Sports Analytics - NBA Demo

includes all regular season games in history between all active teams today

Source: Paolo Uggetti, The Ringer, 2021.

Scrape and Create DataFrame

```
active_team_names =
  ["Atlanta Hawks", "Boston Celtics", "Cleveland Cavaliers", "New Orleans Pelicans", "Chicag
```

```
active_team_ids =
  [1610612737, 1610612738, 1610612739, 1610612740, 1610612741, 1610612742, 1610612743, 16106
```

```
num_teams = 30
```

```
num_years = 78
```

```
year_range = 1946:2023
```

```
id_team_dict =
  Dict(1610612743 => "Denver Nuggets", 1610612742 => "Dallas Mavericks", 1610612746 => "Los
```

```
team_id_dict =
  Dict("Sacramento Kings" => 1610612758, "San Antonio Spurs" => 1610612759, "Toronto Raptors
```

```
old_names =
  Dict("New Orleans Hornets" => "New Orleans Pelicans", "San Francisco Warriors" => "Golden
```

reg_season =

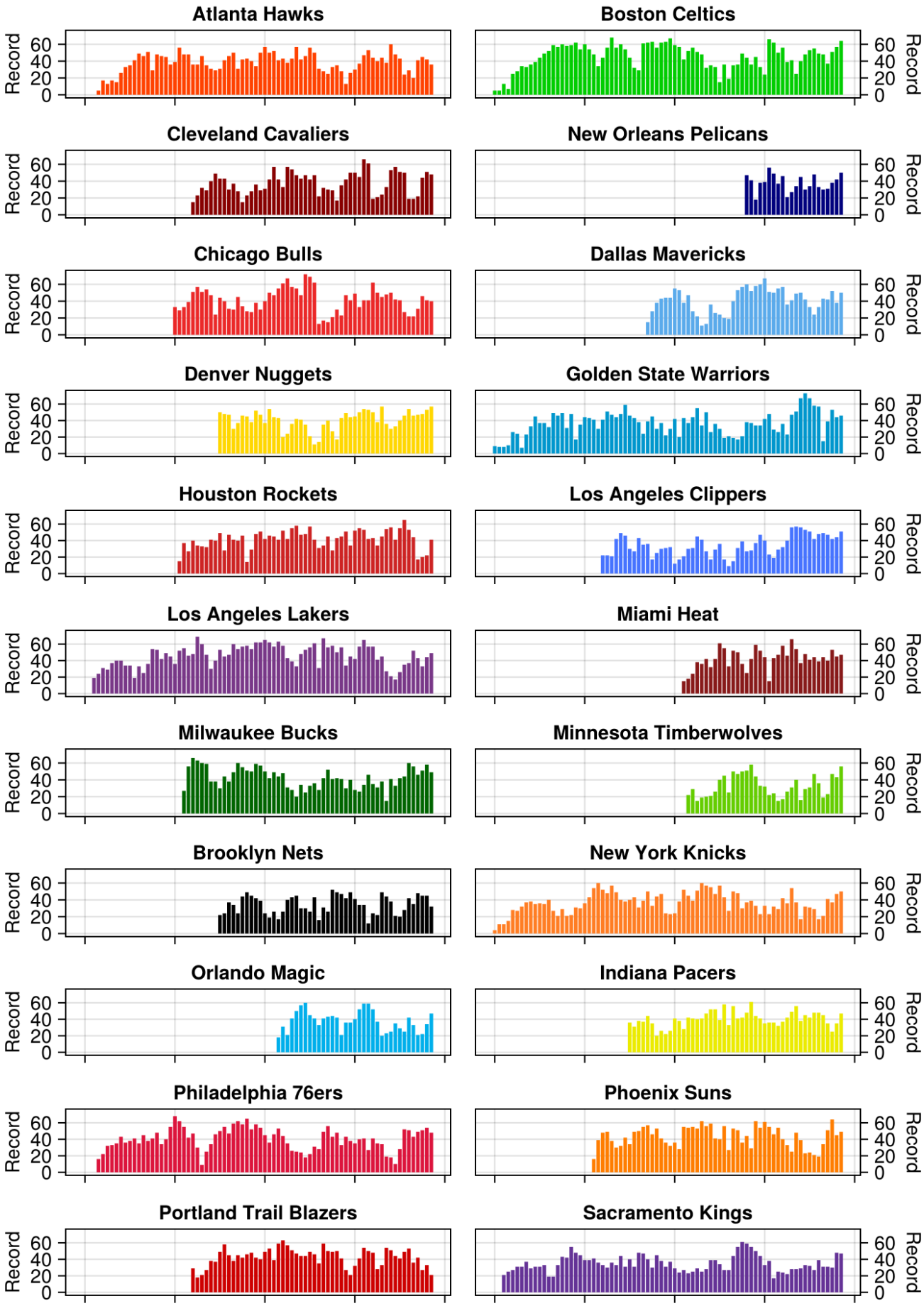
	season_id	team_id_home	team_name_home	wl_home	team_id_away	t
1	1946	1610612744	"Golden State Warriors"	"W"	1610612738	"Bos
2	1946	1610612752	"New York Knicks"	"W"	1610612744	"Gol
3	1946	1610612744	"Golden State Warriors"	"W"	1610612752	"New
4	1946	1610612752	"New York Knicks"	"W"	1610612738	"Bos
5	1946	1610612752	"New York Knicks"	"W"	1610612738	"Bos
6	1946	1610612738	"Boston Celtics"	"W"	1610612744	"Gol
7	1946	1610612744	"Golden State Warriors"	"W"	1610612738	"Bos
8	1946	1610612738	"Boston Celtics"	"W"	1610612752	"New
9	1946	1610612738	"Boston Celtics"	"W"	1610612752	"New
10	1946	1610612744	"Golden State Warriors"	"W"	1610612738	"Bos
more						
64400	2023	1610612740	"New Orleans Pelicans"	"W"	1610612758	"Sac

