# Starcraft 2 League Analysis

By Chandler Kinch

# The Problem

- Starcraft 2 is a highly competitive Real Time Strategy video game made by Blizzard Entertainment
- Millions of people have played and thousands still play competitively.
- What matters most when trying to improve at Starcraft 2?
- League Placement is tricky and a key factor to good games.
- Smurfs cause poor game interactions. How can they be detected?

# The Data

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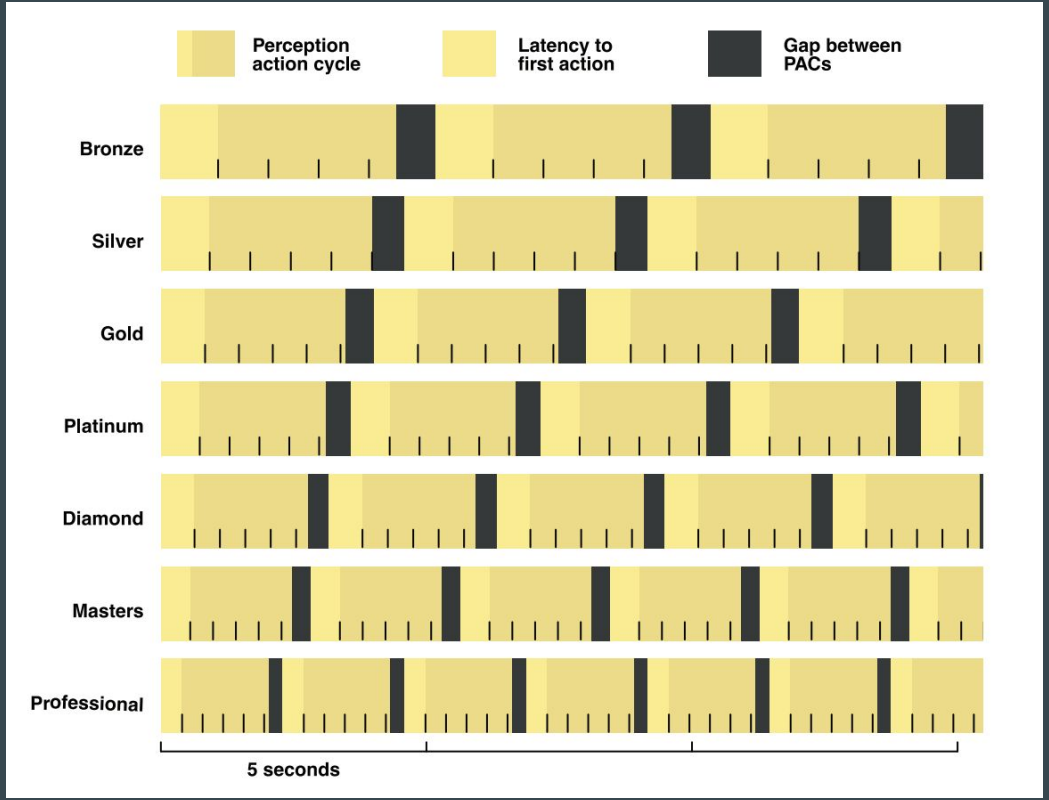
# The Data

- Data taken from a study done at Simon Fraser University in 2013.
- This data set represents 3,395 games and includes 20 features for each game.
- Features cover gameplay aspects such as:
  - League Index(our target feature for this analysis)
  - Minimap Usage
  - Hotkey usage
  - Types of units made
  - Hours played
  - Actions per Minute(APM)
  - Data on the Perception Action Cycle

