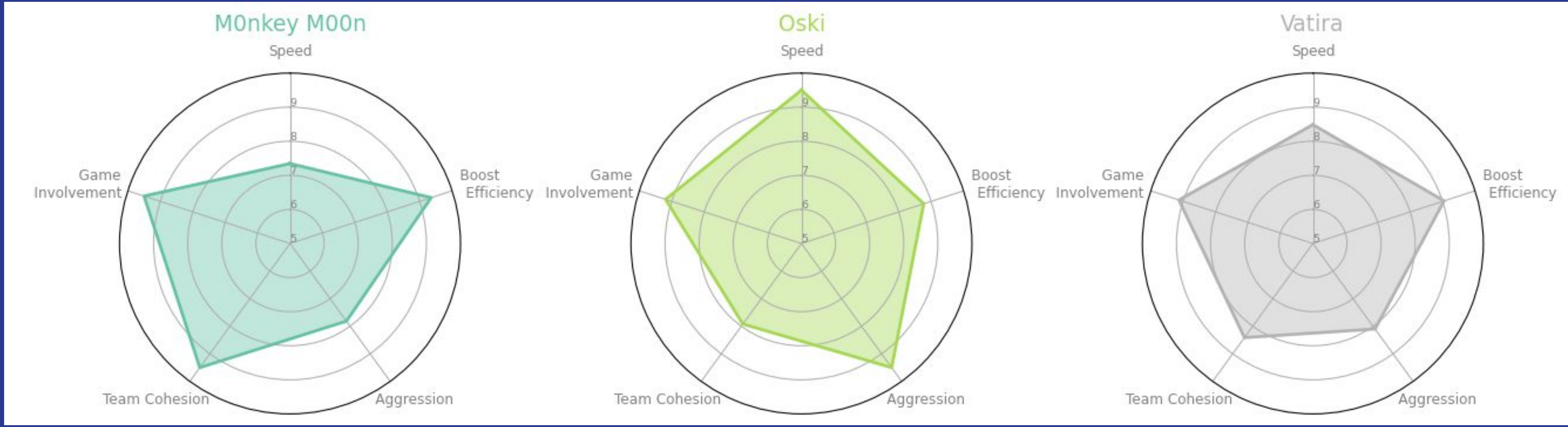
# Capstone - Rocket League

## Analysis and Modeling of play-styles and rank



# Agenda

- Problem Statement
- Introduction to Rocket League
- **Part 1: Playstyle Analysis and Prediction**
  - Pro Examples
  - Casual Examples
  - Modeling Results
- **Part 2: Rank Analysis and Prediction**
  - General trends
  - Modeling Results
- Application Demo
- Conclusions & Recommendations

# Problem Statement

- Very slow improvement rates at high ranks.
  - highly mechanics and precision required
- Professional players can be used as play-style case studies for developing players
  - Particularly at mid to high ranks

This project uses 3 pro players, selected as top-level examples of 3 distinct play-styles:

- MonkeyMoon
- Vatira
- Oski

An ExtraTrees classification model has been trained on replay data from professional tournaments for each of these players, and can be used to predict which play-style a player most closely fits from a submitted 3v3 replay ID and player ID.

Furthermore, a neural network regression model has been produced to estimate the rank of a player given the stats from a 3v3 replay ID and player ID

# Rocket League - A Summary


- 3v3 Player  vs  Player
- Using the car body to score in the opposition teams goal (Car Soccer)
- Team with most goals in a 5 minute game wins!

*Simple…*

# Rocket League - A Summary


Shameless Plug :)

*...Maybe not...*

- Players can collect 'boost' off several spots on the ground
- This allows the cars to fly
- Car control becomes key to improvement

# How Can I Improve?

Plateau Ranks


Lower Ranks:

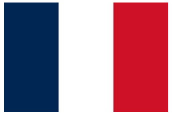
- Game Fundamentals:
  - Team Rotations
  - Muscle Memory

Higher Ranks:

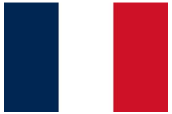
- Unclear:
  - Mechanics?
  - Speed?

# Part 1 - Identify Your Playstyle (or desired playstyle)

- Pro Players have proven that many playstyles can bring success
- 500 international tournament matches were collected for each player from *ballchasing.com*
- I have used three European top level players as exemplar playstyle models:

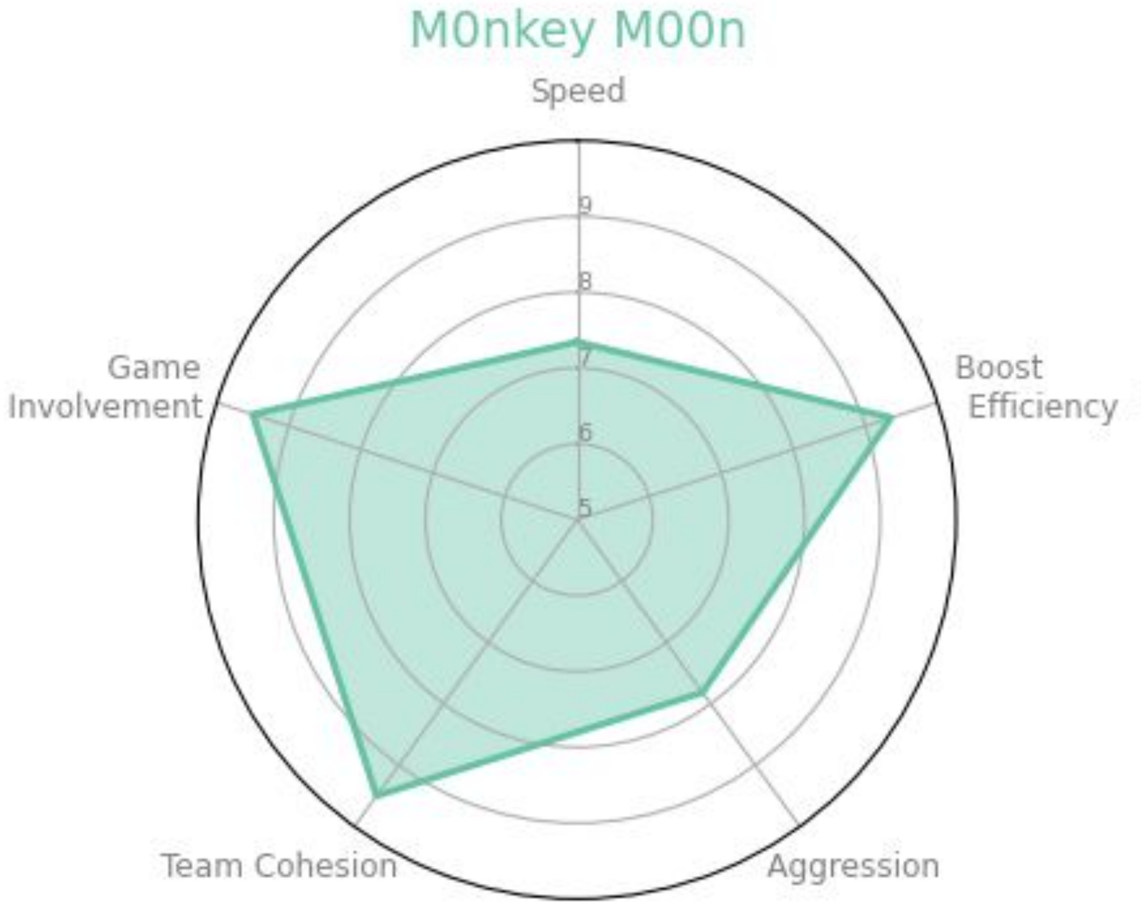
1 - **M0nkey M00n** 

2 - **Oski** 

3 - **Vatira** 

# M0nkey M00n - Team BDS

- **2022 World Champion**
- **2021 Fall Major Champion**
- **Season X 2nd Place**




# M0nkey M00n

- Highly Efficient with boost
  - Uses the minimum resources required

- Always available to receive a pass or intercept opponent

- Most defensive player on his team

# Oski - Team Liquid

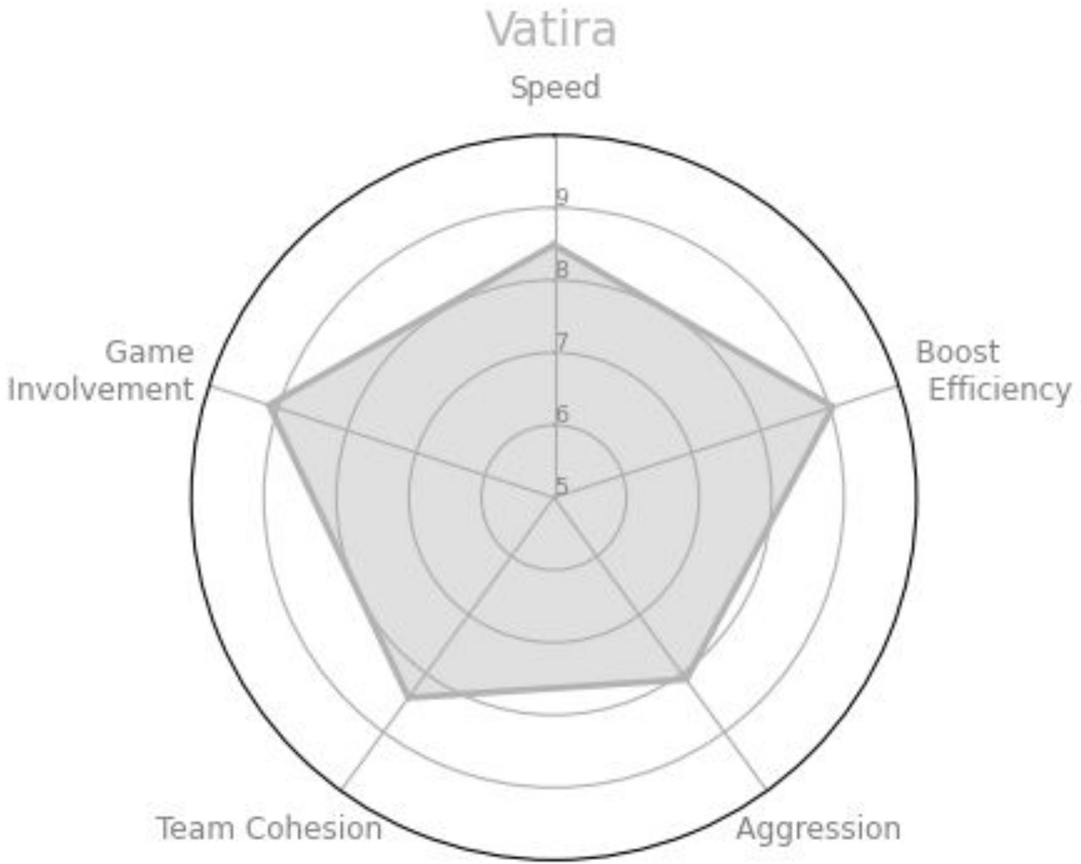
- **2023 Winter Major Semi Finalist**
- **Regarded as one of the most mechanically talented players in Europe**