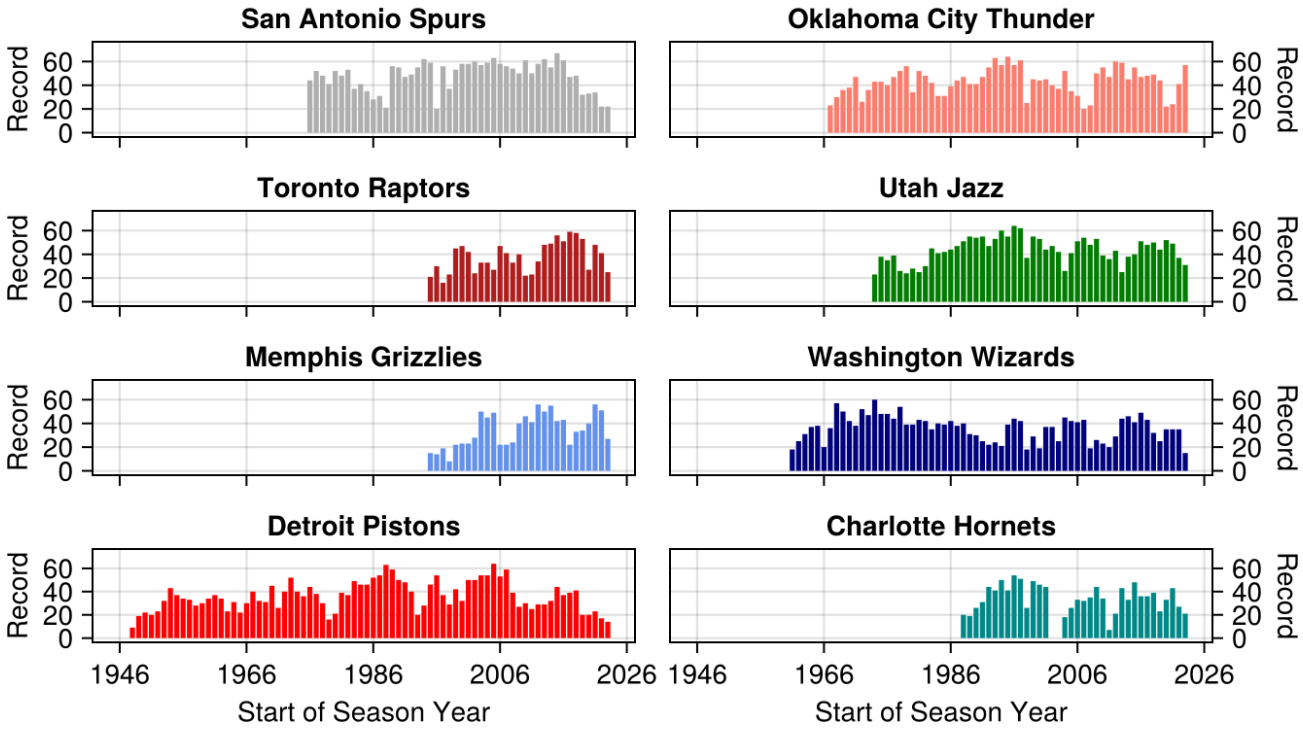
Create Data Tensor

```
 2  1  2  2  1  1  1  1  1  0  1  0  2  1     4  1  0  1  1  2  2  1  1  1  3  2  0

[:, :, 77] =
 0  0  2  1  2  2  1  1  1  1  0  2  2  0  …  2  1  2  1  2  1  1  2  1  0  3  4  1
 3  0  1  2  2  2  1  1  1  1  2  2  2  2     2  3  1  2  2  2  1  4  1  2  2  4  4
 1  3  0  2  4  2  0  0  2  1  2  2  2  0     3  1  2  2  0  1  1  1  1  1  3  4  3
 1  0  0  0  2  2  2  2  3  3  1  0  0  1     1  1  2  3  1  4  3  1  0  2  1  2  2
 2  2  0  0  0  2  1  1  1  0  1  3  2  1     1  2  0  2  0  1  0  2  2  1  2  4  3
 0  0  0  2  0  0  2  1  3  2  3  1  0  1  …  1  1  2  2  2  3  1  1  3  1  0  1  0
 1  1  2  2  1  2  0  3  3  4  2  2  1  2     2  1  2  3  2  2  3  1  2  2  2  1  2
 ⋮              ⋮              ⋮        ⋱           ⋮              ⋮
 1  0  3  1  2  1  1  0  2  0  1  3  1  1     0  1  1  2  1  2  1  0  0  1  2  4  4
 1  1  1  3  0  1  2  1  2  3  2  0  0  2  …  2  0  1  1  1  2  1  2  0  2  1  1  2
 2  0  1  2  1  3  1  2  4  1  1  1  2  2     2  1  2  2  2  4  2  1  2  0  1  2  2
 1  1  0  1  2  2  0  0  1  0  0  2  1  2     2  2  2  1  1  2  0  1  1  1  0  3  3
 0  0  0  0  0  1  1  2  0  0  0  1  0  2     2  0  0  0  0  1  1  0  1  0  0  0  2
