Introduction

The National Hockey League (NHL) is considered to be the premier professional ice hockey league in the world, founded 102 years ago in 1917. Like many other sports, the data about teams, players, games, and more are a great resource to dive in and analyze using modern software tools. Thanks to the open NHL API, the data is accessible to everyone and the `{nhlapi}` R package aims to make that data readily available for analysis to R users.

> In this post, we will use the `{nhlapi}` R package to explore the positional data on in-game events, which will provide us with information on the plays that happened in matches and where they happened in terms of the position on the rink. We will also show ways to plot that information using 2D density charts with `{ggplot2}`.

Contents

Installing the {nhlapi} package

We can install `{nhlapi}` from CRAN. It has only 1 recursive dependency, so the installation is very light and swift. Alternatively, we can also install the latest development version from the master branch on GitHub using the `{remotes}` or `{devtools}` package:

```
# Current CRAN version:
install.packages("nhlapi")

# Development version from GitHub
#  devtools::install_github("jozefhajnala/nhlapi")
#  remotes::install_github("jozefhajnala/nhlapi")

library(nhlapi)
```

Now we attach the package using `library()` or `require()` and can start exploring the data. All the relevant functions start with the `nhl_` prefix so they are easy to find and are well documented, so we can get help by using the `help()` function in R. For example, in this post we will look at the detailed games' data, so running `help(nhl_games)` will provide us with detailed information on the available functions.

Retrieving basic game information

To look at a quick example, we will explore the very first game in the regular season 2017/2018, in which the Toronto Maple Leafs played against the Winnipeg Jets. First, let's look at the very basic game results using the `nhl_games_linescore()` function which retrieves a very limited amount of high-level information:

```
linescore <- nhlapi::nhl_games_linescore(gameIds = 2017020001)[[1]]

# Look at quick info on periods
linescore$periods
```

```
  periodType            startTime              endTime num ordinalNum
1    REGULAR 2017-10-04T23:17:19Z 2017-10-04T23:58:23Z   1        1st
2    REGULAR 2017-10-05T00:16:56Z 2017-10-05T00:54:10Z   2        2nd
3    REGULAR 2017-10-05T01:12:37Z 2017-10-05T01:50:38Z   3        3rd
```

```
  home.goals home.shotsOnGoal home.rinkSide away.goals away.shotsOnGoal
1          0               17         right          3               11
2          0               10          left          1                8
3          2               10         right          3               12
  away.rinkSide
1          left
2         right
3          left
```