# Oski


- Plays extremely aggressively
- Constantly looking to outplay opponents through mechanical skill
- Can leave team exposed, aims to create more chances than conceded

# Vatira - Karmine Corp

- **2 x Major Champion**
- **2022 Winter Major Second Place**
- **Widely Regarded as the current best player in the world**

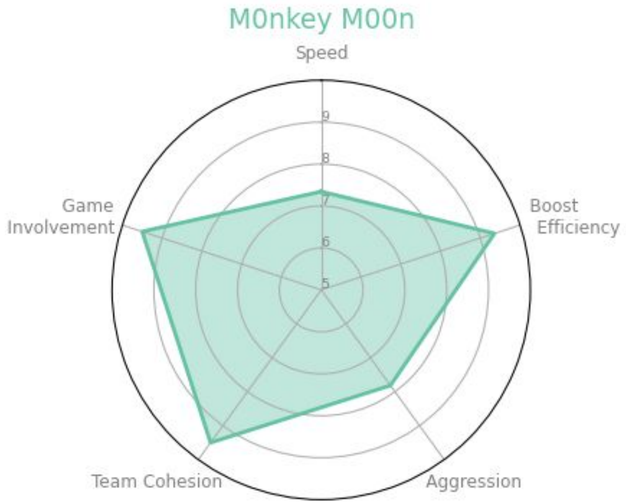



# Vatira

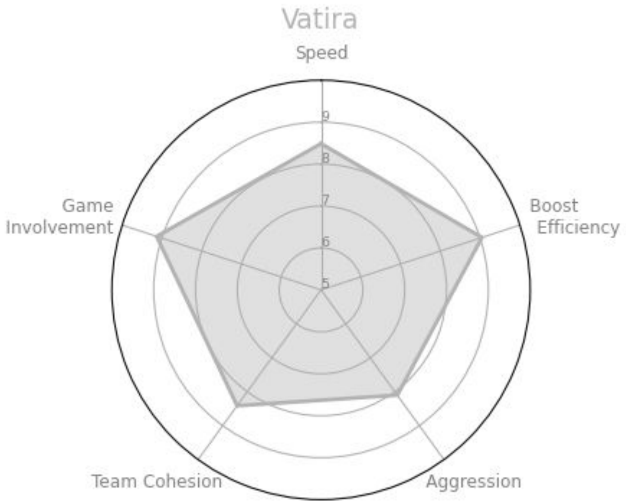
- Very Rounded Playstyle
- Capitalises on opportunities created through constant pressure and teamwork
- Generally plays as the most defensive player on the team, but able to create and score as well as any other player

# Playstyle Modeling

- Playstyle were plotted using a designed algorithm
- Can Classification models replicate this?
- These can then be used to identify which play-style any player's gameplay is most alike





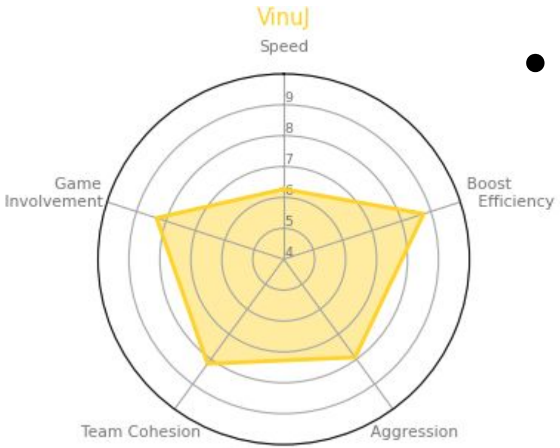


# Playstyle Modeling

- Null Model predicted the majority class - Vatira - with accuracy of 0.37
- Neural Network was by far the strongest predictor, with the lowest variance
- Gaussian Naive Bayes was not a suitable model, performing worse than the null model

