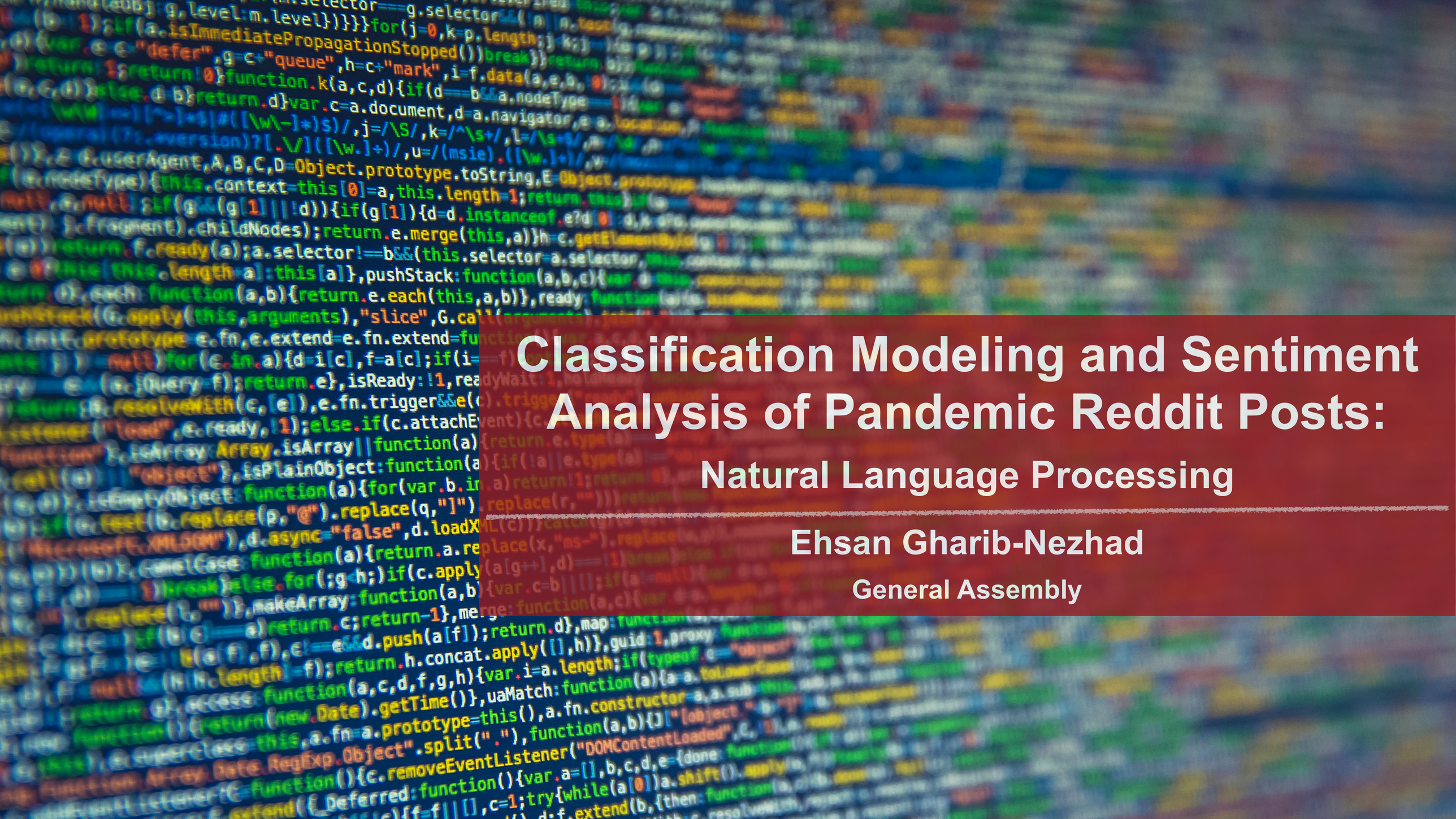

Classification Modeling and Sentiment Analysis of Pandemic Reddit Posts:

Natural Language Processing

Ehsan Gharib-Nezhad

General Assembly

Is this post from PandemicPreps or Covid19Positive subReddit?

For those that have tested positive I hope every single one of you feels better soon!

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Covid19Positive

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I see a lot of people on here buying around the same types of stuff (canned beans, rice, etc). Just remember to know how to cook each item you buy and

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PandemicPrep

Based off of everything I'm reading, hospitals are likely going to have to turn people away at some point.

???

ROADMAP: Text Mining, Processing

Data Scarping

Text Normalization/Processing

- *Lower casing*
- *Removing puctuations*
- *Revoving special characters*
- *Handeling emojis and emoticons*
- *Stop word removals*
- *Common word removal*
- *Rare word removal*
- *Spelling correction*
- *Removing URLs and HTML tags*
- *Tokenization*
- *Stemming*
- *Lemmatization*

For those that have tested positive I hope every single one of you feels better soon!\n\n54

~~For those that have~~ tested positive ~~I~~ hope every single one ~~of you~~ feels better soon~~!\n\n54~~

