object
 11  shotType          238 non-null    object
 12  match_id          238 non-null    object
 13  h_team            238 non-null    object
 14  a_team            238 non-null    object
 15  h_goals           238 non-null    object
 16  a_goals           238 non-null    object
 17  date              238 non-null    object
 18  player_assisted   202 non-null    object
 19  lastAction        238 non-null    object
dtypes: object(20)
memory usage: 37.3+ KB
```

```
shots_df.apply(pd.to_numeric,errors="ignore").info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 238 entries, 0 to 237
Data columns (total 20 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   id                238 non-null    int64  
 1   minute            238 non-null    int64  
 2   result            238 non-null    object 
 3   X                 238 non-null    float64
 4   Y                 238 non-null    float64
 5   xG                238 non-null    float64
 6   player            238 non-null    object 
 7   h_a               238 non-null    object 
 8   player_id         238 non-null    int64  
 9   situation         238 non-null    object 
 10  season            238 non-null    int64  
 11  shotType          238 non-null    object 
 12  match_id          238 non-null    int64  
 13  h_team            238 non-null    object 
 14  a_team           238 non-null    object
 15  h_goals          238 non-null    int64
 16  a_goals          238 non-null    int64
 17  date             238 non-null    object
 18  player_assisted  202 non-null    object
 19  lastAction       238 non-null    object
dtypes: float64(3), int64(7), object(10)
memory usage: 37.3+ KB
```

```
shots_df.shape
```

```
(238, 20)
```

```
shots_df.apply(pd.to_numeric,errors="ignore").info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 238 entries, 0 to 237
Data columns (total 20 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   id               238 non-null    int64
 1   minute           238 non-null    int64
 2   result           238 non-null    object
 3   X                238 non-null    float64
 4   Y                238 non-null    float64
 5   xG               238 non-null    float64
 6   player           238 non-null    object
 7   h_a              238 non-null    object
 8   player_id        238 non-null    int64
 9   situation        238 non-null    object
 10  season           238 non-null    int64
 11  shotType         238 non-null    object
 12  match_id         238 non-null    int64
 13  h_team           238 non-null    object
 14  a_team           238 non-null    object
 15  h_goals          238 non-null    int64
 16  a_goals          238 non-null    int64
 17  date             238 non-null    object
 18  player_assisted  202 non-null    object
 19  lastAction       238 non-null    object
dtypes: float64(3), int64(7), object(10)
memory usage: 37.3+ KB
```

```
shots_df=shots_df.apply(pd.to_numeric,errors="ignore")
```

```
shots_df.describe().round(1)
```

```
             id  minute      X      Y     xG  player_id  season
match_id  \
count     238.0   238.0  238.0  238.0  238.0      238.0   238.0
238.0
mean   422552.7    49.8    0.9    0.5    0.2     8260.0  2020.5
```

```
16097.0
std     40621.3    26.3    0.0    0.1    0.2        0.0     0.9
1866.1
min    354876.0     0.0    0.8    0.3    0.0     8260.0  2019.0
12562.0
25%    387858.2    27.0    0.9    0.5    0.1     8260.0  2020.0
15209.8
50%    417182.5    53.0    0.9    0.5    0.1     8260.0  2020.0
15413.0
75%    452982.5    72.8    0.9    0.6    0.4     8260.0  2021.0
17686.0
max    490656.0    94.0    1.0    0.8    1.0     8260.0  2022.0
18289.0

       h_goals  a_goals
count    238.0    238.0
mean       2.5      1.7
std        1.7      1.3
min        0.0      0.0
25%        1.0      1.0
50%        2.0      2.0
75%        4.0      3.0
max        6.0      5.0
```

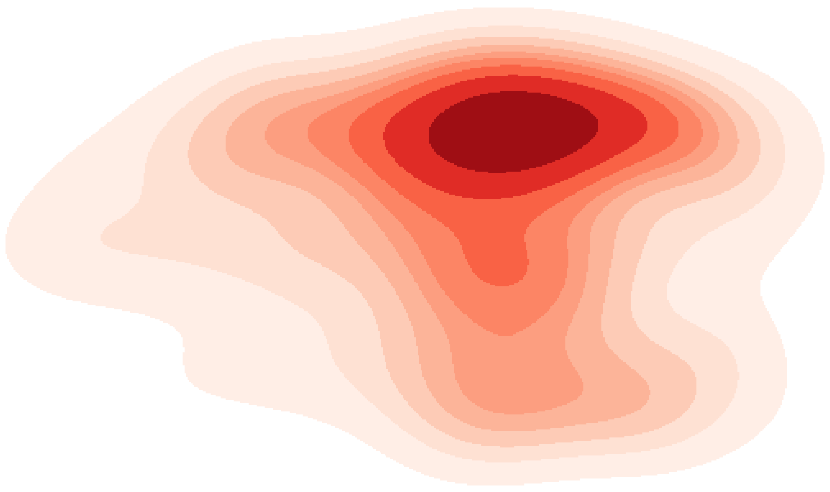
```
shots_df.head()
```

```
       id  minute       result      X      Y        xG          player
h_a  \
0  354876      58         Goal  0.888  0.666  0.079333  Erling Haaland
a
1  354881      69         Goal  0.980  0.489  0.920621  Erling Haaland
a
2  354883      78         Goal  0.883  0.347  0.322831  Erling Haaland
a
3  355527      65  BlockedShot  0.886  0.639  0.119181  Erling Haaland
h
4  355531      76         Goal  0.955  0.495  0.746641  Erling Haaland
h

   player_id situation  season  shotType  match_id            h_team
\
0       8260  OpenPlay    2019  LeftFoot     12562          Augsburg

