



## Introduction

# Customer Churn Modeling

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### Connex Communications

Connex is a communications company that provides phone, internet, and streaming services. In addition, they offer supportive services like online security, device protection, etc.

Connex would like to utilize machine learning methodologies to create a model that gives them the ability to get ahead of customer churn.

# Key Questions

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## What model can best predict churn?

Test and optimize a variety of machine learning algorithms

Use product subscription status, account, and demographic information as inputs into the modeling process



## Which features (inputs) are more likely to predict churn?

Utilize logistic regression feature coefficients and the `feature_importances_` tool in sklearn's random forest



Process

Getting to  
Answers

# The Data

Kaggle Telco Dataset



7,032 observations

30 Features

## Products

- Phone
- Multiple Lines
- Internet
- Online Security
- Online Backup
- Device Protection
- Tech Support
- Streaming TV
- Streaming Movie

## Account Info

- Time as Customer
- Contract Type
- Payment Method
- Paperless Billing
- Monthly Charges
- Total Charges

## Demographics

- Senior
- Dependents
- Gender
- Partner

## Churn

Last month

- Yes
- No

# Approach

## EDA + Benchmark

- Logistic Regression
- Evaluate key metrics
- Address class imbalance

## Test More Models

- Decision Trees, Random Forest, XGBoost
- Tune hyperparameters

## Determine Best Performers

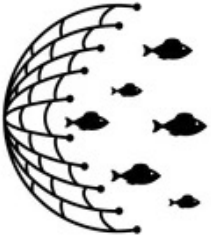
- Best performing models
- Most important features

## Identify Further Optimizations

- Identify further tuning opportunities
- Explore other ideas

Tools: Pandas – Sklearn – Imblearn - Numpy

# Which metric should we use to optimize the model?



## Recall

It's better for the business to cast the net wider and capture more potential churn customers than to use precision metric and miss potential churn customers.



## Recall

- Answers what proportion of actual positives was identified correctly.
- Selects best model when there's a high cost associated with false negative (person that's predicted not to churn when they did churn)

VS.



## Precision

- Answers what proportion of positive identifications was actually correct.
- Selects best model when there's a high cost associated with false positive (person that's predicted to churn when in fact they're not churning.)