 3  0  1  0  1  2  0  1  1  0  1  2  1  2     1  1  0  0  1  2  2  0  0  0  1  2  0

[:, :, 78] =
 0  2  1  1  1  0  0  1  2  1  1  1  1  1  …  0  2  1  1  0  2  1  2  1  1  3  3  1
 2  0  2  2  3  2  0  1  2  1  1  3  2  1     3  3  2  2  2  2  1  4  2  2  4  3  2
 3  1  0  1  3  2  1  2  1  1  0  1  2  1     2  2  0  1  1  2  0  2  2  2  4  4  1
 1  0  1  0  0  2  1  2  2  3  1  1  1  2     1  2  1  3  6  3  1  2  2  2  2  2  2
 3  0  1  2  0  0  0  1  1  0  1  2  1  2     3  2  0  2  1  3  0  2  2  2  2  2  4
 2  0  0  2  2  0  1  3  3  1  2  2  0  1  …  0  1  2  4  2  4  1  1  3  2  2  1  2
 2  2  1  2  2  2  0  4  1  2  3  2  1  2     2  1  1  4  1  3  1  2  3  4  2  2  2
 ⋮              ⋮              ⋮        ⋱           ⋮              ⋮
 2  0  1  0  2  1  0  1  1  0  0  1  2  1     2  0  1  0  0  1  0  0  0  1  3  1  3
 1  0  0  2  0  1  1  0  1  2  1  1  2  0  …  1  1  0  3  0  2  1  2  0  2  2  2  1
 1  0  0  2  0  2  0  1  1  1  1  1  2  0     1  1  1  1  0  3  0  1  1  0  1  3  0
 1  0  0  0  1  0  0  0  0  0  0  1  1  0     1  0  0  1  1  1  0  1  0  1  0  2  2
 0  0  0  0  2  1  0  0  0  0  0  0  0  0     0  0  0  1  1  0  1  2  0  0  2  0  3
 3  1  2  0  0  0  0  0  0  0  0  0  0  1     2  0  0  1  1  1  0  1  1  2  2  0  0
```