1       8260  OpenPlay    2019  LeftFoot     12562          Augsburg

2       8260  OpenPlay    2019  LeftFoot     12562          Augsburg

3       8260  OpenPlay    2019  LeftFoot     12566  Borussia Dortmund

4       8260  OpenPlay    2019  LeftFoot     12566  Borussia Dortmund
```

```
              a_team  h_goals  a_goals                date
player_assisted  \
0  Borussia Dortmund        3        5  2020-01-18 14:30:00    Jadon
Sancho
1  Borussia Dortmund        3        5  2020-01-18 14:30:00  Thorgan
Hazard
2  Borussia Dortmund        3        5  2020-01-18 14:30:00      Marco
Reus
3         FC Cologne        5        1  2020-01-24 19:30:00    Jadon
Sancho
4         FC Cologne        5        1  2020-01-24 19:30:00
None

    lastAction
0  Throughball
1         Pass
2  Throughball
3         Pass
4      Rebound
```

```
plt.figure(figsize=(12,7))
sns.kdeplot(x=shots_df["X"],y=shots_df["Y"],shade=True,n_levels=10,cma
p="Reds")
plt.axis("off")
```

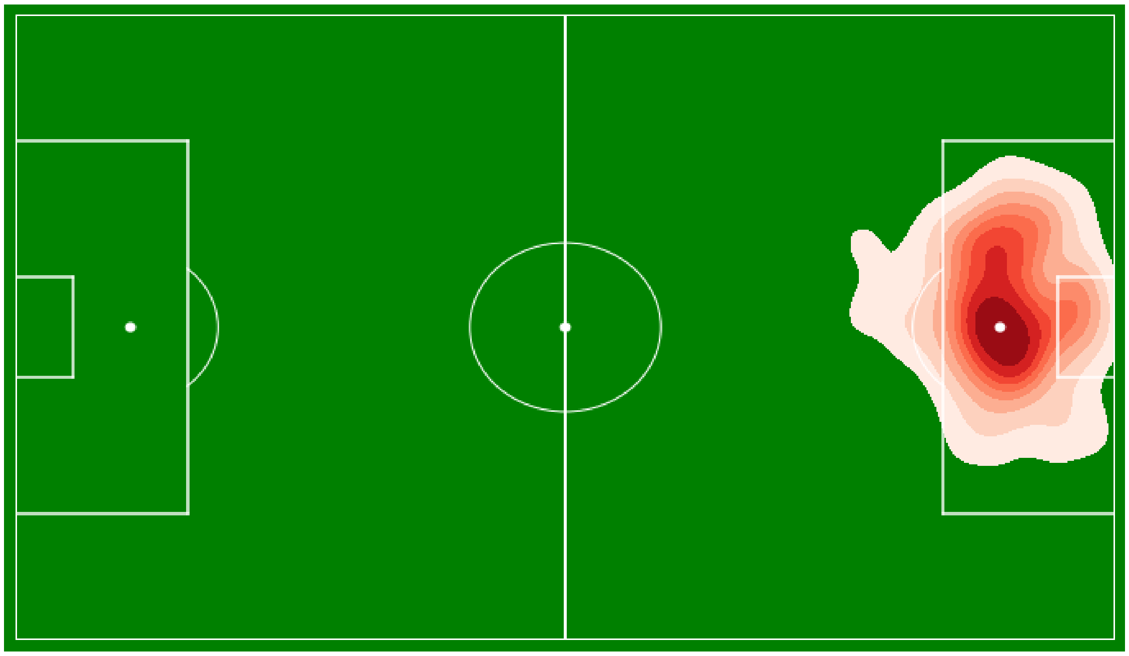
```
(0.6409045413059884,
 1.0500955197291677,
 0.11629502613827397,
 0.903704973861726)
```



```
x_lims = [0, 1.15]
y_lims = [0, 0.74]

x_mid = x_lims[1]/2
y_mid = y_lims[1]/2

# Setting color and linewidth:
background_color = "green"
line_color = "white"
line_width = 2.

full_pitch_shots_df = deepcopy(shots_df)

full_pitch_shots_df["X"] =
full_pitch_shots_df["X"].multiply(x_lims[1])
full_pitch_shots_df["Y"] =
full_pitch_shots_df["Y"].multiply(y_lims[1])

def create_full_pitch(x_lims, y_lims, background_color="green",
line_color="white", line_width=2.):
    """
    Function to create a full-scale pitch based on input dimensions
    :params:
    x_lims: min and max limits for the length of the field
    y_lims: min and max limits for the width/breadth of the field
    background_color: Background color of the field
    line_color: Color for all the lines in the field (Keep this color
in contrast with background_color for optimal visual results)
    line_width: The thickness of the outer and center lines
    """
    # Create figure:
    fig = plt.figure(facecolor=background_color, figsize=(12, 7))
    ax = fig.add_subplot(111, facecolor=background_color)

    # Pitch Outline & Centre Line
    plt.plot([x_lims[0], x_lims[0]], [y_lims[0], y_lims[1]],
linewidth=line_width, color=line_color)  # left goal-line
    plt.plot([x_lims[0], x_lims[1]], [y_lims[1], y_lims[1]],
linewidth=line_width, color=line_color)  # Upper side-line
    plt.plot([x_lims[1], x_lims[1]], [y_lims[1], y_lims[0]],
linewidth=line_width, color=line_color)  # Right goal-line
    plt.plot([x_lims[1], x_lims[0]], [y_lims[0], y_lims[0]],
linewidth=line_width, color=line_color)  # Lower side-line
    plt.plot([x_mid, x_mid], [y_lims[0], y_lims[1]],
linewidth=line_width, color=line_color)  # Center line