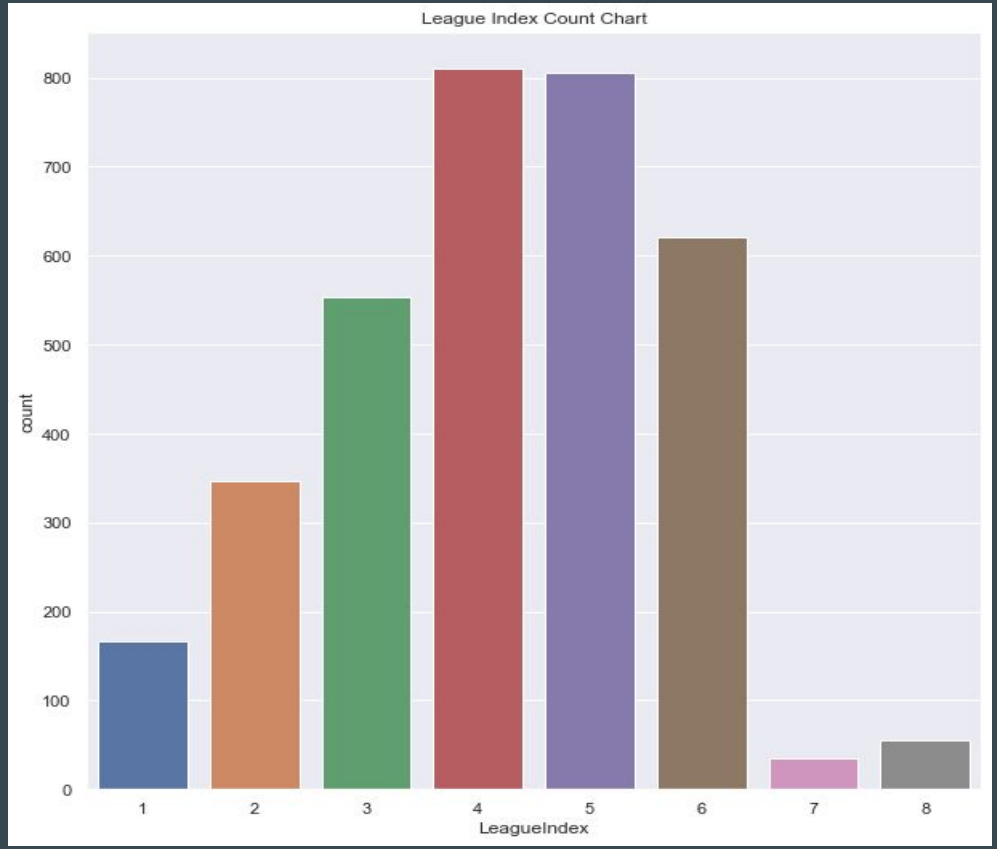
# Perception Action Cycle

- Dark yellow + bright yellow = Perception Action Cycle(PAC)
- Bright yellow = Action Latency
- Black portions = Gaps between PACs
- Most aspects of PAC become faster as League increases



