



# **Detecting Misinformation with Machine Learning**

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Springboard Capstone 3 Project

# Problem

- How can machine learning detect and analyze misinformation?
- Identify key linguistic and structural patterns in fake news.
- Assist social media platforms, public organizations, and the public in combating misinformation.

# Project Goals

- Develop a machine learning-based misinformation detection system.
- Use NLP techniques to differentiate real news from fake news.
- Evaluate model performance using accuracy, precision, recall, and F1-score.

# Data Collection and Preprocessing

- **Dataset:** WELFake dataset (labeled real and fake news articles).
- **Features:**
  - Title (headline of the article).
  - Text (full content of the article).
  - Label (0 = Fake, 1 = Real).

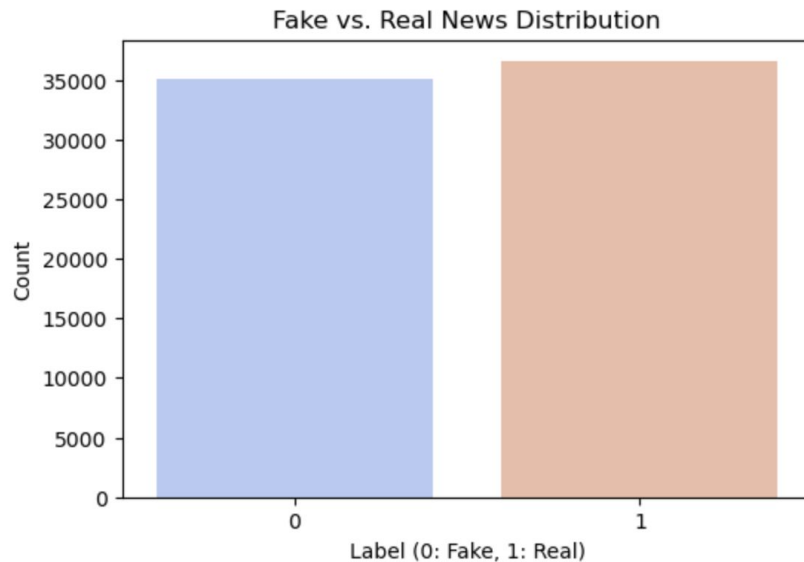
## Preprocessing Steps:

- Removed duplicates and missing values.
- Lowercased text, removed punctuation & stopwords, applied lemmatization.
- Used TF-IDF vectorization for feature transformation.

	title	text	label
0	LAW ENFORCEMENT ON HIGH ALERT	No comment	1
1		Did they post	1
2	UNBELIEVABLE! OBAMA,Ä&S AT	Now, most c	1
3	Bobby Jindal, raised Hindu, uses	A dozen	0
4	SATAN 2: Russia unveils an image	The RS-28	1
5	About Time! Christian Group Sur	All we can sa	1
6	DR BEN CARSON TARGETED BY	DR. BEN CAR	1
7	HOUSE INTEL CHAIR On Trump-I		1
8	Sports Bar Owner Bans NFL Gar	The owner o	1
9	Latest Pipeline Leak Underscore	FILE ,Äi In	1
10	GOP Senator Just Smacked Dow	The most pu	1

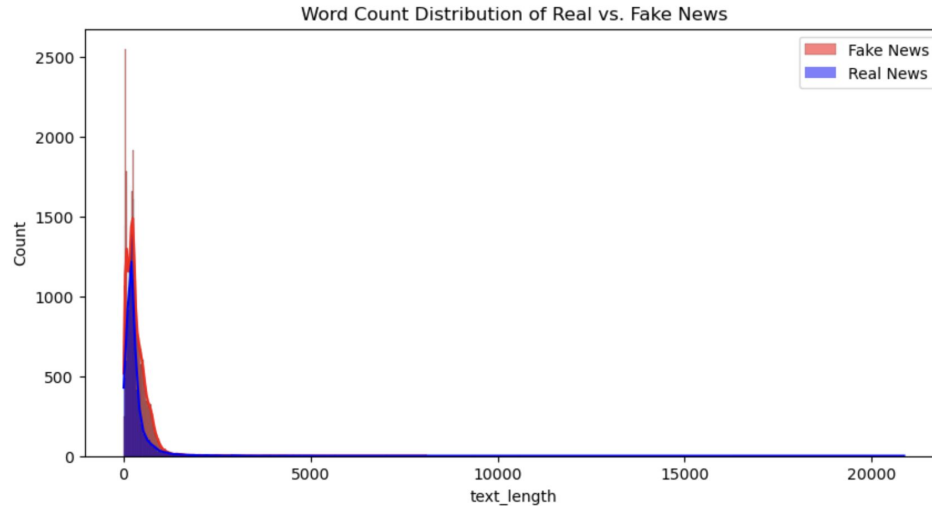
# Exploratory Data Analysis (EDA)

- **Fake vs. Real News Distribution:** The dataset is approximately balanced.



# Exploratory Data Analysis (EDA)

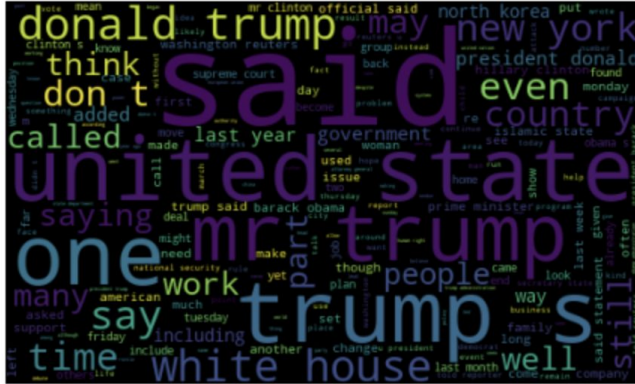
- **Word Count Analysis:** Fake news articles tend to be slightly shorter.