    # Left Penalty Area
    plt.plot([x_lims[0]+.18, x_lims[0]+.18], [y_mid - .22, y_mid +
.22], color=line_color)
    plt.plot([x_lims[0], x_lims[0]+.18], [y_mid + .22, y_mid + .22],
color=line_color)
    plt.plot([x_lims[0], x_lims[0]+.18], [y_mid - .22, y_mid - .22],
color=line_color)

    # Right Penalty Area
    plt.plot([x_lims[1] - .18, x_lims[1] - .18], [y_mid - .22, y_mid +
.22], color=line_color)
    plt.plot([x_lims[1], x_lims[1] - .18], [y_mid + .22, y_mid + .22],
color=line_color)
    plt.plot([x_lims[1], x_lims[1] - .18], [y_mid - .22, y_mid - .22],
color=line_color)

    # Left 6yd box Area
    plt.plot([x_lims[0]+.06, x_lims[0]+.06], [y_mid - .06, y_mid +
.06], color=line_color)
    plt.plot([x_lims[0], x_lims[0]+.06], [y_mid + .06, y_mid + .06],
color=line_color)
    plt.plot([x_lims[0], x_lims[0]+.06], [y_mid - .06, y_mid - .06],
color=line_color)

    # # Right 6yd box Area
    plt.plot([x_lims[1] - .06, x_lims[1] - .06], [y_mid - .06, y_mid +
.06], color=line_color)
    plt.plot([x_lims[1], x_lims[1] - .06], [y_mid + .06, y_mid + .06],
color=line_color)
    plt.plot([x_lims[1], x_lims[1] - .06], [y_mid - .06, y_mid - .06],
color=line_color)

    # Prepare Circles
    centre_circle = plt.Circle((x_mid, y_mid), .1, color=line_color,
fill=False)
    centre_spot = plt.Circle((x_mid, y_mid), 0.005, color=line_color)
    left_pen_spot = plt.Circle((x_lims[0]+0.12, y_mid), 0.005,
color=line_color)
    right_pen_spot = plt.Circle((x_lims[1] - 0.12, y_mid), 0.005,
color=line_color)

    # Draw Circles
    ax.add_patch(centre_circle)
    ax.add_patch(centre_spot)
    ax.add_patch(left_pen_spot)
    ax.add_patch(right_pen_spot)

    # Prepare Arcs
    left_arc = Arc((x_lims[0] + .12, y_mid), height=.183, width=.183,
angle=0, theta1=310, theta2=50, color=line_color)
    right_arc = Arc((x_lims[1] - .12, y_mid), height=.183, width=.183,
angle=0, theta1=130, theta2=230, color=line_color)
```

```
    # Draw Arcs
    ax.add_patch(left_arc)
    ax.add_patch(right_arc)

    plt.axis("off")

create_full_pitch(x_lims,y_lims)
ax=sns.kdeplot(x=full_pitch_shots_df["X"],y=full_pitch_shots_df["Y"],s
hade=True,n_levels=10,cmap="Reds")
plt.xlim(x_lims)
plt.ylim(y_lims)
```

```
(0.0, 0.74)
```



Player heatmaps for top 10 epl scorers

```
scrape_url = "https://understat.com/league/EPL"
page_connect = urlopen(scrape_url)
page_html = BeautifulSoup(page_connect, "html.parser")

json_raw_string = page_html.findAll(name="script")[3].text
start_ind = json_raw_string.index("\\")
stop_ind = json_raw_string.index("')")
json_data = json_raw_string[start_ind:stop_ind]
json_data = json_data.encode("utf8").decode("unicode_escape")

