# Machine Learning Project Presentation

## Title: Gender Classification by Voice

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# Motivation

- Voice: used for human communication
- Why care about Gender Recognition using voice?
  - Audio categorization
  - Speech emotion recognition
  - Human to machine interaction
  - Security purposes
- Speech and voice recognition system can be used for gender identification.
- Example: Human Ear, models for Gender recognition system

# Literature Review (1/2)

- Gender Recognition from Human Voice using Multi-Layer Architecture [1]
  - In this paper, author extracted features from the datasets in two layers and classified the gender with SVM and KNN
  - Researchers tried to find out the exact feature from the vocal cords and extract it from the voices using many methods and models.
  - The recognition rate of the machine depends on extracting the effective features from voice.

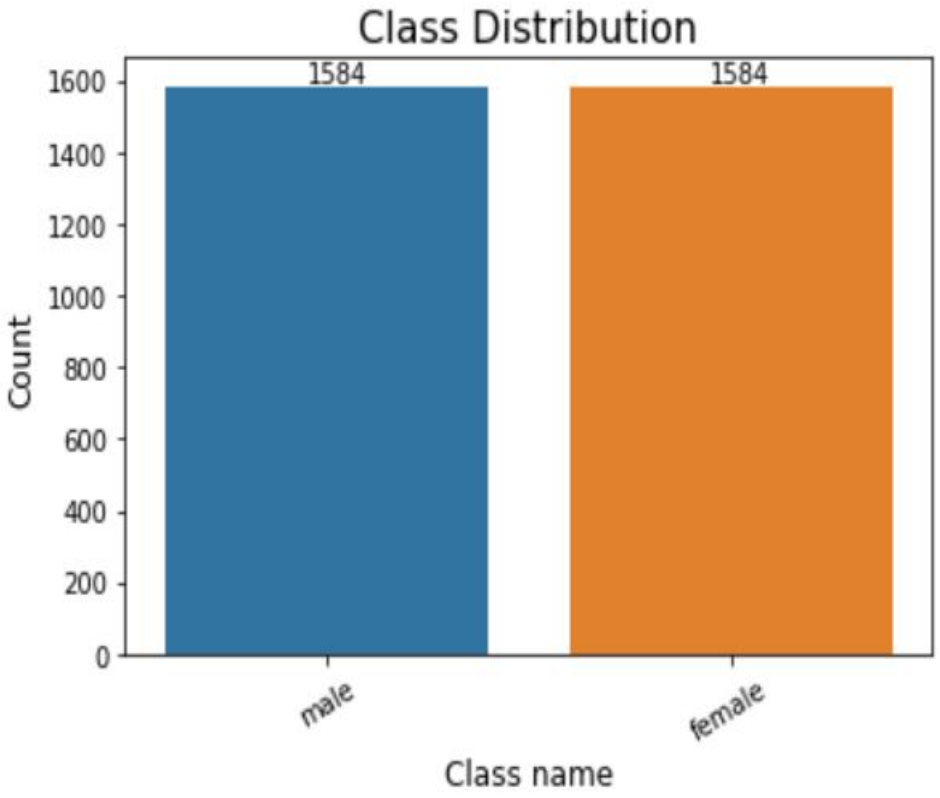
# Literature Review (2/2)

- Voice based Age, Accent and Gender Recognition [2]
  - In this reference paper that is solely based on the self labeled algorithm.
  - The main objective of gender recognition by speech is performed upon the usage of a new ensemble semi-supervised self-labeled algorithm.
  - The algorithm combines the individual predictions of three of the most known and consistent self-labeled methods i.e, Co-training, Self-training, and Tri-training making good use of the ensemble as base learner for the algorithm

