"Predicting Outcomes of Turkish Constitutional Court Decisions Using Explainable Artificial Intelligence"

Team Members (Group 4):

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1. Project Overview and Objectives

The goal of our project is to classify decisions of the Turkish Constitutional Court (TCC) using machine learning and deep learning models. Our objective is to predict the outcome of each decision (violation or no violation) by training models on TCC decision data, followed by an explanation of model predictions through Explainable AI (XAI) techniques.

This project will serve as a case study demonstrating the ability of fundamental machine learning and deep learning algorithms to provide transparent and interpretable predictions within the legal domain. We aim to answer:

- **Primary Objective:** Can machine learning models effectively classify court decisions as "violation" or "no violation" based on the case details?
- **Secondary Objective:** How can XAI methods such as SHAP, LIME, and Explainable Boosting Machine (EBM) provide interpretable insights into model predictions for legal professionals?

2. Dataset Description

The Turkish Constitutional Court dataset, consisting of over 9,500 decision texts, will serve as our primary source. The dataset includes decisions on fundamental rights violations, structured into sections such as case details, application process, and court evaluation. Each decision is labeled based on the outcome as either "violation" or "no violation." The dataset is publicly available in Hugging Face platform.

3. Methodology

Our methodology consists of the following phases:

Phase 1: Data Preprocessing and Exploration

- **Data Cleaning:** Handle missing values, remove unwanted sections, and normalize the text data.
- **Exploratory Data Analysis (EDA):** Visualize decision types and the distribution of "violation" and "no violation" outcomes to understand patterns in the data.

Phase 2: Model Development

- **Baseline Models:** Implement basic machine learning models such as Support Vector Machine (SVM), Decision Tree, and Logistic Regression for initial predictions.
- **Deep Learning Models:** Develop advanced models like Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNNs), Transformers for improved performance on text-based data.

Phase 3: Model Evaluation and Hyperparameter Optimization

- **Performance Metrics:** Evaluate models using accuracy, F1-score, and precision-recall for robust assessment.
- **Optimization:** Apply techniques like cross-validation and grid search to tune hyperparameters for maximum performance.

Phase 4: Explainable AI (XAI) Application

- **XAI Methods:** Use SHAP (Shapley Additive Explanations) to identify which features contribute most to each prediction. Additionally, apply LIME (Local Interpretable Model-Agnostic Explanations) and EBM for local and global interpretability insights.
- **Results Interpretation:** Summarize how XAI methods clarify model behavior, enabling legal professionals to comprehend predictions.

4. Team Roles and Responsibilities

- **Muhammed Talha Karagül:** Lead for model development and optimization.
- **Mohamad Nael Ayoubi:** Responsible for data preprocessing and feature engineering.
- **Cihan Erdoğanyılmaz:** In charge of XAI implementation and model interpretability analysis. He is also our domain expert as a lawyer.
- **Omar Sameh Belal:** Coordinates EDA and assists with documentation.
- **Abdelrahman Zahran:** Ensures code consistency, assists with optimization, and organizes project presentations.

5. Timeline and Milestones:

Week	Milestone	Deliverables
Week 1	Project Initiation	Proposal Document
Week 2	Data Preprocessing and EDA	Data Preprocessing Report
Week 3	Model Development	Initial Model Code and Progress Report
Week 4	Model Evaluation and Optimization	Model Evaluation Report
Week 5	XAI Application and Results Analysis	Explainability Report
Week 6	Finalization and Presentation Preparation	Final Report and Presentation Slides
Week 7	Presentation	Project Presentation

6. Expected Outcomes

We expect to develop accurate predictive models for classifying court decisions and to interpret these predictions with XAI tools. This project will offer insights into the benefits and challenges of explainable AI in the legal domain, contributing to the understanding of how machine learning can be responsibly used in legal contexts.