test posit hope everi singl one feel better soon

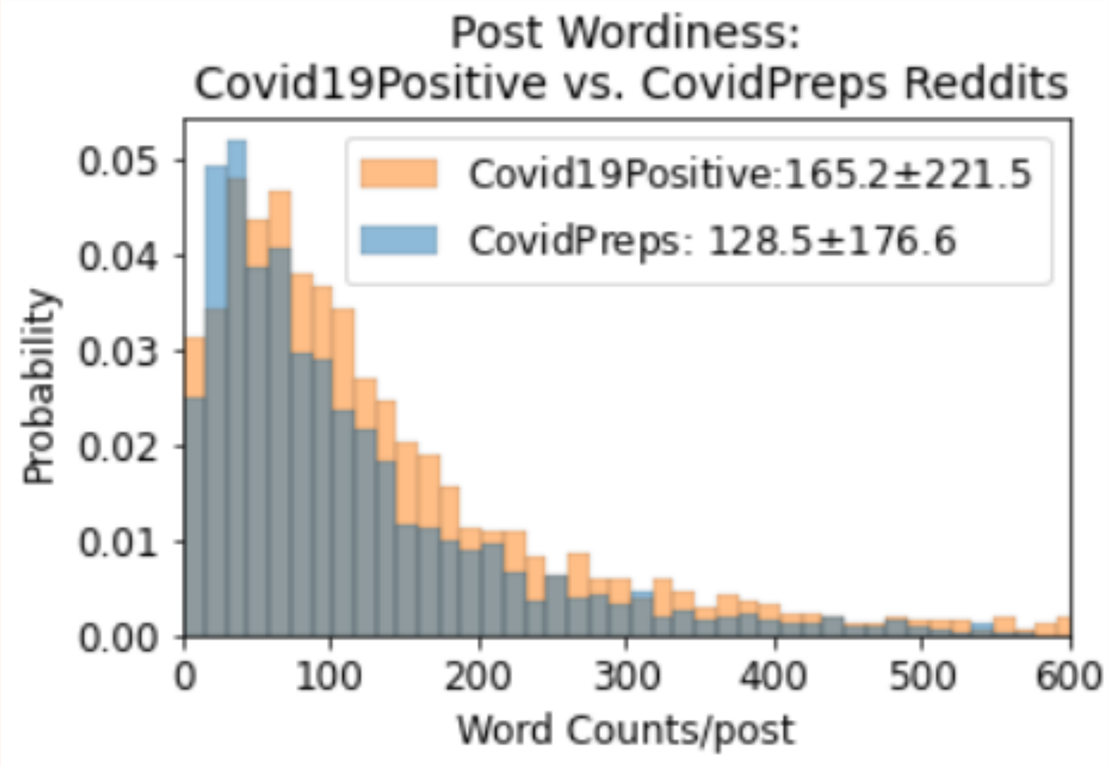
Count Characters

Raw	**23,000,000**
Processed	**12,000,000**

ROADMAP: Exploratory Data Analysis

Scarping

Text Normalization/Processing



Main outcome: Posts in Covid12Positive have more words.

Exploratory Data Analysis

ROADMAP: Modeling

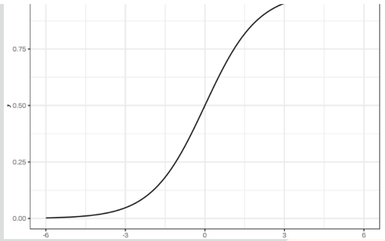
Scarping

Text Normalization/Processing

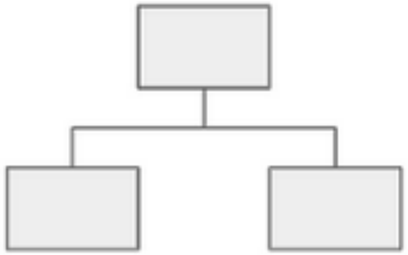
Exploratory Data Analysis

Supervised Learning Classification Models

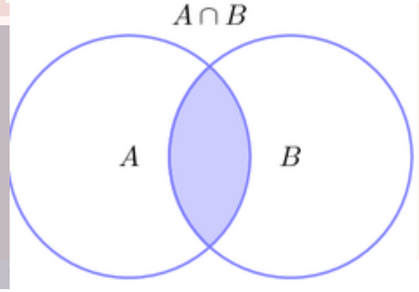
- **Regression**
  - Logistic Regression
  - ElasticNet
  - L1/Lasso
  - L2/Ridge



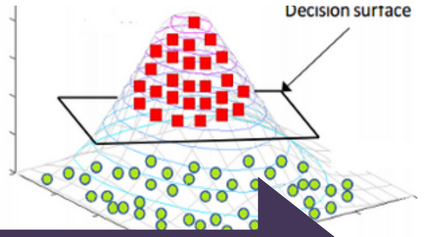
- **Ensemble**
  - Decision Tree
  - Extra Trees
  - Random Forest
  - Bagging



- **Bayes Theorem**
  - Multinomial Naive Bayes



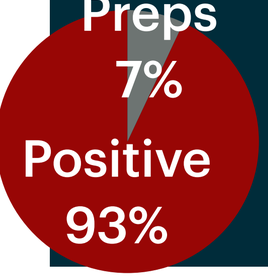
- **Support Vector Machine**



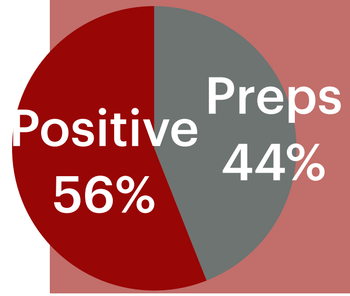
1. Post Classification Models
2. Sentiment Analysis