shots_df = pd.json_normalize(json.loads(json_data))
shots_df = shots_df.apply(pd.to_numeric, errors="ignore")
final_json_df = pd.json_normalize(json.loads(json_data)).head(10)
player_id_list = final_json_df["id"].to_list()
print(player_id_list)
```

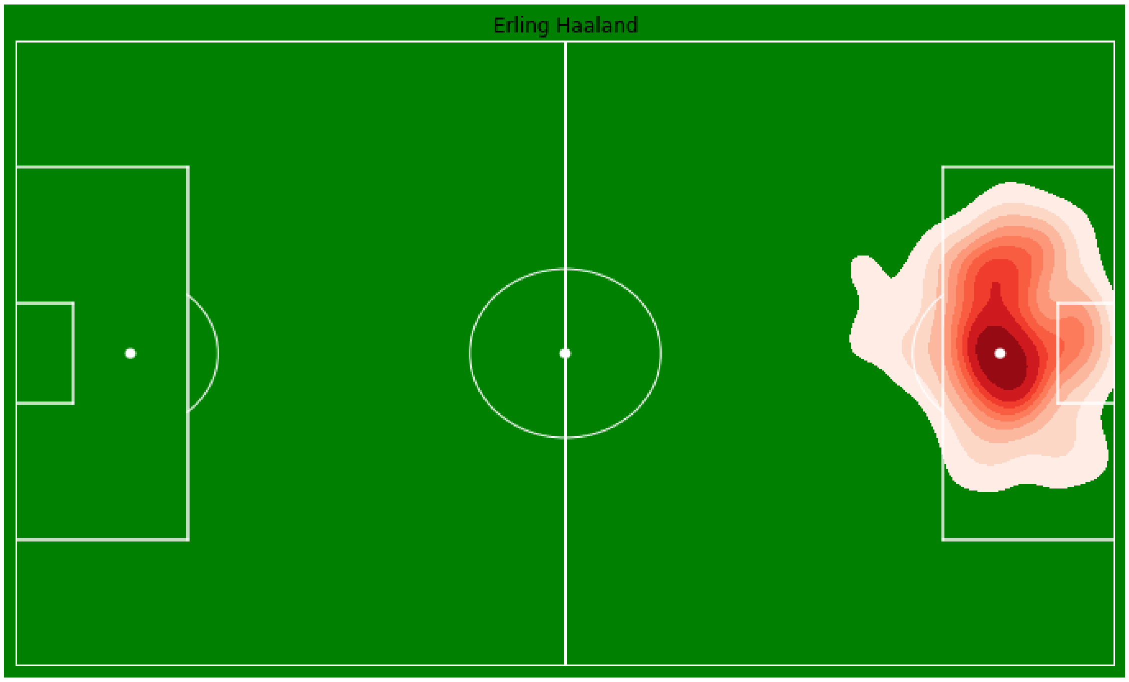
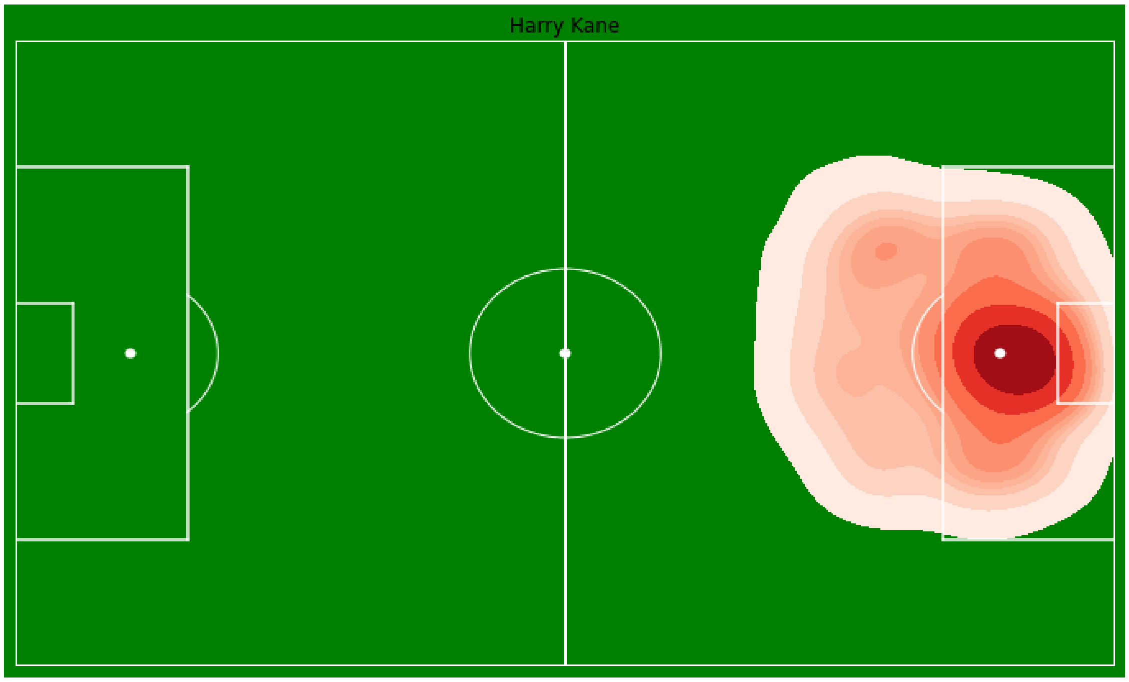
```
['8260', '647', '773', '482', '998', '5543', '6055', '6818', '7698',
'522']
```

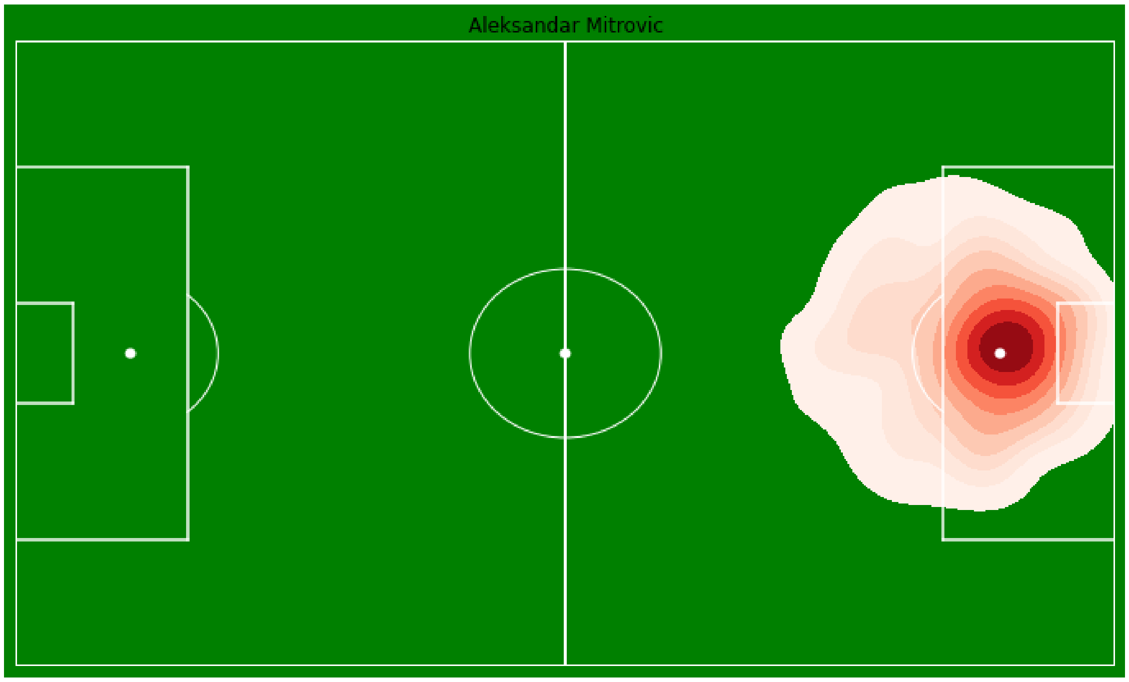
```
player_shot_df_list = []
for p_id in player_id_list:
    # Scrape player stats:
    scrape_url = "https://understat.com/player/{}".format(p_id)
    page_connect = urlopen(scrape_url)
    page_html = BeautifulSoup(page_connect, "html.parser")