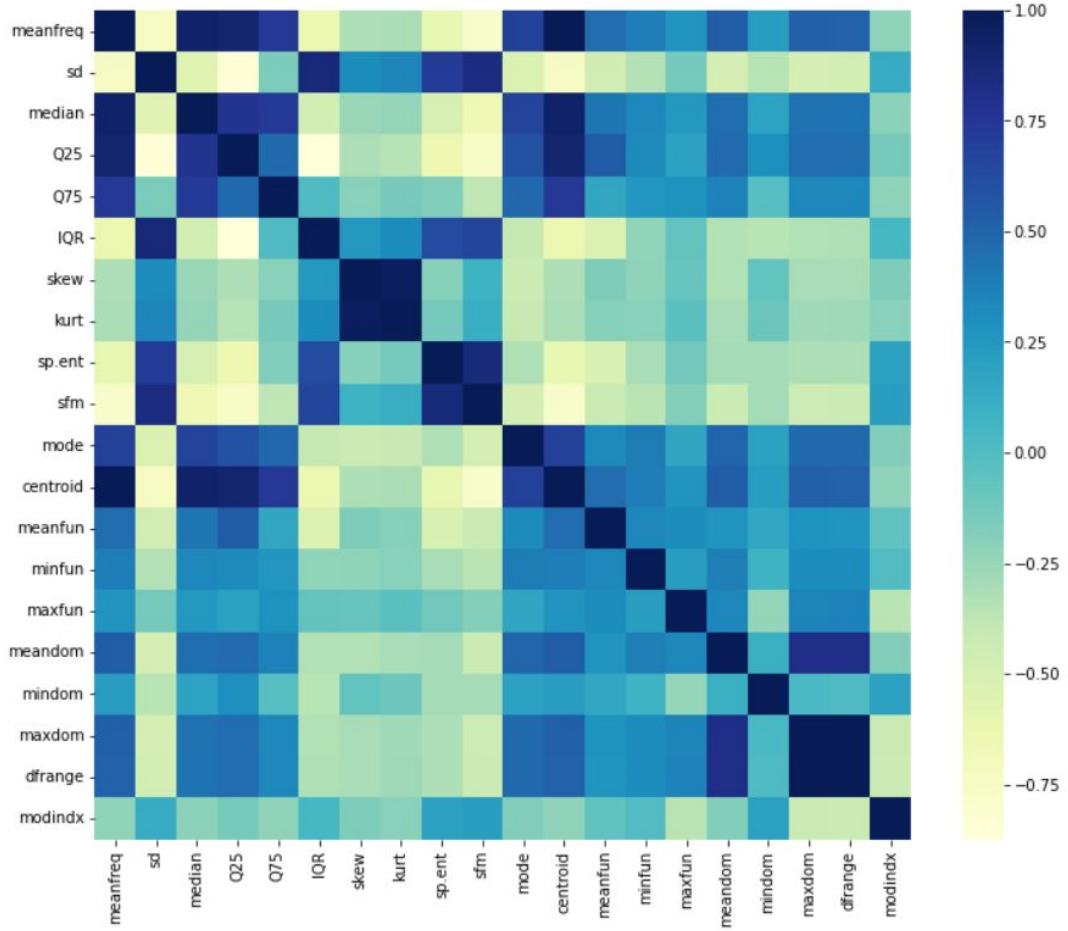
# Dataset description

- We used voice dataset with voice of 3169 different people.
- Output labels were classified as male and female.
- Dataset have different voice attributes like:
  - mean frequency
  - standard deviation in frequency
  - median frequency, etc.
- We extracted 13 different voice features out of 20 using various visualizations techniques and manual testing.