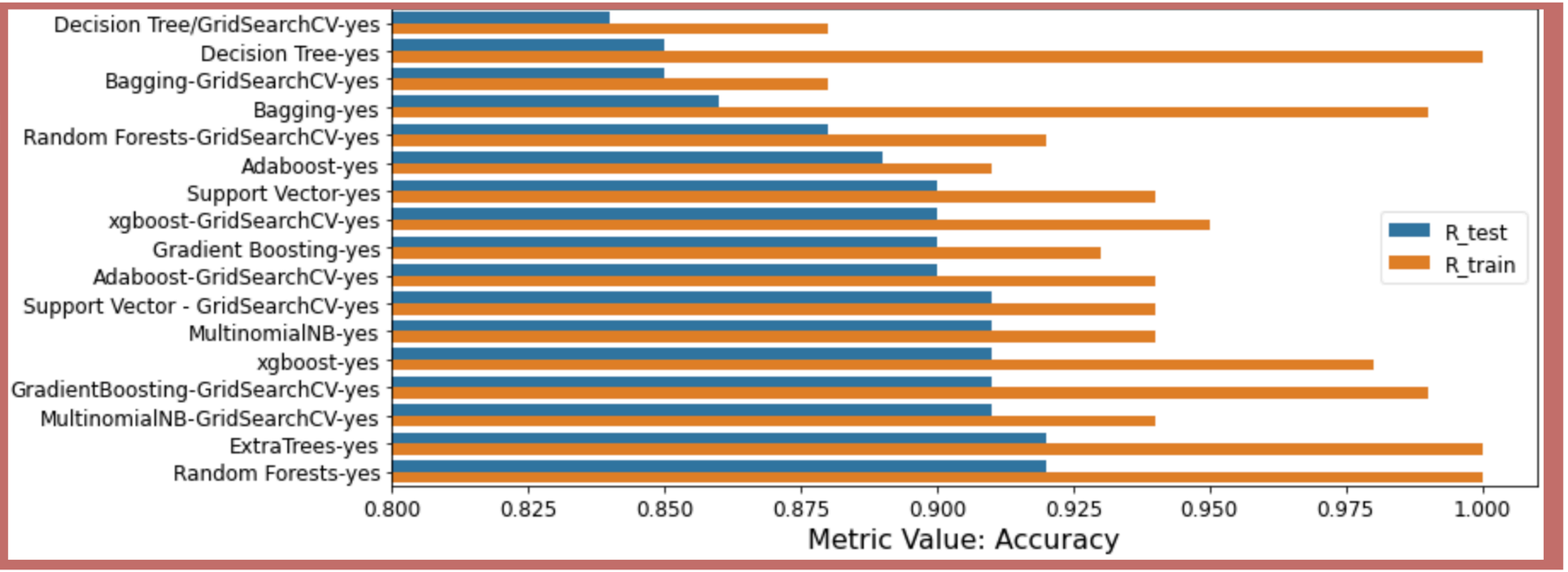
COMPARE DIFFERENT MODELS: ACCURACY

- Variance: LOW
- Bias: LOW
- RandomOverSampler included
- Covid19Positive: ~30,000 posts
  PandemicPreps: ~2,300 posts
- Features: ~19,500



- Variance: High
- Bias: LOW
- RandomOverSampler included
- Covid19Positive: ~2,900 posts
  PandemicPreps: ~2,300 posts
- Features: ~11,000





LOGESTIC REGRESSION GridSerachCV: OUTPUT

Baseline

Model: Logistic Regression
Input: CountVectorizer
Balanced: No / RandomOverSam

INPUTS:

Grids:
'C':
0.01,1.0, 10,50,60,65,70,
75,80,85,90,100 100, 150
'class_weight':
'balanced', 'None'
'penalty':
'l2','l1'

OUTPUT:

'C': 85,
'class_weight': 'balanced',
'penalty': 'l2',
'solver': 'lbfgs'

Recall:

What proportion of actual positives was identified correctly?

$$\text{Precision} = \frac{TP}{TP + FP}$$

Precision:

What proportion of positive identifications was actually correct?

$$\text{Precision} = \frac{TP}{TP + FP}$$

F1-Score:

A way of combining the precision and recall of the model

$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall}$$

Accuracy:

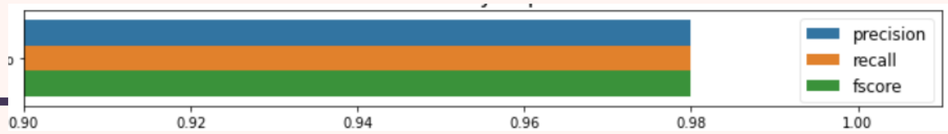
Number of correctly categorized examples divided by total

$$\text{accuracy} = \frac{\text{tp} + \text{tn}}{\text{tp} + \text{tn} + \text{fp} + \text{fn}}$$

$$precision = \frac{tp}{tp + fp}$$

$$recall = \frac{tp}{tp + fn}$$

$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall}$$



LOGESTIC REGRESSION GridSerachCV: OUTPUT

Model: Logistic Regression
Input: CountVectorizer
Balanced: No / RandomOverSampler

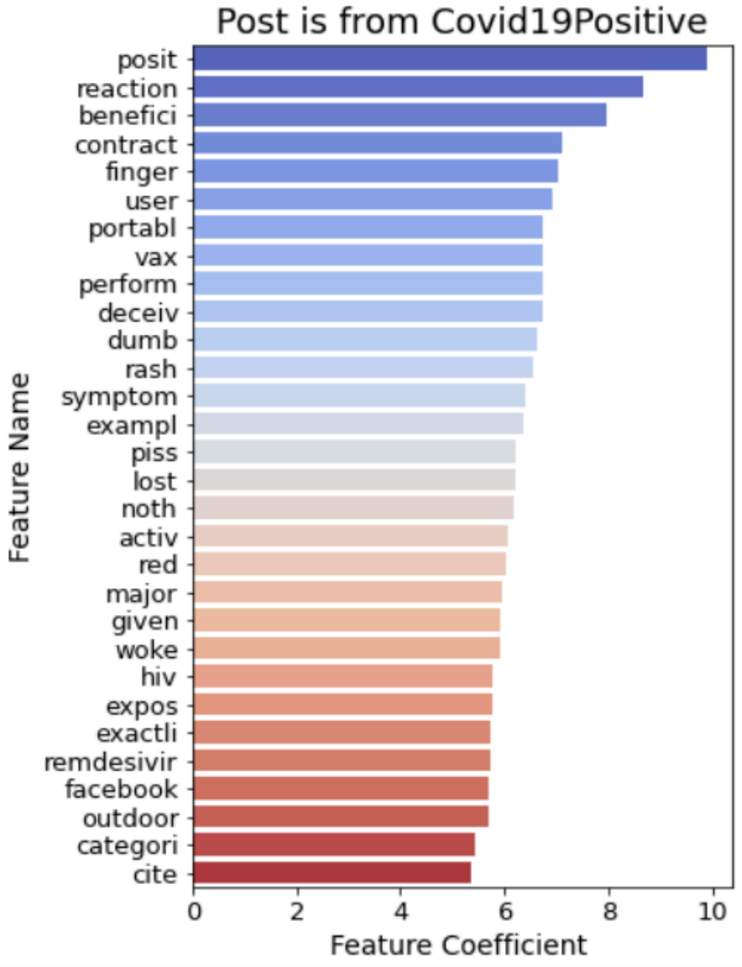
INPUTS:

Grids:

```
'C':
  0.01,1.0, 10,50,60,65,70,
  75,80,85,90,100 100, 150
'class_weight':
  'balanced', 'None'
'penalty':
  'l2','l1'
```

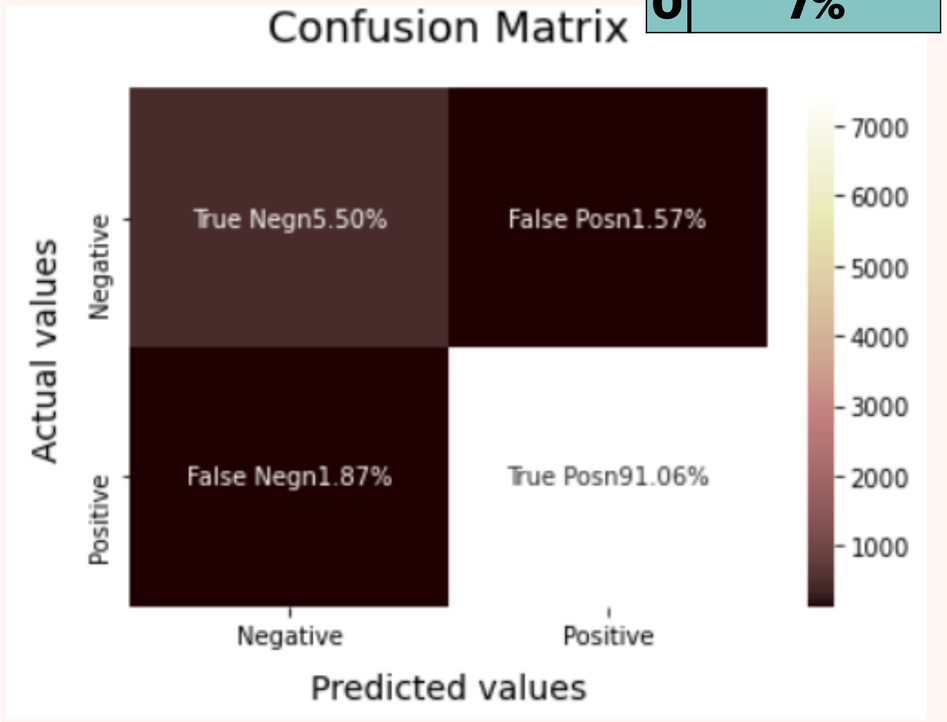
OUTPUT:

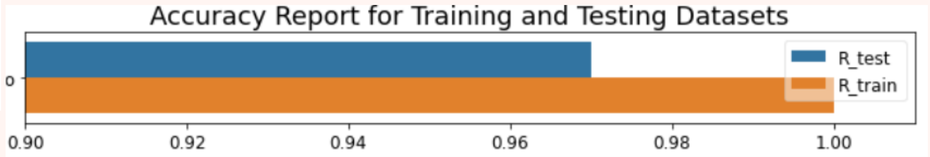
```
'C': 85,
'class_weight': 'balanced',
'penalty': 'l2',
'solver': 'lbfgs'
```