    json_raw_string = page_html.findAll(name="script")[3].text
    start_ind = json_raw_string.index("\\")
    stop_ind = json_raw_string.index("')")

    json_data = json_raw_string[start_ind:stop_ind]
    json_data = json_data.encode("utf8").decode("unicode_escape")

    shots_df = pd.json_normalize(json.loads(json_data))
    shots_df = shots_df.apply(pd.to_numeric, errors="ignore")

    full_pitch_shots_df = deepcopy(shots_df)
    full_pitch_shots_df["X"] =
full_pitch_shots_df["X"].multiply(x_lims[1])
    full_pitch_shots_df["Y"] =
full_pitch_shots_df["Y"].multiply(y_lims[1])
    player_shot_df_list.append(full_pitch_shots_df)

player_shot_df_list[3].head()
```

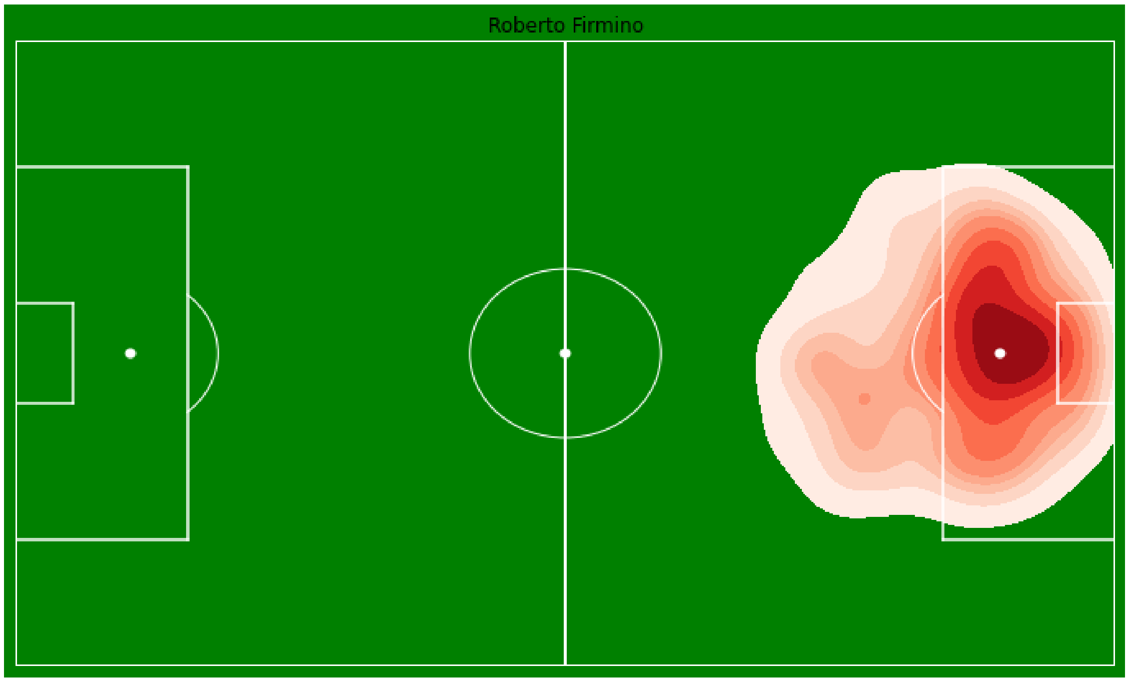
```
      id  minute       result        X        Y        xG
player  \
0  24415       5  BlockedShot  0.84410  0.34780  0.015001  Roberto
Firmino
1  24419      29  MissedShots  0.93725  0.41218  0.045820  Roberto
Firmino
2  24421      32    SavedShot  1.10745  0.50690  0.059303  Roberto
Firmino
3  24686       9  BlockedShot  0.89815  0.27454  0.028346  Roberto
Firmino
4  24689      11  MissedShots  1.09135  0.44992  0.016434  Roberto
Firmino

  h_a  player_id   situation  season   shotType  match_id
h_team  \
0   h        482    OpenPlay    2014  RightFoot      5448
Hoffenheim
1   h        482    OpenPlay    2014  RightFoot      5448
Hoffenheim
2   h        482    OpenPlay    2014   LeftFoot      5448
Hoffenheim
```