# Visualizations




**Class Distribution for Output label**




**Heatmap of various features**

# Visualizations

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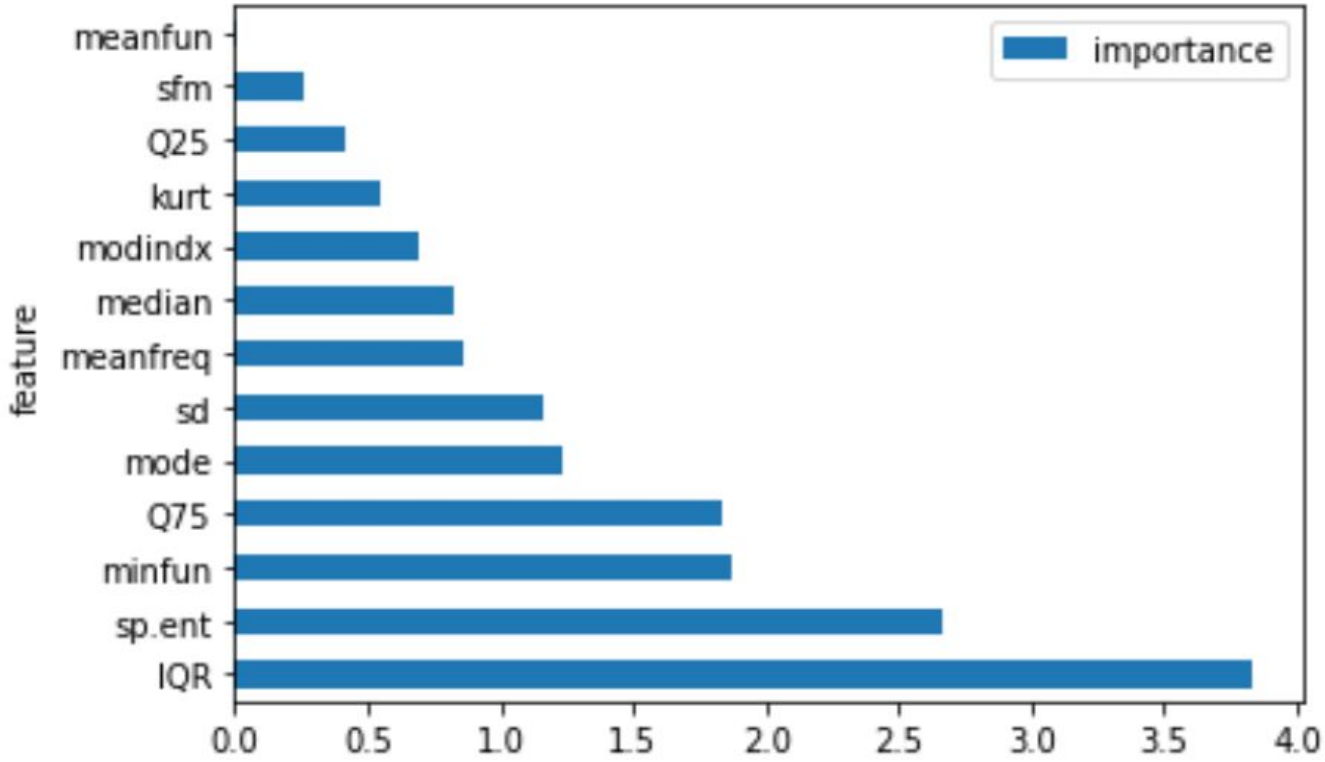
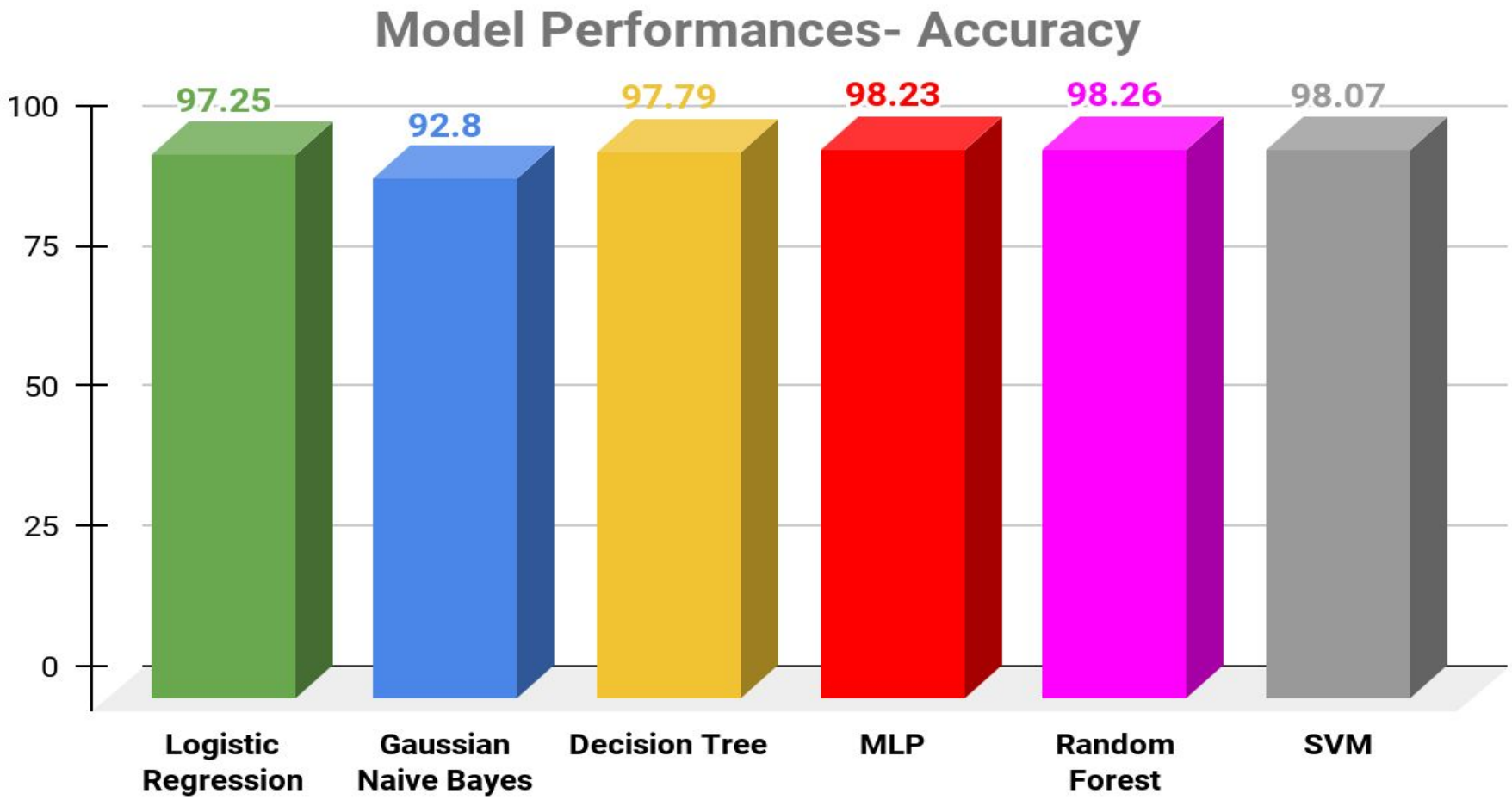
**Feature Importance Graph**