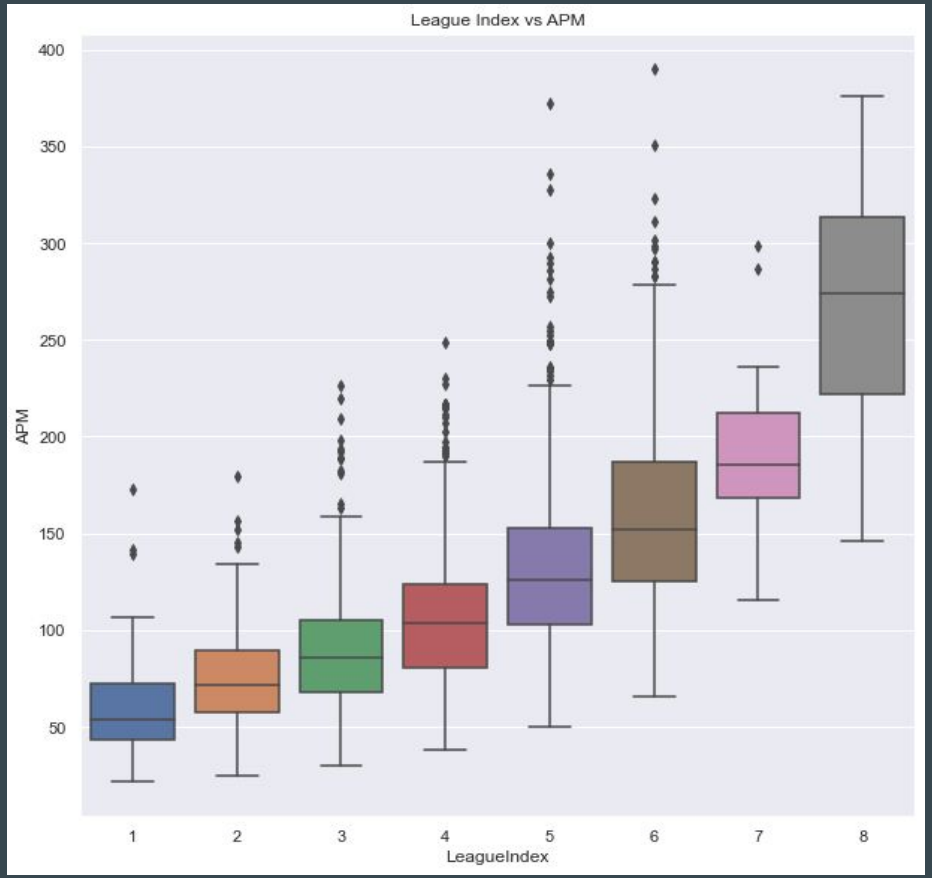
# Data Spread

- Good spread of Leagues 1-6
- Lacking data in Leagues 7-8
- League 1 represents Bronze, 2 Silver and so on to 8 representing Professional games.
- Note, the highest League is Grandmaster(7). League 8 is made of Pro. gameplay.
- Most pros play in League 7.