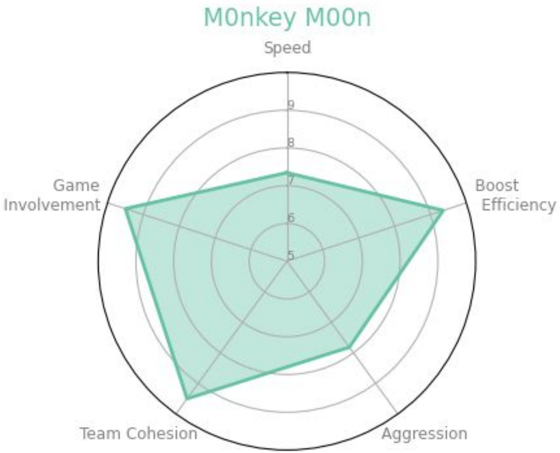
| | train_acc | test_acc | bal_acc |
|---|---|---|---|
| knn | 1.000000 | 0.837500 | 0.831184 |
| et | 1.000000 | 0.879167 | 0.875863 |
| gnb | 0.339833 | 0.283333 | 0.342464 |
| stack | 1.000000 | 0.820833 | 0.817405 |
| neural_network | 0.968000 | 0.903000 | NaN |

# Applying these Models to Casual Players

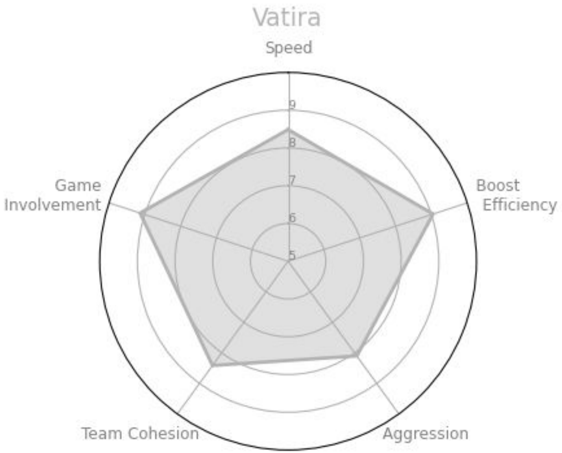



- Over 20-30 replays, Vinu's average predictions for each Playstyle:

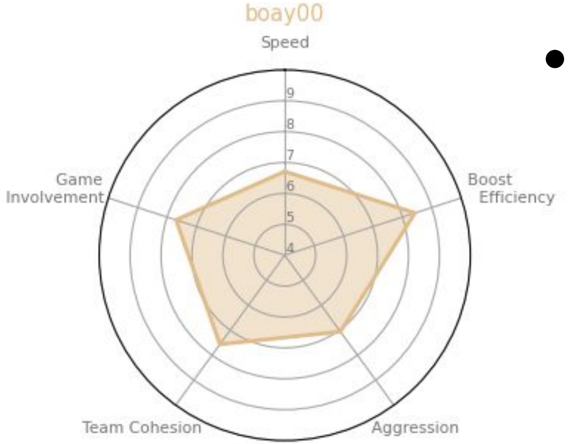
**MonkeyMoon** - 0.483
**Oski** - 0.188
**Vatira** - 0.328





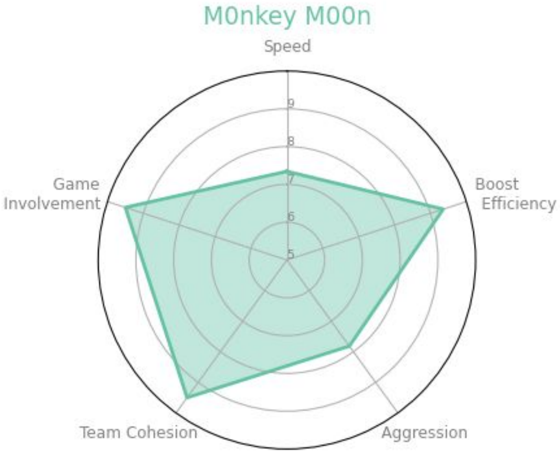


# Applying these Models to Casual Players

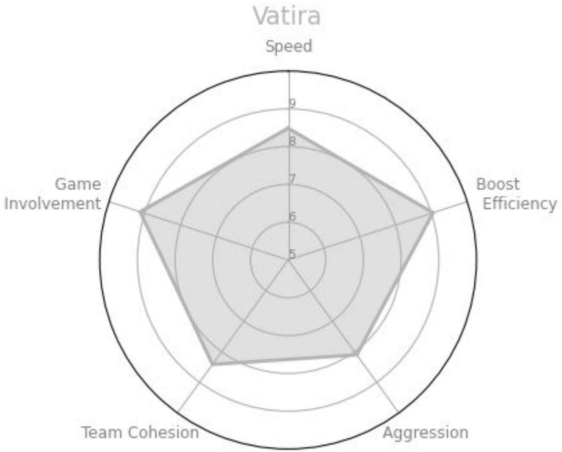



- Over 20 replays, boay00's average predictions for each Playstyle:

**MonkeyMoon** - 0.330
**Oski** - 0.197
**Vatira** - 0.473



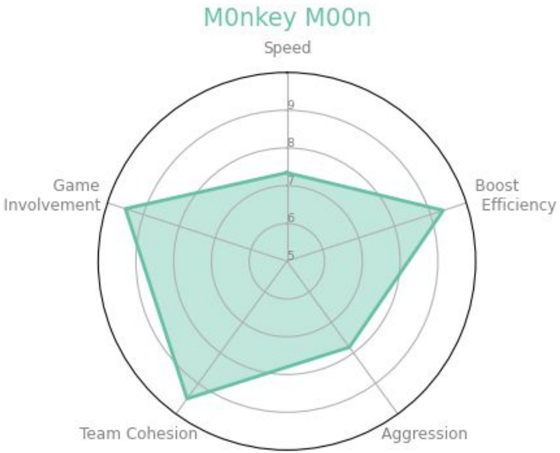




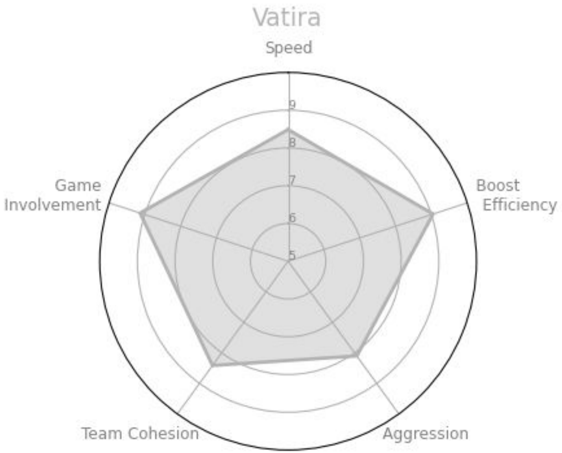
# Applying these Models to Casual Players


- Over 20 replays, Charles' average predictions for each Playstyle:

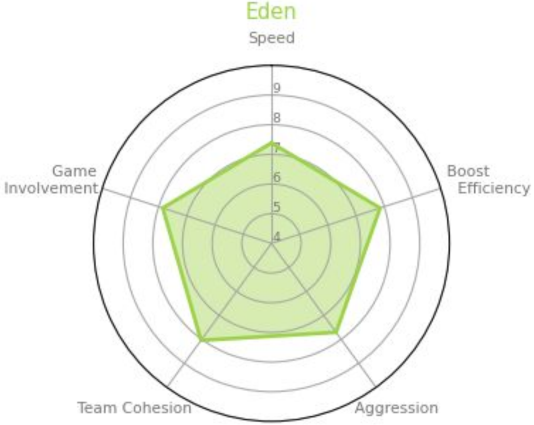
**MonkeyMoon** - 0.280
**Oski** - 0.261
**Vatira** - 0.458





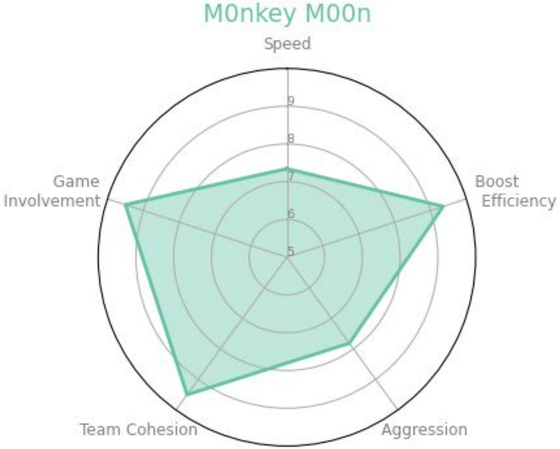


# Applying these Models to Casual Players

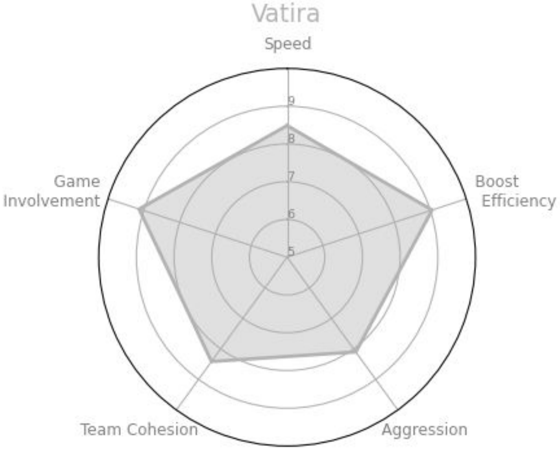



- Over 20 replays, Eden's average predictions for each Playstyle:

**MonkeyMoon** - 0.257
**Oski** - 0.275
**Vatira** - 0.468



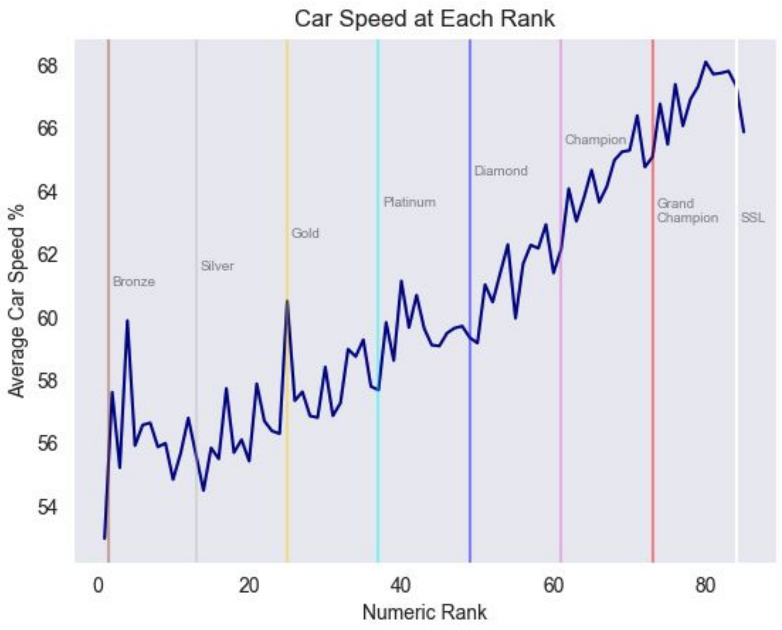


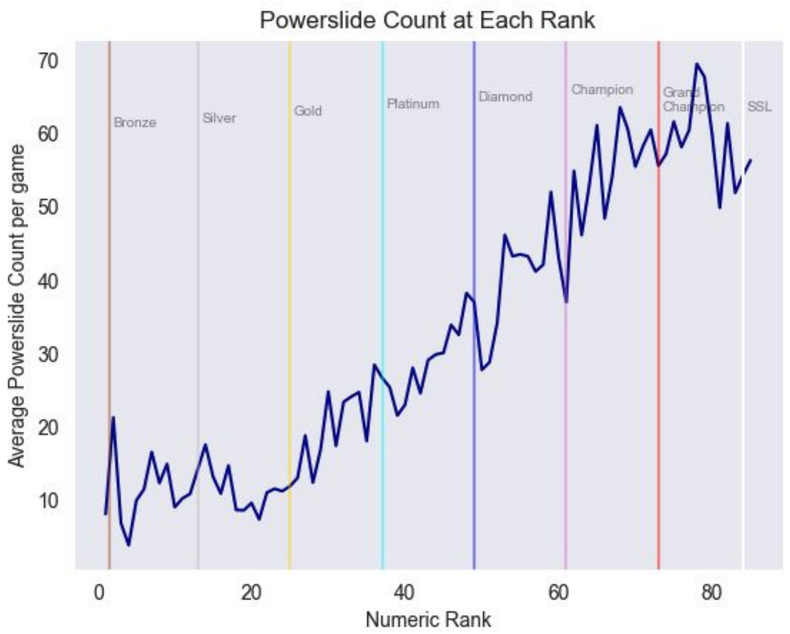


# Part 2 - Rank Predictions

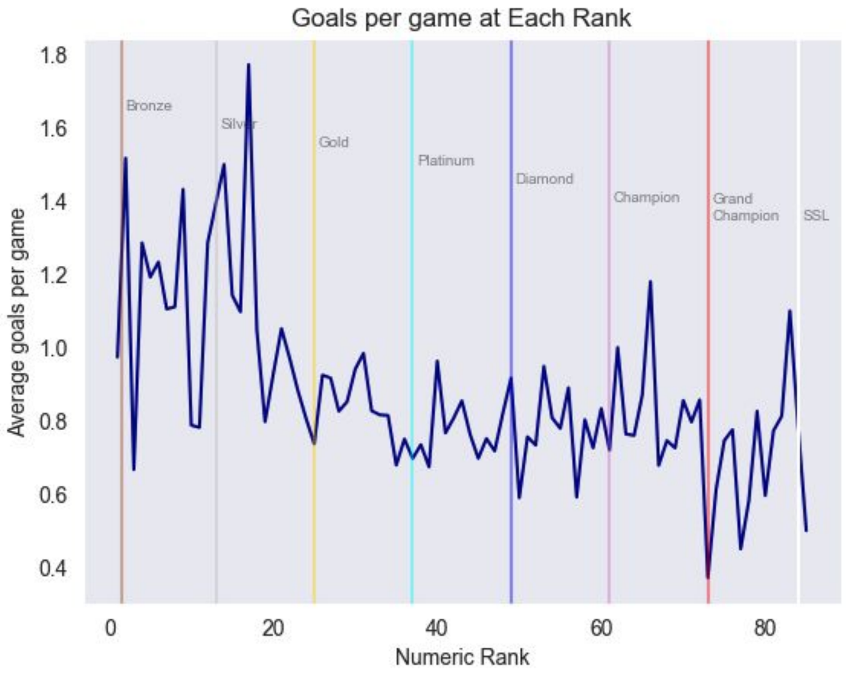
- Many game statistics follow a linear trend as you move up the rank ladder
- Can a regression model predict what rank the gameplay has derived from?
- Can casual players use a rank prediction to determine their current level of skill by comparing this to their actual rank?
- Converted Entire rank ladder to numeric values, with 1 being the lowest rank and 85 being the highest