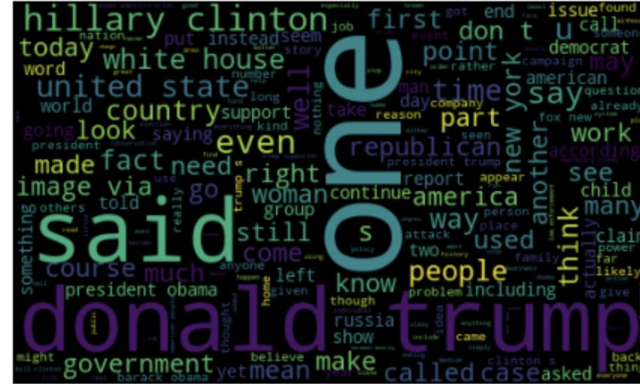
# Exploratory Data Analysis (EDA)

- **Common Words in Fake News:** Fake articles use exaggerated, emotionally charged words.

## Fake News Word Cloud



## Real News Word Cloud



# Baseline Modeling

## Logistic Regression Performance:

	precision	recall	f1-score	support
-1	0.63	0.60	0.61	3505
0	0.63	0.66	0.65	3649
accuracy			0.63	7154
macro avg	0.63	0.63	0.63	7154
weighted avg	0.63	0.63	0.63	7154

Accuracy: 0.6292982946603299

## Random Forest Performance:

	precision	recall	f1-score	support
-1	0.89	0.87	0.88	3505
0	0.87	0.89	0.88	3649
accuracy			0.88	7154
macro avg	0.88	0.88	0.88	7154
weighted avg	0.88	0.88	0.88	7154

Accuracy: 0.8803466592116299

## SVM Model Performance:

	precision	recall	f1-score	support
-1	0.66	0.84	0.74	3505
0	0.79	0.58	0.67	3649
accuracy			0.71	7154
macro avg	0.73	0.71	0.70	7154
weighted avg	0.73	0.71	0.70	7154

Accuracy: 0.7089740005591277

Best Model Selected: RandomForestClassifier(random\_state=42) with Accuracy: 0.8803466592116299



# Model Optimization

- **Random Forest with Hyperparameter Tuning:**

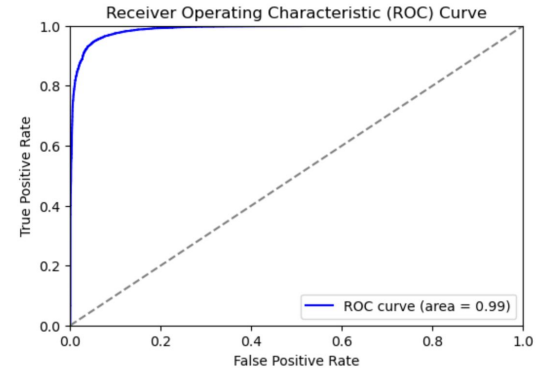
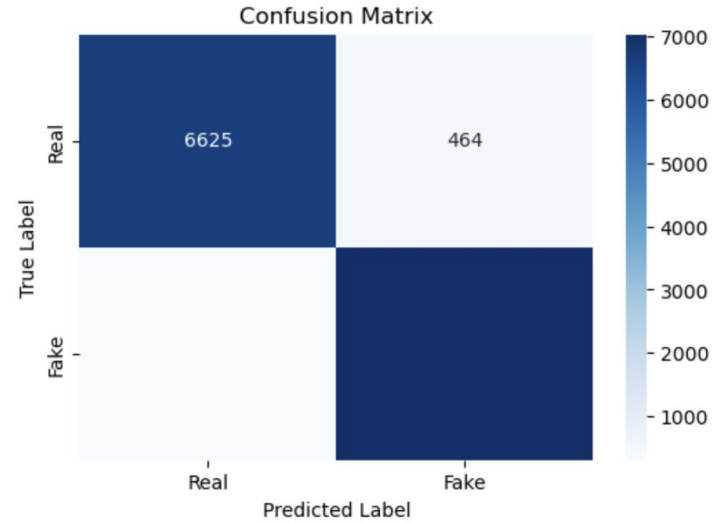
- n\_estimators: 200
- max\_depth: 20
- min\_samples\_split: 5
- min\_samples\_leaf: 2

- **Final Performance:**

- Accuracy: 89%
- Precision: 88%
- Recall: 87%
- F1 Score: 87%

# Model Evaluation

- **Confusion Matrix:**
- Strong precision, low false positives.
- **ROC Curve Analysis:**
- High AUC score, indicating strong classification ability.



# Key Findings

- Fake news articles rely on emotionally charged language.
- Coordinated misinformation campaigns have distinct patterns.
- NLP-based feature extraction is highly effective in identifying fake content.

# Next Steps

- **Future Work:**
  - Experiment with deep learning models like BERT.
  - Apply graph-based network analysis for detecting misinformation campaigns.
  - Implement real-world testing on live news streams.

# Recommendations for Stakeholders

## **For Social Media Platforms:**

- Deploy automated misinformation detection to flag suspicious content.
- Provide warnings for users engaging with fake news.

## **For Public Sector Organizations:**

- Use the model to monitor misinformation trends.
- Develop counter-misinformation strategies.

## **For Researchers:**

- Expand datasets to include multilingual misinformation.
- Explore sentiment analysis for improved detection.

## **For the Public:**

- Promote digital literacy and fact-checking habits.
- Encourage responsible content sharing.

# Final Thoughts

By leveraging machine learning and NLP, this project presents a scalable solution to combat misinformation. Future improvements, such as deep learning and misinformation network analysis, will enhance detection capabilities and help ensure information integrity.