# Actions per Minute or APM

- Topic of constant discussion in the Starcraft 2 community
- High or low APM doesn't automatically determine League
- Shows important trend
- P-value of $3.31 \times 10^{-10}$



# Feature Importance

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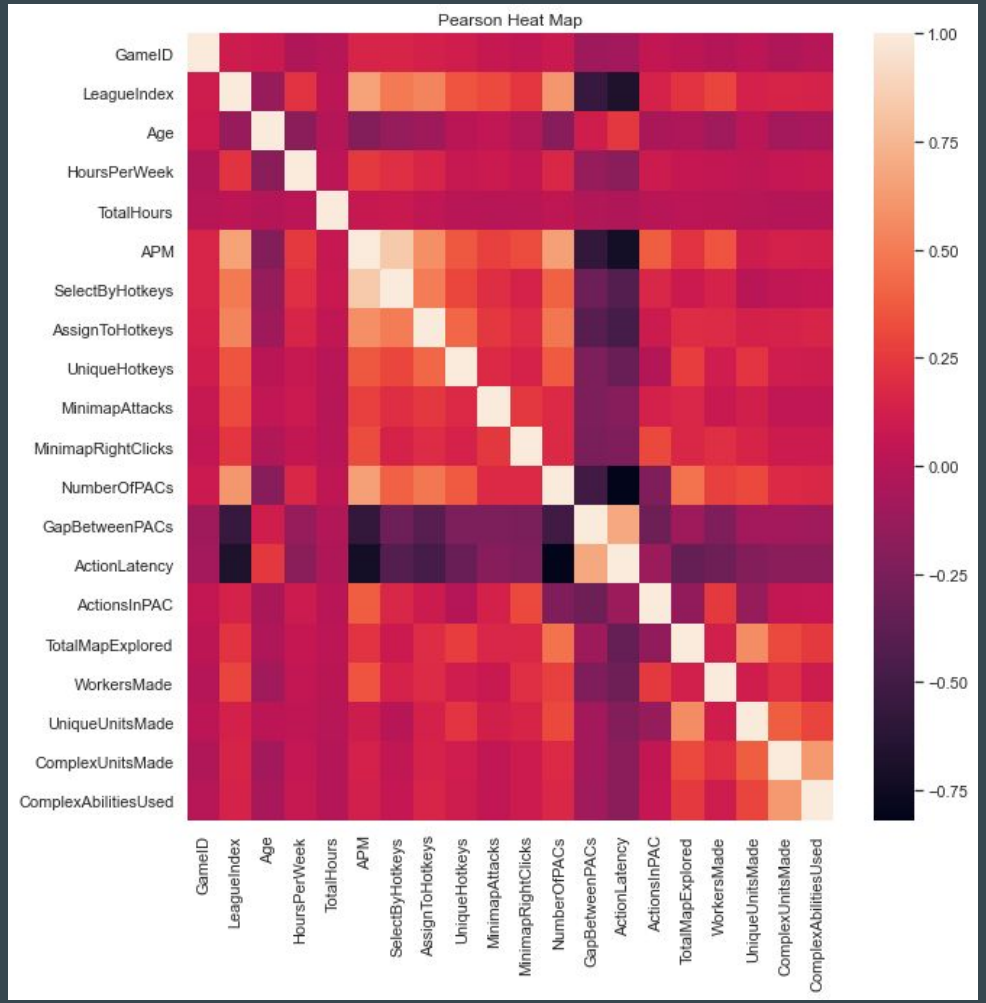
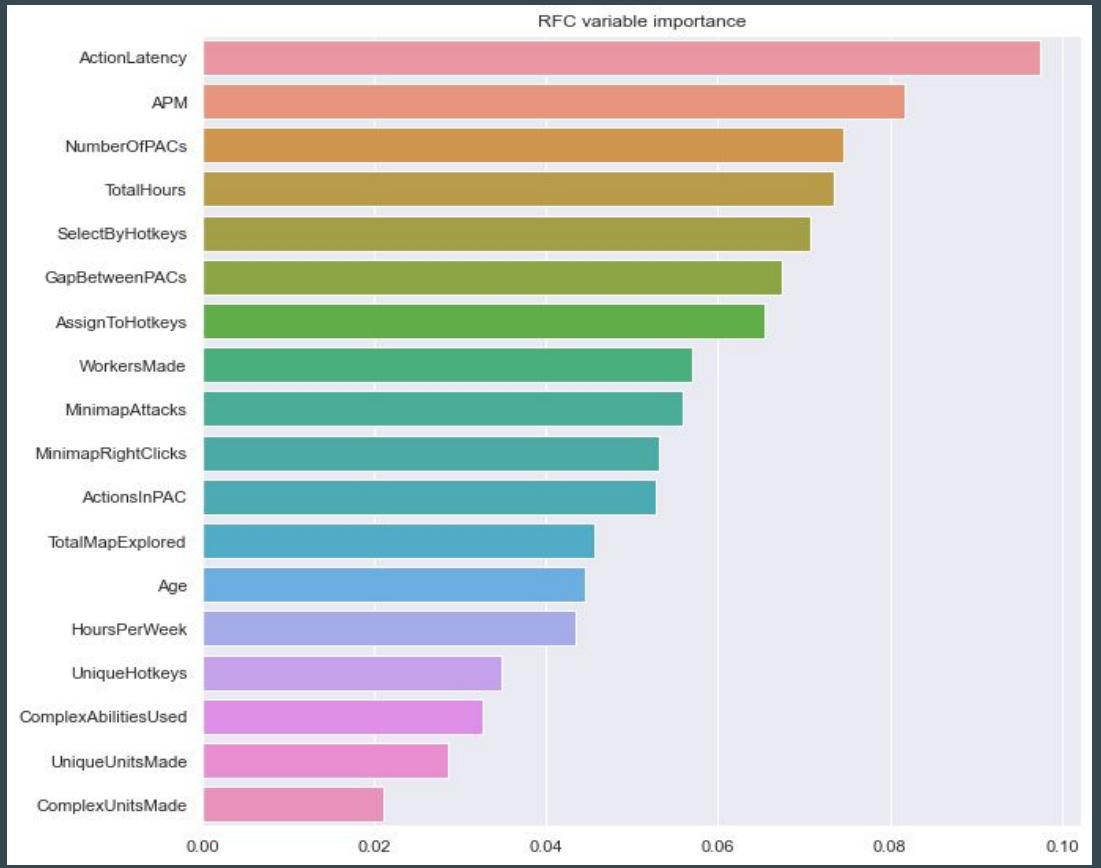
# Correlations