Results

Model  
Performance

- Model Settings:
- Default hyperparameters
  - Oversampling

# Benchmark

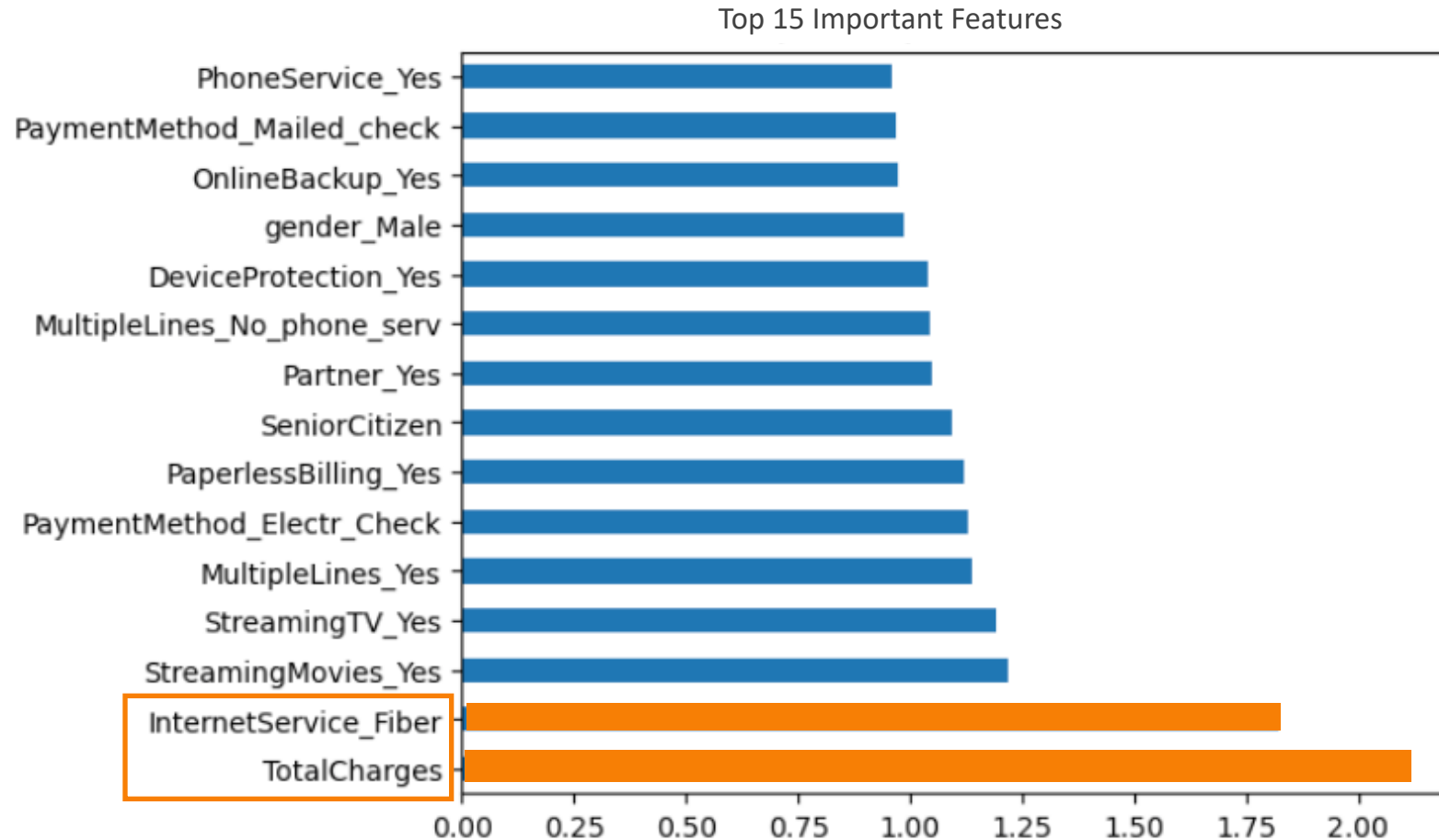
Started with Logistic Regression

Model	Recall	AUC
Logistic Regression	80%	.75



# Features Identified With Churn

## Coefficient Odds Review Logistic Regression



### Highest Magnitude of Indicating Churn

- TotalCharges
- Fiber Internet Service

### Lowest Magnitude of Indicating Churn

- Tenure
- Two Year Contract

- Model Settings:
- Default hyperparameters
  - Oversampling

# Test More Models

Additional algorithms

Model	Recall	AUC
Logistic Regression	80%	.75
XGBoost	74%	.73
Random Forest	60%	.71
Decision Tree	48%	.64

# Tune Hyperparameters

Random Forest + Decision Tree

- Default hyperparameters
- Oversampling
- Tuned hyperparameters
- Oversampling

Model	Recall	AUC
Logistic Regression	80%	.75
Random Forest Hyperparameters Tuned	76%	.71
XGBoost	74%	.73
Random Forest	60%	.71
Decision Tree	48%	.64
Decision Tree Hyperparameters Tuned	48%	.64

Random Forest Gridsearch Best Parameters: max\_features: 23, n\_estimators: 119

Decision Tree Gridsearch Best Parameters: max\_depth: 1, min\_samples\_leaf: 1

# Best Performers

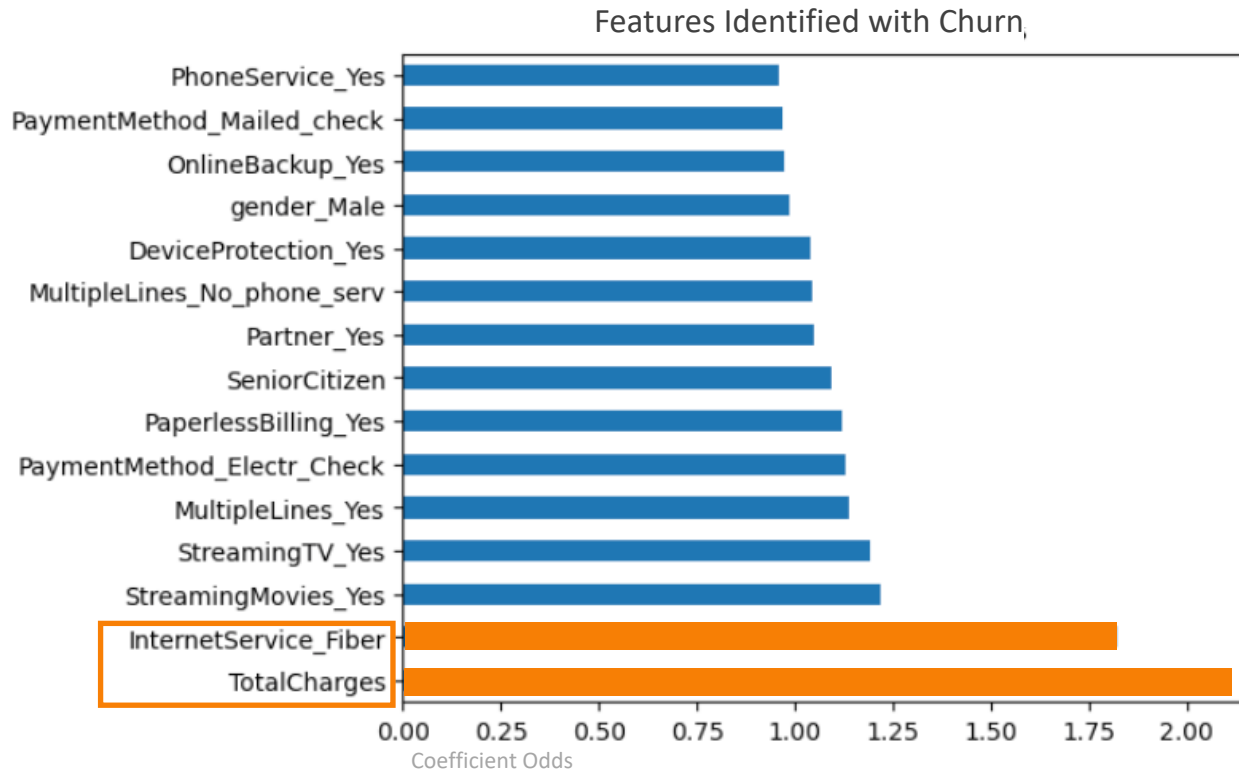
(thus far in the process)

