FAKE NEWS DETECTION USING NATURAL LANGUAGE PROCESSING

TEAM MEMBER

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Phase-1 Document Submission

Project: Fake Detection Using NLP

Machine Learning Project-

Fake Detection Using NLP

OBJECTIVE:

Fake news has become a significant issue in today's digital age, spreading misinformation and causing harm to individuals and society. To combat this problem, this project proposes a fake news detection system using Natural Language Processing (NLP) techniques. The system aims to analyze news articles and determine their authenticity by leveraging various NLP methods and machine learning algorithms. By identifying patterns, linguistic cues, and semantic features, the system can classify news articles as either fake or genuine, thereby helping users make informed decisions about the information they consume.

Phase 1*: Fake News Detection Using NLP*

1.Data Source:

Define data sources as text from news articles and social media, and specify preprocessing and feature extraction techniques for fake news detection, ensuring proper labeling and model selection.

Importing Libraries

In [1]
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report
```

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```
import re
import string
```

Importing Dataset

```
In [2]:df_fake = pd.read_csv("../input/fake-news-detection/Fake.csv")
df_true = pd.read_csv("../input/fake-news-detection/True.csv")
```

```
In [3]:df_fake.head()
```

Output:

	Title	Text	subject	Date
0	Donald Trump Sends Out Embarrassing New Year'...	Donald Trump just couldn t wish all Americans ...	News	December 31, 2017
1	Drunk Bragging Trump Staffer Started Russian ...	House Intelligence Committee Chairman Devin Nu...	News	December 31, 2017
2	Sheriff David Clarke Becomes An Internet Joke...	On Friday, it was revealed that former Milwauk...	News	December 30, 2017
3	Trump Is So Obsessed He Even Has Obama's Name...	On Christmas day, Donald Trump announced that ...	News	December 29, 2017
4	Pope Francis Just Called Out Donald Trump Dur...	Pope Francis used his annual Christmas Day mes...	News	December 25, 2017

2.Data Preprocessing:

Data preprocessing involves cleaning and transforming raw textual data by removing special characters, tokenizing, removing stop words, and applying techniques like lemmatization or stemming to prepare it for analysis and machine learning.

a) **Data Cleaning:** Data cleaning, also known as data cleansing, is the process of identifying and correcting errors, inconsistencies, and inaccuracies in a dataset to improve its quality and reliability for analysis, reporting, or other data-related tasks.

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b) Preprocess the textual data: Textual data preprocessing is the process of cleaning and transforming text data to remove noise, standardize formats, and extract relevant features, making it suitable for analysis or natural language processing tasks.

PYTHON PROGRAM:

```
#Data Pre-processing
import numpy as np
import pandas as pd
#Data Visualisation
import seaborn as sns
import matplotlib.pyplot as plt
import plotly.express as px
import plotly.graph_objects as go
#Handling Warnings
import warnings
warnings.filterwarnings('ignore')
#Text pre-processing
import string
string.punctuation
import re
import nltk
from nltk.stem.porter import PorterStemmer
from nltk.stem import WordNetLemmatizer
#Machine Learning
from sklearn.model_selection import train_test_split,GridSearchCV,RandomizedSearchCV
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_selection import SelectKBest,chi2,f_classif
from sklearn.ensemble import RandomForestClassifier,VotingClassifier,AdaBoostClassifier,GradientBoostingClassi
fier,BaggingClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.naive_bayes import BernoulliNB
from sklearn.naive_bayes import MultinomialNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
import xgboost as xgb
from sklearn import tree
from sklearn.metrics import classification_report , confusion_matrix
from xgboost import XGBClassifier
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
/kaggle/input/fake-and-real-news-dataset/True.csv
/kaggle/input/fake-and-real-news-dataset/Fake.csv
```

```
In [2]:real = pd.read_csv('/kaggle/input/fake-and-real-news-dataset/True.csv')
real['real/fake'] = 'Real'
real.head()
```

Out[2]:

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	Title	Text	subject	date	real/fake
0	As U.S. budget fight looms, Republicans flip t...	WASHINGTON (Reuters) - The head of a conservat...	politicsNews	December 31, 2017	Real
1	U.S. military to accept transgender recruits o...	WASHINGTON (Reuters) - Transgender people will...	politicsNews	December 29, 2017	Real
2	Senior U.S. Republican senator: 'Let Mr. Muell...	WASHINGTON (Reuters) - The special counsel inv...	politicsNews	December 31, 2017	Real
3	FBI Russia probe helped by Australian diplomat...	WASHINGTON (Reuters) - Trump campaign adviser ...	politicsNews	December 30, 2017	Real
4	Trump wants Postal Service to charge 'much mor...	SEATTLE/WASHINGTON (Reuters) - President Donal...	politicsNews	December 29, 2017	Real