Data Visualization

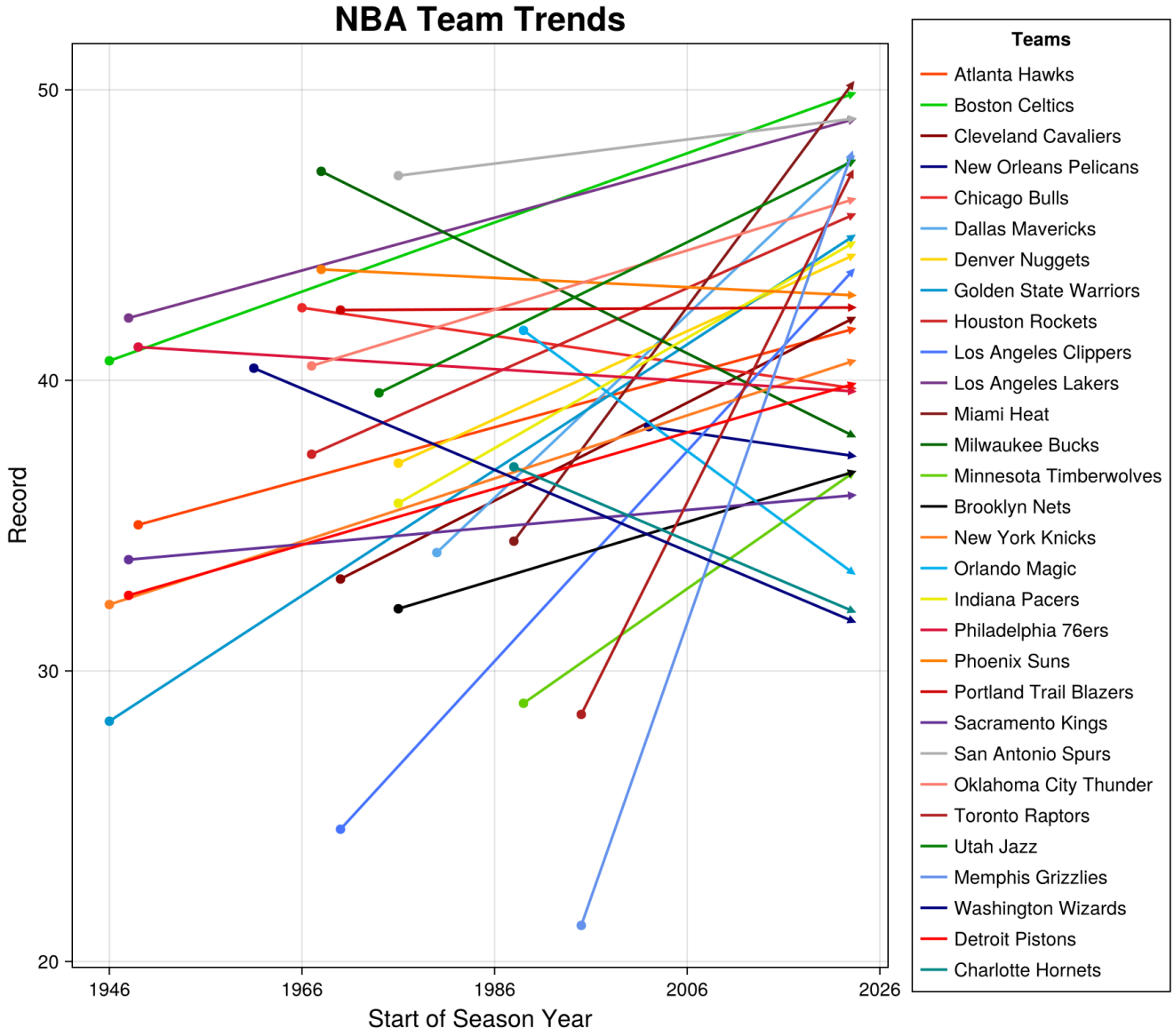
NBA Team Performance Over the Years



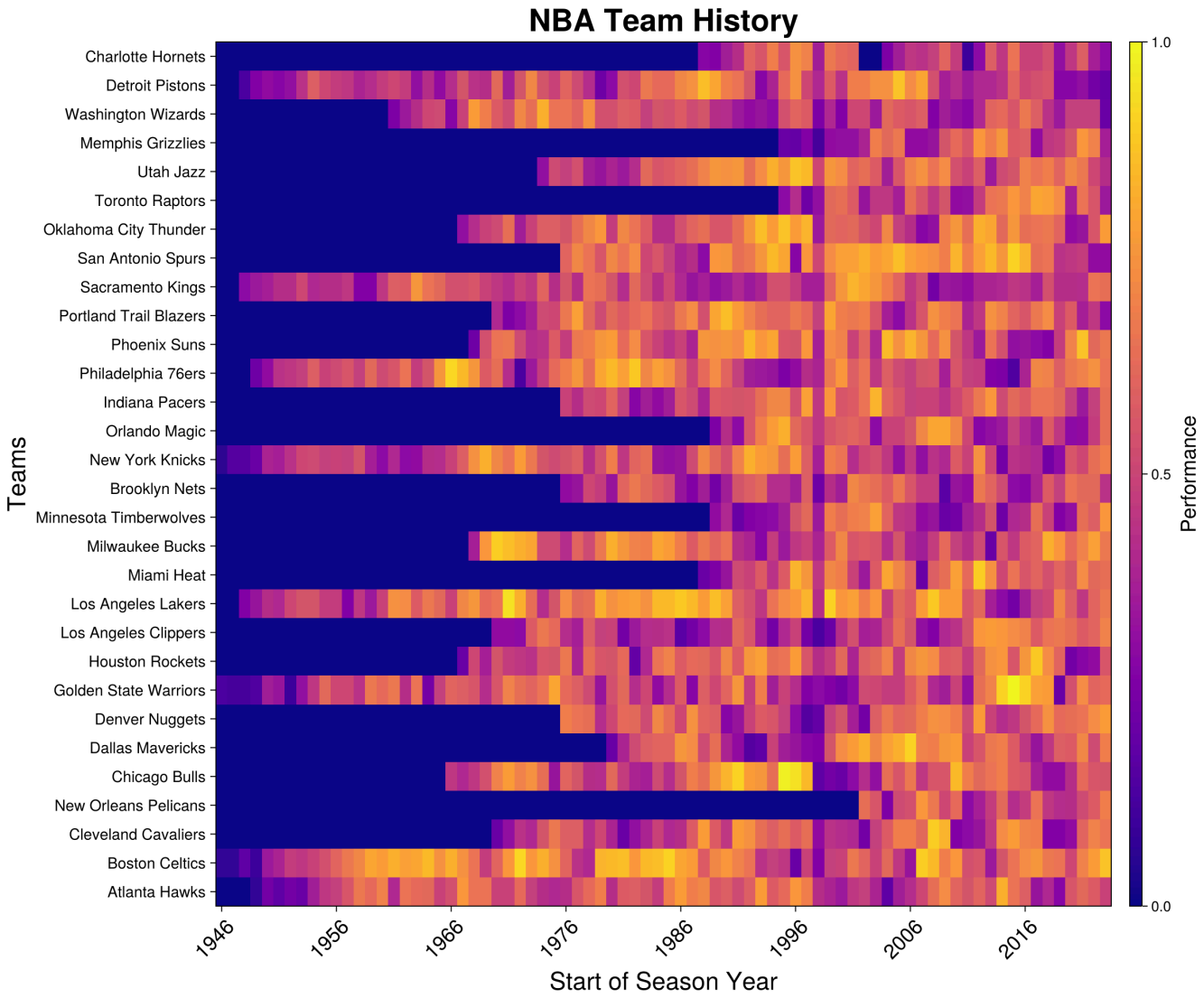


These bar graphs show when teams were inaugurated, re-franchised (Charlotte), and their records throughout the years.

Source: NBA License, NBA, 2021.



This line graph shows the overall trend of each team's performance (fit to a first degree polynomial).