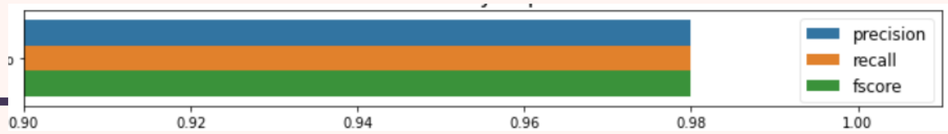


Baseline

1	93%
0	7%







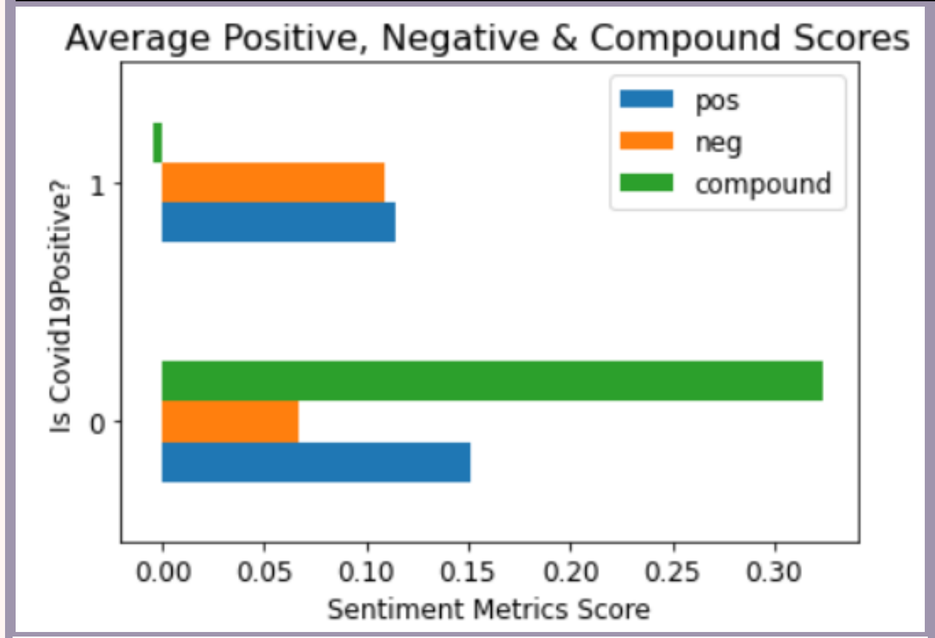
$$precision = \frac{tp}{tp + fp}$$

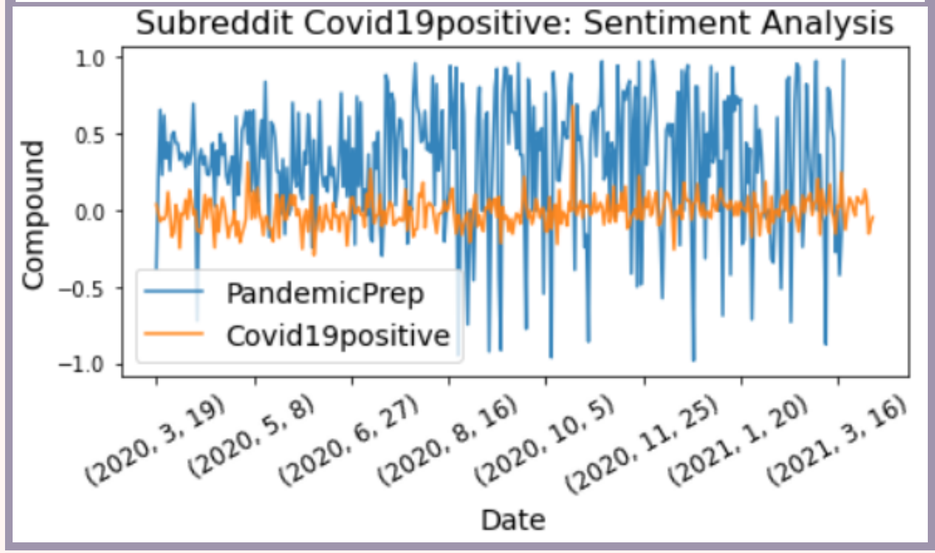
$$recall = \frac{tp}{tp + fn}$$

$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall}$$

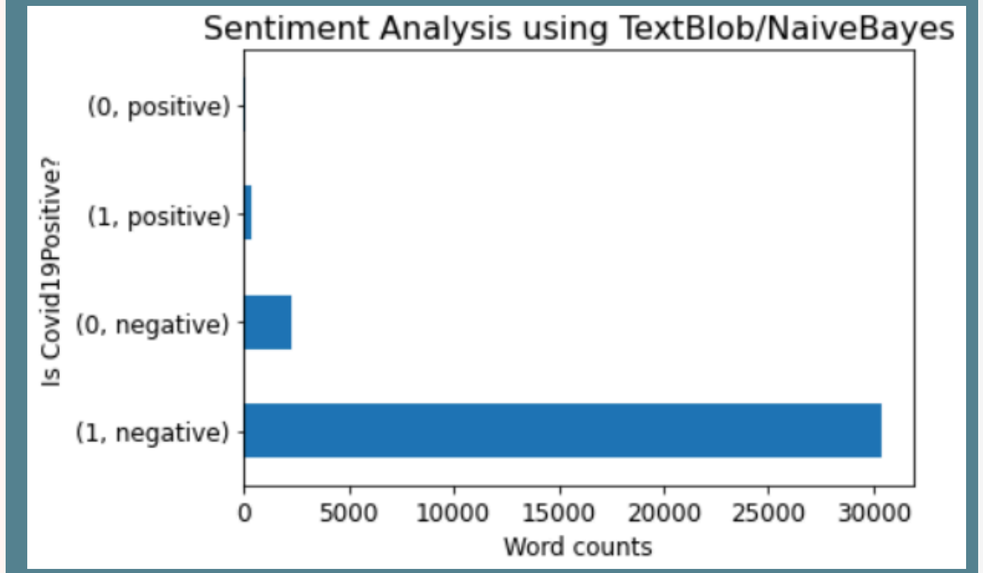
SENTIMENT ANALYSIS: 2020/3 — 2021/3

VADER Sentiment Analyzer





TextBlob/NaiveBayes




```
positive_vocab = ['awesome',
                  'outstanding',
                  'fantastic',
                  'terrific',
                  'good',
                  'nice',
                  'great',
                  'liked',
                  'happy']
```

```
negative_vocab = [
    'sick',
'positive',
'Rhinitis',
'Gastroenteritis',
'Coronaryheartdisease',
'Cough',
'Sputum',
'Runnynose',
'Nasalobstruction',
'Sneezing',
'Sorethroat',
'Dyspnea',
'Shortnessofbreath',
'Chesttightness',
'Chestpain',
'Palpitations',
'Fever',
'Chills',
'Fatigue',
'Myalgia',
'Lumbago',
'Jointpain',
'Headache',
'Dizziness',
'Vertigo',
'Abdominalpain',
'Diarrhea',
'Vomiting',
'Conjunctivalcongestion',
'Itchyeyes',
'Eyespain']
```