In [3]:

```
fake = pd.read_csv('/kaggle/input/fake-and-real-news-dataset/Fake.csv')
fake['real/fake'] = 'Fake'
fake.head()
```

Output:

	Title	Text	subject	date	real/fake
0	Donald Trump Sends Out Embarrassing New Year'...	Donald Trump just couldn t wish all Americans ...	News	December 31, 2017	Fake
1	Drunk Bragging Trump Staffer Started Russian ...	House Intelligence Committee Chairman Devin Nu...	News	December 31, 2017	Fake
2	Sheriff David Clarke Becomes An Internet Joke...	On Friday, it was revealed that former Milwauk...	News	December 30, 2017	Fake

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	Title	Text	subject	date	real/fake
3	Trump Is So Obsessed He Even Has Obama's Name...	On Christmas day, Donald Trump announced that ...	News	December 29, 2017	Fake
4	Pope Francis Just Called Out Donald Trump Dur...	Pope Francis used his annual Christmas Day mes...	News	December 25, 2017	Fake

3) Feature Extraction:

Feature extraction for fake news detection in NLP involves converting text data into numerical representations, such as word frequencies (Bow/TF-IDF), word embeddings, sentiment scores, named entities, or topic distributions, to enable machine learning models to distinguish between fake and real news based on linguistic patterns and context.

a)TF-IDF (Term Frequency-Inverse Document Frequency) :

- TF-IDF (Term Frequency-Inverse Document Frequency) is a numerical statistic used in natural language processing and information retrieval to evaluate the importance of a word in a document relative to a collection of documents (corpus).
- Term Frequency (TF) measures how often a word appears in a specific document, providing a local measure of word importance within that document.
- Inverse Document Frequency (IDF) measures the rarity of a word across the entire corpus. Words that occur frequently across all documents are given lower IDF scores, while rare words are assigned higher IDF scores.

b)word embeddings to convert text into numerical features:

Pre-trained Embeddings: You can use pre-trained word embeddings like Word2Vec or Glove, which have been trained on large corpora, saving you the effort of training embeddings from scratch.

Tokenization: Tokenize your text data into words or phrases.

Embedding Lookup: For each word in your text, look up its corresponding vector from the pre-trained word embeddings. If a word is not found in the pre-trained embeddings, you can choose to omit it, replace it with a special token, or use a generic vector.

Aggregation: Depending on your task, you may need to aggregate word embeddings to represent entire sentences, paragraphs, or documents. Common aggregation methods include averaging or concatenating word vectors.

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Machine Learning Model: Use these numerical embeddings as input features for your machine learning model (e.g., neural network, SVM, or decision tree) to perform tasks like text classification, sentiment analysis, or text similarity.

3.Model Selection:

- Model selection involves choosing the best hyperparameters for your Random Forest classifier. You can use techniques like cross-validation and grid search to do this.
- Perform cross-validation on your training data with different combinations of hyperparameters to find the best configuration.
- For example, you can use the Python library scikit-learn to perform hyperparameter tuning.
- Hyperparameters for Random Forest can include the number of trees (n_ estimators), maximum depth of trees (max_depth), minimum samples per leaf (min_samples_leaf), etc.

PYTHON OROGRAM:

```
rf = RandomForestClassifier(n_estimators=150, max_depth=None, n_jobs=-1)
rf_model = rf.fit(X_train_vect, y_train)
y_pred = rf_model.predict(X_test_vect)
precision, recall, fscore, train_support = score(y_test, y_pred, pos_label=1, average='binary')
print('Precision: {} / Recall: {} / F1-Score: {} / Accuracy: {}'.format(
    round(precision, 3), round(recall, 3), round(fscore,3), round(acs(y_test,y_pred), 3)))
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
class_label = [0, 1]
df_cm = pd.DataFrame(cm, index=class_label,columns=class_label)
sns.heatmap(df_cm, annot=True, fmt='d')
plt.title("Confusion Matrix")
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
plt.show()
```

Precision: 1.0 / Recall: 0.997 / F1-Score: 0.998 / Accuracy: 0.998

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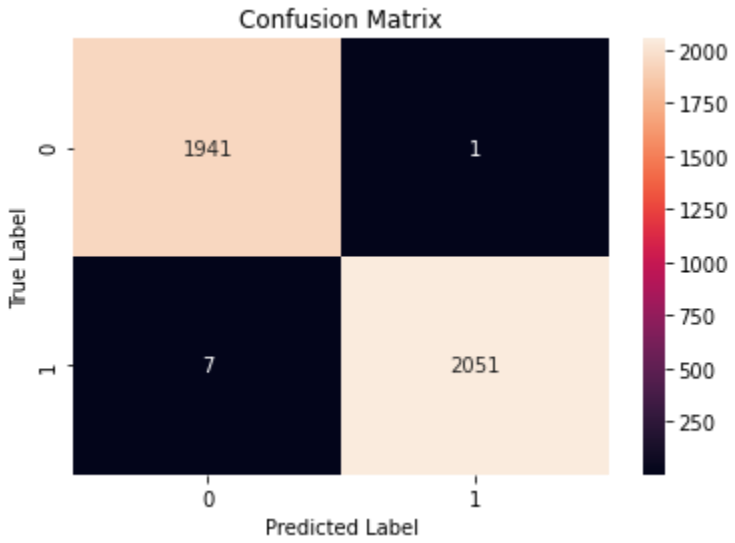