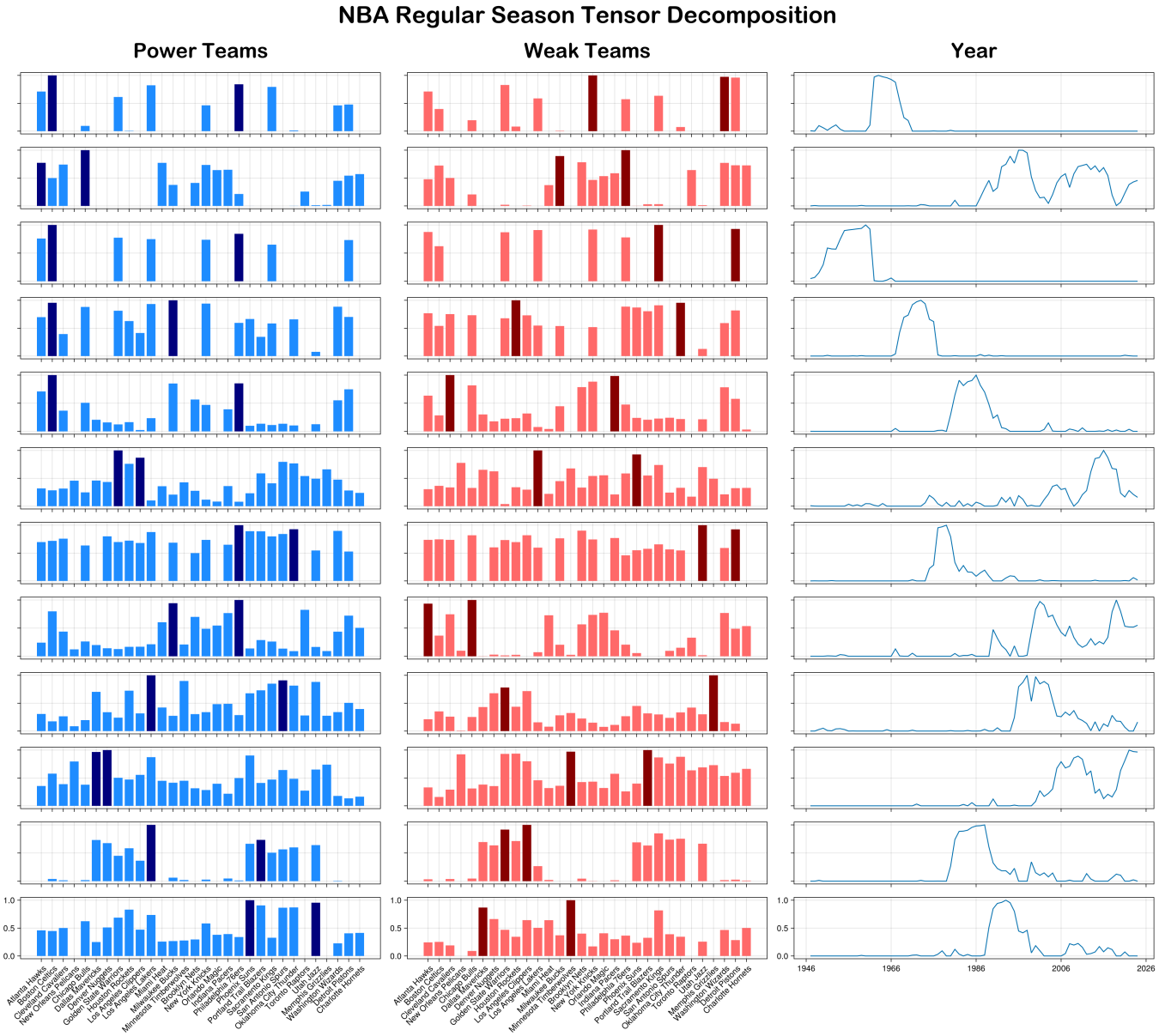


This heatmap is a visually easier graph for determining the prime eras for each team and their inaugural years.

Third Order Tensor Decomposition

```
M = 30×30×78 CPD{Float64, 3, Vector{Float64}, Matrix{Float64}} with 12 components
    λ weights:
    12-element Vector{Float64}: …
    U[1] factor matrix:
    30×12 Matrix{Float64}: …
    U[2] factor matrix:
    30×12 Matrix{Float64}: …
    U[3] factor matrix:
    78×12 Matrix{Float64}: …
```

```
1 M = gcp(X,12;loss = GCPLosses.NonnegativeLeastSquares())
```



This tensor decomposition accurately predicts the NBA champions throughout the years. It captures the Bull's dominance in the 90s, Heat short after, Celtics in the 60s and currently, Lakers in the 2000s, 80s, and 50s, Warriors in the late 2010s, and the upcoming Nuggets, Mavericks, etc... showcasing its versatility and usage in statistics.

References

1. "Land of Basketball", LandOfBasketball.com, 2024. https://www.landofbasketball.com/

2. "NBA Official Site", NBA.com, 2024. https://www.nba.com/