# Methodology

- We classified the gender of the speaker, using the selected voice attributes.
- Classified the voice of speaker as ‘male’ and ‘female’
- For the classification purpose, three different model/methodologies were used.
  - Logistic Regression
  - Naive Bayes
  - Decision Tree
  - Random Forest
  - Artificial Neural network
  - Support Vector Machine

# Results


Model Performances- Accuracy
100
75
50
25
0
97.25
92.8
97.79
98.23
98.26
98.07
Logistic Regression
Gaussian Naive Bayes
Decision Tree
MLP
Random Forest
SVM

# Conclusions

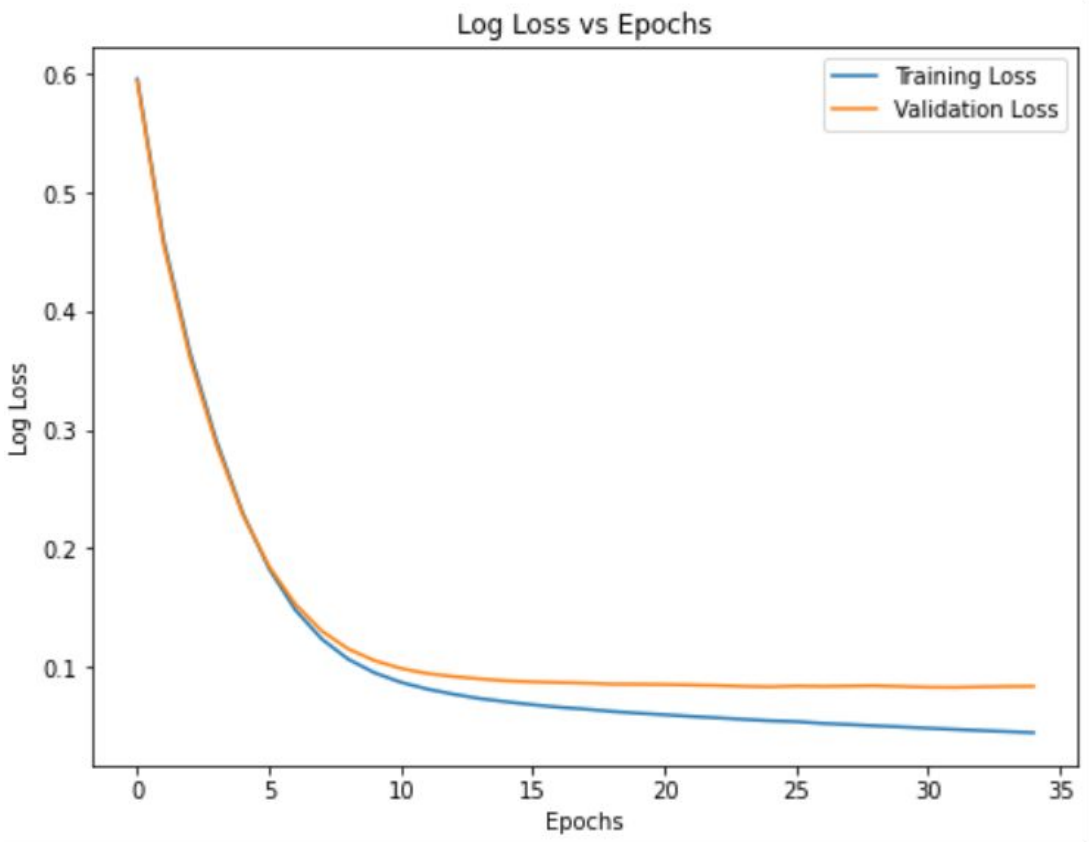
- Logistic Regression provided good results for each of the metrics chosen to judge the model.
- Decision Tree that gave results comparable to Logistic Regression model, had
  - Depth = 10
  - Criterion = Gini
- Gaussian naive bayes also reported good accuracy and other performance metrics, indicating that:
  - gaussian naive model is able to fit well into data
  - voice dataset has gaussian distribution for male and female

