FAKE NEWS DETECTION SYSTEM USING BERT

Project Concept:

The **Fake News Detection System** is a **natural language processing (NLP) project** aimed at identifying **manipulative news headlines** using **machine learning techniques**. This project leverages **BERT (Bidirectional Encoder Representations from Transformers)**, a state-of-the-art deep learning model, to classify headlines as **manipulative** or **non-manipulative** based on their content.

The system follows a multi-step approach, including **data preprocessing, model training, optimization, and evaluation**, ensuring high accuracy in fake news detection. The goal is to contribute to the fight against misinformation by providing an effective detection tool.

Core Features:

1. Model Selection & Implementation:

- **BERT Model:** Chosen for its superior ability to understand language context and nuances.
- **Fine-Tuning:** A pre-trained model from **Hugging Face** (`Fake-News-Bert-Detect`) was fine-tuned on a labeled dataset.
- **Optimization Techniques:**
  - **Layer Freezing:** Embedding layer and first 10 encoder layers were frozen to reduce training time.
  - **Gradient Accumulation:** Simulated a larger batch size for stable training.
  - **Mixed Precision Training:** FP16 precision was enabled to enhance speed and memory efficiency.
  - **Early Stopping:** Implemented to prevent overfitting by halting training when validation loss plateaued.
  - **Custom Learning Rate Scheduler:** A linear decay scheduler with warm-up steps was applied.

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2. Dataset and Preprocessing:

- **Dataset Source:** Collected from **Kaggle** (contains 44,900 news headlines).
- **Data Splitting:**
  - **Training Set (80%)**
  - **Testing Set (20%)**
- **Preprocessing Steps:**
  - Removing **punctuation** and **stopwords**.
  - Converting text to **lowercase**.

- Tokenization using **Hugging Face's AutoTokenizer**.

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3. Model Evaluation and Performance Metrics:

- The model was tested on real-world headlines and evaluated using the following metrics:
  - **Accuracy:** 99.69%
  - **Precision:** 99.44%
  - **Recall:** 99.91%
  - **F1-Score:** 99.68%
- **ROC Curve & Confusion Matrix:** Generated to visualize classification performance.

Technical Stack and Tools:

- **Programming Language:** Python (v3.10)
- **Libraries & Frameworks:**
  - **Hugging Face Transformers** (for model training)
  - **PyTorch** (for deep learning implementation)
  - **Google Colab (GPU Tesla T4)** (for accelerated training)
  - **Scikit-learn** (for evaluation metrics)
  - **Matplotlib & Seaborn** (for visualization)
- **Dataset Storage & Processing:** Google Drive integration for dataset access.

Additional Features and Future Improvements:

- **Multilingual Dataset Support:** Expanding the system to detect fake news in multiple languages.
- **Lightweight Model Alternatives:** Experimenting with smaller transformer models for efficiency.
- **Web Interface Integration:** Deploying the model via a simple web app for user interaction.

This **Fake News Detection System** demonstrates the power of **BERT-based NLP models** in identifying **manipulative news headlines** with high accuracy. The combination of **deep learning techniques, data-driven optimization, and rigorous evaluation** makes this a robust solution for combating misinformation.