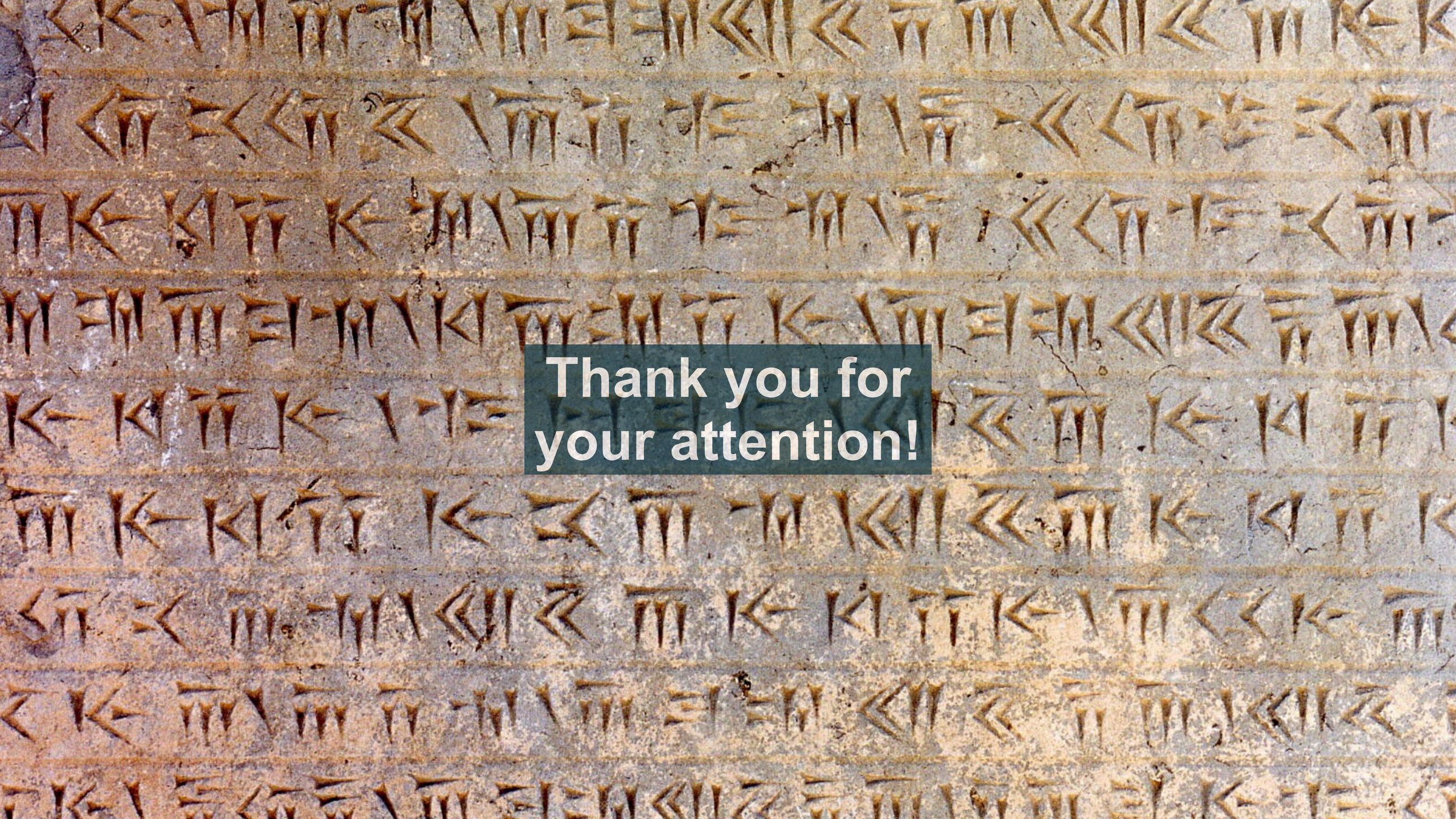
Conclusion

Logistic Regression is found to be the best model for classification because.....

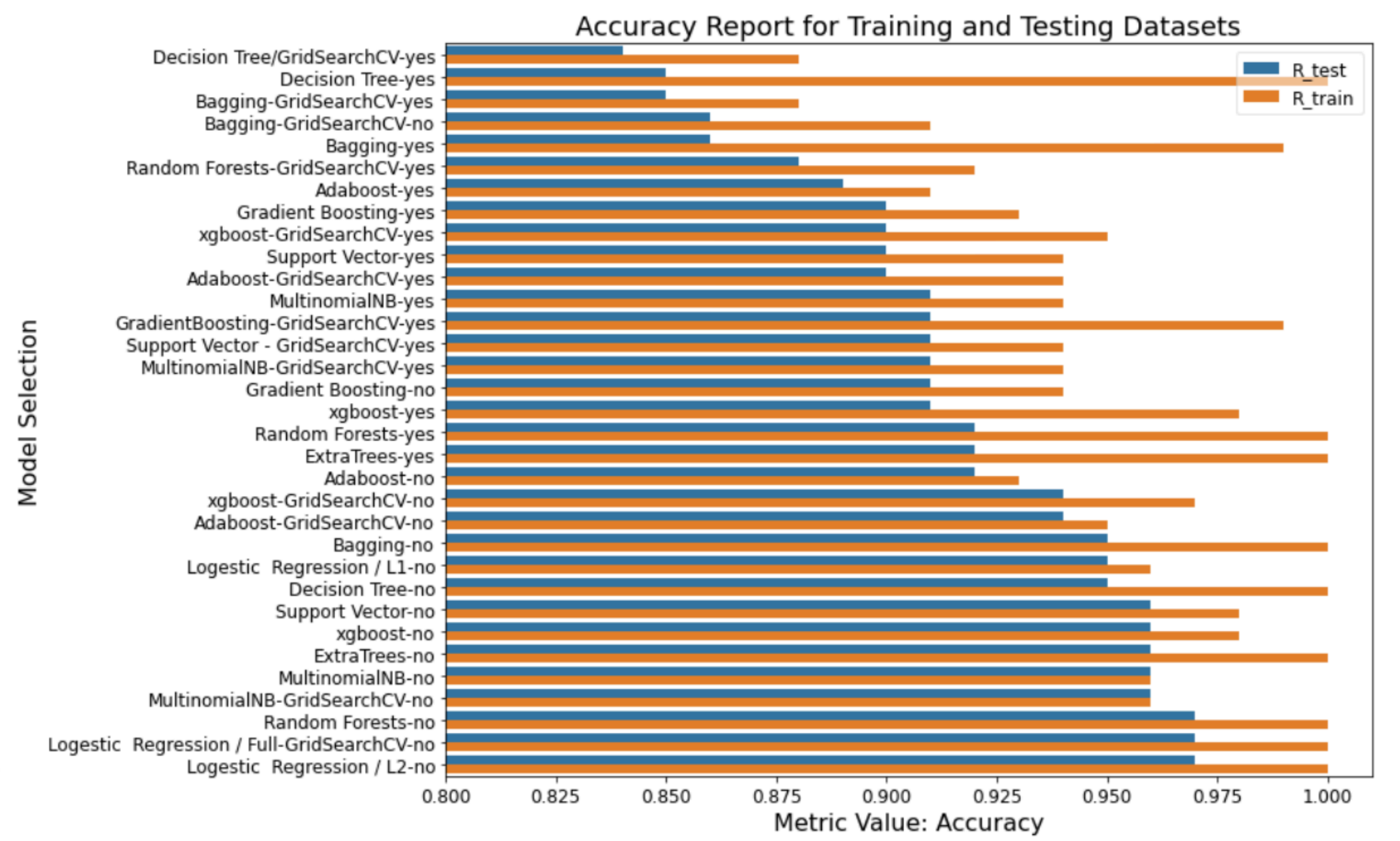
- ✓ Provides the highest accuracy scores, ~**99**% and ~**96**% for training and testing datasets
- ✓ Works great with ultra-imbalanced samples (~**93**% vs. ~**7**%)
- ✓ High rates for *true positive* (91.06% out of 93%) and for *true negative* (5.5% out of 7%)
- ✓ Low scores for *false positive* (1.57%) and *false negative* (1.87%)
- ✓ High scores for precision and recall (~98%)

In addition, this model is.....