Getting detailed events data for a game

Now to something more interesting, lets investigate what plays were made during the game and where on the ice they happened. We can use `nhl_games_feed()` to get the most detailed game data available in the API. To get a picture of the amount of detail, we can print the structure of the retrieved object limited to 3 levels of depth:

```
gameIds <- 2017020001
gameFeed <- nhlapi::nhl_games_feed(gameIds = gameIds)[[1]]
str(gameFeed, max.level = 3)
```

```
List of 6
 $ copyright: chr "NHL and the NHL Shield are registered trademarks of the National
Hockey League. NHL and NHL team marks are the "| __truncated__
 $ gamePk   : int 2017020001
 $ link     : chr "/api/v1/game/2017020001/feed/live"
 $ metaData :List of 2
  ..$ wait     : int 10
  ..$ timeStamp: chr "20171006_173713"
 $ gameData :List of 6
  ..$ game    :List of 3
  .. ..$ pk    : int 2017020001
  .. ..$ season: chr "20172018"
  .. ..$ type  : chr "R"
  ..$ datetime:List of 2
  .. ..$ dateTime   : chr "2017-10-04T23:00:00Z"
  .. ..$ endDateTime: chr "2017-10-05T01:50:41Z"
  ..$ status  :List of 5
  .. ..$ abstractGameState: chr "Final"
  .. ..$ codedGameState   : chr "7"
  .. ..$ detailedState    : chr "Final"
  .. ..$ statusCode       : chr "7"
  .. ..$ startTimeTBD     : logi FALSE
  ..$ teams   :List of 2
  .. ..$ away:List of 16
  .. ..$ home:List of 16
  ..$ players :List of 45
  .. ..$ ID8474709:List of 22
  .. ..$ ID8473618:List of 22
  .. ..$ ID8471218:List of 22
  .. ..$ ID8470828:List of 21
  .. ..$ ID8477939:List of 22
  .. ..$ ID8476945:List of 22
  .. ..$ ID8473412:List of 22
  .. ..$ ID8475716:List of 21
  .. ..$ ID8476941:List of 22
  .. ..$ ID8476469:List of 21
  .. ..$ ID8477359:List of 22
  .. ..$ ID8479339:List of 21
  .. ..$ ID8479318:List of 22
  .. ..$ ID8476410:List of 22
  .. ..$ ID8475883:List of 21
  .. ..$ ID8474574:List of 22
  .. ..$ ID8477940:List of 21
  .. ..$ ID8473463:List of 21
  .. ..$ ID8477464:List of 22
  .. ..$ ID8473461:List of 22
  .. ..$ ID8476392:List of 22
  .. ..$ ID8466139:List of 22
  .. ..$ ID8470834:List of 22
  .. ..$ ID8468575:List of 22
  .. ..$ ID8477429:List of 22
  .. ..$ ID8468493:List of 22
  .. ..$ ID8474037:List of 22
  .. ..$ ID8475786:List of 22
  .. ..$ ID8470611:List of 22
  .. ..$ ID8476853:List of 22
  .. ..$ ID8477448:List of 21
  .. ..$ ID8477504:List of 22
  .. ..$ ID8479458:List of 21
  .. ..$ ID8477015:List of 22
  .. ..$ ID8475179:List of 21
  .. ..$ ID8476885:List of 22
  .. ..$ ID8475279:List of 22
  .. ..$ ID8473574:List of 22
  .. ..$ ID8476460:List of 22
  .. ..$ ID8475098:List of 22
  .. ..$ ID8474581:List of 22
  .. ..$ ID8478483:List of 22
  .. ..$ ID8475172:List of 22
  .. ..$ ID8480158:List of 21
  .. ..$ ID8479293:List of 22
  ..$ venue   :List of 3
  .. ..$ id  : int 5058
  .. ..$ name: chr "Bell MTS Place"
  .. ..$ link: chr "/api/v1/venues/5058"
 $ liveData :List of 4
  ..$ plays    :List of 5
  .. ..$ allPlays     :'data.frame':    312 obs. of  28 variables:
  .. ..$ scoringPlays : int [1:9] 93 108 112 157 225 269 284 286 290
  .. ..$ penaltyPlays : int [1:12] 21 43 66 86 117 148 167 183 247 253 ...
  .. ..$ playsByPeriod:'data.frame':    3 obs. of  3 variables:
  .. ..$ currentPlay  :List of 3
  ..$ linescore:List of 10
  .. ..$ currentPeriod             : int 3
  .. ..$ currentPeriodOrdinal      : chr "3rd"
  .. ..$ currentPeriodTimeRemaining: chr "Final"
  .. ..$ periods                   :'data.frame':   3 obs. of  11 variables:
  .. ..$ shootoutInfo              :List of 2
  .. ..$ teams                     :List of 2
  .. ..$ powerPlayStrength         : chr "Even"
  .. ..$ hasShootout               : logi FALSE
  .. ..$ intermissionInfo          :List of 3
  .. ..$ powerPlayInfo             :List of 3
  ..$ boxscore :List of 2
  .. ..$ teams    :List of 2
  .. ..$ officials:'data.frame':    4 obs. of  4 variables:
```

```
  ..$ decisions:List of 5
  .. ..$ winner    :List of 3
  .. ..$ loser     :List of 3
  .. ..$ firstStar :List of 3
  .. ..$ secondStar:List of 3
  .. ..$ thirdStar :List of 3
 - attr(*, "url")= chr "https://statsapi.web.nhl.com/api/v1/game/2017020001/feed/live"
```