# Conclusions

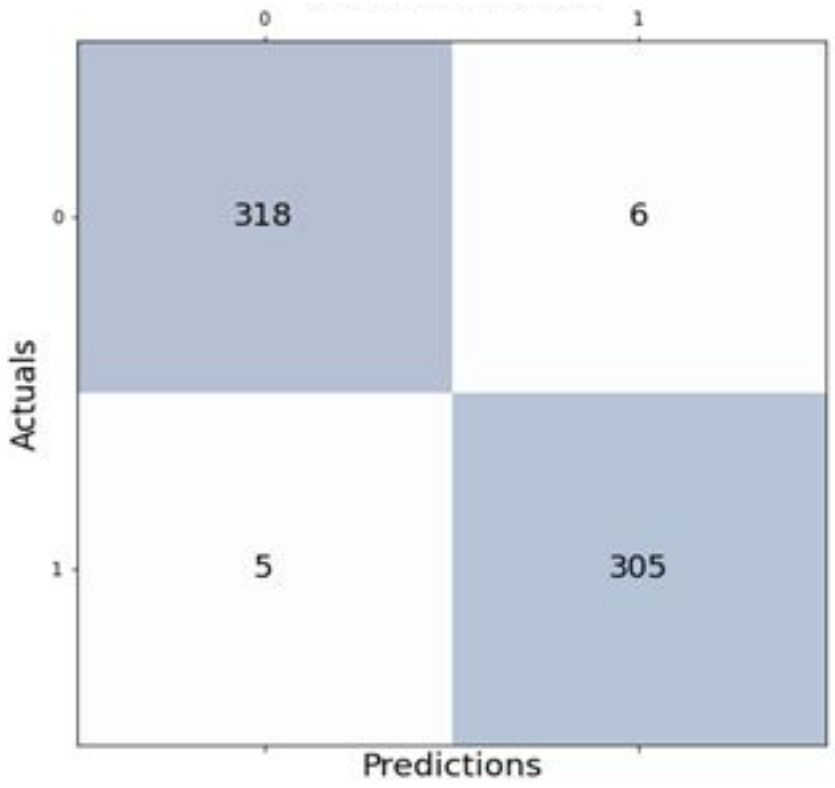
- Random Forest also give us a good accuracy (~98%) with max_tree_depth = 10,  no. of estimators = 200 and ‘Gini’ criteria. Also we performed Adaboost classification, which almost gives the similar result to RF.
- MLP with two hidden layer of sizes (256, 32) and relu activation function gave good accuracy of 98%.
- In SVM model, RBF/Gaussian kernel was observed to be the best one.

# Training and Performance metrics

Loss-Curve for MLP




Performance/Confusion Matrix for MLP



# Timeline

Timeline that we roughly followed is:

- Week 1-2: Data Collection
- Week 3-4: Pre-processing and Data Visualization
- Week 5: EDA, Feature Analysis, Heatmaps, PCA, TSNE
- Week 6: Feature Selection, Logistic Regression
- Week 7: Naive Bayes, Decision Tree
- Mid-sem Break: Report and PPT
- Week 8: Random Forest
- Week 9: MLP
- Week 10: SVM
- Week 11: Analysis & Performance of model, Hyperparameter Tuning, Check for model Overfitting and Underfitting
- Week 12: Report Writing

# Team member contributions

### Arjun Mehra

- Data Collection and Analysis
- Naive  Bayes Model, Random Forest, Decision Tree
- PPT

### Aryman Srivastava

- Exploratory Data Analysis
- Feature Selection
- MLP, SVM
- Report

### Dheeraj

- Data collection & Pre-processing
- Decision Tree model, Random Forest
- Report, PPT

### Khushdev Pandit

- Pre-processing and Data Visualization
- EDA
- Logistic Regression model, MLP, SVM
- PPT

# Thank You!