```
3   a        482    OpenPlay    2014   LeftFoot      5457  Werder
Bremen
4   a        482  FromCorner    2014       Head      5457  Werder
Bremen

       a_team  h_goals  a_goals                 date
player_assisted  \
0    Augsburg        2        0  2014-08-23 14:30:00            None

1    Augsburg        2        0  2014-08-23 14:30:00     Niklas Süle

2    Augsburg        2        0  2014-08-23 14:30:00     Ádám Szalai

3  Hoffenheim        1        1  2014-08-30 14:30:00  Sebastian Rudy

4  Hoffenheim        1        1  2014-08-30 14:30:00  Sebastian Rudy


  lastAction
0       None
1       Pass
2       Pass
3       Pass
4     Aerial
```

```python
for p_df in player_shot_df_list:
    # Generate image of field:
    create_full_pitch(x_lims, y_lims)

    # Plot the heat-map:
    ax = sns.kdeplot(x=p_df["X"], y=p_df["Y"], shade=True,
n_levels=10,cmap="Reds")
    # Set axis tick limits:
    plt.xlim(x_lims)
    plt.ylim(y_lims)
    plt.title(p_df["player"].unique().item())
    plt.show()
```


Erling Haaland

Harry Kane


Aleksandar Mitrovic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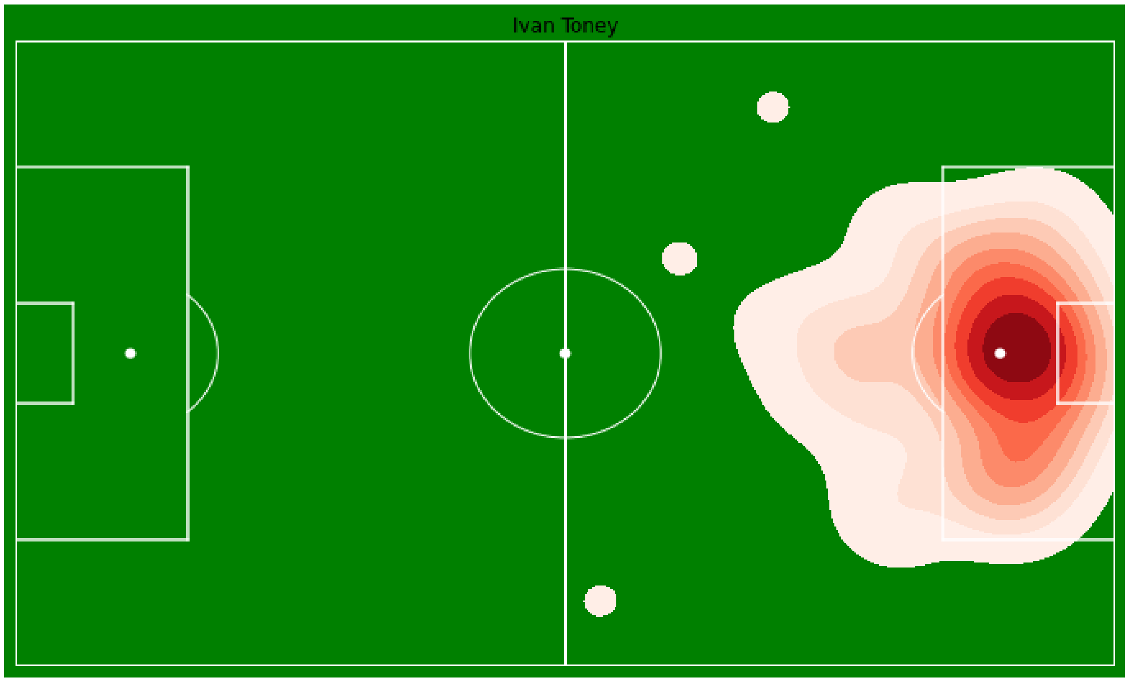
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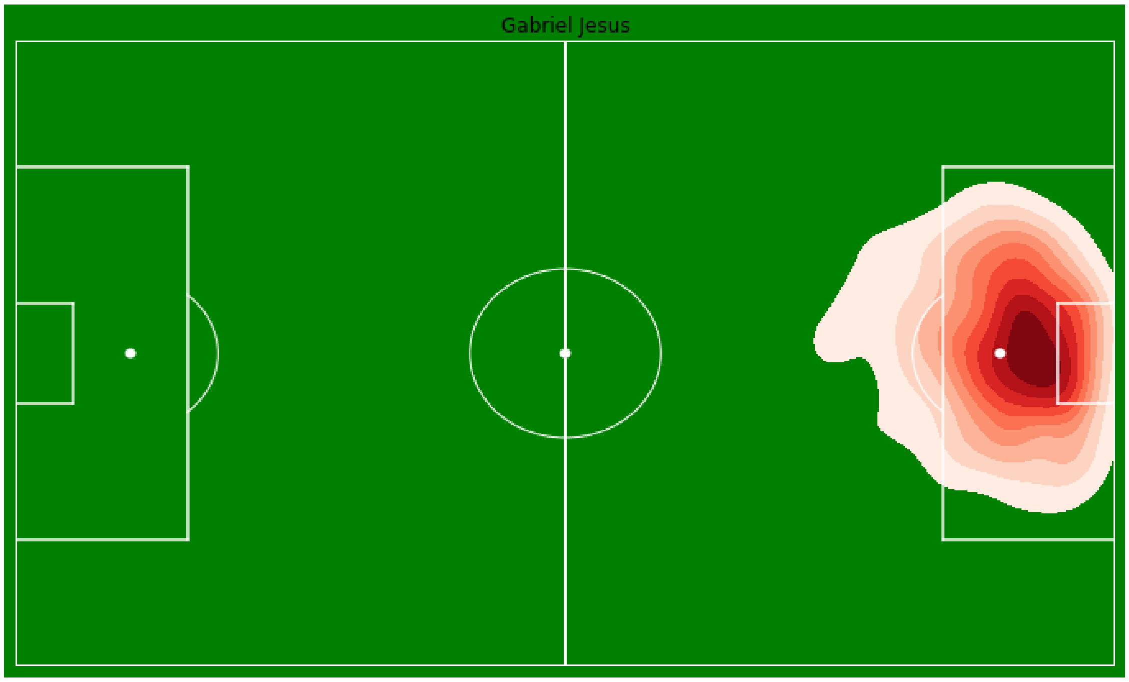
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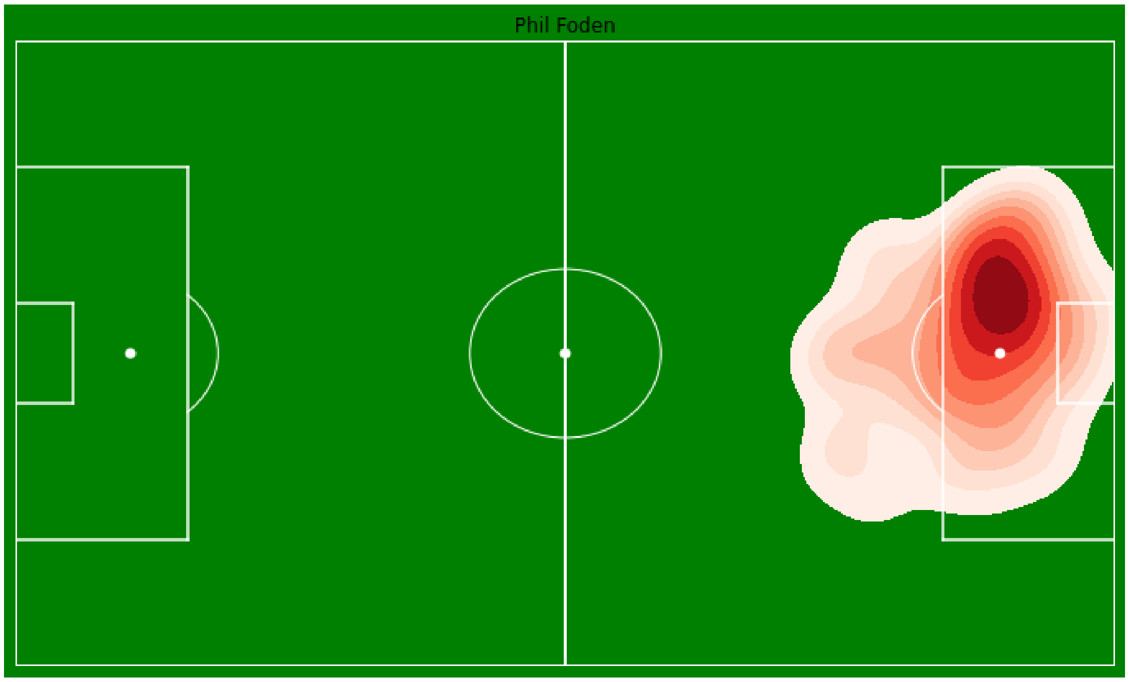
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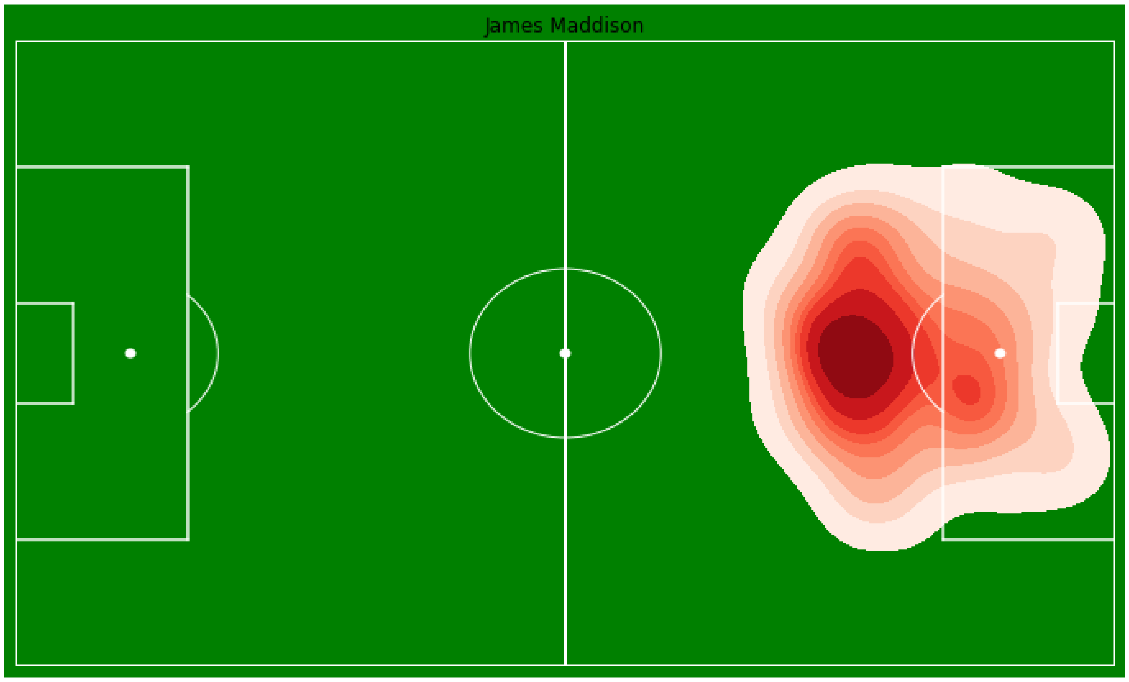
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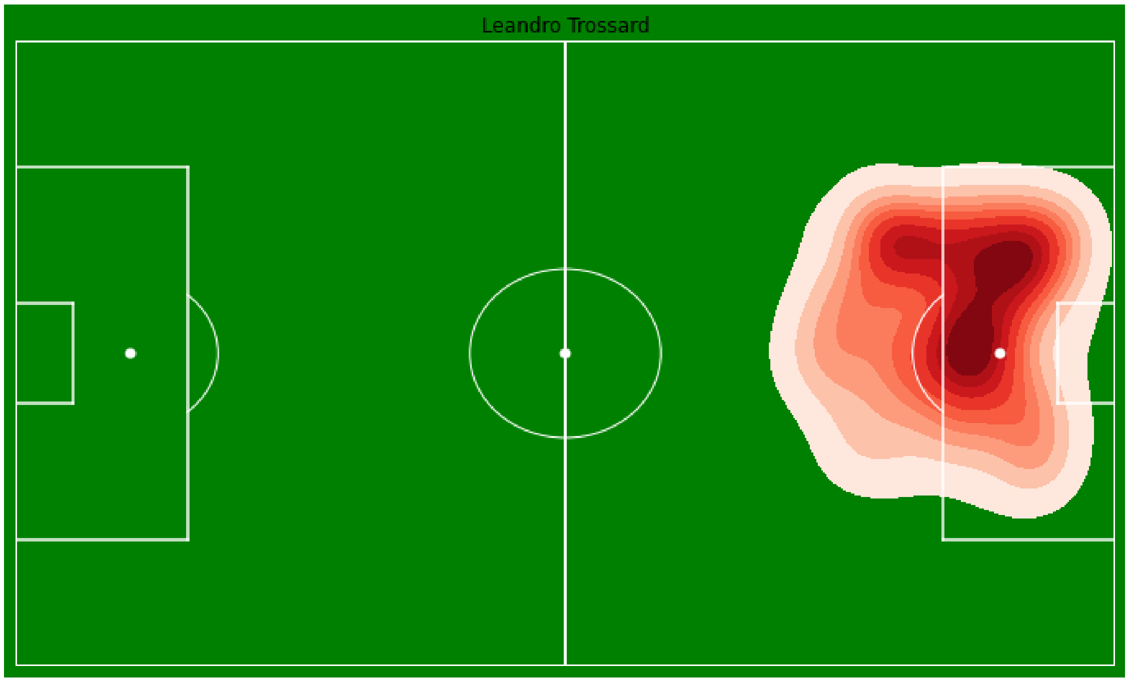
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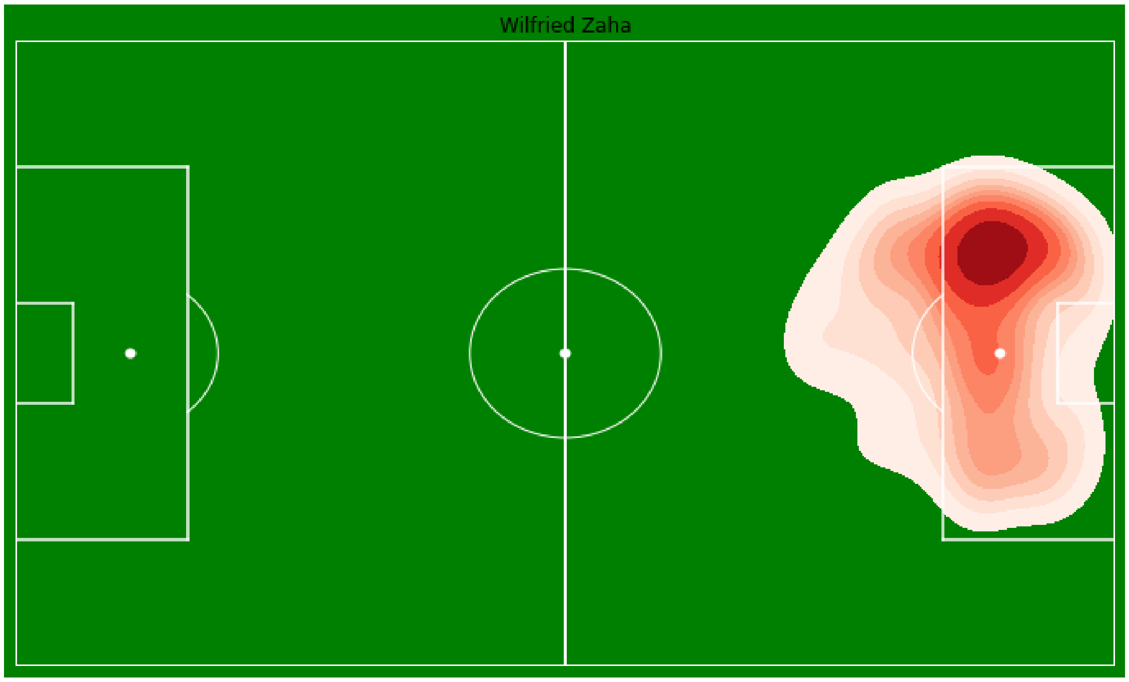
Wilfried Zaha