- High positive correlations with League Index:
  - APM
  - Number of PACs
  - Select by Hotkeys
- High negative correlations with League Index:
  - Action Latency
  - Gaps between PACs



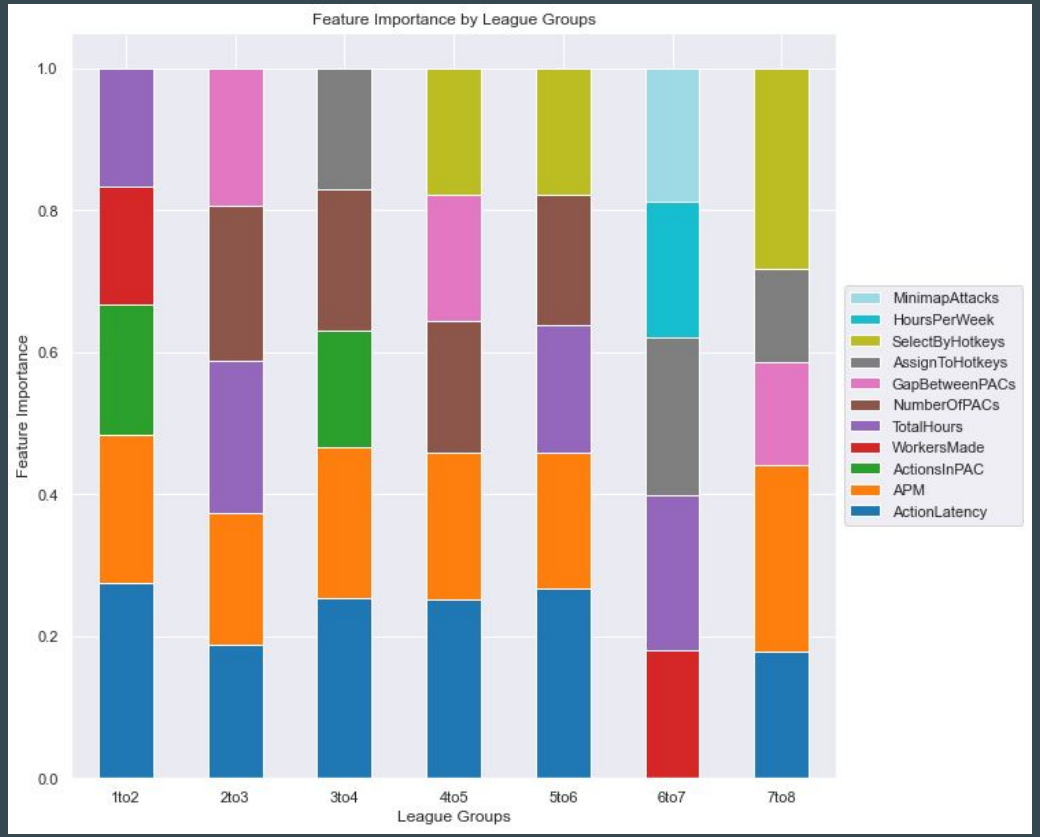
# Feature Importance

- Used Random Forest Classifier
- Missing Age, Total Hours and Hours per Week for League 8, >2% of data



# Feature Importance from League to League

- Action Latency and APM in all columns except 6 to 7
- Actions in PAC and Workers made appear only twice
- 6 to 7 column is very unique. May be due to lack of data.
- All variables that deal with the PAC cycle appear. Only 6 to 7 lacks any of these.



# Modeling

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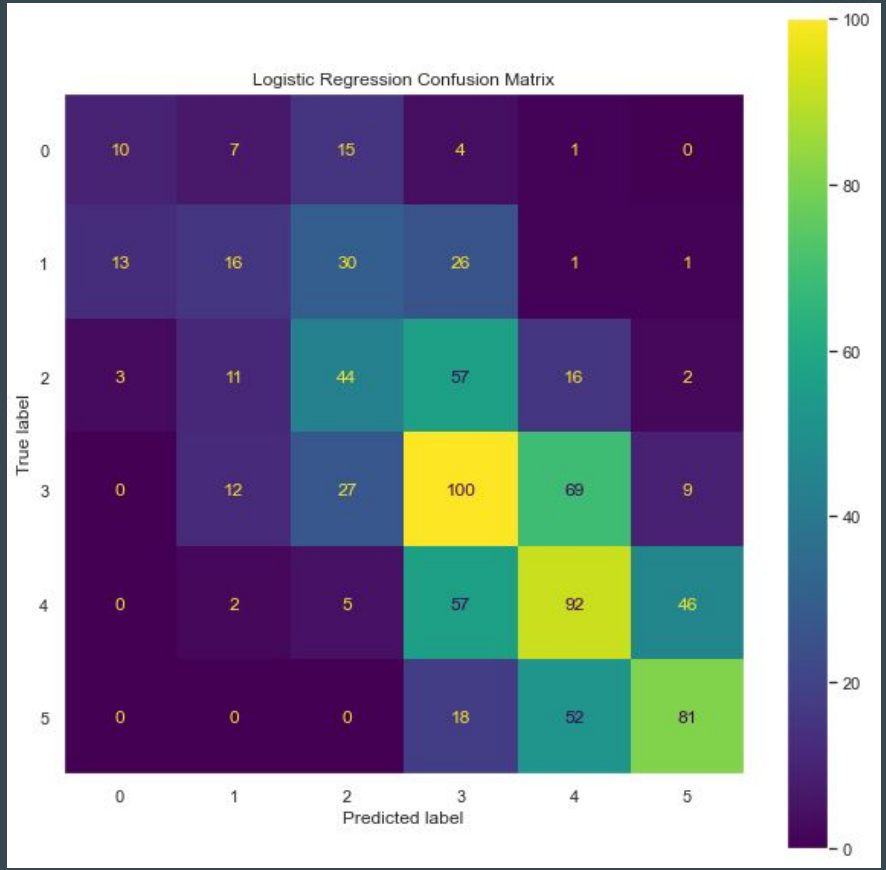
# League Prediction Model