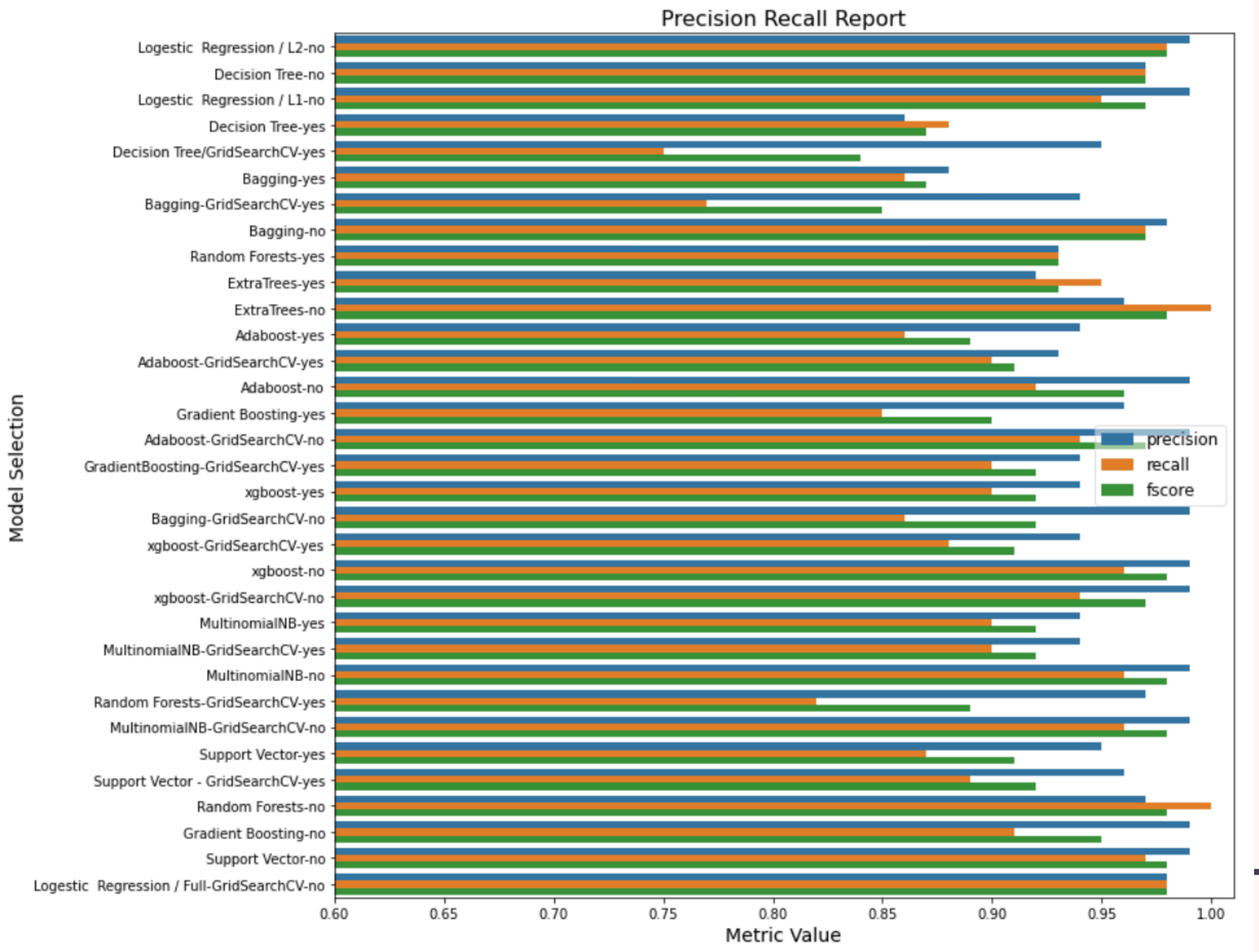
- ✓ Interpretable
- ✓ Optimizable coefficients to reduce variance and bias
- ✓ Capable to use different generalization methods i.e., Lasso, Ridge, ElasticNet
- ✓ Tunable parameters, solvers, and penalty functions for multiple cases
- ✓ Works best with both large and small datasets

