## Portfolio: Data Science and Machine Learning Projects

### Project 1: Credit Risk Prediction Classifier

#### - Objective:

The goal of this project was to train a binary classifier to predict creditworthiness, helping financial institutions determine whether an individual should be granted a loan.

#### - Data and Tools:

The dataset provided by the instructor, with features such as credit history, income, and employment status. The classifier was developed using Python with libraries like Scikit-learn.

#### - Methodology:

A logistic regression model was trained after performing data cleaning and feature engineering. Cross-validation techniques were applied to improve model robustness.

#### - Results:

The model achieved an accuracy of 85% with a precision of 82%, indicating a reliable prediction of creditworthiness. Key metrics like ROC-AUC were used to evaluate performance.

#### - Challenges & Solutions:

Addressed class imbalance using SMOTE (Synthetic Minority Oversampling Technique) and tuned hyperparameters for optimal performance.

#### - Key Takeaways:

This project showcased the importance of feature selection and preprocessing in achieving high-quality results in machine learning tasks.

### Project 2: Model Fairness Benchmarking

#### - Objective:

The purpose of this project was to assess the fairness of a trained credit risk classifier by applying fairness metrics to evaluate potential biases.

#### - Fairness Metrics:

Key metrics such as disparate impact, demographic parity, and equalized odds were employed to assess whether the model treated different demographic groups equitably.

#### - Results:

The analysis revealed a disparity in model predictions across gender and age groups, with a 10% bias toward younger applicants. The model exhibited unequal outcomes between male and female applicants.

#### -Reflection & Action:

The findings emphasized the importance of fairness considerations when deploying machine learning models in sensitive contexts. Recommendations included retraining the model with fairness constraints.

### Project 3: Model Values and Assumptions Analysis

#### - Objective:

This project aimed to analyze the underlying values, commitments, and assumptions embedded in an existing classifier used for credit risk prediction.

#### - Approach:

Feature importance analysis was conducted to examine which variables the model prioritized. The impact of variables like credit history and employment status was closely scrutinized.

#### - Findings:

The model prioritized financial stability over social factors, reflecting a commitment to minimizing financial risk. However, this could unintentionally marginalize individuals from lower socio-economic backgrounds.

#### - Reflection:

The project highlighted how model design can reflect implicit values that may not always align with societal goals of fairness and inclusivity.

### Project 4: Creating a Model Card

#### - Objective:

The task was to create a Model Card to document a classifier's biases, limitations, and potential improvements for credit risk prediction.

#### - Biases Identified:

The model exhibited biases toward applicants from wealthier backgrounds, and those with lower credit histories were disproportionately penalized. A lack of diverse training data contributed to these biases.

#### - Proposed Improvements:

Improvement suggestions included retraining the model on more diverse datasets and applying techniques like adversarial debiasing to mitigate these issues.

#### Model Card:

The Model Card provided transparency on model performance, fairness considerations, and suggestions for ethical deployment.

Conclusion and Reflections

These projects represent a comprehensive exploration of machine learning model development, from training classifiers to ensuring fairness and ethical considerations. Each project deepened my understanding of the impact of machine learning systems on real-world decisions, and I aim to continue exploring responsible AI practices in future work.