5.Model Training:

- Collect and preprocess a labeled dataset of news articles, including cleaning, tokenization, and feature extraction (e.g., TF-IDF).
- Split the data into training, validation, and testing sets (e.g., 80% training SVM) for classification.
- Train the model on the training data while monitoring performance on the validation set for hyperparameter tuning.
- Fine-tune hyperparameters using techniques like grid search or, 10% validation, 10% testing).
- Choose a suitable machine learning model (e.g., Random Forest, random search
- Evaluate the model's performance on the testing set using metrics like accuracy, precision, and recall.
- Interpret the model to understand influential features or words.
- Deploy the model for real-time or batch classification of news articles.
- Continuously monitor and update the model with new data for long-term accuracy.
- Consider ensemble methods or deep learning for enhanced fake news detection performance.

5.Evaluation Metrics:

1. **Accuracy**: Accuracy measures the proportion of correctly classified instances out of the total instances. It's a basic metric but can be misleading if there is a class imbalance.
2. **Precision**: Precision calculates the ratio of true positive predictions to the total positive predictions. It indicates how many of the predicted fake news articles were actually fake.
3. **Recall (Sensitivity)**: Recall calculates the ratio of true positive predictions to the total actual positives. It indicates how many of the actual fake news articles were correctly identified by the model.

4. **F1-Score**: The F1-score is the harmonic mean of precision and recall. It provides a balance between precision and recall, especially useful when dealing with imbalanced datasets.
5. **Specificity**: Specificity calculates the ratio of true negatives to the total actual negatives. It indicates how many of the actual real news articles were correctly identified.
6. **ROC-AUC (Receiver Operating Characteristic - Area Under the Curve)**: ROC-AUC measures the area under the ROC curve, which plots the true positive rate against the false positive rate at different classification thresholds. It assesses the model's ability to distinguish between real and fake news across various thresholds.
7. **PR-AUC (Precision-Recall Area Under the Curve)**: PR-AUC measures the area under the precision-recall curve. It focuses on the precision-recall trade-off and is particularly useful when dealing with imbalanced datasets.
8. **Confusion Matrix**: A confusion matrix provides a detailed breakdown of true positives, true negatives, false positives, and false negatives. It's useful for understanding where the model is making errors.
9. **FPR (False Positive Rate)**: FPR measures the ratio of false positive predictions to the total actual negatives. It complements specificity and is important when considering the cost of false alarms.
10. **FNR (False Negative Rate)**: FNR measures the ratio of false negative predictions to the total actual positives. It indicates the failure to detect fake news articles.
11. **Matthews Correlation Coefficient (MCC)**: MCC takes into account all four values from the confusion matrix and is particularly useful when dealing with imbalanced datasets.

Additional Considerations

1. **Data Quality and Representativeness**:
    - Ensure that your training data is of high quality and representative of the types of fake news articles you expect to encounter in the real world. Biased or incomplete data can lead to model bias.
2. **Semantic Understanding**:
    - Fake news often relies on subtle linguistic and semantic tricks. Advanced NLP techniques like semantic analysis and sentiment analysis can help capture nuanced language patterns.
3. **Multimodal Data**:
    - Fake news may include images, videos, and text. Consider using multimodal models that can analyze both text and visual content to make more accurate determinations.
4. **Contextual Analysis**:

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- Fake news can be context-dependent. Models that can consider the broader context, such as the source of the news, the timing, and related articles, may improve accuracy.

5. **Linguistic Features**:
   - Extract linguistic features beyond simple text, such as syntactic and grammatical structures, to gain deeper insights into the content.
6. **Fact-Checking**:
   - Incorporate fact-checking mechanisms or external fact-checking databases to verify the accuracy of claims made in news articles.
7. **Temporal Analysis**:
   - Analyze how the temporal aspects of news, such as the publication date and update frequency, impact the credibility of articles.

CONCLUSION:

Fake news detection with NLP employs linguistic analysis to identify misinformation. It's vital for safeguarding information integrity. However, it's an ongoing challenge, requiring interdisciplinary collaboration and continuous model improvement. Ethical and legal considerations, along with user education, are crucial for responsible deployment. Together, these efforts promote a more informed and trustworthy digital world.