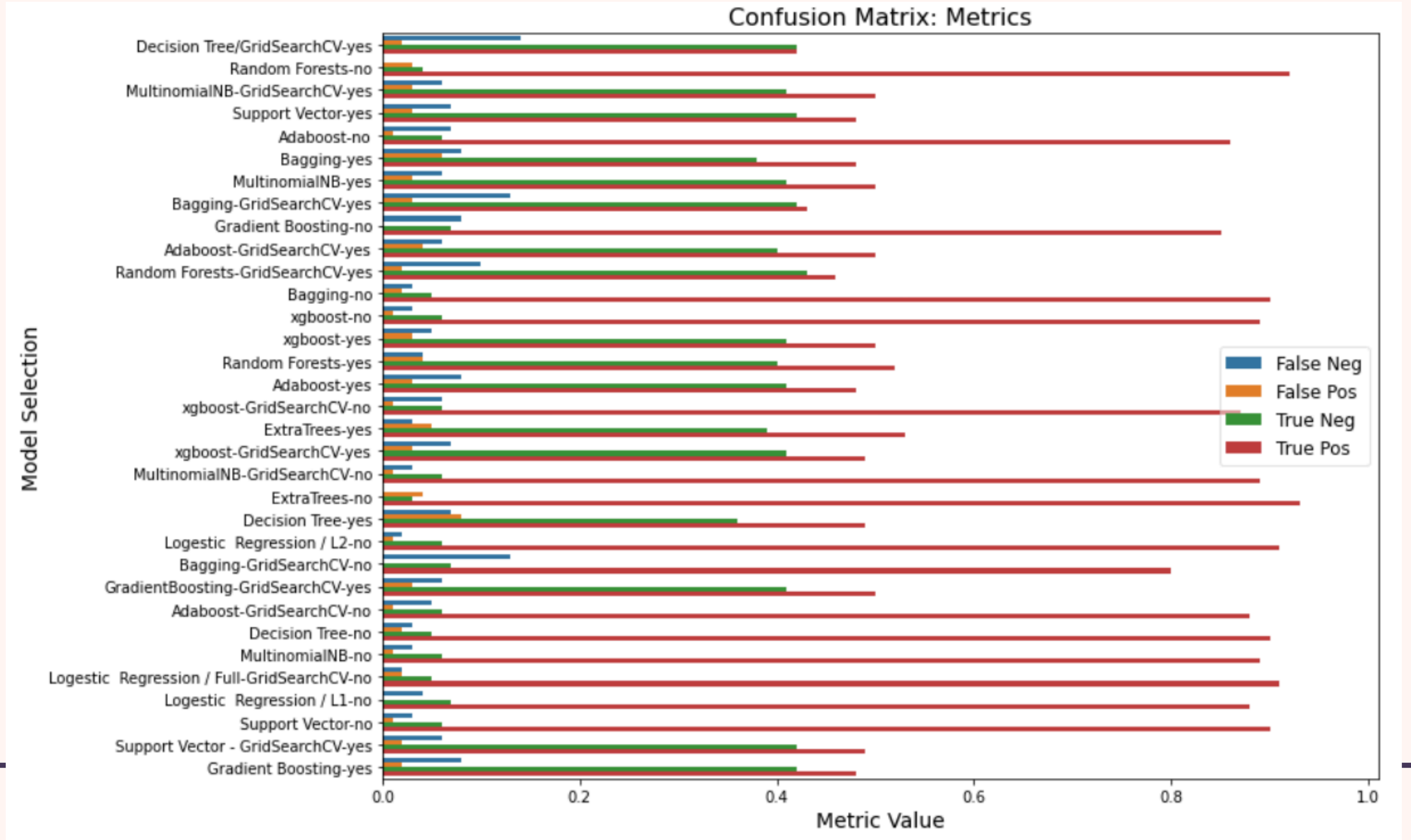

Thank you for
your attention!

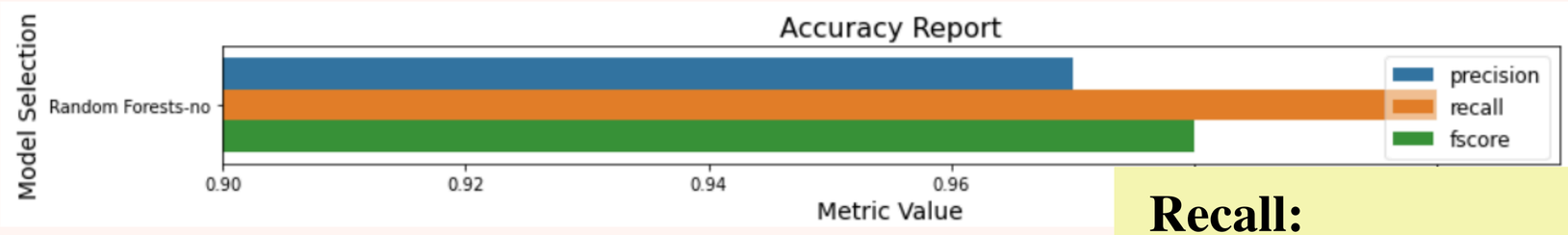
BACKUP 1: ACCURACY REPORT FOR ALL MODELS



BACKUP 2: PRECISION RECALL FOR ALL MODELS




Confusion Matrix: Metrics
Model Selection
Metric Value
False Neg
False Pos
True Neg
True Pos
Decision Tree/GridSearchCV-yes
Random Forests-no
MultinomialNB-GridSearchCV-yes
Support Vector-yes
Adaboost-no
Bagging-yes
MultinomialNB-yes
Bagging-GridSearchCV-yes
Gradient Boosting-no
Adaboost-GridSearchCV-yes
Random Forests-GridSearchCV-yes
Bagging-no
xgboost-no
xgboost-yes
Random Forests-yes
Adaboost-yes
xgboost-GridSearchCV-no
ExtraTrees-yes
xgboost-GridSearchCV-yes
MultinomialNB-GridSearchCV-no
ExtraTrees-no
Decision Tree-yes
Logestic Regression / L2-no
Bagging-GridSearchCV-no
GradientBoosting-GridSearchCV-yes
Adaboost-GridSearchCV-no
Decision Tree-no
MultinomialNB-no
Logestic Regression / Full-GridSearchCV-no
Logestic Regression / L1-no
Support Vector-no
Support Vector - GridSearchCV-yes
Gradient Boosting-yes
0.0
0.2
0.4
0.6
0.8
1.0



OM FORESTS-NO

Recall:

What proportion of actual positives was identified correctly?

$$\text{Precision} = \frac{TP}{TP + FP}$$

Precision:

What proportion of positive identifications was actually correct?

$$\text{Precision} = \frac{TP}{TP + FP}$$

F1-Score:

A way of combining the precision and recall of the model

$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall}$$

Accuracy:

Number of correctly categorized examples divided by total

$$\text{accuracy} = \frac{\text{tp} + \text{tn}}{\text{tp} + \text{tn} + \text{fp} + \text{fn}}$$