Model	Recall	AUC
Logistic Regression	80%	.75
Random Forest Hyperparameters Tuned	76%	.71

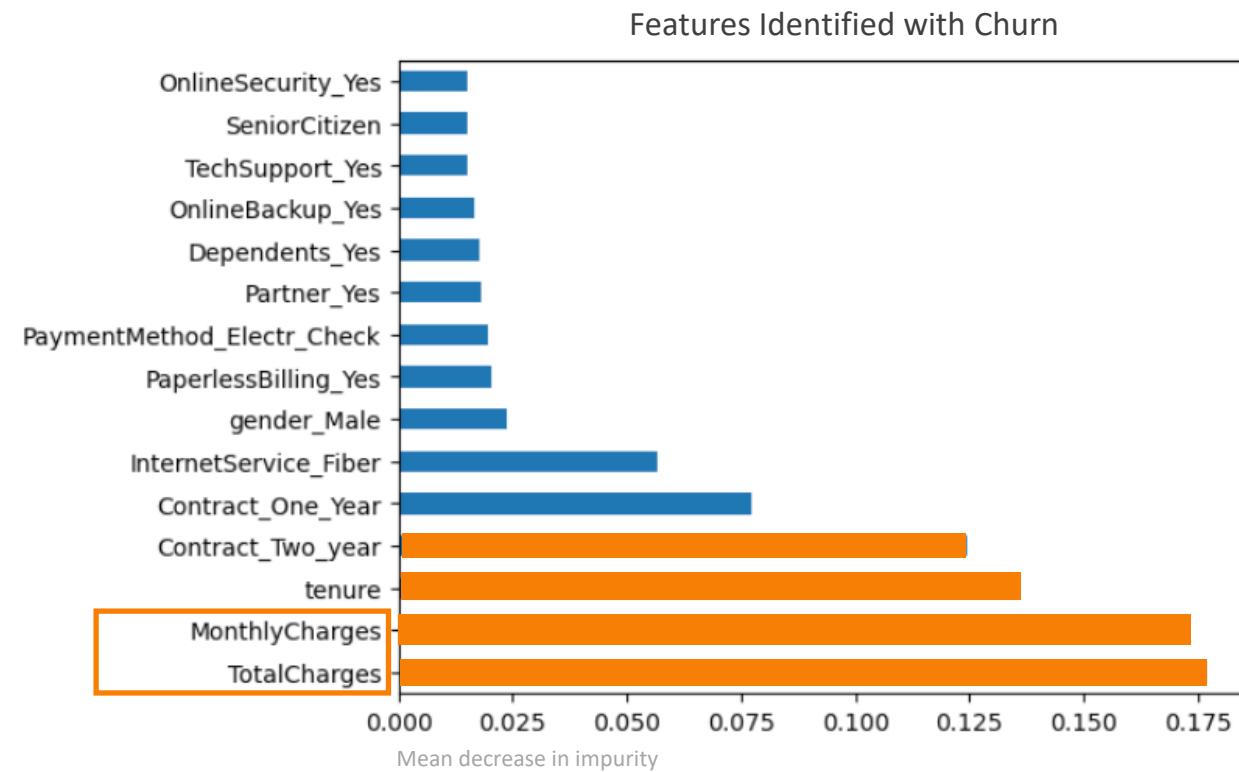
Let's compare how the features performed for each model

# Feature Comparison by Model

Logistic Regression, Default Hyperparameters



Random Forest, Tuned Hyperparameters





## Future Work

## Modeling

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### Further Hyperparameter Tuning

- XGBoost is likely to be the best performing algorithm with hyperparameter tuning
- Logistic Regression:
  - Grid search with lasso regression to reduce feature space and determine impact on model score
  - Experiment with probability threshold

### Create Additional Features

- Review churn research that other departments have implemented to get ideas for new features to enhance model performance

### Try Voting + Stacking Ensemble Techniques

- To learn the different aspects of the data with each model

## Business Strategy

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### Identify customers with highest churn probability

- Create communication strategies toward this audience considering both strongest features that indicate churn and strongest features that don't indicate churn. Features that strongly indicate not churning can also potentially inform retention strategy

## Coding

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### Update pipeline to work with Gridsearch

- Utilize workflows discovered while doing this project

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# Discussion