Project Proposal: Improving Fake News Detection using Ensemble Methods and Hyperparameter Tuning

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Datasets

We have collected multiple datasets that have news articles combined with fake or real labels. The dataset proposed on the course project page (here) contains ~8K samples of labeled fake and real news, but may be too small for some of the larger models we wish to use. We may also supplement with additional dataset(s) in the below table sourced from Kaggle or Huggingface.

Dataset	Number of Samples	Features
Data Flair Dataset	8K	4 - id, title, text, label
Kaggle - ISOT Fake News Dataset	45K	5 - title, text, type, date published, label
HF Gonzalo Fake News Dataest	24K	3 - title, text, label
News Media Bias Election Dataset	10K	2 - text, label

Problems to Work On

We will explore traditional and ensemble methods to tackle Fake News detection. This is a classification problem, so we can start using simpler ML methods or ensembling multiple classical ML modes. We will focus on maximizing F1 score using ensembling or lightweight hyperparameter tuning. As a second phase of the project will also explore more recent NLP advances as a method to classify fake vs real news, using transformer embeddings and possibly fine tuning transformers to improve performance on fake news classification. As a stretch goal, we may also attempt to generate fake news through the use of GANs, or explore other methods in our research to see how we can better understand the characteristics of fake news (e.g. emotion, tone, words used, writing style, etc.).

Potential ways to solve the problem

1. Feature Extraction:
    a. Traditional NLP-based feature extraction: We could use techniques such as Bag of

Words or TF-IDF as discussed in class.

   b. Embeddings to capture semantic meaning: We could utilize pre-trained word embeddings like Word2Vec, GloVe, or distilbert or roBERTa to develop featuresets out of plain text. Transformer embeddings can be used as-is as inputs to a MLP or could be further fine tuned to the task at hand.

2. Model Selection and Hyperparameter Tuning
   a. Classic ML Techniques: We will select one or two classic methods from Logistic Regression, Naive Bayes, Random Forest or Gradient Boosting. For the method(s) we select we will perform hyperparameter tuning using Grid or Randomized Search CV.
   b. Deep Learning: We will use pre-trained embeddings plus a simple MLP or explore fine tuning a model to improve results. Possible choices include DistilBert, Roberta, or one of the other transformer models listed on HuggingFace for this purpose.
3. Ensembling + Fine Tuning
   a. With sufficient time we may also employ ensembling of multiple classical model techniques to compare them to a deep learning approach. We may also fine-tune a transformer base model to the fake news detection problem.

Milestones & Project Plan

Milestone	Description	Target Completion Date
Initial Results with basic NLP + classical ML	Develop an initial ipynb to scope the datasets selected, use basic NLP techniques & classical ML to establish baseline performance. Hyperparameter tuning & results summary if possible.	2/7
Ensembling	Stack, Bag, or Boost multiple classical methods (if time permits)	2/18
Feature extraction with embeddings + MLP or Embeddings + Fine Tuning	Extend the detection to more advanced methods leveraging semantic embeddings and possibly fine tuning of a transformer	3/7
Understand or generate fake news	Use GANs to generate fake news, OR explore more semantic meaning in the encodings earlier in the project to understand characteristics of fake news	3/12
Write Final Report		3/14