Now lets finally look at the data on plays. We can access those via the `allPlays` data.frame inside the element `plays` of `liveData`. The below code chunk will store those in a separate data.frame called `plays`. We can then filter based on `result.event` to look for instance only at goals.

```
plays <- gameFeed$liveData$plays$allPlays
goals <- plays[plays$result.event == "Goal", ]

# Selecting limited columns to keep the print reasonable
goals[, c(2, 5, 6, 12, 15, 18, 26, 23, 24)]
```

```
##     result.event
## 94          Goal
## 109         Goal
## 113         Goal
## 158         Goal
## 226         Goal
## 270         Goal
## 285         Goal
## 287         Goal
## 291         Goal
##
result.description
## 94        Nazem Kadri (1) Wrist Shot, assists: James van Riemsdyk (1), Tyler Bozak
(1)
## 109                        James van Riemsdyk (1) Wrist Shot, assists: Tyler Bozak
(2)
## 113   William Nylander (1) Wrist Shot, assists: Jake Gardiner (1), Auston Matthews
(1)
## 158    Patrick Marleau (1) Backhand, assists: Auston Matthews (2), Mitchell Marner
(1)
## 226          Patrick Marleau (2) Wrist Shot, assists: Nazem Kadri (1), Leo Komarov
(1)
## 270 Mitchell Marner (1) Wrist Shot, assists: James van Riemsdyk (2), Morgan Rielly
(1)
## 285      Mark Scheifele (1) Snap Shot, assists: Patrik Laine (1), Dustin Byfuglien
(1)
## 287       Auston Matthews (1) Tip-In, assists: Connor Carrick (1), Andreas Borgman
(1)
## 291                        Mathieu Perreault (1) Wrist Shot, assists: Bryan Little
(1)
##     result.secondaryType result.strength.name about.period
## 94            Wrist Shot           Power Play            1
## 109           Wrist Shot                 Even            1
## 113           Wrist Shot                 Even            1
## 158             Backhand                 Even            2
## 226           Wrist Shot                 Even            3
## 270           Wrist Shot           Power Play            3
## 285            Snap Shot                 Even            3
## 287               Tip-In                 Even            3
## 291           Wrist Shot                 Even            3
##     about.periodTime           team.name coordinates.x coordinates.y
## 94              15:45 Toronto Maple Leafs            84            -6
## 109             17:40 Toronto Maple Leafs            62             5
## 113             18:23 Toronto Maple Leafs            84           -22
## 158             08:32 Toronto Maple Leafs           -82             2
## 226             00:36 Toronto Maple Leafs            68            12
## 270             08:07 Toronto Maple Leafs            85            -6
## 285             11:31       Winnipeg Jets           -82             8
## 287             11:57 Toronto Maple Leafs            84            -3
## 291             12:57       Winnipeg Jets           -80             1
```

Now we can see that there are many columns, among them `coordinates.x` and `coordinates.y` which tell us the location of the play on the rink, where `[0, 0]` is the center of the rink.

More involved data retrieval – many games in parallel

Now we know how to look at the positional data for one match so one very interesting aspect of the data is where plays happen overall. We will now investigate and plot where different plays were happening in the regular season 2017/2018. Looking at `?nhl_games` we see that for regular seasons we can usually get all the gameIds in the interval `2017020001:2017021271`.

```
# Define the game ids
gameIds <- 2017020001:2017021271

# Retrieve the data
gameFeeds <- nhlapi::nhl_games_feed(gameIds)
```

To retrieve the data a bit faster, we can also use the `parallel` package which is part of the base R installation to retrieve the data in parallel, for example, like so.

```
# Define the game ids
gameIds <- 2017020001:2017021271

# Create a local cluster
cl <- parallel::makeCluster(parallel::detectCores() / 2)

# Retrieve the data using nhlapi::nhl_games_feed()
gameFeeds <- parallel::parLapplyLB(cl, gameIds, nhlapi::nhl_games_feed)

# Stop the cluster
parallel::stopCluster(cl)
```

Now we have the data retrieved in a list called `gameFeeds`. It might be wise to store it on disk such that we do not have to do the long retrieval all the time, for example using `saveRDS()`:

```
saveRDS(gameFeeds, file.path("~", "gamefeeds_regular_2017.rds"))
```

Processing and plotting positional data

Now that the data is safely retrieved, we can process and prepare the data on plays for plotting.

```
# Retrieve the data frames with plays from the data
getPlaysDf <- function(gm) {
  playsRes <- try(gm[[1L]][["liveData"]][["plays"]][["allPlays"]])
  if (inherits(playsRes, "try-error")) data.frame() else playsRes
}
plays <- lapply(gameFeeds, getPlaysDf)

# Bind the list into a single data frame
```

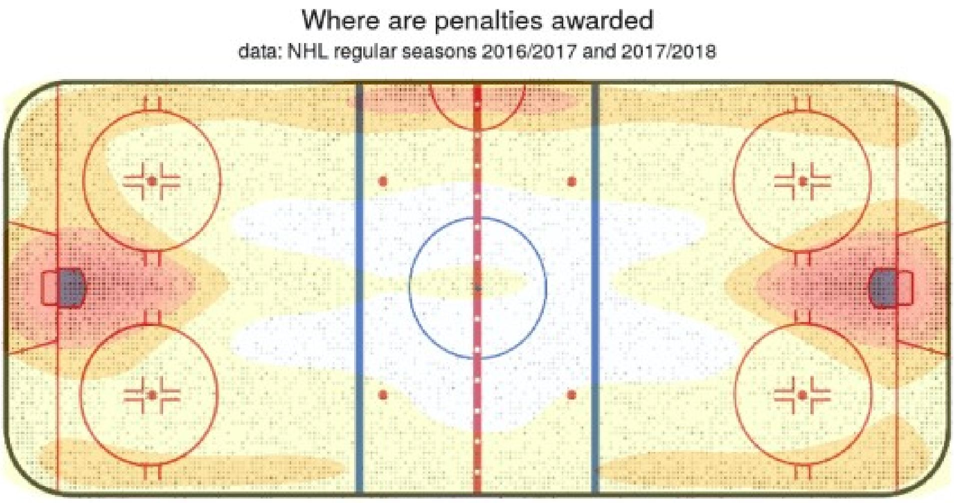
```
plays <- nhlapi:::util_rbindlist(plays)

# Keep only the records that have coordinates
plays <- plays[!is.na(plays$coordinates.x), ]

# Move the coordinates to non-negative values before plotting
plays$coordx <- plays$coordinates.x + abs(min(plays$coordinates.x))
plays$coordy <- plays$coordinates.y + abs(min(plays$coordinates.y))
```