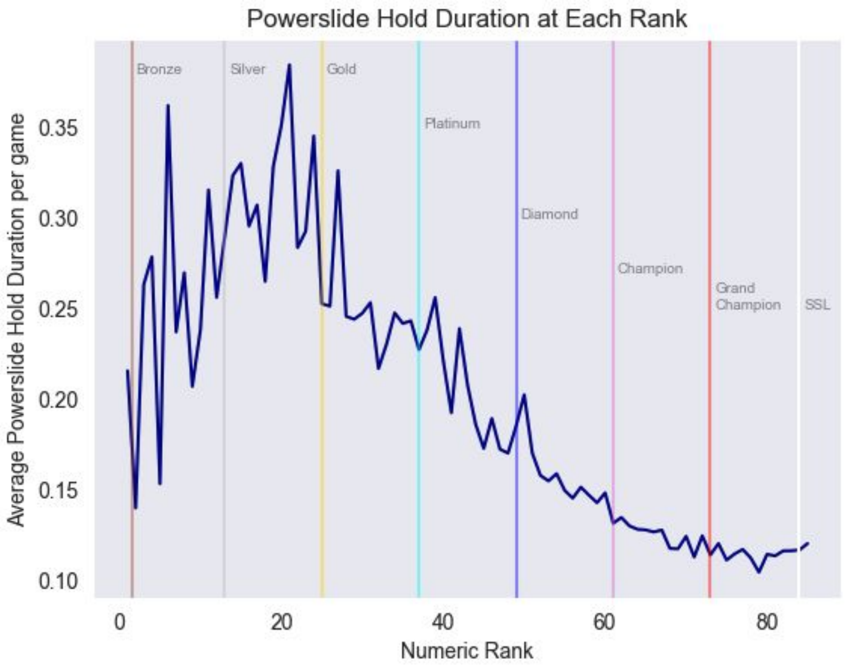
# Trends across ranks



# Trends across ranks



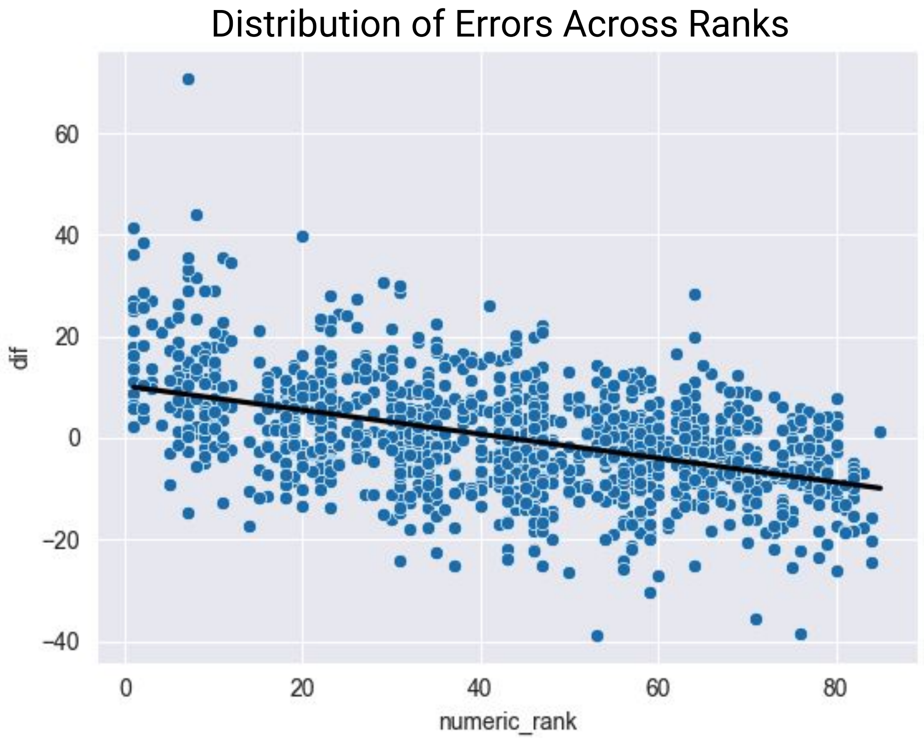
# Rank Models

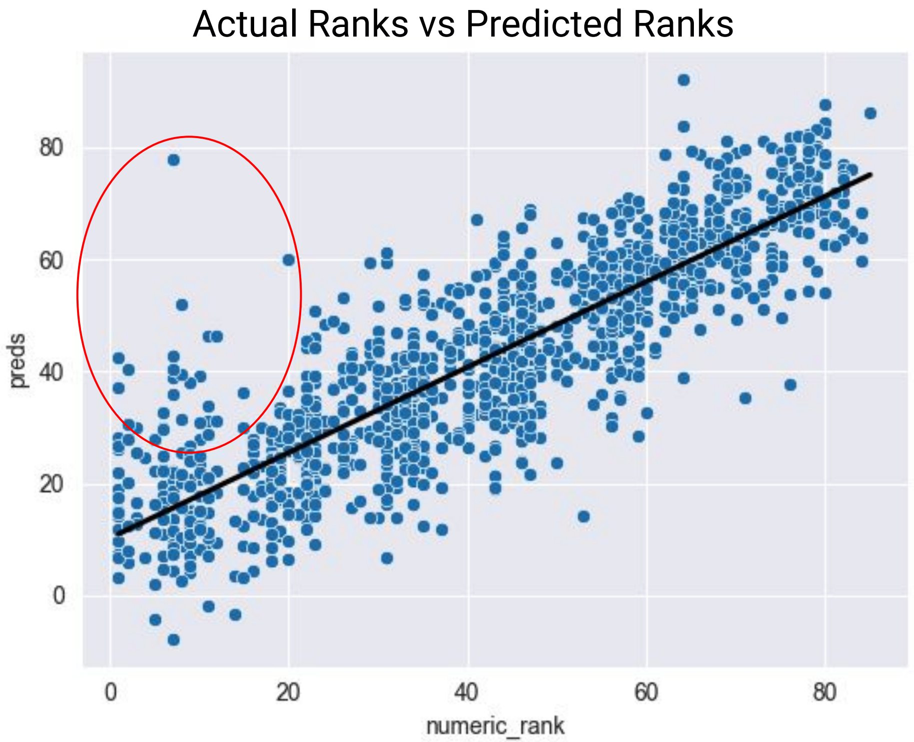
- Null Model $R^2 < 0$
- Neural Network was the model with the lowest variance, whilst still having relatively high $R^2$ scores and low rmse
- Gradient Boosting Regressor (GBRT) models produced very high training scores, and low rmse, but were generally high in variance