- Used three algorithms: K Nearest Neighbors, Logistic Regression and Random Forest
- Split data 75% train, 25% test
- Excluded Grandmaster and Professional games
- Excluded Weekly Hours played, Age and Total Hours
- Gridsearched for accuracy
- Logistic regression had the best score with 41%
- Model can predict league +/- 1 league with 86% accuracy

# Model Scores

| Classifier | Accuracy Score | Hyperparameter Values |
|---|---|---|
| K Neighbors | 0.36 | N_neighbors = 41 |
| Logistic Regression | 0.41 | C = 0.046<br>Penalty = L2 |
| Random Forest | 0.39 | Max_depth =9<br>Max_features = auto<br>N_estimators = 500 |



# Smurf Detection

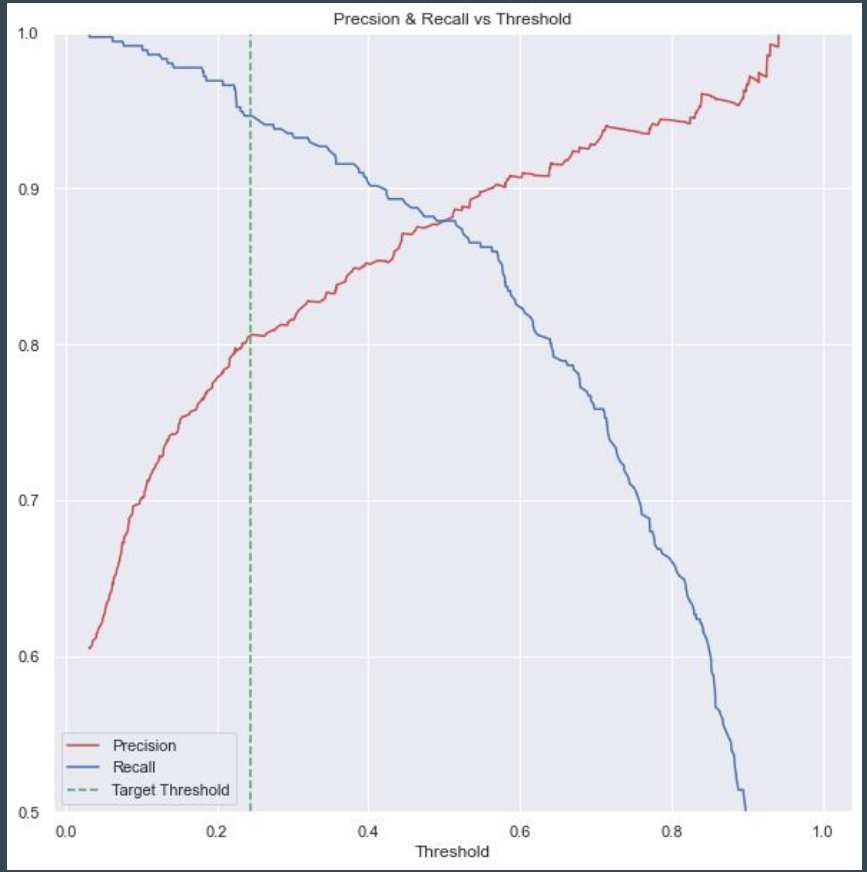
- Built three models using same three algorithms
- Set Leagues 1-3 as Low and 5-6 as High
- Exclude League 4
- Grid searched using ROC AUC
- Random Forest gave best score of 0.93

| Classifier | ROC AUC Scores | Best Hyperparameters |
|---|---|---|
| K Neighbors | 0.92 | N_neighbors = 47 |
| Logistic Regression | 0.93 | C = 0.359<br>Penalty = L2 |
| Random Forest | 0.93 | Max_depth = 9<br>Max_features = auto<br>N_estimators = 500 |

# Thresholding

- Wanted to optimize recall to find as many smurfs as possible
- Threshold of 0.23 gave recall 95%

| Class | Precision | Recall |
|---|---|---|
| Non-smurfs | 0.90 | 0.67 |
| Smurfs | 0.79 | 0.95 |



# Conclusion

- Models can be incredibly useful for ensuring fair and fun gameplay in Starcraft 2
- To answer my question of ‘What matters the most when trying to improve at Starcraft 2?’, seems speed helps. Most important features:
  - Action Latency
  - APM
  - Number of Pacs
- Features more nuanced from League to League
- Dedicated smurf data set could improve smurf detection
- Modern data could improve league placement