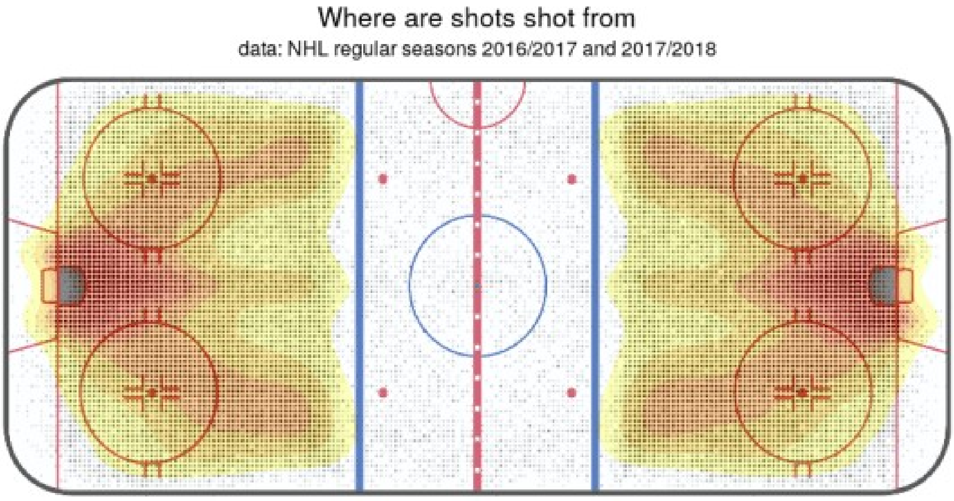
Now we have the data ready in a `plays` data.frame, finally we can create some cool plots. As an example, in the following chunk the popular `ggplot2` package is used to plot densities and events that would yield results similar to the ones shown below:

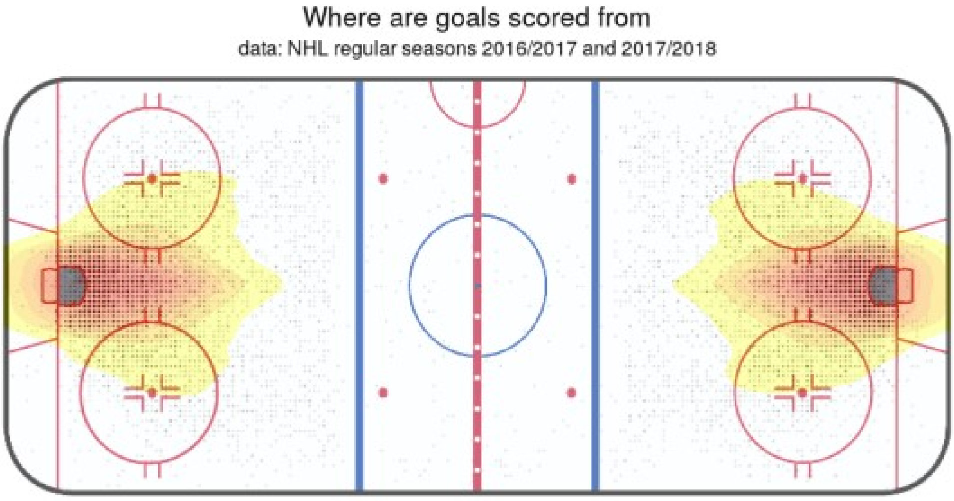
```
library(ggplot2)

# Look at goals only
goals <- plays[result.event == "Goal"]

ggplot(goals, aes(x = coordx, y = coordy)) +
  labs(title = "Where are goals scored from") +
  geom_point(alpha = 0.1, size = 0.2) +
  xlim(0, 198) + ylim(0, 84) +
  geom_density_2d_filled(alpha = 0.35, show.legend = FALSE) +
  theme_void()
```

Some examples of rendered images

With a bit of effort, we can also add a background image of the ice hockey rink to make the density plots more relatable and arrive at some quite informative plots:







Happy exploring!

References

- The `{nhlapi}` package on CRAN