| | train_r2 | test_r2 | MSE |
|---|---|---|---|
| gradient boost | 0.825483 | 0.741011 | 10.939589 |
| gradient boost 2 | 0.848500 | 0.757800 | 10.579077 |
| extra trees | 0.805168 | 0.710879 | 11.558469 |
| random forest | 0.809671 | 0.705284 | 11.669769 |
| k nearest | 0.757530 | 0.633170 | 13.019461 |
| gradient boost (overfit) | 0.947228 | 0.756691 | 10.603269 |
| neural_network | 0.790432 | 0.770315 | 10.908712 |

**GBRT models do not work in render**

# Neural Network - Regression



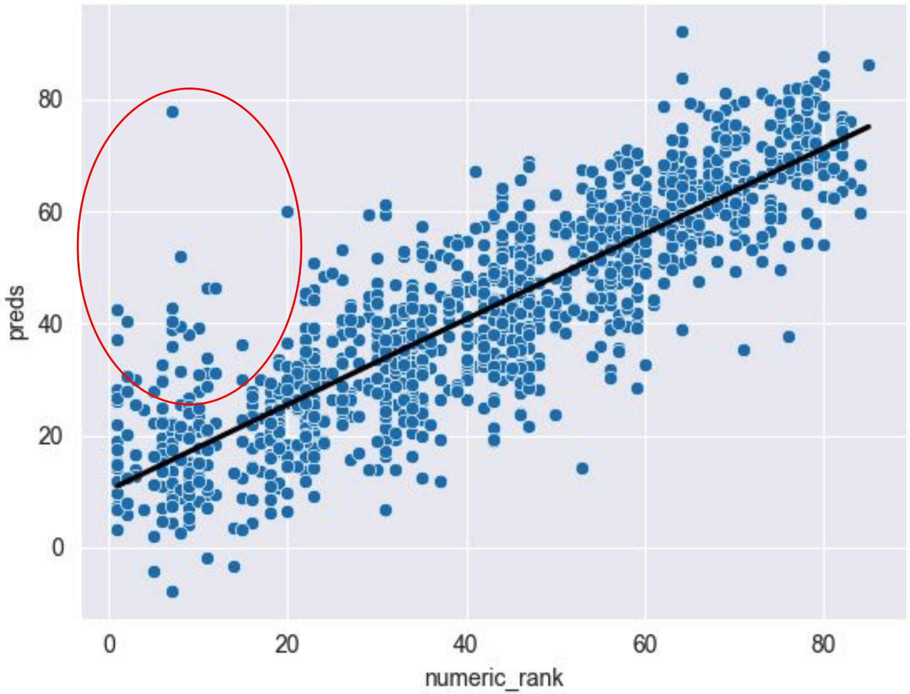



# Why is this happening?

- Players must have the plugin ‘Bakkersmod’ installed in order to upload replay files to Ballchasing.com

- This is something mostly used by more experienced players

- Therefore low rank players using bakkersmod are likely deliberately playing at rank below their skill level, resulting in high rank predictions



# Rocket League Playstyle Predictor Application

Link to the App:

https://rocket-league-playstyle-predictor.onrender.com

# Conclusions

- The Classification model was able to successfully distinguish between the three professional players' playstyles, and provided reasonable estimations for which of these was most suited to a given player

- The playstyle algorithm was somewhat effective in showcasing a players general attributes, however performs better with more than one game's worth of data

- The rank prediction model was unable to accurately place a players' games, however this was never the intention:
  - The model did show a linear increase in the prediction as rank increased, some error is inevitable and successfully highlights the differences in level at any given rank

# Recommendations

- Application
  - Process multiple games
    - Strain on the render server
    - Pressure on the host website's API
    - Would require user authentication and API token
  - Offer specific metric advice, as well as describing how these metrics are calculated
    - Visualise the sub-metrics for each attribute, and which need the most improvement
- Models
  - Classification model is still overfit
    - Further optimisation
  - Train rank prediction model on ranks above Platinum 3
    - Would remove the instances of players deliberately playing at ranks below their skill level and skewing the model

Thank You for Listening to me Talking about Car Football/Soccer for 20 Minutes!

I am happy to answer any questions