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## *Project Title: Bankruptcy Prediction System Using Machine Learning*

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### **Abstract:**

This project presents a machine learning–based binary classification system designed to predict corporate bankruptcy based on a company’s financial and operational risk indicators. The system leverages supervised learning to classify firms as either "bankrupt" or "non-bankrupt" using a trained model and provides an accessible interface through a web-based application developed with Streamlit.

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### **1. Introduction:**

Financial instability and bankruptcy pose major risks to stakeholders in any economy. Accurate and early prediction of bankruptcy can help investors, auditors, and corporate decision-makers mitigate losses and implement corrective measures. This project aims to create a predictive system that classifies companies based on various risk factors using machine learning techniques.

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### **2. Methodology:**

#### **2.1 Input Features:**

The model uses six numerical input variables representing different types of risk:

- **Industrial Risk**
- **Management Risk**
- **Financial Flexibility**
- **Credibility**
- **Competitiveness**
- **Operating Risk**

Each variable is treated as a continuous numerical input and collectively forms a six-dimensional feature vector:

$$\mathbf{x}^T = [x_1, x_2, x_3, x_4, x_5, x_6]$$

#### **2.2 Model Training and Prediction:**

A machine learning model (serialized using Python's pickle module) was trained on historical bankruptcy data using supervised learning techniques. The model approximates a function:

$$f: \mathbb{R}^6 \rightarrow \{0,1\}$$

were,

**0** represents a bankrupt company and

**1** represents a non-bankrupt company.

Upon receiving the input vector  $\vec{x}$ , the model generates a prediction:

$$y=f(\vec{x})$$

The model likely uses classification algorithms such as Random Forest, Logistic Regression, or Support Vector Machines (not explicitly stated in the deployment file), trained to minimise classification error.

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### 3. System Deployment:

A user-friendly interface is developed using **Streamlit**, a Python library for creating interactive web applications. Users can input values for each of the six risk parameters through the interface. Upon clicking the **Predict** button, the app displays one of two possible outcomes:

- “The company is going to be bankrupt” (if  $y=0$ )
- “The company is non-bankrupt” (if  $y=1$ )

This real-time predictive tool can be used by financial institutions or corporate analysts as a decision-support system.

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### 4. Mathematical Concepts Utilized:

- **Vector representation** of multivariate input data.
  - **Binary classification**, where the target output  $y \in \{0,1\}$ .
  - **Function approximation** using machine learning algorithms.
  - **Model persistence and reuse** via Pickle serialisation.
  - Implicit use of **decision boundaries** and **probabilistic learning** to separate the classes in the feature space.
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### 5. Conclusion:

This project successfully demonstrates the application of machine learning for early bankruptcy detection. By integrating predictive analytics with an intuitive user interface, it offers a scalable and accessible solution for financial risk evaluation. Future enhancements could include adding explainable AI (XAI) components to interpret the model's decisions and incorporating additional financial indicators for improved accuracy.

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